



# Vegetation Classification and Mapping at Marsh-Billings-Rockefeller National Historical Park, Vermont

Natural Resource Technical Report NPS/NER/NRTR—2011/493



**ON THE COVER**

Northern Hardwood Limestone Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA10).

Photograph by Sue Gawler, NatureServe.

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## Abstract

Vegetation classification and mapping of Marsh-Billings-Rockefeller National Historical Park followed established U.S. Geological Survey (USGS) - National Park Service (NPS) Vegetation Mapping Program protocols and was conducted under its umbrella agreement with NatureServe and its network of natural heritage programs. After a scoping session with park staff and field reconnaissance, we developed an initial vegetation classification for the park based on NatureServe's U.S. National Vegetation Classification (USNVC), Lautzenheiser's 2002 natural community map, Keeton's 2003 forest data, and other existing information. Thirty vegetation plots were sampled in the summer of 2004, covering the range of variation in the vegetation. Plot sampling included information on vegetation structure and composition and individual species cover by vegetation stratum and environmental setting. Seven plots were entirely new, and 23 existing forest plots established by Keeton in 2003 were re-sampled for understory vegetation. Analysis of the plot data and field notes allowed us to finalize the vegetation classification for the park and to map the vegetation onto an orthorectified composite aerial photo background using on-screen digitizing in 2005. Sixty-three accuracy assessment points were collected in 2007 to verify the accuracy of the 2005 vegetation map. The overall 2005 map accuracy and Kappa index was 76%, which fell below the USGS/NPS vegetation mapping protocol requirement of 80%. Revisions were subsequently made to the 2005 vegetation map to increase the accuracy of the final product. The final 2007 vegetation map accuracy was 85.7% and Kappa index was 84.6%.

Eighteen USNVC vegetation associations were described for Marsh-Billings-Rockefeller National Historical Park: eleven upland forest types (including five plantation types), two wetland forest types, one upland woodland type, two old-field forest types, one upland herbaceous (old-field) type, and one wetland herbaceous type. Two of the upland forest types were each mapped as two map classes: in one case, separating the mixed from conifer expression; in another case, separating a unique variant occurring on limestone. The one wetland herbaceous type is a very small patch wetland within an upland forest. Areas such as the artificial pond, buildings and grounds, and active hayfields that fall outside of the scope of USNVC associations were mapped as land-cover classes.

Hemlock - Northern Hardwood Forest and Northern Hardwood Forest form the dominant vegetation cover at Marsh-Billings-Rockefeller National Historical Park. Many of the plantations that are important to the history of this park show signs of conversion to Northern Hardwood Forest in the absence of management. Plant species considered uncommon in Vermont were noted where they occurred on or near the vegetation plots, as were invasive plant species.

Detailed descriptions of the local and global expressions of each vegetation association, a field key to the vegetation associations, a plant species list derived from the plot and accuracy assessment data collection, metadata for the vegetation plot data, and an index to association photographic documentation are included as appendixes. The digital vegetation map and the spatial location of plot and accuracy assessment points were delivered as shapefiles. The digital orthophoto developed for Marsh-Billings-Rockefeller National Historical Park is also a deliverable of this project.



## Acknowledgements

The National Park Service is gratefully acknowledged for its funding of this project. Marsh-Billings-Rockefeller National Historical Park staff, especially Christina Marts, were very helpful in providing information for this project. Bill Keeton at the University of Vermont's School of Natural Resources provided important forest plot data. The computer portion of the mapping was done at the GIS lab at Lyndon State College in Lyndonville, Vermont; John DeLeo, in the college's Recreation Department, provided invaluable GIS expertise for the project. Tom Platner and Julia Watson provided wonderful hospitality, including food and lodging, at their home in Barnard. Eric Sorenson of the Vermont Natural Heritage Program consulted on the statewide perspective of the park vegetation. Beth Johnson and John Karish of the NPS and Lesley Sneddon of NatureServe provided helpful project oversight. Bill Millinor at North Carolina State University converted the air photos to an orthorectified computer image. Brian Mitchell, Adam Kozlowski, Kathryn Miller, Kyle Jones, Sarah Lupis Kozlowski, and Ed Sharron from the NPS Northeastern Temperate Network provided useful comments and report assistance. Mary Russo and Kristin Snow of NatureServe provided essential data management services for the vegetation type descriptions. Ery Largay of NatureServe assisted with Accuracy Assessment and converted the draft report into its final version. We would also like to thank Stephanie Perles (NPS) and Gregory Podniesinski (PA Natural Heritage) who provided us with NPS vegetation mapping sample final reports. In an effort to achieve consistency from state to state, sections of the text in this report were adopted from previously completed NPS vegetation mapping reports (e.g. Perles et al. 2006) with permission. And finally, thanks goes to G. Marsh, F. Billings, and L. Rockefeller for their roles in conservation history, including their tenure of the land in Woodstock that has become Marsh-Billings-Rockefeller National Historical Park.



## Introduction

Marsh-Billings-Rockefeller National Historical Park (MABI) is a 222.6-ha (555-ac) park located in the town of Woodstock, Vermont, in the temperate northeastern United States. It was established in 1992 to protect lands and buildings that provide a historical record of the evolution of American conservation and forest stewardship, and also as a resource for forest stewardship interpretation services. George Perkins Marsh, Frederick Billings, and Laurance and Mary Rockefeller, all previous owners of park lands, had different pioneering roles in conservation, in terms of both the nation and the Marsh-Billings-Rockefeller National Historical Park itself. Marsh-Billings-Rockefeller National Historical Park, including its buildings, fields, and natural and planted forests, has been, and continues to be, managed for protection of natural resources, sustainable forestry, historic character, scenic beauty, and education.

The purpose of this project was to produce a standardized map and classification of the vegetation communities and land cover of the Marsh-Billings-Rockefeller National Historical Park and to provide thorough baseline data on the park's vegetation. These products will inform natural resource decision-making, for example, in the development and implementation of the park's General Management Plan and the inventory and monitoring network's Vital Signs monitoring plan. This is part of an effort by the National Park Service to map and describe the national parks across the country using the U.S. National Vegetation Classifications, through agreements with NatureServe and its component Natural Heritage programs and other cooperators.

NatureServe ecologists planned the vegetation sampling, oversaw the field effort, and integrated the plot data, accuracy assessment data, and field information into the US National Vegetation Classification (USNVC) to produce a standardized product for the National Park Service.

### **USGS-NPS Vegetation Mapping Program**

The USGS-NPS Vegetation Mapping Program (VMP) is a cooperative effort by the U.S. Geological Survey (USGS) and the National Park Service (NPS) to classify, describe, and map vegetation communities in more than 270 national park units across the United States. The goal of the VMP is to meet specific information needs identified by the NPS. The VMP, managed by the USGS Center for Biological Informatics in Denver, Colorado, is part of the NPS Inventory and Monitoring Program, a long-term effort to acquire the information needed by park managers in their efforts to maintain ecosystem integrity for all national park units that have a significant natural resource component. Vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs, and provide a structure for framing and answering critical scientific questions about vegetation communities and their relation to environmental processes across the landscape.

Three major components essential to every mapping project include vegetation classification, vegetation mapping, and map accuracy assessment. Ecology and mapping teams work together to share knowledge and data and to resolve issues as they carry out the procedures. Program products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata and national standards for spatial accuracy and data transfer. Standards include a minimum mapping unit of 0.5 ha (1.24 ac) and classification accuracy of 80% for each map class. Spatial data products include aerial photography, map classification,

spatial database of vegetation communities, hardcopy maps of vegetation communities, metadata for spatial databases, and complete accuracy assessment of the vegetation map. Vegetation information includes vegetation classification, dichotomous field key of vegetation classes, formal description of each vegetation class, ground photos of vegetation classes, and field data in database format.

### **U.S. National Vegetation Classification**

The U.S. National Vegetation Classification (USNVC) is a hierarchical system with physiognomic features at the highest levels of the hierarchy and floristic features at the lower levels. The physiognomic units have a broad geographic perspective and the floristic units have local and site-specific perspective (Grossman et al. 1998).

The USNVC includes most existing vegetation, whether natural or cultural, but attention is focused on natural vegetation types. “Natural vegetation,” as defined in The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI 1994), includes types that “occur spontaneously without regular management, maintenance, or planting and have a strong component of native species.” “Cultural” vegetation includes planted/cultivated vegetation types such as orchards, pastures, and vineyards.

The physiognomic-floristic classification includes all upland terrestrial vegetation and all wetland vegetation with rooted vascular plants. The hierarchy has five physiognomic levels and two floristic levels.<sup>1</sup> The physiognomic portion of the classification is based upon the United Nations Educational, Scientific, and Cultural Organization (UNESCO) world physiognomic classification of vegetation, which was modified to provide greater consistency at all hierarchical levels and to include additional types (Drake and Faber-Langendoen 1997). At the uppermost level, the USNVC is divided into seven broad physiognomic classes: Forest, Woodland, Shrubland, Dwarf-shrubland, Herbaceous, Sparse (vascular), and Non-vascular. The lowest unit of the physiognomic portion of the classification is the formation, a type defined by dominance of a given growth form in the uppermost stratum and characteristics of the environment (e.g., cold-deciduous alluvial forests).

The two floristic levels are alliances and associations. The alliance is a physiognomically uniform group of plant associations that share dominant or diagnostic species, usually in the uppermost stratum of the vegetation. For forested types, the alliance is roughly equivalent to the “cover type” of the Society of American Foresters. Alliances also include non-forested types.

The basic unit of the classification system, the association, is roughly equivalent in scale to the plant association of European phytosociologists. The association is a unit of vegetation that is more or less homogeneous in composition and structure and occurs on uniform habitat. Alliances are generally more wide-ranging geographically than are associations, although many monotypic alliances have been classified.

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<sup>1</sup> The upper levels of the USNVC were redesigned after the classification phase of this project was completed and accepted as an FGDC standard (FGDC 2008). The association and alliance levels remain the same. Work is underway to place USNVC associations appropriately in the revised hierarchy.

Although associations are defined by the plants that comprise them, they are in fact communities of all the component organisms of that association, including animals, protozoans, bacteria, and fungi. Associations are classified from a rangewide perspective (termed “global,” although, in fact, any association only ranges over part of a continent) and are assigned global rarity ranks as well as ranking specifications to be applied to individual occurrences of associations across their range. A map of associations occurring at a site can provide information about the abundance and distribution of each type, the significance of the individual occurrences, as well as providing surrogate information about the location and abundance of individual species characteristic of the association.

The USNVC has been revised and refined since 1998 and is managed by NatureServe in collaboration with the network of Natural Heritage Programs. The classification is housed in the Biotics database and is updated regularly (NatureServe 2007). 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 and version 2 in 2008). The USGS/NPS Vegetation Mapping Program adopted the alliance level and, where possible, the association level as the mapping unit for national parks.

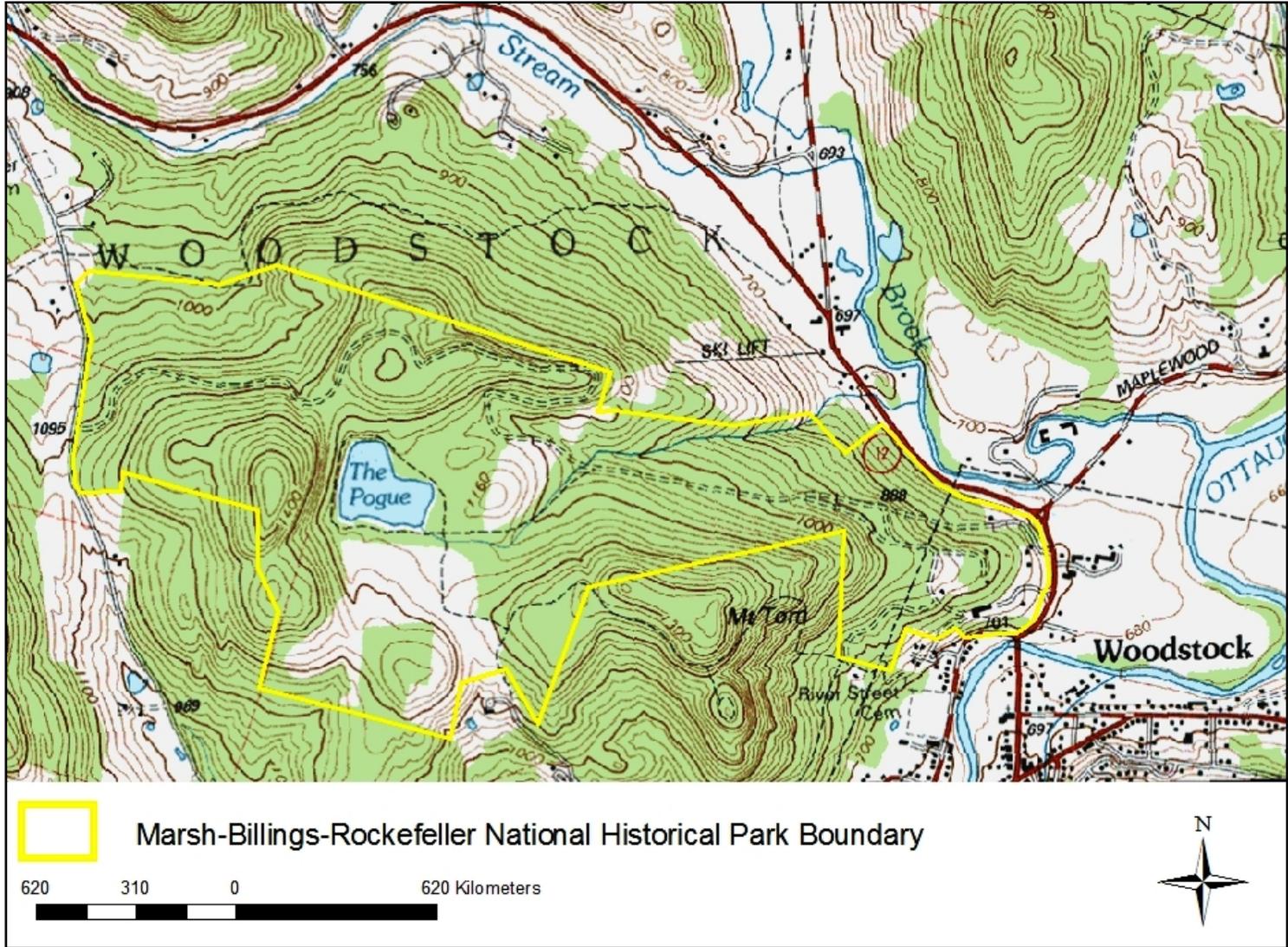
### **Project Area**

Marsh-Billings-Rockefeller National Historical Park lies on the northern edge of Woodstock village in the Ottauquechee Valley of east central Vermont (Windsor County) (Figure 1). It falls within the Vermont Piedmont subsection (M212Ba) in the Forest Service’s Ecological Units map of the eastern United States (Keys et al. 1995)<sup>2</sup>. This area is at the southern limit of the Northern Appalachian - Boreal Forest ecoregion (NAP) where it abuts the Lower New England / Northern Piedmont ecoregion (LNE) (TNC 2001; Figure 2).

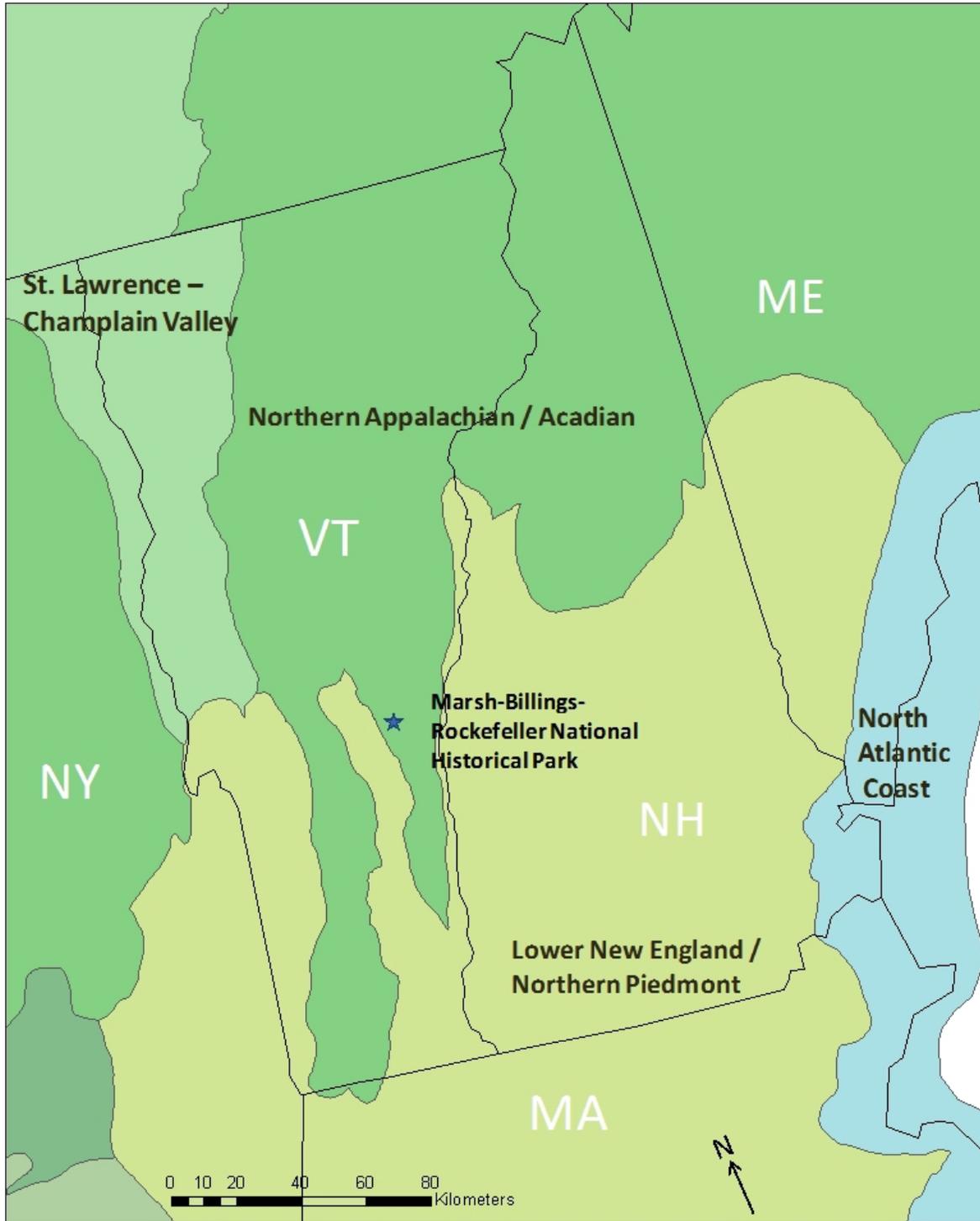
The hilly terrain ranges from 207 m (680 ft) to 433 m (1,421 ft) in elevation. It includes one prominent and several lesser summits and the majority of one intermittent stream drainage. The rocky summit of Mount Tom occurs in Billings Park immediately adjacent to Marsh-Billings-Rockefeller National Historical Park. The local metamorphic bedrock is mapped in the Waits River formation. Schist, phyllite, and quartzite containing thin layers of limestone are characteristic of this Devonian formation. Derived from glacial till, the soils are fertile and loamy, ranging in texture from silt loam to loamy fine sand, and of variable stoniness.

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<sup>2</sup> The Vermont Piedmont subsection is numbered M211Ba in the more recent and national version of USFS ecological subregions (Cleland et al. 2007).



**Figure 1.** Location of Marsh-Billings-Rockefeller National Historical Park, Windsor County, on the Woodstock North, VT 1:24,000 USGS topographic quad map.



**Figure 2.** Location of Marsh-Billings-Rockefeller National Historical Park in the Northern Appalachian / Acadian ecoregion in Vermont.

While largely forested at present, Marsh-Billings-Rockefeller National Historical Park is a combination of several old farms which contained pastures, fields, and woodlots. The current forest is dominated by a mix of northern hardwood and hemlock forest types, with a few small wetlands and one prominent artificial pond (The Pogue). A number of forest plantations were established from the late 1800s through the first few decades of the 1900s.

## **Materials and Methods**

### **Planning and Scoping**

The Marsh-Billings-Rockefeller National Historical Park vegetation classification and map were created using a combination of existing sources of information, vegetation sampling, ground-truthing, and remote sources. In 2004, NatureServe contracted with independent ecologist Brett Engstrom to conduct a field survey and produce a map of the vegetation of the park. A scoping meeting involving NatureServe staff and contractor, Vermont and New Hampshire Natural Heritage Program staff, and NPS staff was held in May 2004 (in conjunction with the Saint-Gaudens National Historic Site vegetation map project) to outline the project, identify resources, and plan the approach.

### **Review of Existing Information and Preliminary Vegetation Classification**

Unlike many large national parks which may have minimal or very coarse vegetation data/maps, Marsh-Billings-Rockefeller National Historical Park is a small park (222.6 ha [555 ac]) with a wealth of existing maps, data, and other information on vegetation and physiographic/cultural characteristics. Primary among the existing vegetation maps are Lautzenheiser's (2002) natural community map, Wiggin's (1993) forest stands map, and tree data from William Keeton's (2003) forest monitoring at the park.

The preliminary classification for Marsh-Billings-Rockefeller National Historical Park was developed by crosswalking the units in existing vegetation maps, primarily Lautzenheiser's (2002) and Wiggin's (1993), to the closest USNVC associations. Lautzenheiser's work focused on potential vegetation and mapped the forest communities as they would be expected to occur without the land use changes, including plantations, of the last few centuries. Because the USNVC classifies existing vegetation, and this project maps existing vegetation, there were fewer units in Lautzenheiser's classification than in the preliminary classification for this project.

The preliminary classification for Marsh-Billings-Rockefeller National Historical Park included 14 associations: 10 natural forest types, three plantation forest types, and one old-field type.

### **Aerial Photography Acquisition and Processing**

On April 28, 2003, William Frament, USDA Forest Service (Northeastern Area State and Private Forestry, Durham, NH), acquired leaf-off color infrared (CIR), stereo pair 1:8,000 scale aerial photography of Marsh-Billings-Rockefeller National Historical Park. The photography was acquired as part of a larger project flown for several eastern national parks at one time, and thus preceded the vegetation classification and mapping project. The photography was captured in late April when deciduous trees were mostly bare and the ground was generally free of snow. The image type consists of a raster 3-band color image. The bands are blue, green, and near infrared. Each pixel contains a value ranging from 0 to 255 per band.

The photos (14 total) were used by North Carolina State University Center for Earth Observation (NCSU-CEO) to create an orthorectified photomosaic using ER Mapper 6.4 and Erdas Imagine 8.7. The photos were scanned at 600 dpi and imported into Imagine. The 30-m Digital Elevation Model USGS National Elevation Dataset (NED) was acquired for the project area and data were transformed from 30 meters to 10 meters to assist with data comparability. The individual digital orthophoto quarter quads (DOQQs) were mosaiced to create a single file for use as ground

control. The images were orthorectified in ERDAS Imagine Orthobase software using the DOQQs and the DEM as ground control. Aerial triangulation produced a single RMSE of less than one meter for the entire block of photos. The orthorectified images were then mosaiced within ER Mapper to form one seamless basemap image for Marsh-Billings-Rockefeller National Historical Park. The mosaic was compressed using Mr. SID software at a 1:20 target compression ratio (NCSU 2004). Key information for the digital Marsh-Billings-Rockefeller National Historical Park photomosaic, finalized in 2004, is summarized in Table 1. FGDC-compliant metadata was also written for the final photomosaic, which was archived at the NPS Northeast Temperate Network office in Woodstock, VT.

### **Photointerpretation and Vegetation Map Preparation**

Aerial photograph interpretation is the act of examining aerial photographs to identify vegetation types (Avery 1978). In addition to the 2003 CIR photos (scale 1:8,000) flown by the USDA Forest Service and the digital mosaic created by NCSU-CEO, pre-existing digital vegetation layers were also used to assist in interpretation and preliminary vegetation map creation (Table 2). Pre-existing vegetation data included attribute data accompanying the Wiggin 1993 Forest Stands map digitized by DuBois and King 1997, the Lautzenheiser (2002) digital natural community map and plots as well as accompanying data found in Lautzenheiser's report, and a shapefile of plots and accompanying tree data from William Keeton's (2003) Forest Monitoring at Marsh-Billings-Rockefeller National Historical Park. Other physiographic data, including cultural features for geographic control, were used as layers in the GIS project to help create the preliminary vegetation map. These included soils, contours, surface waters, trails, and carriage roads. A list of these and other GIS layers can be found in the Cultural Landscape Report by Wilcke et al. (2000). Several additional sources of aerial photography were used, including a 1999 digital orthophoto quad, as well as hard copy aerial photos from 1939 and 1977. Table 2 lists the sources of these pre-existing data layers used in the creation of the Marsh-Billings-Rockefeller National Historical Park vegetation map.

All acquired digital layers were examined onscreen in ArcGIS 9.0 (ESRI 1999-2004). Information gathered during reconnaissance visits to nearly all of Marsh-Billings-Rockefeller National Historical Park's preliminary vegetation polygons was also used to inform the aerial photointerpretation. Preliminary polygons were digitized on-screen, in general adhering to a minimum mapping unit of 0.5 ha (1.24 ac). Polygons smaller than 0.5 ha were drawn for vegetation that occurs naturally in small patches. Stereo pairs of the 2003 CIR photos were examined using a pocket mirror stereoscope to double check photo-signatures during the digitizing process. Polygons that represented other land uses, such as buildings and roads, were attributed with names modified from the Anderson Level II categories (Anderson et al 1976). Photointerpretation was allowed to extend outside the NPS boundary where vegetation associations were arbitrarily truncated by the boundary. Since the mapping did not rely entirely on aerial photointerpretation alone, a separate aerial photograph interpretation key is not provided.

**Table 1.** Summary of key information for the orthorectified photomosaic for Marsh-Billings-Rockefeller National Historical Park.

Title of metadata record:	Marsh-Billings-Rockefeller National Historical Park Color Infrared Orthorectified Photomosaic (ERDAS Imagine 8.7 IMG and Mr. SID formats)
Publication date of mosaic (from metadata):	September 23, 2004
Date aerial photography was acquired:	April 28, 2003 (leaf-off)
Vendor that provided aerial photography:	USDA Forest Service, Northeastern Area State and Private Forestry, Durham, NH
Scale of photography:	1:8,000
Type of photography:	Color Infrared leaf-off conditions
Location of air photos, airborne GPS/IMU files, camera calibration certificate, and hard copy flight report*	USGS, Earth Resources Observation Science (EROS) Center Sioux Falls, SD
Scanning specifications:	Dataset consists of a raster 3-band color image. The bands are blue, green and near infrared. Each pixel contains a value between 0–255
Archive location of mosaic and metadata:	NPS Northeast Temperate Network, Woodstock, VT
Format(s) of archived mosaic:	ERDAS Imagine 8.7 IMG and Mr. SID

The hard copy air photos were misplaced during the extended duration of this project. Scanned images of 10 of the 14 Marsh-Billings-Rockefeller National Historical Park films are on file both at EROS and the NPS Northeast Temperate Network office in Woodstock, VT.

**Table 2.** Pre-existing data layers used in Marsh-Billings-Rockefeller National Historical Park vegetation mapping.

Source type	Data	Location	File name
Images	CIR transparencies – 2003, scale 1:8,000.	USDA Forest Service, Forest Health Protection, Durham, NH	Photo # 8771-8776, 8764-8777
	Film Type 1443 CIR, Focal Length = 6", Flying HT = 5,000'		
	VT digital orthophoto quad, 1999, spring leaf off	MABI <sup>1</sup>	vmpdoq_utm83.gis
	Orthorectified photomosaic of 2003 transparencies, completed in 2004	NETN <sup>2</sup>	mabi_mosaic_final.sid
	1977 Color infrared aerial photograph	MABI	1977 CIR park and surrounds 8x11 150 dpi.tif
	1939 B&W aerial photograph	MABI	1939 B&W 8x10 150 dpi.jpg
Previous Vegetation Sampling	Lautzenheiser 2002 Natural Community Map	MABI	MB_NatCom.shp
	Lautzenheiser 2002 Plot Location Map	MABI	Plots.shp
	Wiggin 1993 Forest Stands map digitized by DuBois and King in 1997	MABI	forest_standsnew.shp
	Keeton 2003 Forest Dynamics plots	MABI	Plotcenterpoints.shp
Other Layers	Surface waters	MABI	uswater arc.shp
	10ft./3m contours	MABI	ctour5.shp
	Carriage roads	MABI	ucarriage arc.shp
	All trails	MABI	Newallrdstrails.shp

<sup>1</sup> MABI - Marsh-Billings-Rockefeller National Historical Park

<sup>2</sup> NETN - Northeast Temperate Network

## **Field Data Collection and Classification**

NatureServe developed a vegetation plot sampling design in the spring of 2004, following NPS Vegetation Mapping Program guidelines (TNC and ESRI 1994b) and using the preliminary classification and existing vegetation data. Plots were allocated to the 14 vegetation associations known to occur in the park (Table 3). To the extent possible, replicate plots were assigned across each association's environmental range. The sampling design called for an average of three plots per targeted natural association where possible. While this was an achievable goal for most associations, some associations occurred within the park only once or twice and additional examples were not present for sampling. Semi-natural or ruderal vegetation associations (i.e. Successional Old Field, White Pine Plantation, European Larch Plantation, and Mixed Conifer Plantation) required less plots per type, as the vegetation is well documented in the USNVC and easily classified in the field; subsequently, 30 plots were sampled.

To be most cost-effective, rather than sample 30 new plots, the forest layer data from 23 of Keeton's 2003 permanent forest plots were used to inform the vegetation classification (Table 3). The shrub and herb layers were resampled in these 23 Keeton plots to provide comprehensive data for the plots. Seven new plots were sampled for vegetation associations not covered by the Keeton 2003 forest dynamics data.<sup>1</sup> Areas classified in the preliminary map as Anderson Level II categories were not sampled.

### ***Field Survey***

Thirty vegetation plots were sampled during July, August, and September of 2004 (Figure 3). For overstory data and resampled for understory data, 23 of Keeton's permanent forest monitoring plots (2003) were used. Herb and shrub layers in these 23 plots were sampled following the NatureServe National Park Vegetation sampling protocol. Seven new plots were established in vegetation associations not sampled by Keeton, including wetland and small patch associations. New forest plots were 0.05 ha (22.36×22.36 m) and were equivalent in size to those used by Keeton's nested plot protocol. Five of the seven newly established plots were smaller, corresponding to the much smaller vegetation units being sampled. They included three 100 m<sup>2</sup> (10×10 m) plots, and two 10 m<sup>2</sup> (3.16×3.16 m) plots.

NatureServe National Park Vegetation Mapping Program plot survey forms were completed for all 30 plots (Appendix A). Completed forms are on file with the NPS and NatureServe. Abbreviated instructions for completing the form and definitions of the fields are in the NPS Vegetation Mapping Program: Field Methods for Vegetation Mapping manual (TNC and ESRI 1994b).

Total cover, height, and characteristic species were documented for each forest structure stratum during plot surveys. Then, segregated by stratum, each species' cover was recorded in the applicable cover class as the class midpoint. A seven-class cover scale was used. Percent cover

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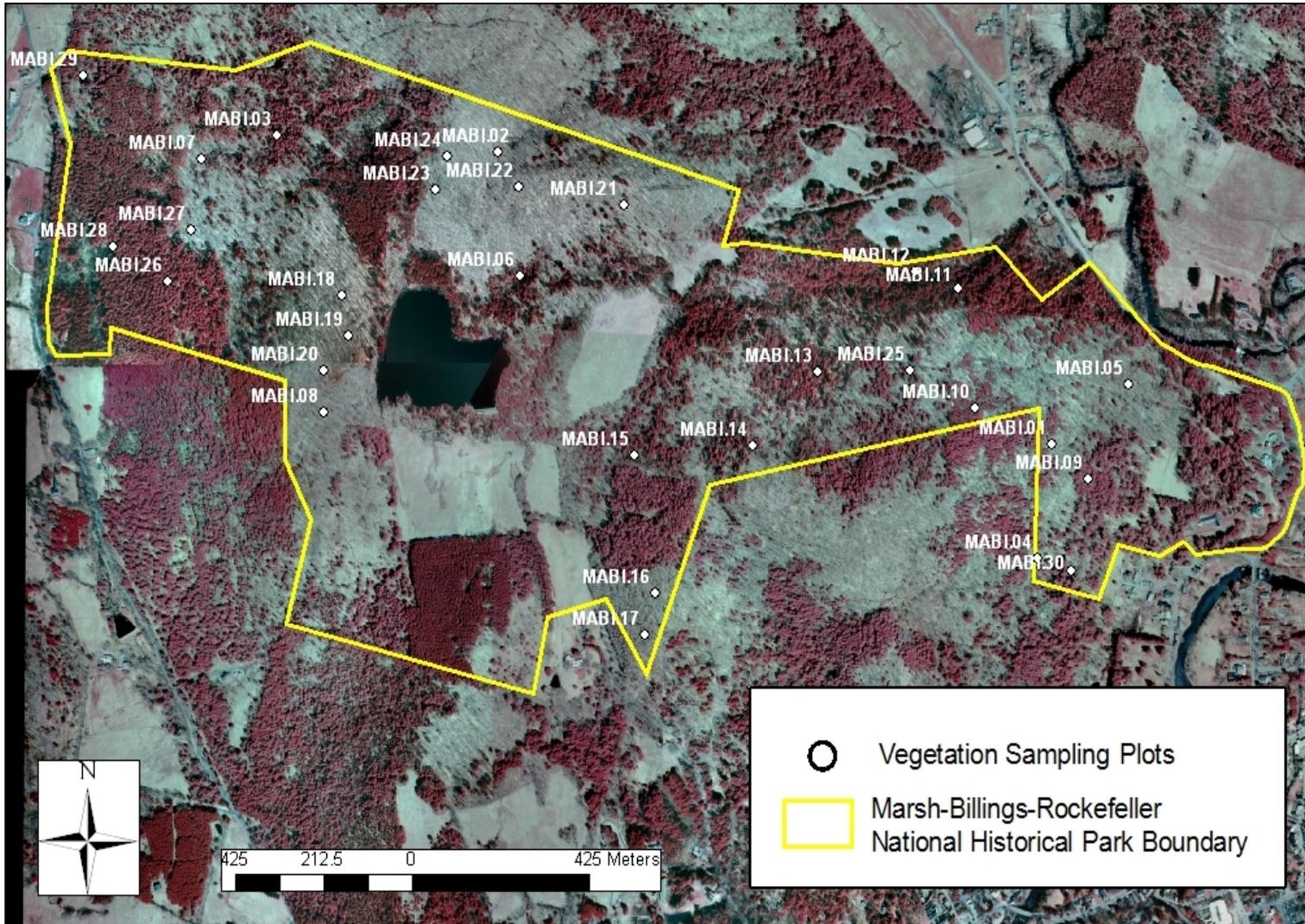
<sup>1</sup> 2003 Keeton data did not include wetland forest associations.

**Table 3.** Preliminary vegetation classification and plot allocation to vegetation types known to occur in the park.

Provisional Community Name <sup>1</sup>	USNVC Code	Keeton plots (2003)	New plots (2004)	Plots used for classification
Hemlock - Beech - Oak Forest	CEGL006088	1	0	1
Hemlock - Hardwood Seepage Forest	CEGL006380	0	1	1
Hemlock - Northern Hardwood Forest	CEGL006109 <sup>2</sup>	3	0	3
Hemlock Forest	CEGL006109 <sup>2</sup>	3	0	3
European Larch Plantation	CEGL006408	2	0	2
Mixed Conifer Plantation	CEGL006313	2	0	2
Northern Hardwood - Hemlock Swamp	CEGL006502	0	1	1
Northern Hardwood Forest	CEGL006252	3	0	3
Northern Hardwood Seep	CEGL006409	1	2	3
Red oak - Northern Hardwood Woodland	CEGL005058	0	1	1
Rich Northern Hardwood Forest	CEGL005008	4	1	5
Semi-rich Northern Hardwood Forest	CEGL006211	2	1	3
Successional Old field	CEGL006107	0	0	0
White Pine Plantation	CEGL007178	2	0	2
Total		23	7	30

<sup>1</sup>Names of vegetation associations listed in the table are from the preliminary classification determined before plot sampling. Numerous changes were made to the classification after plot sampling and accuracy assessment, therefore the provisional community names in this table do not fully match the final association descriptions presented in this report.

<sup>2</sup>These represent two different canopy cover phases of the same association, one canopy dominated by a mixture of hardwoods and hemlock and the other having a canopy dominated by hemlock.



**Figure 3.** Locations of the 30 vegetation plots used for vegetation classification and mapping in Marsh-Billings-Rockefeller National Historical Park.

was estimated for the unvegetated ground surface within categories, including bedrock, litter/duff, wood >1 cm, large rocks (cobbles, boulders >10cm), small rocks (gravel, 0.2–10cm), sand (0.1–2 mm), and bare soil. The total percent cover sums to 100% of the ground surface, including nonvascular plants and herbaceous plants of low stature occurring at the ground surface. This measure provides an overview of what occurs on the ground in addition to the vegetation. Natural disturbance and land use history notes were recorded on each form. Notes were taken on how well each plot represented the surrounding vegetation and any other significant environmental information, such as landscape context, herbivory, stand health, recent disturbance, or evidence of historic disturbance. Digital photographs were taken of most vegetation associations. The center location of each plot was recorded with a global positioning system (GPS) Garmin 12 unit with the datum set to North American 1983 (Conus) and the coordinate system set to Universal Trans-Mercator (UTM) zone 18. The GPS unit was WAAS (Wide-Area Augmentation System) enabled and provided real-time differential correction.

### ***Vegetation Classification and Characterization***

Data from the 30 plots were entered into the PLOTS 2.0 Database on a Microsoft Access platform. Species were assigned standardized names based on the PLANTS database, Version 3.5, developed by Natural Resources Conservation Service (NRCS) in cooperation with the Biota of North America Program (USDA, NRCS 2006). Plot locations are shown in Figure 3. A data dictionary for the PLOTS database is included in Appendix B. Common and scientific names of plants observed during vegetation plot sampling are listed in Appendix C. Some tree and shrub seedlings and immature herbaceous plants could only be identified to genus and are listed as such in Appendix C.

Preliminary vegetation classification was modified based on tree, herb, shrub, and soils data collected during 2004 plot surveys, augmented by previous data from Wiggins, Lautzenheiser, and Keeton. Because Marsh-Billings-Rockefeller National Historical Park is small, relatively simple in terms of vegetation, and had data collected on only 30 plots, quantitative analysis of plot data was not called for; instead we produced plot summaries from the PLOTS database and compared them to the vegetation types in the draft classification. Where differences were apparent, we assigned other existing USNVC associations, as appropriate, and where not, we created new ones.

Preliminary assignment of plots to existing USNVC associations was confirmed by qualitatively comparing each plot to existing associations in the USNVC. Because global descriptions include species from across the range of the association, a park-specific (local) description was included. Any new information collected during 2004 field sampling efforts was incorporated into the global description as appropriate. Global information was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park. The descriptions are included in Appendix D. Each vegetation association was assigned a park-specific common name; if none existed, the U.S. National Vegetation Classification common name was used. A park-specific common name was created for successional and cultural vegetation types not easily handled by the USNVC.

A park-specific dichotomous key was created for the vegetation associations to guide accuracy assessment and for use by park natural resource managers and others (Appendix E). A dichotomous key is a tool 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 leads the user to another couplet and eventually to the correct association. The dichotomous key should be used in conjunction with detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

### **2005 Vegetation Map Preparation**

Following development of vegetation classifications after plot sampling, the preliminary vegetation map was further edited and refined in 2005. Using ArcGIS 9.0, polygon boundaries were revised on-screen based on plot data and additional field observations collected during 2004 field visits. Field notes and limited field mapping supplemented GIS mapping. Each polygon was attributed with a map class name that is the common name of a USNVC association, a park-specific map class name representing a variant of an association, or an Anderson Level II use/land cover map class based on plot data, field observations, aerial photography signatures, and topographic maps.

Map units in the 2005 vegetation map were equivalent to the association level with few exceptions. Two canopy cover variants of Hemlock - Northern Hardwood Forest (CEGL006109) are mapped; one is the conifer-dominated phase called Hemlock Forest and the other is the mixed-canopy phase called Hemlock - Northern Hardwood Forest. Two variants of Northern Hardwood Forest (CEGL006252) were mapped; the typical (standard) variant was called Northern Hardwood Forest and a successional variant characterized by pole-sized trees (<10 cm dbh) was called the Northern Hardwood Forest (Pole Phase). Four variants of Rich Northern Hardwood Forest (CEGL005008) were mapped as individual map classes; these were Rich Northern Hardwood Forest (typic variant), Rich Northern Hardwood Forest (dry-mesic variant), Rich Northern Hardwood Forest (fern glade variant), and Rich Northern Hardwood Forest (successional variant). Enriched Hardwood Forest Seeps (CEGL006409), small occurrences within upland forests that are distinguished by their herb flora, were less than the minimum mapping unit (0.5 ha), and so were mapped in a separate point layer.

The shapefile was projected in Universal Transverse Mercator (UTM) Zone 18 North, North American Datum (NAD) 1983. After the 2005 vegetation association map was completed, the thematic accuracy of this map was assessed.

### **Accuracy Assessment**

Two sources of potential error in the draft vegetation map included: 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. The USGS/NPS Vegetation Mapping Program protocols (TNC and ESRI 1994c) were followed to assess positional and thematic accuracy of the Marsh-Billings-Rockefeller National Historical Park vegetation map.

#### ***Positional Accuracy Assessment***

Horizontal accuracy of the Marsh-Billings-Rockefeller National Historical Park orthorectified photomosaic was assessed on the basis of 25 field survey points distributed throughout the image ([http://nrdata.nps.gov/networks/netn/mabi\\_image\\_orthoquad\\_ncsu\\_2004.xml](http://nrdata.nps.gov/networks/netn/mabi_image_orthoquad_ncsu_2004.xml)). Actual field coordinates for these points were recorded with a Trimble ProXRS GPS unit with real-time

differential correction and a minimum of 120 (180 if field conditions were poor) fixes per point. Field coordinates were then compared to image mosaic coordinates for these points, determined in ESRI ArcView 3.3 software. The accuracy calculation formula is based on root mean square error (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999).

### ***Thematic Accuracy Assessment***

Thematic accuracy of the 2005 vegetation map was assessed by NatureServe vegetation ecologist, Sue Gawler, in September 2006. Accuracy assessment was limited to natural or semi-natural vegetation of uplands and emergent vegetation of wetlands. Highly managed vegetation such as lawns, as well as non-vegetated developed areas, are not covered by the USNVC and were not included in the assessment.

To meet field budget constraints, the four variants of the Rich Northern Hardwood Forest association depicted in the 2005 vegetation map were lumped into one map class, Rich Northern Hardwood Forest, for accuracy assessment. Likewise, the Northern Hardwood Forest and Northern Hardwood Forest (Pole Phase) map classes were lumped into one map class for accuracy assessment because they represent the typical and successional phase of the same association. The map classes Hemlock - Northern Hardwood Forest and Hemlock Forest were maintained despite representing the same association because they provide additional detail on where specifically in the park there are areas with high evergreen cover (>60%) and forest canopy dominance by *Tsuga canadensis* (eastern hemlock). This is informative for park natural resource managers for forest health monitoring. For example, when monitoring for the hemlock woolly adelgid, it is useful to know where there are stands of all hemlock, as well as stands of mixed hemlock - hardwoods. Pure hemlock stands will require more management (i.e. removal of substantial downed hemlock debris from trails) than mixed canopy stands. This canopy cover differentiation is also useful for monitoring wildlife habitat and usage; for example, white tailed deer frequent closed-canopy hemlock stands in winter where snow is not as deep as it is in mixed canopy stands (Ellison et al. 2010).

The number of points to be assessed was determined by evaluating the total number of mapped polygons and total acreage for each association. These calculations were made using GIS software. The number of points was determined using a slightly modified version of the accuracy assessment methodology outlined in the Accuracy Assessment Procedures (ESRI and NCGIA 1994) as follows, quoted directly from the document:

“...it is recommended that 30 samples be specified as the maximum sample size for abundant classes, and that five samples be specified as the sample size for the rarest classes. Any class too rare for five sample sites to be selected should be observed in its entirety. Since a number of classes are intermediate in abundance between abundant and rare, five scenarios based on class abundance and frequency have been defined:

Scenario A: The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.

- Scenario B: The class is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.
- Scenario C: The class is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.
- Scenario D: The class is rare. It has more than five but fewer than 30 polygons and covers less than 50 hectares of the area. In this case, the recommended number of samples is five. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than five sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting five sample sites will allow an accuracy estimate to be computed, although it will not be very precise.
- Scenario E: The class 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 the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than five sample sites (assuming 1 site per polygon), no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).”

Sixty-seven accuracy assessment points were generated using this methodology. Polygon borders were buffered by 10 meters to exclude ecotonal areas that may be of ambiguous classification, and four accuracy assessment points within the buffers were excluded, leaving 63 for accuracy assessment points for sampling. Table 4 shows the allocation of the accuracy assessment points among the vegetation map classes in the 2005 vegetation map and Figure 4 depicts the locations of the 63 points sampled in the park.

Field Methods: Accuracy assessment field work was conducted in September 2006. A Garmin GPSMap 60CSX unit was programmed with coordinates of selected sampling locations. Using the GPS and aerial photos with unlabeled polygons, ecologists navigated to each point. Within a circular area of up to approximately 50 m<sup>2</sup>, depending on polygon size, data were collected using a standardized field form (Appendix F). Vegetation data included average height and percent cover of each stratum, as well as dominant species of each stratum. Percent cover was estimated for the unvegetated ground surface within categories including bedrock, litter/duff, wood >1 cm, large rocks (cobbles, boulders >10 cm), small rocks (gravel, 0.2–10 cm), sand (0.1–2 mm), and bare soil. Other environmental data, such as topographic position, hydrologic regime, or unusual features that further aided identification to association were collected. Using the dichotomous

**Table 4.** Thematic accuracy assessment (AA) sampling strategy for Marsh-Billings-Rockefeller National Historical Park based on the 2005 vegetation map.

2005 Vegetation Map Class Name <sup>1</sup> / Anderson Land Use Name	Number of polygons	Mapped hectares	Protocol AA points <sup>2</sup>	AA points sampled <sup>3</sup>
Vegetation Map Class				
European Larch Plantation	1	2.6	1	1
Field (successional old field)	2	0.3	1	2
Hemlock - Beech - Oak Forest	4	3.2	3	3
Hemlock - Hardwood Seepage Forest	1	1.4	1	1
Hemlock - Northern Hardwood Forest	9	48.7	5	6
Hemlock Forest	5	10.2	5	5
Mixed Conifer Plantation	6	5.8	5	4
Northern Hardwood - Hemlock Swamp	4	1.9	1	4
Northern Hardwood Forest [includes Northern Hardwood Forest (Pole Phase)]	11	35.2	5	5
Norway Spruce Plantation	6	5.2	5	3
Red Oak - Northern Hardwood Woodland	2	0.2	1	1
Red Oak - Northern Hardwood Forest	1	1.7	1	1
Red Pine Plantation	4	18.5	5	3
Rich Northern Hardwood Forest (4 variants in 2005 map: typic, dry-mesic variant, fern glade variant, and successional variant)	11	17.0	5	7
Semi-rich Northern Hardwood Forest	8	10.7	5	4
Successional Black Locust Forest	1	1.5	1	1
White Pine Plantation	8	23.4	5	4
White Pine Successional Forest	6	7.2	5	5
Anderson Level II Category				
Field (Hay / Cropland)	4	17.5	4	2
Gardens and Grounds	2	4.3	1	1
Gravel Parking Lot	1	0.2	1	0
Pond	1	5.8	1	0
Total	98	222.5	67	63

<sup>1</sup> The names of the vegetation associations and map classes listed in the table are from the 2005 vegetation map created before accuracy assessment. Numerous changes were made to the classification after accuracy assessment because of the additional field data provided by the assessment. The preliminary association names in the table do not completely match the final association names in this report.

<sup>2</sup> Number of points recommended by USGS-NPS Vegetation Mapping Program protocol (TNC and ESRI 1994c).

<sup>3</sup> Number of accuracy assessment points sampled may not be equal to the number recommended because four points were excluded that occurred in the ecotones between two map classes. Decisions were made in the field to omit or add points in a map class based on time constraints; for example, the pond and parking lot points were deemed self explanatory, while an additional Rich Northern Hardwood Forest point was completed to provide more data on the map class. Plantations were a lower priority for sampling than naturally occurring associations.

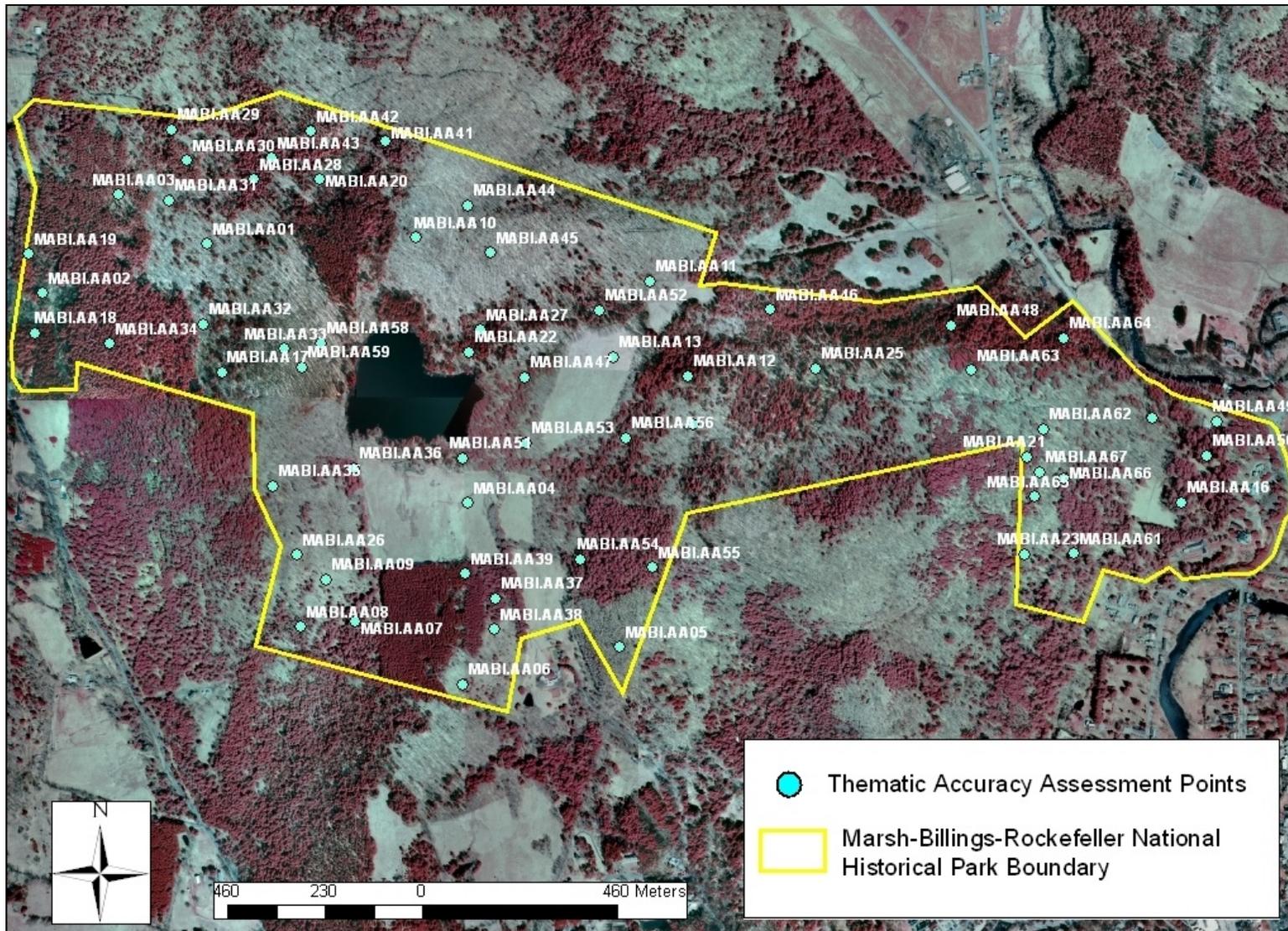


Figure 4. Locations of the 63 accuracy assessment sampling points in Marsh-Billings-Rockefeller National Historical Park.

key to the map classes, the polygon was assigned to the appropriate map class (hereafter referred to as the “first call”). If the classification decision was ambiguous, a comments field was completed to describe the reason for ambiguity, and a “second call” was noted. The ecologists also noted whether the sampling point was characteristic of the polygon as a whole or whether the point was atypical of the polygon.

Data Analysis: Data from the 63 accuracy assessment points were then entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform during the winter of 2007. In the PLOTS database, species found within 50 m<sup>2</sup> of the accuracy assessment points were assigned standardized codes based on the PLANTS 3.5 database (USDA, NRCS 2006). Common and scientific names of plants observed during thematic accuracy assessment sampling are listed in Appendix C.

GPS data points were downloaded into an ArcGIS shapefile to compare the field identification of each accuracy assessment point to the mapped identity in the draft vegetation map. Point coverage was overlain on the draft vegetation map layer and comparisons were made between the association name on the field form and the corresponding association name on the vegetation map. A table was produced to illustrate the comparisons for every point. The senior author also reviewed every field data sheet to ensure that the classification concept was correctly applied. Additional columns were added to the table to record second calls where the initial identification was ambiguous.

Thematic accuracy was then tabulated using a contingency matrix that compared mapped vegetation associations with actual vegetation associations observed in the field. Overall percent accuracy and 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). The USGS-NPS vegetation mapping protocol requires that the Kappa index of vegetation association maps exceed 80% (TNC and ESRI 1994c).

Additional analyses were performed to evaluate the appropriate level of data presentation; i.e., a reasonable compromise between a higher degree of detail but lower accuracy and a lower degree of detail with higher accuracy. The first analysis, or binary analysis, strictly compares the first call to its corresponding map polygon label. The analysis is binary in that the mapped polygon is either correct or incorrect.

A second analysis using “fuzzy logic” (Gopal and Woodcock 1994) was also conducted. Fuzzy logic takes into account the variable and continuous nature of vegetation, and accepts as valid other possible choices beyond the initial field identification. In this analysis calls may be correct, incorrect, or “acceptable.” In those cases in which a second call was made in the field, it was assumed that there was more than one possible acceptable option and the alternate association label would not pose a problem for the user. If the label for the first call was incorrect, but the second calls were in agreement, the point was changed to correct.

A third analysis was conducted in which associations that were often confused with each other on the map were aggregated into map classes. Where the accuracy of each individual association was unacceptably low, aggregating the associations into a single map class yielded a higher degree of accuracy, but one with somewhat lower detail. In most cases, map classes are equivalent to associations, but in a few cases, two associations were aggregated or an association was split into variants. Associations that achieved 80% accuracy or better were not aggregated.

User's accuracy and producer's accuracy were calculated for each map class. The former reflects errors of commission (errors of inclusion) and is calculated by dividing the number of correctly classified samples of a map class by the total number of accuracy assessment points that were attributed to that map class. Producer's accuracy reflects errors of omission (errors of exclusion) and is calculated by dividing the number of correctly classified samples of a map class (same numerator as in user's accuracy) by the total number of accuracy assessment points in polygons of that map class. User's accuracy reflects the degree to which the map reflects what is actually on the ground, while producer's accuracy reflects the probability that field samples have been correctly attributed. Overall accuracy (all classes) was also calculated in each of the contingency tables in the results section.

### **Final Vegetation Classification and Map Preparation**

Based on the results of the accuracy assessment analyses, the 2005 vegetation map was revised to correct errors and provide the park with a more accurate final product that met USGS/NPS vegetation mapping standards. In this final 2007 revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon attributes, map classes, and the final vegetation classification.



## Results

### **Vegetation Classification and Characterization after Plot Sampling**

A total of 18 USNVC associations were identified from plot and reconnaissance work (Table 5). Of the 18 vegetation associations, five are plantation types, three are successional types, and ten could be considered natural types. Only three wetlands are described in the classification. Because they are not clearly represented by different vegetation types, vernal pools, which have been mapped in Lautzenheiser's map (2002), are not a part of this classification; they are subsumed by the forest types.

### **2005 Vegetation Map Production**

The 2005 vegetation map is composed of 26 map classes, including 22 vegetation and four cultural units (Table 4, Figure 5). Cultural map classes are cross-walked to Anderson (1976) Level II units and include Artificial Pond, Gravel Parking Lot, Gardens and Grounds, and Field (Hay/ Cropland).

Vegetation map classes are equivalent to the association level of the USNVC, with three exceptions. The Rich Northern Hardwood Forest association was subdivided into four map classes based on differences in herb flora, setting, and/or successional stage. The map classes include the typical expression, a successional variant, a fern glade variant, and a dry-mesic variant. These are described in detail in the local description of the vegetation association (CEGL005008) in Appendix D of this report. The Northern Hardwood Forest association was subdivided into the typical expression and an earlier-successional pole phase map class. The Hemlock - Northern Hardwood Forest association is mapped in two map classes depending on whether the canopy is mixed deciduous and coniferous (Hemlock - Northern Hardwood Forest map class) or more strongly coniferous (Hemlock Forest map class).

The Enriched Hardwood Forest Seeps, small occurrences within upland forests that are distinguished by their herb flora, are less than the minimum mapping unit, so are mapped in a separate point layer (seeps).

Because Marsh-Billings-Rockefeller National Historical Park is a small park with the vegetation map consisting of fewer than 100 polygons, and because there is management interest in the different types of northern hardwood forests that are distinguished primarily by their herbaceous flora (not discernable from an aerial photo), the mapping did not rely entirely on aerial photointerpretation. Northern Hardwood Forest, Semi-rich Northern Hardwood Forest, and Rich Northern Hardwood Forest, for example, are often indistinguishable on aerial photos; therefore, ground data or soils data were used to differentiate these associations.

**Table 5.** Map classes and USNVC crosswalks for the 2005 vegetation map.

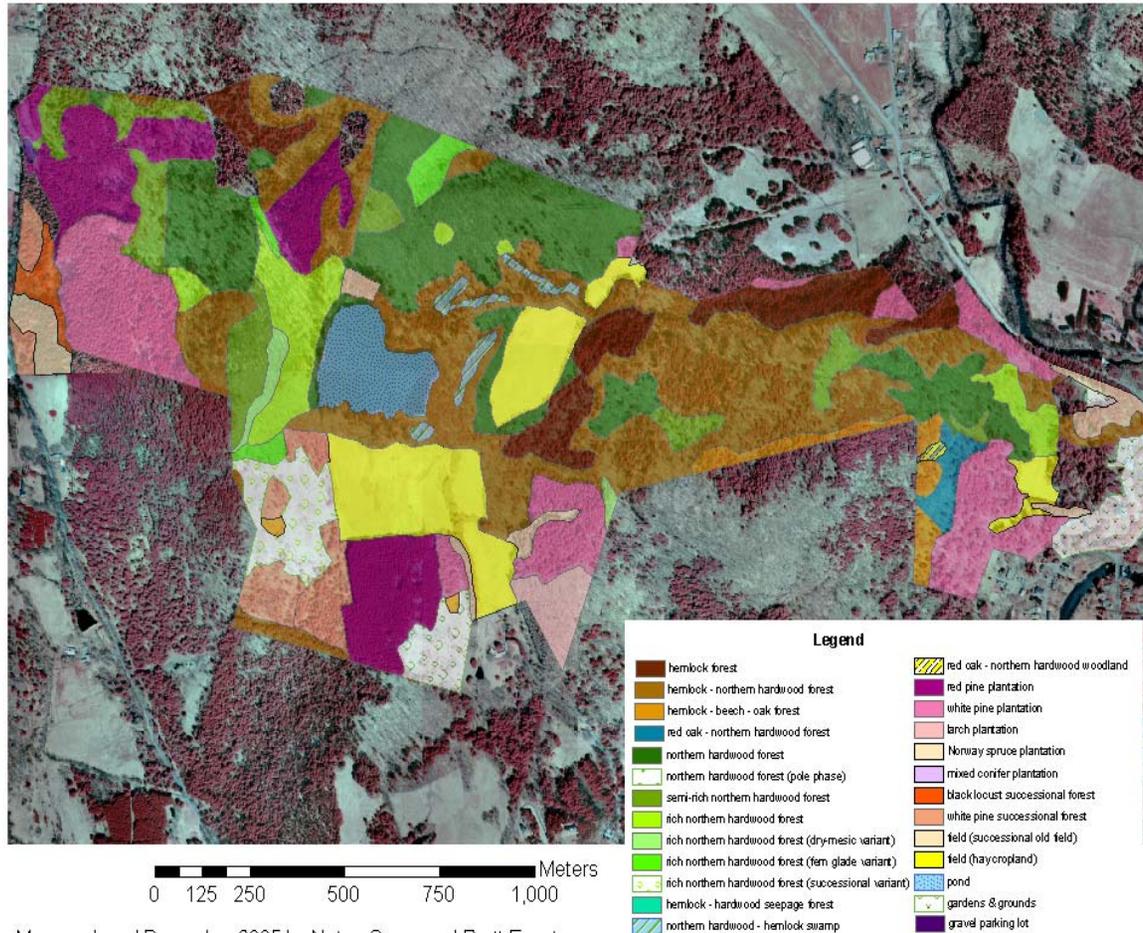
Group	Map Class <sup>1</sup>	USNVC association	USNVC code <sup>2</sup>
Upland Natural Forest	Hemlock - Beech - Oak Forest	<i>Tsuga canadensis</i> - <i>Fagus grandifolia</i> - <i>Quercus rubra</i> Forest	CEGL006088
	Hemlock - Northern Hardwood Forest	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> - <i>Acer saccharum</i> / <i>Dryopteris intermedia</i> Forest	CEGL006109 (mixed phase)
	Hemlock Forest	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> - <i>Acer saccharum</i> / <i>Dryopteris intermedia</i> Forest	CEGL006109 (conifer phase)
	Northern Hardwood Forest	<i>Acer saccharum</i> - <i>Betula alleghaniensis</i> - <i>Fagus grandifolia</i> / <i>Viburnum lantanoides</i> Forest	CEGL006252
	Successional Northern Hardwood Forest	<i>Acer saccharum</i> - <i>Betula alleghaniensis</i> - <i>Fagus grandifolia</i> / <i>Viburnum lantanoides</i> Forest	CEGL006252 (Pole Phase)
	Red Oak - Northern Hardwood Forest	<i>Quercus rubra</i> - <i>Acer saccharum</i> - <i>Fagus grandifolia</i> / <i>Viburnum acerifolium</i> Forest	CEGL006173
	Rich Northern Hardwood Forest	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> / <i>Acer spicatum</i> / <i>Caulophyllum thalictroides</i> Forest	CEGL005008
	Semi-rich Northern Hardwood Forest	<i>Acer saccharum</i> - ( <i>Fraxinus americana</i> ) / <i>Arisaema triphyllum</i> Forest	CEGL006211
Wetland Forest	Hemlock - Hardwood Seepage Forest	<i>Betula alleghaniensis</i> - <i>Acer rubrum</i> - ( <i>Tsuga canadensis</i> , <i>Abies balsamea</i> ) / <i>Osmunda cinnamomea</i> Forest	CEGL006380
	Northern Hardwood - Hemlock Swamp	<i>Acer rubrum</i> - <i>Fraxinus nigra</i> - ( <i>Tsuga canadensis</i> ) / <i>Tiarella cordifolia</i> Forest	CEGL006502
Upland Woodland	Red Oak - Northern Hardwood Woodland	<i>Acer saccharum</i> - <i>Tilia americana</i> - <i>Fraxinus americana</i> / <i>Ostrya virginiana</i> / <i>Geranium robertianum</i> Woodland	CEGL005058
Plantation Forest	European Larch Plantation	<i>Larix (laricina, decidua)</i> Planted Forest	CEGL006408
	Mixed Conifer Plantation	<i>Pinus</i> spp. Planted Forest	CEGL006313
	Norway Spruce Plantation	<i>Picea abies</i> Planted Forest	CEGL007167
	Red Pine Plantation	<i>Pinus resinosa</i> Planted Forest	CEGL007177
	White Pine Plantation	<i>Pinus strobus</i> Planted Forest	CEGL007178
Old-field Forest	Successional Black Locust Forest	<i>Robinia pseudoacacia</i> Forest	CEGL007279
	White Pine Successional Forest	<i>Pinus strobus</i> Successional Forest	CEGL007944
Upland Herbaceous	Successional Old Field	<i>Dactylis glomerata</i> - <i>Phleum pratense</i> - <i>Festuca</i> spp. - <i>Solidago</i> spp. Herbaceous Vegetation	CEGL006107
Wetland Herbaceous	Enriched Hardwood Forest Seep <sup>3</sup>	<i>Onoclea sensibilis</i> – ( <i>Adiantum pedatum</i> ) – <i>Impatiens capensis</i> – <i>Carex plantaginea</i> Herbaceous Vegetation	CEGL006409

<sup>1</sup> 2005 vegetation map class names listed in the table are from the preliminary classification determined before accuracy assessment. Numerous changes were made to the classification and vegetation map after accuracy assessment, therefore the map class names in this table do not fully match the names in the final 2007 vegetation map and classification presented in this report.

<sup>2</sup> Repeated USNVC codes indicate the map class is a variant or successional phase of the association.

<sup>3</sup> Technically this is not a map class, but rather mapped as points.

### Vegetation of Marsh-Billings-Rockefeller National Historical Park



Map produced December 2005 by NatureServe and Brett Engstrom

See accompanying report for description of units and corresponding NVC associations

**Figure 5.** 2005 vegetation map classes and Anderson Level II categories of Marsh-Billings-Rockefeller National Historical Park.

## **Accuracy Assessment**

### ***Positional Accuracy***

The final horizontal positional accuracy of the Marsh-Billings-Rockefeller National Historical Park mosaic was 3.96 meters RMSE, which meets Class 3 National Map Accuracy Standards (FGDC 1998b).

### ***Thematic Accuracy***

Initial Analysis - 2005 Vegetation Map: The initial analysis comparing strictly the first call field identification with the mapped polygon of the 2005 vegetation map resulted in an overall Kappa index of 72.6%, which fell below the USGS/NPS vegetation mapping protocol requirement of 80%. Six out of 20 map classes failed to meet the 60% threshold for producer's accuracy, user's accuracy, or both: Hemlock - Beech - Oak Forest, Hemlock - Hardwood Seepage Forest, Hemlock - Northern Hardwood Forest, Semi-rich Northern Hardwood Forest, Mixed Conifer Plantation, and White Pine Successional Forest (Table 6).

There are several reasons why vegetation on the ground at an accuracy assessment sampling point can be different than the mapped vegetation type. The inaccuracy can be attributed to one or more of the following reasons:

- The polygon is attributed with the incorrect association because of aerial photointerpretation error.
- The sampling area around the point is an inclusion - a small patch of one association embedded within another association.
- Ambiguities in the vegetation key, which led to identification of the wrong association area.
- The classification is incorrect or incomplete and does not include the vegetation in the sampling area.

To address these multiple sources of error, revisions were made to the 2005 vegetation map, vegetation classification, and vegetation key based on the thematic accuracy assessment data analysis.

Revised Map Analysis - Final 2007 Vegetation Map: Revisions were made to the 2005 vegetation map after the initial accuracy assessment to create a product that met the USGS/NPS vegetation mapping protocol requirement with an overall Kappa index of 85.7% (Tables 7 and 8 [these two tables are out of sequence as Tables 8 and 7 due to paper size constraints]). Map classes were formed from the 2005 vegetation map based on ecological knowledge of the associations. For example, White Pine Plantation was frequently confused with White Pine Successional Forest, and aggregating the two types into the White Pine Forest map class in the final 2007 vegetation map provided a more accurate map class.

In another case, variants of associations were not aggregated. The dry-mesic variant of the Rich Northern Hardwood Forest as shown in the 2005 vegetation map occurs in a different ecological setting than the typic, successional, and fern-glade variants of the Rich Northern Hardwood Forest. It occurs in a dry-mesic setting on limestone bedrock, whereas the other variants do not occur on limestone. Therefore, the three polygons depicting the dry-mesic variant of the Rich Northern Hardwood Forest map class were maintained in the final 2007 vegetation map and

**Table 6.** Contingency table for accuracy assessment of the Marsh-Billings-Rockefeller National Historical Park 2005 vegetation map

Map Class Name <sup>1</sup>	Field Call	Mapped as																				Total	Producer's accuracy
		FH	GG	HBO	HEM	HHP	HHS	HNH	NH	NHR	NHS	BL	OF	ONHF	ONHW	PL	PMP	PNS	PRP	PWP	WPS		
Field (Hay/Cropland)	FH	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%
Gardens and Grounds	GG	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%
Hemlock - Beech - Oak Forest	HBO	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%
Hemlock Forest	HEM	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	75%
Hemlock - Hardwood Seepage Forest	HHP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Northern Hardwood - Hemlock Swamp	HHS	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100%
Hemlock - Northern Hardwood Forest	HNH	0	0	2	2	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	9	44%
Northern Hardwood Forest	NH	0	0	0	0	0	0	0	6	2	1	0	0	0	0	0	0	0	0	0	0	9	67%
Rich Northern Hardwood Forest	NHR	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	6	83%
Semi-rich Northern Hardwood Forest	NHS	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	50%
Successional Black Locust Forest	BL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	100%
Successional Old Field	OF	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	100%
Red oak - Northern Hardwood Forest	ONHF	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	100%
Red oak - Northern Hardwood Woodland	ONHW	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100%
European Larch Plantation	PL	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100%
Mixed Conifer Plantation	PMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	2	6	50%	
Norway Spruce Plantation	PNS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	100%	
Red Pine Plantation	PRP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	100%	
White Pine Plantation	PWP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	5	80%	
White Pine Successional Forest	WPS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	100%
	Total	2	1	3	5	1	4	5	6	7	4	1	2	1	1	1	4	3	3	5	4	63	

PERCENT CORRECT																					74.6%																					
KAPPA INDEX																					72.6%																					
User's accuracy																					100%	100%	33%	60%	0%	100%	80%	100%	71%	25%	100%	100%	100%	100%	100%	75%	100%	100%	80%	50%	P chance	0.073621

<sup>1</sup>Names of map class names listed in the table are from the preliminary classification determined before accuracy assessment sampling. Numerous changes were made to the classification after accuracy assessment, therefore the map class names in this table do not fully match the names in the final 2007 vegetation map presented in this report.

**Table 7.** Contingency table for accuracy assessment of the Marsh-Billings-Rockefeller National Historical Park final 2007 vegetation map.

Map Class	Field Call	Mapped as																				User's accuracy	
	AA point	FH	HBO	GG	HEM	HHP	HHS	HNH	NHL	NHP	NHR	NHS	BL	OF	ONHF	ONHW	PL	PMP	PNS	PRP	WP		Total
Field (Hay/Cropland)	FH	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%
Gardens and Grounds	GG	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%
Hemlock - Beech - Oak Forest	HBO	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100%
Hemlock Forest	HEM	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100%
Hemlock - Hardwood Seepage Forest	HHP	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100%
Northern Hardwood - Hemlock Swamp	HHS	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	100%
Hemlock - Northern Hardwood Forest	HNH	0	1	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	7	71%
Northern Hardwood Limestone Forest	NHL	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	3	67%
Successional Northern Hardwood Forest	NHP	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	100%
Rich Northern Hardwood Forest	NHR	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	100%
Northern Hardwood Forest	NHS	0	0	0	0	0	0	1	0	0	1	7	0	0	0	0	0	0	0	0	0	9	78%
Successional Black Locust Forest	BL	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	100%
Successional Old Field	OF	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	100%
Red Oak - Northern Hardwood Forest	ONHF	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100%
Red Oak - Northern Hardwood Woodland	ONHW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	100%
European Larch Plantation	PL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	100%
Mixed Conifer Plantation	PMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	5	60%
Norway Spruce Plantation	PNS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	4	75%
Red Pine Plantation	PRP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	100%
White Pine Forest	WP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6	7	86%
	Total	2	3	1	5	1	4	6	2	2	5	7	1	2	1	1	1	4	3	3	9	63	
																						PERCENT CORRECT	85.7%
																						KAPPA INDEX	84.6%
Producer's Accuracy	100%	67%	100%	80%	100%	100%	83%	100%	100%	60%	100%	100%	100%	100%	100%	100%	100%	75%	100%	100%	67%		
																						P (chance)	0.0752

**Table 8.** Revisions to the 2005 vegetation map class names and vegetation classification after 2007 accuracy assessment to create the final 2007 vegetation map and classification.

<b>2005 Vegetation Map Map Class Name<sup>1</sup></b>	<b>2005 USNVC Code</b>	<b>Final 2007 Vegetation Map Map Class Name</b>	<b>2007 USNVC Code</b>
Northern Hardwood Forest	CEGL006252	Northern Hardwood Forest	CEGL006211
Northern Hardwood Forest (Pole Phase)	CEGL006252	Successional Northern Hardwood Forest	CEGL006252
Rich Northern Hardwood Forest (dry-mesic variant)	CEGL005008	Northern Hardwood Limestone Forest	CEGL005008
Rich Northern Hardwood Forest (fern-glade variant)	CEGL005008	Rich Northern Hardwood Forest	CEGL005008
Rich Northern Hardwood Forest (successional variant)	CEGL005008	Rich Northern Hardwood Forest	CEGL005008
Semi-rich Northern Hardwood Forest	CEGL006211	Northern Hardwood Forest -or- Rich Northern Hardwood Forest	CEGL006211 CEGL005008
White Pine Plantation	CEGL007178	White Pine Forest	CEGL007178
White Pine Successional Forest	CEGL007944	White Pine Forest	CEGL007944

<sup>1</sup> If the 2005 vegetation map class name from Table 5 is not listed, it was not revised in the final 2007 vegetation map.

called Northern Hardwood Limestone Forest. Aggregating all four variants of the Rich Northern Hardwood Forest would have obscured the ecological uniqueness of the Northern Hardwood Limestone Forest.

All eight mapped polygons of Semi-rich Northern Hardwood Forest in the 2005 vegetation map were classified in the field during accuracy assessment as either Rich Northern Hardwood Forest or Northern Hardwood Forest. The one accuracy assessment point that was identified as Semi-rich Northern Hardwood Forest in the field was mapped as Hemlock - Northern Hardwood Forest. In the preliminary vegetation classification, Semi-rich Northern Hardwood Forest was used as an intermediate association between Rich Northern Hardwood Forest and Northern Hardwood Forest map classes. Accuracy assessment indicated that the level of splitting is not supported by the field data, so the Semi-rich Northern Harwood Forest association was removed from the final classification. The Semi-rich Northern Hardwood Forest polygons were reclassified as either Northern Hardwood Forest or Rich Northern Hardwood Forest. In addition, the USNVC code for Northern Hardwood Forest was changed from CEG L006252 to CEG L006211. CEG L006252 was used for Successional Northern Hardwood Forest (formerly called Northern Hardwood Forest (Pole Phase) in the park. The name was changed from “Pole Phase” to “Successional” to eliminate the use of map class jargon and better represent the successional nature of the association.

Two of the three polygons mapped in the 2005 vegetation map as Hemlock-Beech-Oak Forest were field-classified during accuracy assessment as Hemlock - Northern Hardwood Forest. Two of the four polygons preliminarily mapped as White Pine Successional Forest were called Mixed Conifer Plantation. The challenge of differentiating a successional conifer forest from a conifer plantation was noted during preliminary mapping efforts as well as later in the field. Six polygons were called Mixed Conifer Plantation in the field, but only three of those were so mapped; the others were mapped as White Pine Successional Forest or White Pine Plantation. All of these polygons were updated in the final 2007 vegetation map to match the accuracy assessment field calls.

Nine accuracy assessment points were called Hemlock - Northern Hardwood Forest in the field, but only four were so mapped; the others were mapped as Hemlock - Beech - Oak Forest, Hemlock Forest, or Hemlock - Hardwood Seepage Forest. As a result, Hemlock Forest and Hemlock - Northern Hardwood Forest were classified as the same association but mapped with a mixed hardwood and conifer phase and a conifer phase.

In summary, the following final changes were made to the 2005 vegetation map to improve accuracy by map class and improve the final overall map accuracy and Kappa index from 76% and 74%, respectively, for the 2005 vegetation map to 86% and 85%, respectively, for the final 2007 vegetation map:

1. The White Pine Successional Forest and White Pine Plantation associations were combined into one map class: White Pine Forest.
2. The Rich Northern Hardwood Forest was divided into two map classes:
  - a. The “dry-mesic variant” of the Rich Northern Hardwood Forest depicted in the 2005 vegetation map is equivalent to Vermont Natural Heritage Program’s classified Northern Hardwood Limestone Forest, a variant of the Rich Northern Hardwood Forest,

characterized by an upper slope or knoll landscape position, thin soils, and hophornbeam (*Ostrya virginiana*) as an associate (Johnson and Sorensen 2005). It was assigned the map class: Northern Hardwood Limestone Forest.

- b. The “fern-glade variant,” “successional variant,” and “typic variant” of the Rich Northern Hardwood Forest remained to represent one map class: Rich Northern Hardwood Forest.
3. The Semi-rich Northern Hardwood Forest map class was dissolved and those polygons were reattributed to Northern Hardwood Forest or Rich Northern Hardwood Forest. The USNVC crosswalk for Northern Hardwood Forest was changed to CEG L006211. Successional Northern Hardwood Forest (formerly called Northern Hardwood Forest (Pole Phase) in the 2005 vegetation map), distinguished by pole-sized American beech (*Fagus grandifolia*) in the canopy and a depauperate herb layer, was classified as a separate association called Successional Northern Hardwood Forest (CEGL006252).
4. One polygon mapped as a Hemlock-Hardwood Seepage Forest was called Hemlock - Northern Hardwood Forest in the field and the polygon was renamed as such.

Accuracy assessment statistics were recalculated with those consolidations, reducing the map classes where either the producer’s accuracy or the user’s accuracy was <60% from six to two map classes: Mixed Conifer Plantation and Hemlock - Beech - Oak Forest. To correct the Mixed Conifer Plantation misclassifications, accuracy assessment data forms for any field points classified as Mixed Conifer Plantation but called something different on the vegetation map were reviewed to see if they were keyed correctly in the field or indicated a second-choice field call. When accuracy assessment statistics were calculated using the second-choice field call, the Mixed Conifer Plantation class percentage rose to within the acceptable range.

The Hemlock - Beech - Oak Forest polygons and accuracy assessment forms were also reviewed to see if using the second-choice field call improved the accuracy and whether the field key was used correctly. Only three polygons in one small area of the park on the border near Mount Tom were classified as this community. Upon review of the data, the key (which has since been revised) was problematic, as it should have also allowed for a predominance of American beech (*Fagus grandifolia*) over sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) to send the user to Hemlock - Beech - Oak Forest. When considerations for the field key were taken into account, the Hemlock - Beech - Oak Forest class percentage rose to within the acceptable range.

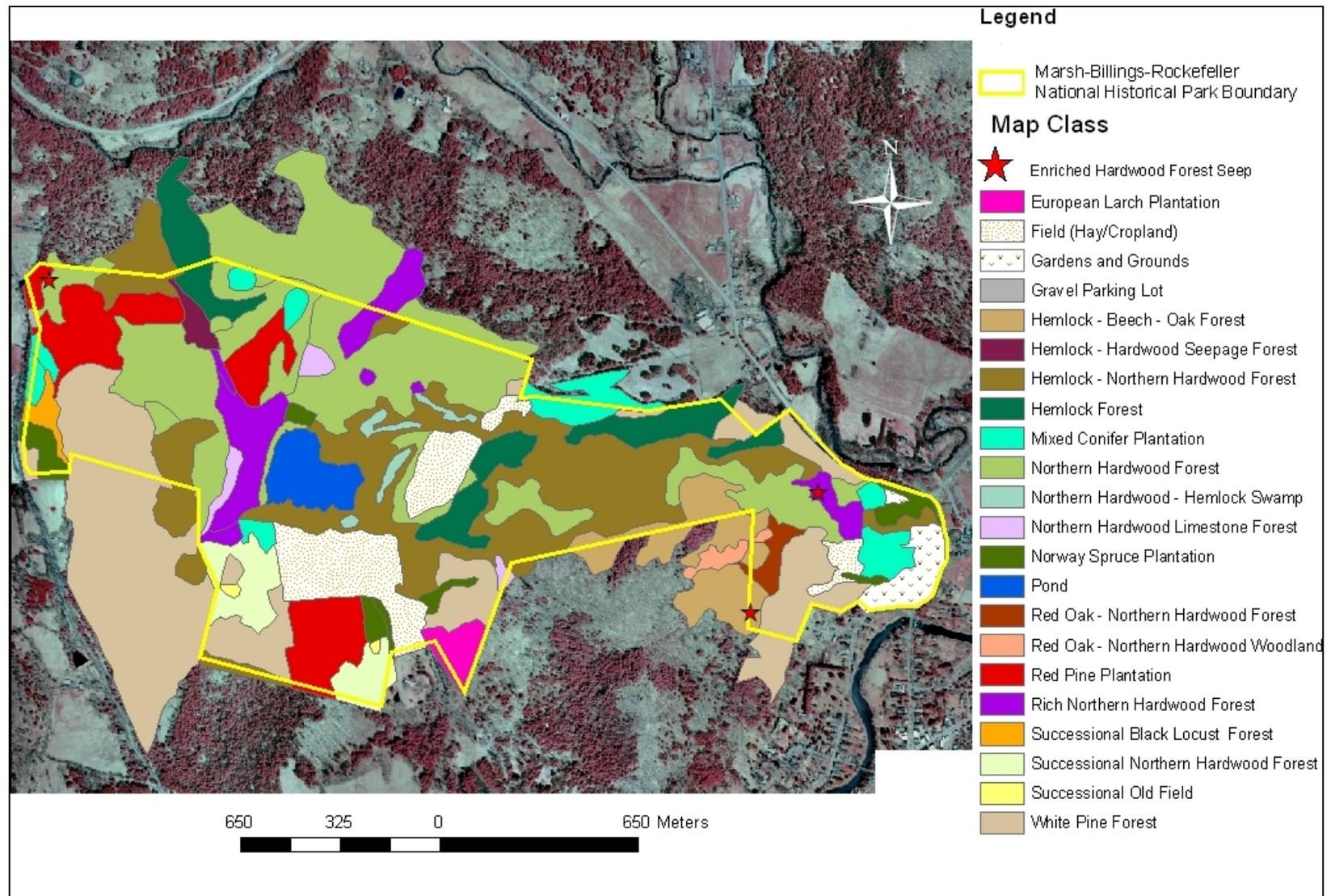
### **Final Vegetation Map Production**

The final 2007 vegetation map incorporates accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps. The overall map accuracy and Kappa index for the final 2007 vegetation map was 85.7% and 84.6%, respectively. USNVC data attributions for the polygons were updated based on accuracy assessment data in the final 2007 vegetation map shapefile (Table 7). Adjacent polygons with the same map class name were merged. NCSU-CEO cleaned the shapefile linework by removing gaps and overlapping polygons.

A summary of the distribution and abundance of the map classes is provided in Table 9 and the resulting final 2007 vegetation map is shown in Figure 6. Metadata for the vegetation association shapefile, the plot location shapefile, the accuracy assessment sampling point location shapefile,

**Table 9.** Number of polygons, total mapped hectares, and mapped hectares within the park boundary for the final 2007 vegetation map.

<b>2007 Vegetation Map Map Classes</b>	<b>Number of Polygons</b>	<b>Total Mapped Hectares</b>	<b>Mapped Hectares within Park Boundary</b>
Vegetation Map Class			
Enriched Hardwood Forest Seep	0 (points)	<0.01	<0.01
European Larch Plantation	1	2.7	2.3
Hemlock - Beech - Oak Forest	3	13.0	4.9
Hemlock - Hardwood Seepage Forest	1	1.4	1.4
Hemlock - Northern Hardwood Forest	8	49.0	48.2
Hemlock Forest	4	16.6	12.4
Mixed Conifer Plantation	8	12.1	6.9
Northern Hardwood - Hemlock Swamp	4	1.9	1.9
Northern Hardwood Forest	12	67.5	41.5
Northern Hardwood Limestone Forest	3	2.3	2.2
Norway Spruce Plantation	6	5.2	4.7
Red Oak - Northern Hardwood Woodland	2	1.3	0.2
Red Oak - Northern Hardwood Forest	1	1.8	1.7
Red Pine Plantation	4	18.5	18.0
Rich Northern Hardwood Forest	7	12.3	10.9
Successional Black Locust Forest	1	1.5	1.3
Successional Northern Hardwood Forest	2	8.1	7.4
Successional Old Field	2	0.3	0.3
White Pine Forest	10	57.5	29.2
Anderson Level II Category			
Field (Hay/Cropland)	4	17.5	17.3
Gardens and Grounds	2	4.3	4.2
Gravel Parking Lot	1	0.2	0.01
Pond	1	5.8	5.8
	<b>Total</b>	<b>87</b>	<b>300.9</b>
			<b>222.5</b>



**Figure 6.** Final 2007 vegetation map classes and Anderson Level II categories of Marsh-Billings-Rockefeller National Historical Park.

and the digital photomosaic were prepared according to FGDC standards and have been provided as a deliverable along with this report.

The vegetation and land cover of Marsh-Billings-Rockefeller National Historical Park was divided into a total of 87 polygons in the map classes (Table 9). The final 2007 vegetation map uses local (park-specific) names for the vegetation associations found in Marsh-Billings-Rockefeller National Historical Park. The vegetation map is composed of 22 map classes, including 18 vegetation classes and four cultural categories mapped as polygons. The cultural map classes include Pond, Gravel Parking Lot, Gardens and Grounds, and Field (Hay/Cropland). An additional association found in the park, Enriched Hardwood Forest Seep, is present as small occurrences within upland forests and distinguished by their herb flora. Smaller in size than the minimum mapping unit (0.5 ha), Enriched Hardwood Forest Seeps are mapped as points in a separate point layer. The linework extends outside the park boundary to avoid truncating the full coverage of the associations.

The final 2007 vegetation map classes are equivalent to the association level of the U.S. National Vegetation Classification (USNVC), with three exceptions:

1. One variant of the Rich Northern Hardwood Forest, the Northern Limestone Forest, was pulled out as a unique map class because the variant is uncommon in the state of Vermont and will likely be monitored by the park. It was not lumped into Rich Northern Hardwood Forest map class with the other three variants (a typical expression, a successional variant, and a fern glade variant) that were individually mapped in the 2005 vegetation map.
2. The Hemlock - Northern Hardwood Forest and Hemlock Forest association is mapped in two map classes depending on whether the canopy is mixed deciduous and coniferous (Hemlock - Northern Hardwood Forest map class) or more strongly coniferous (Hemlock Forest map class). We consider the Hemlock Forest an evergreen-dominated variant of the Hemlock - Northern Hardwood Forest. This is more informative to the park than lumping the two variants. For example, should the park monitor for hemlock woolly adelgid, users can quickly locate the hemlock-dominated forests in the parks using the vegetation map.
3. Because the White Pine Plantation association was frequently confused with White Pine Successional Forest, the two associations were aggregated to provide a more accurate map class (White Pine Forest).

### **Final Vegetation Association Descriptions**

Detailed local and global descriptions for the 18 vegetation associations were written based on the plot and accuracy assessment data and the ecologists' field experiences at Marsh-Billings-Rockefeller National Historical Park. The association descriptions contain information on their occurrence at Marsh-Billings Rockefeller National Historical Park ("Local Description") and rangewide ("Global Information"). These descriptions are included as Appendix D.

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 the PLANTS 3.5 Database (USDA NRCS 2006) in only a very few cases, and when this difference occurs, synonymy is indicated parenthetically in the local description information. Nomenclature for nonvascular plants (mosses) follows Anderson (1990) and Anderson et al.

(1990). English names for associations and alliances use NatureServe Central Ecology-accepted names and may differ slightly from the PLANTS 3.5 Database (USDA NRCS 2006) common names that are used within the local description information and throughout the rest of the report.

A dichotomous key was also developed for these vegetation associations (Appendix E). 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. This key and the park-specific vegetation association descriptions were used in the thematic accuracy assessment and may be used by park resource managers and others to identify vegetation associations in the park.

Representative photographs for most of the associations are provided after the association description. An index to these photos is provided in Appendix G. A bibliography for the sources cited in the USNVC global vegetation descriptions is provided in Appendix H. In addition to the 18 USNVC associations identified at the park, four Anderson Level II land use classes were used to describe managed landscapes distributed around the park: Field (Hay/Cropland), Gardens and Grounds, Gravel Parking Lot, and Pond.

### Project Deliverables

Products of the vegetation mapping project are shown in Table 10. All products have been delivered to the National Park Service Northeast Temperate Inventory and Monitoring Network by NatureServe with this report.

**Table 10.** Summary of products resulting from the Marsh-Billings-Rockefeller National Historical Park vegetation classification and mapping project.

<b>Product</b>	<b>FGDC-compliant spatial metadata</b>
Aerial photos, including flight line map and photoindex <sup>1</sup>	Yes
Photomosaic in digital format	Yes
Annotated field forms with vegetation plot sampling data	Not Applicable
Vegetation plot sampling data in the PLOTS 2.0 database	Yes
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
Digital photos representative of vegetation types	Not Applicable
Final map of vegetation associations as paper copy and in digital format	Yes
Final report as paper copy and in digital format	Yes

<sup>1</sup> The hard copy air photos were misplaced during the extended duration of this project. Scanned images of 10 of the 14 Marsh-Billings-Rockefeller National Historical Park films are on file at EROS and the NPS Northeast Temperate Network office in Woodstock, VT.



## Discussion

### Vegetation Classification and Characterization

This study at Marsh-Billings-Rockefeller National Historical Park identified 18 vegetation map classes in the final 2007 vegetation map: European Larch Plantation, Hemlock - Beech - Oak Forest, Hemlock Forest, Hemlock - Hardwood Seepage Forest, Hemlock - Northern Hardwood Forest, Mixed Conifer Plantation, Northern Hardwood Forest, Northern Hardwood - Hemlock Swamp, Northern Hardwood Limestone Forest, Norway Spruce Plantation, Red Oak - Northern Hardwood Forest, Red Oak - Northern Hardwood Woodland, Red Pine Plantation, Rich Northern Hardwood Forest, Successional Black Locust Forest, Successional Northern Hardwood Forest, Successional Old Field, and White Pine Forest. An additional vegetation type, Enriched Hardwood Forest Seep, occurring as patches too small to be mapped as polygons, is mapped as a separate point layer. The vegetation in the park is influenced by the environmental settings and past land uses in the park. The map classes and component vegetation associations are presented below in order of highest to lowest acreage within each subsection.

### Natural Upland Communities

The Northern Hardwood Forest (41.5 ha [102.5 ac]), Hemlock - Northern Hardwood Forest (48.2 ha [119.1 ac]), and Hemlock Forest (12.4 ha [30.6 ac]) map classes are the most common in the park. These can be distinguished from each other by the percent cover of eastern hemlock (*Tsuga canadensis*) in the canopy. The tree canopy of the Northern Hardwood Forest is dominated by sugar maple (*Acer saccharum*) with white ash (*Fraxinus americana*) co-dominant. American basswood (*Tilia americana*), American beech (*Fagus grandifolia*), and eastern hemlock are sometimes present in lesser amounts. Common and sometimes moderately abundant herbs include white wood aster (*Eurybia divaricata*), marginal woodfern (*Dryopteris marginalis*), Christmas fern (*Polystichum acrostichoides*), and longstalk sedge (*Carex pedunculata*). Enrichment indicators including Jack in the pulpit (*Arisaema triphyllum*), white baneberry (*Actaea pachypoda*), and red trillium (*Trillium erectum*) are regularly present but never abundant in terms of cover. The Successional Northern Hardwood Forest (7.4 ha [18.3 ac]) consists of early successional pole-sized northern hardwoods, primarily sugar maple and American beech. It has a dense sapling layer consisting of tree species from the canopy.

The Hemlock - Northern Hardwood Forest (48.2 ha [119.1 ac]) and Hemlock Forest (12.4 ha [30.6 ac]) map classes represent two cover phases of the same USNVC association at Marsh-Billings Rockefeller National Historical Park. One is a mixed canopy phase, where eastern hemlock shares canopy dominance with northern hardwoods, especially yellow birch (*Betula alleghaniensis*) and sugar maple. The other phase is dominated by eastern hemlock, where it comprises 60–100% of the canopy.

The Rich Northern Hardwood Forest map class covers (10.9 ha [26.9 ac]) of the park. It includes three distinct variants of the association: the fern glade variant, the successional variant, and the typic variant. These can be distinguished by understory composition, tree size and age, and environmental setting. The typic Rich Northern Hardwood Forest canopy dominants include sugar maple and American basswood. The fern glade variant is almost always found in coves and on toeslopes and has a high cover of ferns, especially those indicating rich soils such as Goldie's woodfern (*Dryopteris goldiana*), ostrich fern (*Matteuccia struthiopteris*), and silver false spleenwort (*Deparia acrostichoides*). The successional variant is dominated by pole-sized trees.

This Rich Northern Hardwood Forest map class is distinguished from the Northern Hardwood Forest map class by the greater species richness in the herb layer and the higher cover of ferns in most plots.

The Northern Hardwood Limestone Forest, previously called the ‘dry-mesic variant’ of the Rich Northern Hardwood Forest in the 2005 vegetation map, covers 2.2 ha (5.4 ac) of the park. This variant was not lumped into the Rich Northern Hardwood Forest map class in the final 2007 vegetation map because it is a unique variant that the park will likely want to monitor. It occurs on the upper, over-steepened slopes of West Ridge and on a localized limestone knoll west of Mount Tom’s summit. It has an abundance of *Ostrya virginiana* (hophornbeam) in the subcanopy in addition to some *Quercus rubra* (northern red oak) in the canopy. The herb layer often includes a greater diversity of upland woodland graminoids, especially *Carex* spp. (sedges) and Asteraceae (aster family species). *Carex laxiflora* (broad looseflower sedge), *Piptatherum racemosum* (blackseed ricegrass), *Polystichum acrostichoides* (Christmas fern), and *Solidago caesia* (wreath goldenrod) are particularly common in the drier sites. *Aquilegia canadensis* (red columbine) and *Saxifraga virginensis* (early saxifrage), species typically associated with ledges, tend to occur in the Northern Hardwood Limestone Forest.

The Hemlock - Beech - Oak Forest (4.9 ha [12.1 ac]) occurs in the eastern portion of the park on acidic soils. It is restricted to the generally steep, rocky upper slopes of Mount Tom. It can be distinguished from the adjacent forest associations by the co-dominance of eastern hemlock, American beech, and northern red oak (*Quercus rubra*) in the tree canopy.

The Red Oak - Northern Hardwood Forest (1.7 ha [4.2 ac]) and Red Oak - Northern Hardwood Woodland (0.2 ha [0.5 ac]) communities are uncommon in the park. These associations can be distinguished by their difference in canopy cover. The Red Oak - Northern Hardwood Woodland has a more open canopy and thus a more well-developed and grassy herbaceous layer dominated by wavy hairgrass (*Deschampsia flexuosa*). The closed-canopy Red Oak - Northern Hardwood Forest community occurs on the eastern shoulder of Mount Tom and has a canopy of mature sugar maple, white ash, and northern red oak. This community is very similar to the Northern Hardwood Forest. The presence of northern red oak in the canopy, plus some herbs, particularly wreath goldenrod (*Solidago caesia*), distinguish it from the Northern Hardwood Forest.

### **Natural Wetland Communities**

The Northern Hardwood - Hemlock Swamp (1.9 ha [4.7 ac]) community occupies narrow linear basins within the matrix Hemlock - Northern Hardwood Forest map class. Red maple (*Acer rubrum*) and black ash (*Fraxinus nigra*) characterize the canopy with eastern hemlock characteristic in the sub-canopy. Cinnamon fern (*Osmunda cinnamomea*) and sensitive fern (*Onoclea sensibilis*) are characteristic herbs.

Only one example of the Hemlock - Hardwood Seepage Forest (1.4 ha [3.5 ac]) occurs in the park at the base of a steep slope where groundwater seepage occurs. The mixed canopy includes eastern hemlock, yellow birch, white ash, sugar maple, and black ash. It has a well-developed herb layer dominated by long beechfern (*Phegopteris connectilis*) and common ladyfern (*Athyrium filix-femina*), and sedges including plantainleaf sedge (*Carex plantaginea*) and longstalk sedge (*Carex pedunculata*).

The small patches (<0.02 ha [ $<0.05$  ac]) of Enriched Hardwood Forest Seep are herbaceous wetland communities characterized by common ladyfern (*Athyrium filix-femina*), sensitive fern, and jewelweed (*Impatiens capensis*). It occurs on lower slopes, often at slope breaks within the matrix forest types.

## **Plantations and Ruderal Vegetation**

Conifer plantation associations, European Larch Plantation, Mixed Conifer Plantation, Norway Spruce Plantation, and Red Pine Plantation cover a significant extent of the park (31.9 ha [78.8 ac]). The White Pine Forest map class consists of the White Pine Forest (Successional Forest) and White Pine Forest (Plantation) associations which have combined cover of 29.2 ha (72.1 ac) of the park. These plantations will be replaced by native hardwood and eastern hemlock regeneration in the absence of management over time. This is apparent in the oldest White Pine Plantations and Norway Spruce Plantations, where canopy trees are beginning to die back due to natural succession and vigorous hardwood regeneration is coming up underneath the trees and in the canopy gaps. The herb layers in these plantations are typically dominated by native northern hardwood forest species. This same trend is apparent in the Successional Black Locust Forest (1.3 ha [3.2 ac]).

There are two Successional Old Field polygons, occupying only 0.3 ha (0.7 ac). These fields are maintained for vistas and have a diversity of meadow grasses and herbs, especially *Monarda fistulosa* (wild bergamot), *Asclepias syriaca* (common milkweed), and *Solidago* spp. (goldenrods). Both of these small units occur on gentle slopes of minor hill summits, one with south exposure and the other with an east exposure. The vegetation will succeed to forest if not maintained.

## **Altered Vegetation and Other Land-cover Classes**

In addition to the altered forests and fields in the park, the large pond (The Pogue) is altered as well. Prior to mining and impoundment in the 1890s, The Pogue was a peatland. A dam was built in 1890–1891 to enlarge the pond, and peat was mined for mulch and fertilizer in 1896 (Wilcke et al. 2000). It was a “rich deposit” of a moss type of peat/muck according to samples taken during a study of peat deposits in Vermont (Hills and Hollister 1912). A pre-impoundment black and white photograph taken from the summit of West Ridge shows a low shrubby and/or graminoid dominated peatland, with open water occupying less than a third of the basin. More research is needed, but the wetland was very likely some type of rich fen, given the calcareous bedrock in the Woodstock region. If it was a fen, at nearly 6.1 ha (15 ac) it was a highly significant peatland for the central Vermont region. Other land-cover classes classified at Marsh-Billings-Rockefeller National Historic Park include Field (Hay/Cropland), Garden and Grounds, and Gravel Parking Lot.

## **Uncommon Vegetation Associations, Variants, and Plant Species**

None of the vegetation associations or variants visited and mapped are rare in Vermont or the New England region. The Northern Hardwood Limestone Forest, Rich Northern Hardwood Forest, Red Oak - Northern Hardwood Woodland, and Northern Hardwood-Hemlock Swamp are the least common of the vegetation associations and variants in the state and region and are of local importance for biodiversity.

No federally or state-listed plant species were observed during the study. There were, however, several plants, especially sedges (*Carex* spp.), considered uncommon in Vermont and the New England region documented in 2004 during the project (Table 11). Most of these do not appear in the Hughes and Cass (1997) flora. Table 11 includes the state rank (or S-rank, where S1 is extremely rare, S2 is rare, and S3 is uncommon in Vermont), a descriptor of rarity in Marsh-Billings-Rockefeller National Historical Park, and comments regarding occurrence in sampled vegetation plots. State ranks are developed by the Vermont Fish & Wildlife Department's Nongame and Natural Heritage Program (Vermont Nongame and Natural Heritage Program 2005).

### **Nonnative Plant Species**

Eleven nonnative species were observed in the naturally forested portions of Marsh-Billings-Rockefeller National Historical Park, each occurring at least once in plots (Table 12). While some of these nonnatives have invasive capabilities, none of them showed this tendency within the naturally forested portions of the park. The broadleaf helleborine (*Epipactis helleborine*) and common gypsyweed (*Veronica officinalis*) are especially widespread in the forests of Marsh-Billings-Rockefeller National Historical Park, but do not appear to be endangering other species through competition. Of the nonnative trees planted, only the Norway spruce appears to be naturally regenerating, and this sparingly so.

Three of the nonnative plants listed, the two barberry species and Morrow's honeysuckle, are considered invasive over much of New England. Since they are currently not extensive in the park, removal now is more feasible than in many locations, and could prevent problems later. At the very least, the locations and extent of these aggressive shrubs should be monitored.

### **Vegetation Map Production**

The final vegetation map for Marsh-Billings-Rockefeller National Historical Park includes 19 vegetation map classes and four Anderson Level II categories (Figure 6). This map is based on aerial photography that was flown in April 2004. Since that time, the vegetation has continued to change due to natural and human-related disturbances. Continued natural succession will influence the mapped vegetations. Management of invasive species and woody plants will also alter the vegetation. Despite these continual changes, the vegetation map produced by this project provides crucial baseline data for park resource managers.

It is important to note that the vegetation attributions listed in the attribute table of the final vegetation association / map class shapefile were determined by the hierarchical nature of the USNVC. Based on the USNVC, each polygon was attributed with the appropriate formation, formation code, alliance code, alliance scientific and English name, association code, scientific and English names, and local park-specific names for the polygon's USNVC association.

**Table 11.** Uncommon plants observed in Marsh-Billings-Rockefeller National Historical Park during 2004 plot sampling.

<b>Plant Species</b>		<b>State</b>	
<b>Common Name</b>	<b>Scientific Name</b>	<b>Rank</b>	<b>Comments</b>
Summer sedge	<i>Carex aestivalis</i>	S2	uncommon, not sampled in vegetation plot
White bear sedge	<i>Carex albursina</i>	S3	occasional, sampled in vegetation plot
Back's sedge	<i>Carex backii</i>	S3	occasional, sampled in several vegetation plots
Hitchcock's sedge	<i>Carex hitchcockiana</i>	S3	uncommon, sampled in vegetation plot
Spreading sedge	<i>Carex laxiculmis</i>	S3	uncommon, sampled in vegetation plot
American milletgrass	<i>Milium effusum</i>	S3	rare, not sampled in vegetation plot
Glade fern	<i>Diplazium pycnocarpon</i>	S3	rare, sampled in vegetation plot

**Table 12.** Nonnative plant species observed in Marsh-Billings-Rockefeller National Historical Park in 2004.

<b>Common Name</b>	<b>Scientific Name</b>
Japanese barberry	<i>Berberis thunbergii</i>
Common barberry	<i>Berberis vulgaris</i>
Broadleaf helleborine	<i>Epipactis helleborine</i>
Brittle-stem hempnettle	<i>Galeopsis tetrahit</i>
Morrow's honeysuckle	<i>Lonicera morrowii</i>
Norway spruce	<i>Picea abies</i>
Tall buttercup	<i>Ranunculus acris</i>
Climbing nightshade	<i>Solanum dulcamara</i>
Common dandelion	<i>Taraxacum officinale</i>
Colt's-foot	<i>Tussalga farfara</i>
Common gypsyweed	<i>Veronica officinalis</i>



## Conclusions

The proposed map classes provide the user with a pragmatic balance between acceptable accuracy while retaining sufficient detail. To increase accuracy of the vegetation map, additional field inventory is recommended. As the accuracy assessment indicates, more information is gathered as more time is spent in the field recording community type data. The vegetation map provides baseline data for long-term vegetation monitoring. It can be updated with additional field data over time. Newly developed environmental data layers can be interpreted in addition to the aerial photos and orthophotos to further refine the map for the park. The current map can be used to inform management plans for the park.

A few general observations on species and natural processes are mentioned here. Twenty-five upland sedges (*Carex* spp.) were recorded in the vegetation plots sampled in 2004, several of which had not been recorded previously in Marsh-Billings-Rockefeller National Historical Park. There are undoubtedly other unrecorded plant species outside the plots. Upland and wetland sedges may represent up to 10% of Marsh-Billings-Rockefeller National Historical Park's vascular plant flora, and the contribution of grasses is also likely substantial. Given the apparent lack of knowledge of these diverse groups, it is recommended that a special inventory be done to document the sedges and grasses in Marsh-Billings-Rockefeller National Historical Park.

The vegetation map, detailed vegetation association descriptions, and dichotomous key are essential tools for managing and monitoring the natural communities in the park. These standardized products provide a baseline for assessing the ecological integrity, acreages, and locations of the vegetation communities within the park. Keeping the map up to date should be a high priority for park resource managers because the vegetation will change in response to various disturbances, natural succession, and management. The vegetation map can be used to develop interpretive trails, field guides, and help resource managers identify priority areas for resource protection, restoration, and environmental education. The U.S. National Vegetation Classification can also be used in conjunction with the vegetation map to help describe desired vegetation communities for future vegetation management projects and provide a framework for ecological integrity assessments.



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**Appendix A.** Vegetation plot sampling form for Marsh-Billings-Rockefeller National Historical Park.

**NATURESERVE NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM**

Park Name: **Marsh-Billings-Rockefeller National Historical Park (MABI)** State: **VT**

Plot Code \_\_\_\_\_ Polygon Code \_\_\_\_\_ Airphoto# \_\_\_\_\_

Park sublocation (Surveysite) \_\_\_\_\_

Quad Name \_\_\_\_\_ Quad Code \_\_\_\_\_

Survey Date: 2004-\_\_\_\_ Surveyors: \_\_\_\_\_ Sourcecode: F04ENG

Provisional Community Name \_\_\_\_\_

Classified Community Name \_\_\_\_\_

ELCODE: **CEGL00**

Ecological System type \_\_\_\_\_

Directions to Plot: \_\_\_\_\_

Plot length \_\_\_\_\_ width \_\_\_\_\_ shape \_\_\_\_\_ Permanent (y/n) \_\_\_\_\_ Plot Photos (y/n) \_\_\_\_\_ Roll# \_\_\_\_\_ Frame# \_\_\_\_\_

**Plot representativeness**

GPS file name \_\_\_\_\_ Field UTM X \_\_\_\_\_ m E Field UTM Y \_\_\_\_\_ m N

GPS unit used \_\_\_\_\_ datum \_\_\_\_\_ Error +/- \_\_\_\_\_ m

Corrected UTM X \_\_\_\_\_ m E Corrected UTM Y \_\_\_\_\_ m N UTMZone \_\_\_\_\_

Elevation:			m / ft		Aspect ( <i>usetrue, not magnetic, value</i> ):		
<b>Slope</b>	<b>Degr</b>	<b>%</b>	<b>Topographic Position</b>	<b>Landform</b>	<b>Geology</b>	<b>Geology:</b>	<b>Surficial</b>
Flat	0	0%	Crest/Summit/Ridge	Bar	Kame	Igneous	Bedrock
Gentle	1-5	1-9%	Upper/Shoulder Slope	Basin	Kettle	Granitic	Talus
Modt.	6-14	10-25%	High Plateau	Beach	Lake/pond	Dioritic	Glacial till
Som. Steep	15-26	26-49%	Middle Slope	Bluff/bank	Ledge	Gabbroic	Moraine
Steep	27-45	50-100%	Slope step (terraccette)	Channel	Moraine	Metamorphic	Esker/outwash
V. Steep	46-69	101-275%	Lower Slope	Cliff	Mountain	Slate/phyllite	Glacial delta
Abrupt	70-95	276-300%	Toe Slope	Cove	Outwash plain	Schist	Lacustrine/
Overhang	>100	>300%	Low level/terrace	Delta	Oxbow	Gneiss	fluvial
			Channel wall	Dome	Plain	Marble	Marine
			Channel bed	Drumlin	Plateau	Serpentine	Aeolian
			Depression	Dune	Ravine	Sedimentary	
Record more exact measures if taken:				Escarpment	Ridge	Shale	Other
				Esker	Saddle	Limestone	
				Estuary	Swale	/Dolomite	
				Flat	Talus		
				Floodplain	Terrace	Other	
				Gorge	Valley		
				Hill	Other		

Cowardin System	Hydrologic regime	Salinity
<input type="checkbox"/> Upland	<input type="checkbox"/> Permanently Flooded	<input type="checkbox"/> Coastal salt (>30 ppt)
<input type="checkbox"/> Riverine	<input type="checkbox"/> Semipermanently Flooded	<input type="checkbox"/> Coastal brackish (5-30 ppt)
<input type="checkbox"/> Palustrine	<input type="checkbox"/> Seasonally Flooded	<input type="checkbox"/> Fresh tidal (<5 ppt)
<input type="checkbox"/> Lacustrine	<input type="checkbox"/> Intermittently Flooded	<input type="checkbox"/> Inland salt
<input type="checkbox"/> Estuarine	<input type="checkbox"/> Tidally Flooded	<input type="checkbox"/> Inland brackish
	<input type="checkbox"/> Saturated (& may be seas. flooded)	
	<input type="checkbox"/> Temporarily Flooded	
	<input type="checkbox"/> Intermittently Flooded	
	<input type="checkbox"/> Tidally Flooded	

<b>Soil Taxon/Description:</b>			<b>Soil Profile notes</b>
			<b>Depth examined:</b> _____
Soil Texture	Soil Drainage	<b>Unvegetated Surface:</b> <i>(please use cover scale below)</i>	<b>Horizons, colors, depth to obstruction, depth to water table, depth to mottling, etc.</b>
_____ sand	_____ rapidly drained		
_____ sandy loam	_____ well drained	_____ large rocks (cobble, boulder >10 cm)	
_____ loam	_____ moderately well drained	_____ sand (0.1-2 mm)	
_____ silt loam	_____ somewhat poorly drained	_____ litter, duff	
_____ silt	_____ poorly drained	_____ wood (>1 cm)	
_____ clay loam	_____ very poorly drained	_____ bare soil	
_____ clay		_____ water	
_____ pete		other: _____	
_____ muck			
<b>Soil pH:</b>	<b>Soil stoniness</b>		
	_____ v. little (<1%)		
	_____ moderate (2-20%)		
	_____ very stony (20-50%)		
	_____ exceedingly stony (>50%)		
<b>Additional environmental notes:</b>			

### VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf type (of dominant stratum)	Physiognomic class	Cover classes: Strata & Unveg surface	Height classes for strata
Trees and Shrubs	_____ broad-leaved	_____ forest		<0.5 m
% evergreen: _____	_____ needle-leaved	_____ woodland	5%	0.5-1 m
% deciduous: _____	_____ microphyllous	_____ shrubland	10%	1-2 m
_____ evergreen	_____ gramminoid	_____ dwarf shrubland	20%	2-5 m
_____ cold-deciduous	_____ forb	_____ herbaceous	30%	5-10 m
_____ mixed herbs	_____ pteridophyte	_____ non-vascular	40%	10-15 m
_____ annual	_____ non-vascular	_____ sparsely vegetated	50%	15-20 m
_____ perennial			60%	20-35 m
			70%	35-50 m
			80%	>50 m
			90%	
			100%	
Stratum	Height	Cover	Characteristic / diagnostic species <i>*please use height and cover classes from table above</i>	
T1 Emergent				
T2 Canopy				
T3 Sub-canopy				
S1 Tall Shrub				
S2 Short Shrub				
H Herbaceous				
N Non-vascular				
V Vine/liana				



**ADDITIONAL NOTES** (*continue as needed on reverse*)

Brief word picture of community:
Topographic sketch:
Adjacent vegetation type(s):
Known/inferred land-use history:
Animal use evidence
Natural disturbance evidence:
Invasive species notes:
Other anthropogenic disturbance comments
Other Comments

**Appendix B.** 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	Definition	Comment
Plots	Plot Code	unique identifier assigned by PLOTS using 4-letter park code and sequential numbers	MABI
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 MABI
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 US National Vegetation Classification	
Plots	USNVC ELCODE	standard element code from the US 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	coordinates used for plot geographic location: "1" if UTM, "2" if lat/long	
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	
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 MABI as no post-processing was used
Plots	Corrected UTM Y	corrected Y UTM coordinate if post-processing is used	n/a for MABI as no post-processing was used
Plots	UTM Zone	UTM zone	18 for all of MABI
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 MABI

Table	Field	Definition	Comment
Plots	Photos	yes/no	
Plots	Roll Number	roll number for film photos	
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 MABI
Plots	GPS Accuracy	as recorded in field	
Plots	Slope	slope category (pick-list)	Flat = 0°; Gentle = 0-5°; Moderate = 6-14°; Somewhat steep = 15-25°; Steep = 27-45°; Very steep = 45-69°; Abrupt = 70-100°; Overhanging/sheltered = 100°
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 338-22°; NE 23-67°; E 68-112°; SE 113-157°; S 158-202°; SW 203-247°; W 248-292°; NW 293-337°
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; 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; Escarp-ment; 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	
Plots	Environmental Comments	narrative description of the habitat	

Table	Field	Definition	Comment
Plots	Landscape Comments	narrative description of the surrounding area	
Plots	Soil Taxon/Description	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	
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-decid-uous, 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), 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 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%
Plots	T2 Hgt	height of tree canopy layer	
Plots	T2 Cover	% cover of tree canopy layer	
Plots	T3 Hgt	height of tree subcanopy layer	

Table	Field	Definition	Comment
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	Opt1: Basal area in m2/ha, rounded
Plots	Opt1	for MABI, basal area (m2/ha, rounded)	
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	

<b>Table</b>	<b>Field</b>	<b>Definition</b>	<b>Comment</b>
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
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 MABI
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 MABI
Plots-Species	DBH	Diameter at breast height for all trees above 10 cm diameter recorded on field forms (comma delimited)	
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 common names are in "Scientific Name" field)



**Appendix C.** Plants observed in Marsh-Billings-Rockefeller National Historical Park during vegetation plot sampling in 2004 and thematic accuracy assessment sampling in 2006.

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. Plants observed while in the field but not sampled are denoted with an asterisk (\*). Species marked with a superscript “e” indicate exotic species for Vermont (Vermont Invasive Exotic Plant Committee 2010, Kartesz 1999).

Family	Scientific Name	Common Name
Aceraceae	<i>Acer pensylvanicum</i>	striped maple
	<i>Acer rubrum</i>	red maple
	<i>Acer saccharum</i>	sugar maple
	<i>Acer spicatum</i>	mountain maple
Amblystegiaceae	<i>Calliargon</i> sp. *	calliargon moss
Apiaceae	<i>Daucus carota</i>	Queen Anne’s lace
	<i>Osmorhiza claytonii</i>	Clayton’s sweetroot
	<i>Osmorhiza</i> sp.	sweetroot
	<i>Zizia aurea</i>	golden zizia
Apocynaceae	<i>Apocynum androsaemifolium</i>	spreading dogbane
Araceae	<i>Arisaema triphyllum</i>	Jack in the pulpit
Araliaceae	<i>Aralia nudicaulis</i>	wild sarsaparilla
Aristolochiaceae	<i>Asarum canadense</i>	Canadian wildginger
Asclepiadaceae	<i>Asclepias syriaca</i>	common milkweed
	<i>Asclepias</i> sp.	milkweed
Asteraceae	<i>Ageratina altissima</i>	white snakeroot
	<i>Bidens</i> spp.	beggarticks
	<i>Doellingeria umbellata</i>	parasol whitetop
	<i>Erechtites hieraciifolia</i>	American burnweed
	<i>Erigeron pulchellus</i>	robin’s plantain
	<i>Eupatorium</i> spp.	thoroughwort
	<i>Eurybia divaricata</i>	white wood aster
	<i>Eurybia macrophylla</i> *	bigleaf aster
	<i>Euthamia graminifolia</i>	flat-top goldentop
	<i>Hieracium paniculatum</i>	Allegheny hawkweed
	<i>Hieracium scabrum</i>	rough hawkweed
	<i>Hieracium</i> sp.	hawkweed
	<i>Lactuca biennis</i>	tall blue lettuce
	<i>Lactuca canadensis</i>	Canada lettuce
	<i>Lactuca</i> sp.	lettuce
	<i>Oclemena acuminata</i>	whorled wood aster
	<i>Prenanthes</i> spp.	rattlesnake root
<i>Prenanthes altissima</i>	tall rattlesnakeroot	
<i>Prenanthes trifoliolata</i>	gall of the earth	
<i>Rudbeckia hirta</i>	blackeyed Susan	
<i>Solidago bicolor</i>	white goldenrod	
	<i>Solidago caesia</i>	wreath goldenrod

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>
Asteraceae (continued)	<i>Solidago canadensis</i>	Canada goldenrod
	<i>Solidago flexicaulis</i>	zigzag goldenrod
	<i>Solidago gigantea</i>	giant goldenrod
	<i>Solidago juncea</i>	early goldenrod
	<i>Solidago nemoralis</i>	gray goldenrod
	<i>Solidago rugosa</i>	wrinkleleaf goldenrod
	<i>Solidago</i> sp.	goldenrod
	<i>Symphotrichum lateriflorum</i>	calico aster
	<i>Symphotrichum novae-angliae</i>	New England aster
	<i>Symphotrichum puniceum</i>	purplestem aster
	<i>Taraxacum officinale</i> <sup>e</sup>	common dandelion
Balsaminaceae	<i>Tussilago farfara</i> <sup>e</sup>	coltsfoot
	<i>Impatiens capensis</i>	jewelweed
Berberidaceae	<i>Impatiens pallida</i>	pale touch-me-not
	<i>Berberis thunbergii</i> <sup>f</sup>	Japanese barberry
	<i>Berberis vulgaris</i> <sup>e</sup>	common barberry
Betulaceae	<i>Caulophyllum thalictroides</i>	blue cohosh
	<i>Alnus incana</i>	gray alder
	<i>Alnus glutinosa</i> <sup>*e</sup>	European alder
	<i>Betula alleghaniensis</i>	yellow birch
	<i>Betula papyrifera</i>	paper birch
	<i>Corylus cornuta</i>	beaked hazelnut
Brassicaceae	<i>Ostrya virginiana</i>	hophornbeam
	<i>Barbarea vulgaris</i>	garden yellowrocket
	<i>Cardamine diphylla</i>	crinkleroot
	<i>Cardamine pratensis</i>	cuckoo flower
Caprifoliaceae	<i>Hesperis matronalis</i> <sup>e</sup>	dames rocket
	<i>Lonicera japonica</i> <sup>e</sup>	Japanese honeysuckle
	<i>Lonicera morrowii</i> <sup>f</sup>	Morrow's honeysuckle
	<i>Sambucus canadensis</i>	common elderberry
	<i>Sambucus racemosa</i>	red elderberry
	<i>Viburnum dentatum</i>	southern arrowwood
Clusiaceae	<i>Viburnum lantanoides</i>	hobblebush
Cornaceae	<i>Hypericum punctatum</i>	spotted St. Johnswort
Cyperaceae	<i>Cornus alternifolia</i>	alternateteaf dogwood
	<i>Cornus sericea</i>	redosier dogwood
Cyperaceae	<i>Carex albursina</i>	white bear sedge
	<i>Carex alopecoidea</i> <sup>*</sup>	foxtail sedge
	<i>Carex aestivalis</i> <sup>*</sup>	Summer sedge
	<i>Carex appalachica</i>	Appalachian sedge
	<i>Carex arctata</i>	drooping woodland sedge
	<i>Carex backii</i>	Back's sedge
	<i>Carex blanda</i>	eastern woodland sedge
	<i>Carex communis</i>	fibrousroot sedge
	<i>Carex debilis</i>	white edge sedge
	<i>Carex deweyana</i>	Dewey sedge
	<i>Carex digitalis</i>	slender woodland sedge
	<i>Carex flava</i>	yellow sedge
	<i>Carex gracillima</i>	graceful sedge
	<i>Carex gynandra</i>	nodding sedge
	<i>Carex hitchcockiana</i>	Hitchcock's sedge

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	
Cyperaceae (continued)	<i>Carex intumescens</i>	greater bladder sedge	
	<i>Carex lacustris</i>	hairy sedge	
	<i>Carex laxiculmis</i>	spreading sedge	
	<i>Carex laxiflora</i>	broad looseflower sedge	
	<i>Carex leptalea</i>	bristlystalked sedge	
	<i>Carex leptoneuria</i>	nerveless woodland sedge	
	<i>Carex ormostachya</i>	necklace spike sedge	
	<i>Carex peckii</i>	Peck's sedge	
	<i>Carex pedunculata</i>	longstalk sedge	
	<i>Carex pennsylvanica</i>	Pennsylvania sedge	
	<i>Carex plantaginea</i>	plantainleaf sedge	
	<i>Carex platyphylla</i>	broadleaf sedge	
	<i>Carex projecta</i>	necklace sedge	
	<i>Carex radiata</i>	eastern star sedge	
	<i>Carex rosea</i>	rosy sedge	
	<i>Carex scabrata</i>	eastern rough sedge	
	<i>Carex</i> spp.	sedge	
<i>Carex virescens</i>	ribbed sedge		
Dennstaedtiaceae	<i>Dennstaedtia punctilobula</i>	eastern hayscented fern	
	<i>Pteridium aquilinum</i>	western brackenfern	
Dicranaceae	<i>Dicranum</i> spp.	dicranum moss	
Dryopteridaceae	<i>Athyrium filix-femina</i>	common ladyfern	
	<i>Cystopteris fragilis</i>	brittle bladderfern	
	<i>Deparia acrostichoides</i>	silver false spleenwort	
	<i>Diplazium pycnocarpon</i>	glade fern	
	<i>Dryopteris carthusiana</i>	spinulose woodfern	
	<i>Dryopteris cristata</i>	crested woodfern	
	<i>Dryopteris goldiana</i>	Goldie's woodfern	
	<i>Dryopteris intermedia</i>	intermediate woodfern	
	<i>Dryopteris marginalis</i>	marginal woodfern	
	<i>Gymnocarpium dryopteris</i>	western oakfern	
	<i>Matteuccia struthiopteris</i>	ostrich fern	
	<i>Onoclea sensibilis</i>	sensitive fern	
	<i>Polystichum acrostichoides</i>	Christmas fern	
	Elaeagnaceae	<i>Elaeagnus umbellata</i>	autumn olive
	Equisetaceae	<i>Equisetum arvense</i>	field horsetail
<i>Equisetum scirpoides</i>		dwarf scouringrush	
<i>Equisetum</i> spp.		horsetail	
Fabaceae	<i>Robinia pseudoacacia</i>	black locust	
	<i>Trifolium repens</i>	white clover	
	<i>Trifolium</i> sp.	clover	
Fagaceae	<i>Fagus grandifolia</i>	American beech	
	<i>Quercus rubra</i>	northern red oak	
	<i>Quercus</i> sp.	oak	
Fumariaceae	<i>Dicentra canadensis</i>	squirrel corn	
Geraniaceae	<i>Geranium bicknellii</i>	Bicknell's cranesbill	
	<i>Geranium robertianum</i>	Robert geranium	
Grossulariaceae	<i>Ribes americanum</i>	American black currant	
Hydrophyllaceae	<i>Hydrophyllum virginianum</i>	Shawnee salad	
Hylocomiaceae	<i>Rhytidiadelphus triquetrus</i>	rough goose neck moss	
Juglandaceae	<i>Juglans cinerea</i>	butternut	

Family	Scientific Name	Common Name
Juncaceae	<i>Luzula multiflora</i> *	common woodrush
	<i>Luzula acuminata</i> *	hairy woodrush
Lamiaceae	<i>Clinopodium vulgare</i>	wild basil
	<i>Galeopsis tetrahit</i>	brittlestem hempnettle
	<i>Monarda fistulosa</i>	wild bergamot
	<i>Monarda</i> sp.	bee balm
	<i>Prunella vulgaris</i>	common selfheal
	<i>Scutellaria lateriflora</i>	blue skullcap
Leucobryaceae	<i>Leucobryum glaucum</i>	leucobryum moss
Liliaceae	<i>Allium tricoccum</i>	wild leek
	<i>Convallaria majalis</i> *	European lily of the valley
	<i>Maianthemum canadense</i>	Canada mayflower
	<i>Maianthemum racemosum</i>	feathery false lily of the valley
	<i>Medeola virginiana</i>	Indian cucumber
	<i>Polygonatum biflorum</i>	smooth Solomon's seal
	<i>Polygonatum pubescens</i>	hairy Solomon's seal
	<i>Streptopus lanceolatus</i> *	twistedstalk
	<i>Trillium cernuum</i>	whip-poor-will flower
	<i>Trillium erectum</i>	red trillium
	<i>Trillium</i> sp.	trillium
	<i>Uvularia sessilifolia</i>	sessileleaf bellwort
Lycopodiaceae	<i>Huperzia lucidula</i>	shining clubmoss
	<i>Lycopodium annotinum</i>	stiff clubmoss
	<i>Lycopodium clavatum</i>	running clubmoss
	<i>Lycopodium digitatum</i>	fan clubmoss
	<i>Lycopodium obscurum</i>	rare clubmoss
	<i>Lycopodium</i> sp.	clubmoss
	<i>Lycopodium tristachyum</i>	deeproot clubmoss
Mniaceae	<i>Mnium</i> sp.*	mnium calcareous moss
Monotropaceae	<i>Monotropa hypopithys</i>	pinenap
	<i>Monotropa uniflora</i>	Indianpipe
Oleaceae	<i>Fraxinus americana</i>	white ash
	<i>Fraxinus nigra</i>	black ash
	<i>Fraxinus</i> sp.	ash
Onagraceae	<i>Circaea lutetiana</i>	broadleaf enchanter's nightshade
	<i>Epilobium ciliatum</i>	fringed willowherb
Ophioglossaceae	<i>Botrychium</i> sp.	grapefern
	<i>Botrychium virginianum</i>	rattlesnake fern
Orchidaceae	<i>Epipactis helleborine</i> <sup>o</sup>	broadleaf helleborine
	<i>Galearis spectabilis</i>	showy orchid
	<i>Spiranthes</i> spp.	ladies'-tresses
Orobanchaceae	<i>Epifagus virginiana</i>	beechnuts
Osmundaceae	<i>Osmunda cinnamomea</i>	cinnamon fern
	<i>Osmunda claytoniana</i>	interrupted fern
	<i>Osmunda regalis</i>	royal fern
	<i>Osmunda</i> sp.	osmunda
Oxalidaceae	<i>Oxalis montana</i>	mountain woodsorrel
	<i>Oxalis stricta</i>	common yellow oxalis
Papaveraceae	<i>Sanguinaria canadensis</i>	bloodroot
Pinaceae	<i>Abies balsamea</i>	balsam fir
	<i>Larix decidua</i> <sup>o</sup>	European larch

Family	Scientific Name	Common Name	
Pinaceae (continued)	<i>Picea</i> sp.	spruce	
	<i>Picea abies</i> <sup>e</sup>	Norway spruce	
	<i>Picea rubens</i>	red spruce	
	<i>Pinus resinosa</i>	red pine	
	<i>Pinus strobus</i>	eastern white pine	
	<i>Pinus sylvestris</i> <sup>e</sup>	Scotch pine	
	<i>Tsuga canadensis</i>	eastern hemlock	
Poaceae	<i>Agrostis perennans</i>	upland bentgrass	
	<i>Anthoxanthum odoratum</i>	sweet vernalgrass	
	<i>Brachyelytrum erectum</i>	bearded shorthusk	
	<i>Cinna latifolia</i>	drooping woodreed	
	<i>Danthonia spicata</i>	poverty oatgrass	
	<i>Deschampsia flexuosa</i>	wavy hairgrass	
	<i>Elymus hystrix</i> *	eastern bottlebrush grass	
	<i>Festuca</i> spp.	fescue	
	<i>Glyceria striata</i>	fowl mannagrass	
	<i>Leersia oryzoides</i>	rice cutgrass	
	<i>Leersia virginica</i>	whitegrass	
	<i>Milium effusum</i> *	American milletgrass	
	<i>Muhlenbergia frondosa</i>	wirestem muhly	
	<i>Muhlenbergia mexicana</i>	Mexican muhly	
	<i>Phleum pratense</i>	timothy	
	<i>Piptatherum racemosum</i>	blackseed ricegrass	
	<i>Poa alsodes</i>	grove bluegrass	
	<i>Poa compressa</i>	Canada bluegrass	
	<i>Poa nemoralis</i>	wood bluegrass	
	<i>Schizachne purpurascens</i>	false melic	
	<i>Sphenopholis intermedia</i>	slender wedgescale	
	<i>Polygonaceae</i>	<i>Polygonum cilinode</i>	fringed black bindweed
	<i>Polypodiaceae</i>	<i>Polypodium virginianum</i>	rock polypody
	<i>Polytrichaceae</i>	<i>Polytrichum</i>	polytrichum moss
	<i>Pteridaceae</i>	<i>Adiantum pedatum</i>	northern maidenhair
	<i>Pyrolaceae</i>	<i>Pyrola elliptica</i>	waxflower shinleaf
<i>Ranunculaceae</i>	<i>Actaea pachypoda</i>	white baneberry	
	<i>Actaea rubra</i>	red baneberry	
	<i>Anemone</i> sp.	anemone	
	<i>Anemone virginiana</i>	tall thimbleweed	
	<i>Aquilegia canadensis</i>	red columbine	
	<i>Clematis virginiana</i>	devil's darning needles	
	<i>Coptis trifolia</i>	threeleaf goldthread	
	<i>Hepatica nobilis</i> var. <i>acuta</i>	sharplobe hepatica	
	<i>Ranunculus abortivus</i>	littleleaf buttercup	
	<i>Ranunculus acris</i> <sup>e</sup>	tall buttercup	
	<i>Ranunculus recurvatus</i>	blisterwort	
	<i>Rhamnaceae</i>	<i>Rhamnus cathartica</i>	common buckthorn
	<i>Rosaceae</i>	<i>Agrimonia</i> spp.	agrimony
		<i>Amelanchier</i> spp.	serviceberry
<i>Amelanchier laevis</i>		Allegheny serviceberry	
<i>Crataegus</i> spp.		hawthorn	
<i>Fragaria virginiana</i>		Virginia strawberry	
	<i>Geum rivale</i>	purple avens	

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>
Rosaceae (continued)	<i>Malus</i> spp.	apple
	<i>Malus pumila</i> <sup>o</sup>	paradise apple
	<i>Potentilla simplex</i>	common cinquefoil
	<i>Prunus pensylvanica</i>	pin cherry
	<i>Prunus serotina</i>	black cherry
	<i>Prunus virginiana</i>	chokecherry
	<i>Prunus</i> sp.	cherry
	<i>Rubus</i> sp.	blackberry
	<i>Rubus allegheniensis</i>	Allegheny blackberry
	<i>Rubus flagellaris</i>	northern dewberry
	<i>Rubus idaeus</i>	American red raspberry
	<i>Rubus occidentalis</i>	black raspberry
	<i>Rubus odoratus</i>	purpleflowering raspberry
	<i>Rubus pensilvanicus</i>	Pennsylvania blackberry
	<i>Rubus pubescens</i>	dwarf red blackberry
	<i>Spiraea alba</i>	white meadowsweet
	<i>Spiraea tomentosa</i>	steeplebush
Rubiaceae	<i>Galium lanceolatum</i>	lanceleaf wild licorice
	<i>Galium mollugo</i>	false baby's breath
	<i>Galium</i> sp.	bedstraw
	<i>Galium triflorum</i>	fragrant bedstraw
	<i>Mitchella repens</i>	partridgeberry
Salicaceae	<i>Populus grandidentata</i>	bigtooth aspen
	<i>Populus tremuloides</i>	quaking aspen
	<i>Salix discolor</i>	pussy willow
Saxifragaceae	<i>Chrysosplenium americanum</i>	American golden saxifrage
	<i>Mitella nuda</i>	naked miterwort
	<i>Saxifraga pensylvanica</i>	eastern swamp saxifrage
	<i>Saxifraga virginiana</i>	early saxifrage
	<i>Tiarella cordifolia</i>	heartleaf foamflower
Scrophulariaceae	<i>Chelone glabra</i>	white turtlehead
	<i>Chelone</i> sp.	turtlehead
	<i>Verbascum thapsus</i>	common mullein
	<i>Veronica officinalis</i> <sup>o</sup>	common gypsyweed
	<i>Veronica</i> spp.	speedwell
Solanaceae	<i>Solanum dulcamara</i> <sup>o</sup>	climbing nightshade
Sphagnaceae	<i>Sphagnum</i> spp.	sphagnum
Thelypteridaceae	<i>Phegopteris connectilis</i>	long beechfern
	<i>Phegopteris</i> spp.	beechfern
	<i>Thelypteris noveboracensis</i>	New York fern
	<i>Thelypteris palustris</i>	eastern marsh fern
Thuidiaceae	<i>Thuidium</i> spp.	thuidium moss
Thymelaeaceae	<i>Daphne mezereum</i>	paradise plant
Tiliaceae	<i>Tilia americana</i>	American basswood
Ulmaceae	<i>Ulmus americana</i>	American elm
	<i>Ulmus rubra</i>	slippery elm
Urticaceae	<i>Laportea canadensis</i>	Canadian woodnettle
Verbenaceae	<i>Phryma leptostachya</i>	American lopseed
Violaceae	<i>Viola adunca</i>	hookedspur violet
	<i>Viola blanda</i>	sweet white violet
	<i>Viola canadensis</i>	Canadian white violet

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>
Violaceae (continued)	<i>Viola pubescens</i>	downy yellow violet
	<i>Viola selkirkii</i>	Selkirk's violet
	<i>Viola</i> spp.	violet
Vitaceae	<i>Parthenocissus quinquefolia</i>	Virginia creeper
	<i>Vitis riparia</i>	riverbank grape



**Appendix D.** Global and Local descriptions for the USNVC vegetation associations and map classes in Marsh-Billings-Rockefeller National Historical Park.

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**COMMON NAME (PARK-SPECIFIC): ENRICHED HARDWOOD FOREST SEEP**

**SYNONYMS**

**USNVC English Name:** Sensitive Fern - (Northern Maidenhair) - Orange Jewelweed  
Plantainleaf Sedge Herbaceous Vegetation

**USNVC Scientific Name:** *Onoclea sensibilis* - (*Adiantum pedatum*) - *Impatiens capensis* -  
*Carex plantaginea* Herbaceous Vegetation [Provisional]

**USNVC Identifier:** CEGLO06409

**LOCAL INFORMATION**

**Environmental Description:** Seeps are usually very distinct, very small (<0.02 ha) wetlands imbedded in an upland forest matrix. They occur on lower slopes, often at slope breaks. Saturated soils have a shallow muck or muddy surface horizon underlain by gleyed and/or mottled mineral soil. Occasionally seeps occur as shallow muck over bedrock.

**Vegetation Description:** Because of their small size, seeps are generally shaded by surrounding forest communities; however, their herbaceous flora and hydrology are distinctly different from the surrounding forest. In the park, these surrounding communities include hemlock - northern hardwood forest and rich northern hardwood forest. The seeps are characterized by a lush herb layer, variously dominated by graminoids, such as *Carex scabrata* (eastern rough sedge), ferns, especially *Athyrium filix-femina* (common ladyfern) and *Onoclea sensibilis* (sensitive fern), and herbs, such as *Impatiens capensis* (jewelweed). Other herbs characteristic of forested seeps in the region, such as *Chrysosplenium americanum* (American golden saxifrage), *Tiarella cordifolia* (heartleaf foamflower), and *Symphyotrichum puniceum* (purplestem aster), were not observed at the seeps in the park, though are likely present somewhere in the park. Nonvascular plants, especially mosses, are present but often form low cover. Mosses found at seeps in the park may be characteristic but have not been identified.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Impatiens capensis</i> (jewelweed)
Herb (field)	Graminoid	<i>Carex scabrata</i> (eastern rough sedge)
Herb (field)	Fern or fern ally	<i>Athyrium filix-femina</i> (common ladyfern)

**Characteristic Species:** *Carex scabrata* (eastern rough sedge), *Laportea canadensis* (Canadian woodnettle)

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Desmognathus fuscus fuscus</i> (northern dusky salamander)	-	animal	

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** The observed seeps are concentrated in the eastern portion of the park, though others are likely elsewhere.

**Classification Comments:** This type is often well-defined in soils, flora and fauna, though dominants vary. A micro-scale community on the landscape, this type is more appropriately mapped as point locations. One plot (MABI.29) has a luxuriant tall-herb/fern layer uncharacteristic of seeps. A canopy opening occurs at this plot, and the area is influenced by intermittent surface water flow.

**Other Comments:** Mapped as a separate point theme, not polygons.No photograph available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.04, MABI.05, MABI.29.

**Marsh-Billings-Rockefeller 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	<i>Symplocarpus foetidus</i> - <i>Caltha palustris</i> Saturated Herbaceous Alliance (A.1694)
Alliance (English name)	Skunk-cabbage - Yellow Marsh-marigold Saturated Herbaceous Alliance
Association	<i>Onoclea sensibilis</i> - ( <i>Adiantum pedatum</i> ) - <i>Impatiens capensis</i> - <i>Carex plantaginea</i> Herbaceous Vegetation [Provisional]
Association (English name)	Sensitive Fern - (Northern Maidenhair) - Orange Jewelweed - Plantainleaf Sedge Herbaceous Vegetation
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Hardwoods Forest (CES201.564).

### GLOBAL DESCRIPTION

**Concept Summary:** These small seepage wetlands occur as pockets or narrow linear patches within northern hardwood forests where seepage waters create saturated and mineral-rich conditions. Streamheads and lower slopes are typical settings, and the ground surface is usually gently sloping. Though generally shaded by the overhanging forest canopy, this association is defined by the herbaceous vegetation which is distinctly different from the herb and shrub layers in the surrounding forest. Shrub cover is generally low, and herb cover is lush (typically in the range of 60-85%). Bryophytes may be present but are often patchy. Herb composition is variable depending on the nutrient status of the soil and seepage water. Ferns, such as *Onoclea sensibilis* (sensitive fern), *Athyrium filix-femina* (common ladyfern), and *Matteuccia struthiopteris* (ostrich fern), may be prominent. *Impatiens capensis* (jewelweed) and *Arisaema triphyllum* (Jack in the pulpit) are typical forb species. On the more enriched sites, *Adiantum pedatum* (northern maidenhair), *Hydrophyllum virginianum* (Shawnee salad), *Impatiens pallida* (pale touch-me-not), *Milium effusum* (American milletgrass), *Carex platyphylla* (broadleaf sedge), and/or *Carex plantaginea* (plantainleaf sedge) may be present. Other species commonly recorded from this vegetation are *Carex scabrata* (eastern rough sedge), *Carex debilis* (white edge sedge), *Polystichum acrostichoides* (Christmas fern), *Glyceria striata* (fowl mannagrass), *Solidago caesia* (wreath goldenrod), and *Ageratina altissima* (white snakeroot).

**Environmental Description:** These small seepage wetlands occur as pockets or narrow linear patches within northern hardwood forests where seepage waters create saturated and mineral-rich conditions. Streamheads and lower slopes are typical settings, and the ground surface is usually gently sloping.

**Vegetation Description:** Though generally shaded by the overhanging forest canopy, this association is defined by the herbaceous vegetation which is distinctly different from the herb and shrub layers in the surrounding forest. Shrub cover is generally low, and herb cover is lush (typically in the range of 60-85%). Bryophytes may be present but are often patchy. Herb composition is variable depending on the nutrient status of the soil and seepage water. Ferns, such as *Onoclea sensibilis* (sensitive fern), *Athyrium filix-femina* (common ladyfern), and

*Matteuccia struthiopteris* (ostrich fern), may be prominent. *Impatiens capensis* (jewelweed) and *Arisaema triphyllum* (Jack in the pulpit) are typical forb species. On the more enriched sites, *Adiantum pedatum* (northern maidenhair), *Hydrophyllum virginianum* (Shawnee salad), *Impatiens pallida* (pale touch-me-not), *Milium effusum* (American milletgrass), *Carex platyphylla* (broadleaf sedge), and/or *Carex plantaginea* (plantainleaf sedge) may be present. Other species commonly recorded from this vegetation are *Carex scabrata* (eastern rough sedge), *Carex debilis* (white edge sedge), *Polystichum acrostichoides* (Christmas fern), *Glyceria striata* (fowl mannagrass), *Solidago caesia* (wreath goldenrod), and *Ageratina altissima* (white snakeroot).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit) <i>Impatiens capensis</i> (jewelweed)
Herb (field)	Fern or fern ally	<i>Athyrium filix-femina</i> (common ladyfern) <i>Matteuccia struthiopteris</i> (ostrich fern) <i>Onoclea sensibilis</i> (sensitive fern)

**Characteristic Species:** *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), *Carex plantaginea* (plantainleaf sedge), *Carex platyphylla* (broadleaf sedge), *Impatiens capensis* (jewelweed).

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

**USFWS Wetland System:** Palustrine.

**DISTRIBUTION**

**Range:** This association ranges across northern New England and New York and is expected to occur in adjacent Canada; its extent southward is unknown.

**States/Provinces:** ME, NB?, NH, NY?, QC?, VT.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Saint-Gaudens).

**CONSERVATION STATUS**

**Rank:** G4? (6-Dec-2005).

**Reasons:** Rank has not been evaluated.

**CLASSIFICATION INFORMATION**

**Status:** Provisional.

**Confidence:** 2 – Moderate.

**Comments:** This type is supported by plot data from parks in Vermont and New Hampshire. Similar vegetation has been observed elsewhere in the region but not generally documented as distinct. Attention to these forested seeps could provide data to refine their classification and distribution.

**Similar Associations:**

- *Symplocarpus foetidus* - *Impatiens capensis* Herbaceous Vegetation (CEGL006567).

**Related Concepts:** Information not available.

**SOURCES**

**Description Authors:** S. C. Gawler.

**References:** Eastern Ecology Working Group n.d., Sperduto and Nichols 2004.

No photograph available.



## COMMON NAME (PARK-SPECIFIC): EUROPEAN LARCH PLANTATION

### SYNONYMS

**USNVC English Name:** (Tamarack, European Larch) Planted Forest  
**USNVC Scientific Name:** *Larix (laricina, decidua)* Planted Forest  
**USNVC Identifier:** CEGLO06408

### LOCAL INFORMATION

**Environmental Description:** The *Larix decidua* (European larch) plantation occurs on the southwest-facing slope and summit of a small hill with non-stony, fine sandy loam soils. No bedrock outcrops were observed. Soils in the plantation have thin organic and A horizons and a strongly acidic soil reaction (pH 5.3) in the upper B horizon.

**Vegetation Description:** This old (planted 1887) European larch plantation has a 70% canopy of ±30 m *Larix decidua* (European larch), 35-45 cm dbh, with a slightly shorter (20-25 m) understory dominated by *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash), plus *Quercus rubra* (northern red oak) in places. The tall- and short-shrub layers are poorly developed for the most part, composed largely of seedlings and small saplings of the same understory hardwoods. The herb layer is very sparse, composed of a few species of ferns (*Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern), and *Polystichum acrostichoides* (Christmas fern), plus several sedges (especially *Carex arctata* [drooping woodland sedge], *Carex pedunculata* [longstalk sedge], *Carex communis* [fibrousroot sedge], and *Carex deweyana* [Dewey sedge]).

#### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Larix decidua</i> (European larch)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Fraxinus americana</i> (white ash) <i>Quercus rubra</i> (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Fraxinus americana</i> (white ash)

**Characteristic Species:** Information not available.

#### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex backii</i> (Back's sedge)	-	plant	a regionally uncommon to rare upland sedge

#### Subnational Distribution with Crosswalk Data:

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

**Local Range:** Restricted to a single unit (about 5 ha) located towards the middle of the park's south boundary, southeast of the French Lot. A small portion of this plantation extends outside the park boundary.

**Classification Comments:** Anthropogenic association.

**Other Comments:** While presumably of glacial till origin, the flatness of the hilltop along with almost terraced slopes suggest perhaps a glacial-fluvial landform, such as a kame terrace.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.16, MABI.17; MABI.AA05; Keeton 17.

**Marsh-Billings-Rockefeller 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	Planted/Cultivated cold-deciduous forest (I.B.2.C.)
Formation	Planted/cultivated cold-deciduous forest (I.B.2.C.x.)
Alliance	<i>Larix</i> spp. Planted Forest Alliance (A.3029)
Alliance (English name)	Larch species Planted Forest Alliance
Association	<i>Larix</i> ( <i>laricina</i> , <i>decidua</i> ) Planted Forest
Association (English name)	(Tamarack, European Larch) Planted Forest
<b>Ecological System(s):</b>	Information not available.

### GLOBAL DESCRIPTION

**Concept Summary:** These planted forests are dominated by the European *Larix decidua* (European larch) or the native *Larix laricina* (tamarack), often in monoculture. They typically occur in small patches, often on abandoned agricultural or cleared lands. Understory species vary with geography and site history. In Vermont, for example, the indigenous northern hardwoods *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) form an understory. Shrub and ground layers are poorly developed.

**Environmental Description:** These plantations typically occur in small patches, often on abandoned agricultural or cleared lands in a variety of environmental settings.

**Vegetation Description:** These planted forests are dominated by the European *Larix decidua* (European larch) or the native *Larix laricina* (tamarack), often in monoculture. Understory species vary with geography and site history. In Vermont, for example, the indigenous northern hardwoods *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) form an understory. Shrub and ground layers are poorly developed.

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Larix decidua</i> (European larch)

**Characteristic Species:** *Larix decidua* (European larch), *Larix laricina* (tamarack).

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

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** The range of this association is not well-documented, but scattered locations have been observed throughout most of New England, New York and Pennsylvania.

**States/Provinces:** ME, NY, PA, VT.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Upper Delaware).

### CONSERVATION STATUS

**Rank:** GNA (cultural) (6-Dec-2005).

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

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

**Similar Associations:** Information not available.

**Related Concepts:** Information not available.

**SOURCES**

**Description Authors:** S. C. Gawler.

**References:** Eastern Ecology Working Group n.d.



**Figure D1.** European Larch Plantation in Marsh-Billings-Rockefeller National Historical Park(MABI.AA05).  
September 2006. NAD 1983 / UTM easting 4833532, northing 698732.



## COMMON NAME (PARK-SPECIFIC): HEMLOCK - BEECH - OAK FOREST

### SYNONYMS

USNVC English Name: Eastern Hemlock - American Beech - Northern Red Oak Forest

USNVC Scientific Name: *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest

USNVC Identifier: CEGLO06088

### LOCAL INFORMATION

**Environmental Description:** This community is restricted to the generally steep, rocky upper slopes of Mount Tom. In the park it occurs on slope exposures ranging from north to east and southeast. Small phyllite/schist and quartzite outcrops are common and appear to lack the impure limestone typical of the mapped Waits River Formation. The till-derived soils are loamy and quite acidic for the area. They often contain a thin but notable E horizon.

**Vegetation Description:** The canopy in this upland forest community is dominated by a mix of *Tsuga canadensis* (eastern hemlock), *Quercus rubra* (northern red oak), and *Acer rubrum* (red maple). The small tree understory is moderately well-developed (20-30% cover), with *Tsuga canadensis* (eastern hemlock) and *Ostrya virginiana* (hophornbeam) of common occurrence, and *Acer saccharum* (sugar maple) and *Quercus rubra* (northern red oak) less commonly. The tall- and small-shrub layer is largely missing, consisting of sparse *Fagus grandifolia* (American beech) and *Tsuga canadensis* (eastern hemlock) seedlings/saplings. Herbs are notably sparse, consisting of a low diversity of ferns, especially *Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern), and *Pteridium aquilinum* (western brackenfern), forbs, especially *Maianthemum canadense* (Canada mayflower), and sedges, especially *Carex communis* (fibrousroot sedge). Herbs typical of rich woods are missing. Mosses are not typically a significant part of the vegetation, yet a *Polytrichum* (polytrichum moss) sp. formed distinct patches on top of old windthrow mounds in one area visited.

#### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple) <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Ostrya virginiana</i> (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)
Herb (field)	Forb	<i>Maianthemum canadense</i> (Canada mayflower)
Herb (field)	Fern or fern ally	<i>Dryopteris intermedia</i> (intermediate woodfern) <i>Dryopteris marginalis</i> (marginal woodfern) <i>Pteridium aquilinum</i> (western brackenfern)

**Characteristic Species:** *Quercus rubra* (northern red oak), *Tsuga canadensis* (eastern hemlock)

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

#### Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S4*	B	.	Hemlock-Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** Restricted to slopes of Mount Tom. Extends out of the park along the southeast boundary.

**Classification Comments:** The examples in this park lack *Betula lenta* (sweet birch). Soils are less acidic than those described for this community from further south.

**Other Comments:** More field observations and plots are needed to fully describe this community in the park. *Quercus rubra* (northern red oak) on north-facing slopes is unusual in Vermont. It suggests some major forest disturbance, such as clearing, fire, or a major wind event, followed by colonization by oaks common on the summit and south side of Mount Tom.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.10; MABI.AA21, MABI.AA65; Lautzenheiser 3, 5.

**Marsh-Billings-Rockefeller 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	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> Forest Alliance (A.412)
Alliance (English name)	Eastern Hemlock - Yellow Birch Forest Alliance
Association	<i>Tsuga canadensis</i> - <i>Fagus grandifolia</i> - <i>Quercus rubra</i> Forest
Association (English name)	Eastern Hemlock - American Beech - Northern Red Oak Forest
<b>Ecological System(s):</b>	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563).

### GLOBAL DESCRIPTION

**Concept Summary:** This association comprises dry-mesic hemlock-mixed hardwood forests of the northeastern United States. It occurs on dry to dry-mesic, nutrient-poor, well-drained, often stony sandy loams or loamy sands over acidic bedrock. The canopy is a mixture of *Tsuga canadensis* (eastern hemlock), with *Fagus grandifolia* (American beech) and/or *Quercus rubra* (northern red oak) in variable proportions depending on soil (site) and disturbance characteristics. The overstory can range from mostly coniferous to mostly deciduous; drier sites tend to have more abundant beech or oak, and cooler sites tend to have more abundant hemlock. Associated tree species include *Betula lenta* (sweet birch) (sometimes replaced by *Betula papyrifera* (paper birch) at the northern end of this type's range), *Pinus strobus* (eastern white pine), and *Acer rubrum* (red maple). Shrubs are often sparse but locally abundant and, in addition to saplings of canopy species, include *Hamamelis virginiana* (American witch-hazel), *Acer pensylvanicum* (striped maple), *Viburnum acerifolium* (mapleleaf viburnum), *Kalmia latifolia* (mountain laurel), and in the south *Ilex montana* (mountain holly). Though heaths may be present, they are rarely prominent. The herb layer is generally sparse but usually includes several of the following: *Mitchella repens* (partridgeberry), *Lycopodium digitatum* (fan clubmoss), *Lycopodium obscurum* (rare clubmoss), *Lycopodium annotinum* (stiff clubmoss), *Epifagus virginiana* (beechdrops), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Medeola virginiana* (Indian cucumber), *Aralia nudicaulis* (wild sarsaparilla), *Uvularia sessilifolia* (sessileleaf bellwort), *Pteridium aquilinum* (western brackenfern), *Dryopteris intermedia* (intermediate woodfern), *Monotropa*

*uniflora* (Indianpipe), and occasionally *Lycopodium dendroideum* (tree groundpine), *Coptis trifolia* (threeleaf goldthread), and *Dennstaedtia punctilobula* (eastern hayscented fern).

**Environmental Description:** This forest occurs on dry to dry-mesic, nutrient-poor, well-drained, often stony sandy loams or loamy sands. Underlying bedrock is acidic. In Virginia, it occupies extremely acidic (mean pH = 3.8), infertile silt loams on mesic to submesic valley sideslopes and broad, convex ridges at elevations from 1,000-1,200 m. In New England, it is a common forest type found on dry-mesic acidic soils on various landscape settings.

**Vegetation Description:** The canopy is a mixture of *Tsuga canadensis* (eastern hemlock) with *Fagus grandifolia* (American beech) and/or *Quercus rubra* (northern red oak) in variable proportions depending on soil (site) and disturbance characteristics; drier sites tend to have more abundant beech or oak and cooler sites tend to have more abundant hemlock. Associated tree species include *Betula lenta* (sweet birch) (sometimes replaced by *Betula papyrifera* (paper birch) at the northern end of this type's range), *Pinus strobus* (eastern white pine), and *Acer rubrum* (red maple). Shrubs are often sparse but locally abundant and, in addition to saplings of canopy species, include *Hamamelis virginiana* (American witch-hazel), *Acer pensylvanicum* (striped maple), *Viburnum acerifolium* (mapleleaf viburnum), *Kalmia latifolia* (mountain laurel), and in the south *Ilex montana* (mountain holly). Though heaths may be present, they are rarely prominent. The herb layer is generally sparse but usually includes several of the following: *Mitchella repens* (partridgeberry), *Lycopodium digitatum* (fan clubmoss), *Lycopodium obscurum* (rare clubmoss), *Lycopodium annotinum* (stiff clubmoss), *Epifagus virginiana* (beechdrops), *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Medeola virginiana* (Indian cucumber), *Aralia nudicaulis* (wild sarsaparilla), *Uvularia sessilifolia* (sessileleaf bellwort), *Dryopteris intermedia* (intermediate woodfern), *Monotropa uniflora* (Indianpipe), and occasionally *Lycopodium dendroideum* (tree groundpine), *Coptis trifolia* (threeleaf goldthread), and *Dennstaedtia punctilobula* (eastern hayscented fern).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech) <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple) <i>Betula lenta</i> (sweet birch)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple) <i>Hamamelis virginiana</i> (American witch-hazel) <i>Viburnum acerifolium</i> (mapleleaf viburnum)
Tall shrub/sapling	Broad-leaved evergreen shrub	<i>Kalmia latifolia</i> (mountain laurel)
Herb (field)	Forb	<i>Aralia nudicaulis</i> (wild sarsaparilla) <i>Trientalis borealis</i> (starflower)

**Characteristic Species:** *Betula lenta* (sweet birch), *Dryopteris intermedia* (intermediate woodfern), *Fagus grandifolia* (American beech), *Quercus rubra* (northern red oak), *Tsuga canadensis* (eastern hemlock).

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

**USFWS Wetland System:** Not applicable.

## DISTRIBUTION

**Range:** This association is widespread in southern New England and ranges south locally in the northern Piedmont and high Allegheny Mountains to Virginia and West Virginia. In Virginia, the type is confined to the Allegheny Mountain / Laurel Fork area in northwestern Highland County.

**States/Provinces:** CT, MA, ME, NH, NY, PA, RI, VA:SI, VT.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Saint-Gaudens, Saratoga, Upper Delaware); USFS (George Washington).

## CONSERVATION STATUS

**Rank:** G4G5 (26-Jun-1998).

**Reasons:** This community type is widely distributed in the northern part of its range. Its long-term viability is threatened by pathogens associated with its two dominant canopy trees.

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** At least in the southern portion of this type's range, the *Tsuga canadensis* (eastern hemlock) component of this community type appears to have been heavily reduced by past disturbances because of this species' commercial timber value and its vulnerability to fire.

## Similar Associations:

- *Pinus strobus* - *Quercus (rubra, velutina)* - *Fagus grandifolia* Forest (CEGL006293).
- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129).
- *Tsuga canadensis* - *Betula alleghaniensis* - *Acer saccharum* / *Dryopteris intermedia* Forest (CEGL006109).
- *Tsuga canadensis* - *Fagus grandifolia* - (*Acer saccharum*) Great Lakes Forest (CEGL005042).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus (prinus, alba)* Forest (CEGL006474).

## Related Concepts:

- *Fagus grandifolia* - *Tsuga canadensis* / *Dryopteris intermedia* Forest (Fleming and Coulling 2001) =
- *Fagus grandifolia* / *Dryopteris intermedia* Association (Fleming and Moorhead 1996)
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984)
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984)
- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984)
- Central New England mesic conifer forest on acidic bedrock / till (Rawinski 1984)
- Eastern Hemlock: 23 (Eyre 1980)
- Hemlock Forest (Thompson 1996)

## SOURCES

**Description Authors:** G. Fleming and P. Coulling, mod. S. L. Neid and S. C. Gawler.

**References:** Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Metzler and Barrett 2001, NRCS 2004, Rawinski 1984, Reschke 1990, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003.



**Figure D2.** Hemlock - Beech - Oak Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.10). September 2004. NAD 1983 / UTM easting 4834023, northing 699530.



**Figure D3.** Hemlock - Beech - Oak Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA65). September 2006. NAD 1983 / UTM easting 4833887, northing 699530.



**COMMON NAME (PARK-SPECIFIC): HEMLOCK FOREST (VARIANT OF HEMLOCK - NORTHERN HARDWOOD FOREST)**

**SYNONYMS**

**USNVC English Name:** Eastern Hemlock - Yellow Birch - Sugar Maple / Intermediate Woodfern Forest

**USNVC Scientific Name:** *Tsuga canadensis* - *Betula alleghaniensis* - *Acer saccharum* / *Dryopteris intermedia* Forest

**USNVC Identifier:** C EGL006109

**LOCAL INFORMATION**

**Environmental Description:** This hemlock dominated phase of the Hemlock – Northern Hardwood Forest community dominates the deep soils on the lower, gentler slopes throughout the park and the low relief ground on three sides of The Pogue. It also dominates the Pogue Hole Brook ravine. One unit also occurs on the gently-sloped west side of West Ridge summit. It occurs in soils with loamy fine sand, fine sandy loam, and silt loam textures with pHs tending toward the low 5s and ranging up to 6.0. Leached layers are uncommon in soil profiles. Deep A horizons can be found in the rich soils.

**Vegetation Description:** The percent cover of *Tsuga canadensis* (eastern hemlock) is 60+% in the conifer dominated phase of this association whereas the mixed phase of the community eastern hemlock ranges from 20-60% cover in the canopy (See Hemlock – Northern Hardwood description). The canopy is dominated by *Tsuga canadensis* (eastern hemlock) with scattered northern hardwoods, especially *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple), plus *Fraxinus americana* (white ash), *Tilia americana* (American basswood) (in only small amounts), and *Fagus grandifolia* (American beech). The understory is typically poorly developed, with *Tsuga canadensis* (eastern hemlock) most frequent in the subcanopy layer and widely scattered *Fagus grandifolia* (American beech) seedlings and saplings in the shrub layer. *Ostrya virginiana* (hophornbeam) is a common small tree. The herb cover varies from almost none in the deepest hemlock shade, up to 50% in areas with some wet spots and other small physical differences, such as small intermittent drainages. Ferns clearly dominate the herb cover, especially *Polystichum acrostichoides* (Christmas fern), *Dryopteris intermedia* (intermediate woodfern), and *Dryopteris marginalis* (marginal woodfern). Other ferns, such as *Thelypteris noveboracensis* (New York fern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Gymnocarpium dryopteris* (western oakfern), occur in some areas. In areas with richer soils, herb richness can be quite high (over 30 species in 0.05 ha plot) and include some enrichment indicators, such *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Carex plantaginea* (plantainleaf sedge). Little moss cover occurs in this community.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)
Herb (field)	Fern or fern ally	<i>Dryopteris intermedia</i> (intermediate woodfern) <i>Dryopteris marginalis</i> (marginal woodfern) <i>Polystichum acrostichoides</i> (Christmas fern)

**Characteristic Species:** *Tsuga canadensis* (eastern hemlock).

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

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S4*	B	.	Hemlock-Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** It occurs throughout the park and extends out of the park along both north and south boundaries.

**Classification Comments:** This community was mapped in a mixed (conifer-hardwood) phase and conifer phase. In the mixed phase, *Tsuga canadensis* (eastern hemlock) ranges from 20-60% cover in the canopy, while in the conifer phase it ranges from 60-100% of the canopy. In addition to canopy differences, the conifer phase tends to lack understory and herb layers. While mappable based on canopy conifer/hardwood ratios, the soils and ground cover composition can be quite similar between the two phases when viewed from the ground. The highly acidic hemlock forest supporting significant moss ground cover, yet devoid of understory and herb cover, was not observed in the park. *Picea rubens* (red spruce) occurs rarely in the park and is not a component of this hemlock-northern hardwood forest community.

**Other Comments:** Information not available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.11, MABI.12, MABI.15 (conifer phase); MABI.AA12, MABI.AA23, MABI.AA43, MABI.AA48, MABI.AA56; Keeton 41 (conifer phase); Lautzenheiser 4 and 21 (conifer phase).

**Marsh-Billings-Rockefeller 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	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> Forest Alliance (A.412)
Alliance (English name)	Eastern Hemlock - Yellow Birch Forest Alliance
Association	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> - <i>Acer saccharum</i> / <i>Dryopteris intermedia</i> Forest
Association (English name)	Eastern Hemlock - Yellow Birch - Sugar Maple / Intermediate Woodfern Forest
<b>Ecological System(s):</b>	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

## GLOBAL DESCRIPTION

**Concept Summary:** This association comprises hemlock - northern hardwood forests of the northeastern United States. This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. *Tsuga canadensis* (eastern hemlock) is characteristic and usually dominant in the coniferous to mixed canopy. While hemlock generally forms at least 50% of the canopy, in some cases it may be as low as 25% relative dominance. Hardwood codominants include *Betula alleghaniensis* (yellow birch) or *Acer saccharum* (sugar maple), with *Fagus grandifolia* (American beech) common but not usually abundant in all but the very southern portion of the range of this type. *Betula lenta* (sweet birch) may replace *Betula alleghaniensis* (yellow birch) in some areas. *Ostrya virginiana* (hophornbeam) may be present as a small tree. *Quercus* (oak) spp. and *Pinus strobus* (eastern white pine) tend to be absent or, if present, only occur with low abundance. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* (mapleleaf viburnum) and *Acer pensylvanicum* (striped maple) in addition to *Tsuga canadensis* (eastern hemlock) regeneration. Herbs may be sparse, particularly in dense shade, but include *Dryopteris intermedia* (intermediate woodfern), *Medeola virginiana* (Indian cucumber), *Oxalis montana* (mountain woodsorrel), *Mitchella repens* (partridgeberry), *Maianthemum canadense* (Canada mayflower), *Uvularia sessilifolia* (sessileleaf bellwort), *Polystichum acrostichoides* (Christmas fern), *Trientalis borealis* (starflower), *Huperzia lucidula* (shining clubmoss), *Eurybia divaricata* (white wood aster), *Oclemena acuminata* (whorled wood aster), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Thelypteris noveboracensis* (New York fern). Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple) and a lack of abundant *Quercus* (oak) spp., *Pinus strobus* (eastern white pine), or *Betula lenta* (sweet birch).

**Environmental Description:** This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. In the southern part of the range, stands often occur in deep, sheltered ravines and along high-gradient mountain streams.

**Vegetation Description:** *Tsuga canadensis* (eastern hemlock) is dominant and forms at least 50% of the canopy. *Betula alleghaniensis* (yellow birch) can be codominant, with *Fagus grandifolia* (American beech) and *Acer saccharum* (sugar maple) common but not usually abundant in all but the very southern portion of the range for this type. At the southern end of the range (in Virginia and Maryland), *Liriodendron tulipifera* (tuliptree) may be an important overstory associate. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* (mapleleaf viburnum) and *Acer pensylvanicum* (striped maple) in addition to *Tsuga canadensis* (eastern hemlock) regeneration. Herbs may be sparse, particularly in dense shade, but often include *Dryopteris intermedia* (intermediate woodfern), *Medeola virginiana* (Indian cucumber), *Oxalis montana* (mountain woodsorrel), *Mitchella repens* (partridgeberry), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Huperzia lucidula* (shining clubmoss), *Eurybia divaricata* (white wood aster), and *Thelypteris noveboracensis* (New York fern). Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple) and a lack of abundant *Quercus* (oak) spp., *Pinus strobus* (eastern white pine), or *Betula lenta* (sweet birch).

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple) <i>Viburnum acerifolium</i> (mapleleaf viburnum)
Herb (field)	Forb	<i>Maianthemum canadense</i> (Canada mayflower)

**Characteristic Species:** *Betula alleghaniensis* (yellow birch), *Carex albicans* (whiteninge sedge), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Mitchella repens* (partridgeberry), *Oclemena acuminata* (whorled wood aster), *Thelypteris noveboracensis* (New York fern), *Tsuga canadensis* (eastern hemlock).

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

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This community is generally distributed in large patches from New Hampshire south through Pennsylvania, becoming more local in the north Atlantic Piedmont and restricted to local patches at higher elevations of the Central Appalachians in Maryland, West Virginia, and Virginia. In Virginia it is restricted to the northwestern part of the state, where occurrences are rather local but sometimes extensive.

**States/Provinces:** CT, MA, MD, NH, NJ:S3, NY, PA, RI, VA:S3, VT, WV?

**Federal Lands:** NPS (Catoctin Mountain?, Delaware Water Gap, Johnstown Flood, Marsh-Billings-Rockefeller, Saratoga, Shenandoah, Upper Delaware); USFS (Finger Lakes, George Washington, Green Mountain); USFWS (Erie, Iroquois).

### CONSERVATION STATUS

**Rank:** G4? (31-Dec-1997).

**Reasons:** This association has a very large geographic distribution and occurs in large patches in the northern part of its range. All stands of this community are now highly threatened by the exotic insect pest hemlock woolly adelgid (*Adelges tsugae*), which causes decline and eventual mortality in *Tsuga canadensis* (eastern hemlock).

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Many stands of this vegetation type in the national forests and Shenandoah National Park have been devastated during the past decade by adelgid-caused tree mortality. In some cases, 100% of the canopy hemlocks have been killed, littering the forest floor with downed wood and stimulating massive increases in understory growth, particularly of *Betula* (birch) spp. and *Acer pensylvanicum* (striped maple). Since there is no practical treatment for the adelgid on a landscape level, one can only hope that natural pathogens will emerge to keep the adelgid in check before all of our examples of this community are severely degraded or lost.

### Similar Associations:

- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129).
- *Tsuga canadensis* - (*Betula alleghaniensis*, *Quercus rubra*) / *Ilex montana* / *Rhododendron catawbiense* Forest (CEGL008513).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus (prinus, alba)* Forest (CEGL006474).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest (CEGL006088).

### Related Concepts:

- *Betula alleghaniensis* - *Tsuga canadensis* / *Dryopteris intermedia* - *Huperzia lucidula* Forest (Coulling and Rawinski 1999)
- *Tsuga canadensis* - *Betula (alleghaniensis, lenta)* / *Dryopteris intermedia* Forest (Fleming and Coulling 2001)
- *Tsuga canadensis* - *Betula lenta* - *Betula alleghaniensis* Association (Fleming and Moorhead 1996)
- *Tsuga canadensis* / *Dryopteris intermedia* / *Bazzania trilobata* Association (Rawinski et al. 1994)
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984)
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984)
- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984)
- Eastern Hemlock: 23 (Eyre 1980)
- Hemlock - Yellow Birch: 24 (Eyre 1980)
- Hemlock Forest (Thompson 1996)
- Mesic Hemlock-Hardwood Forest (Breden 1989)

### SOURCES

**Description Authors:** S. L. Neid, mod. S. C. Gawler and G. P. Fleming.

**References:** Breden 1989, Breden et al. 2001, Coulling and Rawinski 1999, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, NAP pers. comm. 1998, NRCS 2004, Rawinski 1984, Rawinski et al. 1994, Smith 1983, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003, Young et al. 2006.



**Figure D4.** Hemlock Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA23). September 2006. NAD 1983 / UTM easting 4833751, northing 699690.



**COMMON NAME (PARK-SPECIFIC): HEMLOCK - HARDWOOD SEEPAGE FOREST**

**SYNONYMS**

**USNVC English Name:** Yellow Birch - Red Maple - (Eastern Hemlock, Balsam Fir) / Cinnamon Fern Forest

**USNVC Scientific Name:** *Betula alleghaniensis* - *Acer rubrum* - (*Tsuga canadensis*, *Abies balsamea*) / *Osmunda cinnamomea* Forest

**USNVC Identifier:** C EGL006380

**LOCAL INFORMATION**

**Environmental Description:** The single example of this community is located on the lower portion of a moderately steep (10-25%), northwest-facing slope. In addition to seepage, the gently concave slope displays numerous shallow, intermittent channels. The subacidic soil is a wet-mesic silt loam with a well-developed organic/A horizon.

**Vegetation Description:** This forest community has a mixed canopy of *Tsuga canadensis* (eastern hemlock), *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Acer saccharum* (sugar maple), and *Fraxinus nigra* (black ash), with a poorly developed sapling, shrub and seedling understory of the same species, plus *Fagus grandifolia* (American beech) and *Ostrya virginiana* (hophornbeam). The herb layer is well-developed, containing a wide variety of ferns, especially *Phegopteris connectilis* (long beechfern) and *Athyrium filix-femina* (common ladyfern), sedges (*Carex plantaginea* (plantainleaf sedge) and *Carex pedunculata* (longstalk sedge), and herbs. Rich woods indicators, such as *Adiantum pedatum* (northern maidenhair), *Carex plantaginea* (plantainleaf sedge), and *Trillium erectum* (red trillium), are present but generally not in abundance. Seep species, such as *Carex scabrata* (eastern rough sedge), occur in the wettest spots. The nonvascular layer is well-developed, with *Thuidium* (thuidium moss) sp. a prominent moss found on mineral soil and dead wood.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	<i>Betula alleghaniensis</i> (yellow birch) <i>Fraxinus americana</i> (white ash)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Betula alleghaniensis</i> (yellow birch)
Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit)
Herb (field)	Graminoid	<i>Carex pedunculata</i> (longstalk sedge) <i>Carex plantaginea</i> (plantainleaf sedge)
Herb (field)	Fern or fern ally	<i>Athyrium filix-femina</i> (common ladyfern) <i>Phegopteris connectilis</i> (long beechfern)

**Characteristic Species:** *Arisaema triphyllum* (Jack in the pulpit), *Carex pedunculata* (longstalk sedge), *Tiarella cordifolia* (heartleaf foamflower).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Tussilago farfara</i> (coltsfoot)	-	plant	heavy infestation w/associated logging traces

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** Restricted to a single area in the northwestern portion of park.

**Classification Comments:** This unit broadly fits into the global concept, yet is much more influenced by circumneutral seepage/washing versus simple perching of water.

**Other Comments:** A technical soil workup is needed for this community in the park.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.03; MABI.AA28; Lautzenheiser 28, 29?.

**Marsh-Billings-Rockefeller 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	Saturated mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.d.)
Alliance	<i>Tsuga canadensis</i> - <i>Acer rubrum</i> Saturated Forest Alliance (A.447)
Alliance (English name)	Eastern Hemlock - Red Maple Saturated Forest Alliance
Association	<i>Betula alleghaniensis</i> - <i>Acer rubrum</i> - ( <i>Tsuga canadensis</i> , <i>Abies balsamea</i> ) / <i>Osmunda cinnamomea</i> Forest
Association (English name)	Yellow Birch - Red Maple - (Eastern Hemlock, Balsam Fir) / Cinnamon Fern Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574) North-Central Appalachian Acidic Swamp (CES202.604).

### GLOBAL DESCRIPTION

**Concept Summary:** This mixed forest type occurs in moist ecotonal areas between uplands and wetlands in New England and the Northern Appalachians. Settings include stream drainages, seepage channels, inactive river terraces, and slope bottoms, but not permanently saturated basins. Perennial seepage from upslope or an impervious soil layer keeps water near the surface. There is often pronounced hummock-and-hollow microtopography. The somewhat acidic to circumneutral mineral soils are typically saturated early in the season but may dry out as summer progresses. The canopy closure ranges from somewhat open to nearly closed. Shrubs are sparse; the herb layer is patchy and may be locally dense. The bryoid layer is typically fairly sparse. The canopy is codominated by *Tsuga canadensis* (eastern hemlock) and mixed hardwoods such as *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), and *Acer rubrum* (red maple). Less frequent species can include *Pinus strobus* (eastern white pine), *Fraxinus pennsylvanica* (green ash), and *Fraxinus nigra* (black ash). *Picea rubens* (red spruce) may occur sporadically at the northern extent of this community, and *Nyssa sylvatica* (blackgum) may occur to the south. The shrub layer often includes *Lindera benzoin* (northern spicebush), *Viburnum lantanoides* (hobblebush), and *Acer pensylvanicum* (striped maple). The herb layer reflects the underlying moisture gradients, with *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Geum rivale* (purple avens), *Impatiens capensis* (jewelweed), *Thelypteris palustris* (eastern marsh fern), *Arisaema triphyllum* (Jack in the pulpit), *Symplocarpus foetidus* (skunk-cabbage), *Hydrocotyle americana* (American marshpennywort), and *Cardamine pensylvanica* (Pennsylvania bittercress) in the more moist areas, and *Coptis trifolia* (threeleaf goldthread), *Thelypteris noveboracensis* (New York fern), *Athyrium filix-femina* (common ladyfern), *Oclemena acuminata* (whorled wood aster), *Dryopteris intermedia* (intermediate woodfern), *Cornus canadensis* (bunchberry dogwood), *Aralia nudicaulis* (wild sarsaparilla), and *Clintonia borealis* (bluebead) typical of the areas grading to upland. Bryophyte cover is variable and often includes *Sphagnum girgensohnii* (Girgensohn's sphagnum), *Thuidium*

*delicatulum* (delicate thuidium moss), *Bazzania trilobata*, and *Mnium* (mnium calcareous moss) spp. These forests are somewhat similar to *Tsuga canadensis* - *Betula alleghaniensis* / *Ilex verticillata* / *Sphagnum* spp. Forest (CEGL006226) but occur on mineral soils, not in peaty basins, and have understory species that indicate somewhat more nutrient-enriched conditions.

**Environmental Description:** This mixed forest type occurs in moist ecotonal areas between uplands and wetlands in New England and the northern Appalachians. Settings include stream drainages, seepage channels, inactive river terraces, and slope bottoms where an impervious soil layer keeps water near the surface, but not permanently saturated basins. The somewhat acidic to circumneutral mineral soils are typically saturated early in the season, but may dry out as summer progresses. There is often pronounced hummock-and-hollow microtopography.

**Vegetation Description:** The canopy closure ranges from somewhat open to nearly closed. Shrubs are sparse; the herb layer is patchy and may be locally dense. The bryoid layer is typically fairly sparse. The canopy is codominated by *Tsuga canadensis* (eastern hemlock) and mixed hardwoods such as *Betula alleghaniensis* (yellow birch) and *Acer rubrum* (red maple). Less frequent species can include *Pinus strobus* (eastern white pine), *Fraxinus pennsylvanica* (green ash), and *Fraxinus nigra* (black ash). *Picea rubens* (red spruce) may occur sporadically at the northern extent of this community, and *Nyssa sylvatica* (blackgum) may occur to the south. The shrub layer often includes *Lindera benzoin* (northern spicebush), *Viburnum lantanoides* (hobblebush), and *Acer pensylvanicum* (striped maple). The herb layer reflects the underlying moisture gradients, with *Osmunda cinnamomea* (cinnamon fern), *Osmunda claytoniana* (interrupted fern), *Geum rivale* (purple avens), *Impatiens capensis* (jewelweed), *Thelypteris palustris* (eastern marsh fern), *Arisaema triphyllum* (Jack in the pulpit), *Symplocarpus foetidus* (skunk-cabbage), *Hydrocotyle americana* (American marshpennywort), and *Cardamine pensylvanica* (Pennsylvania bittercress) in the more moist areas, and *Coptis trifolia* (threeleaf goldthread), *Thelypteris noveboracensis* (New York fern), *Oclemena acuminata* (whorled wood aster), *Dryopteris intermedia* (intermediate woodfern), *Cornus canadensis* (bunchberry dogwood), *Aralia nudicaulis* (wild sarsaparilla), and *Clintonia borealis* (bluebead) typical of the areas grading to upland. Bryophyte cover is spotty, and often includes *Sphagnum girgensohnii* (Girgensohn's sphagnum), *Bazzania trilobata*, and *Mnium* (mnium calcareous moss) spp.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
(canopy/subcanopy)	Broad-leaved deciduous tree	<i>Betula alleghaniensis</i> (yellow birch)
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Shrub/sapling	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple)
(tall & short)		<i>Lindera benzoin</i> (northern spicebush)
		<i>Viburnum lantanoides</i> (hobblebush)
Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit)
		<i>Impatiens capensis</i> (jewelweed)
Herb (field)	Fern or fern ally	<i>Osmunda cinnamomea</i> (cinnamon fern)
		<i>Osmunda claytoniana</i> (interrupted fern)

**Characteristic Species:** *Arisaema triphyllum* (Jack in the pulpit), *Tsuga canadensis* (eastern hemlock).

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

**USFWS Wetland System:** Palustrine.

## DISTRIBUTION

**Range:** This mixed forest type occurs in moist ecotonal areas between uplands and wetlands in New England and the Northern Appalachians.

**Federal Lands:** NPS (Acadia, Marsh-Billings-Rockefeller).

## CONSERVATION STATUS

**Rank:** G4? (1-Dec-1997).

**Reasons:** Information not available.

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Conifers are characteristic but not necessarily prominent. The more southerly examples have hemlock as an associate, while more northerly examples tend to have balsam fir.

## Similar Associations:

- *Tsuga canadensis* - *Betula alleghaniensis* / *Ilex verticillata* / *Sphagnum* spp. Forest (CEGL006226).

## Related Concepts:

- Hardwood seepage forest (Gawler 2000)
- Hemlock - Yellow Birch: 24 (Eyre 1980)
- Hemlock Swamp (Thompson 1996)
- Palustrine Needle-leaved Evergreen Forested Wetland (PFO4) (Cowardin et al. 1979)

## SOURCES

**Description Authors:** S. C. Gawler, mod. S. L. Neid.

**References:** Cowardin et al. 1979, Eastern Ecology Working Group n.d., Enser 1999, Eyre 1980, Gawler 2000, Gawler 2002, Kost et al. 2007, Metzler and Barrett 2001, Sperduto 1997b, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2000, Thompson 1996, Thompson and Sorenson 2000.



**Figure D5.** Hemlock – Hardwood Seepage Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.03). September 2004. NAD 1983 / UTM easting 4834635, northing 697850.



**Figure D6.** Hemlock - Hardwood Seepage Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA28). September 2006. NAD 1983 / UTM easting 4834638, northing 697869.



**COMMON NAME (PARK-SPECIFIC): HEMLOCK - NORTHERN HARDWOOD FOREST**

**SYNONYMS**

**USNVC English Name:** Eastern Hemlock - Yellow Birch - Sugar Maple / Intermediate Woodfern Forest

**USNVC Scientific Name:** *Tsuga canadensis* - *Betula alleghaniensis* - *Acer saccharum* / *Dryopteris intermedia* Forest

**USNVC Identifier:** C EGL006109

**LOCAL INFORMATION**

**Environmental Description:** This matrix community dominates the deep soils on the lower, gentler slopes throughout the park and the low relief ground on three sides of The Pogue. It also dominates the Pogue Hole Brook ravine. One unit also occurs on the gently-sloped west side of West Ridge summit. It occurs in soils with loamy fine sand, fine sandy loam, and silt loam textures with pHs tending toward the low 5s and ranging up to 6.0. Leached layers are uncommon in soil profiles. Deep A horizons can be found in the rich soils.

**Vegetation Description:** The canopy is a mix of *Tsuga canadensis* (eastern hemlock) and northern hardwoods, especially *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple), plus *Fraxinus americana* (white ash), *Tilia americana* (American basswood) (in only small amounts), and *Fagus grandifolia* (American beech). The percent cover of *Tsuga canadensis* (eastern hemlock) ranges from 20-60% in the mixed phase of the community, to 60+% in the conifer phase. The understory is typically poorly developed, with *Tsuga canadensis* (eastern hemlock) most frequent in the subcanopy layer and widely scattered *Fagus grandifolia* (American beech) seedlings and saplings in the shrub layer. *Ostrya virginiana* (hophornbeam) is a common small tree. The herb cover varies from almost none in the deepest hemlock shade, up to 50% in areas with some wet spots and other small physical differences, such as small intermittent drainages. Ferns clearly dominate the herb cover, especially *Polystichum acrostichoides* (Christmas fern), *Dryopteris intermedia* (intermediate woodfern), and *Dryopteris marginalis* (marginal woodfern). Other ferns, such as *Thelypteris noveboracensis* (New York fern), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Gymnocarpium dryopteris* (western oakfern), occur in some areas. In areas with richer soils, herb richness can be quite high (over 30 species in 0.05-ha plot) and include some enrichment indicators, such *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Carex plantaginea* (plantainleaf sedge). Little moss cover occurs in this community.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Betula alleghaniensis</i> (yellow birch)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)
Herb (field)	Fern or fern ally	<i>Dryopteris intermedia</i> (intermediate woodfern) <i>Dryopteris marginalis</i> (marginal woodfern) <i>Polystichum acrostichoides</i> (Christmas fern)

**Characteristic Species:** *Tsuga canadensis* (eastern hemlock).

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

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S4*	B	.	Hemlock-Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** It occurs throughout the park and extends out of the park along both north and south boundaries.

**Classification Comments:** This community was mapped in a mixed (conifer-hardwood) phase and conifer phase. In the mixed phase, *Tsuga canadensis* (eastern hemlock) ranges from 20-60% cover in the canopy, while in the conifer phase it ranges from 60-100% of the canopy. In addition to canopy differences, the conifer phase tends to lack understory and herb layers. While mappable based on canopy conifer/hardwood ratios, the soils and ground cover composition can be quite similar between the two phases when viewed from the ground. The highly acidic hemlock forest supporting significant moss ground cover, yet devoid of understory and herb cover, was not observed in the park. *Picea rubens* (red spruce) occurs rarely in the park and is not a component of this hemlock-northern hardwood forest community.

**Other Comments:** Information not available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.13, MABI.14, MABI.25 (mixed phase); MABI.AA17, MABI.AA22, MABI.AA25, MABI.AA29, MABI.AA63 (mixed phase); Keeton 39, 43, 44, 45 (mixed phase); Lautzenheiser 6?, 7?, 8, 11, 14, 16, 20, 27, 30?, 38, 39 (mixed phase).

**Marsh-Billings-Rockefeller 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	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> Forest Alliance (A.412)
Alliance (English name)	Eastern Hemlock - Yellow Birch Forest Alliance
Association	<i>Tsuga canadensis</i> - <i>Betula alleghaniensis</i> - <i>Acer saccharum</i> / <i>Dryopteris intermedia</i> Forest
Association (English name)	Eastern Hemlock - Yellow Birch - Sugar Maple / Intermediate Woodfern Forest
<b>Ecological System(s):</b>	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

### GLOBAL DESCRIPTION

**Concept Summary:** This association comprises hemlock - northern hardwood forests of the northeastern United States. This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. *Tsuga canadensis* (eastern hemlock) is characteristic and usually dominant in the coniferous to mixed canopy. While hemlock generally forms at least 50% of the canopy, in some cases it may be as low as 25% relative dominance. Hardwood codominants include *Betula alleghaniensis* (yellow birch) or *Acer saccharum* (sugar maple), with *Fagus grandifolia* (American beech) common but not usually abundant in all but the very southern portion of the range of this type. *Betula lenta* (sweet birch) may replace *Betula alleghaniensis* (yellow birch) in some areas. *Ostrya virginiana* (hophornbeam) may be present as a small tree.

*Quercus* (oak) spp. and *Pinus strobus* (eastern white pine) tend to be absent or, if present, only occur with low abundance. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* (mapleleaf viburnum) and *Acer pensylvanicum* (striped maple) in addition to *Tsuga canadensis* (eastern hemlock) regeneration. Herbs may be sparse, particularly in dense shade, but include *Dryopteris intermedia* (intermediate woodfern), *Medeola virginiana* (Indian cucumber), *Oxalis montana* (mountain woodsorrel), *Mitchella repens* (partridgeberry), *Maianthemum canadense* (Canada mayflower), *Uvularia sessilifolia* (sessileleaf bellwort), *Polystichum acrostichoides* (Christmas fern), *Trientalis borealis* (starflower), *Huperzia lucidula* (shining clubmoss), *Eurybia divaricata* (white wood aster), *Oclemena acuminata* (whorled wood aster), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Thelypteris noveboracensis* (New York fern). Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple) and a lack of abundant *Quercus* (oak) spp., *Pinus strobus* (eastern white pine), or *Betula lenta* (sweet birch).

**Environmental Description:** This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. In the southern part of the range, stands often occur in deep, sheltered ravines and along high-gradient mountain streams.

**Vegetation Description:** *Tsuga canadensis* (eastern hemlock) is dominant and forms at least 50% of the canopy. *Betula alleghaniensis* (yellow birch) can be codominant, with *Fagus grandifolia* (American beech) and *Acer saccharum* (sugar maple) common but not usually abundant in all but the very southern portion of the range for this type. At the southern end of the range (in Virginia and Maryland), *Liriodendron tulipifera* (tuliptree) may be an important overstory associate. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* (mapleleaf viburnum) and *Acer pensylvanicum* (striped maple) in addition to *Tsuga canadensis* (eastern hemlock) regeneration. Herbs may be sparse, particularly in dense shade, but often include *Dryopteris intermedia* (intermediate woodfern), *Medeola virginiana* (Indian cucumber), *Oxalis montana* (mountain woodsorrel), *Mitchella repens* (partridgeberry), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Huperzia lucidula* (shining clubmoss), *Eurybia divaricata* (white wood aster), and *Thelypteris noveboracensis* (New York fern). Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* (yellow birch) and *Acer saccharum* (sugar maple) and a lack of abundant *Quercus* (oak) spp., *Pinus strobus* (eastern white pine), or *Betula lenta* (sweet birch).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple) <i>Viburnum acerifolium</i> (mapleleaf viburnum)
Herb (field)	Forb	<i>Maianthemum canadense</i> (Canada mayflower)

**Characteristic Species:** *Betula alleghaniensis* (yellow birch), *Carex albicans* (whiteninge sedge), *Dryopteris intermedia* (intermediate woodfern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Mitchella repens* (partridgeberry), *Oclemena acuminata* (whorled wood aster), *Thelypteris noveboracensis* (New York fern), *Tsuga canadensis* (eastern hemlock).

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

**USFWS Wetland System:** Not applicable.

## DISTRIBUTION

**Range:** This community is generally distributed in large patches from New Hampshire south through Pennsylvania, becoming more local in the north Atlantic Piedmont and restricted to local patches at higher elevations of the Central Appalachians in Maryland, West Virginia, and Virginia. In Virginia it is restricted to the northwestern part of the state, where occurrences are rather local but sometimes extensive.

**States/Provinces:** CT, MA, MD, NH, NJ:S3, NY, PA, RI, VA:S3, VT, WV?

**Federal Lands:** NPS (Catoctin Mountain?, Delaware Water Gap, Johnstown Flood, Marsh-Billings-Rockefeller, Saratoga, Shenandoah, Upper Delaware); USFS (Finger Lakes, George Washington, Green Mountain); USFWS (Erie, Iroquois).

## CONSERVATION STATUS

**Rank:** G4? (31-Dec-1997).

**Reasons:** This association has a very large geographic distribution and occurs in large patches in the northern part of its range. All stands of this community are now highly threatened by the exotic insect pest hemlock woolly adelgid (*Adelges tsugae*), which causes decline and eventual mortality in *Tsuga canadensis* (eastern hemlock).

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Many stands of this vegetation type in the national forests and Shenandoah National Park have been devastated during the past decade by adelgid-caused tree mortality. In some cases, 100% of the canopy hemlocks have been killed, littering the forest floor with downed wood and stimulating massive increases in understory growth, particularly of *Betula* (birch) spp. and *Acer pensylvanicum* (striped maple). Since there is no practical treatment for the adelgid on a landscape level, one can only hope that natural pathogens will emerge to keep the adelgid in check before all of our examples of this community are severely degraded or lost.

### Similar Associations:

- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129).
- *Tsuga canadensis* - (*Betula alleghaniensis*, *Quercus rubra*) / *Ilex montana* / *Rhododendron catawbiense* Forest (CEGL008513).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus (prinus, alba)* Forest (CEGL006474).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest (CEGL006088).

### Related Concepts:

- *Betula alleghaniensis* - *Tsuga canadensis* / *Dryopteris intermedia* - *Huperzia lucidula* Forest (Coulling and Rawinski 1999)
- *Tsuga canadensis* - *Betula (alleghaniensis, lenta)* / *Dryopteris intermedia* Forest (Fleming and Coulling 2001)
- *Tsuga canadensis* - *Betula lenta* - *Betula alleghaniensis* Association (Fleming and Moorhead 1996)
- *Tsuga canadensis* / *Dryopteris intermedia* / *Bazzania trilobata* Association (Rawinski et al. 1994)
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984)
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984)
- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984)
- Eastern Hemlock: 23 (Eyre 1980)
- Hemlock - Yellow Birch: 24 (Eyre 1980)
- Hemlock Forest (Thompson 1996)
- Mesic Hemlock-Hardwood Forest (Breden 1989)

## SOURCES

**Description Authors:** S. L. Neid, mod. S. C. Gawler and G. P. Fleming.

**References:** Breden 1989, Breden et al. 2001, Coulling and Rawinski 1999, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, NAP pers. comm. 1998, NRCS 2004, Rawinski 1984, Rawinski et al. 1994, Smith 1983, Spurduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003, Young et al. 2006.



**Figure D7.** Hemlock - Northern Hardwood Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.14). September 2006. NAD 1983 / UTM easting 4833936, northing 698996.



**Figure D8.** Hemlock - Northern Hardwood Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA22). September 2006. NAD 1983 / UTM easting 4834230, northing 698377.

**COMMON NAME (PARK-SPECIFIC): MIXED CONIFER PLANTATION**

**SYNONYMS**

**USNVC English Name:** Pine species Planted Forest  
**USNVC Scientific Name:** *Pinus* spp. Planted Forest  
**USNVC Identifier:** C EGL006313

**LOCAL INFORMATION**

**Environmental Description:** The mixed conifer plantations occur on lower slopes with fertile, silt loam and loamy fine sand soils that are less rocky than some areas in the park.

**Vegetation Description:** These plantations consist of mature *Pinus strobus* (eastern white pine) or *Pinus sylvestris* (Scotch pine), with other conifers sometimes present in smaller amounts, planted in post-agricultural fields and pastures. Associated canopy conifers include *Pinus resinosa* (red pine) or *Picea abies* (Norway spruce). *Larix decidua* (European larch) may also be present. In one of the three Scotch pine plantation units mapped, Scotch pine is a secondary species to *Pinus resinosa* (red pine). Where *Pinus strobus* (eastern white pine) is the most common species, it is usually strongly dominant, associated with a relatively small amount of *Picea abies* (Norway spruce). While more information is needed on the understory, in general northern hardwoods dominate the sapling and seedling layers under pine canopies at the park. No information is available on herb cover.

**Most Abundant Species:**

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

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

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

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** All of the Scotch pine plantations are in the northwestern portion of the park. Other mixed conifer plantations are in the eastern half of the park.

**Classification Comments:** Anthropogenic association.

**Other Comments:** The *Pinus sylvestris* (Scotch pine) trees were planted in 1917 and 1930. This association was noted in passing and not sampled in 2004. Overstory plots from Keeton provide data on the tree canopy.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA16, MABI.AA19, MABI.AA36, MABI.AA41, MABI.AA42, MABI.AA46; Keeton 2, 13, 14, 15.

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	<i>Pinus strobus</i> Planted Forest Alliance (A.98)
Alliance (English name)	Eastern White Pine Planted Forest Alliance
Association	<i>Pinus</i> spp. Planted Forest
Association (English name)	Pine species Planted Forest
<b>Ecological System(s):</b>	Information not available.

### GLOBAL DESCRIPTION

**Concept Summary:** These plantations consist of mature *Pinus strobus* (eastern white pine) or *Pinus sylvestris* (Scotch pine), with other conifers sometimes present in smaller amounts, planted in post-agricultural fields and pastures. Associated canopy conifers include *Pinus resinosa* (red pine), *Picea abies* (Norway spruce), *Picea pungens* (blue spruce), or *Larix decidua* (European larch). The understory varies widely in its degree of development and may be virtually absent. Northern hardwoods dominate the sapling and seedling layers in some areas; *Juniperus virginiana* (eastern red-cedar) is common in others. Cover is proportional to the degree of canopy break-up or opening that has occurred. Common hardwoods include *Prunus serotina* (black cherry), *Acer rubrum* (red maple), and *Fraxinus americana* (white ash). A tall-shrub layer may be present; common species (aside from smaller individuals of the hardwood saplings) include *Crataegus* (hawthorn) spp., *Hamamelis virginiana* (American witch-hazel), and *Lindera benzoin* (northern spicebush). Common short shrubs include *Viburnum recognitum* (smooth arrow-wood), *Vaccinium pallidum* (Blue Ridge blueberry), *Rubus hispidus* (bristly dewberry), and *Rubus flagellaris* (northern dewberry). The species composition and abundance of the herbaceous layer vary widely due to variation in canopy tree species composition, stand stocking, and soil drainage. Herbaceous species include *Ageratina altissima* (white snakeroot), *Dryopteris intermedia* (intermediate woodfern), *Dryopteris carthusiana* (spinulose woodfern), *Oxalis stricta* (common yellow oxalis), *Potentilla simplex* (common cinquefoil), *Mitchella repens* (partridgeberry), *Galium aparine* (stickywilly), *Galium asprellum* (rough bedstraw), *Brachyelytrum erectum* (bearded shorthusk), *Veronica officinalis* (common gypsyweed), *Polystichum acrostichoides* (Christmas fern), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Lycopodium clavatum* (running clubmoss), and *Lycopodium digitatum* (fan clubmoss). Graminoid and forb species associated with disturbed areas, such as *Agrostis stolonifera* (creeping bentgrass), *Dichanthelium clandestinum* (deertongue), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Hypericum perforatum* (common St. Johnswort), are often dominant in these communities. Vines such as *Toxicodendron radicans* (eastern poison-ivy), *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis* (grape) spp., and *Parthenocissus quinquefolia* (Virginia creeper) may be present, but not abundant, in these plantations. Disturbance from silvicultural treatments and landscape fragmentation leaves these communities prone to invasion by exotic species, including *Lonicera tatarica* (Tatarian honeysuckle), *Berberis vulgaris* (common barberry), *Rosa multiflora* (multiflora rose), *Celastrus orbiculata* (Asian bittersweet), *Microstegium vimineum* (Nepalese browntop), and *Alliaria petiolata* (garlic mustard), which are locally abundant.

**Environmental Description:** These mature plantations are planted in post-agricultural fields and pastures. The trees are typically even-aged and regularly-spaced. Soils are usually moderately well-drained to well-drained and vary from sandy to loamy.

**Vegetation Description:** These plantations consist of mature *Pinus strobus* (eastern white pine) or *Pinus sylvestris* (Scotch pine), with other conifers sometimes present in smaller amounts, planted in post-agricultural fields and pastures. Associated canopy conifers include *Pinus resinosa* (red pine), *Picea abies* (Norway spruce), *Picea pungens* (blue spruce), or *Larix decidua* (European larch). The understory varies widely in its degree of development and may be virtually absent. Northern hardwoods dominate the sapling and seedling layers in some areas; *Juniperus virginiana* (eastern red-cedar) is common in others. Cover is proportional to the degree of canopy break-up or opening that has occurred. Common hardwoods include *Prunus serotina* (black cherry), *Acer rubrum* (red maple), and *Fraxinus americana* (white ash). A tall-shrub layer may be present; common species (aside from smaller individuals of the hardwood saplings) include *Crataegus* (hawthorn) spp., *Hamamelis virginiana* (American witch-hazel), and *Lindera benzoin* (northern spicebush). Common short shrubs include *Viburnum recognitum* (smooth arrow-wood), *Vaccinium pallidum* (Blue Ridge blueberry), *Rubus hispidus* (bristly dewberry), and *Rubus flagellaris* (northern dewberry). The species composition and abundance of the herbaceous layer vary widely due to variation in canopy tree species composition, stand stocking, and soil drainage. Herbaceous species include *Ageratina altissima* (white snakeroot), *Dryopteris intermedia* (intermediate woodfern), *Dryopteris carthusiana* (spinulose woodfern), *Oxalis stricta* (common yellow oxalis), *Potentilla simplex* (common cinquefoil), *Mitchella repens* (partridgeberry), *Galium aparine* (stickywilly), *Galium asprellum* (rough bedstraw), *Brachyelytrum erectum* (bearded shorthusk), *Veronica officinalis* (common gypsyweed), *Polystichum acrostichoides* (Christmas fern), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Lycopodium clavatum* (running clubmoss), and *Lycopodium digitatum* (fan clubmoss). Graminoid and forb species associated with disturbed areas, such as *Agrostis stolonifera* (creeping bentgrass), *Dichanthelium clandestinum* (deertongue), *Dennstaedtia punctilobula* (eastern hayscented fern), and *Hypericum perforatum* (common St. Johnswort), are often dominant in these communities. Vines such as *Toxicodendron radicans* (eastern poison-ivy), *Smilax glauca* (cat greenbrier), *Smilax rotundifolia* (roundleaf greenbrier), *Vitis* (grape) spp., and *Parthenocissus quinquefolia* (Virginia creeper) may be present, but not abundant, in these plantations. Disturbance from silvicultural treatments and landscape fragmentation leaves these communities prone to invasion by exotic species, including *Lonicera tatarica* (Tatarian honeysuckle), *Berberis vulgaris* (common barberry), *Rosa multiflora* (multiflora rose), *Celastrus orbiculata* (Asian bittersweet), *Microstegium vimineum* (Nepalese browntop), and *Alliaria petiolata* (garlic mustard), which are locally abundant.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine) <i>Pinus sylvestris</i> (Scotch pine)
Herb (field)	Forb	<i>Maianthemum canadense</i> (Canada mayflower) <i>Trientalis borealis</i> (starflower) <i>Veronica officinalis</i> (common gypsyweed)

**Characteristic Species:** *Pinus strobus* (eastern white pine), *Pinus sylvestris* (Scotch pine), *Veronica officinalis* (common gypsyweed).

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Alliaria petiolata</i> (garlic mustard)	-	plant	exotic
<i>Berberis vulgaris</i> (common barberry)	-	plant	exotic
<i>Celastrus orbiculata</i> (Asian bittersweet)	-	plant	exotic
<i>Hypericum perforatum</i> (common St. Johnswort)	-	plant	exotic
<i>Lonicera tatarica</i> (Tatarian honeysuckle)	-	plant	exotic
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	exotic
<i>Picea abies</i> (Norway spruce)	-	plant	exotic
<i>Pinus sylvestris</i> (Scotch pine)	-	plant	exotic
<i>Rosa multiflora</i> (multiflora rose)	-	plant	exotic

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** Mixed pine plantations are common throughout the northeastern United States.

**States/Provinces:** NJ, NY, PA, VT.

**Federal Lands:** NPS (Allegheny Portage Railroad, Delaware Water Gap, Fort Necessity, Friendship Hill, Johnstown Flood, Marsh-Billings-Rockefeller, Upper Delaware); USFWS (Erie, Iroquois).

### CONSERVATION STATUS

**Rank:** GNA (modified/managed) (1-Dec-2004).

**Reasons:** Information not available.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 3 – Weak.

**Comments:** This type is intended for plantations of mixed pines or pine mixed with other non-native planted conifers.

### Similar Associations:

- *Pinus strobus* Planted Forest (CEGL007178)--monotypic white pine.

**Related Concepts:** Information not available.

### SOURCES

**Description Authors:** S. C. Gawler.

**References:** Eastern Ecology Working Group n.d., Perles et al. 2006a, Perles et al. 2006b, Perles et al. 2007.



**Figure D9.** Mixed Conifer Plantation in Marsh-Billings-Rockefeller National Historical Park (MABI.AA42).  
September 2006. NAD 1983 / UTM easting 4834751, northing 698006.



**COMMON NAME (PARK-SPECIFIC): NORTHERN HARDWOOD FOREST**

**SYNONYMS**

**USNVC English Name:** Sugar Maple - (White Ash) / Jack-in-the-Pulpit Forest

**USNVC Scientific Name:** *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest

**USNVC Identifier:** CEGLO06211

**LOCAL INFORMATION**

**Environmental Description:** This community occurs at mid to lower positions of moderately steep slopes with a concave shape. It also occurs in a concavity on top of a ridge, as well as a smooth to ledgy slope on the top of another ridge. Derived from glacial till, soils at these sites are generally moderately fertile (pH 5.6-6+), sandy or fine sandy loams with a thin but notable A horizon (2-9 cm thick). Soils are generally moderately stony.

**Vegetation Description:** The tree canopy of this community is characterized by *Acer saccharum* (sugar maple) with *Fraxinus americana* (white ash) codominant or subdominant. *Tilia americana* (American basswood), *Fagus grandifolia* (American beech), and *Tsuga canadensis* (eastern hemlock) are sometimes present in lesser amounts. The subcanopy is moderately well-developed, with *Acer saccharum* (sugar maple) and *Ostrya virginiana* (hophornbeam) the most prominent species. The shrub layer is poorly developed, seedling/sapling *Fagus grandifolia* (American beech) being the most common species. The herb layer is moderately well-developed, ranging up to 50% cover, and quite diverse. In each of three 0.05 ha plots, herb richness ranged from 26-41 species, the latter being unusually rich for the community. Common and sometimes moderately abundant herbs include *Eurybia divaricata* (white wood aster), *Dryopteris marginalis* (marginal woodfern), *Polystichum acrostichoides* (Christmas fern), and *Carex pedunculata* (longstalk sedge). Enrichment indicators, especially *Arisaema triphyllum* (Jack in the pulpit), *Actaea pachypoda* (white baneberry), and *Trillium erectum* (red trillium), are regularly present but never abundant in terms of cover. In some cases, enrichment indicator species are quite numerous. Most of the units surveyed appear to be maturing second-growth forest that had been selectively thinned within the last 15 years.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Fraxinus americana</i> (white ash)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Ostrya virginiana</i> (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech) <i>Ostrya virginiana</i> (hophornbeam)
Herb (field)	Forb	<i>Eurybia divaricata</i> (white wood aster)
Herb (field)	Graminoid	<i>Carex pedunculata</i> (longstalk sedge)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern) <i>Polystichum acrostichoides</i> (Christmas fern)

**Characteristic Species:** *Acer saccharum* (sugar maple), *Arisaema triphyllum* (Jack in the pulpit), *Eurybia divaricata* (white wood aster), *Fraxinus americana* (white ash), *Trillium erectum* (red trillium).

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex backii</i> (Back's sedge)	-	plant	rare/uncommon in New England
<i>Galearis spectabilis</i> (showy orchid)	-	plant	

### Subnational Distribution with Crosswalk Data:

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	SNR	=	1	Sugar Maple-White Ash-Jack-in-the-pulpit Northern Hardwood Forest	Thompson and Sorenson 2000 Sorenson 2000

**Local Range:** There are 12 polygons ranging from 0.3 to 2.7 ha scattered throughout park. It extends outside the park along the north boundary.

**Classification Comments:** In earlier versions of MABI classification (preliminary classification and in the 2005 vegetation map) this community was called Semi-rich Northern Hardwood Forest. Accuracy assessment data for the Northern Hardwood Forest indicated that the original USNVC crosswalk (CEGL006252) selected in the preliminary vegetation classification was incorrect because this matrix northern hardwood forest in the park has a lower cover of *Fagus grandifolia* (American beech) in the canopy and has a slightly richer, more diverse herbaceous layer than the original 'standard northern hardwoods' USNVC global vegetation association (CEGL006252). Therefore, the USNVC crosswalk was changed to CEGL006211 after accuracy assessment and the map class name 'Northern Hardwood Forest' was retained because this is the standard, typic, matrix northern hardwood forest for the park. The CEGL006252 USNVC crosswalk was used for the Successional Northern Hardwood Forest which has *Fagus grandifolia* (American beech) co-dominant in the canopy and subcanopy and a depauperate herbaceous understory. One plot (MABI.07) borders on being rich northern hardwood forest, based on soil and species. None of the vegetation plots had significant fern cover of rich woods ferns, which is often a good indicator of the rich northern hardwood forest community.

**Other Comments:** A sloping seepage forest unit below the minimum mapping size (MABI.29 plot) is included in a semi-rich forest area in the northwestern corner of the park; see the Enriched Northern Hardwood Forest Seep description for further information.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.07, MABI.21, MABI.22, MABI.24, MABI.27; MABI.AA01, MABI.AA11, MABI.AA14; MABI.AA20; MABI.AA24, MABI.AA31; MABI.AA32; MABI.AA33; MABI.AA53; MABI.AA62; Keeton 32; Lautzenheiser 19, 25, 26?, 33, 34, 35.

**Marsh-Billings-Rockefeller 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	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> Forest Alliance (A.217)
Alliance (English name)	Sugar Maple - White Ash - American Basswood Forest Alliance
Association	<i>Acer saccharum</i> - ( <i>Fraxinus americana</i> ) / <i>Arisaema triphyllum</i> Forest
Association (English name)	Sugar Maple - (White Ash) / Jack-in-the-Pulpit Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Hardwoods Forest (CES201.564).

## GLOBAL DESCRIPTION

**Concept Summary:** These are northern hardwood forests of slightly enriched soils in the northern Appalachian Mountains and adjacent northeastern United States and Canada. They occur at moderate elevations of 245 to 610 m (800-2,000 feet) on slightly enriched soils, often silt loams derived from pelite or other subacidic bedrock. Ridgetops and slight concavities on hillslopes are both typical settings. They may occur as inclusions within typical northern hardwood forests or may occur over larger areas and be the locally dominant northern hardwood forest. The closed-canopy forest has sparse to moderate shrub cover, moderate herb cover, and may have local carpets of *Acer saccharum* (sugar maple) seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. The canopy is dominated by *Acer saccharum* (sugar maple), frequently with *Fraxinus americana* (white ash) as an associate or even canopy codominant. Other associated hardwood species include *Betula alleghaniensis* (yellow birch) and *Betula lenta* (sweet birch). *Fagus grandifolia* (American beech) is often present but less abundant than in matrix northern hardwood forests. *Liriodendron tulipifera* (tuliptree) may occur in southern New England. Conifers are usually sparse. Shrubs can include *Cornus alternifolia* (alternateleaf dogwood), *Lindera benzoin* (northern spicebush), *Sambucus racemosa* (red elderberry), *Acer pensylvanicum* (striped maple), and *Ostrya virginiana* (hophornbeam). Typical herbs, which are scarce or absent from standard beech-birch-maple forests, include *Arisaema triphyllum* (Jack in the pulpit), *Viola rotundifolia* (roundleaf yellow violet), *Tiarella cordifolia* (heartleaf foamflower), *Actaea pachypoda* (white baneberry), *Osmunda claytoniana* (interrupted fern), *Osmunda cinnamomea* (cinnamon fern), *Carex laxiculmis* (spreading sedge), *Carex platyphylla* (broadleaf sedge), *Carex pedunculata* (longstalk sedge), *Eurybia divaricata* (white wood aster), *Botrychium* (grapefern) spp., and *Solidago flexicaulis* (zigzag goldenrod). These forests are intermediate in nutrient regime and composition between *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest (CEGL005008) and *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252). They are more depauperate than other communities of this alliance, for example lacking rich-soil indicators such as *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Tilia americana* (American basswood) that are typical of CEGL005008.

**Environmental Description:** These are northern hardwood forests of slightly enriched soils in the northern Appalachian Mountains and adjacent northeastern United States and Canada. They occur at moderate elevations of 245 to 610 m (800-2000 feet) on slightly enriched soils, often silt loams derived from pelite or other subacidic bedrock. Ridgetops and slight concavities on hillslopes are both typical settings.

**Vegetation Description:** The closed-canopy forest has sparse to moderate shrub cover, moderate herb cover, and may have local carpets of *Acer saccharum* (sugar maple) seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. The canopy is dominated by *Acer saccharum* (sugar maple), with associated hardwood species including *Betula alleghaniensis* (yellow birch) and *Fraxinus americana* (white ash). *Fraxinus* (ash) may be a canopy codominant in some areas. *Fagus grandifolia* (American beech) is often present but less abundant than in matrix northern hardwood forests. Conifers are usually sparse. Shrubs can include *Cornus alternifolia* (alternateleaf dogwood), *Sambucus racemosa* (red elderberry), *Acer pensylvanicum* (striped maple), and *Ostrya virginiana* (hophornbeam). Typical herbs include *Arisaema triphyllum* (Jack in the pulpit), *Viola rotundifolia* (roundleaf yellow violet), *Tiarella*

*cordifolia* (heartleaf foamflower), *Actaea pachypoda* (white baneberry), *Botrychium* (grapefern) spp., and *Solidago flexicaulis* (zigzag goldenrod).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Fraxinus americana</i> (white ash)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple), <i>Cornus alternifolia</i> (alternateleaf dogwood), <i>Ostrya virginiana</i> (hophornbeam)
Herb (field)	Forb	<i>Sambucus racemosa</i> (red elderberry) <i>Arisaema triphyllum</i> (Jack in the pulpit)

**Characteristic Species:** *Acer saccharum* (sugar maple), *Arisaema triphyllum* (Jack in the pulpit).

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

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This forest association occurs in New England west to New York and Ontario.

**States/Provinces:** CT, MA, ME, NB, NH, NY, ON, PA, RI, VT.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Saint-Gaudens, Saratoga, Upper Delaware, Weir Farm).

**CONSERVATION STATUS**

**Rank:** G4 (7-Dec-2005).

**Reasons:** This association is fairly well-distributed in northern New England and adjacent Canada.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** This type is conceptually well understood, but not well documented in published sources. Additional characterization would be helpful.

**Similar Associations:**

- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252).
- *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest (CEGL005008).

**Related Concepts:**

- Mesic Northern Hardwood Forest (Beech-Birch-Maple Forest) (Thompson 1996)
- Semi-rich northern hardwood forest (NAP pers. comm. 1998)
- Sugar Maple: 27 (Eyre 1980)

**SOURCES**

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

**References:** Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Gawler 2002, Metzler and Barrett 2001, Metzler and Barrett 2004, NAP pers. comm. 1998, NRCS 2004, Sperduto and Nichols 2004, Thompson 1996, Thompson and Sorenson 2000.



**Figure D10.** Northern Hardwood Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.07). September 2004. NAD 1983 / UTM easting 4834582, northing 697669.



**Figure D11.** Northern Hardwood Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA24). September 2006. NAD 1983 / UTM easting 4834074, northing 699993.



**COMMON NAME (PARK-SPECIFIC): NORTHERN HARDWOOD - HEMLOCK SWAMP**

**SYNONYMS**

**USNVC English Name:** Red Maple - Black Ash - (Eastern Hemlock) / Heartleaf Foamflower Forest  
**USNVC Scientific Name:** *Acer rubrum* - *Fraxinus nigra* - (*Tsuga canadensis*) / *Tiarella cordifolia* Forest  
**USNVC Identifier:** C EGL006502

**LOCAL INFORMATION**

**Environmental Description:** Several of these small swamps are located in small (0.5 ha, 1.24 ac), shallow basins and gently sloping headwater drainages in the lowland east of The Pogue. Poorly drained soils of slightly acidic (pH 6.6), well-decomposed mucks ranging from 20 to 80 cm depth are characteristic of these swamps. The shallower mucks are associated with the sloping sites.

**Vegetation Description:** This mixed swamp type has a very irregular canopy composed of scattered full-sized *Acer rubrum* (red maple) and *Fraxinus nigra* (black ash), 20-35 m in height, and a very broken (30% cover) second canopy dominated by pole-sized *Tsuga canadensis* (eastern hemlock), *Fraxinus nigra* (black ash), and *Betula alleghaniensis* (yellow birch). The understory consists of a moderately well-developed ( $\pm$  30% cover) sapling/tall-shrub layer of all the canopy species, plus *Ulmus americana* (American elm), and a poorly developed low-shrub layer (0.5-1 m) of *Ribes americanum* (American black currant), *Cornus sericea* (red-osier dogwood), and seedlings of all the canopy species. The herb layer is very lush and diverse (31 species in a 100 m<sup>2</sup> plot) clearly dominated by a higher layer 0.5-1 m tall of *Osmunda cinnamomea* (cinnamon fern) and *Onoclea sensibilis* (sensitive fern), under which grows many forbs and several graminoids. Some of the herbs characteristic of these swamps include *Rubus pubescens* (dwarf red blackberry), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Carex leptalea* (bristlystalked sedge), and *Chrysosplenium americanum* (American golden saxifrage). In the sloping swamp example, *Carex scabrata* (eastern rough sedge), *Osmunda claytoniana* (interrupted fern), *Matteuccia struthiopteris* (ostrich fern), and *Athyrium filix-femina* (common ladyfern) are dominant in the herb layer. A nonvascular layer is definitely present but patchy. *Mnium* (mniium calcareous moss), *Thuidium* (thuidium moss), and *Calliergon* (calliergon moss) are three genera well-represented among the mosses.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple) <i>Fraxinus nigra</i> (black ash)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Betula alleghaniensis</i> (yellow birch)
Herb (field)	Forb	<i>Rubus pubescens</i> (dwarf red blackberry) <i>Saxifraga pensylvanica</i> (eastern swamp saxifrage) <i>Scutellaria lateriflora</i> (blue skullcap)
Herb (field)	Fern or fern ally	<i>Onoclea sensibilis</i> (sensitive fern) <i>Osmunda cinnamomea</i> (cinnamon fern)

**Characteristic Species:** *Carex leptalea* (bristlystalked sedge), *Carex scabrata* (eastern rough sedge), *Chrysosplenium americanum* (American golden saxifrage), *Rubus pubescens* (dwarf red blackberry).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Alnus glutinosa</i> (European alder)	-	plant	exotic

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	SNR*	B	.	Red Maple-Black Ash Seepage Swamp	Thompson and Sorenson 2000

**Local Range:** In low terrain east of The Pogue.

**Classification Comments:** The sloping examples of this community need to be sampled and fully described.

**Other Comments:** Two of these swamps also function as vernal pools, which are important amphibian breeding habitat.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.06; MABI.AA27, MABI.AA47, MABI.AA51, MABI.AA52; Lautzenheiser 13, 15.

**Marsh-Billings-Rockefeller 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	<i>Fraxinus nigra</i> - <i>Acer rubrum</i> Saturated Forest Alliance (A.347)
Alliance (English name)	Black Ash - Red Maple Saturated Forest Alliance
Association	<i>Acer rubrum</i> - <i>Fraxinus nigra</i> - ( <i>Tsuga canadensis</i> ) / <i>Tiarella cordifolia</i> Forest
Association (English name)	Red Maple - Black Ash - (Eastern Hemlock) / Heartleaf Foamflower Forest
<b>Ecological System(s):</b>	North-Central Interior and Appalachian Rich Swamp (CES202.605).

### GLOBAL DESCRIPTION

**Concept Summary:** This is a northern hardwood-conifer seepage forest of central New England. It typically occurs in basins or along streambanks that are associated with groundwater discharge or seeps at the wetland margin; pH is often circumneutral or at least not highly acidic. Stands often form at stream headwaters. Soil substrate is well-decomposed peat or muck of variable thickness, ranging from 20 cm to several meters thick. The canopy is dominated by *Acer rubrum* (red maple) or codominated with *Fraxinus nigra* (black ash), which is generally indicative of mineral enrichment from groundwater in this region. Typical canopy associates include *Betula alleghaniensis* (yellow birch) and *Tsuga canadensis* (eastern hemlock); *Pinus strobus* (eastern white pine) and *Ulmus americana* (American elm) may also be present. The shrub layer includes saplings of canopy tree species plus *Rhamnus alnifolia* (alderleaf buckthorn), *Vaccinium corymbosum* (highbush blueberry), *Ribes americanum* (American black currant), *Ilex verticillata* (common winterberry), and *Toxicodendron radicans* (eastern poison-ivy). In the southern extent of the range, *Toxicodendron vernix* (poison-sumac) and *Lindera benzoin* (northern spicebush) become more abundant. Common herbs include *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Impatiens capensis* (jewelweed),

*Chrysosplenium americanum* (American golden saxifrage), *Mitella nuda* (naked miterwort), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Rubus pubescens* (dwarf red blackberry), *Geum rivale* (purple avens), *Tiarella cordifolia* (heartleaf foamflower), *Carex leptalea* (bristlystalked sedge), *Carex leptoneuria* (nerveless woodland sedge), *Carex interior* (inland sedge), *Glyceria striata* (fowl mannagrass), and *Dryopteris cristata* (crested woodfern). In some cases, the ferns form an herbaceous “canopy” with the forbs and graminoids scattered among and below them. The nonvascular layer is usually well-developed and includes *Thuidium delicatulum* (delicate thuidium moss), *Mnium* (mnium calcareous moss) spp., *Rhytidiadelphus triquetrus* (rough goose neck moss), and *Climacium dendroides* (tree climacium moss) with *Calliergon cordifolium* (calliergon moss) in hollows.

**Environmental Description:** Seepage forest that typically occurs in basins or along streamsides that are associated with groundwater discharge or seeps at the wetland margin. pH is often circumneutral or at least not highly acidic. Stands often form at stream headwaters. Soil substrate is well-decomposed peat of variable thickness, ranging from 20 cm to several meters thick.

**Vegetation Description:** The canopy is dominated by *Acer rubrum* (red maple) or codominated with *Fraxinus nigra* (black ash), which is generally indicative of mineral enrichment from groundwater in this region. Typical canopy associates include *Betula alleghaniensis* (yellow birch) and *Tsuga canadensis* (eastern hemlock); *Pinus strobus* (eastern white pine) and *Ulmus americana* (American elm) may also be present. The shrub layer includes saplings of canopy tree species plus *Rhamnus alnifolia* (alderleaf buckthorn), *Vaccinium corymbosum* (highbush blueberry), *Ribes americanum* (American black currant), *Ilex verticillata* (common winterberry), and *Toxicodendron radicans* (eastern poison-ivy). In the southern extent of the range, *Toxicodendron vernix* (poison-sumac) and *Lindera benzoin* (northern spicebush) become more abundant. Common herbs include *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Impatiens capensis* (jewelweed), *Chrysosplenium americanum* (American golden saxifrage), *Mitella nuda* (naked miterwort), *Saxifraga pensylvanica* (eastern swamp saxifrage), *Rubus pubescens* (dwarf red blackberry), *Geum rivale* (purple avens), *Tiarella cordifolia* (heartleaf foamflower), *Carex leptalea* (bristlystalked sedge), *Carex leptoneuria* (nerveless woodland sedge), *Carex interior* (inland sedge), *Glyceria striata* (fowl mannagrass), and *Dryopteris cristata* (crested woodfern). In some cases, the ferns form an herbaceous “canopy” with the forbs and graminoids scattered among and below them. The nonvascular layer is usually well-developed and includes *Thuidium delicatulum* (delicate thuidium moss), *Mnium* (mnium calcareous moss) spp., *Rhytidiadelphus triquetrus* (rough goose neck moss), and *Climacium dendroides* (tree climacium moss) with *Calliergon cordifolium* (calliergon moss) in hollows.

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple) <i>Fraxinus nigra</i> (black ash)
Tree subcanopy	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
Tree subcanopy	Broad-leaved deciduous tree	<i>Betula alleghaniensis</i> (yellow birch)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Rhamnus alnifolia</i> (alderleaf buckthorn) <i>Ribes americanum</i> (American black currant) <i>Vaccinium corymbosum</i> (highbush blueberry)
Shrub/sapling (tall & short)	Vine/Liana	<i>Toxicodendron radicans</i> (eastern poison-ivy)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Ilex verticillata</i> (common winterberry)
Herb (field)	Forb	<i>Impatiens capensis</i> (jewelweed)
Herb (field)	Fern or fern ally	<i>Onoclea sensibilis</i> (sensitive fern) <i>Osmunda cinnamomea</i> (cinnamon fern)

**Characteristic Species:** *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), *Tiarella cordifolia* (heartleaf foamflower).

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

**USFWS Wetland System:** Palustrine.

### DISTRIBUTION

**Range:** This type is currently described from Vermont and New Hampshire.

**States/Provinces:** MA, MI, NH, VT.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller); USFWS (Pondicherry).

### CONSERVATION STATUS

**Rank:** GNR (15-Oct-1999).

**Reasons:** Information not available.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

### Similar Associations:

- *Acer rubrum* - *Fraxinus* (*pennsylvanica*, *americana*) / *Lindera benzoin* / *Symplocarpus foetidus* Forest (CEGL006406).
- *Acer rubrum* / *Nemopanthus mucronatus* - *Vaccinium corymbosum* Forest (CEGL006220).
- *Fraxinus nigra* - *Acer rubrum* - (*Larix laricina*) / *Rhamnus alnifolia* Forest (CEGL006009).

**Related Concepts:** Information not available.

### SOURCES

**Description Authors:** S. L. Neid, mod. S. C. Gawler.

**References:** Eastern Ecology Working Group n.d., Edinger et al. 2002, Kost et al. 2007, Sperduto 2000a, Sperduto and Nichols 2004, Thompson and Sorenson 2000.



**Figure D12.** Northern Hardwood - Hemlock Swamp in Marsh-Billings-Rockefeller National Historical Park (Plot MABI.06). September 2004. NAD 1983 / UTM easting 4834320, northing 698435.



**Figure D13.** Northern Hardwood - Hemlock Swamp in Marsh-Billings-Rockefeller National Historical Park (MABI.AA51). September 2006. NAD 1983 / UTM easting 4833978, northing 698364.



**COMMON NAME (PARK-SPECIFIC): NORTHERN HARDWOOD LIMESTONE FOREST (VARIANT OF RICH NORTHERN HARDWOOD FOREST)**

**SYNONYMS**

**USNVC English Name:** Sugar Maple - White Ash - American Basswood / Mountain Maple / Blue Cohosh Forest

**USNVC Scientific Name:** *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest

**USNVC Identifier:** CEGLO05008

**LOCAL INFORMATION**

**Environmental Description:** The Northern Hardwood Limestone Forest is a dry-mesic version of the Rich Northern Hardwood Forest. It occurs on the upper, over-steepened slope of West Ridge and on a very localized rocky knoll west of Mount Tom’s summit on limestone. Downslope movement of nutrients and moisture is likely a critical process in the creation of soils with pH values ranging from 5.8-6.8 and well-developed, humus-rich, A horizons, usually 10-15 cm thick, and sometimes as thick as 24 cm.

**Vegetation Description:** A high (20-35 m) canopy dominated by *Acer saccharum* (sugar maple) is highly characteristic of the community. *Tilia americana* (American basswood) and *Fraxinus americana* (white ash) are also frequently present in the canopy, and indicator species, such as *Juglans cinerea* (butternut) and *Ulmus rubra* (slippery elm), are occasionally present. *Ostrya virginiana* (hophornbeam) forms a substantial subcanopy. The herb layer provides the best characterization of the community, not only forming quite abundant cover; but also being diverse and containing several to many indicator species. The most common, though not usually of great abundance, indicator species are *Actaea pachypoda* (white baneberry), *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Piptatherum racemosum* (blackseed ricegrass). Spring ephemerals, such as *Allium tricoccum* (wild leek), *Dicentra canadensis* (squirrel corn), *Dicentra cucullaria* (Dutchman’s breeches), *Claytonia caroliniana* (Carolina springbeauty), and *Erythronium americanum* (dogtooth violet), are likely present in these rich woods but were generally not visible during the period of survey. Only fruiting stalks and underground parts of the first two species were observed during field work. Some less common, and often regionally rare or uncommon, indicator species observed include *Carex albursina* (white bear sedge), *Carex backii* (Back’s sedge), *Carex hitchcockiana* (Hitchcock’s sedge), *Diplazium pycnocarpon* (glade fern), *Dryopteris goldiana* (Goldie’s woodfern), and *Galearis spectabilis* (showy orchid). Some of the most common and abundant species in this community, especially *Arisaema triphyllum* (Jack in the pulpit), *Dryopteris marginalis* (marginal woodfern), and *Eurybia divaricata* (white wood aster), are also species common to the northern hardwood community.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Tilia americana</i> (American basswood) <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Ostrya virginiana</i> (hophornbeam)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Sambucus racemosa</i> var. <i>racemosa</i> (red elderberry)

Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit) <i>Eurybia divaricata</i> (white wood aster) <i>Prenanthes altissima</i> (tall rattlesnakeroot)
Herb (field)	Graminoid	<i>Carex</i> spp. (sedge) <i>Piptatherum racemosum</i> (blackseed ricegrass)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern)

**Characteristic Species:** *Actaea pachypoda* (white baneberry), *Ageratina altissima* (white snakeroot), *Caulophyllum thalictroides* (blue cohosh), *Dicentra canadensis* (squirrel corn), *Elymus hystrix* (eastern bottlebrush grass), *Geranium robertianum* (Robert geranium), *Juglans cinerea* (butternut), *Matteuccia struthiopteris* (ostrich fern), *Sanguinaria canadensis* (bloodroot), *Ulmus rubra* (slippery elm), *Viola canadensis* (Canadian white violet), *Viola selkirkii* (Selkirk's violet).

**Other Noteworthy Species:**

<u>Species</u>	<u>G</u> Rank	<u>Type</u>	<u>Note</u>
<i>Carex albursina</i> (white bear sedge)	-	plant	uncommon in New England
<i>Carex backii</i> (Back's sedge)	-	plant	rare/uncommon in New England
<i>Carex hitchcockiana</i> (Hitchcock's sedge)	-	plant	rare/uncommon in New England
<i>Diplazium pycnocarpon</i> (glade fern)	-	plant	
<i>Dryopteris goldiana</i> (Goldie's woodfern)	-	plant	
<i>Galearis spectabilis</i> (showy orchid)	-	plant	

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>S</u> Rank	<u>Rel</u>	<u>Conf</u>	<u>S</u> Name	<u>Reference</u>
VT	S4	=	1	Rich Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** This forest type is distributed throughout the park in units ranging from 0.2 to 5 ha. Three of the four phases extend out of the Park, both along north and south boundaries.

**Classification Comments:** The Rich Northern Hardwood Forest community was originally divided into four variants in the 2005 vegetation map: typic, dry-mesic, fern glade, and successional. In the final 2007 vegetation map, the dry-mesic variant was renamed and mapped as Northern Hardwood Limestone Forest and the typic, successional and fern-glade variants were lumped into the Rich Northern Hardwood Forest map class. The fern glade version displayed a high cover of ferns, especially those indicating rich soils such as *Dryopteris goldiana* (Goldie's woodfern), *Matteuccia struthiopteris* (ostrich fern), and *Deparia acrostichoides* (silver false spleenwort). The Northern Hardwood Limestone Forest (dry-mesic variant in the 2005 map) has an abundance of *Ostrya virginiana* (hophornbeam) in the subcanopy, plus some *Quercus rubra* (northern red oak) in canopy. The herb layer often includes a greater diversity of upland woodland graminoids, especially *Carex* (sedge), and Asteraceae. Some herbs especially common in the drier sites include *Carex laxiflora* (broad looseflower sedge), *Piptatherum racemosum* (blackseed ricegrass), *Polystichum acrostichoides* (Christmas fern), and *Solidago caesia* (wreath goldenrod). Some species associated with ledges, such as *Aquilegia canadensis* (red columbine) and *Saxifraga virginensis* (early saxifrage), tend to occur in the dry-mesic version. This version occurs in drier landscape positions, especially steep (or oversteepened), rocky upper slopes or knolls. This rich northern hardwoods association is distinguished from the Northern Hardwood Forest type by the greater species richness in the herb layer and the higher cover of ferns in most plots.

**Other Comments:** Information not available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.20 and MABI.23; MABI.AA10 and MABI.AA59.

**Marsh-Billings-Rockefeller 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	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> Forest Alliance (A.217)
Alliance (English name)	Sugar Maple - White Ash - American Basswood Forest Alliance
Association	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> / <i>Acer spicatum</i> / <i>Caulophyllum thalictroides</i> Forest
Association (English name)	Sugar Maple - White Ash - American Basswood / Mountain Maple / Blue Cohosh Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwoods Forest (CES201.564).

### GLOBAL DESCRIPTION

**Concept Summary:** This rich sugar maple - white ash - basswood forest is found from the northeastern United States and Canada to the central Great Lakes area, south to the High Alleghenies of Virginia and West Virginia. Stands occur on nutrient-rich, mesic or wet-mesic settings on sloped to rolling terrain. Slope bottoms, where colluvium collects, are a common landscape position. The surface soils are deep sand, loamy sand, or loam and may be underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. Small (<1 ha) seep areas that may occur within these forests have soils that are usually saturated. This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is generally extensive. Bryoids are only a minor component of the ground layer, which is predominantly nitrogen-rich sugar maple leaves. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates, in small amounts. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, including many spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out. Fern richness is often high. Various sedges are present (particularly the Laxiflorae). These forests are differentiated from less-rich northern hardwood forests, e.g., *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252), primarily by their abundant and diverse herbaceous layer, as well as by the greater prominence of sugar maple and ash in the canopy and reduced importance of beech.

**Environmental Description:** In Virginia, stands occur on nutrient-rich, mesic or, sometimes, wet-mesic situations on flat to rolling terrain. The surface soils are deep sand, loamy sand, or loam and underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. In the northern Appalachian region, sites occur in enriched cove and concave slopes within northern hardwood forests. The

elevation of known examples ranges from 115-830 m (380-2,700 feet). Ground cover is deciduous litter, predominantly of nitrogen-rich sugar maple leaves.

**Vegetation Description:** This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is well-represented. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, much of which is spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out; *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel corn), *Hepatica* (hepatica) spp., *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Viola canadensis* (Canadian white violet), *Viola rotundifolia* (roundleaf yellow violet), *Actaea pachypoda* (white baneberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Panax quinquefolius* (American ginseng), *Sanguinaria canadensis* (bloodroot), and *Erythronium americanum* (dogtooth violet) are typical. Fern richness is often high, with characteristic species including *Adiantum pedatum* (northern maidenhair), *Cystopteris bulbifera* (bulblet bladderfern), *Deparia acrostichoides* (silver false spleenwort), *Dryopteris goldiana* (Goldie's woodfern), *Dryopteris filix-mas* (male fern), *Dryopteris marginalis* (marginal woodfern), *Botrychium virginianum* (rattlesnake fern), *Athyrium filix-femina* (common ladyfern), *Phegopteris hexagonoptera* (broad beechfern), and, especially in seepy spots, *Matteuccia struthiopteris* (ostrich fern). Various sedges are present (particularly the Laxiflorae group) such as *Carex laxiflora* (broad looseflower sedge), *Carex platyphylla* (broadleaf sedge), *Carex plantaginea* (plantainleaf sedge), *Carex leptonevia* (nerveless woodland sedge), *Carex hitchcockiana* (Hitchcock's sedge), *Carex aestivalis* (summer sedge), *Carex davisii* (Davis' sedge), *Carex bebbii* (Bebb's sedge), and others. The herbaceous flora in seeps often contains *Calamagrostis canadensis* (bluejoint), *Carex scabrata* (eastern rough sedge), *Ageratina altissima* (white snakeroot), *Glyceria melicaria* (melic mannagrass), *Impatiens capensis* (jewelweed) (sometimes *Impatiens pallida* [pale touch-me-not] as well), and *Solidago flexicaulis* (zigzag goldenrod).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Tree canopy	Broad-leaved deciduous tree	<i>Fraxinus americana</i> (white ash)
Tree subcanopy	Broad-leaved deciduous tree	<i>Ostrya virginiana</i> (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Cornus alternifolia</i> (alternateleaf dogwood) <i>Dirca palustris</i> (eastern leatherwood) <i>Hamamelis virginiana</i> (American witch-hazel) <i>Lonicera canadensis</i> (American fly honeysuckle) <i>Viburnum lantanoides</i> (hobblebush)
Herb (field)	Fern or fern ally	<i>Adiantum pedatum</i> (northern maidenhair) <i>Botrychium virginianum</i> (rattlesnake fern)

**Characteristic Species:** *Acer saccharum* (sugar maple), *Adiantum pedatum* (northern maidenhair), *Allium tricoccum* (wild leek), *Botrychium virginianum* (rattlesnake fern), *Cardamine diphylla* (crinkleroot), *Caulophyllum thalictroides* (blue cohosh), *Claytonia caroliniana* (Carolina springbeauty), *Dryopteris goldiana* (Goldie's woodfern), *Fraxinus americana* (white ash), *Milium effusum* (American milletgrass), *Phlox stolonifera* (creeping phlox), *Tiarella cordifolia* (heartleaf foamflower), *Tilia americana* (American basswood), *Viola blanda* (sweet white violet), *Viola canadensis* (Canadian white violet).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Cuscuta rostrata</i> (beaked dodder)	-	plant	VA S2
<i>Meleagris gallopavo</i> (wild turkey)	-	animal	
<i>Panax quinquefolius</i> (American ginseng)	G3G4	plant	

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** This forest association ranges generally from Ontario and New England west to Michigan and south to New Jersey and New York, with a discontinuous southward extension in the high Allegheny Mountains to western Virginia and eastern West Virginia.

**States/Provinces:** CT, MA, MD?, ME:S3, MI:S3, NB, NH, NJ:S2?, NY, ON, PA, RI, VA, VT:S4, WV.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Sleeping Bear Dunes, Upper Delaware); USFS (Finger Lakes, George Washington, Huron-Manistee, Huron?, Manistee, Ottawa, White Mountain).

**CONSERVATION STATUS**

**Rank:** G4? (28-Sep-2001).

**Reasons:** This community has a wide geographic distribution, but is locally distributed within its range due to specific requirements for mesic sites with fertile soils. In gentler topographic regions, many examples of this community have probably been destroyed for agriculture, and most remaining examples elsewhere have been altered by past logging. Consequently much of the remaining acreage is of variable quality.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** The attribution of this type to the Ridge and Valley subsection is based on the location of a single stand on the westernmost scarp slope of the Ridge Valley (east slope of Middle Mountain) at the Allegheny Front. The status of this association in Maryland is uncertain.

**Similar Associations:**

- *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest (CEGL006211).
- *Acer saccharum* - *Betula alleghaniensis* - (*Tilia americana*) Forest (CEGL002457).
- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252).
- *Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest (CEGL005004).

**Related Concepts:**

- *Acer saccharum* - *Tilia americana* - *Fagus grandifolia* / *Caulophyllum thalictroides* - *Viola blanda* - (*Allium tricoccum*) Forest (Fleming and Coulling 2001)
- *Acer saccharum* - *Tilia americana* / *Caulophyllum thalictroides* - *Laportea canadensis* Association (Fleming and Moorhead 1996)
- Dry-Mesic Calcareous Forest (Breden 1989)
- Mesic Northern Forest - Sugar Maple-Basswood (Chapman et al. 1989)
- Rich Northern Hardwood Forest (Thompson 1996)

- Rich northern hardwood forest (NAP pers. comm. 1998)
- SNE rich mesic forest (circumneutral to basic) (Rawinski 1984)
- Sugar Maple - Basswood: 26 (Eyre 1980)
- Sugar maple-white ash-basswood-bluebead cove forest (CAP pers. comm. 1998)

#### SOURCES

**Description Authors:** D. Faber-Langendoen, mod. L. Sneddon, G. Fleming, S. C. Gawler.

**References:** Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Chapman et al. 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Metzler and Barrett 2004, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



**Figure D14.** Northern Hardwood Limestone Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA10). September 2006. NAD 1983 / UTM easting 4834500, northing 698254.

## COMMON NAME (PARK-SPECIFIC): NORWAY SPRUCE PLANTATION

### SYNONYMS

**USNVC English Name:** Norway Spruce Planted Forest  
**USNVC Scientific Name:** *Picea abies* Planted Forest  
**USNVC Identifier:** CEGLO07167

### LOCAL INFORMATION

**Environmental Description:** This planted forest type generally occurs on deeper soils of lower slopes within the park. It is not tied to any particular soil type. In general these plantations have fertile, loamy soils that are less rocky than areas on the upper slopes and summits of the park's hills. Based on herbs present, some of the areas where this plantation type occurs were formerly rich woods, i.e., sugar maple - ash - basswood northern rich mesic forest.

**Vegetation Description:** This conifer plantation type includes some areas where the 100+-year-old *Picea abies* (Norway spruce) is over 60 cm dbh and over 25 m tall. *Picea abies* (Norway spruce) makes up 70-100% of the canopy, except in rare instances where it is codominant with *Pinus strobus* (eastern white pine). In some places where the trees are especially large, the canopy is beginning to break apart as trees naturally die. There is generally little conifer regeneration and abundant hardwood regeneration, especially *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash). The herb layer is variable. In some places with higher natural soil fertility, *Carex pedunculata* (longstalk sedge) forms almost a lawn, and *Luzula acuminata* (hairy woodrush), *Carex plantaginea* (plantainleaf sedge), *Dryopteris marginalis* (marginal woodfern), and *Milium effusum* (American milletgrass) are present. Native woodland composites, especially *Solidago caesia* (wreath goldenrod) and *Eurybia divaricata* (white wood aster), can also be common. The alien *Convallaria majalis* (European lily of the valley), which commonly spreads from old home sites, is abundant in places.

#### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Picea abies</i> (Norway spruce)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Fraxinus americana</i> (white ash)
Short shrub/sapling	Broad-leaved deciduous tree	<i>Acer pensylvanicum</i> (striped maple)
Herb (field)	Forb	<i>Convallaria majalis</i> (European lily of the valley)
Herb (field)	Graminoid	<i>Carex pedunculata</i> (longstalk sedge)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern)

**Characteristic Species:** Information not available.

#### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex plantaginea</i> (plantainleaf sedge)	-	plant	
<i>Eurybia divaricata</i> (white wood aster)	-	plant	
<i>Luzula acuminata</i> (hairy woodrush)	-	plant	
<i>Milium effusum</i> (American milletgrass)	-	plant	
<i>Solidago caesia</i> (wreath goldenrod)	-	plant	

#### Subnational Distribution with Crosswalk Data:

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

**Local Range:** Since these plantations occupy former agricultural lands (fields or pasture), they are mostly located near roads and habitations.

**Classification Comments:** Anthropogenic association.

**Other Comments:** *Picea abies* (Norway spruce) plantings occurred in 1880, 1887, 1913, and 1950. This association was noted in passing and not sampled in 2004. Overstory plots from Keeton provide data on the tree canopy.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA18, MABI.AA37, MABI.AA50, MABI.AA54; Keeton 4, 19, 52, 53, 54.

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	<i>Picea abies</i> Planted Forest Alliance (A.91)
Alliance (English name)	Norway Spruce Planted Forest Alliance
Association	<i>Picea abies</i> Planted Forest
Association (English name)	Norway Spruce Planted Forest
<b>Ecological System(s):</b>	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074).

### GLOBAL DESCRIPTION

**Concept Summary:** These plantation forests are dominated by the exotic species *Picea abies* (Norway spruce), which makes up 70-100% of the canopy. The understory is typically sparse with little, if any, spruce regeneration. Hardwood regeneration and herbaceous species composition tend to reflect the pre-plantation forest types. In the Southeast this occurs as experimental plantations.

**Environmental Description:** Information not available.

**Vegetation Description:** These plantation forests are dominated by the exotic species *Picea abies* (Norway spruce), which makes up 70-100% of the canopy. The understory is typically sparse with little, if any, spruce regeneration. Hardwood regeneration and herbaceous species composition tend to reflect the pre-plantation forest types.

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Picea abies</i> (Norway spruce)

**Characteristic Species:** *Picea abies* (Norway spruce).

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Picea abies</i> (Norway spruce)	-	plant	exotic

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** Information not available.

**States/Provinces:** DE, ME, NC, NJ, NY, PA, VA?, VT.

**Federal Lands:** NPS (C&O Canal?, Great Smoky Mountains?, Marsh-Billings-Rockefeller, Saratoga); USFWS (Aroostook, Erie, Iroquois, Supawna Meadows).

### CONSERVATION STATUS

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

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

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

**Similar Associations:** Information not available.

### Related Concepts:

- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B

### SOURCES

**Description Authors:** S. C. Gawler.

**References:** Allard 1990, NRCS 2004, Southeastern Ecology Working Group n.d.



**Figure D15.** Norway Spruce Plantation in Marsh-Billings-Rockefeller National Historical Park (MABI.AA18). September 2006. NAD 1983 / UTM easting 4834274, northing 697352.



**COMMON NAME (PARK-SPECIFIC): RED OAK - NORTHERN HARDWOOD FOREST**

**SYNONYMS**

**USNVC English Name:** Northern Red Oak - Sugar Maple - American Beech / Mapleleaf Viburnum Forest  
**USNVC Scientific Name:** *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest  
**USNVC Identifier:** CEG006173

**LOCAL INFORMATION**

**Environmental Description:** Restricted to a single 1.7 ha unit, this forest community is found on the mid to lower portions of smooth to concave, steep slopes with southeast to northeast exposures. The soil here is a very rocky, fine sandy loam derived from glacial till of generally mesic character. This unit includes a bedrock outcrop knoll with shallower soil.

**Vegetation Description:** As detailed in the global description, this forest community has a canopy of mature *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), and *Quercus rubra* (northern red oak), plus a minor component of *Tsuga canadensis* (eastern hemlock), *Fagus grandifolia* (American beech), and *Betula alleghaniensis* (yellow birch). The understory, both small tree/sapling and shrub layers, is moderately well-developed (25-50% cover). Prevalent understory plants are *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Acer pensylvanicum* (striped maple), and *Cornus alternifolia* (alternateleaf dogwood). The herb layer can be a quite lush ( $\pm 50\%$ ) mixture of ferns (*Polystichum acrostichoides* [Christmas fern], *Dryopteris marginalis* [marginal woodfern], and *Dennstaedtia punctilobula* [eastern hayscented fern]), forbs (*Solidago caesia* [wreath goldenrod], *Eurybia macrophylla* [bigleaf aster], and *Arisaema triphyllum* [Jack in the pulpit]), and sedges (*Carex* spp.).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Fraxinus americana</i> (white ash) <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Quercus rubra</i> (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Acer pensylvanicum</i> (striped maple) <i>Fagus grandifolia</i> (American beech)
Herb (field)	Forb	<i>Solidago caesia</i> (wreath goldenrod)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern) <i>Polystichum acrostichoides</i> (Christmas fern)

**Characteristic Species:** *Quercus rubra* (northern red oak).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex backii</i> (Back's sedge)	-	plant	rare/uncommon in New England

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S4	=	1	Mesic Red Oak-Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** Restricted to a single 1.7 ha unit on the east shoulder of Mount Tom. Extends out of the park along the southeast boundary.

**Classification Comments:** This community is very similar to the northern hardwood forest. The presence of *Quercus rubra* (northern red oak) in the canopy, plus some herbs, particularly *Solidago caesia* (wreath goldenrod), distinguish it from the northern hardwood forest.

**Other Comments:** Association was noted in passing and not sampled. More field observation/data is needed. No photograph available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** Lautzenheiser 40, MABI.AA66.

**Marsh-Billings-Rockefeller 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	<i>Quercus rubra</i> - ( <i>Acer saccharum</i> ) Forest Alliance (A.251)
Alliance (English name)	Northern Red Oak - (Sugar Maple) Forest Alliance
Association	<i>Quercus rubra</i> - <i>Acer saccharum</i> - <i>Fagus grandifolia</i> / <i>Viburnum acerifolium</i> Forest
Association (English name)	Northern Red Oak - Sugar Maple - American Beech / Mapleleaf Viburnum Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

### GLOBAL DESCRIPTION

**Concept Summary:** Transitional between temperate and boreal regions, these mesic forests of oak and northern hardwoods, sometimes mixed with hemlock or pine, are distributed across the glaciated northeastern United States. They occur on slightly acidic, well-drained loamy and often rocky soils of intermediate fertility, most often positioned on midslopes and coves. Soil depth is often shallow, but some stands occur on deep tills. Most are at low to mid elevations, usually under 520 m (1,700 feet), but in the southern portion of their distribution they may range up to 765 m (2,500 feet). The deciduous-to-mixed canopy is mostly closed, and the lower layers are variable in extent. Tall shrubs are well-represented, although scattered, with occasional denser patches. Herbs are sparse and bryoids are nearly absent. Ericads and other dwarf-shrubs are also nearly absent, a characteristic that distinguishes this association from most other red oak forests in the Northeast. Canopy composition is a variable mixture of *Quercus rubra* (northern red oak) (usually at least 30% of the canopy), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), and in some stands *Pinus strobus* (eastern white pine) or *Tsuga canadensis* (eastern hemlock). Conifers generally make up less than 20% of the canopy cover, and even in mixed stands the cover of deciduous trees exceeds that of conifers. Minor canopy associates include *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Juglans cinerea* (butternut), and *Ulmus americana* (American elm). *Acer pensylvanicum* (striped maple) is common as a small tree; in the central and southern portions of the distribution, *Cornus florida* (flowering dogwood) and *Prunus serotina* (black cherry) are common small trees as well. *Corylus cornuta* (beaked hazelnut), *Viburnum acerifolium* (mapleleaf viburnum), and *Hamamelis virginiana* (American witch-hazel) are standard shrubs, with *Kalmia latifolia* (mountain laurel) and *Lindera benzoin* (northern spicebush) occasional in all but the northern portions of the range. Typical species in the herb

layer include *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Aralia nudicaulis* (wild sarsaparilla), *Trientalis borealis* (starflower), *Uvularia sessilifolia* (sessileleaf bellwort), *Medeola virginiana* (Indian cucumber), *Brachyelytrum erectum* (bearded shorthusk), *Dryopteris intermedia* (intermediate woodfern), *Polystichum acrostichoides* (Christmas fern), *Dennstaedtia punctilobula* (eastern hayscented fern), *Pteridium aquilinum* (western brackenfern), and *Thelypteris noveboracensis* (New York fern). On more nutrient-rich soils, the herb layer may contain *Solidago caesia* (wreath goldenrod), *Caulophyllum thalictroides* (blue cohosh), *Dryopteris marginalis* (marginal woodfern), and *Eurybia divaricata* (white wood aster). This association is distinguished from northern hardwood forests by its greater amount of oak, from other oak forests by its greater prominence of northern hardwoods and lack of dwarf-shrub ericads, and from hemlock-hardwoods by the relatively low importance of hemlock.

**Environmental Description:** Transitional between temperate and boreal regions, these mesic forests of oak, beech, and maple are distributed across the glaciated northeastern United States. They occur on slightly acidic, well-drained loamy and often rocky soils of intermediate fertility, most often positioned on mid-slopes and coves. Soil depth is often shallow, but some occur on deep tills. Most are at low to mid elevations, usually under 520 m (1,700 feet), but in the southern portion of their distribution they may range up to 760 m (2,500 feet).

**Vegetation Description:** The deciduous-to-mixed canopy is mostly closed, and the lower layers are variable in extent. Tall shrubs are well represented, although scattered, with occasional denser patches. Herbs are sparse, and bryoids are nearly absent. Ericads and other dwarf-shrubs are also nearly absent, a characteristic that distinguishes this association from most other red oak forests in the Northeast. Canopy composition is a variable mixture of *Quercus rubra* (northern red oak) (usually at least 30% of the canopy), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), and, in some stands, *Pinus strobus* (eastern white pine) or *Tsuga canadensis* (eastern hemlock). In mixed stands, the cover of deciduous trees exceeds that of conifers. Minor canopy associates include *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Juglans cinerea* (butternut), and *Ulmus americana* (American elm). *Acer pensylvanicum* (striped maple) is common as a small tree; in the central and southern portions of the distribution, *Cornus florida* (flowering dogwood) and *Prunus serotina* (black cherry) are common small trees as well. *Corylus cornuta* (beaked hazelnut), *Viburnum acerifolium* (mapleleaf viburnum), and *Hamamelis virginiana* (American witch-hazel) are standard shrubs, with *Kalmia latifolia* (mountain laurel) and *Lindera benzoin* (northern spicebush) occasional in all but the northern portions of the range. Typical species in the herb layer include *Gaultheria procumbens* (eastern teaberry), *Maianthemum canadense* (Canada mayflower), *Aralia nudicaulis* (wild sarsaparilla), *Trientalis borealis* (starflower), *Uvularia sessilifolia* (sessileleaf bellwort), *Medeola virginiana* (Indian cucumber), *Brachyelytrum erectum* (bearded shorthusk), *Dryopteris intermedia* (intermediate woodfern), *Polystichum acrostichoides* (Christmas fern), *Dennstaedtia punctilobula* (eastern hayscented fern), *Pteridium aquilinum* (western brackenfern), and *Thelypteris noveboracensis* (New York fern). On more nutrient-rich soils, the herb layer may contain *Solidago caesia* (wreath goldenrod), *Caulophyllum thalictroides* (blue cohosh), and *Eurybia divaricata* (white wood aster).

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Fagus grandifolia</i> (American beech) <i>Quercus rubra</i> (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer pensylvanicum</i> (striped maple) <i>Cornus florida</i> (flowering dogwood) <i>Prunus serotina</i> (black cherry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Corylus cornuta</i> (beaked hazelnut), <i>Hamamelis virginiana</i> (American witch-hazel) <i>Viburnum acerifolium</i> (mapleleaf viburnum)
Herb (field)	Forb	<i>Aralia nudicaulis</i> (wild sarsaparilla) <i>Trientalis borealis</i> (starflower)
Herb (field)	Fern or fern ally	<i>Dennstaedtia punctilobula</i> (eastern hayscented fern)

**Characteristic Species:** *Acer pensylvanicum* (striped maple), *Acer rubrum* (red maple), *Aralia nudicaulis* (wild sarsaparilla), *Cornus florida* (flowering dogwood), *Corylus cornuta* (beaked hazelnut), *Dennstaedtia punctilobula* (eastern hayscented fern), *Hamamelis virginiana* (American witch-hazel), *Polystichum acrostichoides* (Christmas fern), *Prunus serotina* (black cherry), *Pteridium aquilinum* (western brackenfern), *Quercus rubra* (northern red oak), *Trientalis borealis* (starflower), *Viburnum acerifolium* (mapleleaf viburnum).

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

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This association occurs in New England and adjacent Canada and in New Jersey.

**States/Provinces:** MA, ME:S4, NB, NH, NJ, NY, PA, RI, VT:S4.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Minute Man, Saratoga); USFS (Finger Lakes); USFWS (Iroquois).

### CONSERVATION STATUS

**Rank:** G4G5 (7-Dec-2005).

**Reasons:** This association is well-distributed in the northeastern U.S. in its large-patch setting.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

### Similar Associations:

- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252).
- *Acer saccharum* - *Betula alleghaniensis* - *Quercus rubra* / *Viburnum acerifolium* Forest (CEGL006943).
- *Acer saccharum* - *Pinus strobus* / *Acer pensylvanicum* Forest (CEGL005005).
- *Pinus strobus* - *Quercus (rubra, velutina)* - *Fagus grandifolia* Forest (CEGL006293).
- *Quercus rubra* - *Acer rubrum* - *Betula* spp. - *Pinus strobus* Forest (CEGL006506).
- *Quercus rubra* - *Acer saccharum* - *Tilia americana* var. *heterophylla* - *Aesculus flava* - (*Cladrastis kentukea*) Forest (CEGL007698).
- *Quercus rubra* - *Acer saccharum* Forest (CEGL002461).
- *Quercus rubra* - *Quercus alba* - (*Quercus velutina*, *Acer rubrum*) / *Viburnum acerifolium* Forest (CEGL002462).
- *Tsuga canadensis* - *Betula alleghaniensis* - *Acer saccharum* / *Dryopteris intermedia* Forest (CEGL006109).
- *Tsuga canadensis* - *Fagus grandifolia* - *Quercus rubra* Forest (CEGL006088).

**Related Concepts:**

- CNE mesic hardwood forest on acidic bedrock/till (Rawinski 1984)
- Mesic Red Oak-Northern Hardwood Forest (Thompson 1996)
- Northern Red Oak: 55 (Eyre 1980)

**SOURCES**

**Description Authors:** S. C. Gawler.

**References:** Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Gawler 2002, Metzler and Barrett 2001, NRCS 2004, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

No photograph available.



**COMMON NAME (PARK-SPECIFIC): RED OAK - NORTHERN HARDWOOD  
WOODLAND**

**SYNONYMS**

**USNVC English Name:** Sugar Maple - American Basswood - White Ash /  
Hophornbeam / Robert's Geranium Woodland  
**USNVC Scientific Name:** *Acer saccharum* - *Tilia americana* - *Fraxinus americana* / *Ostrya virginiana* / *Geranium robertianum* Woodland  
**USNVC Identifier:** C EGL005058

**LOCAL INFORMATION**

**Environmental Description:** This woodland community is associated with shallow soils over convex, moderate to steep, east-facing phyllite and quartzite outcrops on the east shoulder of Mount Tom. This bedrock, with its occasional thin layers of limestone, produces localized enrichment, though soils on the outcrops are quite acidic (pH 5.0). Because of the exposed bedrock and shallow soils, the vegetation in this community is likely subject to mortality during droughts. This might be one factor in maintaining the broken canopy.

**Vegetation Description:** The canopy in this woodland is very broken, consisting of somewhat stunted *Quercus rubra* (northern red oak), *Ostrya virginiana* (hophornbeam), *Acer saccharum* (sugar maple), and *Fraxinus americana* (white ash). A shrub layer is generally lacking, though *Rubus* (blackberry) spp. are scattered throughout. Heaths are noticeably absent. *Deschampsia flexuosa* (wavy hairgrass) clearly dominates the well-developed (>50%) herb layer, with a modest diversity of other herbs present, especially *Dryopteris marginalis* (marginal woodfern), *Carex communis* (fibrousroot sedge), *Maianthemum canadense* (Canada mayflower), and *Polygonatum pubescens* (hairy Solomon's seal). Patches of *Polytrichum* moss are frequent though never extensive.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple), <i>Fraxinus americana</i> (white ash) <i>Ostrya virginiana</i> (hophornbeam) <i>Quercus rubra</i> (northern red oak)
Herb (field)	Graminoid	<i>Carex communis</i> (fibrousroot sedge) <i>Deschampsia flexuosa</i> (wavy hairgrass)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern)

**Characteristic Species:** *Ostrya virginiana* (hophornbeam), *Polygonum cilinode* (fringed black bindweed), *Quercus rubra* (northern red oak), *Schizachne purpurascens* (false melic).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Erechtites hieraciifolia</i> (American burnweed)	-	plant	
<i>Hieracium paniculatum</i> (Allegheny hawkweed)	-	plant	

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S3*	B	.	Northern Hardwood Talus Woodland	Thompson and Sorenson 2000

**Local Range:** This tiny piece of woodland in the park extends west on the east shoulder of Mount Tom for at least 200 m into Billings Park. It covers a total area of one hectare or more.

**Classification Comments:** This woodland in the park and adjacent Billings Park (town park) is intermediate between Red Oak - Northern Hardwood Woodland (as classified) and Red Oak -

Heath Woodland / Rocky Summit (CEGL006134). Its *Ostrya virginiana* (hophornbeam) and some herbs indicative of fertile soils, as well as the lack of heath shrubs, place it as Red Oak - Northern Hardwood Woodland. Also, *Geranium robertianum* (Robert geranium) and other rich woods indicator species do occur below this outcrop area. However, the dominance of *Deschampsia flexuosa* (wavy hairgrass) and lack of real calciphiles is more suggestive of the Red Oak - Heath Woodland.

**Other Comments:** Entire Mount Tom summit, including this woodland, likely subject to 19th century grazing and fires.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.01; MABI.AA67.

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Deciduous woodland (II.B.)
Physiognomic Group	Cold-deciduous woodland (II.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous woodland (II.B.2.N.)
Formation	Cold-deciduous woodland (II.B.2.N.a.)
Alliance	<i>Tilia americana</i> - <i>Fraxinus americana</i> - ( <i>Acer saccharum</i> ) Woodland Alliance (A.628)
Alliance (English name)	American Basswood - White Ash - (Sugar Maple) Woodland Alliance
Association	<i>Acer saccharum</i> - <i>Tilia americana</i> - <i>Fraxinus americana</i> / <i>Ostrya virginiana</i> / <i>Geranium robertianum</i> Woodland
Association (English name)	Sugar Maple - American Basswood - White Ash / Hophornbeam / Robert's Geranium Woodland
<b>Ecological System(s):</b>	Central Interior Calcareous Cliff and Talus (CES202.690) Laurentian-Acadian Calcareous Cliff and Talus (CES201.570) North-Central Appalachian Circumneutral Cliff & Talus (203.603).

### GLOBAL DESCRIPTION

**Concept Summary:** These open, circumneutral woodlands range from the Great Lakes to the Northern Appalachians and Lower New England regions. They typically occur on talus and colluvial slopes where soils are derived from circumneutral to calcareous bedrock, and often extend upslope onto ridges and low summits. The elevation range is from about 150 to 610 m (500-2,000 feet) with most occurrences below 365 m (1,200 feet), and southerly exposure is common. Soils are thin, patchy and dry. The hardwood canopy is very patchy, with open talus interspersed with wooded areas. Even the wooded areas generally have an open canopy, and canopy closure overall is usually less than 50%, often with stunted trees. Shrubs and herbs are scattered where soil is available; vines are unusually well-represented. Herb cover may be locally extensive on stabilized areas. The bryoid layer is very minor and varies from patches of lichens on the open talus to sparse mosses in wooded areas. The ground cover is boulder talus and deciduous litter. Canopy dominants are typically *Acer saccharum* (sugar maple) and *Quercus rubra* (northern red oak), with the characteristic but usually subordinate species *Ostrya virginiana* (hophornbeam), *Fraxinus americana* (white ash), and *Tilia americana* (American basswood). Where shrubs are even present, they are scattered and clumped and include *Cornus rugosa* (roundleaf dogwood), *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Rubus odoratus* (purpleflowering raspberry), *Corylus cornuta* (beaked hazelnut),

*Viburnum acerifolium* (mapleleaf viburnum), *Staphylea trifolia* (American bladdernut), and *Ribes* (currant) spp. Vines are locally abundant on talus. Rich-site herbs indicative of these talus slopes include *Asplenium platyneuron* (ebony spleenwort), *Polystichum braunii* (Braun's hollyfern), *Aralia racemosa* (American spikenard), *Saxifraga virginensis* (early saxifrage), *Geranium robertianum* (Robert geranium), *Arabis drummondii* (Drummond's rockcress), *Asarum canadense* (Canadian wildginger), *Carex rosea* (rosy sedge), *Carex sprengei* (Sprengel's sedge), *Carex platyphylla* (broadleaf sedge), and *Piptatherum racemosum* (blackseed ricegrass). This association is distinguished from other deciduous talus and low summit woodlands by the presence of enriched-site species such as *Tilia americana* (American basswood) and *Juglans cinerea* (butternut) in the canopy, and the characteristic rich-site herb species listed above. However, sites do occur that are intermediate between this type and the more acidic oak-birch talus woodland, *Betula alleghaniensis* - *Quercus rubra* / *Polypodium virginianum* Woodland (CEGL006320).

**Environmental Description:** Stands occur on talus and colluvial slopes where soils are derived from circumneutral to calcareous bedrock, and often extend upslope onto ridges and low summits. The elevation range is from about 150 to 610 m (500-2,000 feet) with most occurrences below 370 m (1,200 feet), and southerly exposure is common. Soils are thin, patchy, and dry.

**Vegetation Description:** The hardwood canopy is very patchy, with open talus interspersed with wooded areas. Even the wooded areas generally have an open canopy, and canopy closure overall is usually less than 50%. Shrubs and herbs are scattered where soil is available; vines are unusually well represented. Herb cover may be locally extensive on stabilized areas. The bryoid layer is very minor, and varies from patches of lichens on the open talus to sparse mosses in wooded areas. The ground cover is boulder talus and deciduous litter. Canopy dominants are typically *Acer saccharum* (sugar maple) and *Quercus rubra* (northern red oak), with the characteristic but usually subordinate species *Ostrya virginiana* (hophornbeam), *Fraxinus americana* (white ash), and *Tilia americana* (American basswood). Other canopy associates include *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Betula papyrifera* (paper birch), *Betula alleghaniensis* (yellow birch), *Juglans cinerea* (butternut), and *Ulmus rubra* (slippery elm). Where shrubs are even present, they are scattered and clumped and include *Cornus rugosa* (roundleaf dogwood), *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Rubus odoratus* (purpleflowering raspberry), *Corylus cornuta* (beaked hazelnut), *Viburnum acerifolium* (mapleleaf viburnum), *Staphylea trifolia* (American bladdernut), and *Ribes* (currant) spp. Vines are locally abundant on talus and include *Parthenocissus quinquefolia* (Virginia creeper), *Parthenocissus vitacea* (woodbine), *Toxicodendron radicans* (eastern poison-ivy), *Clematis virginiana* (devil's darning needles), *Clematis occidentalis* (western blue virginsbower), *Adlumia fungosa* (allegheny vine), *Celastrus scandens* (American bittersweet), and *Polygonum cilinode* (fringed black bindweed). Rich-site herbs indicative of these talus slopes include *Asplenium platyneuron* (ebony spleenwort), *Polystichum braunii* (Braun's hollyfern), *Aralia racemosa* (American spikenard), *Saxifraga virginensis* (early saxifrage), *Geranium robertianum* (Robert geranium), *Arabis drummondii* (Drummond's rockcress), *Asarum canadense* (Canadian wildginger), *Carex rosea* (rosy sedge), *Carex sprengei* (Sprengel's sedge), *Carex platyphylla* (broadleaf sedge), and *Piptatherum racemosum* (blackseed ricegrass). Also present, and less restricted to circumneutral conditions, are *Cystopteris bulbifera* (bulblet bladderfern), *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (fibrousroot sedge), *Deschampsia flexuosa* (wavy hairgrass), *Schizachne purpurascens* (false melic),

*Hepatica nobilis* var. *obtusata* (roundlobe hepatica), *Dryopteris marginalis* (marginal woodfern), *Polypodium virginianum* (rock polypody), and *Athyrium filix-femina* (common ladyfern).

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Quercus rubra</i> (northern red oak)
Herb (field)	Graminoid	<i>Carex pensylvanica</i> (Pennsylvania sedge) <i>Deschampsia flexuosa</i> (wavy hairgrass)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern)

**Characteristic Species:** *Arabis drummondii* (Drummond's rockcress), *Aralia racemosa* (American spikenard), *Asarum canadense* (Canadian wildginger), *Asplenium platyneuron* (ebony spleenwort), *Carex platyphylla* (broadleaf sedge), *Carex rosea* (rosy sedge), *Carex sprengei* (Sprengel's sedge), *Fraxinus americana* (white ash), *Geranium robertianum* (Robert geranium), *Ostrya virginiana* (hophornbeam), *Polystichum braunii* (Braun's hollyfern), *Saxifraga virginiana* (early saxifrage), *Tilia americana* (American basswood).

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

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

**Range:** Information not available.

**States/Provinces:** CT, MA, ME:S2S3, NB, NH, NJ, NY, ON, VT, WI.

**Federal Lands:** NPS (Apostle Islands, Marsh-Billings-Rockefeller).

**CONSERVATION STATUS**

**Rank:** G3G5 (15-Dec-1994).

**Reasons:** Information not available.

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

**Similar Associations:**

- *Acer saccharum* - *Fraxinus americana* - *Juglans cinerea* / *Staphylea trifolia* / *Adlumia fungosa* Forest (CEGL006577).
- *Betula alleghaniensis* - *Quercus rubra* / *Polypodium virginianum* Woodland (CEGL006320).

**Related Concepts:**

- Northern Hardwoods Talus Woodland (Thompson 1996)
- Rich talus slope woodland (NAP pers. comm. 1998)
- SNE Circumneutral Talus Forest/Woodland (Rawinski 1984)

**SOURCES**

**Description Authors:** S. C. Gawler.

**References:** Eastern Ecology Working Group n.d., Edinger et al. 2002, Gawler 2002, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



**Figure D16.** Red Oak - Northern Hardwood Woodland in Marsh-Billings-Rockefeller National Historical Park (MABI.01). September 2004. NAD 1983 / UTM easting 4833942, northing 699716.



**Figure D17.** Red Oak - Northern Hardwood Woodland in Marsh-Billings-Rockefeller National Historical Park (MABI.AA67). September 2006. NAD 1983 / UTM easting 4833946, northing 699726.



**COMMON NAME (PARK-SPECIFIC): RED PINE PLANTATION**

**SYNONYMS**

**USNVC English Name:** Red Pine Planted Forest  
**USNVC Scientific Name:** *Pinus resinosa* Planted Forest  
**USNVC Identifier:** C EGL007177

**LOCAL INFORMATION**

**Environmental Description:** This planted forest type is not tied to any particular soil type. It generally occurs on fertile, loamy soils that are less rocky than some areas in the park and occupies a variety of topographic positions and slopes with various aspects.

**Vegetation Description:** A canopy dominated by mature *Pinus resinosa* (red pine) (80-100% of the canopy) planted in post-agricultural fields and pastures is the primary characteristic. Under this mature canopy and in gaps, the hardwoods *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), and *Fraxinus americana* (white ash), and the conifers *Tsuga canadensis* (eastern hemlock), *Picea abies* (Norway spruce), and *Pinus strobus* (eastern white pine) are regenerating and will eventually replace the pine in the canopy unless another planting cycle intervenes. *Acer pensylvanicum* (striped maple) is a common small tree in the understory. Shrubs are few. Herbs are principally native herbs of the surrounding hemlock - northern hardwood forest and various northern hardwood forest associations, plus several widespread alien species.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus resinosa</i> (red pine)
Shrub/sapling	Needle-leaved tree	<i>Tsuga canadensis</i> (eastern hemlock)
(tall & short)	Broad-leaved deciduous tree	<i>Acer pensylvanicum</i> (striped maple)
		<i>Acer saccharum</i> (sugar maple)
		<i>Fagus grandifolia</i> (American beech)
		<i>Fraxinus americana</i> (white ash)

**Characteristic Species:** *Pinus resinosa* (red pine).

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

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** All of the *Pinus resinosa* (red pine) plantations are in the western half of the park.

**Classification Comments:** Anthropogenic association.

**Other Comments:** The red pines were planted in 1917 and 1952. This association was noted in passing and not sampled in 2004. Overstory plots from Keeton provide data on the tree canopy.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA03, MABI.AA30, MABI.AA39; Keeton 20, 21, 22, 55, 56, 57, 58, 60, 61.

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	<i>Pinus resinosa</i> Planted Forest Alliance (A.97)
Alliance (English name)	Red Pine Planted Forest Alliance
Association	<i>Pinus resinosa</i> Planted Forest
Association (English name)	Red Pine Planted Forest
<b>Ecological System(s):</b>	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074).

### GLOBAL DESCRIPTION

**Concept Summary:** Plantations of *Pinus resinosa* (red pine) occur in various settings and soil types. *Pinus resinosa* (red pine) makes up 80-100% of the canopy. In older stands, or in canopy gaps, native regeneration includes hardwoods such as *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), and *Fagus grandifolia* (American beech), as well as the conifers *Pinus strobus* (eastern white pine), *Picea rubens* (red spruce), and/or *Tsuga canadensis* (eastern hemlock). *Acer pensylvanicum* (striped maple) may be present as a small tree. Shrubs and herbs are typically few.

**Environmental Description:** Plantations of *Pinus resinosa* (red pine) occur in various settings and soil types.

**Vegetation Description:** *Pinus resinosa* (red pine) makes up 80-100% of the canopy. In older stands, or in canopy gaps, native regeneration includes hardwoods such as *Acer rubrum* (red maple), *Acer saccharum* (sugar maple), and *Fagus grandifolia* (American beech), as well as the conifers *Pinus strobus* (eastern white pine), *Picea rubens* (red spruce), and/or *Tsuga canadensis* (eastern hemlock). *Acer pensylvanicum* (striped maple) may be present as a small tree. Shrubs and herbs are typically few.

### Most Abundant Species:

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

**Characteristic Species:** *Pinus resinosa* (red pine).

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

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** Information not available.

**States/Provinces:** DE, MD, ME, NC, NY, VA, VT, WV.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller); USFS (George Washington, Monongahela); USFWS (Aroostook, Moosehorn).

### CONSERVATION STATUS

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

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

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** In the southern portion of the range, these plantations are known from the Laurel Fork area of the Warm Springs Ranger District; in New England, they are scattered and generally small.

**Similar Associations:** Information not available.

### Related Concepts:

- Coniferous Plantation (Fleming and Moorhead 1996) ?
- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B

## SOURCES

**Description Authors:** S. C. Gawler.

**References:** Allard 1990, Coxe 2008, Fleming and Coulling 2001, Fleming and Moorhead 1996, Southeastern Ecology Working Group n.d.



**Figure D18.** Red Pine Plantation in Marsh-Billings-Rockefeller National Historical Park (MABI.AA39). September 2006. NAD 1983 / UTM easting 4833705, northing 698370.



**COMMON NAME (PARK-SPECIFIC): RICH NORTHERN HARDWOOD FOREST**

**SYNONYMS**

**USNVC English Name:** Sugar Maple - White Ash - American Basswood / Mountain Maple / Blue Cohosh Forest

**USNVC Scientific Name:** *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest

**USNVC Identifier:** CEGLO05008

**LOCAL INFORMATION**

**Environmental Description:** This community most frequently is associated with toeslopes and concavities, especially so-called coves, as in a bowl set into a slope. Calcareous ledges or ledges containing calcareous layers are frequently associated with the community. Downslope movement of nutrients and moisture is likely a critical process in the creation of soils with pH values ranging from 5.8-6.8 and well-developed, humus-rich, A horizons, usually 10-15 cm thick, and sometimes as thick as 24 cm. The Northern Hardwood Limestone Forest is a dry-mesic version of this community. It occurs on the upper, over-steepened slope of West Ridge and on a very localized rocky knoll west of Mount Tom's summit on limestone. The fern glade version is almost always found in coves and on toeslopes.

**Vegetation Description:** A high (20-35 m) canopy dominated by *Acer saccharum* (sugar maple) is highly characteristic of the community. *Tilia americana* (American basswood) and *Fraxinus americana* (white ash) are also frequently present in the canopy, and indicator species, such as *Juglans cinerea* (butternut) and *Ulmus rubra* (slippery elm), are occasionally present. The subcanopy and shrub/sapling layers are poorly developed for the most part, though in the Northern Hardwood Limestone Forest (a dry-mesic variant of this association) *Ostrya virginiana* (hophornbeam) forms a substantial subcanopy. The herb layer provides the best characterization of the community, not only forming quite abundant cover; but also being diverse and containing several to many indicator species. The most common, though not usually of great abundance, indicator species are *Actaea pachypoda* (white baneberry), *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Piptatherum racemosum* (blackseed ricegrass). Spring ephemerals, such as *Allium tricoccum* (wild leek), *Dicentra canadensis* (squirrel corn), *Dicentra cucullaria* (Dutchman's breeches), *Claytonia caroliniana* (Carolina springbeauty), and *Erythronium americanum* (dogtooth violet), are likely present in these rich woods but were generally not visible during the period of survey. Only fruiting stalks and underground parts of the first two species were observed during field work. Some less common, and often regionally rare or uncommon, indicator species observed include *Carex albursina* (white bear sedge), *Carex backii* (Back's sedge), *Carex hitchcockiana* (Hitchcock's sedge), *Diplazium pycnocarpon* (glade fern), *Dryopteris goldiana* (Goldie's woodfern), and *Galearis spectabilis* (showy orchid). Some of the most common and abundant species in this community, especially *Arisaema triphyllum* (Jack in the pulpit), *Dryopteris marginalis* (marginal woodfern), and *Eurybia divaricata* (white wood aster), are also species common to the northern hardwood community.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Tilia americana</i> (American basswood)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Ostrya virginiana</i> (hophornbeam)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Sambucus racemosa</i> var. <i>racemosa</i> (red elderberry)
Herb (field)	Forb	<i>Arisaema triphyllum</i> (Jack in the pulpit) <i>Eurybia divaricata</i> (white wood aster) <i>Prenanthes altissima</i> (tall rattlesnakeroot)
Herb (field)	Graminoid	<i>Piptatherum racemosum</i> (blackseed ricegrass)
Herb (field)	Fern or fern ally	<i>Dryopteris marginalis</i> (marginal woodfern)

**Characteristic Species:** *Actaea pachypoda* (white baneberry), *Ageratina altissima* (white snakeroot), *Caulophyllum thalictroides* (blue cohosh), *Dicentra canadensis* (squirrel corn), *Elymus hystrix* (eastern bottlebrush grass), *Geranium robertianum* (Robert geranium), *Juglans cinerea* (butternut), *Matteuccia struthiopteris* (ostrich fern), *Sanguinaria canadensis* (bloodroot), *Ulmus rubra* (slippery elm), *Viola canadensis* (Canadian white violet), *Viola selkirkii* (Selkirk's violet).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex albursina</i> (white bear sedge)	-	plant	uncommon in New England
<i>Carex backii</i> (Back's sedge)	-	plant	rare/uncommon in New England
<i>Carex hitchcockiana</i> (Hitchcock's sedge)	-	plant	rare/uncommon in New England
<i>Diplazium pycnocarpon</i> (glade fern)	-	plant	
<i>Dryopteris goldiana</i> (Goldie's woodfern)	-	plant	
<i>Galearis spectabilis</i> (showy orchid)	-	plant	

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S4	=	1	Rich Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** This forest type is distributed throughout the park in units ranging from 0.2 to 5 ha. Three of the four phases extend out of the Park, both along north and south boundaries.

**Classification Comments:** This community was initially divided into four variants in the 2005 vegetation map: typical, dry-mesic, fern glade, and successional. In the final 2007 vegetation map, the dry-mesic variant was renamed and mapped as Northern Hardwood Limestone Forest and the typical, successional and fern-glade variants were lumped into the Rich Northern Hardwood Forest map class. The fern glade version displayed a high cover of ferns, especially those indicating rich soils such as *Dryopteris goldiana* (Goldie's woodfern), *Matteuccia struthiopteris* (ostrich fern), and *Deparia acrostichoides* (silver false spleenwort). The Northern Hardwood Limestone Forest (dry-mesic variant in the 2005 map) has an abundance of *Ostrya virginiana* (hophornbeam) in the subcanopy, plus some *Quercus rubra* (northern red oak) in canopy. The herb layer often includes a greater diversity of upland woodland graminoids, especially *Carex* (sedge), and Asteraceae. Some herbs especially common in the drier sites include *Carex laxiflora* (broad looseflower sedge), *Piptatherum racemosum* (blackseed ricegrass), *Polystichum acrostichoides* (Christmas fern), and *Solidago caesia* (wreath goldenrod). Some species associated with ledges, such as *Aquilegia canadensis* (red columbine) and *Saxifraga virginiana* (early saxifrage), tend to occur in the dry-mesic version. This version occurs in drier landscape positions, especially steep (or oversteepened), rocky upper slopes or knolls. This rich northern hardwoods association is distinguished from the Northern Hardwood Forest type by the greater species richness in the herb layer and the higher cover of ferns in most plots.

**Other Comments:** Information not available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.02, MABI.08, MABI.18, MABI.19, MABI.20, MABI.23; MABI.AA44; MABI.AA45, MABI.AA58; Lautzenheiser 22, 23, 31

**Marsh-Billings-Rockefeller 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	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> Forest Alliance (A.217)
Alliance (English name)	Sugar Maple - White Ash - American Basswood Forest Alliance
Association	<i>Acer saccharum</i> - <i>Fraxinus americana</i> - <i>Tilia americana</i> / <i>Acer spicatum</i> / <i>Caulophyllum thalictroides</i> Forest
Association (English name)	Sugar Maple - White Ash - American Basswood / Mountain Maple / Blue Cohosh Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Hardwoods Forest (CES201.564).

### GLOBAL DESCRIPTION

**Concept Summary:** This rich sugar maple - white ash - basswood forest is found from the northeastern United States and Canada to the central Great Lakes area, south to the High Alleghenies of Virginia and West Virginia. Stands occur on nutrient-rich, mesic or wet-mesic settings on sloped to rolling terrain. Slope bottoms, where colluvium collects, are a common landscape position. The surface soils are deep sand, loamy sand, or loam and may be underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. Small (<1 ha) seep areas that may occur within these forests have soils that are usually saturated. This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is generally extensive. Bryoids are only a minor component of the ground layer, which is predominantly nitrogen-rich sugar maple leaves. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates, in small amounts. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, including many spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out. Fern richness is often high. Various sedges are present (particularly the Laxiflorae). These forests are differentiated from less-rich northern hardwood forests, e.g., *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252), primarily by their abundant and diverse herbaceous layer, as well as by the greater prominence of sugar maple and ash in the canopy and reduced importance of beech.

**Environmental Description:** In Virginia, stands occur on nutrient-rich, mesic or, sometimes, wet-mesic situations on flat to rolling terrain. The surface soils are deep sand, loamy sand, or loam and underlain by sandy clay loam to clay loam. The sites are somewhat poorly drained to well-drained and can have a water table 0.4-2 m below the surface. In the northern Appalachian region, sites occur in enriched cove and concave slopes within northern hardwood forests. The elevation of known examples ranges from 115-830 m (380-2,700 feet). Ground cover is deciduous litter, predominantly of nitrogen-rich sugar maple leaves.

**Vegetation Description:** This forest community has a well-developed tree canopy composed of deciduous species. Shrubs are scattered, but the herbaceous stratum is well-represented. *Acer saccharum* (sugar maple) and *Fraxinus americana* (white ash) are the dominant trees; *Tilia americana* (American basswood) is frequent but not necessarily abundant. *Ostrya virginiana* (hophornbeam) is very common as a small tree. *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Prunus serotina* (black cherry) are typical associates. *Ulmus rubra* (slippery elm) and *Juglans cinerea* (butternut) are occasional. Shrubs that may be found in this community include *Cornus alternifolia* (alternateleaf dogwood), *Viburnum lantanoides* (hobblebush), *Hamamelis virginiana* (American witch-hazel), *Dirca palustris* (eastern leatherwood), and *Lonicera canadensis* (American fly honeysuckle). The ground flora, much of which is spring ephemerals, is diverse and consists primarily of nutrient- and light-requiring species. Many of these flower and fruit early in the spring before the tree canopy has fully leafed out; *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel corn), *Hepatica* (hepatica) spp., *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Viola canadensis* (Canadian white violet), *Viola rotundifolia* (roundleaf yellow violet), *Actaea pachypoda* (white baneberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Panax quinquefolius* (American ginseng), *Sanguinaria canadensis* (bloodroot), and *Erythronium americanum* (dogtooth violet) are typical. Fern richness is often high, with characteristic species including *Adiantum pedatum* (northern maidenhair), *Cystopteris bulbifera* (bulblet bladderfern), *Deparia acrostichoides* (silver false spleenwort), *Dryopteris goldiana* (Goldie's woodfern), *Dryopteris filix-mas* (male fern), *Dryopteris marginalis* (marginal woodfern), *Botrychium virginianum* (rattlesnake fern), *Athyrium filix-femina* (common ladyfern), *Phegopteris hexagonoptera* (broad beechfern), and, especially in seepy spots, *Matteuccia struthiopteris* (ostrich fern). Various sedges are present (particularly the Laxiflorae group) such as *Carex laxiflora* (broad looseflower sedge), *Carex platyphylla* (broadleaf sedge), *Carex plantaginea* (plantainleaf sedge), *Carex leptonevia* (nerveless woodland sedge), *Carex hitchcockiana* (Hitchcock's sedge), *Carex aestivalis* (summer sedge), *Carex davisii* (Davis' sedge), *Carex bebbii* (Bebb's sedge), and others. The herbaceous flora in seeps often contains *Calamagrostis canadensis* (bluejoint), *Carex scabrata* (eastern rough sedge), *Ageratina altissima* (white snakeroot), *Glyceria melicaria* (melic mannagrass), *Impatiens capensis* (jewelweed) (sometimes *Impatiens pallida* (pale touch-me-not) as well), and *Solidago flexicaulis* (zigzag goldenrod).

### Most Abundant Species:

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Tree canopy	Broad-leaved deciduous tree	<i>Fraxinus americana</i> (white ash)
Tree subcanopy	Broad-leaved deciduous tree	<i>Ostrya virginiana</i> (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Cornus alternifolia</i> (alternateleaf dogwood)
		<i>Dirca palustris</i> (eastern leatherwood)
		<i>Hamamelis virginiana</i> (American witch-hazel)
		<i>Lonicera canadensis</i> (American fly honeysuckle)
		<i>Viburnum lantanoides</i> (hobblebush)
Herb (field)	Fern or fern ally	<i>Adiantum pedatum</i> (northern maidenhair)
		<i>Botrychium virginianum</i> (rattlesnake fern)

**Characteristic Species:** *Acer saccharum* (sugar maple), *Adiantum pedatum* (northern maidenhair), *Allium tricoccum* (wild leek), *Botrychium virginianum* (rattlesnake fern), *Cardamine diphylla* (crinkleroot), *Caulophyllum thalictroides* (blue cohosh), *Claytonia caroliniana* (Carolina springbeauty), *Dryopteris goldiana* (Goldie's woodfern), *Fraxinus americana* (white ash), *Milium effusum* (American milletgrass), *Phlox stolonifera* (creeping phlox), *Tiarella cordifolia* (heartleaf foamflower), *Tilia americana* (American basswood), *Viola blanda* (sweet white violet), *Viola canadensis* (Canadian white violet).

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Cuscuta rostrata</i> (beaked dodder)	-	plant	VA S2
<i>Meleagris gallopavo</i> (wild turkey)	-	animal	
<i>Panax quinquefolius</i> (American ginseng)	G3G4	plant	

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This forest association ranges generally from Ontario and New England west to Michigan and south to New Jersey and New York, with a discontinuous southward extension in the high Allegheny Mountains to western Virginia and eastern West Virginia.

**States/Provinces:** CT, MA, MD?, ME:S3, MI:S3, NB, NH, NJ:S2?, NY, ON, PA, RI, VA, VT:S4, WV.

**Federal Lands:** NPS (Marsh-Billings-Rockefeller, Sleeping Bear Dunes, Upper Delaware); USFS (Finger Lakes, George Washington, Huron-Manistee, Huron?, Manistee, Ottawa, White Mountain).

### CONSERVATION STATUS

**Rank:** G4? (28-Sep-2001).

**Reasons:** This community has a wide geographic distribution, but is locally distributed within its range due to specific requirements for mesic sites with fertile soils. In gentler topographic regions, many examples of this community have probably been destroyed for agriculture, and most remaining examples elsewhere have been altered by past logging. Consequently much of the remaining acreage is of variable quality.

### CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** The attribution of this type to the Ridge and Valley subsection is based on the location of a single stand on the westernmost scarp slope of the Ridge Valley (east slope of Middle Mountain) at the Allegheny Front. The status of this association in Maryland is uncertain.

### Similar Associations:

- *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest (CEGL006211).
- *Acer saccharum* - *Betula alleghaniensis* - (*Tilia americana*) Forest (CEGL002457).
- *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest (CEGL006252).
- *Acer saccharum* - *Fagus grandifolia* - *Betula* spp. / *Maianthemum canadense* Forest (CEGL005004).

### Related Concepts:

- *Acer saccharum* - *Tilia americana* - *Fagus grandifolia* / *Caulophyllum thalictroides* - *Viola blanda* - (*Allium tricoccum*) Forest (Fleming and Coulling 2001)
- *Acer saccharum* - *Tilia americana* / *Caulophyllum thalictroides* - *Laportea canadensis* Association (Fleming and Moorhead 1996)
- Dry-Mesic Calcareous Forest (Breden 1989)
- Mesic Northern Forest - Sugar Maple-Basswood (Chapman et al. 1989)
- Rich Northern Hardwood Forest (Thompson 1996)
- Rich northern hardwood forest (NAP pers. comm. 1998)
- SNE rich mesic forest (circumneutral to basic) (Rawinski 1984)
- Sugar Maple - Basswood: 26 (Eyre 1980)
- Sugar maple-white ash-basswood-bluebead cove forest (CAP pers. comm. 1998)

### SOURCES

**Description Authors:** D. Faber-Langendoen, mod. L. Sneddon, G. Fleming, S. C. Gawler.

**References:** Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Chapman et al. 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Metzler and Barrett 2004, NAP pers. comm. 1998, Rawinski 1984, Spurduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.



**Figure D19.** Rich Northern Hardwood Forest (typic variant) in Marsh-Billings-Rockefeller National Historical Park (MABI.02). September 2004. NAD 1983 / UTM easting 4834599, northing 698381.



**Figure D20.** Rich Northern Hardwood Forest (fern-glade variant) in Marsh-Billings-Rockefeller National Historical Park (MABI.AA44). September 2006. NAD 1983 / UTM easting 4834576, northing 698374.



**COMMON NAME (PARK-SPECIFIC):** SUCCESIONAL BLACK LOCUST FOREST

**SYNONYMS**

**USNVC English Name:** Black Locust Forest  
**USNVC Scientific Name:** *Robinia pseudoacacia* Forest  
**USNVC Identifier:** C EGL007279

**LOCAL INFORMATION**

**Environmental Description:** This map unit occurs on a gently sloping, northwest-facing slope with silt loam soils.

**Vegetation Description:** A canopy dominated by mature *Robinia pseudoacacia* (black locust) and *Prunus serotina* (black cherry) that seeded in post-agricultural fields and pastures is the characteristic vegetation of this association. While more information is needed on the understory, in general northern hardwoods dominate the sapling and seedling layers under pine canopies at the park. No information is available on herb cover.

**Most Abundant Species:**

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

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

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

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** Restricted to a single, 1.5-ha unit adjacent Prosper Road.

**Classification Comments:** Information not available.

**Other Comments:** A “natural stand” (i.e., not a planted stand) in Wiggin 1993 forest stands. Presumably the *Robinia pseudoacacia* (black locust) seeded in from a few planted trees, perhaps near former dwellings/buildings in the west portion of the park.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA02.

**Marsh-Billings-Rockefeller 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	<i>Robinia pseudoacacia</i> Forest Alliance (A.256)
Alliance (English name)	Black Locust Forest Alliance
Association	<i>Robinia pseudoacacia</i> Forest
Association (English name)	Black Locust Forest
<b>Ecological System(s):</b>	Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898).

## 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 red-cedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Carya ovata* (shagbark hickory), *Celtis occidentalis* (common hackberry), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), *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); *Lindera benzoin* (northern spicebush) is sometimes present. The invasive non-native *Rosa multiflora* (multiflora rose) may be present as a shrub, along with the non-native bramble *Rubus phoenicolasius* (wine raspberry). Non-native 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, which may also have a native component.

**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 red-cedar), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Carya ovata* (shagbark hickory), *Celtis occidentalis* (common hackberry), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), *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). Understory vegetation is highly variable depending on site history and often includes *Toxicodendron radicans* (eastern poison-ivy); *Lindera benzoin* (northern spicebush) is sometimes present. The invasive non-natives *Rosa multiflora* (multiflora rose) and *Elaeagnus umbellata* (autumn olive) are typically the most common shrubs, along with the non-native bramble *Rubus phoenicolasius* (wine raspberry). *Cornus florida* (flowering dogwood) may be present in the subcanopy. Non-native 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 (depending on geography) *Ageratina altissima* (white snakeroot), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Leersia virginica* (whitegrass), *Parthenocissus quinquefolia* (Virginia creeper), *Pilea pumila* (Canadian clearweed), *Solidago canadensis* (Canada goldenrod), *Solidago rugosa* (wrinkleleaf goldenrod), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), and *Viola* (violet) spp.

### Most Abundant Species:

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

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

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Acer platanoides</i> (Norway maple)	-	plant	exotic
<i>Ailanthus altissima</i> (tree of heaven)	-	plant	exotic
<i>Alliaria petiolata</i> (garlic mustard)	-	plant	exotic
<i>Chelidonium majus</i> (celandine)	-	plant	exotic
<i>Convallaria majalis</i> (European lily of the valley)	-	plant	exotic
<i>Dactylis glomerata</i> (orchardgrass)	-	plant	exotic
<i>Daucus carota</i> (Queen Anne's lace)	-	plant	exotic
<i>Elaeagnus umbellata</i> (autumn olive)	-	plant	exotic
<i>Glechoma hederacea</i> (ground ivy)	-	plant	exotic
<i>Rosa multiflora</i> (multiflora rose)	-	plant	exotic
<i>Rubus phoenicolasius</i> (wine raspberry)	-	plant	exotic

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

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

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

**Federal Lands:** NPS (Blue Ridge Parkway, Bluestone, Buffalo River?, C&O Canal?, Cape Cod, Catoclin Mountain?, George Washington Birthplace, Marsh-Billings-Rockefeller, Minute Man, Morristown, National Capital-East?, New River Gorge, Saratoga, Vicksburg); USFS (George Washington, Jefferson, Monongahela, Nantahala, Ouachita, Ouachita (Mountains), Ozark, Pisgah); USFWS (Montezuma).

### 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 high 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* - (*Robinia pseudoacacia*) 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)

### 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. 2007, Vanderhorst et al. 2008.



**Figure D21.** Successional Black Locust Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA02). September 2006. NAD 1983 / UTM easting 4834369, northing 697369.

**COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL NORTHERN HARDWOOD FOREST**

**SYNONYMS**

**USNVC English Name:** Sugar Maple - Yellow Birch - American Beech / Hobblebush Forest

**USNVC Scientific Name:** *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* / *Viburnum lantanoides* Forest

**USNVC Identifier:** CEG006252

**LOCAL INFORMATION**

**Environmental Description:** This community occurs on mid to upper slopes and on flat ridge crests, in rocky fine sandy loam to loamy fine sand Inceptisols with pH ranging from 5.4-5.9. It occurs on all except eastern aspects. All of the soils are derived from glacial till.

**Vegetation Description:** The canopy of this successional community is most frequently dominated by *Acer saccharum* (sugar maple), or less commonly by a mixture of *Acer saccharum* (sugar maple) with *Fagus grandifolia* (American beech). The well-developed small tree and shrub understory is clearly dominated by *Fagus grandifolia* (American beech), with *Ostrya virginiana* (hophornbeam) of secondary importance. *Betula alleghaniensis* (yellow birch) is a common associate. Generally the canopy trees are pole sized: 20-45cm dbh and 20-25 m tall. The understory is of variable height, with a small sapling layer 2-5 m and a large sapling to pole-sized layer anywhere from 5-15 m. The herb layer is generally poorly developed, though in an unusual situation *Carex pensylvanica* (Pennsylvania sedge) forms a "lawn." Herb richness is generally low, with 10-15 species present in each of two 0.05-ha plots. Herb diversity jumped to 28 species in the third plot with the *Carex pensylvanica* (Pennsylvania sedge) suggesting that this might be a northern hardwood variant, though not likely mappable. No herbaceous species were clearly characteristic of the community, though both *Actaea pachypoda* (white baneberry) and *Solidago caesia* (wreath goldenrod) are present in examples of this community. The herb layer was split between forbs, ferns, and *Carex* (sedge) spp. graminoids.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Tree subcanopy	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech) <i>Ostrya virginiana</i> (hophornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)

**Characteristic Species:** *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Carex backii</i> (Back's sedge)	-	plant	regionally rare/uncommon

**Subnational Distribution with Crosswalk Data:**

<u>State</u>	<u>SRank</u>	<u>Rel</u>	<u>Conf</u>	<u>SName</u>	<u>Reference</u>
VT	S5*	B	.	Northern Hardwood Forest	Thompson and Sorenson 2000

**Local Range:** This forest type is distributed throughout the park.

**Classification Comments:** Indicators of hardwood forests with richer soils, such as *Adiantum pedatum* (northern maidenhair), *Caulophyllum thalictroides* (blue cohosh), and *Actaea pachypoda* (white baneberry), occur regularly but very sparsely, indicating that the northern hardwood forests in this park are somewhat richer than those elsewhere in New England on more

acidic soils. Notably missing are typical northern hardwood forest species, such as *Acer pensylvanicum* (striped maple), *Viburnum lantanoides* (hobblebush), *Uvularia sessilifolia* (sessileleaf bellwort), and *Streptopus lanceolatus* (twistedstalk).

This association forms a continuum with the other northern hardwood types (CEGL006211 and CEGL005008, respectively) from less to more nutrient availability in the soil. It is distinguished from the more rich types primarily by its greater amount of *Fagus grandifolia* (American beech) relative to *Fraxinus* sp. (ash).

**Other Comments:** More plot data and field observations are needed to fully describe this community in the park. The 2005 vegetation map class name for this community is Northern Hardwood Forest (Pole Phase). Accuracy assessment data for the Northern Hardwood Forest at Marsh-Billings-Rockefeller National Historical Park indicated that the original USNVC crosswalk (CEGL006252) selected in the preliminary vegetation classification was incorrect because this matrix northern hardwood forest in the park has a lower cover of *Fagus grandifolia* (American beech) in the canopy and has a slightly richer, more diverse herbaceous layer than the typic ‘standard northern hardwoods’ USNVC global vegetation association (CEGL006252). Therefore, the USNVC crosswalk was changed to CEGL006211 after accuracy assessment and the map class name Northern Hardwood Forest was retained because this is the standard, typic, matrix northern hardwood forest for the park. The CEGL006252 USNVC crosswalk was used for the Successional Northern Hardwood Forest which has *Fagus grandifolia* (American beech) co-dominant in the canopy and subcanopy and a depauperate herbaceous understory.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** Keeton 10, 31, 32, 34, 40, 42, 44, 45; Lautzenheiser 9, 10, 12, 17, 32?, 37, MABI.AA06, MABI.AA09; MABI.AA35.

**Marsh-Billings-Rockefeller 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	<i>Acer saccharum</i> - <i>Betula alleghaniensis</i> - ( <i>Fagus grandifolia</i> ) Forest Alliance (A.216)
Alliance (English name)	Sugar Maple - Yellow Birch - (American Beech) Forest Alliance
Association	<i>Acer saccharum</i> - <i>Betula alleghaniensis</i> - <i>Fagus grandifolia</i> / <i>Viburnum lantanoides</i> Forest
Association (English name)	Sugar Maple - Yellow Birch - American Beech / Hobblebush Forest
<b>Ecological System(s):</b>	Laurentian-Acadian Northern Hardwoods Forest (CES201.564). Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).

### GLOBAL DESCRIPTION

**Concept Summary:** This association, known commonly as “northern hardwood forest,” is a widespread matrix forest in central New England and at lower elevations in northern New England. This forest occurs most commonly on acidic (pH 5-6), moderate to well-drained tills at elevations generally below 762 m (2,500 feet). In northern New England, they cover extensive

mid-elevation ridges; elsewhere, slope settings are common. The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. On some rocky, higher-elevation sites, dense ferns and other herbs may form a lush understory (the “fern-glade variant”). The canopy is dominated by *Acer saccharum* (sugar maple) mixed with variable amounts of *Fagus grandifolia* (American beech) and/or *Betula alleghaniensis* (yellow birch). Associated hardwood species include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Fraxinus americana* (white ash). At the southern end of this type’s range, especially in mid-successional stands, *Betula lenta* (sweet birch) may be present. Conifers are usually present at low abundance. Characteristic species include *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and in the northern portion of the range, *Picea rubens* (red spruce). Oaks are generally not present, although *Quercus rubra* (northern red oak) and (southward) *Quercus alba* (white oak) are sometimes present in low numbers. The shrub layer is often dominated by saplings of canopy tree species. Characteristic understory shrubs or small trees include *Acer pensylvanicum* (striped maple), *Ostrya virginiana* (hophornbeam), *Viburnum lantanoides* (hobblebush), *Acer spicatum* (mountain maple) (in the northern part of this type’s range), and *Lindera benzoin* (northern spicebush) (in the southern part of this type’s range). The patchy herbaceous layer is a mix of ferns, rhizomatous herbs and clubmosses. Characteristic species include *Dryopteris intermedia* (intermediate woodfern), *Dryopteris carthusiana* (spinulose woodfern), *Polystichum acrostichoides* (Christmas fern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Clintonia borealis* (bluebead), *Trientalis borealis* (starflower), *Oclemena acuminata* (whorled wood aster), and *Uvularia sessilifolia* (sessileleaf bellwort). Occasional species include *Aralia nudicaulis* (wild sarsaparilla), *Trillium erectum* (red trillium), *Trillium undulatum* (painted trillium), *Dryopteris campyloptera* (mountain woodfern), *Streptopus lanceolatus* (twistedstalk), *Cinna latifolia* (drooping woodreed), *Thelypteris noveboracensis* (New York fern), *Mitchella repens* (partridgeberry), *Solidago macrophylla* (largeleaf goldenrod), and *Medeola virginiana* (Indian cucumber). The bryophyte layer may include *Dicranum* (dicranum moss) spp. and *Leucobryum glaucum* (leucobryum moss). Sugar maple leaf litter is high in nitrogen relative to lignin and thus decomposes rapidly, increasing the nutrient pool in the soil organic layer. Structure and composition of the forest are maintained primarily by single small tree-fall gaps. Yellow birch is maintained in the system by mineral soils on “tip-up mounds.”

**Environmental Description:** This association, known commonly as “northern hardwood forest,” is a widespread matrix forest in central New England, and at lower elevations in northern New England. This forest occurs most commonly on acidic (pH 5-6), moderate to well-drained tills at elevations generally below 760 m (2,500 feet). In northern New England, they cover extensive mid-elevation ridges; elsewhere, slope settings are common.

**Vegetation Description:** The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. On some rocky, higher-elevation sites, dense ferns and other herbs may form a lush understory (the “fern-glade variant”). The canopy is dominated by *Acer saccharum* (sugar maple) mixed with variable amounts of *Fagus grandifolia* (American beech) and/or *Betula alleghaniensis* (yellow birch). Associated hardwood species include *Acer rubrum* (red maple), *Betula papyrifera* (paper birch), and *Fraxinus americana* (white ash). At the

southern end of this type's range, especially in mid-successional stands, *Betula lenta* (sweet birch) may be present. Conifers are usually present at low abundance. Characteristic species include *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and in the northern portion of the range, *Picea rubens* (red spruce). Oaks are generally not present, although *Quercus rubra* (northern red oak) and (southward) *Quercus alba* (white oak) are sometimes present in low numbers. The shrub layer is often dominated by saplings of canopy tree species. Characteristic understory shrubs or small trees include *Acer pensylvanicum* (striped maple), *Ostrya virginiana* (hophornbeam), *Viburnum lantanoides* (hobblebush), *Acer spicatum* (mountain maple) (in the northern part of this type's range), and *Lindera benzoin* (northern spicebush) (in the southern part of this type's range). The patchy herbaceous layer is a mix of ferns, rhizomatous herbs and clubmosses. Characteristic species include *Dryopteris intermedia* (intermediate woodfern), *Dryopteris carthusiana* (spinulose woodfern), *Polystichum acrostichoides* (Christmas fern), *Huperzia lucidula* (shining clubmoss), *Maianthemum canadense* (Canada mayflower), *Clintonia borealis* (bluebead), *Trientalis borealis* (starflower), *Oclemena acuminata* (whorled wood aster), and *Uvularia sessilifolia* (sessileleaf bellwort). Occasional species include *Aralia nudicaulis* (wild sarsaparilla), *Trillium erectum* (red trillium), *Trillium undulatum* (painted trillium), *Dryopteris campyloptera* (mountain woodfern), *Streptopus lanceolatus* (twistedstalk), *Cinna latifolia* (drooping woodreed), *Thelypteris noveboracensis* (New York fern), *Mitchella repens* (partridgeberry), *Solidago macrophylla* (largeleaf goldenrod), and *Medeola virginiana* (Indian cucumber). The bryophyte layer may include *Dicranum* (dicranum moss) spp. and *Leucobryum glaucum* (leucobryum moss). At higher elevations any of the understory herbs characteristic of montane spruce-fir forests may be locally abundant. In the southern portion of the range, exotic species including *Berberis thunbergii* (Japanese barberry) and *Microstegium vimineum* (Nepalese browntop) may be common in the shrub and herb layers.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple) <i>Fagus grandifolia</i> (American beech)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Acer pensylvanicum</i> (striped maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Ostrya virginiana</i> (hophornbeam)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Acer saccharum</i> (sugar maple) <i>Fagus grandifolia</i> (American beech)
Herb (field)	Fern or fern ally	<i>Polystichum acrostichoides</i> (Christmas fern)

**Characteristic Species:** *Acer pensylvanicum* (striped maple), *Acer saccharum* (sugar maple), *Betula alleghaniensis* (yellow birch), *Dryopteris intermedia* (intermediate woodfern), *Fagus grandifolia* (American beech), *Ostrya virginiana* (hophornbeam), *Pinus strobus* (eastern white pine), *Polystichum acrostichoides* (Christmas fern), *Tsuga canadensis* (eastern hemlock), *Viburnum lantanoides* (hobblebush).

### Other Noteworthy Species:

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Accipiter striatus</i> (sharp-shinned hawk)	-	animal	
<i>Aegolius acadicus</i> (northern saw-whet owl)	-	animal	
<i>Ambystoma maculatum</i> (spotted salamander)	-	animal	
<i>Berberis thunbergii</i> (Japanese barberry)	-	plant	exotic
<i>Contopus virens</i> (eastern wood-pewee)	-	animal	
<i>Dendroica caerulescens</i> (black-throated blue warbler)	-	animal	
<i>Dendroica virens</i> (black-throated green warbler)	-	animal	
<i>Desmognathus fuscus</i> (dusky salamander)	-	animal	
<i>Empidonax minimus</i> (least flycatcher)	-	animal	
<i>Empidonax virescens</i> (Acadian flycatcher)	-	animal	
<i>Erethizon dorsatum</i> (North American porcupine)	-	animal	
<i>Eurycea bislineata</i> (northern two-lined salamander)	-	animal	
<i>Glaucomys sabrinus</i> (northern flying squirrel)	-	animal	
<i>Hylocichla mustelina</i> (wood thrush)	-	animal	
<i>Martes pennanti</i> (fisher)	-	animal	
<i>Melanerpes carolinus</i> (red-bellied woodpecker)	-	animal	
<i>Meleagris gallopavo</i> (wild turkey)	-	animal	
<i>Microstegium vimineum</i> (Nepalese browntop)	-	plant	exotic
<i>Mniotilta varia</i> (black-and-white warbler)	-	animal	
<i>Napaeozapus insignis</i> (woodland jumping mouse)	-	animal	
<i>Notophthalmus viridescens</i> (eastern newt)	-	animal	
<i>Parula americana</i> (northern parula)	-	animal	
<i>Peromyscus leucopus</i> (white-footed deermouse)	-	animal	
<i>Peromyscus maniculatus</i> (North American deermouse)	-	animal	
<i>Picoides pubescens</i> (downy woodpecker)	-	animal	
<i>Picoides villosus</i> (hairy woodpecker)	-	animal	
<i>Piranga olivacea</i> (scarlet tanager)	-	animal	
<i>Poecile atricapillus</i> (black-capped chickadee)	-	animal	
<i>Rana sylvatica</i> (wood frog)	-	animal	
<i>Seiurus aurocapilla</i> (ovenbird)	-	animal	
<i>Setophaga ruticilla</i> (American redstart)	-	animal	
<i>Sitta carolinensis</i> (white-breasted nuthatch)	-	animal	
<i>Sorex cinereus</i> (cinereus shrew)	-	animal	
<i>Tamias striatus</i> (eastern chipmunk)	-	animal	
<i>Urocyon cinereoargenteus</i> (gray fox)	-	animal	
<i>Ursus americanus</i> (American black bear)	-	animal	
<i>Vireo olivaceus</i> (red-eyed vireo)	-	animal	

**USFWS Wetland System:** Not applicable.

### DISTRIBUTION

**Range:** This association is a widespread matrix forest from southern Quebec and the Maritime Provinces of Canada south through New England, continuing in more limited distribution to northern New Jersey and northeastern Pennsylvania.

**States/Provinces:** CT, MA, ME, NB, NH, NJ:S1S3, NY, PA, VT.

**Federal Lands:** NPS (Acadia, Delaware Water Gap, Marsh-Billings-Rockefeller, Upper Delaware); USFS (Finger Lakes?); USFWS (Aroostook, Moosehorn, Nulhegan Basin, Pondicherry).

### CONSERVATION STATUS

**Rank:** G5 (7-Dec-2005).

**Reasons:** This association is a widespread matrix forest in New England, upstate New York, and adjacent Canada.

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** Information not available.

### Similar Associations:

- *Acer saccharum* - (*Fraxinus americana*) / *Arisaema triphyllum* Forest (CEGL006211).
- *Acer saccharum* - *Fraxinus americana* - *Tilia americana* / *Acer spicatum* / *Caulophyllum thalictroides* Forest (CEGL005008).
- *Quercus rubra* - *Acer saccharum* - *Fagus grandifolia* / *Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis* - (*Betula alleghaniensis*) - *Picea rubens* / *Cornus canadensis* Forest (CEGL006129).

### Related Concepts:

- *Acer saccharum* - *Fagus grandifolia* - *Betula alleghaniensis* / *Viburnum alnifolium* Community (Metzler and Barrett 1996)
- Beech - Sugar Maple: 60 (Eyre 1980)
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984)
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984)
- Mesic Hemlock-Hardwood Forest (Breden 1989)
- Mesic Northern Hardwood Forest (Beech-Birch-Maple Forest) (Thompson 1996)
- Northern hardwood forest: boreal/montane type (NAP pers. comm. 1998)
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980)
- Sugar Maple: 27 (Eyre 1980)

## SOURCES

**Description Authors:** S. C. Gawler.

**References:** Adamus 1978, Baldwin 1977, Breden 1989, Breden et al. 2001, Campbell and Eastman 1978, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Flaccus 1972, Gawler 2002, Gordon 1937b, Kern 1985, Kuchler 1956, Kuchler 1964, Little 1974, McIntosh 1972, Metzler and Barrett 1996, Metzler and Barrett 2001, Moore and Taylor 1927, NAP pers. comm. 1998, Niering 1953, Ohmann and Buell 1968, Rawinski 1984, Simko 1987, Sperduto 1996, Sperduto and Nichols 2004, Thompson 1996, Thompson and Sorenson 2000, Woods 1987.



**Figure D22.** Successional Northern Hardwood Forest in Marsh-Billings-Rockefeller National Historical Park (MABI.AA09). September 2006. NAD 1983 / UTM easting 4833532, northing 698433.

**COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL 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:** C EGL006107

**LOCAL INFORMATION**

**Environmental Description:** Both of these small units occur on gentle slopes of minor hill summits, one with south exposure and the other with east exposure. Soil textures at both occurrences range from fine sandy loam to loamy fine sand. This vegetation type is a post-agricultural artifact that will succeed to forest if not artificially maintained.

**Vegetation Description:** At one opening west of Elm Lot, vegetation consisted of a mix of field grasses with herbs, especially *Monarda fistulosa* (wild bergamot), *Asclepias syriaca* (common milkweed), and *Solidago* (goldenrod) spp. This vegetation type was not formally surveyed.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Herb (field)	Forb	<i>Asclepias syriaca</i> (common milkweed)

**Characteristic Species:** *Asclepias syriaca* (common milkweed).

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Monarda fistulosa</i> (wild bergamot)	-	plant	

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** Information not available.

**Classification Comments:** This vegetation type does not include fields maintained for hay crop.

**Other Comments:** Information not available.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA26, MABI.AA38.

**Marsh-Billings-Rockefeller 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	<i>Dactylis glomerata</i> - <i>Rumex acetosella</i> Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Common Sheep Sorrel Herbaceous Alliance
Association	<i>Dactylis glomerata</i> - <i>Phleum pratense</i> - <i>Festuca</i> spp. - <i>Solidago</i> spp. Herbaceous Vegetation
Association (English name)	Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation
<b>Ecological System(s):</b>	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074).

## GLOBAL DESCRIPTION

**Concept Summary:** This broadly defined vegetation type includes pastures and post-agricultural fields and is largely composed of non-native 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 (610-1,220 m [2,000-4,000 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 altissima* (tall goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* (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 altissima* (tall goldenrod), *Euthamia graminifolia* (flat-top goldentop), *Cerastium arvense* (field chickweed), *Oenothera biennis* (common evening-primrose), *Potentilla simplex* (common cinquefoil), *Symphyotrichum lateriflorum* (calico aster), *Symphyotrichum novae-angliae* (New England aster), *Symphyotrichum lanceolatum* (white panicle aster), *Daucus carota* (Queen Anne's lace), *Ambrosia artemisiifolia* (annual ragweed), *Vicia cracca* (bird vetch), *Trifolium* (clover) spp., and many others.

**Most Abundant Species:**

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

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

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Anthoxanthum odoratum</i> (sweet vernalgrass)	-	plant	exotic
<i>Bromus tectorum</i> (cheatgrass)	-	plant	exotic
<i>Dactylis glomerata</i> (orchardgrass)	-	plant	exotic
<i>Daucus carota</i> (Queen Anne's lace)	-	plant	exotic
<i>Elymus repens</i> (quackgrass)	-	plant	exotic
<i>Lolium perenne</i> (perennial ryegrass)	-	plant	exotic
<i>Phleum pratense</i> (timothy)	-	plant	exotic
<i>Poa compressa</i> (Canada bluegrass)	-	plant	exotic

**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, Cape May, Carlton Pond, Erie, Great Meadows, Iroquois, Montezuma, Moosehorn, Nulhegan Basin, Oxbow, Parker River, Supawna Meadows).

**CONSERVATION STATUS**

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

**Reasons:** This vegetation type includes pasture and post-agricultural fields and is largely composed of non-native 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).
- *Panicum virgatum* - (*Andropogon virginicus*) Herbaceous Vegetation (CEGL006616).
- *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 D23.** Successional Old Field in Marsh-Billings-Rockefeller National Historical Park (MABI.AA38). September 2006. NAD 1983 / UTM easting 4833574, northing 698438.

**COMMON NAME (PARK-SPECIFIC): WHITE PINE FOREST (WHITE PINE PLANTATION ASSOCIATION)**

**SYNONYMS**

**USNVC English Name:** Eastern White Pine Planted Forest

**USNVC Scientific Name:** *Pinus strobus* Planted Forest

**USNVC Identifier:** CEGLO07178

**LOCAL INFORMATION**

**Environmental Description:** This planted forest type is found on gentle to moderately steep slopes with a variety of aspects scattered throughout the park. It occurs on relatively fertile, well-drained to moderately well-drained, sandy loam soils that are less rocky than some areas in the park. Because these conifers were planted in former agricultural fields, in some cases soils may have been cultivated and show a plow horizon.

**Vegetation Description:** This forest association is characterized by a high (20-35 m) canopy of mature, planted *Pinus strobus* (eastern white pine) making up 70-95% of the tree cover. In some places, there is a well-developed understory of typical northern hardwood forest species, especially *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Prunus serotina* (black cherry), and *Acer pensylvanicum* (striped maple). *Fraxinus americana* (white ash) and *Tsuga canadensis* (eastern hemlock) are occasional associates. In some areas, other conifers, such as *Picea abies* (Norway spruce) or *Pinus sylvestris* (Scotch pine), were planted with the *Pinus strobus* (eastern white pine) and co-occur in the canopy. In rare instances, *Pinus strobus* (eastern white pine) and *Ostrya virginiana* (hophornbeam) are important in the understory, especially on the ridge at the west end of the park. In the herb layer, three species of ferns, *Dennstaedtia punctilobula* (eastern hayscented fern), *Dryopteris intermedia* (intermediate woodfern), and *Thelypteris noveboracensis* (New York fern), are often the most important species, and *Arisaema triphyllum* (Jack in the pulpit), *Carex arctata* (drooping woodland sedge), *Dryopteris marginalis* (marginal woodfern), *Maianthemum canadense* (Canada mayflower), and *Polystichum acrostichoides* (Christmas fern) regularly occur in low abundance. All of these species are generic to mesic northern hardwood forests. Holdover species of former open conditions, including *Danthonia spicata* (poverty oatgrass), *Luzula multiflora* (common woodrush), and *Solidago* (goldenrod) spp., occur sparsely. Occasionally, species indicative of rich soils can be found, such as *Actaea pachypoda* (white baneberry), *Trillium erectum* (red trillium), and *Carex deweyana* (Dewey sedge). In the moister, finer-textured soils, *Osmunda claytoniana* (interrupted fern) and *Onoclea sensibilis* (sensitive fern) occur in abundance. Species richness in the herb layer is relatively high, ranging from 23-34 species in each of four 500 m<sup>2</sup> plots.

**Most Abundant Species:**

<u>Stratum</u>	<u>Lifeform</u>	<u>Species</u>
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)
Tree subcanopy	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Acer pensylvanicum</i> (striped maple)
		<i>Acer saccharum</i> (sugar maple)
		<i>Fagus grandifolia</i> (American beech)
Herb (field)	Fern or fern ally	<i>Dennstaedtia punctilobula</i> (eastern hayscented fern)
		<i>Dryopteris intermedia</i> (intermediate woodfern)
		<i>Thelypteris noveboracensis</i> (New York fern)

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

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

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** Scattered throughout the park. Extends out of the park along the southeast and northeast boundaries.

**Classification Comments:** *Pinus strobus* (eastern white pine) planted forests were broken into two types according to the species planted, i.e. *Pinus strobus* (eastern white pine) or mixed conifer. *Pinus strobus* (eastern white pine) was dominant in most of these units. The present type is used for stands where only *Pinus strobus* (eastern white pine) was planted. Mixed plantations, where *Pinus strobus* (eastern white pine) occurs mixed with exotic conifers such as *Picea abies* (Norway spruce) or *Pinus sylvestris* (Scotch pine), are treated as Mixed Conifer Plantation (CEGL006313).

**Other Comments:** Plantings occurred in 1880, 1905, 1911, and 1917. This type is an artifact of human history. Without more human manipulation, it will naturally shift to a northern hardwoods-dominated forest type.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA34, MABI.AA55, MABI.AA61, MABI.AA64, MABI.09, MABI.26, MABI.28, MABI.30; Keeton 48, 49, 50, 51; Lautzenheiser 1?, 2?

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	<i>Pinus strobus</i> Planted Forest Alliance (A.98)
Alliance (English name)	Eastern White Pine Planted Forest Alliance
Association	<i>Pinus strobus</i> Planted Forest
Association (English name)	Eastern White Pine Planted Forest
<b>Ecological System(s):</b>	Semi-natural / Altered Vegetation and Conifer Plantations (CES203.074).

### GLOBAL DESCRIPTION

**Concept Summary:** This white pine plantation type is found throughout the northeastern and midwestern United States and adjacent Canada. Stands contain plantations of *Pinus strobus* (eastern white pine) that are maintained for the extraction of forest products. Some have been planted as reclamation projects (e.g., following strip-mining). At maturity, the tree canopy is usually dense and contains a monospecific layer of *Pinus strobus* (eastern white pine). *Pinus resinosa* (red pine) or *Pinus virginiana* (Virginia pine) is occasionally present in small amounts. In older stands or gaps, regenerating trees may include *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), and *Prunus serotina* (black cherry); *Robinia pseudoacacia* (black locust) and *Betula lenta* (sweet birch) are occasionally present. *Acer pensylvanicum* (striped maple) and *Ostrya virginiana* (hophornbeam) are common small trees. The shrub layer is typically sparse and mostly consists of smaller individuals of the tree

species. The field layer varies from sparse to absent; it may be locally well-developed in small openings, with variable composition. In some stands, mosses may be abundant. Susceptibility to a variety of pests or diseases, including white pine blister rust (*Cronartium ribicola*) and southern pine beetle (*Dendroctonus frontalis*), has had some impact on its commercial use.

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

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

**Most Abundant Species:**

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

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

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

**USFWS Wetland System:** Not applicable.

**DISTRIBUTION**

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

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

**Federal Lands:** BIA (Eastern Band of Cherokee); NPS (Antietam?, Blue Ridge Parkway, Booker T. Washington, C&O Canal?, Catoctin Mountain?, Chattahoochee River, Chickamauga-Chattanooga, Indiana Dunes, Marsh-Billings-Rockefeller, Monocacy?, New River Gorge, Saratoga, Valley Forge); USFS (Chattahoochee, Chattahoochee (Southern Blue Ridge), Cherokee, Daniel Boone, George Washington, Jefferson, Nantahala, Pisgah, Sumter, Sumter [Mountains]); USFWS (Chesapeake Marshlands, Supawna Meadows).

**CONSERVATION STATUS**

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

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

**CLASSIFICATION INFORMATION**

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** There was a lot of planting of white pine from the 1930s into the 1950s, but there has been very little planting since then (P. Manion pers. comm. 2001). On the Daniel Boone National Forest of Kentucky, *Pinus strobus* (eastern white pine) plantings are of limited extent

and are related to wildlife plantings. In the southern part of this type's range, there has been some damage from southern pine beetle (*Dendroctonus frontalis*). These plantations have been observed in the Peters Mountain area (James River Ranger District) and various other sites in the George Washington and Jefferson national forests.

**Similar Associations:**

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

**Related Concepts:**

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

**SOURCES**

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

**References:** Allard 1990, Coxe 2008, Fleming and Coulling 2001, Fleming and Moorhead 2000, NRCS 2004, Reschke 1990, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001a, Vanderhorst 2001b, Vanderhorst and Streets 2006, Vanderhorst et al. 2007.



**Figure D24.** White Pine Forest (Successional Forest) in Marsh-Billings-Rockefeller National Historical Park (MABI.AA64). September 2006. NAD 1983 / UTM easting 4834262, northing 699782.

**COMMON NAME (PARK-SPECIFIC): WHITE PINE FOREST (WHITE PINE SUCCESSIONAL FOREST ASSOCIATION)**

**SYNONYMS**

**USNVC English Name:** Eastern White Pine Successional Forest  
**USNVC Scientific Name:** *Pinus strobus* Successional Forest  
**USNVC Identifier:** CEGL007944

**LOCAL INFORMATION**

**Environmental Description:** This successional forest type is found on gentle to moderately steep slopes with a variety of aspects in the western portion of the park. It occurs on relatively fertile, well-drained to moderately well-drained, fine sandy loam soils that are less rocky than some areas in the park. Because the *Pinus strobus* (eastern white pine) occurs in former agricultural fields, in some cases soils may have been cultivated and show a plow horizon.

**Vegetation Description:** This association occurs where no *Pinus strobus* (eastern white pine) was planted, yet *Pinus strobus* (eastern white pine) forms at least 50% of the canopy, mixed with *Fraxinus americana* (white ash) (fairly common as an old-field colonist in this region) and *Acer saccharum* (sugar maple). In at least three of the mapped units, the areas where the association now occurs were open field/pasture in 1939 aerial photographs. While more information is needed on the understory, in general northern hardwoods dominate the sapling and seedling layers under pine canopies at the park. In one of these mapped units, *Pinus strobus* (eastern white pine) is successional to an old apple orchard. No information is available on herb cover.

**Most Abundant Species:**

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

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

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

**Subnational Distribution with Crosswalk Data:**

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

**Local Range:** This type occurs in the park as three small units southwest of The Pogue and two small units along Prosper Road. It extends out of the park along the south boundary.

**Classification Comments:** Information not available.

**Other Comments:** Association was noted in passing and not sampled in 2004. Overstory plots from Keeton provide data on the tree canopy.

**Local Description Authors:** B. Engstrom, S. C. Gawler.

**Plots:** MABI.AA07, MABI.AA08; Keeton 23, 24, 25.

**Marsh-Billings-Rockefeller National Historical Park Inventory Notes:** Information not available.

## GLOBAL INFORMATION

### USNVC Classification

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.)
Alliance	<i>Pinus strobus</i> Forest Alliance (A.128)
Alliance (English name)	Eastern White Pine Forest Alliance
Association	<i>Pinus strobus</i> Successional Forest
Association (English name)	Eastern White Pine Successional Forest
<b>Ecological System(s):</b>	Information not available.

### GLOBAL DESCRIPTION

**Concept Summary:** This is an early-successional forest dominated by *Pinus strobus* (eastern white pine), typically with a very dense canopy and little understory. It is commonly associated with anthropogenic disturbance (e.g., former old fields and formerly cleared flats along streams) and could potentially occur anywhere within the range of the *Pinus strobus* Forest Alliance (A.128). Associated woody and herbaceous species vary with geography. In the northeastern states, the tree canopy is often monotypic and even-aged, with occasional associates including *Acer rubrum* (red maple), *Juniperus virginiana* (eastern red-cedar), *Liriodendron tulipifera* (tuliptree) (within its range), or scattered *Quercus rubra* (northern red oak) or *Quercus velutina* (black oak). In regions where northern hardwoods are more prevalent, canopy associates include *Fraxinus americana* (white ash) and *Acer saccharum* (sugar maple). In the Southern Blue Ridge and nearby areas, typical canopy and subcanopy associates include *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), *Pinus rigida* (pitch pine), and *Liquidambar styraciflua* (sweetgum), with *Tsuga canadensis* (eastern hemlock) often forming a dense shrub stratum. The understory is typically poorly developed or characterized by scattered individuals found in the canopy. The herbaceous cover is variable depending on the density of tree and shrub cover, and may be characterized by ruderal or exotic species that favor openings or disturbance. In more open stands, typical species are those associated with old fields, including *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Anthoxanthum odoratum* (sweet vernalgrass), *Poa pratensis* (Kentucky bluegrass), *Schizachyrium scoparium* (little bluestem), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Agrostis gigantea* (redtop), *Euthamia graminifolia* (flat-top goldentop), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In stands that are more heavily forested, typical herbs include *Aralia nudicaulis* (wild sarsaparilla), *Ageratina altissima* (white snakeroot), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), and *Lycopodium* (clubmoss) species. The particular composition of the herb layer will vary with geography. The substrate is usually covered by a thick layer of pine needle duff. In the Daniel Boone National Forest of Kentucky, *Pinus strobus* (eastern white pine) is spreading from plantings, especially in the Red River Gorge.

**Environmental Description:** This wide-ranging successional forest is commonly associated with anthropogenic disturbance and could potentially occur anywhere within the range of the *Pinus strobus* Forest Alliance (A.128). It typically occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed, developing as *Pinus strobus*

(eastern white pine) colonizes the open fields. Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species that favor openings or disturbance.

**Vegetation Description:** The tree canopy ranges from woodland to forest closure, with 25-85% cover. It is often monotypic and even-aged *Pinus strobus* (eastern white pine), with occasional associates, including *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Juniperus virginiana* (eastern red-cedar), or scattered *Quercus rubra* (northern red oak) or *Quercus velutina* (black oak). In regions where northern hardwoods are more prevalent, canopy associates include *Fraxinus americana* (white ash) and *Acer saccharum* (sugar maple). In the Southern Blue Ridge and nearby areas, typical canopy and subcanopy associates include *Liriodendron tulipifera* (tuliptree), *Acer rubrum* (red maple), *Pinus rigida* (pitch pine), and *Liquidambar styraciflua* (sweetgum), with *Tsuga canadensis* (eastern hemlock) often forming a dense shrub stratum. The understory is poorly developed or characterized by scattered individuals found in the canopy. Shrubs are often present in the more open stands and include native species, such as *Cornus racemosa* (gray dogwood), *Rhus glabra* (smooth sumac), *Viburnum prunifolium* (blackhaw), and *Rubus* (blackberry) spp., as well as exotics, such as *Elaeagnus umbellata* (autumn olive), *Rosa multiflora* (multiflora rose), *Lonicera morrowii* (Morrow's honeysuckle), and *Berberis thunbergii* (Japanese barberry). The herbaceous cover is variable depending on the density of tree and shrub cover, and may be characterized by ruderal or exotic species that favor openings or disturbance. In more open stands, typical species are those associated with old fields, such as *Solidago rugosa* (wrinkleleaf goldenrod), *Solidago gigantea* (giant goldenrod), *Anthoxanthum odoratum* (sweet vernalgrass), *Poa pratensis* (Kentucky bluegrass), *Schizachyrium scoparium* (little bluestem), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Agrostis gigantea* (redtop), *Euthamia graminifolia* (flat-top goldentop), *Achillea millefolium* (common yarrow), and *Daucus carota* (Queen Anne's lace). In stands that are more heavily forested, typical herbs include *Aralia nudicaulis* (wild sarsaparilla), *Ageratina altissima* (white snakeroot), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber), *Polystichum acrostichoides* (Christmas fern), *Trientalis borealis* (starflower), *Mitchella repens* (partridgeberry), and *Lycopodium* (clubmoss) species. The particular composition of the herb layer will vary with geography. The substrate is usually covered by a thick layer of pine needle duff.

**Most Abundant Species:**

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

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

**Other Noteworthy Species:**

<u>Species</u>	<u>GRank</u>	<u>Type</u>	<u>Note</u>
<i>Achillea millefolium</i> (common yarrow)	-	plant	exotic
<i>Agrostis gigantea</i> (redtop)	-	plant	exotic
<i>Anthoxanthum odoratum</i> (sweet vernalgrass)	-	plant	exotic
<i>Berberis thunbergii</i> (Japanese barberry)	-	plant	exotic
<i>Daucus carota</i> (Queen Anne's lace)	-	plant	exotic
<i>Elaeagnus umbellata</i> (autumn olive)	-	plant	exotic
<i>Elymus repens</i> (quackgrass)	-	plant	exotic
<i>Lonicera morrowii</i> (Morrow's honeysuckle)	-	plant	exotic
<i>Rosa multiflora</i> (multiflora rose)	-	plant	exotic

**USFWS Wetland System:** Not applicable.

## DISTRIBUTION

**Range:** This successional type may be expected to occur throughout the range of the alliance (i.e., from Michigan, northern Wisconsin, northern and eastern Minnesota, extreme northeastern Iowa, and from Maine and New Hampshire south to Georgia and Tennessee, as well as in Ontario, Canada). It has been documented primarily in areas where project-specific needs have required it.

**States/Provinces:** CT, GA, KY, MA, MD?, ME, MI, MN, NC, NH, NJ, NY, PA, RI, SC, TN, VA, VT, WI, WV.

**Federal Lands:** BIA (Eastern Band of Cherokee); NPS (Big South Fork, Blue Ridge Parkway, Bluestone, Carl Sandburg Home, Delaware Water Gap, Gettysburg, Great Smoky Mountains, Marsh-Billings-Rockefeller, New River Gorge, Obed, Saint-Gaudens, Saratoga); USFS (Cherokee?, Daniel Boone, George Washington, Jefferson, Monongahela); USFWS (Great Meadows, Moosehorn).

## CONSERVATION STATUS

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

**Reasons:** This forest represents successional vegetation and is thus not of high conservation concern and does not receive a conservation status rank.

## CLASSIFICATION INFORMATION

**Status:** Standard.

**Confidence:** 2 – Moderate.

**Comments:** This successional type may be expected to occur throughout the range of the alliance but has primarily been attributed in areas where The Nature Conservancy ecoregional planning or other project-specific needs have documented its occurrence. Rangewide review should greatly expand its geographic scope.

### Similar Associations:

- *Pinus strobus* Planted Forest (CEGL007178).

### Related Concepts:

- *Pinus strobus*/(*Diphasiastrum digitatum*, *Lycopodium obscurum*) forest (Vanderhorst 2001b)
- White Pine - White Oak - Chestnut Oak Type (Schmalzer and DeSelm 1982)
- semi-natural (Chapman et al. 1989)

## SOURCES

**Description Authors:** K. D. Patterson, mod. L. A. Sneddon and S. C. Gawler.

**References:** Chapman et al. 1989, Fleming and Coulling 2001, NRCS 2004, NatureServe Ecology - Southeastern U.S. unpubl. data, Schmalzer and DeSelm 1982, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008.



**Figure D25.** White Pine Forest (Plantation) in Marsh-Billings-Rockefeller National Historical Park (MABI.AA07). September 2006. NAD 1983 / UTM easting 4833594, northing 698109.



**Appendix E.** Dichotomous field key to the USNVC vegetation associations<sup>1</sup> and land cover types of Marsh-Billings-Rockefeller National Historical Park.

<b>1</b>	Non-forested communities: shrubs or herbaceous species dominate .....	2
	Forest communities: trees dominant, canopy >25% .....	5
<b>2</b>	Open water .....	<b>Pond</b>
	Vegetated wetlands or uplands .....	3
<b>3</b>	Field/opening lacking woody plants and with even-textured grass-dominated vegetation and well-defined boundaries; no buildings .....	<b>Field (Hay / Cropland)</b>
	Field/opening with some woody plants and boundaries ill-defined; may have buildings.....	4
<b>4</b>	Small openings of old pasture vegetation with mixture of herbs and low woody plants; not characterized by horticultural plantings; no buildings.....	<b>Successional Old Field (CEGL006107)</b>
	Openings adjacent to buildings, with extensive horticultural plantings .....	<b>Gardens and Grounds</b>
<b>5</b>	Forest canopy conifer dominated ( $\geq 65\%$ cover).....	6
	Mixed or deciduous forests, conifers forming <65% of the canopy.....	13
<b>6</b>	Planted conifer forest, i.e. canopy composed of non-native species usually in discernable rows; if composed of native species that were planted very long time ago (75 or more years ago), historical documentation may be needed .....	7
	Forest dominated by native species that were not apparently planted (or known to be planted) there.....	11
<b>7</b>	Forest dominated by European larch ( <i>Larix</i> <i>decidua</i> ).....	<b>European Larch Plantation (CEGL006408)</b>
	Forest not dominated by European larch .....	8

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<sup>1</sup> Key lists the local (park-specific) common name for the vegetation type, followed by a cross-reference to the map class when necessary, and the USNVC global association identifying code. Map units for cultural features are listed without corresponding USNVC vegetation types.

<b>8</b>	Forest dominated by Norway spruce ( <i>Picea abies</i> ).....	<b>Norway Spruce Plantation (CEGL007167)</b>	
	Forest not dominated by Norway spruce .....		9
<b>9</b>	Forest dominated by red pine ( <i>Pinus resinosa</i> ) .....	<b>Red Pine Plantation (CEGL007177)</b>	
	Forest not dominated by red pine .....		10
<b>10</b>	Planted forest dominated by eastern white pine ( <i>Pinus strobus</i> ) .....	<b>White Pine Forest (Plantation) (CEGL007178)</b>	
	Forest dominated by a mix of conifers, usually including eastern white pine and/or Scotch pine ( <i>Pinus sylvestris</i> ).....	<b>Mixed Conifer Plantation (CEGL006313)</b>	
<b>11</b>	Forest dominated by eastern white pine, not known to have been planted.....	<b>White Pine Forest (Successional Forest) (CEGL007944)</b>	
	Forest dominated by eastern hemlock ( <i>Tsuga canadensis</i> ) .....		12
<b>12</b>	Upland forest dominated by eastern hemlock ( <i>Tsuga canadensis</i> ) .....	<b>Hemlock Forest (CEGL006109)</b>	
	Forested seep dominated by <i>Tsuga canadensis</i> (eastern hemlock) with <i>Betula alleghaniensis</i> (yellow birch), <i>Fraxinus americana</i> (white ash), <i>Acer saccharum</i> (sugar maple), and <i>Fraxinus nigra</i> (black ash) in the canopy, shrub layer sparse to absent and herb layer dominated by ferns .....	<b>Hemlock - Hardwood Seepage Forest (CEGL006308)</b>	
<b>13</b>	Mixed forest with conifers forming 35-65% of the canopy .....		14
	Deciduous-dominated forest, with conifers forming <35% of the canopy .....		18
<b>14</b>	Wetland, evidenced by hydric soils and indicator species such as black ash ( <i>Fraxinus nigra</i> ), cinnamon fern ( <i>Osmunda cinnamomea</i> ), interrupted fern ( <i>Osmunda claytoniana</i> ), sensitive fern ( <i>Onoclea sensibilis</i> ), and/or jewelweed ( <i>Impatiens capensis</i> ), may be basin wetlands or pockets within upland forests .....		15
	Upland forest with mixed hemlock-hardwood canopy .....		17
<b>15</b>	Basin swamp with a canopy composed of <i>Acer rubrum</i> (red maple) and <i>Fraxinus nigra</i> (black ash) and a very broken (30% cover) second canopy dominated by pole-sized <i>Tsuga canadensis</i> (eastern hemlock), <i>Fraxinus nigra</i> (black ash), and <i>Betula alleghaniensis</i> (yellow birch) and prominent bryophyte groundcover .....	<b>Northern Hardwood - Hemlock Swamp (CEGL006502)</b>	
	Seep wetland .....		16

**16**  
 Wetland forest (seep) dominated by *Tsuga canadensis* (eastern hemlock) with *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Acer saccharum* (sugar maple), and *Fraxinus nigra* (black ash) in the canopy and a herb layer dominated by ferns..... **Hemlock - Hardwood Seepage Forest (CEGL006308)**  
 Very small (0.01-0.1ha) shaded wetland seeps within upland forests, without trees growing in their shallow muck or muddy soils, and generally lacking extensive bryophyte cover ..... **Enriched Hardwood Forest Seep (CEGL006409)**

**17**  
 Mixed canopy containing northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*) common, sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) infrequent; forest usually on rocky, upper slopes, often south-facing..... **Hemlock – Beech - Oak Forest (CEGL006088)**  
 Mixed canopy with northern hardwoods and lacking northern red oak (or, if present, merely incidental) ..... **Hemlock - Northern Hardwood Forest (CEGL006109)**

**18**  
 Upland Forest.....19  
 Wetland Forest.....25

**19**  
 Hardwood dominated forest with northern red oak (*Quercus rubra*) and other species forming a broken canopy ( $\leq 75\%$  cover), trees somewhat stunted, soils shallow, herb layer extensive and dominated by wavy hairgrass (*Deschampsia flexuosa*)..... **Red Oak - Northern Hardwood Woodland (CEGL005058)**  
 Hardwood forest with complete canopy, soils may be shallow but are more often well-developed, herb layer various but not typically dominated by wavy hairgrass .....20

**20**  
 Hardwood forest with at least 15% canopy cover of black locust (*Robinia pseudoacacia*) ..... **Successional Black Locust Forest (CEGL007279)**  
 Hardwood forest lacking any appreciable amount of black locust .....21

**21**  
 Hardwood forest with significant ( $\geq 15\%$ ) northern red oak (*Quercus rubra*) component ..... **Red Oak - Northern Hardwood Forest (CEGL006173)**  
 Hardwood forest with northern red oak present in only minor amounts, if at all .....22

**22**

Hardwood forest dominated by sugar maple (*Acer saccharum*), small sapling layer 2-5 m and a large sapling to pole-sized layer anywhere from 5-15 m; lacking calciphiles such as blue cohosh (*Caulophyllum thalictroides*), maidenhair fern (*Adiantum pedatum*), silver false spleenwort (*Deparia acrostichoides*), and wild ginger (*Asarum canadense*), and often on upper and convex slopes ..... **Successional Northern Hardwood Forest (CEGL006252)**

Hardwood forest dominated by sugar maple (American beech (*Fagus grandifolia*) absent or minor) and often with significant white ash (*Fraxinus americana*) in the canopy; containing some calciphiles (see above); often associated with lower, concave slopes .....23

**23**

Hardwood forest with a few calciphiles, herb layer not particularly species-rich<sup>1</sup> and not dominated by ferns; white ash (*Fraxinus americana*) frequently important canopy species; soils usually with  $\leq 10$ cm OA/A horizon; usually on gentle lower slopes ..... **Northern Hardwood Forest (CEGL006211)**

Hardwood forest with many calciphilic herbs and often with prominent cover of ferns<sup>2</sup>, usually with  $\geq 10$ cm humus-rich OA/A horizon; often associated with protected coves, or over-steepened slopes below calcareous ledge .....24

**24**

Typical rich northern hardwood forest in mesic settings, with little or no hophornbeam (*Ostrya virginiana*). Calciphilic ferns may be abundant (but not required) in coves, especially silver false spleenwort (*Deparia acrostichoides*), Goldie's fern (*Dryopteris goldiana*), and ostrich fern (*Matteucia struthiopteris*) ..... **Rich Northern Hardwood Forest (CEGL005008)**

Dry-mesic variant of the Rich Northern Hardwood Forest on oversteepened slopes with calcareous limestone outcrops, often with some northern red oak (*Quercus rubra*) and with subcanopy characterized by hophornbeam (*Ostrya virginiana*); with herb species indicating somewhat more dry-mesic conditions compared to other rich northern hardwood forests, including blackseed ricegrass (*Piptatherum racemosum*), Robert geranium (*Geranium robertianum*), and wreath goldenrod (*Solidago caesia*) frequent herbs.....**Northern Hardwood Limestone Forest (CEGL005008)**

**25**

Basin swamp with a canopy composed of *Acer rubrum* (red maple) and *Fraxinus nigra* (black ash) and a very broken (30% cover) second canopy dominated by pole-sized *Tsuga canadensis* (eastern hemlock), *Fraxinus nigra* (black ash), and *Betula alleghaniensis* (yellow birch) and prominent bryophyte groundcover ..... **Northern Hardwood - Hemlock Swamp (CEGL006502)**

Seep wetland .....26

<sup>1</sup> typically 25 or fewer species in a 20×20 m plot

<sup>2</sup> typically >33 species in a 20×20 m plot

**26**

Wetland forest (seep) dominated by *Tsuga canadensis* (eastern hemlock) with *Betula alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Acer saccharum* (sugar maple), and *Fraxinus nigra* (black ash) in the canopy and a herb layer dominated by ferns.....**Hemlock - Hardwood Seepage Forest (CEGL006308)**

Very small (0.01-0.1ha) shaded wetland seeps within upland forests, without trees growing in their shallow muck or muddy soils, and generally lacking extensive bryophyte cover .....**Enriched Hardwood Forest Seep (CEGL006409)**



**Appendix F.** Accuracy assessment data form for Marsh-Billings-Rockefeller National Historical Park.

**NATIONAL PARK VEGETATION MAPPING PROGRAM: ACCURACY ASSESSMENT POINT IDENTIFIERS/LOCATORS - Marsh-Billings-Rockefeller National Historical Park (MABI) – VT**

Field Point Code _____	Database Point Code _____
Primary Map Unit _____	Assoc Code/Name _____
Secondary Map Unit _____	Assoc Code/Name _____
Other Map Unit / Assoc within 50 m _____	
Key or Classification Comments: _____ _____	
GPS file name _____ Field UTM X _____ m E Field UTM Y _____ m N	
GPS Error _____ m GPS unit: <u>Garmin GPSMAP 60CSx, WAAS enabled, internal processing</u>	
<i>please do not complete the following information when in the field</i>	
Corrected UTM X _____ m E Corrected UTM Y _____ m N UTM Zone <u>18</u>	
Survey Date _____ Surveyors _____	Area surveyed:
Park Site Name: _____	25 m radius circle _____
Quad Name <u>Woodstock North</u>	other (describe) _____
Quad Code <u>4307265</u>	

**ENVIRONMENTAL DESCRIPTION**

Elevation _____ m Slope _____ Aspect _____	
Topographic Position _____	
Landform _____	
Environmental Comments (including hydrology): _____ _____	Unvegetated Surface: <i>(please use the cover scale below)</i> <input type="checkbox"/> Bedrock <input type="checkbox"/> Litter, duff <input type="checkbox"/> Wood (> 1 cm) <input type="checkbox"/> Large rocks (cobbles, boulders > 10 cm) <input type="checkbox"/> Small rocks (gravel, 0.2-10 cm) <input type="checkbox"/> Sand (0.1-2 mm) <input type="checkbox"/> Bare soil <input type="checkbox"/> Other: _____

**VEGETATION DESCRIPTION**

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Unvegetated Surface
<u>Trees and Shrubs</u>			
<input type="checkbox"/> Evergreen	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Forest	01 5%
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Needle-leaved	<input type="checkbox"/> Woodland	02 10%
<input type="checkbox"/> Mixed evergreen - cold-deciduous	<input type="checkbox"/> Mixed Broad/Needle leaved	<input type="checkbox"/> Shrubland	03 20%
<input type="checkbox"/> % evergreen _____% deciduous	<input type="checkbox"/> Graminoid	<input type="checkbox"/> Dwarf Shrubland	04 30%
	<input type="checkbox"/> Forb	<input type="checkbox"/> Herbaceous	05 40%
<u>Herbs</u>	<input type="checkbox"/> Pteridophyte	<input type="checkbox"/> Nonvascular	06 50%
<input type="checkbox"/> Annual		<input type="checkbox"/> Sparsely Vegetated	07 60%
<input type="checkbox"/> Perennial			08 70%
			09 80%
			10 90%
			11 100%

Stratum	Height	Cover Class	Dominant / characteristic species (mark dominants "D" and diagnostic or characteristic species "**" )
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short Shrub	_____	_____	_____
S3 Dwarf-shrub	_____	_____	_____
H Herbaceous	_____	_____	_____
N Non-vascular	_____	_____	_____
V Vine/liana	_____	_____	_____
Comments:			
		Cover Scale:	
		Strata and	
		Species Strata	
		01	5%
		02	10%
		03	20%
		04	30%
		05	40%
		06	50%
		07	60%
		08	70%
		09	80%
		10	90%
		11	100%
		Height Scale:	
		01	<0.5 m
		02	0.5-1 m
		03	1-2 m
		04	2-5 m
		05	5-10 m
		06	10-15 m
		07	15-20 m
		08	20-35 m
		09	35-50 m
		10	>50 m

**Appendix G.** Index of representative photographs of vegetation classification sampling plots and accuracy assessment points at Marsh-Billings-Rockefeller National Historical Park.

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**Red Pine Plantation**

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**Rich Northern Hardwood Forest**

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## **Appendix H.** Bibliography for global vegetation descriptions from the U.S. National Vegetation Classification.

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