National Park Service
U.S. Department of the Interior

Northeast Region
Philadelphia, Pennsylvania

Vegetation Classification and Mapping of Bluestone National Scenic River, West Virginia

Technical Report NPS/NER/NRTR—2008/106

ON THE COVER
Sycamore - Yellow Buckeye Floodplain Forest along the Bluestone River (plot BLUE.104).
Photograph by J. P. Vanderhorst.

Addendum (April 2009) to Vegetation Mapping and Classification of Bluestone National Scenic River, West Virginia (Technical Report NPS/NER/NRTR – 2008/106).

The following redactions are necessary due to specimen misidentifications and taxonomic controversy. This page is the only revision to the original report. All redactions listed below apply to the entire report and appendixes.

Scientific Name	New Scientific Name	Common Name	New Common Name	Family	Division
Achillea millefolium L. var. *occidentalis* DC.	*Achillea millefolium* L.	western yarrow*	common yarrow*	Asteraceae	Magnoliophyta
Heuchera americana L. var. *hispida (Pursh) E. Wells*	*Heuchera pubescens* Pursh.	American alumroot	downy alumroot	Saxifragaceae	Magnoliophyta
Rubus deamii Bailey	*Rubus flagellaris* Willd.	Deam's dewberry	northern dewberry	Rosaceae	Magnoliophyta
Symphyotrichum oblongifolium (Nutt.) Nesom	*Symphyotrichum* Nees	aromatic aster	aster	Asteraceae	Magnoliophyta

* Taxa not native to North America north of Mexico (Harmon et al. 2006).

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

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Abstract

A vegetation classification and map were developed by the West Virginia Natural Heritage Program for Bluestone National Scenic River following the standards of the U.S. Geological Survey / National Park Service Vegetation Mapping Program. Classification was based, in part, on multivariate analysis of complete floristic data from 135 plots sampled in 2003–2005. The classification for the park was crosswalked to the U.S. National Vegetation Classification in consultation with NatureServe. A digital vegetation map was produced using Geographic Information System software. Base layers for vegetation mapping included two digital orthophoto mosaics of the park developed by North Carolina State University from aerial photography flown for this project in March 2003 and October 2004. Spatial and thematic accuracy assessments were performed by North Carolina State University.

Vegetation of the park was classified in 22 associations of the U.S. National Vegetation Classification including 12 upland types and 10 riparian types. Prevailing physiognomic expressions include 17 forest associations, four woodland associations, and one herbaceous association. The vegetation map includes 24 map classes. Upland forests and woodlands comprise about 85% of the park area and are represented by 12 map classes, each class being a USNVC association. Three major forest associations (Oak - Hickory - Sugar Maple Forest, Oak - Eastern White Pine / Ericad Forest, and Sugar Maple - Yellow Buckeye - American Basswood Forest) comprise about 70% of the park area. Riparian vegetation comprises about eight percent of the park area and is represented by five map classes, including two map classes comprised of multiple associations. These five riparian map classes represent a total of 12 associations, two of which are upland forest and woodland associations. Four percent of the park is mapped as natural waterways and the remaining three percent is mapped as disturbed areas and cultural and transportation features. Overall thematic accuracy of the vegetation map was estimated to be 92.2%.

Executive Summary

A vegetation classification and map were developed by the West Virginia Natural Heritage Program for Bluestone National Scenic River (BLUE) following the standards of the U.S. Geological Survey / National Park Service Vegetation Mapping Program. Standards include a minimum mapping unit of 0.5 ha (1.23 ac) and classification accuracy of 80% or greater for each map class. The U.S. National Vegetation Classification (USNVC) was used as the standard for vegetation classification.

Classification was based, in part, on multivariate analysis of complete floristic data from 135 plots sampled in 2003–2005. Plots were stratified to cover the geographic range and ecological gradients within the park. Multivariate analyses of plot data included hierarchical agglomerative cluster analysis, non-metric multidimensional scaling, and indicator species analysis. The classification for the park was crosswalked to the USNVC in consultation with NatureServe.

Vegetation of the park was classified in 22 USNVC associations including 12 upland types and 10 riparian types. Prevailing physiognomic expressions include 17 forest associations, four woodland associations, and one herbaceous association. One association new to the USNVC, the Eastern Hemlock Floodplain Forest, was recognized and described for the first time. Three upland forest associations are currently considered globally rare and five riparian associations are likely to be globally rare but have not yet been assigned formal global conservation ranks.

A digital vegetation map for BLUE was developed as a personal geodatabase using Environmental Systems Research Institute ArcGIS software. The geodatabase includes a point feature class for locations of plots and two polygon-feature classes (clipped by the park boundary and unclipped) for vegetation, including non-vegetated land cover. Delineation of vegetation map classes was based on interpretation of two digital orthophoto mosaics developed by North Carolina State University from leaf-off color infrared aerial photography flown in March 2003 and leaf-on color infrared aerial photography flown in October 2004.

The vegetation map for BLUE includes 24 map classes. Approximately 93% of the park area is mapped as natural and semi-natural vegetation and an additional four percent is mapped as natural waterways. The remaining three percent is mapped as disturbed areas and cultural and transportation features.

Upland forests and woodlands comprise about 85% of the park area and are represented by 12 map classes, each map class equivalent to a single association. Three major forest associations comprise about 70% of the park area. The Sugar Maple - Yellow Buckeye - American Basswood Forest is the predominant association on cool, moist aspect gorge slopes with fertile soils. The Oak - Eastern White Pine / Ericad Forest is the predominant association on warm slopes with relatively infertile soils. The most abundant association in the park, the Oak - Hickory - Sugar Maple Forest, occurs in positions with intermediate soil moisture and fertility. Smaller areas of uplands are mapped as three mixed conifer-deciduous forest associations codominated by eastern hemlock (Eastern Hemlock - American Basswood Forest, Eastern Hemlock - Chesnut Oak Forest, and Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest) which occur on cooler aspects, the Calcaeourous Oak Forest and Virginia Pine - Oak

Shale Woodland which occur in specialized habitats on warm aspects, and four semi-natural successional forest/woodland associations (Successional Black Locust Woodland, Successional Eastern White Pine - Tuliptree Forest, Successional Tuliptree / Northern Spicebush Forest, and Successional Virginia Pine Forest) which occur in areas previously cleared for agriculture.

Riparian vegetation comprises about eight percent of the park area and is represented by five map classes and 12 associations, including two successional forest associations also found in the uplands. Most of the area of riparian vegetation in the park is mapped as two complex map classes which include patches of multiple associations. The Floodplain Forest and Woodland map class includes five associations (Eastern Hemlock Floodplain Forest, Oak - Hickory Floodplain Forest, Riverbank Tall Herbs, Sycamore - River Birch Riverscour Woodland, and Sycamore - Yellow Buckeye Floodplain Forest) which represent natural vegetation in areas that were not converted to or have long recovered from agriculture and are not currently affected by reservoir backup from Bluestone Lake. The Modified Successional Floodplain Forest and Woodland map class includes seven associations (River Birch Backwater Floodplain Forest, Riverbank Tall Herbs, Successional Black Walnut Floodplain Forest, Successional Box-elder Floodplain Forest, Successional Eastern White Pine - Tuliptree Forest, Successional Tuliptree / Northern Spicebush Forest, and Sycamore - Ash Floodplain Forest) which represent semi-natural and disturbed vegetation in areas that were more recently abandoned from agriculture and/or are currently affected by reservoir backup from Bluestone Lake.

Spatial and thematic accuracy assessments were performed by North Carolina State University. Thematic accuracy of 18 map classes was assessed, excluding five non-vegetated map classes and one vegetation map class known from just one polygon. Producer's and user's accuracy of individual map classes ranges from 83.3–100%. Overall thematic accuracy of the vegetation map was estimated to be 92.2%.

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Introduction

This report describes vegetation classification and mapping of Bluestone National Scenic River (BLUE) in southern West Virginia. This project fulfills an important goal of the National Park Service Inventory and Monitoring Program and was completed following standards of the U.S. Geological Survey (USGS) / National Park Service (NPS) Vegetation Mapping Program (USGS 2001).

USGS / NPS Vegetation Mapping Program products meet Federal Geographic Data Committee (FGDC) standards for vegetation classification and metadata, and national standards for spatial accuracy. Standards include a minimum mapping unit of 0.5 ha (1.23 ac) and classification accuracy of 80% or greater for each map class. The U.S. National Vegetation Classification (USNVC), maintained by NatureServe, is used as the standard for vegetation classification.

The USNVC represents the terrestrial component in the U.S. of an International Classification of Ecological Communities (Grossman et al. 1998). Ecological communities are classified and mapped to serve as a "coarse filter" for conservation of biological diversity. Although plants are used to classify terrestrial ecological communities, these units also include and represent species in all kingdoms.

The USNVC is a hierarchical system which uses physiognomy to define the coarsest levels, and floristic composition to define the finest levels of the classification (Grossman et al. 1998). The vegetation classification and map presented here for BLUE utilize the finest level of the USNVC, the association, as the basic unit. The association is floristically based, and is named and described based on dominant and diagnostic plant species. Dominant species are those with the highest cover in each stratum (canopy layer) of vegetation. Diagnostic species are those which differentiate a community from others, either by abundance, constancy, or fidelity. Thus, a typical plant association may be named after dominants of one or two strata (species in the same stratum are divided by a dash, species in different strata are divided by a forward slash) with or without diagnostic taxa added for further refinement. For example *Platanus occidentalis - Betula nigra / Cornus amomum / (Andropogon gerardii, Chasmanthium latifolium)* Temporarily Flooded Woodland indicates a riparian woodland community where the tree canopy is typically dominated by American sycamore (*Platanus occidentalis*) and river birch (*Betula nigra*), the shrub layer is characterized by silky dogwood (*Cornus amomum*), and big bluestem (*Andropogon gerardii*) and/or Indian woodoats (*Chasmanthium latifolium*) have high constancy in the herb layer. Nominate species in parentheses are those which may be important in some examples or geographical range but which may be uncommon or absent in others. Because the USNVC covers a broad geographic range, the association names may not always represent local vegetation very well; it is important to consider the entire concept, including the local description for the association.

This report and related database products also use local, park-specific, BLUE community type names for each association. For the example above, the BLUE community type name is Sycamore - River Birch Riverscour Woodland. Throughout the main body of this report associations are referred to by the BLUE community type name. Corresponding scientific names and alphanumeric identifiers (CEGL codes) for associations in the USNVC are listed in tables

and are used in some of the appendixes to this report. The terms “association” and “community type” are conceptually synonymous within the scope of this report.

Relationships between community types and map classes are usually one-to-one, but can sometimes be more complex. Most map classes for natural and semi-natural vegetation are more-or-less equivalent (excluding ectotones, inclusions, and errors) to community types (and corresponding USNVC associations) and these are named by the corresponding BLUE community type name. However, due to patchiness of vegetation or mapping constraints of scale and/or photointerpretation, some map classes include multiple community types. For example, patches of the Sycamore - Ash Floodplain Forest are not mapped individually, but are included along with several other community types in the Modified Successional Floodplain Forest and Woodland map class. Additional map classes which do not correspond to classified BLUE community types include aquatic, cultural, and disturbed areas and features.

Vegetation classification and mapping for BLUE was completed by the West Virginia Natural Heritage Program (WVNHP), part of the Wildlife Resources Section of the WV Division of Natural Resources (WVDNR). WVNHP classifies, conducts inventories for, maps, and maintains databases on the natural biological diversity of the state, including natural ecological communities and rare plants and animals. North Carolina State University Center for Earth Observation provided supporting products and services for this project, including development of a digital orthophoto mosaic and performance of spatial and thematic accuracy assessment. NatureServe, a private non-profit organization serving as the network coordinator for Natural Heritage Programs throughout the Americas, assisted with the crosswalk to the USNVC. While contributing to the needs of the NPS, this project has also developed tools and information which can be applied to classification, mapping, and conservation of natural communities on public and private lands throughout the state and region.

Study Area

The Bluestone National Scenic River (BLUE) is centered on a 17 km (10.5 mi) stretch of the Bluestone River which flows through a relatively unspoiled section of northeastern Mercer and southwestern Summers counties in southern West Virginia (Figure 1). The park begins approximately 3 km (1.8 mi) upstream from the mouth of Mountain Creek and follows the Bluestone River downstream to the boundary of Bluestone State Park. The proclamation boundary of the park encompasses approximately 1,755 ha (4,337 ac) mapped on the Flat Top and Pipestem 1:24,000 USGS quadrangles.

The park encompasses much of the inner Bluestone River gorge, most of Pilot ridge, 2 km (1.2 mi) of the lower section of the Little Bluestone River, and a few smaller named tributaries (Indian Branch, Mountain Creek, and Tony Hollow). The park includes the Bluestone River and its tributaries and shores, and extends upslope to include small areas of alluvial floodplains, large areas of moderate to steep gorge slopes, and a few narrow ridge tops. Elevations in the park range from 435 m (1,429 ft) along the Bluestone River at the northern boundary to 730 m (2,389 ft) along the boundary on a ridge north of Tony Hollow.

Ecoregional assignment of the park is highly variable depending on which mapping system is used. The Environmental Protection Agency (Woods et al. 2003) includes the park within the Dissected Appalachian Plateau Level III Ecoregion within the Central Appalachian Level IV Ecoregion. The United States Forest Service (Bailey et al. 1994) places the park within the Northern Cumberland Mountains Section of the Central Appalachian Broad Leaf Forest - Coniferous Forest - Meadow Province. The Nature Conservancy places the park within the Central Appalachian Forest Ecoregion (Sotomayor 2004).

The climate of the park is a humid continental type characterized by marked seasonal temperature changes and relatively uniform precipitation throughout the year. Mean monthly temperatures at nearby Bluestone Lake (elevation 423 m [1,390 ft]) range from -0.44°C (31.2°F) in January to 22.9°C (73.3°F) in July (NOAA 2002). Normal annual precipitation at Bluestone Lake is 95.8 cm (37.72 in) and monthly precipitation ranges from 6.4 cm (2.52 in) in October to 10.6 cm (4.19 in) in July (NOAA 2002).

The bedrock geology of the park is mapped as Hinton, Bluestone, and Princeton formations of the Mauch Chunk Group (Cardwell et al. 1968). These Mississippian-aged formations consist primarily of shale and siltstone with lesser amounts of sandstone and limestone. The older Hinton formation is the predominant formation in the park and forms the valley floor and most gorge slopes. The Hinton formation includes partly calcareous shales and siltstones and the Stony Gap Member of the Avis Limestone (Englund et al. 1977; Englund et al. 1982). Smaller areas of the younger Bluestone and Princeton formations outcrop on the upper gorge slopes and plateaus of the park.

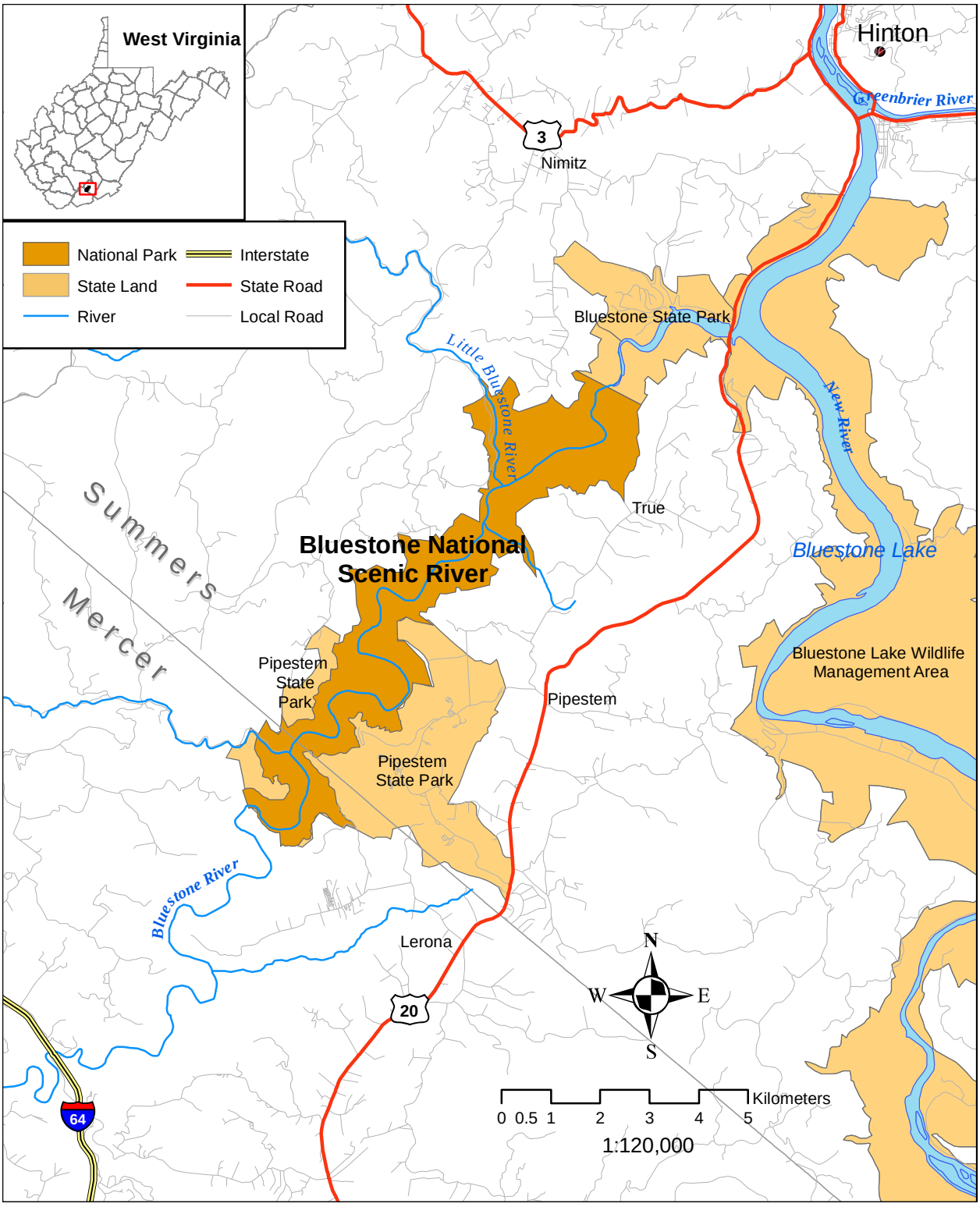


Figure 1. Bluestone National Scenic River, West Virginia, and vicinity.

Soils within the park are mapped as the Calvin high base substratum - Berks - Gilpin association and are described as moderately deep, strongly sloping to very steep, well-drained, lime-influenced and acidic soils (Sponaugle et al. 1984). Three major soil series are mapped here. The Calvin series is made up of moderately deep, well-drained soils formed in weathered acidic and lime-influenced shales, siltstones, and sandstones. The Berk series and the Gilpin series are made up of moderately deep, well-drained soils formed in weathered acidic shales, siltstones, and sandstones. Minor soil series occurring in the park include the Coolville, Dekalb, Latham, Lily, and Tilsit series on uplands, the Ernest, Jefferson, and Shouns series on footslopes, and the Orrville series on floodplains (Sponaugle et al. 1984).

Previous species-level botanical studies of the park include a floristic inventory and a rare plant survey. Oxley (1975) completed a floristic inventory of the Indian Branch Gorge of Pipestem State Park, which is located entirely within the current BLUE proclamation boundary. Norris (1992) surveyed and mapped locations of rare, threatened, and endangered plants and animals in the park. A floristic inventory was also conducted for the park in conjunction with the vegetation classification and mapping project described in this report. Methods and results of this floristic inventory are presented in a separate report (Streets et al. 2008).

Ecological studies on vegetation patterns in the park were conducted by researchers from West Virginia University. Grafton (1993) established two transects to compare vegetation occurring on moist and dry sites in the park. Fortney et al. (1994) completed a reconnaissance vegetation study of the Bluestone, New, and Gauley River gorges with transects established within each gorge; the Bluestone Gorge transect was located within Pipestem State Park, just north of the tramway. Rentch et al. (2005) combined previous vegetation plot data (Grafton 1993; Fortney et al. 1994) and sampled additional plots to describe vegetation patterns in the lower Bluestone River Gorge, mostly within the park. They classified and described seven forest types based on cluster analysis of tree importance values and related these types to topographic and soil fertility gradients.

The park is included within the mixed mesophytic region of the eastern deciduous forest biome (Braun 1950). The vegetation of the park is characterized by extensive upland deciduous forests and mixed conifer-deciduous forests with smaller areas of floodplain forests and riparian communities. Common upland trees include red maple (*Acer rubrum* var. *rubrum*), sugar maple (*Acer saccharum* var. *saccharum*), yellow buckeye (*Aesculus flava*), mockernut hickory (*Carya alba*), pignut hickory (*Carya glabra*), shagbark hickory (*Carya ovata*), white ash (*Fraxinus americana*), tuliptree (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), sourwood (*Oxydendrum arboreum*), eastern white pine (*Pinus strobus*), white oak (*Quercus alba*), scarlet oak (*Quercus coccinea* var. *coccinea*), chestnut oak (*Quercus prinus*), northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), American basswood (*Tilia americana*), and eastern hemlock (*Tsuga canadensis*). Additional tree species common on floodplains include boxelder (*Acer negundo* var. *negundo*), river birch (*Betula nigra*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), black walnut (*Juglans nigra*), and American sycamore (*Platanus occidentalis*).

The area of the park has a long history of human influence and occupation starting with Paleo-Americans and continuing to the present (Rentch et al. 2005). In the late 1700s the first permanent white settlements were established along the river, including the historical town of

Lilly at the the confluence of the Bluestone and Little Bluestone rivers. Rock piles and walls, which can still be seen on floodplains, lower gorge slopes, and benches in the park, attest to these early agricultural settlements. Topographic maps from 1912 (Big Bend 7.5' quadrangle) and 1929 (Flattop 7.5' quadrangle) show large unforested areas and numerous buildings on gentle topography in the park, indicating the extent of settlement and agricultural activity. Large scale commercial logging commenced in the late 1800s and by the early 1900s there were only a few remaining tracts of virgin forest (Brooks 1910). Logging continued through the 1950s; average tree ages of upland forest stands in the park determined by a recent study ranged from 54 to 100 years although some older individual remnant trees were also found (Rentch et al. 2005).

In the 1940s, the area of the park was depopulated after the U.S. Army Corps of Engineers exercised eminent domain to facilitate construction of Bluestone Dam (Lilly 1998). Bluestone Lake was first flooded behind the dam in 1949. BLUE was established as a National Park Service unit by Public Law 100-534 on October 26, 1988. It was created from sections of Pipestem State Park, Bluestone State Park, and Bluestone Wildlife Management Area (U.S. Army Corps of Engineers land leased to the state of West Virginia).

Although BLUE is a designated National Scenic River, the Bluestone River is not entirely free flowing within the park. Lower reaches of the Bluestone and Little Bluestone rivers in the park are subject to occasional flooding by reservoir backup from Bluestone Lake. Yearly maximum pool elevation of Bluestone Lake from 1950–2007 ranged from 430–459 m (1,411–1,506 ft) (U.S. Army Corps of Engineers, unpublished data). High water events usually occurred during winter and early spring but sometimes occurred during the growing seasons. Effects of reservoir backup are most evident below the confluence of the Bluestone River with the Little Bluestone River (elevation 436 m [1,430 ft]), while river reaches upstream from Pilot Ridge (elevations >459 m [1,506 ft]) have never been affected.

Today, the area of the park is again almost entirely forested and nearly roadless. Motorized access to the park is limited to an aerial tramway and an admistrative road which terminate at Mountain Creek Lodge, a hotel and restaurant along the Bluestone River operated by Pipestem State Park. A pedestrian trail, the Bluestone Turnpike Trail, runs along the Bluestone River on river left, connecting Bluestone State Park to Pipestem State Park, and there are a few other trails connecting the river to gorge tops in Pipestem State Park where it overlaps with BLUE.

Methods

Vegetation Classification

The vegetation classification for BLUE was based in part on multivariate analysis of floristic plot data. Landform and ecological land unit (ELU) models were developed for the park to assist with plot stratification. These models were developed using ArcGIS following AML code developed by The Nature Conservancy (Biasi 2001) with modifications appropriate for the study area (Bender 2003). The landform model was developed from a 30 m digital elevation model, using moisture and topographic position indices combined with slope and aspect to classify 14 landform types (steep slope N/NE, steep slope S/SW, slope crest, upper slope, flat summit/ridge, sideslope N/NE, cove/ravine N/NE, sideslope S/SW, cove/ravine S/SW, dry flat, moist flat, slope bottom, stream, and river). Due to the scale and precision of the digital elevation model many areas of floodplain along the Bluestone River were classified as river. The ELU model combines the 14 landforms with two elevation classes (<426 m and >426 m [<1,700 ft and >1,700 ft]) to classify 27 units which occur in the park (Table 1). Running tallies of plots sampled within each ELU type were maintained, and an attempt was made to stratify plot sampling in ELU types in proportion to the area and community diversity within the ELU type. Representative polygons of undersampled ELU types were selected in the office using GIS, and GPS units were used in the field to navigate to these polygons to sample plots. Despite this, due to poor GPS reception and other logistical difficulties, some uncommon ELU types were not sampled, and there is some sampling inequity among more common types (Table 1). Plots were also sampled to document unique vegetation types which were recognized in the field or from aerial imagery. One hundred and thirty five vegetation plots were sampled within or very close to the boundary of the park (Figure 2) during the growing seasons of 2003–2005.

Methods for sampling plots for this project are consistent with standards of the U.S. Geological Survey / National Park Service Vegetation Mapping Program (TNC and ESRI 1994a) and the Ecological Society of America (2002). The standard vegetation plot field form used for this project in 2003 was Form 3: Quantitative Community Characterization (Sneddon 1993). In 2004 and 2005, the West Virginia Natural Heritage Program Vegetation Plot Form was used. Completed examples of both of these forms are provided in Appendix A. Plots were placed in the field to sample homogenous vegetation representative of the stand (Mueller-Dombois and Ellenberg 1974) and, usually, to avoid disturbed sites and weedy areas. Plots were typically 20×20 m^2 (65×65 ft^2), but size and shape were sometimes altered to accommodate small patch and linear communities. When satellite reception was possible, coordinates for plot locations were collected using Trimble GPS units and these positions were post-process differentially corrected. When satellite reception was poor, Garmin GPS units were used or the plot locations were mapped by hand on topographic maps. Photographs were taken of most plots. Three types of data were collected: metadata, environmental data, and vegetation data. Metadata included plot code, directions to the plot, representativeness, surveyors' names, sampling date, location coordinates, and associated GPS files.

Table 1. Ecological Land Unit (ELU) codes, specifications, area, and plot sampling stratification within Bluestone National Scenic River. ELUs are listed in order of abundance (hectares).

ELU	Elevation	Landform	Hectares	# Plots Sampled
2311	>1700 ft	steep slope S/SW	284.50	18
1333	<1700 ft	slope bottom	229.19	39
2310	>1700 ft	steep slope N/NE	228.02	10
2313	>1700 ft	upper slope	117.79	10
1321	<1700 ft	cove/ravine N/NE	101.26	6
2323	>1700 ft	cove/ravine S/SW	95.58	5
1323	<1700 ft	cove/ravine S/SW	90.69	1
1311	<1700 ft	steep slope S/SW	88.09	8
2321	>1700 ft	cove/ravine N/NE	77.81	3
1341	<1700 ft	river	70.51	11
1310	<1700 ft	steep slope N/NE	67.36	3
2312	>1700 ft	slope crest	61.69	6
2314	>1700 ft	flat summit/ridge	43.39	3
2322	>1700 ft	sideslope S/SW	35.63	1
2320	>1700 ft	sideslope N/NE	31.84	1
1330	<1700 ft	dry flat	30.89	2
1320	<1700 ft	sideslope N/NE	16.15	1
1313	<1700 ft	upper slope	15.33	1
2330	>1700 ft	dry flat	14.64	1
2333	>1700 ft	slope bottom	12.36	0
1331	<1700 ft	moist flat	12.27	3
1322	<1700 ft	sideslope S/SW	9.66	1
1314	<1700 ft	flat summit/ridge	7.70	1
1340	<1700 ft	stream	6.00	0
2340	>1700 ft	stream	4.61	0
1312	<1700 ft	slope crest	1.09	0
2331	>1700 ft	moist flat	0.76	0
Totals			1,754.81	135

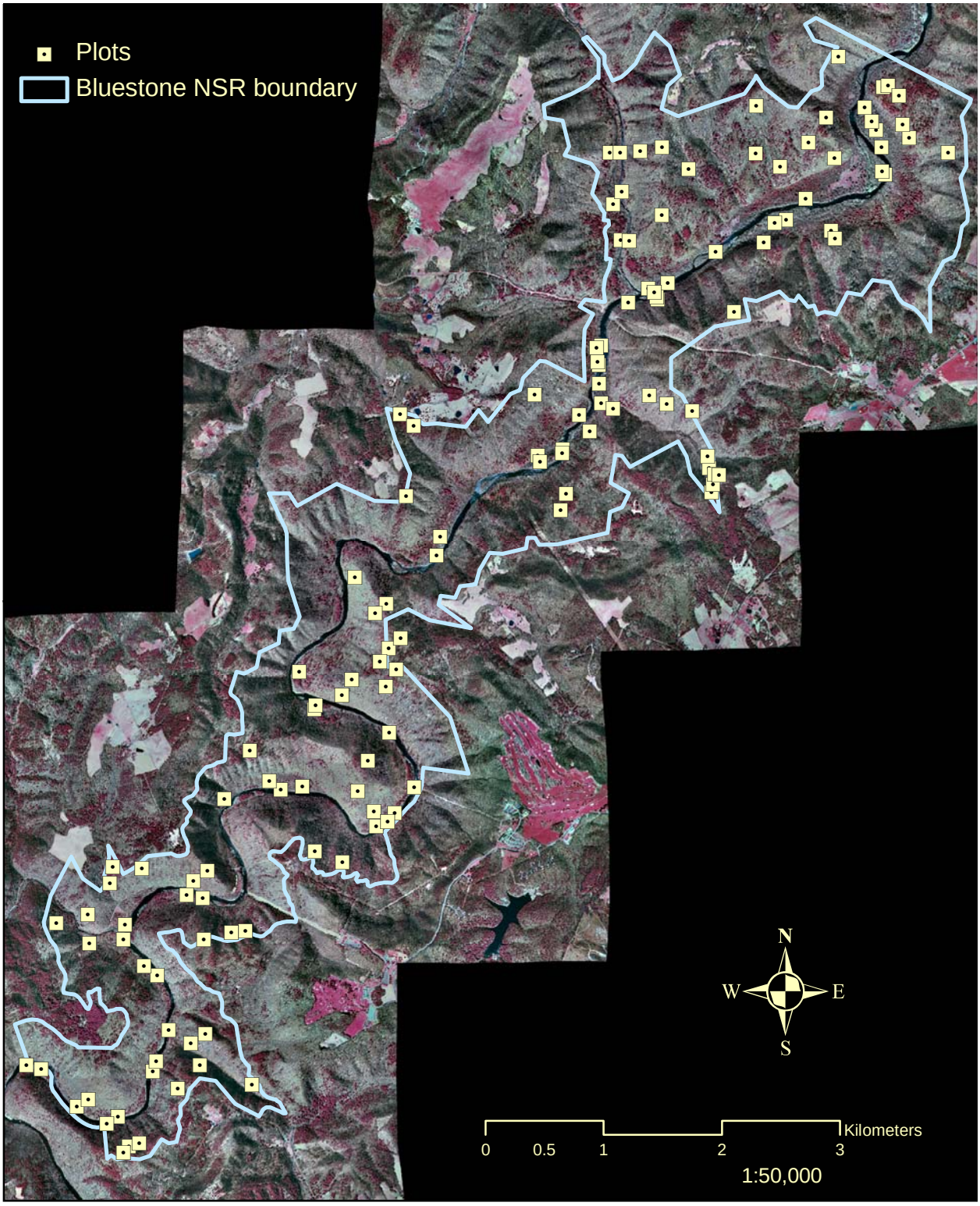


Figure 2. Locations of plots sampled for vegetation classification and mapping of Bluestone National Scenic River. Background is an orthomosaic of leaf off color-infrared aerial photography flown in April 2003.

Environmental plot data included environmental comments, landscape comments, slope, aspect, elevation, and information on geology, landform, topographic position, hydrology, and soils. Soil information included a profile description, texture determined by hand in the field, and pH determined in the field. Soil samples were collected from plots for chemical analysis. The surface organic layer was scraped off and soil was collected from the top 10–15 cm (4–6 in) of the mineral horizon from three to five subsamples scattered around each plot. Subsamples from each plot were combined and mixed, the soil was dried and sieved, and 50-g (1.6-oz) samples were sent to Brookside Laboratories Inc. (New Knoxville, OH) for chemical analysis; tests included total exchange capacity, pH, % organic matter, estimated N release, and ppm S, P, Ca, Mg, K, Na, B, Fe, Mn, Cu, Zn, and Al (Brookside Laboratories Inc. 2008).

Vegetation plot data included information on physiognomy (structure) and species composition. Height and percent cover of each stratum (canopy, subcanopy, tall shrub, short shrub, herb, and nonvascular) were estimated. Physiognomic type (forest, woodland, shrubland, herbaceous, non-vascular, and sparsely vegetated) of the stand was determined according to the definitions provided in Appendix B (adapted from Sneddon 1993; TNC and ESRI 1994a). Diameter at breast height (dbh) was measured for all woody stems greater than 7 cm (2.75 in) dbh. All vascular plants in plots were identified and percent cover in each stratum by each taxon was determined by ocular estimation. Starting in 2004, total cover by each taxon (combining cover in all strata but not including overlap) was also recorded. Percent cover by individual bryophytes and lichens was recorded for species having greater than 1% cover. Primary references used in the field to key out vascular plants included Flora of West Virginia (Strausbaugh and Core 1977) and Manual of Vascular Plants of Northeastern United States and Canada (Gleason and Cronquist 1991). Bryophyte collections were identified by Susan Studlar (WV University) and lichen collections were identified by Don Flenniken, author of the Macrolichens in West Virginia (Flenniken 1999).

A collection-based floristic inventory of BLUE was conducted in concurrence with plot sampling for vegetation classification. Because of this, a large proportion of the vascular plant species identified in vegetation plots was collected from the park and deposited in herbaria of the NPS in Glen Jean, WV, and West Virginia University in Morgantown, WV. Details on the methods and results of the floristic inventory are covered in a separate report (Streets et al. 2008).

Data from plots were entered in the Plots database version 2.0 (NatureServe 2004), an Access application developed for the USGS / NPS Vegetation Mapping Program. Plots were assigned alphanumeric plot codes beginning with BLUE. Nomenclature for vascular plants follows the Checklist and Atlas of the Vascular Flora of West Virginia (Harmon et al. 2006), except for *Dichanthelium* and *Panicum* which follow the Flora of North America (Freckmann and Lelong 2003). Nomenclature for mosses and liverworts (Bryophyta) follows the Annotated Checklist of the Hornworts, Liverworts, and Mosses of West Virginia (Studlar et al. 2002). Nomenclature for lichens (Ascomycota) follows Lichens of North America (Brodo et al. 2001) except *Cladina* is used for reindeer lichens not identified to the species level. Nomenclature for mushrooms (Basiodmycota) follows Mushrooms of West Virginia and the Central Appalachians (Roody 2003). These references are the standards used by WVNHP for vegetation plots and represent the most complete, up-to-date, and consistent taxonomy available for West Virginia. Nomenclature for 96% (all but 26) of the taxa is also consistent with the excepted name listed in the PLANTS database (USDA, NRCS 2008).

Multivariate analysis, utilizing PC-Ord software (McCune and Mefford 1999), was used to provide insight for classification of vegetation. This was an iterative process which involved analyses of various sets and subsets of plot data, using one-way and two-way hierarchical agglomerative cluster analysis, non-metric multidimensional scaling (NMS), and indicator species analysis. Data screening for all analyses included elimination of all nonvascular taxa, vascular taxa with uncertain identification or identified to the generic or higher taxonomic level, and taxa which occurred in only one plot. Outlier plots were identified and removed from analyses because they can have large effects on outcomes and conclusions (McCune and Grace 2002). Several data transformations were tried but most analyses performed best with cover values square-root transformed. Cluster analysis was performed on the entire data set and on various subgroups. Cluster analysis was run using the Sorenson distance measure and Flexible Beta group linkage method with Beta set to -0.25. Indicator species analysis (Dufrêne and Legendre 1997) was used to identify the species which help define the groups. NMS was run on smaller subgroups, either defined by the cluster analysis or by physiognomy (e.g. deciduous forest, herbaceous) or hydrology (e.g. upland, riparian). NMS was run using the Sorenson distance measure and the auto-pilot mode in PC-Ord set to "slow and thorough."

The final vegetation classification for the park also incorporates information gained from plot environmental data, plot data from other WV sites (Vanderhorst 2000a, 2001a, 2001b, 2002a, 2002b; Vanderhorst and Streets 2006; Vanderhorst et al. 2007; WVNHP 2007), and aerial imagery interpretation, and has been molded by a need for conformity with the USNVC. Because of this, and the realization that plot sampling is always an imperfect representation of the total range of variability in complex systems, the classification does not conform to the results of any one multivariate analysis.

After the final classified BLUE community types (putative associations) were decided upon, individual plots were attributed to each community type. Six plots were not assigned to community types because they represented ectotones, disturbed areas, or seemingly unique vegetation. Indicator species analysis was run on various subgroupings to identify plant species most useful for distinguishing types in the field. Floristic constancy/cover tables and plot floristic synthesis tables were developed for each community type using Access queries and Excel pivot tables. Similar summary tables were produced for environmental variables using Access queries. A key to vegetation community types (Appendix C) was developed to facilitate identification of BLUE community types in the field based on floristic and environmental variables, and was provided to North Carolina State University to serve as the basis for assessing thematic accuracy of the completed vegetation map.

The vegetation classification for the park was crosswalked to the USNVC in consultation with NatureServe ecologists. Data from each BLUE community type was compared to existing associations in the USNVC and decisions were made either to place the local types in existing associations or to develop new associations. Final revisions to the USNVC crosswalk were made following thematic accuracy assessment of the vegetation map, resulting in two changes to the classification as it was presented in the key to vegetation community types which was used for accuracy assessment (Appendix C). These changes were the lumping of two community types (Sycamore - River Birch Riverscour Woodland and River Birch / River Oats Floodplain Woodland) into one association (Sycamore - River Birch Riverscour Woodland), and recognition of one association that was not included in the key (Sycamore - Ash Floodplain Forest). These

changes affected riparian associations that were mapped within complex map classes consisting of multiple associations, and therefore they do not affect the validity of the accuracy assessment results for any map class.

Data from the floristic and environmental tables were used to write local association descriptions and new global USNVC association descriptions, and to edit existing global USNVC association descriptions to accommodate BLUE vegetation. Local and global descriptions were entered in Biotics, the central database for biodiversity information maintained by NatureServe.

Aerial Photography Acquisition and Processing

Two digital orthophoto mosaics, leaf-off and leaf-on, were created for Bluestone National Scenic River (BLUE). Sanborn Mapping Company, Inc. acquired 43 aerial photographs for the leaf-off mosaic on March 27, 2003 and a second set of 43 aerial photographs for the leaf-on mosaic on October 7, 2004. Both sets of aerial photographs are 1:12,000 scale, color infrared, stereo pairs. The photographs were delivered to the National Park Service (NPS), quality checked, accepted as provided, and sent to North Carolina State University (NCSU). Upon receipt at NCSU, they were counted to make sure that none were missing, scanned and saved in TIFF format, and placed in the archive that NCSU maintains for the NPS Northeast Region Inventory and Monitoring Program. The airborne global positioning system (GPS) and inertial mapping unit (IMU) data, flight report, camera calibration certificate, and digital flight index map provided by Sanborn Mapping Company, Inc. for each set of aerial photographs are also stored in the NCSU archive.

The leaf-off and leaf-on mosaics were each produced from 43 color infrared aerial photographs scanned at 600 dpi with 24-bit color depth. For each mosaic, scanned TIFF images of the aerial photographs were imported into ERDAS IMAGINE IMG format where a photo block was created using the airborne GPS and IMU data that Sanborn Mapping Company, Inc. supplied with the aerial photographs. Each photo block was manipulated until it could be triangulated with a root mean square error of less than one. Single frame orthophotos (one for each aerial photograph) were then generated within IMAGINE and exported to IMAGINE LAN format. The LAN files were imported into ER Mapper's native (ERS) format, and ER Mapper was used to define cutlines, color balance and mosaic the images, generate band interleaved by line (BIL) image and header files for each mosaic, and convert the BIL images to IMAGINE IMG format. The IMG image for each mosaic was compressed using MrSID software with a 20:1 compression ratio. The final mosaics, in both IMG and MrSID formats, are stored in the NCSU data archive.

Metadata records for each mosaic were prepared in accordance with the current Federal Geographic Data Committee standards (FGDC 1998a). Metadata were produced in notepad and parsed using the USGS metadata compiler (USGS 2004). After all errors and omissions identified by the parser were corrected, the metadata compiler was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the data archive. Key information for the leaf-off and leaf-on mosaics is summarized in Tables 2 and 3, respectively.

Table 2. Summary of key information for the Bluestone National Scenic River (BLUE) leaf-off mosaic.

Title of metadata record:	Bluestone National Scenic River Color Infrared Orthorectified Photomosaic - Leaf-off (ERDAS IMAGINE 8.6 IMG and MrSID formats)
Publication date of mosaic (from metadata):	15-Sep-2004
Date aerial photographs were acquired:	27-Mar-2003
Vendor that provided aerial photographs:	Sanborn Mapping Company, Inc.
Scale of aerial photographs:	1:12,000
Type of aerial photographs:	Color infrared, stereo pairs
Number of aerial photographs delivered:	43
Archive location of aerial photographs, airborne GPS and IMU data, flight report, camera calibration certificate, and digital flight index map:	North Carolina State University, Center for Earth Observation
Scanning specifications:	600 dpi, 24-bit color depth
Horizontal positional accuracy of mosaic:	1.31 meters, meets Class 1 National Map Accuracy Standard (Calculated for BLUE, Gauley River National Recreation Area (GARI) and New River Gorge National River (NERI) together)
Number of ground control points upon which estimated accuracy is based:	147 (for BLUE, GARI, and NERI together)
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Formats of archived mosaic:	IMG (uncompressed) and MrSID (20:1 compression)

Table 3. Summary of key information for the Bluestone National Scenic River leaf-on mosaic.

Title of metadata record:	Bluestone National Scenic River Color Infrared Leaf-on Orthorectified Photomosaic (ERDAS IMAGINE 8.7 IMG and MrSID formats)
Publication date of mosaic (from metadata):	Jul-2005
Date aerial photographs were acquired:	7-Oct-2004
Vendor that provided aerial photographs:	Sanborn Mapping Company, Inc.
Scale of aerial photographs:	1:12,000
Type of aerial photographs:	Color infrared, stereo pairs
Number of aerial photographs delivered:	43
Archive location of aerial photographs, airborne GPS and IMU data, flight report, camera calibration certificate, and digital flight index map:	North Carolina State University, Center for Earth Observation
Scanning specifications:	600 dpi, 24-bit color depth
Horizontal positional accuracy of mosaic:	1.60 meters, meets Class 1 National Map Accuracy Standard
Number of ground control points upon which estimated accuracy is based:	34
Method of calculating positional accuracy:	Root mean square error
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Formats of archived mosaic:	IMG (uncompressed) and MrSID (20:1 compression)

Vegetation Mapping

A vegetation map for BLUE was developed as a personal geodatabase using ESRI ArcGIS software. The geodatabase includes a point feature class for locations of plots, and two polygon feature classes (clipped by the park boundary and unclipped) for vegetation, including non-vegetated land cover.

The plots point feature class (Figure 2) was produced from locational coordinates collected using GPS units (Trimble Explorer3 and GeoExplorerXT; Garmin E-Trex) or from coordinates mapped by hand on topographic maps. Trimble GPS units were used to collect coordinates of plot locations whenever satellite reception was available. GPS data from Trimble units were post-process differentially corrected and exported as attributed GIS files using Trimble Pathfinder Office software. Locations determined by the Garmin unit were used for three plots when reception using a Trimble unit was poor. Locations of 13 plots were hand mapped on topographic maps because GPS reception was not possible with any unit due to poor satellite reception (most common on north slopes and in deep, narrow canyons). All plot points were combined in one feature class that includes attribute information on GPS methods and estimated accuracy for each point and BLUE community type names for each plot determined by the vegetation classification.

Delineation of vegetation map classes was based on interpretation of digital aerial imagery utilizing additional digital and non-digital data sources. The primary imagery used as base layers for mapping were the digital orthophoto mosaics of leaf-off color infrared aerial photography flown for this project in March 2003 and leaf-on color infrared aerial photography flown for this project in October 2004. Additional digital aerial imagery sets which were used included leaf-off color infra-red digital orthophoto quarter quads flown in spring 1996 (USGS 1995) and true color leaf-off orthophoto quarter quads flown in spring 2003 (WVSAMB 2005).

Transparencies of leaf-on color infrared aerial photography flown in October 2003 (Vanderhorst et al. 2007) and the original transparencies used to produce the orthophoto mosaics for this project were examined on a light table to help distinguish signatures which were not apparent on the digital imagery. Utilization of these multiple sets of aerial photography often helped to overcome deficiencies (e.g. shading) of the primary orthophoto mosaics. Ancillary GIS layers used to assist photointerpretation included digital rastor graphs of USGS topographic maps and the landform and Ecological Land Unit models developed for this project.

Aerial imagery interpretation was initiated by examining signatures throughout the park in relation to GIS-mapped plot locations. Selection of map classes was driven by the imagery. When individual associations could be reliably mapped, these were chosen as map classes. Complex map classes were used when individual associations could not be distinguished due to tight zonation or patchiness. Map classes were also developed for aquatic, cultural, and disturbed areas and features. The stated minimum mapping unit for this project was 0.5 ha (1.23 ac), but smaller polygons were sometimes delineated for small patch or linear types with distinct signatures. Small creeks were mapped to the extent that their courses were visible on photography, with only short gaps estimated. Polygons were drawn using the ArcGIS editing tools with the screen set at various scales, commonly 1:3,000, depending on the vegetation patch size and distinctiveness of boundaries. Polygons were attributed with the name of the map class

and, sometimes, comments related to the vegetation or its photo signature. After a relatively complete list of map classes was established, an attribute domain (a constrained picklist of values) was created to limit map class names to this list. The domain was altered as a few additional map classes were identified. Topology was established to enforce rules for no gaps or overlaps. All areas within the park boundary were mapped and mapping was usually extended somewhat beyond the boundary to insure complete coverage. Mapping was extended to cover the park boundaries as shown on USGS topographic maps when these were located outside the area included within the park boundary of the GIS boundary layer (bluebnd01.shp) provided by the NPS.

A field was included in the vegetation map attribute table to indicate which United States Fish and Wildlife Service wetland system (Cowardin et al. 1979) a map class represents. Polygons representing USNVC associations which are classified as wetland formations (i.e. those with hydrologic modifiers of "temporarily flooded" in the formation name) were attributed "palustrine." Polygons of two complex floodplain map classes (Floodplain Forest and Woodland and Modified Successional Floodplain Forest and Woodland), which are comprised of multiple USNVC associations, were also attributed as palustrine. Polygons representing USNVC associations that are not classified as wetland formations were attributed as "upland." Wetland status of individual polygons of the Developed Area, Disturbed Area, and Utility Corridor map classes, which do not represent USNVC associations, were attributed as palustrine or upland depending on landscape position, adjacent map classes, plot data, and air photo signature. All polygons of the Road and Trail map classes were attributed as upland although some sections may cross wetlands. Polygons of the River and Creek map classes were attributed as "open water." These attributions are not intended to represent a rigorous delineation of jurisdictional wetland status, but they do identify polygons where jurisdictional wetlands are most likely to occur. The actual area of jurisdictional wetlands is contained in a polygon attributed palustrine is likely to be less than the actual area of the polygon due to inclusions of uplands in the floodplain map classes; whereas, polygons attributed upland may actually contain jurisdictional wetlands due to small wetland inclusions in the upland map classes.

A few changes were made to the vegetation map after results of thematic accuracy assessment were received from North Carolina State University. Aerial photo signatures of all misclassified accuracy assessment points were reviewed and polygons in the vegetation feature class were edited when appropriate. Most edits involved splitting polygons and reattributing the parts of the original polygon according to the correct classification determined by the accuracy assessment point. In a few cases the entire original polygon was reattributed or comments were added to indicate gradation or inclusions within the polygon. Comments were added to all edited polygons to indicate they were edited post accuracy assessment. The completed vegetation polygon feature class was clipped by the NPS park boundary layer and aerial statistics were calculated to summarize the relative abundance of each map class within the park.

Metadata records for each feature class in the vegetation map geodatabase were prepared in accordance with the current FGDC standards (FGDC 1998a). Metadata records were edited with ESRI ArcGIS, the NPS Metadata Tools and Editor, and Microsoft Notepad and were parsed using the USGS metadata compiler (USGS 2004). All errors and omissions identified by the parser were corrected. Metadata records are included within the final geodatabase for the vegetation map.

Accuracy Asessment

Positional Accuracy Assessment

Horizontal positional accuracy of the BLUE leaf-off mosaic was assessed in conjunction with leaf-off mosaics of Gauley River National Recreation Area (GARI) and New River Gorge National River (NERI) because aerial photographs for all three mosaics were acquired in a single flight with the same camera and with one set of airborne GPS and IMU data. Positional accuracy of the BLUE leaf-on mosaic was assessed independently. Guidelines of the USGS/NPS Vegetation Mapping Program (ESRI, NCGIA, and TNC 1994) were followed in both cases. Well-defined positional accuracy ground control points were placed throughout all quadrants of each mosaic in ArcView (leaf-off mosaics) or ArcMap (leaf-on mosaic). Ground control points and zoomed-in screenshots of each point were plotted on hard copy maps with the mosaic as a background. These maps and plots were used to locate the ground control points in the field. Field staff recorded the ground control point coordinates with a Trimble ProXRS GPS unit with real-time differential correction. Mapped ground control points that were physically inaccessible were also noted. The field crew collected accuracy assessment data at 160 ground control points for the BLUE, GARI, and NERI leaf-off mosaics and at 35 ground control points for the BLUE leaf-on mosaic.

Prior to calculating accuracy, 13 ground control points for the BLUE, GARI, and NERI leaf-off mosaics were identified as outliers with SAS's JMP program and removed. The field-collected GPS coordinates for the remaining 147 points were compared to the coordinates obtained from the mosaics viewed in ArcView.

One ground control point for the BLUE leaf-on mosaic was similarly identified as an outlier with SAS's JMP program and removed. The field-collected GPS coordinates for the remaining 34 points were compared to the coordinates obtained from the mosaic viewed in ArcMap.

Both pairs of coordinates for each point were entered into spreadsheets in order to calculate horizontal accuracy (in meters). The accuracy calculation formula was based on root mean square error (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). Figures 3 and 4 show the distribution of the ground control points for the leaf-off and leaf-on mosaics, respectively.

Thematic Accuracy Assessment

The thematic accuracy of the vegetation map was assessed by the North Carolina State University Center for Earth Observation. The draft vegetation map from which accuracy assessment sampling points were selected consisted of 705 polygons representing 24 map classes (18 vegetation classes and six other land cover classes) covering a total area of 2,029 ha (5,013.75 ac). The total area covered by this draft vegetation map exceeds the total area of the park because it was not clipped to the park boundary (i.e., polygons located along the park

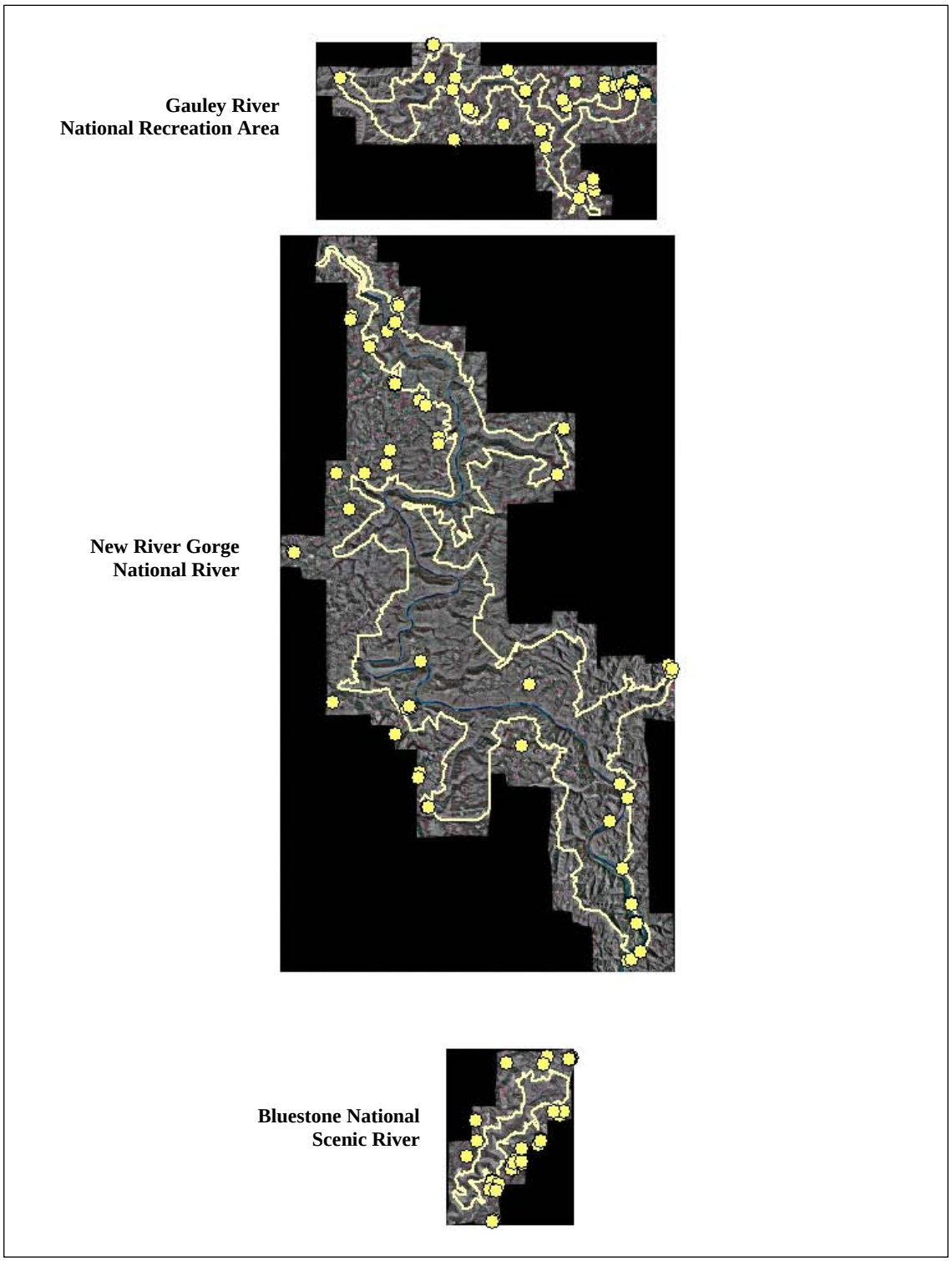


Figure 3. Ground control points used to calculate horizontal positional accuracy of the Gauley River National Recreation Area, New River Gorge National River, and Bluestone National Scenic River leaf-off mosaics.

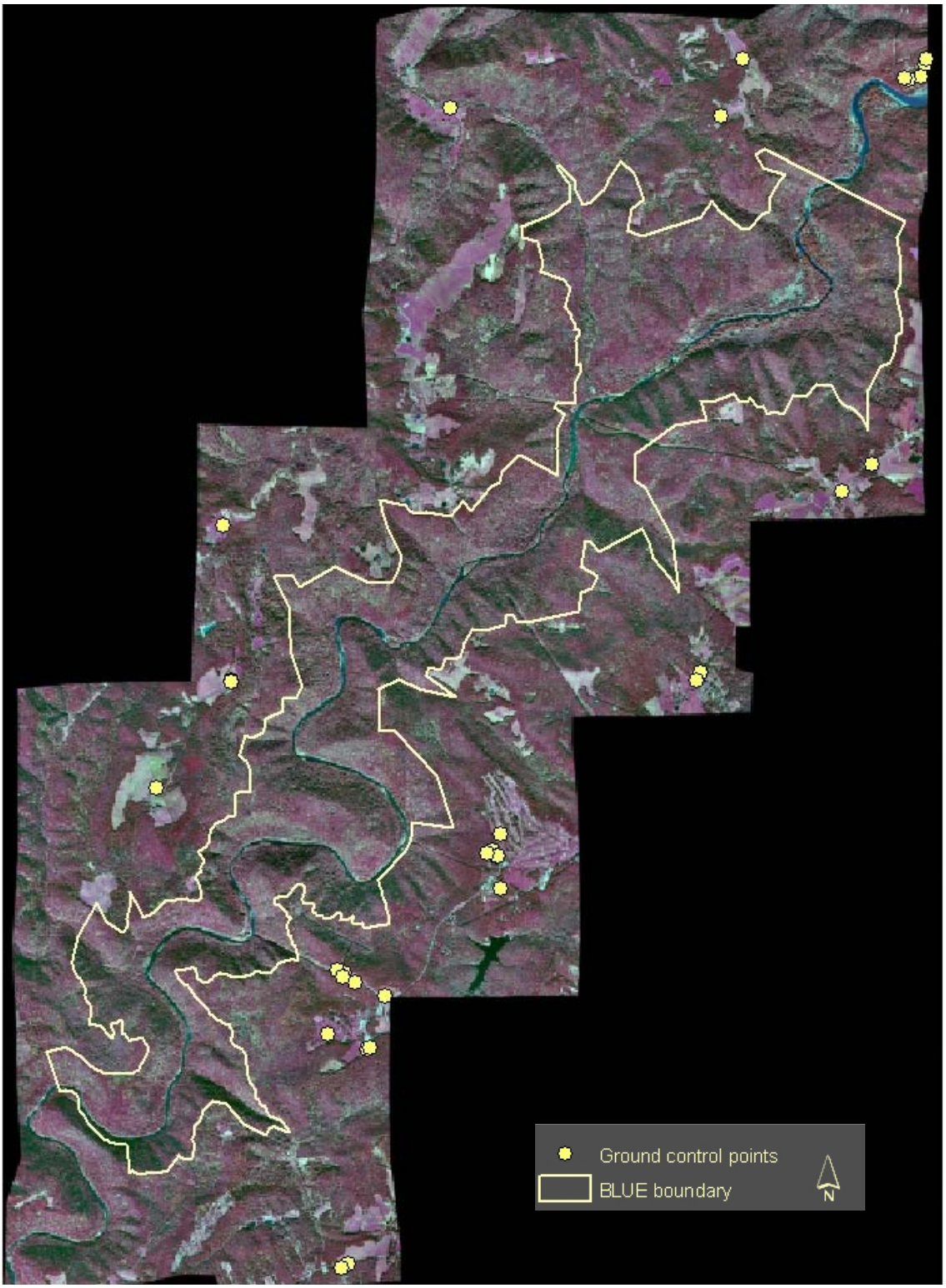


Figure 4. Ground control points used to calculate horizontal positional accuracy of the Bluestone National Scenic River (BLUE) leaf-on mosaic.

boundary extended beyond the boundary). Prior to selecting the sample of thematic accuracy assessment points, polygons were excluded from the sampling frame based on the following criteria:

- Polygons smaller than the minimum mapping unit of 0.5 hectares were excluded.
- Polygons representing non-vegetated land cover classes such as roads, trails, creeks, etc. were excluded.

Based on the criteria, one vegetation class, Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest, and five non-vegetated land cover classes, Creek, Developed Area, River, Road, and Trail, were excluded from the accuracy assessment. The Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest was excluded because it was mapped as a single small polygon which was plot-sampled and therefore known to be accurate.

Table 4 shows the 18 map classes that were included in the accuracy assessment. A total of 439 polygons covering 1,922 ha (4,749 ac) was used to determine the recommended number of accuracy assessment points for each map class (Table 4). Again, the total area of these 439 polygons exceeds the total area of the park because they were not clipped to the park boundary.

The recommended number of sample points per map class varies according to the rarity of the class in terms of number of polygons and total area, as follows (TNC and ESRI 1994b):

Scenario A: The class is abundant. It covers more than 50 ha (123.5 ac) 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 ha (123.5 ac), but consists of fewer than 30 polygons. In this case, the recommended sample size is 20.

Scenario C: The class is relatively rare. It covers less than 50 ha (123.5 ac), but consists of more than 30 polygons. In this case, the recommended sample size is 20.

Scenario D: The class is rare. It has more than five but fewer than 30 polygons and covers less than 50 ha (123.5 ac). In this case, the recommended sample size is five.

Scenario E: The class is very rare. It has fewer than five polygons and occupies less than 50 ha (123.5 ac). In this case, it is recommended that the existence of the class be confirmed by sampling one point per polygon.

Initially, a random sample of polygons stratified by vegetation map class was selected. Point locations within the sample polygons were selected using Hawth's Tools random point generator in ArcGIS (ESRI 2005; Beyer 2006). An ecologist collected field data at 83 of these sample point locations from May 21–25, 2007. These points were visited based on their geographic location, without regard to vegetation map class. The intent was to minimize field costs by first collecting data from the most accessible points in the most accessible areas of the park.

Table 4. Thematic accuracy assessment (AA) sampling strategy for the Bluestone National Scenic River vegetation map.

Map Class	Number of Polygons	Area Mapped (Hectares)	Minimum number of AA Points Recommended by Protocol[a]	Number of AA Points Visited
Vegetation Class				
Successional Black Locust Woodland	1	2.1	1	2
Successional Eastern Red-cedar Woodland	1	1.6	1	2
Sycamore - River Birch Riverscour Woodland	1	0.8	1	5
Eastern Hemlock Floodplain Forest	2	2.0	2	4
Successional Virginia Pine Forest	2	4.4	2	2
Calcareous Oak Forest	10	20.9	5	6
Successional Tuliptree / Northern Spicebush Forest	10	23.4	5	5
Virginia Pine - Oak Shale Woodland	14	27.5	5	9
Disturbed Area	15	39.8	5	21
Eastern Hemlock - Chesnut Oak Forest	22	45.0	20	30
Eastern Hemlock - American Basswood Forest	26	81.0	20	30
Modified Successional Floodplain Forest and Woodland	15	79.9	20	30
Floodplain Forest and Woodland	26	53.5	20	40
Successional Eastern White Pine - Tuliptree Forest	40	78.6	30	31
Sugar Maple - Yellow Buckeye - American Basswood Forest	40	223.7	30	30
Oak - Hickory - Sugar Maple Forest	93	694.9	30	30
Oak - Eastern White Pine / Ericad Forest	116	473.0	30	29
Other Land Cover Class				
Utility Corridor	5	70.0	5	4
Total	439	1922.0	232	310

[a]TNC and ESRI 1994

During the last week of May 2007, conversations with NPS personnel culminated in a decision to implement a point-based, rather than a polygon-based, sample design. In a polygon-based sampling design, every polygon has an equal chance of being sampled and, as a result, the probability of selection for a small polygon is the same as for a large polygon. In a point-based design, every minimum mapping unit in the map has an equal chance of being sampled, and therefore, it is likely that more than one sample point will fall in some of the largest polygons and that no sample points will fall in some of the smallest polygons. The USGS-NPS Vegetation Mapping Program recommends a point-based sampling design because it avoids potential bias due to oversampling of small polygons that is inherent in a polygon-based design (TNC and ESRI 1994b). During the first week of June 2007, a point-based, stratified random sample of all vegetation map classes included in the accuracy assessment was selected using Hawth's Tools in ArcGIS. Field data were collected at 227 of these sample locations from June 12–19, 2007.

Prior to collecting field data, sample points located close to polygon boundaries were moved to at least 30 m (98 ft) inside the polygon to avoid ecotones. In some cases, that was not possible, for example, where long, narrow polygons follow a linear pattern associated with the gorge or a

riparian zone. Examples of these types of vegetation and land cover classes are Floodplain Forest and Woodland, Modified Successional Floodplain Forest and Woodland, Sycamore-River Birch Riverscour Woodland, and Utility Corridor. In these cases, sample points were moved to a point approximately equidistant from the polygon perimeter. Fortunately, most of these vegetation and land cover map classes had fairly discrete boundaries that could be easily identified in the field.

Four vegetation map classes were intentionally oversampled. The Eastern Hemlock - Chestnut Oak Forest and the Eastern Hemlock - American Basswood Forest were oversampled due to suspected overlap between these two vegetation map classes. Floodplain Forest and Woodland and Modified Successional Floodplain Forest and Woodland were oversampled to obtain more information on the multiple vegetation associations found in these two map classes.

An ArcGIS shapefile containing the sample points was created and the attribute table was edited to include fields needed to record the data to be collected at each point. The shapefile was imported into Trimble .ssf format and loaded into a Trimble GeoXT global positioning system (GPS) unit. This allowed the field ecologist to enter data directly into an electronic file in real time, eliminating the need for paper forms.

A field ecologist navigated to sample points using a Trimble GeoXT GPS unit. The following rules were established to deal with anticipated problems with site accessibility and/or GPS satellite signals:

1) Good GPS readings and good access to point
   a. Navigate to the point as close as possible.
   b. Enter field observation data and store the new GPS coordinates.

2) Good GPS readings and poor access to point (point extremely difficult to reach)
   a. Use GPS to navigate to at least 25 m (82 ft) inside the polygon boundary.
   b. Enter field observation data and store the new GPS coordinates.

3) Poor GPS readings and good access to point
   a. Use GPS to navigate as close as possible to the point, then use the Measure Tool in the GPS Navigation screen to obtain a bearing and distance to the point. Compass and pace to the point. Check the topographic map and aerial photography to make sure location is close to the sample point.
   b. Enter field observation data; do not alter GPS coordinates of the sample point.

Satellite information for 225 accuracy assessment points was sufficient to differentially correct the GPS data, yielding sub-meter accuracy of the planimetric coordinates. Because of the steep terrain and limited time for fieldwork, satellite information for 73 points was not adequate for differential correction, yielding planimetric accuracy of $\pm$10 m (32.8 ft). At 12 accuracy assessment points, no GPS position could be recorded and therefore estimated planimetric accuracy is approximately $\pm$20 m (65 ft).

In May and June 2007, the ecologist collected field data at a total of 310 accuracy assessment points (Figure 5). Approximately one-quarter of the accuracy assessment points (83) came from

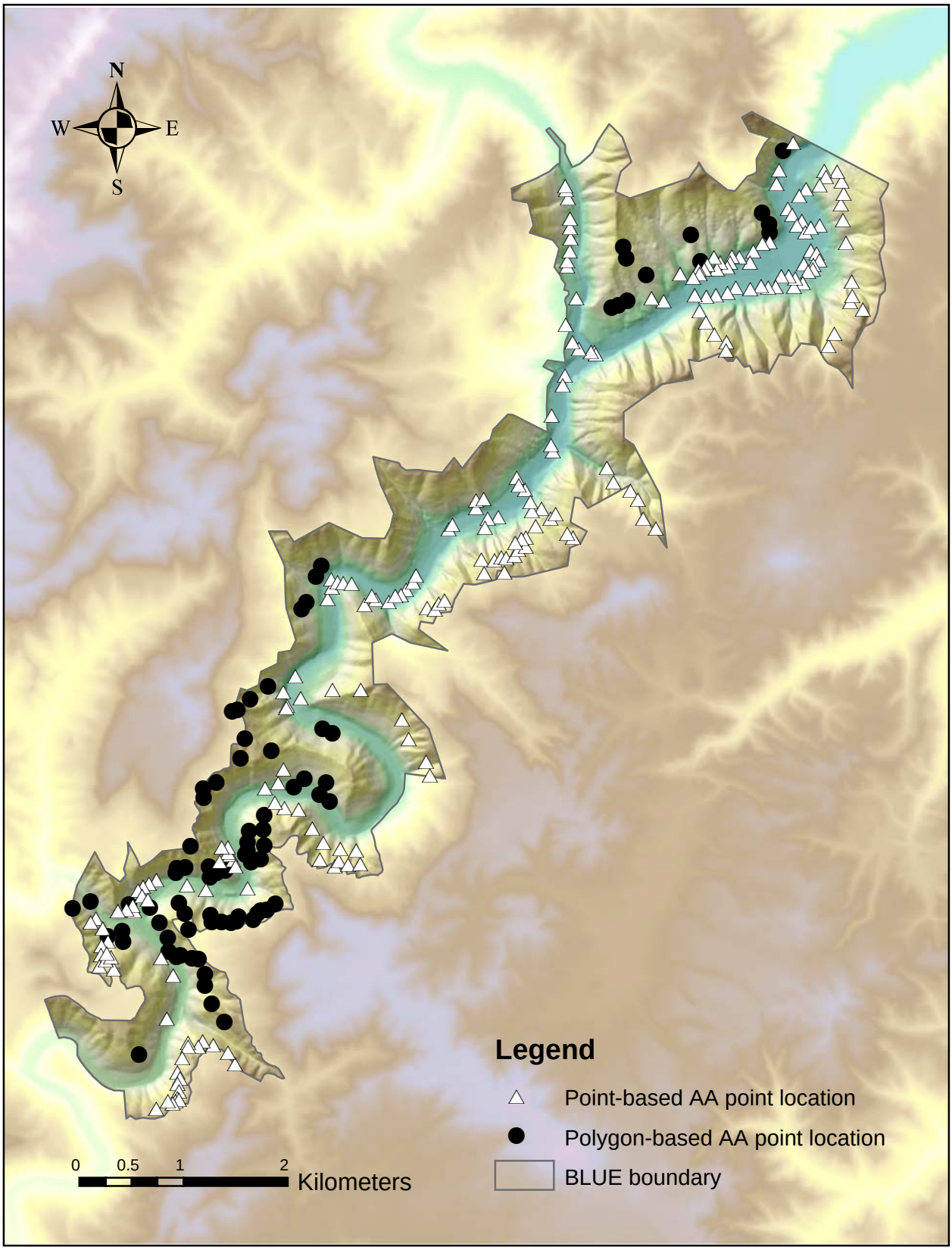


Figure 5. Locations of thematic accuracy assessment (AA) sampling points in Bluestone National Scenic River (BLUE).

the initial polygon-based sample and the remaining three-quarters (227) were from the point-based sample. The vegetation or land cover at each accuracy assessment point was identified and classified based on the vegetation key developed for the vegetation mapping project. The map classes Floodplain Forest and Woodland and Modified Successional Floodplain Forest and

Woodland include multiple vegetation associations. For accuracy assessment points in these two map classes, both the vegetation map class and the vegetation association as determined from the key were noted. Additional data collected for each sample point are described in Appendix D and include all items recommended in the USGS/NPS vegetation mapping protocol (TNC and ESRI 1994b). Digital photographs were taken at 302 sample points. Data from the 310 accuracy assessment points were entered into the NatureServe PLOTS 2.0 Database System on a Microsoft Access platform in summer 2007. In the PLOTS 2.0 database, species were assigned standardized codes based on the PLANTS database (USDA, NRCS 2008).
Estimates of thematic accuracy - overall percent accuracy and the Kappa index - were calculated using a contingency matrix that compared the mapped vegetation and land cover classes with the actual vegetation and land cover classes observed in the field. 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 exceed 80% (TNC and ESRI 1994b).

Errors of omission and commission, referred to as Producer's Accuracy and User's Accuracy, respectively, were calculated for individual map classes. Producer's Accuracy indicates the probability that an accuracy assessment point classification is correct. It is calculated by dividing the number of correctly classified points for a map class by the total number of sample points mapped as that map class. User's Accuracy indicates the probability that a mapped vegetation or land cover type actually represents the vegetation or land cover on the ground. It is calculated by dividing the number of correctly classified points for a map class by the total number of points that the field observer identified as being of that map class. Producer's Accuracy and User's Accuracy should exceed 80% according to the USGS/NPS vegetation mapping protocol (TNC and ESRI 1994b).

Results

Vegetation Classification

Vegetation community types of the park were classified in 22 associations of the U.S. National Vegetation Classification (USNVC), including 12 upland associations and 10 riparian associations (Table 5). Two primarily upland associations, the Successional Tuliptree / Spicebush Forest and the Successional Eastern White Pine - Tuliptree Forest, may also occur in riparian habitats on higher floodplains. Prevailing physiognomic expressions include 17 forest associations, four woodland associations, and one herbaceous association. One association new to the USNVC, the Eastern Hemlock Floodplain Forest, is recognized and described here for the first time based on data from one plot at BLUE and additional plots along other rivers in West Virginia.

Fifteen associations represent natural vegetation types in the park and seven associations are semi-natural successional vegetation types that have developed on land previously cleared for agriculture. Successional status in the park is indicated in the BLUE community type name. The global conservation rank (Table 5) for six of the successional types is GNA (not applicable), indicating that the associations are not considered appropriate targets for conservation of biological diversity, although they may provide important habitat for some native species and may eventually succeed towards more natural vegetation types. Global ranks have been assigned for ten associations that range from G2? (imperiled, with some uncertainty as to degree) to G5 (secure). Six riparian associations have not yet been assigned global conservation ranks (GNR) because relatively little is known about their global distributions. State conservation ranks have not been assigned for any of the associations. State and global conservation status rank definitions are provided in Appendix E.

A list of vascular and non-vascular plant taxa identified from plots and accuracy assessment points is provided in Appendix F. The list is alphabetically sorted by scientific name and includes common name, family, and division. Six hundred eighty-five taxa are listed, representing 582 plant species; the additional 103 taxa represent multiple subspecific taxa per species and identifications made to the genus level. One hundred twenty-three families are represented in nine divisions, including 89 families in the Magnoliophyta (flowering plants), two families in the Pinophyta (conifers), nine families in the Polypodiophyta (ferns), one family in the Lycopodiophyta (club mosses, spike mosses), one family in the Equisetophyta (horsetails), 15 families in the Bryophyta (mosses), two families in the Marchantiophyta (liverworts), three families in the Ascomycota (cup fungi, limited to lichens for this project), and one family in the Basidiomycota (club fungi). Detailed results of the floristic inventory which was conducted concurrently with vegetation mapping for BLUE are provided in a separate report (Streets et al. 2008).

Examples of graphic results of cluster analyses and NMS ordinations are provided in Appendix G. These analyses represent middle level iterations with the plot data set divided into two subsets, upland and riparian, without any outliers removed. The final classification of plots is indicated by symbology overlain on the graphics. Six plots were not assigned to community types because they represented ectotones, disturbed areas, or seemingly unique vegetation.

Table 5. Vegetation community types occurring in Bluestone National Scenic River (BLUE), the corresponding U.S. National Vegetation Classification (USNVC) association names, and their global conservation ranks.

BLUE Community Type Name	USNVC Association Name	USNVC Element Code	Global Conservation Rank
Upland Forests and Woodlands			
Calcareous Oak Forest	*Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest	CEGL004793	G3G4
Eastern Hemlock - American Basswood Forest	*Tsuga canadensis - (Fagus grandifolia, Tilia americana* var. *heterophylla) / Magnolia tripetala* Forest	CEGL008407	G4
Eastern Hemlock - Chesnut Oak Forest	*Tsuga canadensis - Quercus prinus - Betula lenta* Forest	CEGL006923	G3
Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest	*Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest	CEGL007543	G5
Oak - Eastern White Pine / Ericad Forest	*Pinus strobus - Quercus alba - Quercus prinus / Vaccinium stamineum* Forest	CEGL008539	G4
Oak - Hickory - Sugar Maple Forest	*Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest	CEGL007268	G4?
Successional Black Locust Woodland	*Robinia pseudoacacia* Forest	CEGL007279	GNA
Successional Eastern White Pine - Tuliptree Forest	*Pinus strobus* Successional Forest	CEGL007944	GNA
Successional Tuliptree / Northern Spicebush Forest	*Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest	CEGL007220	GNA
Successional Virginia Pine Forest	*Pinus virginiana* Successional Forest	CEGL002591	GNA
Sugar Maple - Yellow Buckeye - American Basswood Forest	*Liriodendron tulipifera - Tilia americana* var. *heterophylla - Aesculus flava - Acer saccharum / (Magnolia tripetala)* Forest	CEGL005222	G4?
Virginia Pine - Oak Shale Woodland	*Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum* Woodland	CEGL008540	G2?
Riparian Communities			
Eastern Hemlock Floodplain Forest	*Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia* Forest	CEGL006620	GNR
Oak - Hickory Floodplain Forest	*Quercus (rubra, velutina, alba) / Carpinus caroliniana - (Halesia tetraptera) / Maianthemum racemosum* Forest	CEGL006462	GNR
River Birch Backwater Floodplain Forest	*Betula nigra - Platanus occidentalis* Forest	CEGL002086	G5
Riverbank Tall Herbs	*Verbesina alternifolia - Elymus riparius - Solidago gigantea (Teucrium canadense)* Herbaceous Vegetation	CEGL006480	GNR
Successional Black Walnut Floodplain Forest	*Juglans nigra / Verbesina alternifolia* Forest	CEGL007879	GNA
Successional Box-elder Floodplain Forest	*Acer negundo* Forest	CEGL005033	G4G5

Table 5. Vegetation community types occurring in Bluestone National Scenic River (BLUE), the corresponding U.S. National Vegetation Classification (USNVC) association names, and their global conservation ranks (continued).

BLUE Community Type Name	USNVC Association Name	USNVC Element Code	Global Conservation Rank
Riparian Communities (continued)			
Successional Eastern Red-cedar Woodland	*Juniperus virginiana* Forest	CEGL006024	GNA
Sycamore - Ash Floodplain Forest	*Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest	CEGL006458	GNR
Sycamore - River Birch Riverscour Woodland	*Platanus occidentalis - Betula nigra / Cornus amomum / (Andropogon gerardii, Chasmanthium latifolium)* Temporarily Flooded Woodland	CEGL003725	GNR
Sycamore - Yellow Buckeye Floodplain Forest	*Platanus occidentalis / Aesculus flava* Forest	CEGL006466	GNR

These graphics illustrate the relationships between the associations by grouping plots with most similar floristic compostion closest to each other. Misclassifications of individual plots are apparent, but the overall pattern of the classification is supported by these quantitative analyses.

Tables of plot floristic summary statistics for each association that was sampled are provided in Appendix H. Association tables are arranged alphabetically by the BLUE community type name listed in Table 5. Plant taxa in the tables are sorted in descending order by constancy in plots, then in descending order by mean cover, then in ascending alphabetical order. These tables provide a quick, quantitative summary of the plant species composition of each association. Appendix I is a table of average soil chemical analysis results from plots of each association.

Two associations classified at BLUE, Successional Virginia Pine Forest and Successional Eastern Red-cedar Woodland, are not included in Appendixes G, H, and I because they were not sampled by plots.

A revised final dichotomous key to vegetation associations is provided in Appendix J. This key can be used to identify the associations in the field and to increase understanding of the distinctions between closely related types.

Detailed global and local association descriptions are provided in Appendix K. These are arranged within the hierarchical structure of the USNVC (Anderson et al. 1998); however, the hierarchy is not indicated in the table of contents for Appendix K. Vegetation classified in the park is grouped within nine formations, arranged in the following order: 1) rounded-crowned temperate or subpolar needle-leaved evergreen forest (two associations), 2) conical-crowned temperate or subpolar needle-leaved evergreen forest (one association), 3) temporarily flooded temperate or subpolar needle-leaved evergreen forest (one association) 4) lowland or submontane cold-deciduous forest (six associations), 5) temporarily flooded cold-deciduous forest (five associations), 6) mixed needle-leaved evergreen - cold-deciduous forest (four associations), 7) temporarily flooded cold-deciduous woodland (one association), 8) mixed needle-leaved evergreen - cold-deciduous woodland (one association), and 9) temporarily flooded temperate perennial forb vegetation (one association). Local information provided for each association includes a photograph of a representative plot or observation point, environmental and vegetation descriptions, geographic range within the park, classification comments, and a list of plots which represent the type. Global information includes the classification hierarchy, range-wide environmental and vegetation descriptions, range-wide geographic distribution, global conservation staus, classification information, and references. Appendix L is the bibliography for the global descriptions.

Vegetation Mapping

The vegetation map (Figure 6) for BLUE includes 24 map classes covering a total of 1,754.64 ha (4,335.79 ac) within park boundaries (Table 6). Approximately 93% of the park area is mapped as natural and semi-natural vegetation and an additional 4% is mapped as natural waterways. The remaining 3% is mapped as cultural and disturbed areas and transportation features.

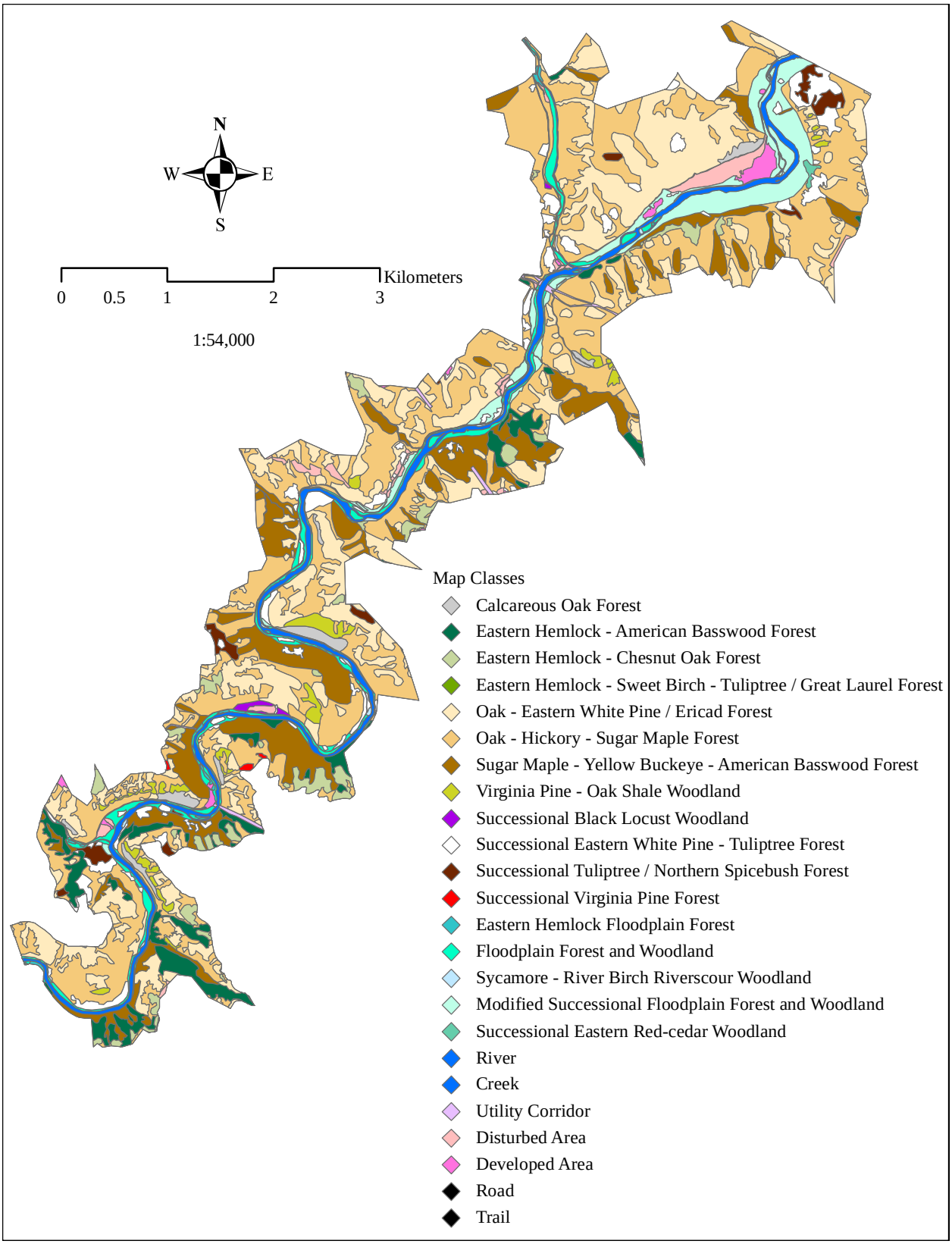


Figure 6. Vegetation map of Bluestone National Scenic River, West Virginia.

Table 6. Number of polygons and total area of vegetation-map classes in Bluestone National Scenic River.

Map Class	Number of Polygons	Total Acres	Total Hectares
Upland Forests and Woodlands			
Calcareous Oak Forest	9	47.77	19.33
Eastern Hemlock - American Basswood Forest	38	172.03	69.62
Eastern Hemlock - Chesnut Oak Forest	38	106.48	43.09
Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest	1	0.24	0.10
Oak - Eastern White Pine / Ericad Forest	184	980.58	396.83
Oak - Hickory - Sugar Maple Forest	142	1538.31	622.53
Successional Black Locust Woodland	3	7.10	2.87
Successional Eastern White Pine - Tuliptree Forest	94	178.02	72.04
Successional Tuliptree / Northern Spicebush Forest	13	49.80	20.15
Successional Virginia Pine Forest	4	3.24	1.31
Sugar Maple - Yellow Buckeye - American Basswood Forest	47	524.14	212.11
Virginia Pine - Oak Shale Woodland	23	64.49	26.10
Total upland forests and woodlands	596	3672.19	1486.08
Riparian Communities			
Eastern Hemlock Floodplain Forest	12	7.24	2.93
Floodplain Forest and Woodland	48	141.12	57.11
Modified Successional Floodplain Forest and Woodland	25	201.00	81.34
Successional Eastern Red-cedar Woodland	1	3.98	1.61
Sycamore - River Birch Riverscour Woodland	11	7.82	3.17
Total riparian communities	97	361.16	146.16
Aquatic Features			
Creek	10	4.50	1.82
River	4	171.04	69.22
Total aquatic features	14	175.54	71.04
Cultural and Disturbed Areas			
Developed Area	19	27.36	11.07
Disturbed Area	33	62.65	25.35
Utility Corridor	11	15.10	6.11
Total cultural and disturbed areas	63	105.10	42.53
Transportation Features			
Road	13	8.32	3.37
Trail	4	13.61	5.51
Total transportation features	17	21.93	8.87
Grand Total	787	4335.92	1754.68

Upland forests and woodlands comprise about 85% of the park area and are represented by 12 map classes, each consisting of a unique association. All map classes for upland forests and woodlands represent single predominating associations in the USNVC as listed in Table 5, but polygons may have inclusions of other associations less than the minimum mapping unit (0.5 ha [1.23 ac]) and may grade towards adjacent polygons of related map classes. Three major upland forest associations comprise about 70% of the park area; these are, in decreasing order of abundance, Oak - Hickory - Sugar Maple Forest, Oak - Eastern White Pine Forest, and Sugar Maple - Yellow Buckeye - American Basswood Forest.

Riparian vegetation comprises about 8% of the park area and is represented by five map classes. Most of the area of riparian vegetation in the park is mapped as two complex map classes that include patches of multiple USNVC associations (Table 7). The Floodplain Forest and Woodland map class includes five associations which represent natural vegetation in areas that were not converted to or have long recovered from agriculture and are not currently affected by reservoir backup from Bluestone Lake. The Modified Successional Floodplain Forest and Woodland map class includes seven associations, including two upland successional forest associations, which represent semi-natural and disturbed stands in areas that were more recently abandoned from agriculture and/or are currently affected by reservoir backup from Bluestone Lake. The remaining three riparian map classes represent small areas of single associations in the USNVC (Table 5) that could be delineated from aerial imagery; small patches of two of these associations may also be also included in the Floodplain Forest and Woodland map class (Table 7).

Cultural areas include the Utility Corridor and Developed Area map classes which represent land without vegetation cover or with vegetation which is maintained by periodic, usually frequent, human management activities. Examples of developed areas mapped in BLUE include agricultural hayfields and pastures, wildlife openings mowed by WVDNR, and a hotel/restaurant facility and grounds.

The Disturbed Area map class represents land where natural vegetation has been significantly altered by recent human activities or rare catastrophic natural disturbance events but which is not actively maintained by human activities. Disturbed areas typically have vegetation comprised of both native and exotic species with physiognomy often differing from typical natural stands in similar topographic positions. Examples of disturbed areas mapped in BLUE include recently abandoned farmland, recently logged or burned areas, areas subject to heavy recreational use, and three forested polygons with abundant downfall, probably the result of a tornado or other catastrophic wind event.

Accuracy Assessment

Positional Accuracy of Mosaics

The horizontal positional accuracies of the leaf-off and leaf-on mosaics are 1.31 meters and 1.60 meters, respectively, both of which meet the Class 1 National Map Accuracy Standard (FGDC 1998b). A copy of the spreadsheet for each mosaic, containing the x and y coordinates for each ground control point and the accuracy calculation formula, is included in the NCSU archive.

Table 7. Associations of the U.S. National Vegetation Classification (USNVC) occurring in complex riparian map classes at Bluestone National Scenic River (BLUE).

Map Class	BLUE Community Type Names of USNVC Associations included in Map Class
Floodplain Forest and Woodland	Eastern Hemlock Floodplain Forest
	Oak - Hickory Floodplain Forest
	Riverbank Tall Herbs
	Sycamore - River Birch Riverscour Woodland
	Sycamore - Yellow Buckeye Floodplain Forest
Modified Successional Floodplain Forest and Woodland	River Birch Backwater Floodplain Forest
	Riverbank Tall Herbs
	Successional Black Walnut Floodplain Forest
	Successional Box-elder Floodplain Forest
	Successional Eastern White Pine - Tuliptree Forest
	Successional Tuliptree / Northern Spicebush Forest
	Sycamore - Ash Floodplain Forest

Thematic Accuracy

Thematic accuracy of the vegetation map was assessed based on data collected using both the polygon-based and point-based sampling approaches. Data from 227 accuracy assessment points selected using the point-based sampling approach were combined with data from 83 accuracy assessment points selected using a polygon-based sampling approach. Visual inspection of the 310 sample points indicates that oversampling of small polygons, a potential bias with the polygon-based sampling protocol, is minimal in the combined sample.

Based on the contingency matrix (Table 8), the Kappa index for the vegetation map is 91.5% ± 2.76% and the overall percent accuracy is estimated to be 92.2%. Both estimates meet the USGS / NPS Vegetation Mapping Program requirement of 80%. User's Accuracy (error of commission) is 100% for 11 of the 18 map classes analyzed and ranges from 80.0 % to 90.3% for the remaining seven map classes, while Producer's Accuracy (errors of omission) is 100% for nine map classes and ranges from 77.7% to 93.3% for the remaining nine map classes. Floodplain Forest and Woodland (error of omission 87.5%) was most often confused with Modified Successional Floodplain Forest and Woodland (error of commission 85.7%). This is understandable because these two map classes are comprised of multiple vegetation associations, it is difficult to assess the fine distinctions between "modified" versus "natural" vegetation associations, and the two classes often have wide overlaps of ecotones depending on the environmental gradiant and the historical use of the area.

Table 8. Contingency matrix and calculated errors for the thematic accuracy assessmnt of the Bluestone National Scenic River vegetation map.

	Mapped Vegetation or Land Cover Class																			
Accuracy Assessment Observation	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Total	Error of Commission- User's Accuracy, (% correct)
A - Calcareous Oak Forest	5																		**5**	100.0
B - Disturbed Area		21																	**21**	100.0
C - Eastern Hemlock - American Basswood Forest			26	2		1				1									**30**	86.7
D - Eastern Hemlock - Chesnut Oak Forest			3	28															**31**	90.3
E - Eastern Hemlock Floodplain Forest					4					1									**5**	80.0
F - Floodplain Forest and Woodland						35													**35**	100.0
G - Modified Successional Floodplain Forest and Woodland						4	30		1										**35**	85.7
H - Oak - Eastern White Pine / Ericad Forest								27	1	1							2		**31**	87.1
I - Oak - Hickory - Sugar Maple Forest	1							1	28						1				**31**	90.3
J - Successional Eastern White Pine - Tuliptree Forest			1					1		28					1				**31**	90.3
K - Successional Black Locust Woodland											2								**2**	100.0
L - Successional Eastern Red-cedar Woodland												2							**2**	100.0
M - Successional Tuliptree / Northern Spicebush Forest													5						**5**	100.0
N - Successional Virginia Pine Forest														2					**2**	100.0
O - Sugar Maple - Yellow Buckeye - American Basswood Forest															28				**28**	100.0
P - Sycamore - River Birch Riverscour Woodland																5			**5**	100.0
Q - Virginia Pine - Oak Shale Woodland																	7		**7**	100.0
R - Utility Corridor																		4	**4**	100.0
Total	**6**	**21**	**30**	**30**	**4**	**40**	**30**	**29**	**30**	**31**	**2**	**2**	**5**	**2**	**30**	**5**	**9**	**4**	**310**	
Error of Omission - Producer's Accuracy (% correct)	83.3	100.0	86.7	93.3	100.0	87.5	100.0	93.1	93.3	90.3	100.0	100.0	100.0	100.0	93.3	100.0	77.7	100.0		

Total Points Correct	287
Overall Accuracy	92.6%
Kappa Index	91.8%
90% Confidence Interval	2.73%

Discussion

Vegetation patterns of upland habitats in the park are probably best explained by soil water availability, related to aspect and topographic position, and soil chemistry (Appendix I), related to bedrock geology. Although the west slope of the Appalachian Mountains, including the area of the park, receives relatively abundant precipitation, soil moisture remains a primary factor limiting productivity and affecting species composition of forests in the region (Day and Monk 1974, Fekedulegn et al. 2004). Southwesterly aspects and upper slope positions have highest solar insolation, but forest productivity is highest on cooler, wetter, northeasterly aspects and lower slope positions.

In the park, the Sugar Maple - Yellow Buckeye - American Basswood Forest is the predominant association on cool, moist aspect gorge slopes with fertile soils. Soil fertility gradients within this association are reflected by cover and species composition in the herb layer. Cool habitats with somewhat less fertile soils support forests codominated by eastern hemlock (*Tsuga canadensis*), including the Eastern Hemlock - American Basswood Forest in moist coves and the Eastern Hemlock - Chestnut Oak Forest in somewhat dryer convex positions, often further upslope.

Warmer, dryer aspect gorge slopes support forests with larger components of oak (*Quercus* spp.) and pine (*Pinus* spp.). The Oak - Eastern White Pine / Ericad Forest is the predominant association on warm slopes with relatively infertile soils. The Virginia Pine - Oak Shale Woodland is a small patch type which is confined to the hottest, driest sites with shallow, extremely acidic soils. The Calcareous Oak Forest is a small patch type confined to warm aspects with circumneutral soils enriched by limestone geology. These two small patch types often occur adjacent to each other, the former upslope from the latter, exemplifying a steep gradient of soil chemistry which can result in bizarre ecotonal species combinations.

The most abundant association in the park, the Oak - Hickory - Sugar Maple Forest, occurs in positions with intermediate soil moisture and fertility. It ranges from well-drained, convex, upper slope positions with northeasterly aspects to moisture-collecting, concave, lower slope positions with southwesterly aspects. Floristic composition of this association is variable and it may grade towards any of the other upland forest types. In multivariate anayses, plots of this association do not cluster together in a single group and ordinate in the “messy middle” of species space (Appendix G, Dendrogram 1 and Graph 1).

Although nearly all upland forests in the park were logged in the past, most current stands represent relatively natural vegetation types. Regeneration of deciduous stands following logging was probably dominated by root sprouts, resulting in rapid reestablishment of canopy composition similar to the original stands. The conifer tree species in the park do not usually grow from root sprouts (Burns and Honkala 1990), but regeneration of pine seedlings is promoted by canopy removal and ground disturbance and this component may have increased following logging. In contrast, abundance of eastern hemlock, a slow growing, long lived, late successional species, and extent of communities characterized by its dominance, probably decreased following logging. Many contemporary deciduous forest stands have eastern hemlock

in their understories and this species would probably become more important in the future except it is now threatened by an exotic insect pest, hemlock wooly adelgid (*Adelgis tsugae*).

Rentch et al. (2005) found that most upland forest stands in the park average less than 100 years old but cored individual trees as old as 278 years. We also observed some stands in the park which appear older than average although we did not core trees. Older stands were seen in narrow zones on upper gorge slopes and plateau tops along the park boundaries, perhaps a relict of imprecise surveys and dubious land ownership. The park boundaries are not well marked, and GIS boundary layers available for the park (used to clip the vegetation map for this project) do not always agree with boundaries marked on USGS topographic maps. Stands with old growth characteristics (including large contorted trees, snags, and abundant coarse woody debris) were sampled by plots along the NPS boundary with Pipestem State Park northwest of McKeever Lodge and the golf course (plots BLUE.19 and BLUE.20) and along the boundary with private land north of Tony Hollow (BLUE.90).

Three upland associations are globally rare: Calcareous Oak Forest (G3G4), Eastern Hemlock - Chestnut Oak Forest (G3), and Virginia Pine - Oak Shale Woodland (G2?). Their rarity is also reflected in the small areas occupied by these associations in BLUE (Table 6). These associations occur in relatively small patches of specialized habitat constrained by geology, aspect, and slope position.

The floodplain habitats of the park have been most impacted by a long history of human activities. Most floodplains were cleared for agriculture and settlements before the early 1900s, but these developments were abandoned before 1949 when Bluestone Dam was built. After the dam was built, floodplains along the lower reaches of the Bluestone and Little Bluestone rivers in the park have had their natural flooding regimes altered by reservoir backup from Bluestone Lake. These combined influences have created a complex patchwork of intergrading semi-natural successional vegetation types, degraded natural vegetation types, and weedy disturbed areas which are difficult to map at the association level. These complexes were mapped as the Modified Successional Floodplain Forest and Woodland map class (Table 7). In areas affected by reservoir backup, more natural vegetation types (e.g. Sycamore - Ash Floodplain Forest) occur closer to the river where downstream flows maintain a natural flooding regime superimposed on the reservoir backup zone. Further back from the river edge, semi-natural successional vegetation predominates in areas previously cleared for agriculture. As time passes, composition of these successional stands, which are dominated by shade intolerant tree species, will change; but due to an altered flooding regime these stands may never resemble natural floodplain vegetation of the region. One BLUE community type, the River Birch Backwater Floodplain Forest, is crosswalked to a natural floodplain forest association in the USNVC, but its occurrence in the park may be dependent on wetland conditions created by reservoir backup. Likewise, occurrence of Sycamore - Ash Floodplain Forest along the lower Bluestone River may be related to reservoir backup; it is the predominant floodplain forest type along the New River (Vanderhorst et al. 2007) and is simlar to the Sycamore - Yellow Buckeye Floodplain Forest which occurs upstream along the Bluestone River but lacks yellow buckeye (*Aesculus flava*), a species only somewhat tolerant of flooding (Burns and Honkala 1990). Other ongoing human influences on floodplain vegetation in the park are burning and mowing for game management by WV Division of Natural Resources, which maintains some areas as pastures and weedy thickets.

Floodplains along the upper reaches of the Bluestone River in the park support more natural vegetation although these patches are often narrow zones squeezed between the river and higher floodplains that were previously cleared and now support successional vegetation types. These natural areas are mapped as the Floodplain Forest and Woodland map class and include small patches and linear zones of five natural vegetation associations (Table 7). Successional vegetation along these upper reaches is not subject to flooding from reservoir backup and as time passes these stands may develop into more natural floodplain forests or, if they are never flooded, into upland forest types. For example, some stands of Successional Eastern White Pine Forest on higher floodplains have reproduction by eastern hemlock (*Tsuga canadensis*) in their understories, evidence of possible succession towards Eastern Hemlock Floodplain Forest, a late successional type which was probably more abundant prior to white settlement of the area.

Riparian communities cover a small area but contribute greatly to the overall biological diversity of the park. The riparian data set for multivariate analysis (results presented in Appendix G) included 468 vascular plant taxa in 47 plots compared to 445 taxa in 88 plots included in the upland forest and woodland data set. There are nearly as many riparian community types classified in the park (10) as upland forest and woodland community types (12), although the mapped area of upland forests and woodlands is over 10 times greater than the mapped area of riparian communities.

Additional diversity in the riparian zone is evident in one community type, the Sycamore - River Birch Riverscour Woodland, for which two phases can be recognized. Stands on cobble and boulder substrate, which are subject to more frequent, higher energy floods, have more open canopies and relatively sparse herb layers, with big bluestem (*Andropogon gerardii*) prominent in late season. Stands on sand substrate, which are subject to less frequent, lower energy floods, have taller, more closed canopies, often dominated by river birch (*Betula nigra*) over lush, tall herb layers with abundant deertongue (*Dichanthelium clandestinum*) and Indian woodoats (*Chasmanthium latifolium*). The tough-rooted, flood-tolerant Emory's sedge (*Carex emoryi*) often grows in a line along the riverside edge of this community, sometimes beyond the woodland canopy. These zones are included within the Sycamore - River Birch Riverscour Woodland, although purely herbaceous stands could be recognized (but not mapped) as a distinct community analogous to the Twisted Sedge Rocky Creekbed which occurs along tributaries of the New River (Vanderhorst et al. 2007).

Even prior to white settlement of the Appalachians, riparian communities occupied a small fraction of the landscape and, following settlement, these habitats were disproportionately developed for farmland and were degraded by altered flooding regimes, water pollution, and invasions of exotic plants. Protection of riparian areas along the free flowing reaches within the park represents a significant contribution towards conservation of these important community types, however, due to their small area they may remain vulnerable to concentrated recreational use and development. They may also be threatened by off-site activities upstream which effect water quality, sedimentation, flooding regimes, and seed dissemination.

Five of the riparian associations that have not yet been assigned global ranks (Table 5) are likely to be globally rare. These are Eastern Hemlock Floodplain Forest, Oak - Hickory Floodplain Forest, Sycamore - Ash Floodplain Forest, Sycamore - Yellow Buckeye Floodplain Forest, and

Sycamore - River Birch Riverscour Woodland. All of these are known from other West Virginia rivers, but none have yet been documented outside the state.

None of the associations which occur in BLUE have been assigned West Virginia state conservation ranks. State ranks for associations will be assigned when information on their distribution, ecological integrity, and the threats they face throughout their ranges in the state has been assembled and assessed.

Vegetation mapping of BLUE utilized two digital orthophoto mosaics flown in different seasons. Two sets of aerial photography were also flown for vegetation mapping of New River Gorge National River (Vanderhorst et al. 2007) but a digital orthophoto mosaic was only developed for the leaf-off set flown on March 27, 2003. Leaf-on photography for New River Gorge National River was flown in late fall (October 16, 2003) after the beginning of leaf drop, and examination of the leaf-on photo transparencies on a light table was found to be very useful for distinquishing decidous canopy signatures. Leaf-on photography was also flown for BLUE on October 16, 2003 but it included large areas which were heavily shaded due to low sun angle. Leaf-on photography for BLUE was reflown on October 7, 2004 and, based on the utility of leaf-on photography for vegetation mapping of New River Gorge National River, this set was processed to create a digital orthophoto mosaic. Unfortunately, the 2004 leaf-on photography was taken at an earlier phenological stage than the beginning of leaf drop, and was not as useful for distinguishing deciduous canopy signatures compared to the New River Gorge National River leaf-on photography. These experiences demonstrate the utility of late season photography for distinguishing deciduous forest types and the importance of timing and luck.

Literature Cited

Anderson, M., P. Bougeron, M. T. Bryler, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D. H. Grossman, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A. S. Weakley. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume II. The National Vegetation Classification System: list of types. The Nature Conservancy. Arlington, VA. 502 pp.

Bailey, R. G., P. E. Avers, T. King, and W. H. McNab. 1994. Ecoregions and subregions of the United States. USDA Forest Service [map].

Biasi, F. 2001. ELU AML pack: annotated AML code and documentation for generating ecological land units (ELUs) from a DEM and geology grid using ArcInfo. The Nature Conservancy (website). ftp://gis.tnc.org/pub/software/Analysis_tools/eluamls.zip.

Bender, J. R. 2003. Bluestone National Scenic River ecological land units (ELUs). [rastor dataset, including metadata]. Atlanta, GA.

Beyer, H. 2006. Hawth's Analysis Tools for ArcGIS. www.spatialecology.com. Last accessed July 5, 2007.

Braun, E. L. 1950. Deciduous forests of eastern North America. Hafner Press. New York, NY.

Brodo, I. M., S. D. Sharnoff, and S. Sharnoff. 2001. Lichens of North America. Yale University Press. New Haven, CN.

Brooks, A. B. 1910. Forestry and Wood Industries, West Virginia. Volume 5. West Virginia Geological and Economic Survey. Acme Pub. Co. Morgantown, WV. 481 pp.

Brookside Laboratories Inc. 2008. Soil methodologies: (for standard packages). http://www.blinc.com/worksheet_pdf/SoilMethodologies.pdf.

Burns, R. M., and B. H. Honkala, tech. coords. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture. Forest Service. Washington, DC. Vol.2. 877 p.

Cardwell, D. H., R. B. Erwin, and H. P. Woodward. 1968. Geology map of West Virginia. West Virginia Geological and Economic Survey. Map 1. Scale 1:250000.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Day, F. P., and C. D. Monk. 1974. Vegetation patterns on a southern Appalachian watershed. Ecology 55:1064–1074.

Dufrêne, M., and P. Legendre. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. Ecological Monographs 67:345–366.

Ecological Society of America. 2002. Standards for Associations and Alliances of the National Vegetation Classification. Version 1.0. Available on the web at http://vegbank.nceas.ucsb.edu/vegbank/panel/standards_v1.pdf.

Englund, K. J., H. H. Arnt, T. W. Henry, C. R. Meissner Jr., J. F. Windolph Jr., and R. C. Warlow. 1977. Geologic map of the New River Gorge Area, Fayette, Raleigh, and Summers Counties, West Virginia. U.S. Geological Survey Open File Report OF-77-76-A.

Englund, K. J., P. L. Johnson, and H. H. Arndt. 1982. Geology of the New River Gorge, West Virginia. *In* New River Symposium Proceedings. May 6–8, 1982. Beckley, WV. Pp 136–145.

Environmental Systems Research Institute, Inc. (ESRI). 2005. ArcMap 9.1. Environmental Systems Research Institute, Inc., 380 New York St., Redlands, CA 92373.

Environmental Systems Research Institute, National Center for Geographic Information and Analysis, and The Nature Conservancy (ESRI, NCGIA, and TNC). 1994. Accuracy assessment procedures. NBS/NPS Vegetation Mapping Program. Retrieved October 2001 from http://biology.usgs.gov/npsveg/aa/aa.html.

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

Federal Geographic Data Committee (FGDC). 1998b. Geospatial positioning accuracy standards, Part 3: National Standard for Spatial Data Accuracy. (FGDC-STD-007.3-1998). Retrieved October 2001 from http://www.fgdc.gov/standards/status/sub1_3.html.

Fekedulegen, D., J. J. Colbert, J. S. Rentch, and K. W. Gottschalk. 2004. Aspect induced differences in vegetation, soil, and microclimatic characteristics of an Appalachian watershed. Castanea 69:92–108.

Flenniken, D. G. 1999. The macrolichens in West Virginia. Carlisle Printing. Sugarcreek, OH.

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

Fortney, R. H., S. L. Stephenson, H. S. Adams. 1994. Reconnaissance vegetation study of the Bluestone, New, and Gauley River Gorges. National Park Service.

Freckmann, R. W., and M. G. Lelong. 2003. Dichanthelium and Panicum sections. *In* Flora of North America north of Mexico. Volume 25. Magnoliophyta: Commelinidae (in part): Poaceae, part 2. Ed Flora of North America Editorial Committee. Oxford University Press. New York, NY.

Gleason, H. A., and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. The New York Botanical Garden. Bronx, NY.

Grafton, W. N. 1993. Vascular flora on the lower sections of the Gauley. Meadow, and Bluestone rivers. WVU Extension Service. National Park Service. Cooperative Agreement CA 400-2-1016.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy. Arlington, VA.

Harmon, P. J., D. Ford-Werntz, and W. Grafton. 2006. Checklist and atlas of the vascular flora of West Virginia. West Virginia Division of Natural Resources. Wildlife Resources Section. Elkins. 381 pp.

Lilly, J. 1998. The lost village of Lilly. Goldenseal: West Virginia Traditional Life 24 (Summer):42–47.

McCune, B., and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design. Gleneden Beach, OR. 300 pp.

McCune, B., and M. J. Mefford. 1999. PC-Ord. Multivariate analysis of ecological data. Versions 4.0–5.02. MjM Software Design. Gleneden Beach, OR.

Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center. October 1999. Positional accuracy handbook, using the National Standard for Spatial Data Accuracy to measure and report geographic data quality. Retrieved October 2001 from: http://server.admin.state.mn.us/resource.html?Id=1852.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons. New York, NY. 547 pp.

National Oceanic and Atmospheric Administration (NOAA). 2002. Monthly station normals of temperature, precipitation, and heating and cooling degree days 1971–2000. Climatography of the United States No. 81. National Climatic Data Center. Ashville, NC.

Norris, S. J. 1992. Rare species survey of Bluestone Scenic River, West Virginia. West Virginia Division of Natural Resources. National Park Service. Cooperative Agreement CA 4000-0-9020.

Oxley, E. 1975. Floristics and vegetation of the gorge region of Indian Branch. Unpublished report prepared for Pipestem State Park, Pipestem, West Virginia.

Rentch, J. S., R. H. Fortney, S. L. Stephenson, H. S. Adams, W. N. Grafton, R. B. Coxe, and, H. H. Mills. 2005. Vegetation patterns within the lower Bluestone River Gorge in southern West Virginia. Castanea 70(3):184–203.

Roody, W. 2003. Mushrooms of West Virginia and the Central Appalachians. University of Kentucky Press. Lexington, KY.

Sneddon, L. 1993. Field form instructions for the description of sites and terrestrial, palustrine, and vegetated estuarine communities. The Nature Conservancy, Eastern Task Force. Boston, MA. 69 pp.

Sotomayor, L. 2004. Terrestrial and Marine Ecoregions of the United States. The Nature Conservancy Data Sources. Global Priorities Group. http://gis.tnc.org/data/MapbookWebsite/getimage.php?id=104.

Sponaugle, K. N., D. E. McKinney, L. Wright, Jr., C. E. Nelson, R. E. Pyle, and C. L. Marra. 1984. Soil survey of Mercer and Summers Counties, West Virginia. Soil Conservation Service. U.S. Department of Agriculture. Washington, DC.

Strausbaugh, P. D., and E. L. Core. 1977. Flora of West Virginia. 2nd edition. Seneca Books. Grantsville, WV. 1,079 pp.

Streets B. P., J. P. Vanderhorst, C. Good, and G. Short. 2008. Floristic Inventory of Bluestone National Scenic River, West Virginia. Technical Report NPS/NER/NRTR—2008/105. National Park Service. Philadelphia, PA.

Studlar, S. M., S. L. Stephenson, and P. J. Harman. 2002. Annotated checklist of the hornworts, liverworts, and mosses of West Virginia. Wildlife Resources technical document 02-3. West Virginia Division of Natural Resources. Elkins, WV.

The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994a. Field methods for vegetation mapping. Prepared for USDI National Biological Survey and National Park Service. Arlington, VA.

The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI). 1994b. NBS/NPS Vegetation Mapping Program: Accuracy Assessment Procedures. Report to the National Biological Survey and the National Park Service. Arlington, VA and Redlands, CA. http://biology.usgs.gov/npsveg/standards.html. Last accessed 6 June 2006.

United States Department of Agriculture, National Resource Conservation Service (USDA, NRCS). 2008. The PLANTS Database. http://plants.usda.gov. Last accessed 2 January 2008. National Plant Data Center. Baton Rouge, LA.

United States Geological Survey (USGS). 1995. Digital orthophoto quarter qudsrangles. Reston, VA. Available ftp://ftp.wvgis.wvu.edu/pub/Clearinghouse/DOQQ/NAD83.

United States Geological Survey (USGS). 2001. USGS-NPS Vegetation Mapping Program: Program documents and standards. http://biology.usgs.gov/npsveg/standards.html. Web site last updated 26 June 2001.

United States Geological Survey (USGS). 2004. Tools for creation of formal metadata, a compiler for formal metadata. Retrieved June 2004 from http://geology.usgs.gov/tools/metadata/tools/doc/mp.html.

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

Vanderhorst, J. 2001a. Plant community classification and mapping of the Camp Dawson Collective Training Area, Preston County, West Virginia. Natural Heritage Program. WV Division of Natural Resources. Elkins, WV.

Vanderhorst, J. 2001b. Plant communities of the New River Gorge National River, West Virginia: Northern and southern thirds. Non-game Wildlife and Natural Heritage Program. West Virginia Division of Natural Resources. Elkins. 146 pp.

Vanderhorst, J. 2002a. Ecological community classification and mapping of Camp Dawson Collective Training Area, Preston County, West Virginia. Proc. WV Academy of Science. Vol. 74. No. 3:18–26.

Vanderhorst, J. 2002b. Two cliff top pine communities in the north section of New River Gorge National River, West Virginia. Abies Ecology. Elkins, WV. Prepared for National Park Service. Glen Jean, WV. 16 pp.

Vanderhorst, J. P., J. Jeuck, and S. C. Gawler. 2007. Vegetation Classification and Mapping of New River Gorge National River, West Virginia. Technical Report NPS/NER/NRTR—2007/092. National Park Service. Philadelphia, PA.

Vanderhorst, J., and B. P. Streets. 2006. Vegetation Classification and Mapping of Camp Dawson Army Training Site, Preston County, West Virginia: Second Approximation. Natural Heritage Program. West Virginia Division of Natural Resources. Elkins, WV. 80 pp.

West Virginia Natural Heritage Program (WVNHP). 2007. Plots2-WV database of community ecology plots. WV Division of Natural Resources. Elkins, WV.

West Virginia Statewide Addressing and Mapping Board (WVSAMB). 2005. High resolution 7.5' quarter-quad orthoimages for the state of West Virginia, UTM Zone 17 for entire state, MrSID compressed. Sioux Falls, SD. Available ftp://ftp.wvgis.wvu.edu/pub/Clearinghouse/SAMB03/UTM83/utm83zone17n.

Woods, A. J., J. M. Omernik, and D. D. Brown. 2003. Level III and level IV Ecoregions of EPA Region 3. U.S. Environmental Protection Agency. Corvallis, OR [map]. ftp://ftp.epa.gov/wed/ecoregions/reg3/reg3_eco.pdf.

Appendix A. Vegetation plot field forms.

QC ENV GLS

Form 3: Quantitative Community Characterization Draft: Spring, 1993

A. Identifiers (general EOR information)

Sci. name: 1.SNAME: _____ 2.GNAME: _____

3.Site name: Bluestone

4.Survey site name: Mt Creek Lodge

5.Quad name(s): _____ 6.Quad code(s): _____

7.County name(s): _____ 8.County code(s): _____

9.Town (LOCALJURIS): _____

10.Lat: _____ N 11.Long: 0 _____ W 12.Directions: _____

Just upstream from Mountain Creek Lodge on River Left

About 100 yards above road and river → below cliff band.

GPS File - A062114A.cor UTM x = 498858.20 y = 4154611.76

13.Sourcecode: BLUE.24 14.Survey date: 2003 . 06 . 20

15.Last obs: _____ . _____ . _____ 16.First obs: _____ . _____ . _____ 17.State: WV

18.Surveyors: Jim Vanderhorst, Brian Streets

B. Environmental Description

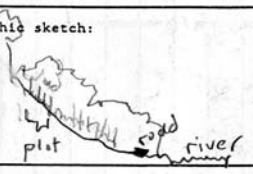
19.Transect / Observation point #

20.Image annotation #

21.Elevation: 503 m

22.Topographic position:
- _Interfluve
- _High slope
- _High level
- _Midslope
- _Low level
- _Channel bed
- _Other
- _Backslope
- _Step in slope
- X Lowslope
- _Toeslope
- _Channel wall
- _Basin floor

23.Topographic sketch:



24.Slope degrees: 36°

25.Slope aspect: 180°

26.Parent material: shale (calcareous)

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

Soil Map Unit - CkF

28.Organic horizon depth: patchy 0-5

29.Organic horizon type: _____

30.Average pH of mineral soil: _____

0-1

A

7.5 YR 3/3 pH 7.0

8 cm

rocky B pH 6.5

7.5 YR 4/4

25m

rocky

hard pack

31.Soil moisture regime:
- _Extremely dry
- _Very dry
- X Dry
- _Somewhat moist
- _Moist
- _Somewhat wet
- _Wet
- _Very wet
- _Permanently inundated
- _Periodically inundated

32.Stoniness:
- _Stone free <0.1%
- _Moderately stony 0.1-1%
- _Stony 3-15%
- X Very stony 15-50%
- _Exceedingly stony 50-90%
- _Stone piles >90%

33.Soil drainage:
- _Rapidly drained
- X Well drained
- _Moderately well drained
- _Somewhat poorly drained
- _Poorly drained
- _Very poorly drained

34.Average texture:
- _ sand
- _ sandy loam
- _ loam
- _ silt loam
- X other sandy clay loam - channery silt loam
- _ clay loam
- _ clay
- _ peat
- _ muck

35.Unvegetated surface:
- 10 % Bedrock
- 10 % Large rocks (cobbles, boulders > 10 cm)
- 10 % Small rocks (gravel 0.2-10 cm)
- 40 % Sand (0.1-2 mm)
- 20 % Litter, duff
- 1 % Wood (> 1 cm)
- _____ % Water
- _____ % Other: _____

36.Environmental Comments: Note homogeneity of vegetation, erosion / sedimentation, inundation, etc. Steep south slope below a cliffband with dry/rich forest of Quercus muhlenbergii, Q alba, Carya ovata. Red channery soil with large proportion of exposed soil and platy fragments (sandstone?). Fossiliferous sheety rocks. Shrub layers almost non-existent ~ state park no hunting - Lush herb layer

37.Plot representativeness: small patch of rich-dry forest below cliff at nose of the bend ~ community patch ~

Form 3. Quantitative Community Characterization, page 1.

Form 3. Quantitative Community Characterization, page 2.

West Virginia Natural Heritage Program, Vegetation Plot Form

Identifiers Entered by GLS 10/10 — Revised June 2004

Plot code BLUE.58 — Location name Bluestone National Scenic River

County name Summers — Sublocation Little Bluestone — Quad name Pipestem

Provisional community name Carya cordiformis - Quercus rubra - Juglans / Carpinus floodplain forest

Survey date May 24, 2005 — Time: 4PM — Surveyors Jim Vandermorst, Brian Streets

Plot directions: Along Little Bluestone River, river right, ca 0.9 stream miles upstream from confluence w/ Bluestone.

X dimension (m) 16 — Y dimension (m) 25 — Plot shape rectangle — Canon A95 JPV

GPS file R052415A — GPS feature Plot — ☐ corrected ☒ raw ☐ map dot — ☒ Photos — Roll number ____

UTM x 502470 — UTM y 4160788 — Datum NAD83 — PDOP 10 — Frame number ____

Environmental data Lowered percision

Hydrology evidence
☒ flood scour
☒ flotsam
☐ hydrophytes
☐ standing water
☐ saturated soil
☐ soil features
☐ other:

Hydrologic regime
☒ temporarily flooded
☐ permanently flooded
☐ intermittently flooded
☐ semi-permanently flooded
☐ saturated
☐ seasonally flooded
☐ moist

☐ somewhat moist
☐ dry ☐ unknown
☐ very dry
☐ extremely dry

Elevation (m) ____

Slope (°) 1 — **Aspect (°):** 180°

Slope shape-vert.: concave straight convex (undulating)

Slope shape-horiz.: concave straight convex (undul)

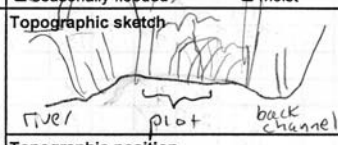
Landform: stream terrace

Cowardin system: U (B) R L ?

Geologic unit: ____

Surficial geology: alluvium

Topographic sketch



Topographic position
☐ interfluve ☐ backslope ☒ low level
☐ high slope ☐ step in slop ☐ channel wall
☐ high level ☐ lowslope ☐ channel bed
☐ midslope ☐ toeslope ☐ basin floor

Stoniness
☐ <.1% ☐ 15-50%
☒ .1-3% ☐ 50-90%
☐ 3-15% ☐ >90%

Soil drainage
☐ rapid ☐ mod-poor
☐ well ☐ poor
☒ moderate ☐ very poor

Rosgen stream type
A B C D DA E F G
1 2 3 4 5 6
a+ a b c c-

Hummocks ___% ___% hollow

 # per plot ____

Height (cm): ____

Roundness: high med low

Unvegetated surface (%)
____ bedrock
1 lg rocks >10 cm
____ sm rocks .2-10 cm
____ sand .1-2 mm
80 litter/duff
10 wood >1 cm
____ water
10 bare soil
1 other: garbage, tires,

Soil
Depth to water table (cm): ____
Texture (mineral soil): Loamy Sand
Soil map unit: Ud
90% root penetration depth (cm): 5 cm (herb.)
Depth to mottling (cm): ____
Pore water pH: ____
Pore water EC: ____
Pore water T (°C) ____
pH (mineral soil): 6.25

Soil profile: *indicate depth, horizon, texture, matrix & mottle colors, redoxymorphic features, peat decomposition, comments* ⇨

Litter/Duff — 2cm
A- Loamy Sand
7.5YR 2.5/2
PH 6.5 — 7cm
B- Loamy sand
7.5YR 3/3
pH 6.0 — 40cm

Hydric indicators: ____

Estimated stand size (ha): ____

Representativeness: Stand is a highly variable narrow terrace with mostly young trees. Plot is towards high end of "island" which may flood less often than lower end. Some other areas have abundant Robinia or Carpinus tall shrub w/ scattered Juglans

Environmental condition: Floodplain forest along flashy tributary river on alluvial terrace with a backchannel at edge of a steep slope/cliff band. Forest of walnut, bitternut hickory, ash, red oak with tall shrub layer of blue beech and spicebush. Sycamore are along edges of stand both on river side and along backchannel. Stick flotsam piles behind trees ≈ 2 ft tall, decayed.

Landscape context: Across backchannel is a steep slope/cliffband which has some Rhododendron maximum (rare in Bluestone). Above that is an old road and oak matrix on east slope (see BLUE.58). Very steep slope across creek

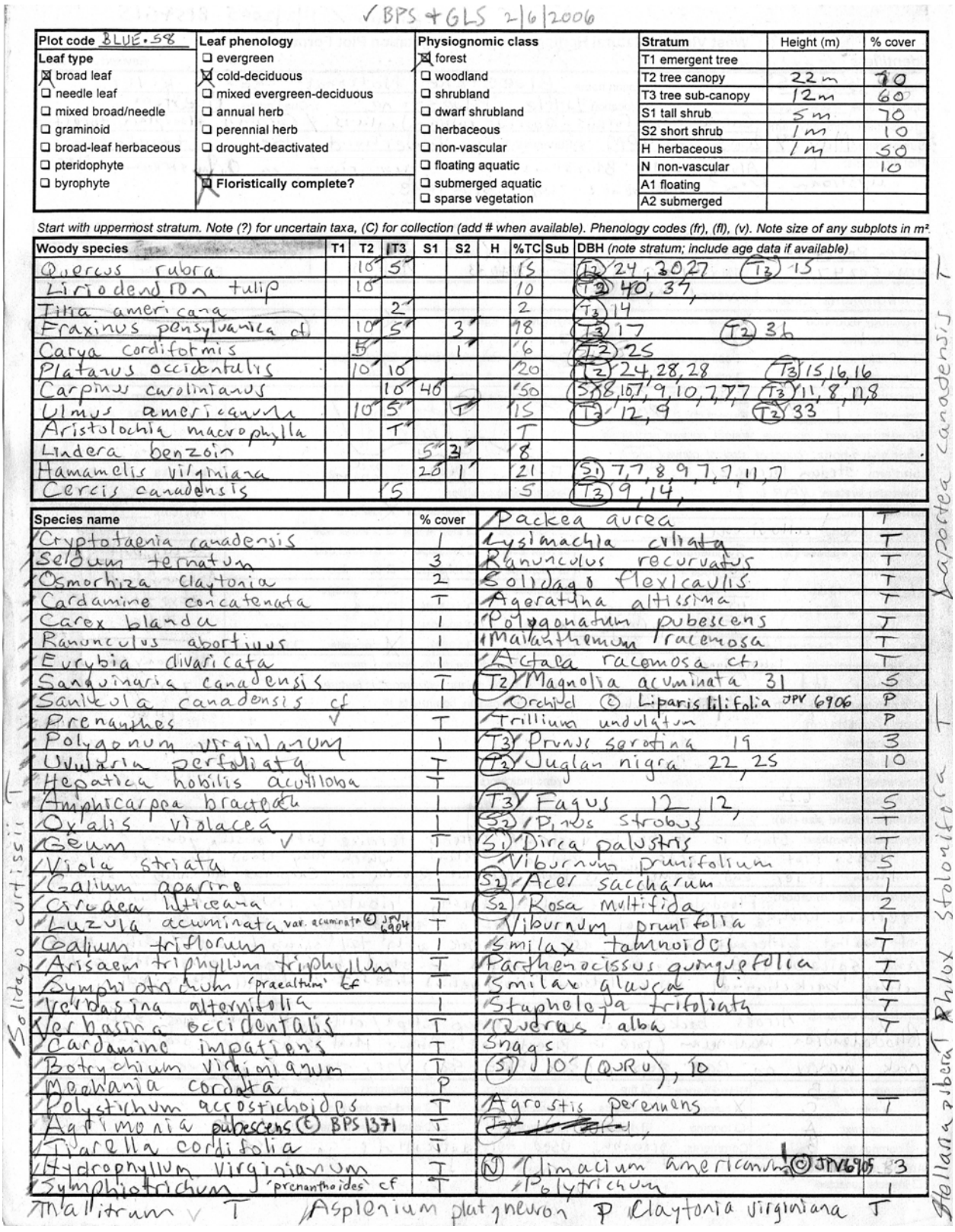
Ranking: size: B — condition: C — context: A — composite: B

Disturbance:
☒ clearing ☐ fire ☐ exotic plants ☐ trails/roads ☐ deer trails
☐ insects ☐ grazing ☐ wind-ice damage ☐ other
☐ logging ☐ disease ☐ browsing ☐ ditching/hydro alteration

Comments: probably used for agriculture in past

Animal use evidence:
☐ insects collected

West Virginia Natural Heritage Program Vegetation Plot Form, page 1.



✓BPS + GLS 2/6/2006

Plot code BLUE·58	Leaf phenology	Physiognomic class	Stratum	Height (m)	% cover
Leaf type	☐ evergreen	☒ forest	T1 emergent tree		
☒ broad leaf	☒ cold-deciduous	☐ woodland	T2 tree canopy	22 m	90
☐ needle leaf	☐ mixed evergreen-deciduous	☐ shrubland	T3 tree sub-canopy	12 m	60
☐ mixed broad/needle	☐ annual herb	☐ dwarf shrubland	S1 tall shrub	5 m	70
☐ graminoid	☐ perennial herb	☐ herbaceous	S2 short shrub	1 m	10
☐ broad-leaf herbaceous	☐ drought-deactivated	☐ non-vascular	H herbaceous	1 m	50
☐ pteridophyte		☐ floating aquatic	N non-vascular		10
☐ byrophyte	☒ **Floristically complete?**	☐ submerged aquatic ☐ sparse vegetation	A1 floating		
			A2 submerged		

Start with uppermost stratum. Note (?) for uncertain taxa, (C) for collection (add # when available). Phenology codes (fr), (fl), (v). Note size of any subplots in m².

Woody species	T1	T2	T3	S1	S2	H	%TC	Sub	DBH *(note stratum; include age data if available)*
Quercus rubra		10	5				15		T2 24, 30, 27 T3 15
Liriodendron tulip		10					10		T2 40, 34,
Tilia americana			2				2		T3 14
Fraxinus pensylvanica cf		10	5		3		98		T3 17 T2 36
Carya cordiformis		5			1		6		T2 25
Platanus occidentalis		10	10				20		T2 24, 28, 28 T3 15, 16, 16
Carpinus caroliniana			10	40			50		S1 8, 10, 9, 10, 7, 7, 7 T3 11, 8, 11, 8
Ulmus americana/rubra		10	5		T		15		T3 12, 9 T2 33
Aristolochia macrophylla			T				T		
Lindera benzoin				5	3		8		
Hamamelis virginiana				20	1		21		S1 7, 7, 8, 9, 7, 7, 11, 7
Cercis canadensis			5				5		T3 9, 14,

Species name	% cover	Species name	% cover
Cryptotaenia canadensis	1	Packera aurea	T
Selbum ternatum	3	Lysimachia ciliata	T
Osmorhiza claytonia	2	Ranunculus recurvatus	T
Cardamine concatenata	T	Solidago flexicaulis	T
Carex blanda	1	Ageratina altissima	T
Ranunculus abortivus	1	Polygonatum pubescens	T
Eurybia divaricata	1	Maianthemum racemosa	T
Sanguinaria canadensis	T	Actaea racemosa cf.	T
Sanicula canadensis cf	1	T2 Magnolia acuminata 31	5
Prenanthes	T	Orchid © Liparis lilifolia JPV 6906	P
Polygonum virginianum	1	Trillium undulatum	P
Uvularia perfoliata	T	T3 Prunus serotina 19	3
Hepatica nobilis acutiloba	T	T3 Juglan nigra 22, 25	10
Amphicarpa bracteata	1	T3 Fagus 12, 12,	5
Oxalis violacea	1	S2 Pinus strobus	T
Geum	T	S1 Dirca palustris	T
Viola striata	1	Viburnum prunifolium	5
Galium aparine	1	S2 Acer saccharum	1
Cruciata latifolia	T	S2 Rosa multifida	2
Luzula acuminata var. acuminata © JPV 6904	T	Viburnum prunifolia	1
Galium triflorum	1	Smilax tamnoides	T
Arisaema triphyllum triphyllum	T	Parthenocissus quinquefolia	T
Symphyotrichum 'praealtum' cf	T	Smilax glauca	T
Verbesina alternifolia	1	Staphylea trifoliata	T
Verbesina occidentalis	T	Quercus alba	T
Cardamine impatiens	T	Snags	
Botrychium virginianum	T	S1 10 (QURU), 10	
Meehania cordata	P		
Polystichum acrostichoides	T	Agrostis perennens	T
Agrimonia pubescens © BPS 1371	T	[illegible]	
Tiarella cordifolia	T		
Hydrophyllum virginianum	T	N Climacium americanum © JPV 6905	3
Symphiotrichum 'prenanthoides' cf	T	Polytrichum	1

Mallitrum T Asplenium platyneuron P Claytonia virginiana T

Solidago curtissii T Sanguinaria canadensis T Hollanta pubera T Phlox stolonifera T

Appendix B. Physiognomic type definitions.

FOREST: Trees usually over 5 m tall with crowns interlocking (generally forming 60–100% cover). Shrubs, herbs, and nonvascular plants may be present at any cover value.

WOODLAND: Open stands of trees usually over 5 m tall with crowns not usually touching (generally forming 25–60% cover). Shrubs, herbs, and nonvascular plants may be present at any cover value.

SHRUBLAND: Shrubs and/or small trees usually 0.5–5.0 m tall with individuals or clumps not touching to interlocking (generally forming >25% canopy cover). Trees may be present, but with cover of 10% or less. Herbs and nonvascular plants may be present at any cover value.

HERBACEOUS: Graminoids and/or forbs (including ferns) generally forming >10% cover. Trees, shrubs, and dwarf shrubs may be present, but with cover 10 percent or less. Nonvascular plants may be present at any cover value.

NON-VASCULAR: Non-vascular vegetation (bryophytes, lichen, or other non-vascular plants) with cover greater than 25%. Trees, shrubs, and herbns may be present, but with cover of 25% or less.

SPARSELY VEGETATED: Substrate is predominantly not vegetated, cover of trees, shrubs, herbs, and non-vascular vegetation combined is 25% or less.

Appendix C. Original key to vegetation community types used for thematic accuracy assessment.

The following is the original key provided to North Carolina State University on June 8, 2007 for use as the basis for thematic accuracy assessment. After accuracy assessment was completed some changes were made to the classification of riparian communities (lead 2.), and scientific names and element codes were added for each association. This key should not be used to classify vegetation associations at BLUE according to the U. S. National Vegetation Classification but is provided to document the accuracy assessment procedure. The final key to vegetation associations at BLUE is provided in Appendix J.

1. Upland communities not including riparian jurisdictional uplands. Located on plateaus, ridges, gorge slopes and benches, in coves and ravines, on cliffs, and in positions along streams which are never flooded.
    1.1. Mixed forests and woodlands with a significant conifer component in the stand. Cover by conifers usually > 10% in the canopy layers. If conifer cover is < 10% in the canopy then conifers are more abundant in the surrounding stand and there is generally conifer regeneration in the understory.
        1.1.1. Most abundant conifer is a species of *Pinus* (pine).
            1.1.1.1. Woodlands and forests with *Pinus virginiana* (Virginia pine) the most abundant conifer in the canopy.
                1.1.1.1.1. Forests strongly dominated by *Pinus virginiana*. Even-aged successional stands on sites previously cleared for agriculture. Successional Virginia Pine Forest (map class: Successional Virginia Pine Forest)
                1.1.1.1.2. *Pinus virginiana* codominant with deciduous trees including species of *Quercus* (oaks) and *Carya* (hickories). Stands usually have somewhat open canopies and trees may be stunted due to hot, dry soil conditions on south aspect slopes. Indicator species include *Quercus stellata* (post oak) and *Carex pensylvanica* (Pennsylvania sedge). Virginia Pine - Oak Shale Woodland (map class: Virginia Pine - Oak Shale Woodland)
            1.1.1.2. Forests usually lacking *Pinus virginiana* (Virginia pine) in the canopy. Most abundant conifer is *Pinus strobus* (eastern white pine).
                1.1.1.2.1. *Pinus strobus* (eastern white pine) dominant in the canopy, typically growing in even-aged stands on sites previously cleared for agriculture. Most common deciduous tree is *Liriodendron tulipifera* (tuliptree), which may be codominant in some stands. Indicator species include *Lonicera japonica* (Japanese honeysuckle) and *Salvia lyrata* (lyreleaf sage). Successional Eastern White Pine - Tuliptree Forest (map class: Successional Eastern White Pine - Tuliptree Forest)
                1.1.1.2.2. Canopy dominated or codominated by species of *Quercus* (oaks). *Liriodendron tulipifera* (tuliptree) is absent or less abundant. *Oxydendrum arborea* (sourwood) is usually abundant in the subcanopy. Understories are characterized by an abundance of shrubs in the Ericaceae (heath family). Indicator species include *Vaccinium pallidum* (hillside

blueberry), *Kalmia latifolia* (mountain laurel), and *Gaultheria procumbens* (wintergreen). Oak - Eastern White Pine / Ericad Forest (map class: Oak - Eastern White Pine / Ericad Forest)

1.1.2. Most abundant conifer is *Tsuga canadensis* (eastern hemlock).

1.1.2.1. *Tilia americana* (American basswood) with > 2 % cover in the canopy layers along with high constancy of *Quercus rubra* (northern red oak) and *Acer saccharum* (sugar maple). Forests in protected positions on colluvial gorge slopes, usually on northerly aspects. The herb layer is relatively diverse and includes some nutrient demanding herbs. Indicator species include *Dryopteris marginalis* (marginal woodfern), *Aristolochia macrophylla* (pipevine), and *Hydrangea arborescens* (smooth hydrangea). Eastern Hemlock - American Basswood Forest (map class: Eastern Hemlock - American Basswood Forest)

1.1.2.2. *Tilia americana* absent from the canopy layers. Herb layers have low cover and diversity and usually lack nutrient demanding species.

1.1.2.2.1. Canopies codominated by *Quercus prinus* (chestnut oak) and/or other species of *Quercus* (oaks) or *Oxydendron arborea* (sourwood). *Liriodendron tulipifera* absent from canopy. Cover by *Rhododendron maximum* (great laurel) < 10%. Indicator species include *Leucobryum glaucum* (pincushion moss) and *Monotropa uniflora* (Indian-pipe). Forests in exposed positions (upper slopes and ridges) with various aspects. Eastern Hemlock – Chestnut Oak Forest (map class: Eastern Hemlock - Chesnut Oak Forest)

1.1.2.2.2. Canopies codominated by *Betula lenta* (sweet birch) and *Liriodendron tulipifera* (tuliptree). Cover by *Rhododendron maximum* (great laurel) > 10%. Uncommon type at Bluestone, occurring on sandstone derived substrates near heads of ravines. Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest (map class: Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest)

1.2. Deciduous forests without a significant conifer component. Confers with < 10% cover in the canopy layers.

1.2.1. Successional forests and woodlands with strong dominance by a single tree species, either *Liriodendron tulipifera* (tuliptree) or *Robinia pseudoacacia* (black locust). Stands with even-aged canopies on sites previously cleared for agriculture.

1.2.1.1. Forests dominated by *Liriodendron tulipifera* (tuliptree). Successional Tuliptree / Northern Spicebush Forest (map class: Successional Tuliptree / Northern Spicebush Forest)

1.2.1.2. Woodlands and forests dominated by *Robinia pseudoacacia* (black locust). Successional Black Locust Woodland (map classes: Successional Black Locust Woodland, Disturbed Area)

1.2.2. Forests without clear dominance by a single species.

1.2.2.1. Forests with canopies dominated by *Quercus* spp. (oaks) and/or *Carya* spp. (hickories). Species of *Quercus* (oaks) or *Carya* (hickories) alone or in combination comprising > 50% of total canopy cover.

1.2.2.1.1. *Quercus muehlenbergii* (chinquapin oak) with > 5% canopy cover. *Quercus prinus* (chestnut oak) usually absent. Forests in small patches on calcium rich soils downslope from outcrops of limestone or calcareous

shale. Indicator species include *Oxalis grandis* (great yellow wood sorrel) and *Desmodium glabellum* (Dillenius' tick-trefoil). Calcareous Oak Forest (map class: Calcareous Oak Forest)

1.2.2.1.2. *Quercus muehlenbergii* (chinquapin oak) with < 5% canopy cover, usually absent. *Quercus prinus* (chestnut oak) often present to codominant. Widespread forests on the predominating acidic shale formations of the park. Oak - Hickory - Sugar Maple Forest (map class: Oak - Hickory - Sugar Maple Forest)

1.2.2.2. Forests codominated by a mixture of mesophytic species including *Tilia americana* (American basswood), *Acer saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak), and *Aesculus* flava (yellow buckeye). Species of *Quercus* (oaks) or *Carya* (hickories) alone or in combination comprising < 50% of total canopy cover. Forests on gorge slopes with northerly aspects. Sugar Maple - Yellow Buckeye - American Basswood Forest (map class: Sugar Maple - Yellow Buckeye - American Basswood Forest)

2. Riparian communities. Vegetation affected by flooding or seepage. Includes jurisdictional wetlands and other areas which are seasonally, temporarily, or occasionally flooded, either naturally or by reservoir backup. Frequency of flooding may range from intervals of decades to semi-permanent. Located in slope bottom and level landscape positions on alluvial landforms.

2.1. Natural vegetation in areas not greatly altered by human activities such as past farming and settlement and/or more recently altered flooding regimes caused by reservoir backup. Includes vegetation along the river edge which is inundated by reservoir backup but which is also affected by a natural downstream flooding regime. Often occurring in narrow zones on lower floodplains below terraces which were farmed. Also includes areas of higher floodplains beyond the zone of reservoir backup which were not intensively settled or farmed or where natural vegetation has become reestablished after long abandonment.

2.1.1. Woodland and herbaceous communities along the river edge. Canopy cover by trees < 60%.

2.1.1.1. Woodlands along the river edge with relatively short canopies dominated by *Platanus occidentalis* (sycamore) and/or *Betula nigra* (river birch). Open canopies are maintained by frequent, high energy flooding which removes and damages trees.

2.1.1.1.1. *Betula nigra* usually dominant in the canopy over an herbaceous layer dominated by *Chasmanthium latifolium* (river oats) and *Dicanthelium clandestinum* (deer-toungue grass). Occurs on relatively fine textured (sand) alluvial deposits. River Birch / River Oats Floodplain Woodland. (map class: Floodplain Forest and Woodland)

2.1.1.1.2. *Platanus occidentalis* dominant or codominant with *Betula nigra* in the canopy over an herbaceous layer dominated by *Andropogon gerardii* (big bluestem). Occurs on relatively coarse textured alluvial deposits (boulders, cobbles, and sand).Sycamore - River Birch Riverscour Woodland. (map classes: Floodplain Forest and Woodland, Sycamore - River Birch Riverscour Woodland)

2.1.1.2. Herbaceous communities dominated by tall herbs. Common herb species include *Apios americana* (groundnut), *Dicanthelium clandestinum* (deer-tongue grass), *Solidago gigantea* (giant goldenrod), and *Verbesina alternifolia* (wingstem). Located on sandy riverbanks which are sunny to partially shaded by overhanging canopies of tall trees. Riverbank Tall Herbs. (map class: Floodplain Forest and Woodland)

2.1.2. Forests. Canopy cover by trees > 60%.

2.1.2.1. Mixed evergreen-deciduous forests on higher floodplains and terraces with *Tsuga canadensis* (eastern hemlock) codominant in the canopy and/or subcanopy. Associated deciduous trees may include *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), and *Liriodendron tulipifera* (tuliptree). Eastern Hemlock Floodplain Forest. (map classes: Floodplain Forest and Woodland, Eastern Hemlock Floodplain Forest)

2.1.2.2. Deciduous forests without significant *Tsuga canadensis* in the canopy.

2.1.2.2.1. Forests with species of *Quercus* (oaks) and/or *Carya* (hickories) having > 15% cover in the canopy layers. Oak - Hickory Floodplain Forest (map class: Floodplain Forest and Woodland)

2.1.2.2.2. Forests without significant cover by species of *Quercus* or *Carya* in the canopy.

2.1.2.2.2.1. Forests with relatively short canopies dominated by flood-battered *Betula nigra* (river birch) over an herbaceous layer dominated by *Chasmanthium latifolium* (river oats). Shrub layer usually poorly developed (< 10% cover). Occurs in frequently flooded positions on sloping banks along the river edge. River Birch / River Oats Floodplain Woodland. (map class: Floodplain Forest and Woodland)

2.1.2.2.2.2. Forests with relatively tall canopies dominated by *Platanus occidentalis* (sycamore). *Aesculus flava* present to dominant in the subcanopy. Shrub layers often well developed (> 10% cover). Occurs on floodplains above the river bank. Sycamore - Yellow Buckeye Floodplain Forest. (map class: Floodplain Forest and Woodland)

2.2. Semi-natural vegetation in areas altered by human activities including past farming and settlement and/or by modified flooding regimes caused by reservoir backup. Reservoir backup influence is evident up to about 445 meters (1460 feet) elevation.

2.2.1. Herbaceous communities dominated by tall herbs. Common herb species include *Apios americana* (groundnut), *Dicanthelium clandestinum* (deer-tongue grass), *Solidago gigantea* (giant goldenrod), and *Verbesina alternifolia* (wingstem). Degraded examples may have dominance by exotic species including *Humulus japonicus* (Japanese hops) and *Urtica dioica* (stinging nettle). Located in openings which are sunny to partially shaded by overhanging canopies of tall trees. Riverbank Tall Herbs. (map class: Modified Successional Floodplain Forest and Woodland).

2.2.2. Forests and woodlands

2.2.2.1. Forests and woodlands with a significant conifer component in the stand. Cover by conifers > 10% in the canopy layers.

2.2.2.1.1. Forests dominated by *Pinus strobus* (Eastern White Pine). *Liriodendron tulipifera* (tuliptree) may be codominant. Successional Eastern White Pine - Tuliptree Forest. (map classes: Successional Eastern White Pine - Tuliptree Forest, Modified Successional Floodplain Forest and Woodland).

2.2.2.1.2. Woodlands and Forests with a significant component of *Juniperus virginiana* (Eastern Red-cedar) in the canopy. Successional Eastern Red-cedar Woodland. (map class: Successional Eastern Red-cedar Woodland).

2.2.3. Forests, woodlands, and herbaceous vegetation without a significant conifer component.

2.2.3.1.1. Forests and woodlands in backwater positions strongly dominated by *Betula nigra* (River Birch). If present, *Betula nigra* contributes less than 50% of total canopy cover. Standing water and wetland indicator species such as *Glyceria* spp. (manna grasses) are often present. River Birch Backwater Floodplain Forest (map class: Modified Successional Floodplain Forest and Woodland)

2.2.3.1.2. Forests and woodlands not strongly dominated by *Betula nigra* (River Birch). If present, *Betula nigra* contributes less than 50% of canopy cover.

2.2.3.1.2.1. Forests and woodlands strongly dominated by *Acer negundo* (box-elder). Successional Box-elder Floodplain Forest. (map class: Modified Successional Floodplain Forest and Woodland)

2.2.3.1.2.2. Forests and woodlands not strongly dominated by *Acer negundo* (box-elder). If present, *Acer negundo* contributes less than 50% of total canopy cover.

2.2.3.1.2.2.1. Forests and woodlands strongly dominated by *Juglans nigra* (black walnut). If present, *Juglans nigra* contributes less than 50% of total canopy cover. Successional Black Walnut Floodplain Forest. (map class: Modified Successional Floodplain Forest and Woodland)

2.2.3.1.2.2.2. Forests and woodlands not strongly dominated by *Juglans nigra.*

2.2.3.1.2.2.2.1. Forests strongly dominated by *Liriodendron tulipifera* (tuliptree). Successional Tuliptree / Northern Spicebush Forest. (map class: Modified Successional Floodplain Forest and Woodland)

2.2.3.1.2.2.2.2. Forests and woodlands not strongly dominated by *Liriodendron tulipifera* (tuliptree). If present, *Liriodendron tulipifera* contributes less than 50% of total canopy cover. Canopy trees may include *Platanus occidentalis* (sycamore), *Betula nigra* (river birch), *Ulmus americana* (American elm), *Fraxinus pennsylvanica* (red ash), *Acer negundo* (box-elder), *Acer nigrum* (black maple), *Liriodendron tulipifera* (tulip poplar) and others. Unclassified Floodplain Forest. (map class: Modified Successional Floodplain Forest and Woodland)

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

Plot Number _____ Park _____ Date _____ Observers _____

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

Topographic Description: _____ Elevation: _____ Aspect: _____ Canopy Closure: _____

Vegetation Association at Point: _____

Veg Assoc 1 w/in 50 m of point: _____

Veg Assoc 2 w/in 50 m of point: _____

Major Species by Strata:

Rationale for Classification:

Comments:

A table containing the fields that appear on this standard accuracy assessment form was created in ArcGIS and converted to a Trimble data dictionary file for use in the field. All field data were entered directly into the electronic data dictionary.

Descriptions of fields:

Plot Number: randomly generated in ArcGIS
Park: NERI - New River Gorge National River
Date: automatically generated in the field
Observers: name of observer
Easting / Northing: UTM coordinates automatically generated in field if GPS satellites were available, otherwise edited in ArcGIS after field data were collected
EPE / APE: estimated from GPS differential correction software if collected, otherwise estimated by observer
DOP: estimated from GPS software
Map Datum: NAD 83
Zone: 17N
Topographic Description: descriptors of slope steepness, shape of slope and position on slope
Elevation: calculated by the GPS software, otherwise taken from a topographic map
Aspect: measured to the nearest 1º Azimuth using a Silva ranger handcompass
Canopy Closure: ocular estimate in percent
Vegetation Association at Point: based on the vegetation key
Vegetation Association 1 and 2 within 50 m of point: based on vegetation key and distance to these are also recorded
Major species by strata: common names of major canopy trees seen at point
Rationale for Classification: indicate if it was a strong match to the vegetation key; if it was not record reasons why the match was not so good
Comments: any other comments

The following fields that are not on the standard form were added to the data dictionary:
Canopy height: measured to the nearest 5 feet
Minor species: herbaceous, shrub, or minor tree species worth noting

Appendix E. State and global conservation status rank definitions.

West Virginia State Ranks

State ranks are assigned by the West Virginia Natural Heritage Program and refer to the conservation status of the element across its range within West Virginia.

Rank	Definition
S1	Five or fewer documented occurrences, or very few remaining individuals within the state. Extremely rare and critically imperiled; or because of some factor(s) making it especially vulnerable to extirpation.
S2	Six to 20 documented occurrences, or few remaining individuals within the state. Very rare and imperiled; or because of some factor(s) making it vulnerable to extirpation.
S3	Twenty-one to 100 documented occurrences. May be somewhat vulnerable to extirpation.
S4	Common and apparently secure with more than 100 occurrences.
S5	Very common and demonstrably secure.
SH	Historical. Species which have not been relocated within the last 20 years. May be rediscovered.
SR	Reported from state, but not yet verified.
SX	Believed extirpated. Little likelihood of rediscovery.
SU	Possibly rare, but status uncertain until more data are gathered.
S?	Unranked, or, if following a number, rank uncertain (ex. S2?).
SNR	Not ranked.

Global Ranks

Global ranks are assigned by NatureServe and refer to the conservation status acoss the global range of the element.

Global basic ranks

Rank	Definition
GX	Presumed Extinct (species) - Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated (ecological communities) - Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
GH	Possibly Extinct (species) - Missing; known from only historical occurrences but still some hope of rediscovery. Presumed Eliminated - (Historic, ecological communities)-Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut Forest.
G1	Critically Imperiled - At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled - At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable - At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure - Common; widespread and abundant.

Global variant ranks

Rank	Definition
G#G#	Range Rank - A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. A G2G3 rank would indicate that there is a roughly equal chance of G2 or G3 and other ranks are much less likely. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
GU	Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and a question mark qualifier may be added (e.g., G2?) to express minor uncertainty, or a range rank (e.g., G2G3) may be used to delineate the limits (range) of uncertainty.
GNR	Unranked - Global rank not yet assessed.
GNA	Not Applicable - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

Global rank qualifiers

Rank	Definition
?	Inexact Numeric Rank - Denotes some uncertainty about the numeric rank (e.g. G3? - Believed most likely a G3, but some chance of either G2 or G4).
Q	Questionable taxonomy - Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.
C	Captive or Cultivated Only - At present extant only in captivity or cultivation, or as a reintroduced population not yet established.

Infraspecific taxon conservation status ranks

Infraspecific taxa refer to subspecies, varieties and other designations below the level of the species. Infraspecific taxon status ranks (T-ranks) apply to plants and animal species only; these T-ranks do not apply to ecological communities.

Rank	Definition
T#	Infraspecific Taxon (trinomial) - The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T-rank cannot imply the subspecies or variety is more abundant than the species as a whole-for example, a G1T2 cannot occur. A vertebrate animal population, such as those listed as distinct population segments under under the U.S. Endangered Species Act, may be considered an infraspecific taxon and assigned a T-rank; in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status. At this time, the T rank is not used for ecological communities.

Appendix F. Vascular and non-vascular plant taxa found in plots and accuracy assessment points in Bluestone National Scenic River.

Nomenclature for vascular plants follows the Checklist and Atlas of the Vascular Flora of West Virginia (Harmon et al. 2006), except for *Dichanthelium* and *Panicum* which follow the Flora of North America (Freckmann and Lelong 2003). Nomenclature for mosses and liverworts (Bryophyta) follows the Annotated Checklist of the Hornworts, Liverworts, and Mosses of West Virginia (Studlar et al. 2002). Nomenclature for lichens (Ascomycota) follows Lichens of North America (Brodo et al. 2001) except *Cladina* is listed for reindeer lichens not identified to the species level. Nomenclature for mushrooms (Basiodmycota) follows Mushrooms of West Virginia and the Central Appalachians (Roody 2003). Nomenclature for 96% (all but 26) of the taxa is also consistent with the excepted name listed in the PLANTS database (USDA, NRCS 2008).

Scientific Name	Common Name	Family	Division
Acalypha gracilens Gray var. *gracilens*	slender threeseed mercury	Euphorbiaceae	Magnoliophyta
Acalypha L.	copperleaf	Euphorbiaceae	Magnoliophyta
Acalypha rhomboidea Raf.	Virginia threeseed mercury	Euphorbiaceae	Magnoliophyta
Acalypha virginica L.	Virginia threeseed mercury	Euphorbiaceae	Magnoliophyta
Acer negundo L. var. *negundo*	boxelder	Aceraceae	Magnoliophyta
Acer nigrum Michx. f.	black maple	Aceraceae	Magnoliophyta
Acer pensylvanicum L.	striped maple	Aceraceae	Magnoliophyta
Acer rubrum L. var. *rubrum*	red maple	Aceraceae	Magnoliophyta
Acer saccharum Marsh. var. *saccharum*	sugar maple	Aceraceae	Magnoliophyta
Achillea millefolium L. var. *occidentalis* DC.	western yarrow*	Asteraceae	Magnoliophyta
Actaea racemosa L. var. *racemosa*	black bugbane	Ranunculaceae	Magnoliophyta
Adiantum pedatum L.	northern maidenhair	Adiantaceae	Polypodiophyta
Aesculus flava Ait.	yellow buckeye	Hippocastanaceae	Magnoliophyta
Ageratina altissima (L.) King & H.E. Robins. var. altissima	white snakeroot	Asteraceae	Magnoliophyta
Agrimonia L.	agrimony	Rosaceae	Magnoliophyta
Agrimonia parviflora Ait.	harvestlice	Rosaceae	Magnoliophyta
Agrimonia pubescens Wallr.	soft agrimony	Rosaceae	Magnoliophyta
Agrimonia rostellata Wallr.	beaked agrimony	Rosaceae	Magnoliophyta
Agrostis capillaris L.	colonial bentgrass*	Poaceae	Magnoliophyta
Agrostis gigantea Roth	redtop*	Poaceae	Magnoliophyta
Agrostis L.	bentgrass	Poaceae	Magnoliophyta
Agrostis perennans (Walt.) Tuckerman	upland bentgrass	Poaceae	Magnoliophyta
Albizia julibrissin Durazz.	silktree*	Fabaceae	Magnoliophyta
Alliaria petiolata (Bieb.) Cavara & Grande	garlic mustard*	Brassicaceae	Magnoliophyta
Allium canadense L. var. *canadense*	meadow garlic	Liliaceae	Magnoliophyta

Scientific Name	Common Name	Family	Division
Allium oxyphilum Wherry	lillydale onion	Liliaceae	Magnoliophyta
Allium vineale L. ssp. *vineale*	wild garlic*	Liliaceae	Magnoliophyta
Alnus serrulata (Ait.) Willd.	hazel alder	Betulaceae	Magnoliophyta
Amblystegium serpens (Hedw.) Schimp. in B.S.G.	amblystegium moss	Amblystegiaceae	Bryophyta
Ambrosia artemisiifolia L. var. *elatior* (L.) Descourtils	annual ragweed	Asteraceae	Magnoliophyta
Ambrosia trifida L. var. *trifida*	great ragweed	Asteraceae	Magnoliophyta
Amelanchier arborea (Michx. f.) Fern. var. *arborea*	common serviceberry	Rosaceae	Magnoliophyta
Amelanchier Medik.	serviceberry	Rosaceae	Magnoliophyta
Ampelopsis arborea (L.) Koehne	peppervine	Vitaceae	Magnoliophyta
Amphicarpaea bracteata (L.) Fern.	American hogpeanut	Fabaceae	Magnoliophyta
Andropogon gerardii Vitman	big bluestem	Poaceae	Magnoliophyta
Anemone quinquefolia L.	nightcaps	Ranunculaceae	Magnoliophyta
Anemone quinquefolia L. var. *quinquefolia*	nightcaps	Ranunculaceae	Magnoliophyta
Anomodon attenuatus (Hedw.) Hüb.	anomodon moss	Anomodontaceae	Bryophyta
Anomodon Hook. & Tayl.	anomodon moss	Anomodontaceae	Bryophyta
Anomodon rostratus (Hedw.) Schimp.	anomodon moss	Anomodontaceae	Bryophyta
Antennaria Gaertn.	pussytoes	Asteraceae	Magnoliophyta
Antennaria plantaginifolia (L.) Richards.	woman's tobacco	Asteraceae	Magnoliophyta
Antennaria virginica Stebbins	shalebarren pussytoes	Asteraceae	Magnoliophyta
Anthoxanthum odoratum L. ssp. odoratum	sweet vernalgrass*	Poaceae	Magnoliophyta
Apios americana Medik.	groundnut	Fabaceae	Magnoliophyta
Apocynum cannabinum L.	Indianhemp	Apocynaceae	Magnoliophyta
Aquilegia canadensis L.	red columbine	Ranunculaceae	Magnoliophyta
Arabis L.	rockcress	Brassicaceae	Magnoliophyta
Arabis laevigata (Muhl. ex Willd.) Poir.	smooth rockcress	Brassicaceae	Magnoliophyta
Aralia nudicaulis L.	wild sarsaparilla	Araliaceae	Magnoliophyta
Aralia racemosa L. ssp. *racemosa*	American spikenard	Araliaceae	Magnoliophyta
Arisaema dracontium (L.) Schott	green dragon	Araceae	Magnoliophyta
Arisaema triphyllum (L.) Schott ssp. *triphyllum*	Jack in the pulpit	Araceae	Magnoliophyta
Aristolochia macrophylla Lam.	pipevine	Aristolochiaceae	Magnoliophyta
Aristolochia serpentaria L.	Virginia snakeroot	Aristolochiaceae	Magnoliophyta
Arnoglossum atriplicifolium (L.) H.E. Robins.	pale Indian plaintain	Asteraceae	Magnoliophyta
Arnoglossum muehlenbergii (Schultz-Bip.) H.E. Robins.	great Indian plaintain	Asteraceae	Magnoliophyta
Artemisia vulgaris L. var. *vulgaris*	common wormwood*	Asteraceae	Magnoliophyta
Asarum canadense L.	Canadian wildginger	Aristolochiaceae	Magnoliophyta

Scientific Name	Common Name	Family	Division
Asclepias L.	milkweed	Asclepiadaceae	Magnoliophyta
Asclepias quadrifolia Jacq.	fourleaf milkweed	Asclepiadaceae	Magnoliophyta
Asclepias syriaca L.	common milkweed	Asclepiadaceae	Magnoliophyta
Asclepias tuberosa L.	butterfly milkweed	Asclepiadaceae	Magnoliophyta
Asclepias verticillata L.	whorled milkweed	Asclepiadaceae	Magnoliophyta
Asimina triloba (L.) Dunal	pawpaw	Annonaceae	Magnoliophyta
Asplenium ×ebenoides R.R. Scott (pro sp.)	walking spleenwort	Aspleniaceae	Polypodiophyta
Asplenium platyneuron (L.) B.S.P.	ebony spleenwort	Aspleniaceae	Polypodiophyta
Asplenium rhizophyllum L.	walking fern	Aspleniaceae	Polypodiophyta
Aster	aster	Asteraceae	Magnoliophyta
Atrichum P. Beauv.	atrichum moss	Polytrichaceae	Bryophyta
Aulacomnium heterostichum (Hedw.) Bruch & Schimp. in B.S.G.	aulacomnium moss	Aulacomniaceae	Bryophyta
Aureolaria flava (L.) Farw.	smooth yellow false foxglove	Scrophulariaceae	Magnoliophyta
Aureolaria flava (L.) Farw. var. *flava*	smooth yellow false foxglove	Scrophulariaceae	Magnoliophyta
Aureolaria flava (L.) Farw. var. *macrantha* Pennell	smooth yellow false foxglove	Scrophulariaceae	Magnoliophyta
Aureolaria virginica (L.) Pennell	downy yellow false foxglove	Scrophulariaceae	Magnoliophyta
Barbarea vulgaris Ait. f.	garden yellowrocket*	Brassicaceae	Magnoliophyta
Berberis canadensis P. Mill.	American barberry	Berberidaceae	Magnoliophyta
Berberis L.	barberry	Berberidaceae	Magnoliophyta
Berberis vulgaris L.	common barberry*	Berberidaceae	Magnoliophyta
Betula lenta L.	sweet birch	Betulaceae	Magnoliophyta
Betula nigra L.	river birch	Betulaceae	Magnoliophyta
Bidens bipinnata L.	Spanish needles	Asteraceae	Magnoliophyta
Bidens cernua L.	nodding beggartick	Asteraceae	Magnoliophyta
Bidens frondosa L.	devil's beggartick	Asteraceae	Magnoliophyta
Bidens L.	beggarticks	Asteraceae	Magnoliophyta
Bidens tripartita L.	threelobe beggarticks	Asteraceae	Magnoliophyta
Bidens vulgata Greene	big devils beggartick	Asteraceae	Magnoliophyta
Boehmeria cylindrica (L.) Sw.	smallspike false nettle	Urticaceae	Magnoliophyta
Botrychium virginianum (L.) Sw.	rattlesnake fern	Ophioglossaceae	Polypodiophyta
Brachyelytrum erectum (Schreb. ex Spreng.) Beauv.	bearded shorthusk	Poaceae	Magnoliophyta
Brachythecium oxycladon (Brid.) Jaeg.	brachythecium moss	Brachytheciaceae	Bryophyta
Brachythecium plumosum (Hedw.) Schimp. in B.S.G.	brachythecium moss	Brachytheciaceae	Bryophyta
Brachythecium salebrosum (Web. & Mohr) Schimp. in B.S.G.	brachythecium moss	Brachytheciaceae	Bryophyta
Brassica nigra (L.) W.D.J. Koch	black mustard*	Brassicaceae	Magnoliophyta
Bromus L.	brome	Poaceae	Magnoliophyta
Bromus pubescens Muhl. ex Willd.	hairy woodland brome	Poaceae	Magnoliophyta
Brotherella recurvans (Michx.) Fleisch.	recurved brotherella moss	Sematophyllaceae	Bryophyta

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Bryhnia novae-angliae (Sull. & Lesq. in Sull.) Grout	New England bryhnia moss	Brachytheciaceae	Bryophyta
Bryoandersonia illecebra (Hedw.) Robins.	bryoandersonia moss	Brachytheciaceae	Bryophyta
Campanula divaricata Michx.	small bonny bellflower	Campanulaceae	Magnoliophyta
Campanulastrum americanum (L.) Small	American bellflower	Campanulaceae	Magnoliophyta
Cantharellus cibarius Fr.	chantrelle mushroom	Cantharellaceae	Basidiomycota
Cardamine angustata O.E. Schulz	slender toothwort	Brassicaceae	Magnoliophyta
Cardamine bulbosa (Schreb. ex Muhl.) B.S.P.	bulbous bittercress	Brassicaceae	Magnoliophyta
Cardamine concatenata (Michx.) Sw.	cutleaf toothwort	Brassicaceae	Magnoliophyta
Cardamine hirsuta L.	hairy bittercress	Brassicaceae	Magnoliophyta
Cardamine impatiens L.	narrowleaf bittercress*	Brassicaceae	Magnoliophyta
Cardamine L.	bittercress	Brassicaceae	Magnoliophyta
Cardamine parviflora L. var. *arenicola* (Britt.) O.E. Schulz	sand bittercress	Brassicaceae	Magnoliophyta
Cardamine pensylvanica Muhl. ex Willd.	Pennsylvania bittercress	Brassicaceae	Magnoliophyta
Carex albursina Sheldon	white bear sedge	Cyperaceae	Magnoliophyta
Carex amphibola Steud.	eastern narrowleaf sedge	Cyperaceae	Magnoliophyta
Carex annectens (Bickn.) Bickn.	yellowfruit sedge	Cyperaceae	Magnoliophyta
Carex blanda Dewey	eastern woodland sedge	Cyperaceae	Magnoliophyta
Carex caroliniana Schwein.	Carolina sedge	Cyperaceae	Magnoliophyta
Carex cephalophora Muhl. ex Willd.	oval-leaf sedge	Cyperaceae	Magnoliophyta
Carex communis Bailey var. *communis*	fibrousroot sedge	Cyperaceae	Magnoliophyta
Carex crinita Lam. var. *crinita*	fringed sedge	Cyperaceae	Magnoliophyta
Carex cumberlandensis Naczi, Kral & Bryson	Cumberland sedge	Cyperaceae	Magnoliophyta
Carex digitalis Willd. var. *digitalis*	slender woodland sedge	Cyperaceae	Magnoliophyta
Carex emoryi Dewey	Emory's sedge	Cyperaceae	Magnoliophyta
Carex frankii Kunth	Frank's sedge	Cyperaceae	Magnoliophyta
Carex gracillima Schwein.	graceful sedge	Cyperaceae	Magnoliophyta
Carex hirsutella Mackenzie	fuzzy wuzzy sedge	Cyperaceae	Magnoliophyta
Carex hitchcockiana Dewey	Hitchcock's sedge	Cyperaceae	Magnoliophyta
Carex jamesii Schwein.	James' sedge	Cyperaceae	Magnoliophyta
Carex L.	sedge	Cyperaceae	Magnoliophyta
Carex laxiculmis Schwein. var. *laxiculmis*	spreading sedge	Cyperaceae	Magnoliophyta
Carex laxiflora Lam.	broad looseflower sedge	Cyperaceae	Magnoliophyta
Carex lupulina Muhl. ex Willd.	hop sedge	Cyperaceae	Magnoliophyta
Carex lurida Wahlenb.	shallow sedge	Cyperaceae	Magnoliophyta
Carex oligocarpa Schkuhr ex Willd.	richwoods sedge	Cyperaceae	Magnoliophyta
Carex pensylvanica Lam.	Pennsylvania sedge	Cyperaceae	Magnoliophyta
Carex plantaginea Lam.	plantainleaf sedge	Cyperaceae	Magnoliophyta

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Carex platyphylla Carey	broadleaf sedge	Cyperaceae	Magnoliophyta
Carex prasina Wahlenb.	drooping sedge	Cyperaceae	Magnoliophyta
Carex radiata (Wahlenb.) Small	eastern star sedge	Cyperaceae	Magnoliophyta
Carex squarrosa L.	squarrose sedge	Cyperaceae	Magnoliophyta
Carex stipata Muhl. ex Willd. var. *stipata*	owlfruit sedge	Cyperaceae	Magnoliophyta
Carex swanii (Fern.) Mackenzie	Swan's sedge	Cyperaceae	Magnoliophyta
Carex tribuloides Wahlenb.	blunt broom sedge	Cyperaceae	Magnoliophyta
Carex vulpinoidea Michx.	fox sedge	Cyperaceae	Magnoliophyta
Carex willdenowii Schkuhr ex Willd.	Willdenow's sedge	Cyperaceae	Magnoliophyta
Carex woodii Dewey	pretty sedge	Cyperaceae	Magnoliophyta
Carpinus caroliniana Walt. ssp. *virginiana* (Marsh.) Furlow	American hornbeam	Betulaceae	Magnoliophyta
Carya alba (L.) Nutt. ex Ell.	mockernut hickory	Juglandaceae	Magnoliophyta
Carya cordiformis (Wangenh.) K. Koch	bitternut hickory	Juglandaceae	Magnoliophyta
Carya glabra (P. Mill.) Sweet	pignut hickory	Juglandaceae	Magnoliophyta
Carya Nutt.	hickory	Juglandaceae	Magnoliophyta
Carya ovata (P. Mill.) K. Koch	shagbark hickory	Juglandaceae	Magnoliophyta
Castanea dentata (Marsh.) Borkh.	American chestnut	Fagaceae	Magnoliophyta
Catalpa bignonioides Walt.	southern catalpa	Bignoniaceae	Magnoliophyta
Catalpa Scop.	catalpa	Bignoniaceae	Magnoliophyta
Catalpa speciosa (Warder) Warder ex Engelm.	northern catalpa	Bignoniaceae	Magnoliophyta
Caulophyllum thalictroides (L.) Michx.	blue cohosh	Berberidaceae	Magnoliophyta
Ceanothus americanus L.	New Jersey tea	Rhamnaceae	Magnoliophyta
Celtis occidentalis L.	common hackberry	Ulmaceae	Magnoliophyta
Cephalanthus occidentalis L.	common buttonbush	Rubiaceae	Magnoliophyta
Cerastium glomeratum Thuill.	sticky chickweed*	Caryophyllaceae	Magnoliophyta
Cercis canadensis L. var. *canadensis*	eastern redbud	Fabaceae	Magnoliophyta
Chasmanthium latifolium (Michx.) Yates	Indian woodoats	Poaceae	Magnoliophyta
Cheilanthes lanosa (Michx.) D.C. Eat.	hairy lipfern	Pteridaceae	Polypodiophyta
Chelone glabra L.	white turtlehead	Scrophulariaceae	Magnoliophyta
Chenopodium ambrosioides L. var. *ambrosioides*	Mexican tea*	Chenopodiaceae	Magnoliophyta
Chimaphila maculata (L.) Pursh	striped prince's pine	Pyrolaceae	Magnoliophyta
Chionanthus virginicus L.	white fringetree	Oleaceae	Magnoliophyta
Cicuta maculata L. var. *maculata*	spotted water hemlock	Apiaceae	Magnoliophyta
Cinna arundinacea L.	sweet woodreed	Poaceae	Magnoliophyta
Circaea lutetiana L. ssp. *canadensis* (L.) Aschers. & Magnus	broadleaf enchanter's nightshade	Onagraceae	Magnoliophyta
Cirsium discolor (Muhl. ex Willd.) Spreng.	field thistle	Asteraceae	Magnoliophyta
Cladina (Nyl.) Nyl.	reindeer lichen	Cladoniaceae	Ascomycota

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Cladonia arbuscula (Wallr.) Flotow	reindeer lichen	Cladoniaceae	Ascomycota
Cladonia furcata (Hudson) Schrader	cup lichen	Cladoniaceae	Ascomycota
Cladonia P. Browne	cup lichen	Cladoniaceae	Ascomycota
Claytonia virginica L.	Virginia springbeauty	Portulacaceae	Magnoliophyta
Clematis virginiana L.	devil's darning needles	Ranunculaceae	Magnoliophyta
Climacium americanum Brid.	American climacium moss	Climaciaceae	Bryophyta
Climacium Web. & Mohr ex Mohr	climacium moss	Climaciaceae	Bryophyta
Clintonia umbellulata (Michx.) Morong	white clintonia	Liliaceae	Magnoliophyta
Collinsonia canadensis L.	richweed	Lamiaceae	Magnoliophyta
Commelina communis L. var. *communis*	Asiatic dayflower*	Commelinaceae	Magnoliophyta
Conium maculatum L.	poison hemlock*	Apiaceae	Magnoliophyta
Conopholis americana (L.) Wallr. f.	American squawroot	Orobanchaceae	Magnoliophyta
Coreopsis auriculata L.	lobed tickseed	Asteraceae	Magnoliophyta
Coreopsis major Walt.	greater tickseed	Asteraceae	Magnoliophyta
Coreopsis pubescens Ell.	star tickseed	Asteraceae	Magnoliophyta
Coreopsis tinctoria Nutt. var. *tinctoria*	golden tickseed	Asteraceae	Magnoliophyta
Cornus amomum P. Mill.	silky dogwood	Cornaceae	Magnoliophyta
Cornus florida L.	flowering dogwood	Cornaceae	Magnoliophyta
Cornus racemosa Lam.	gray dogwood	Cornaceae	Magnoliophyta
Coronilla varia L.	purple crownvetch*	Fabaceae	Magnoliophyta
Corylus americana Walt.	American hazelnut	Betulaceae	Magnoliophyta
Crataegus crus-galli L.	cockspur hawthorn	Rosaceae	Magnoliophyta
Crataegus L.	hawthorn	Rosaceae	Magnoliophyta
Cryptotaenia canadensis (L.) DC.	Canadian honewort	Apiaceae	Magnoliophyta
Cunila origanoides (L.) Britt.	common dittany	Lamiaceae	Magnoliophyta
Cynoglossum virginianum L. var. *virginianum*	wild comfrey	Boraginaceae	Magnoliophyta
Cyperus strigosus L.	strawcolored flatsedge	Cyperaceae	Magnoliophyta
Cypripedium acaule Ait.	moccasin flower	Orchidaceae	Magnoliophyta
Dactylis glomerata L. ssp. *glomerata*	orchardgrass*	Poaceae	Magnoliophyta
Danthonia spicata (L.) Beauv. ex Roemer & J.A. Schultes	poverty oatgrass	Poaceae	Magnoliophyta
Daucus carota L.	Queen Anne's lace*	Apiaceae	Magnoliophyta
Deparia acrostichoides (Sw.) M. Kato	silver false spleenwort	Dryopteridaceae	Polypodiophyta
Desmodium Desv.	ticktrefoil	Fabaceae	Magnoliophyta
Desmodium glabellum (Michx.) DC.	Dillenius' ticktrefoil	Fabaceae	Magnoliophyta
Desmodium glutinosum (Muhl. ex Willd.) Wood	pointedleaf ticktrefoil	Fabaceae	Magnoliophyta
Desmodium nudiflorum (L.) DC.	nakedflower ticktrefoil	Fabaceae	Magnoliophyta

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Desmodium obtusum (Muhl. ex Willd.) DC.	stiff ticktrefoil	Fabaceae	Magnoliophyta
Desmodium paniculatum (L.) DC. var. *paniculatum*	panicledleaf ticktrefoil	Fabaceae	Magnoliophyta
Desmodium rotundifolium DC.	prostrate ticktrefoil	Fabaceae	Magnoliophyta
Dichanthelium (A.S. Hitchc. & Chase) Gould	rosette grass	Poaceae	Magnoliophyta
Dichanthelium boscii (Poir.) Gould & C.A. Clark	Bosc's panicgrass	Poaceae	Magnoliophyta
Dichanthelium clandestinum (L.) Gould	deertongue	Poaceae	Magnoliophyta
Dichanthelium commutatum (J.A. Schultes) Gould	variable panicgrass	Poaceae	Magnoliophyta
Dichanthelium commutatum (J.A. Schultes) Gould ssp. *ashei* (T.G. Pearson ex Ashei) Freckmann & Lelong	variable panicgrass	Poaceae	Magnoliophyta
Dichanthelium commutatum (J.A. Schultes) Gould ssp. *commutatum*	variable panicgrass	Poaceae	Magnoliophyta
Dichanthelium depauperatum (Muhl.) Gould	starved panicgrass	Poaceae	Magnoliophyta
Dichanthelium dichotomum (L.) Gould	cypress panicgrass	Poaceae	Magnoliophyta
Dichanthelium dichotomum (L.) Gould ssp. *dichotomum*	cypress panicgrass	Poaceae	Magnoliophyta
Dichanthelium dichotomum (L.) Gould ssp. *microcarpon* (Muhl. ex Elliott) Freckmann & Lelong	cypress panicgrass	Poaceae	Magnoliophyta
Dichanthelium dichotomum (L.) Gould ssp. *yadkinense* (Ashe) Freckmann & Lelong	cypress panicgrass	Poaceae	Magnoliophyta
Dicranodontium denudatum (Brid.) Britt. in Williams	denuded dicranodontium moss	Dicranaceae	Bryophyta
Dicranum fulvum Hook.	dicranum moss	Dicranaceae	Bryophyta
Dicranum Hedw.	dicranum moss	Dicranaceae	Bryophyta
Dicranum scoparium Hedw.	dicranum moss	Dicranaceae	Bryophyta
Dioscorea quaternata J.F. Gmel.	fourleaf yam	Dioscoreaceae	Magnoliophyta
Diospyros virginiana L.	common persimmon	Ebenaceae	Magnoliophyta
Dipsacus fullonum L.	Fuller's teasel*	Dipsacaceae	Magnoliophyta
Dirca palustris L.	eastern leatherwood	Thymelaeaceae	Magnoliophyta
Dodecatheon meadia L. ssp. *meadia*	pride of Ohio	Primulaceae	Magnoliophyta
Draba ramosissima Desv.	branched draba	Brassicaceae	Magnoliophyta
Dryopteris intermedia (Muhl. ex Willd.) Gray	intermediate woodfern	Dryopteridaceae	Polypodiophyta
Dryopteris marginalis (L.) Gray	marginal woodfern	Dryopteridaceae	Polypodiophyta
Echinochloa crus-galli (L.) Beauv.	barnyardgrass	Poaceae	Magnoliophyta

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Elaeagnus umbellata Thunb. var. *parvifolia* (Royle) Schneid.	autumn olive*	Elaeagnaceae	Magnoliophyta
Eleocharis tenuis (Willd.) J.A. Schultes	slender spikerush	Cyperaceae	Magnoliophyta
Eleocharis tenuis (Willd.) J.A. Schultes var. *tenuis*	slender spikerush	Cyperaceae	Magnoliophyta
Elephantopus carolinianus Raeusch.	Carolina elephantsfoot	Asteraceae	Magnoliophyta
Elymus canadensis L.	Canada wildrye	Poaceae	Magnoliophyta
Elymus hystrix L. var. *hystrix*	eastern bottlebrush grass	Poaceae	Magnoliophyta
Elymus L.	wildrye	Poaceae	Magnoliophyta
Elymus riparius Wieg.	riverbank wildrye	Poaceae	Magnoliophyta
Elymus virginicus L. var. *virginicus*	Virginia wildrye	Poaceae	Magnoliophyta
Epifagus virginiana (L.) W. Bart.	beechdrops	Orobanchaceae	Magnoliophyta
Epigaea repens L.	trailing arbutus	Ericaceae	Magnoliophyta
Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eat.	scouringrush horsetail	Equisetaceae	Equisetophyta
Eragrostis hypnoides (Lam.) B.S.P.	teal lovegrass	Poaceae	Magnoliophyta
Erechtites hieraciifolia (L.) Raf. ex DC. var. *hieraciifolia*	American burnweed	Asteraceae	Magnoliophyta
Erigeron annuus (L.) Pers.	eastern daisy fleabane	Asteraceae	Magnoliophyta
Erigeron L.	fleabane	Asteraceae	Magnoliophyta
Erigeron philadelphicus L. var. *philadelphicus*	Philadelphia fleabane	Asteraceae	Magnoliophyta
Erigeron pulchellus Michx.	robin's plantain	Asteraceae	Magnoliophyta
Erigeron strigosus Muhl. ex Willd. var. *strigosus*	prairie fleabane	Asteraceae	Magnoliophyta
Euonymus americana L.	strawberry bush	Celastraceae	Magnoliophyta
Euonymus atropurpurea Jacq. var. *atropurpurea*	eastern wahoo	Celastraceae	Magnoliophyta
Eupatorium fistulosum Barratt	trumpetweed	Asteraceae	Magnoliophyta
Eupatorium perfoliatum L. var. *perfoliatum*	common boneset	Asteraceae	Magnoliophyta
Eupatorium purpureum L. var. *purpureum*	sweetscented joepyeweed	Asteraceae	Magnoliophyta
Euphorbia corollata L.	flowering spurge	Euphorbiaceae	Magnoliophyta
Eurybia divaricata (L.) Nesom	white wood aster	Asteraceae	Magnoliophyta
Eurybia macrophylla (L.) Cass.	bigleaf aster	Asteraceae	Magnoliophyta
Eurybia schreberi (Nees) Nees	Schreber's aster	Asteraceae	Magnoliophyta
Fagus grandifolia Ehrh.	American beech	Fagaceae	Magnoliophyta
Festuca subverticillata (Pers.) Alexeev	nodding fescue	Poaceae	Magnoliophyta
Flavoparmelia baltimorensis (Gyelnik & Foriss) Hale	rock greenfield lichen	Parmeliaceae	Ascomycota
Fraxinus americana L.	white ash	Oleaceae	Magnoliophyta
Fraxinus pennsylvanica Marsh.	green ash	Oleaceae	Magnoliophyta
Galinsoga quadriradiata Cav.	shaggy-soldier*	Asteraceae	Magnoliophyta
Galium aparine L.	stickywilly	Rubiaceae	Magnoliophyta

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Galium asprellum Michx.	rough bedstraw	Rubiaceae	Magnoliophyta
Galium circaezans Michx.	licorice bedstraw	Rubiaceae	Magnoliophyta
Galium circaezans Michx. var. *circaezans*	licorice bedstraw	Rubiaceae	Magnoliophyta
Galium circaezans Michx. var. *hypomalacum* Fern.	licorice bedstraw	Rubiaceae	Magnoliophyta
Galium lanceolatum Torr.	lanceleaf wild licorice	Rubiaceae	Magnoliophyta
Galium latifolium Michx.	purple bedstraw	Rubiaceae	Magnoliophyta
Galium triflorum Michx.	fragrant bedstraw	Rubiaceae	Magnoliophyta
Gaultheria procumbens L.	eastern teaberry	Ericaceae	Magnoliophyta
Gaylussacia baccata (Wangenh.) K. Koch	black huckleberry	Ericaceae	Magnoliophyta
Geranium maculatum L.	spotted geranium	Geraniaceae	Magnoliophyta
Geum canadense Jacq. var. *canadense*	white avens	Rosaceae	Magnoliophyta
Geum L.	avens	Rosaceae	Magnoliophyta
Geum vernum (Raf.) Torr. & Gray	spring avens	Rosaceae	Magnoliophyta
Glechoma hederacea L.	ground ivy*	Lamiaceae	Magnoliophyta
Gleditsia triacanthos L.	honeylocust	Fabaceae	Magnoliophyta
Glyceria striata (Lam.) A.S. Hitchc.	fowl mannagrass	Poaceae	Magnoliophyta
Goodyera pubescens (Willd.) R. Br. ex Ait. f.	downy rattlesnake plantain	Orchidaceae	Magnoliophyta
Hackelia virginiana (L.) I.M. Johnston	beggarslice	Boraginaceae	Magnoliophyta
Hamamelis virginiana L.	American witchhazel	Hamamelidaceae	Magnoliophyta
Hedwigia ciliata (Hedw.) P. Beauv.	ciliate hedwigia moss	Hedwigiaceae	Bryophyta
Helenium autumnale L. var. *autumnale*	common sneezeweed	Asteraceae	Magnoliophyta
Helianthus divaricatus L.	woodland sunflower	Asteraceae	Magnoliophyta
Helianthus strumosus L.	paleleaf woodland sunflower	Asteraceae	Magnoliophyta
Heliopsis helianthoides (L.) Sweet	smooth oxeye	Asteraceae	Magnoliophyta
Heliopsis helianthoides (L.) Sweet var. *helianthoides*	smooth oxeye	Asteraceae	Magnoliophyta
Heliopsis helianthoides (L.) Sweet var. *scabra* (Dunal) Fern.	smooth oxeye	Asteraceae	Magnoliophyta
Hepatica nobilis Schreb.	hepatica	Ranunculaceae	Magnoliophyta
Hepatica nobilis Schreb. var. *acuta* (Pursh) Steyermark	sharplobe hepatica	Ranunculaceae	Magnoliophyta
Hepatica nobilis Schreb. var. *obtusa* (Pursh) Steyermark	roundlobe hepatica	Ranunculaceae	Magnoliophyta
Hesperis matronalis L.	dames rocket*	Brassicaceae	Magnoliophyta
Heuchera americana L.	American alumroot	Saxifragaceae	Magnoliophyta
Heuchera americana L. var. *americana*	American alumroot	Saxifragaceae	Magnoliophyta
Heuchera americana L. var. *hispida* (Pursh) E. Wells	American alumroot	Saxifragaceae	Magnoliophyta

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Heuchera L.	alumroot	Saxifragaceae	Magnoliophyta
Heuchera villosa Michx. var. *villosa*	hairy alumroot	Saxifragaceae	Magnoliophyta
Hexastylis Raf.	heartleaf	Aristolochiaceae	Magnoliophyta
Hexastylis virginica (L.) Small	Virginia heartleaf	Aristolochiaceae	Magnoliophyta
Hieracium L.	hawkweed	Asteraceae	Magnoliophyta
Hieracium paniculatum L.	Allegheny hawkweed	Asteraceae	Magnoliophyta
Hieracium venosum L.	rattlesnakeweed	Asteraceae	Magnoliophyta
Holcus lanatus L.	common velvetgrass*	Poaceae	Magnoliophyta
Houstonia caerulea L.	azure bluet	Rubiaceae	Magnoliophyta
Houstonia longifolia Gaertn.	longleaf summer bluet	Rubiaceae	Magnoliophyta
Humulus japonicus Sieb. & Zucc.	Japanese hop*	Cannabaceae	Magnoliophyta
Hydrangea arborescens L.	wild hydrangea	Hydrangeaceae	Magnoliophyta
Hydrophyllum canadense L.	bluntleaf waterleaf	Hydrophyllaceae	Magnoliophyta
Hydrophyllum virginianum L.	Shawnee salad	Hydrophyllaceae	Magnoliophyta
Hygrohypnum ochraceum (Turn. ex Wils.) Loeske	hygrohypnum moss	Hypnaceae	Bryophyta
Hypericum ellipticum Hook.	pale St. Johnswort	Clusiaceae	Magnoliophyta
Hypericum L.	St. Johnswort	Clusiaceae	Magnoliophyta
Hypericum mutilum L.	dwarf St. Johnswort	Clusiaceae	Magnoliophyta
Hypericum perforatum L.	common St. Johnswort*	Clusiaceae	Magnoliophyta
Hypericum prolificum L.	shrubby St. Johnswort	Clusiaceae	Magnoliophyta
Hypericum punctatum Lam.	spotted St. Johnswort	Clusiaceae	Magnoliophyta
Hypnum Hedw.	hypnum moss	Hypnaceae	Bryophyta
Hypnum imponens Hedw.	hypnum moss	Hypnaceae	Bryophyta
Hypoxis hirsuta (L.) Coville	common goldstar	Liliaceae	Magnoliophyta
Impatiens capensis Meerb.	jewelweed	Balsaminaceae	Magnoliophyta
Impatiens L.	touch-me-not	Balsaminaceae	Magnoliophyta
Ipomoea pandurata (L.) G.F.W. Mey.	man of the earth	Convolvulaceae	Magnoliophyta
Iris L.	iris	Iridaceae	Magnoliophyta
Iris pseudacorus L.	paleyellow iris*	Iridaceae	Magnoliophyta
Juglans cinerea L.	butternut	Juglandaceae	Magnoliophyta
Juglans nigra L.	black walnut	Juglandaceae	Magnoliophyta
Juncus dichotomus Ell.	forked rush	Juncaceae	Magnoliophyta
Juncus effusus L.	common rush	Juncaceae	Magnoliophyta
Juncus effusus L. var. *solutus* Fern. & Wieg.	lamp rush	Juncaceae	Magnoliophyta
Juncus tenuis Willd.	poverty rush	Juncaceae	Magnoliophyta
Juniperus virginiana L. var. *virginiana*	eastern redcedar	Cupressaceae	Pinophyta
Kalmia latifolia L.	mountain laurel	Ericaceae	Magnoliophyta
Lactuca canadensis L.	Canada lettuce	Asteraceae	Magnoliophyta
Laportea canadensis (L.) Weddell	Canadian woodnettle	Urticaceae	Magnoliophyta
Lathyrus venosus Muhl. ex Willd.	veiny pea	Fabaceae	Magnoliophyta
Leersia virginica Willd.	whitegrass	Poaceae	Magnoliophyta
Lespedeza cuneata (Dum.-Cours.) G. Don	Chinese lespedeza*	Fabaceae	Magnoliophyta

Scientific Name	Common Name	Family	Division
Lespedeza frutescens (L.) Hornem.	shrubby lespedeza	Fabaceae	Magnoliophyta
Lespedeza Michx.	lespedeza	Fabaceae	Magnoliophyta
Lespedeza procumbens Michx.	trailing lespedeza	Fabaceae	Magnoliophyta
Lespedeza violacea (L.) Pers.	violet lespedeza	Fabaceae	Magnoliophyta
Leucanthemum vulgare Lam.	oxeye daisy*	Asteraceae	Magnoliophyta
Leucobryum glaucum (Hedw.) Ångstr. in Fries	leucobryum moss	Leucobryaceae	Bryophyta
Leucobryum Hampe	leucobryum moss	Leucobryaceae	Bryophyta
Ligusticum canadense (L.) Britt.	Canadian licorice-root	Apiaceae	Magnoliophyta
Ligustrum vulgare L.	European privet*	Oleaceae	Magnoliophyta
Lindera benzoin (L.) Blume	northern spicebush	Lauraceae	Magnoliophyta
Lindera benzoin (L.) Blume var. *pubescens* (Palmer & Steyermark) Rehd.	northern spicebush	Lauraceae	Magnoliophyta
Lindernia dubia (L.) Pennell var. *dubia*	yellowseed false pimpernel	Scrophulariaceae	Magnoliophyta
Liparis L.C. Rich.	widelip orchid	Orchidaceae	Magnoliophyta
Liparis liliifolia (L.) L.C. Rich. ex Ker-Gawl.	brown widelip orchid	Orchidaceae	Magnoliophyta
Liriodendron tulipifera L.	tuliptree	Magnoliaceae	Magnoliophyta
Lithospermum latifolium Michx.	American stoneseed	Boraginaceae	Magnoliophyta
Lobelia cardinalis L.	cardinalflower	Campanulaceae	Magnoliophyta
Lobelia inflata L.	Indian-tobacco	Campanulaceae	Magnoliophyta
Lobelia L.	lobelia	Campanulaceae	Magnoliophyta
Lobelia siphilitica L. var. *siphilitica*	great blue lobelia	Campanulaceae	Magnoliophyta
Lolium arundinaceum (Schreb.) S.J. Darbyshire	tall fescue*	Poaceae	Magnoliophyta
Lolium pratense (Huds.) S.J. Darbyshire	meadow ryegrass*	Poaceae	Magnoliophyta
Lonicera japonica Thunb.	Japanese honeysuckle*	Caprifoliaceae	Magnoliophyta
Lonicera L.	honeysuckle	Caprifoliaceae	Magnoliophyta
Lophocolea heterophylla (Schrad.) Dumort.	variable malepouch liverwort	Lophocoleaceae	Marchantiophyta
Luzula acuminata Raf. var. *acuminata*	hairy woodrush	Juncaceae	Magnoliophyta
Luzula multiflora (Ehrh.) Lej. ssp. *multiflora* var. *multiflora*	common woodrush	Juncaceae	Magnoliophyta
Lycopodium digitatum Dill. ex A. Braun	fan clubmoss	Lycopodiaceae	Lycopodiophyta
Lycopus uniflorus Michx. var. *uniflorus*	northern bugleweed	Lamiaceae	Magnoliophyta
Lycopus virginicus L.	Virginia water horehound	Lamiaceae	Magnoliophyta
Lysimachia ciliata L.	fringed loosestrife	Primulaceae	Magnoliophyta
Lysimachia japonica Thunb.	Japanese yellow loosestrife*	Primulaceae	Magnoliophyta
Lysimachia nummularia L.	creeping jenny*	Primulaceae	Magnoliophyta
Lysimachia quadrifolia L.	whorled yellow loosestrife	Primulaceae	Magnoliophyta
Lythrum salicaria L.	purple loosestrife*	Lythraceae	Magnoliophyta
Magnolia acuminata (L.) L.	cucumber-tree	Magnoliaceae	Magnoliophyta

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Maianthemum canadense Desf.	Canada mayflower	Liliaceae	Magnoliophyta
Maianthemum racemosum (L.) Link ssp. *racemosum*	feathery false lily of the valley	Liliaceae	Magnoliophyta
Malus coronaria (L.) P. Mill. var. *coronaria*	sweet crabapple	Rosaceae	Magnoliophyta
Medeola virginiana L.	Indian cucumber	Liliaceae	Magnoliophyta
Medicago lupulina L.	black medick*	Fabaceae	Magnoliophyta
Meehania cordata (Nutt.) Britt.	Meehan's mint	Lamiaceae	Magnoliophyta
Melilotus officinalis (L.) Lam.	yellow sweetclover*	Fabaceae	Magnoliophyta
Menispermum canadense L.	common moonseed	Menispermaceae	Magnoliophyta
Mentha arvensis L.	wild mint	Lamiaceae	Magnoliophyta
Metzgeria conjugata Lindb.	fertile hedgehog liverwort	Metzgeriaceae	Marchantiophyta
Metzgeria crassipilis (Lindb.) A. Evans	fuzzy hedgehop liverwort	Metzgeriaceae	Marchantiophyta
Mimulus alatus Ait.	sharpwing monkeyflower	Scrophulariaceae	Magnoliophyta
Mimulus L.	monkeyflower	Scrophulariaceae	Magnoliophyta
Mimulus ringens L. var. *ringens*	Allegheny monkeyflower	Scrophulariaceae	Magnoliophyta
Mitchella repens L.	partridgeberry	Rubiaceae	Magnoliophyta
Mitella diphylla L.	twoleaf miterwort	Saxifragaceae	Magnoliophyta
Mnium Hedw.	mnium calcareous moss	Mniaceae	Bryophyta
Monarda clinopodia L.	white bergamot	Lamiaceae	Magnoliophyta
Monarda fistulosa L. ssp. *brevis* (Fosberg & Artz) Scora, comb. nov. ined.	Smoke Hole bergamot	Lamiaceae	Magnoliophyta
Monarda L.	beebalm	Lamiaceae	Magnoliophyta
Monotropa hypopithys L.	pinesap	Monotropaceae	Magnoliophyta
Monotropa uniflora L.	Indianpipe	Monotropaceae	Magnoliophyta
Morus rubra L. var. *rubra*	red mulberry	Moraceae	Magnoliophyta
Muhlenbergia sylvatica Torr. ex Gray	woodland muhly	Poaceae	Magnoliophyta
Myosotis macrosperma Engelm.	largeseed forget-me-not	Boraginaceae	Magnoliophyta
Myosotis verna Nutt.	spring forget-me-not	Boraginaceae	Magnoliophyta
Myosoton aquaticum (L.) Moench	giantchickweed*	Caryophyllaceae	Magnoliophyta
Nyssa sylvatica Marsh.	blackgum	Cornaceae	Magnoliophyta
Oenothera parviflora L.	northern evening-primrose	Onagraceae	Magnoliophyta
Onoclea sensibilis L.	sensitive fern	Dryopteridaceae	Polypodiophyta
Orthotrichum Hedw.	orthotrichum moss	Orthotrichaceae	Bryophyta
Osmorhiza claytonii (Michx.) C.B. Clarke	Clayton's sweetroot	Apiaceae	Magnoliophyta
Osmorhiza longistylis (Torr.) DC.	longstyle sweetroot	Apiaceae	Magnoliophyta
Osmunda claytoniana L.	interrupted fern	Osmundaceae	Polypodiophyta
Osmunda regalis L. var. *spectabilis* (Willd.) Gray	royal fern	Osmundaceae	Polypodiophyta
Ostrya virginiana (P. Mill.) K. Koch var. *virginiana*	hophornbeam	Betulaceae	Magnoliophyta
Oxalis corniculata L.	creeping woodsorrel*	Oxalidaceae	Magnoliophyta
Oxalis dillenii Jacq.	slender yellow woodsorrel	Oxalidaceae	Magnoliophyta
Oxalis grandis Small	great yellow woodsorrel	Oxalidaceae	Magnoliophyta

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Oxalis L.	woodsorrel	Oxalidaceae	Magnoliophyta
Oxalis stricta L.	common yellow oxalis	Oxalidaceae	Magnoliophyta
Oxalis violacea L.	violet woodsorrel	Oxalidaceae	Magnoliophyta
Oxydendrum arboreum (L.) DC.	sourwood	Ericaceae	Magnoliophyta
Packera anonyma (Wood) W.A. Weber & A. Löve	Small's ragwort	Asteraceae	Magnoliophyta
Packera aurea (L.) A.& D. Löve	golden ragwort	Asteraceae	Magnoliophyta
Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Löve	roundleaf ragwort	Asteraceae	Magnoliophyta
Panax quinquefolius L.	American ginseng	Araliaceae	Magnoliophyta
Panicum anceps Michx. ssp. *anceps*	beaked panicgrass	Poaceae	Magnoliophyta
Panicum virgatum L.	switchgrass	Poaceae	Magnoliophyta
Paronychia canadensis (L.) Wood	smooth forked nailwort	Caryophyllaceae	Magnoliophyta
Paronychia fastigiata (Raf.) Fern. var. *paleacea* Fern.	hairy forked nailwort	Caryophyllaceae	Magnoliophyta
Parthenocissus quinquefolia (L.) Planch.	Virginia creeper	Vitaceae	Magnoliophyta
Passiflora lutea L.	yellow passionflower	Passifloraceae	Magnoliophyta
Paulownia tomentosa (Thunb.) Sieb. & Zucc. ex Steud.	princesstree*	Scrophulariaceae	Magnoliophyta
Pellaea atropurpurea (L.) Link	purple cliffbrake	Adiantaceae	Polypodiophyta
Pennisetum glaucum (L.) R. Br.	pearl millet*	Poaceae	Magnoliophyta
Penstemon hirsutus (L.) Willd.	hairy beardtongue	Scrophulariaceae	Magnoliophyta
Penstemon pallidus Small	pale beardtongue	Scrophulariaceae	Magnoliophyta
Phalaris arundinacea L.	reed canarygrass	Poaceae	Magnoliophyta
Phegopteris hexagonoptera (Michx.) Fée	broad beechfern	Thelypteridaceae	Polypodiophyta
Phleum pratense L.	timothy*	Poaceae	Magnoliophyta
Phlox maculata L. ssp. *pyramidalis* (Sm.) Wherry	wild sweetwilliam	Polemoniaceae	Magnoliophyta
Phlox stolonifera Sims	creeping phlox	Polemoniaceae	Magnoliophyta
Phlox subulata L.	moss phlox	Polemoniaceae	Magnoliophyta
Phryma leptostachya L.	American lopseed	Verbenaceae	Magnoliophyta
Physalis longifolia Nutt. var. *subglabrata* (Mackenzie & Bush) Cronq.	longleaf groundcherry	Solanaceae	Magnoliophyta
Physocarpus opulifolius (L.) Maxim. var. *opulifolius*	common ninebark	Rosaceae	Magnoliophyta
Phytolacca americana L. var. *americana*	American pokeweed	Phytolaccaceae	Magnoliophyta
Picea abies (L.) Karst.	Norway spruce*	Pinaceae	Pinophyta
Picea rubens Sarg.	red spruce	Pinaceae	Pinophyta
Pilea pumila (L.) Gray var. *pumila*	Canadian clearweed	Urticaceae	Magnoliophyta
Pinus strobus L.	eastern white pine	Pinaceae	Pinophyta
Pinus virginiana P. Mill.	Virginia pine	Pinaceae	Pinophyta
Plagiomnium ciliare (C. Müll.) T. Kop.	plagiomnium moss	Mniaceae	Bryophyta

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Plagiothecium denticulatum (Hedw.) Schimp. in B.S.G.	toothed plagiothecium moss	Plagiotheciaceae	Bryophyta
Plantago L.	plantain	Plantaginaceae	Magnoliophyta
Plantago rugelii Dcne. var. *rugelii*	blackseed plantain	Plantaginaceae	Magnoliophyta
Platanthera L.C. Rich.	fringed orchid	Orchidaceae	Magnoliophyta
Platanthera orbiculata (Pursh) Lindl.	lesser roundleaved orchid	Orchidaceae	Magnoliophyta
Platanus occidentalis L.	American sycamore	Platanaceae	Magnoliophyta
Poa alsodes Gray	grove bluegrass	Poaceae	Magnoliophyta
Poa cuspidata Nutt.	early bluegrass	Poaceae	Magnoliophyta
Poa L.	bluegrass	Poaceae	Magnoliophyta
Poa pratensis L. ssp. *pratensis*	Kentucky bluegrass*	Poaceae	Magnoliophyta
Poa sylvestris Gray	woodland bluegrass	Poaceae	Magnoliophyta
Poa trivialis L.	rough bluegrass*	Poaceae	Magnoliophyta
Podophyllum peltatum L.	mayapple	Berberidaceae	Magnoliophyta
Polygala paucifolia Willd.	gaywings	Polygalaceae	Magnoliophyta
Polygonatum biflorum (Walt.) Ell.	smooth Solomon's seal	Liliaceae	Magnoliophyta
Polygonatum pubescens (Willd.) Pursh	hairy Solomon's seal	Liliaceae	Magnoliophyta
Polygonum caespitosum Blume var. *longisetum* (de Bruyn) A.N. Steward	oriental ladysthumb*	Polygonaceae	Magnoliophyta
Polygonum convolvulus L. var. *convolvulus*	black bindweed*	Polygonaceae	Magnoliophyta
Polygonum cuspidatum Sieb. & Zucc.	Japanese knotweed*	Polygonaceae	Magnoliophyta
Polygonum hydropiperoides Michx.	swamp smartweed	Polygonaceae	Magnoliophyta
Polygonum L.	knotweed	Polygonaceae	Magnoliophyta
Polygonum pensylvanicum L.	Pennsylvania smartweed	Polygonaceae	Magnoliophyta
Polygonum punctatum Ell.	dotted smartweed	Polygonaceae	Magnoliophyta
Polygonum punctatum Ell. var. *punctatum*	dotted smartweed	Polygonaceae	Magnoliophyta
Polygonum sagittatum L.	arrowleaf tearthumb	Polygonaceae	Magnoliophyta
Polygonum scandens L.	climbing false buckwheat	Polygonaceae	Magnoliophyta
Polygonum scandens L. var. *cristatum* (Engelm. & Gray) Gleason	climbing false buckwheat	Polygonaceae	Magnoliophyta
Polygonum virginianum L.	jumpseed	Polygonaceae	Magnoliophyta
Polypodium appalachianum Haufler & Windham	Appalachian polypody	Polypodiaceae	Polypodiophyta
Polypodium virginianum L.	rock polypody	Polypodiaceae	Polypodiophyta
Polystichum acrostichoides (Michx.) Schott	Christmas fern	Dryopteridaceae	Polypodiophyta
Polytrichum Hedw.	polytrichum moss	Polytrichaceae	Bryophyta
Polytrichum juniperinum Hedw.	juniper polytrichum moss	Polytrichaceae	Bryophyta
Polytrichum ohioense Ren. & Card.	Ohio polytrichum moss	Polytrichaceae	Bryophyta
Populus grandidentata Michx.	bigtooth aspen	Salicaceae	Magnoliophyta

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Potentilla canadensis L. var. *canadensis*	dwarf cinquefoil	Rosaceae	Magnoliophyta
Potentilla L.	cinquefoil	Rosaceae	Magnoliophyta
Potentilla simplex Michx.	common cinquefoil	Rosaceae	Magnoliophyta
Prenanthes alba L.	white rattlesnakeroot	Asteraceae	Magnoliophyta
Prenanthes altissima L.	tall rattlesnakeroot	Asteraceae	Magnoliophyta
Prenanthes L.	rattlesnakeroot	Asteraceae	Magnoliophyta
Prosartes lanuginosa (Michx.) D. Don	yellow fairybells	Liliaceae	Magnoliophyta
Prunella vulgaris L.	common selfheal*	Lamiaceae	Magnoliophyta
Prunus americana Marsh.	American plum	Rosaceae	Magnoliophyta
Prunus L.	plum	Rosaceae	Magnoliophyta
Prunus serotina Ehrh. var. *serotina*	black cherry	Rosaceae	Magnoliophyta
Pteridium aquilinum (L.) Kuhn	western brackenfern	Dennstaedtiaceae	Polypodiophyta
Pycnanthemum incanum (L.) Michx. var. *incanum*	hoary mountainmint	Lamiaceae	Magnoliophyta
Pycnanthemum tenuifolium Schrad.	narrowleaf mountainmint	Lamiaceae	Magnoliophyta
Pylaisiadelpha tenuirostris (Bruch & Schimp. ex Sull.) Buck	pylaisiadelpha moss	Hypnaceae	Bryophyta
Pyrularia pubera Michx.	buffalo nut	Santalaceae	Magnoliophyta
Pyrus pyrifolia (Burm. f.) Nakai	Chinese pear*	Rosaceae	Magnoliophyta
Quercus alba L.	white oak	Fagaceae	Magnoliophyta
Quercus coccinea Muenchh. var. *coccinea*	scarlet oak	Fagaceae	Magnoliophyta
Quercus muehlenbergii Engelm.	chinkapin oak	Fagaceae	Magnoliophyta
Quercus prinus L.	chestnut oak	Fagaceae	Magnoliophyta
Quercus rubra L.	northern red oak	Fagaceae	Magnoliophyta
Quercus stellata Wangenh.	post oak	Fagaceae	Magnoliophyta
Quercus velutina Lam.	black oak	Fagaceae	Magnoliophyta
Ranunculus abortivus L.	littleleaf buttercup	Ranunculaceae	Magnoliophyta
Ranunculus fascicularis Muhl. ex Bigelow	early buttercup	Ranunculaceae	Magnoliophyta
Ranunculus hispidus Michx. var. *nitidus* (Chapman) T. Duncan	bristly buttercup	Ranunculaceae	Magnoliophyta
Ranunculus L.	buttercup	Ranunculaceae	Magnoliophyta
Ranunculus recurvatus Poir. var. *recurvatus*	blisterwort	Ranunculaceae	Magnoliophyta
Rhizomnium (Broth.) T. Kop.	rhizomnium moss	Mniaceae	Bryophyta
Rhododendron arborescens (Pursh) Torr.	smooth azalea	Ericaceae	Magnoliophyta
Rhododendron L.	rhododendron	Ericaceae	Magnoliophyta
Rhododendron maximum L.	great laurel	Ericaceae	Magnoliophyta
Rhus aromatica Ait. var. *aromatica*	fragrant sumac	Anacardiaceae	Magnoliophyta
Ribes L.	currant	Grossulariaceae	Magnoliophyta
Robinia pseudoacacia L.	black locust	Fabaceae	Magnoliophyta
Rorippa Scop.	yellowcress	Brassicaceae	Magnoliophyta

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Rorippa sylvestris (L.) Bess.	creeping yellowcress*	Brassicaceae	Magnoliophyta
Rosa carolina L. var. *carolina*	Carolina rose	Rosaceae	Magnoliophyta
Rosa multiflora Thunb. ex Murr.	multiflora rose*	Rosaceae	Magnoliophyta
Rubus deamii Bailey	Deam's dewberry	Rosaceae	Magnoliophyta
Rubus L.	blackberry	Rosaceae	Magnoliophyta
Rubus laciniatus Willd.	cutleaf blackberry*	Rosaceae	Magnoliophyta
Rubus occidentalis L.	black raspberry	Rosaceae	Magnoliophyta
Rubus odoratus L. var. *odoratus*	purpleflowering raspberry	Rosaceae	Magnoliophyta
Rubus phoenicolasius Maxim.	wine raspberry*	Rosaceae	Magnoliophyta
Rudbeckia laciniata L. var. *laciniata*	cutleaf coneflower	Asteraceae	Magnoliophyta
Rumex acetosella L.	common sheep sorrel*	Polygonaceae	Magnoliophyta
Rumex crispus L. ssp. *crispus*	curly dock*	Polygonaceae	Magnoliophyta
Rumex obtusifolius L.	bitter dock*	Polygonaceae	Magnoliophyta
Salix caroliniana Michx.	coastal plain willow	Salicaceae	Magnoliophyta
Salix nigra Marsh.	black willow	Salicaceae	Magnoliophyta
Salix sericea Marsh.	silky willow	Salicaceae	Magnoliophyta
Salvia lyrata L.	lyreleaf sage	Lamiaceae	Magnoliophyta
Sambucus L.	elderberry	Caprifoliaceae	Magnoliophyta
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli	common elderberry	Caprifoliaceae	Magnoliophyta
Sanguinaria canadensis L.	bloodroot	Papaveraceae	Magnoliophyta
Sanicula canadensis L.	Canadian blacksnakeroot	Apiaceae	Magnoliophyta
Sanicula canadensis L. var. *canadensis*	Canadian blacksnakeroot	Apiaceae	Magnoliophyta
Sanicula L.	sanicle	Apiaceae	Magnoliophyta
Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe	clustered blacksnakeroot	Apiaceae	Magnoliophyta
Sanicula trifoliata Bickn.	largefruit blacksnakeroot	Apiaceae	Magnoliophyta
Saponaria officinalis L.	bouncingbet	Caryophyllaceae	Magnoliophyta
Sassafras albidum (Nutt.) Nees	sassafras	Lauraceae	Magnoliophyta
Schizachyrium scoparium (Michx.) Nash var. *scoparium*	little bluestem	Poaceae	Magnoliophyta
Scirpus cyperinus (L.) Kunth	woolgrass	Cyperaceae	Magnoliophyta
Scirpus polyphyllus Vahl	leafy bulrush	Cyperaceae	Magnoliophyta
Scutellaria elliptica Muhl. ex Spreng.	hairy skullcap	Lamiaceae	Magnoliophyta
Scutellaria elliptica Muhl. ex Spreng. var. *elliptica*	hairy skullcap	Lamiaceae	Magnoliophyta
Scutellaria L.	skullcap	Lamiaceae	Magnoliophyta
Scutellaria lateriflora L. var. *lateriflora*	blue skullcap	Lamiaceae	Magnoliophyta
Scutellaria nervosa Pursh	veiny skullcap	Lamiaceae	Magnoliophyta
Scutellaria ovata Hill	heartleaf skullcap	Lamiaceae	Magnoliophyta
Scutellaria ovata Hill ssp. *rugosa* (Wood) Epling	heartleaf skullcap	Lamiaceae	Magnoliophyta
Scutellaria saxatilis Riddell	smooth rock skullcap	Lamiaceae	Magnoliophyta
Sedum ternatum Michx.	woodland stonecrop	Crassulaceae	Magnoliophyta
Senna hebecarpa (Fern.) Irwin & Barneby	American senna	Fabaceae	Magnoliophyta

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Sicyos angulatus L.	oneseed burr cucumber	Cucurbitaceae	Magnoliophyta
Silene caroliniana Walt. ssp. *pensylvanica* (Michx.) Clausen	Pennsylvania catchfly	Caryophyllaceae	Magnoliophyta
Silene stellata (L.) Ait. f.	widowsfrill	Caryophyllaceae	Magnoliophyta
Silphium trifoliatum L. var. *trifoliatum*	whorled rosinweed	Asteraceae	Magnoliophyta
Sisyrinchium angustifolium P. Mill.	narrowleaf blue-eyed grass	Iridaceae	Magnoliophyta
Smallanthus uvedalius (L.) Mackenzie ex Small	hairy leafcup	Asteraceae	Magnoliophyta
Smilax ecirrata (Engelm. ex Kunth) S. Wats.	upright carrionflower	Smilacaceae	Magnoliophyta
Smilax glauca Walt.	cat greenbrier	Smilacaceae	Magnoliophyta
Smilax herbacea L.	smooth carrionflower	Smilacaceae	Magnoliophyta
Smilax rotundifolia L.	roundleaf greenbrier	Smilacaceae	Magnoliophyta
Smilax tamnoides L.	bristly greenbrier	Smilacaceae	Magnoliophyta
Solanum carolinense L. var. *carolinense*	Carolina horsenettle	Solanaceae	Magnoliophyta
Solidago arguta Ait. var. *caroliniana* Gray	Atlantic goldenrod	Asteraceae	Magnoliophyta
Solidago bicolor L.	white goldenrod	Asteraceae	Magnoliophyta
Solidago caesia L.	wreath goldenrod	Asteraceae	Magnoliophyta
Solidago canadensis L.	Canada goldenrod	Asteraceae	Magnoliophyta
Solidago curtisii Torr. & Gray	mountain decumbent goldenrod	Asteraceae	Magnoliophyta
Solidago flexicaulis L.	zigzag goldenrod	Asteraceae	Magnoliophyta
Solidago gigantea Ait.	giant goldenrod	Asteraceae	Magnoliophyta
Solidago hispida Muhl. ex Willd. var. *hispida*	hairy goldenrod	Asteraceae	Magnoliophyta
Solidago juncea Ait. var. *juncea*	early goldenrod	Asteraceae	Magnoliophyta
Solidago L.	goldenrod	Asteraceae	Magnoliophyta
Solidago rugosa P. Mill.	wrinkleleaf goldenrod	Asteraceae	Magnoliophyta
Solidago rugosa P. Mill. ssp. *rugosa* var. *rugosa*	wrinkleleaf goldenrod	Asteraceae	Magnoliophyta
Solidago sphacelata Raf.	autumn goldenrod	Asteraceae	Magnoliophyta
Solidago ulmifolia Muhl. ex Willd. var. *ulmifolia*	elmleaf goldenrod	Asteraceae	Magnoliophyta
Sonchus asper (L.) Hill ssp. *asper*	spiny sowthistle*	Asteraceae	Magnoliophyta
Sphenopholis nitida (Biehler) Scribn.	shiny wedgescale	Poaceae	Magnoliophyta
Spiraea L.	spirea	Rosaceae	Magnoliophyta
Spiraea virginiana Britt.	Virginia meadowsweet	Rosaceae	Magnoliophyta
Stachys L.	hedgenettle	Lamiaceae	Magnoliophyta
Stachys nuttallii Shuttlw. ex Benth.	heartleaf hedgenettle	Lamiaceae	Magnoliophyta
Stachys tenuifolia Willd.	smooth hedgenettle	Lamiaceae	Magnoliophyta
Staphylea trifolia L.	American bladdernut	Staphyleaceae	Magnoliophyta
Steerecleus serrulatus (Hedw.) Robins.	steerecleus moss	Brachytheciaceae	Bryophyta

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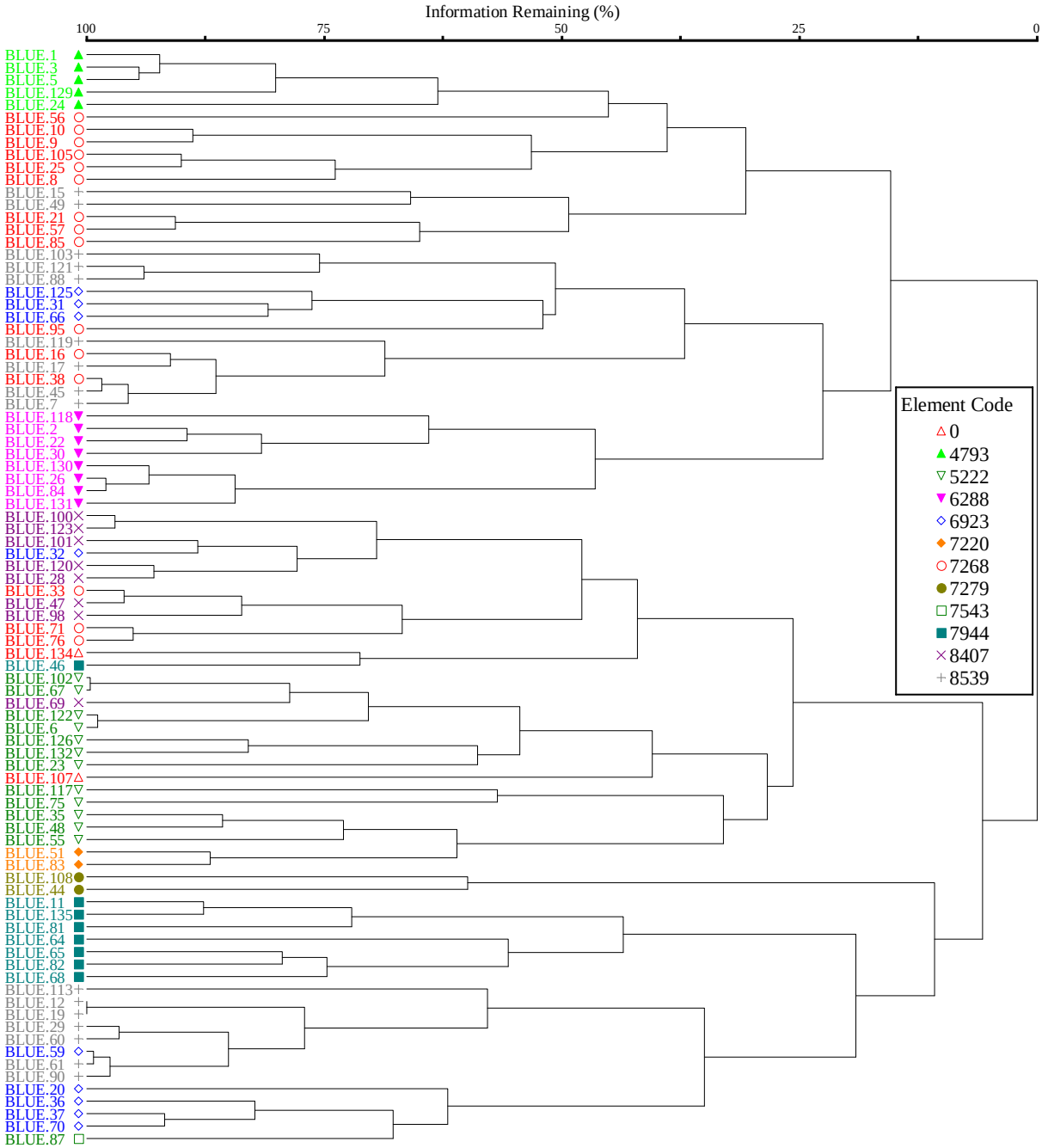
Stellaria longifolia Muhl. ex Willd. var. *longifolia*	longleaf starwort	Caryophyllaceae	Magnoliophyta
Stellaria media (L.) Vill.	common chickweed*	Caryophyllaceae	Magnoliophyta
Stellaria media (L.) Vill. ssp. *media*	common chickweed*	Caryophyllaceae	Magnoliophyta
Stellaria media (L.) Vill. ssp. *pallida* (Dumort.) Aschers. & Graebn.	common chickweed*	Caryophyllaceae	Magnoliophyta
Stellaria pubera Michx.	star chickweed	Caryophyllaceae	Magnoliophyta
Symphyotrichum cordifolium (L.) Nesom	common blue wood aster	Asteraceae	Magnoliophyta
Symphyotrichum laeve (L.) A.& D. Löve var. *laeve*	smooth blue aster	Asteraceae	Magnoliophyta
Symphyotrichum lateriflorum (L.) A.& D. Löve	calico aster	Asteraceae	Magnoliophyta
Symphyotrichum Nees	aster	Asteraceae	Magnoliophyta
Symphyotrichum oblongifolium (Nutt.) Nesom	aromatic aster	Asteraceae	Magnoliophyta
Symphyotrichum patens (Ait.) Nesom var. *patens*	late purple aster	Asteraceae	Magnoliophyta
Symphyotrichum praealtum (Poir.) Nesom	willowleaf aster	Asteraceae	Magnoliophyta
Symphyotrichum prenanthoides (Muhl. ex Willd.) Nesom	crookedstem aster	Asteraceae	Magnoliophyta
Symphyotrichum puniceum (L.) A.& D. Löve var. *puniceum*	purplestem aster	Asteraceae	Magnoliophyta
Symphyotrichum undulatum (L.) Nesom	waxyleaf aster	Asteraceae	Magnoliophyta
Taenidia integerrima (L.) Drude	yellow pimpernel	Apiaceae	Magnoliophyta
Taraxacum officinale G.H. Weber ex Wiggers ssp. officinale	common dandelion*	Asteraceae	Magnoliophyta
Teucrium canadense L. var. *canadense*	Canada germander	Lamiaceae	Magnoliophyta
Thalictrum dioicum L.	early meadow-rue	Ranunculaceae	Magnoliophyta
Thalictrum L.	meadow-rue	Ranunculaceae	Magnoliophyta
Thalictrum thalictroides (L.) Eames & Boivin	rue anemone	Ranunculaceae	Magnoliophyta
Thaspium barbinode (Michx.) Nutt.	hairyjoint meadowparsnip	Apiaceae	Magnoliophyta
Thelypteris noveboracensis (L.) Nieuwl.	New York fern	Thelypteridaceae	Polypodiophyta
Thuidium delicatulum (Hedw.) Schimp. in B.S.G.	delicate thuidium moss	Thuidiaceae	Bryophyta
Thuja occidentalis L.	arborvitae	Cupressaceae	Pinophyta
Tiarella cordifolia L.	heartleaf foamflower	Saxifragaceae	Magnoliophyta
Tilia americana L.	American basswood	Tiliaceae	Magnoliophyta
Toxicodendron radicans (L.) Kuntze	eastern poison ivy	Anacardiaceae	Magnoliophyta

Scientific Name	Common Name	Family	Division
Toxicodendron radicans (L.) Kuntze ssp. *negundo* (Greene) Gillis	eastern poison ivy	Anacardiaceae	Magnoliophyta
Tradescantia ohiensis Raf.	bluejacket	Commelinaceae	Magnoliophyta
Tradescantia virginiana L.	Virginia spiderwort	Commelinaceae	Magnoliophyta
Trautvetteria caroliniensis (Walt.) Vail var. *caroliniensis*	Carolina bugbane	Ranunculaceae	Magnoliophyta
Trifolium hybridum L.	alsike clover*	Fabaceae	Magnoliophyta
Trifolium pratense L.	red clover*	Fabaceae	Magnoliophyta
Trifolium repens L.	white clover*	Fabaceae	Magnoliophyta
Trillium erectum L.	red trillium	Liliaceae	Magnoliophyta
Trillium L.	trillium	Liliaceae	Magnoliophyta
Trillium undulatum Willd.	painted trillium	Liliaceae	Magnoliophyta
Tsuga canadensis (L.) Carr.	eastern hemlock	Pinaceae	Pinophyta
Tussilago farfara L.	coltsfoot*	Asteraceae	Magnoliophyta
Ulmus americana L.	American elm	Ulmaceae	Magnoliophyta
Ulmus rubra Muhl.	slippery elm	Ulmaceae	Magnoliophyta
Umbilicaria Hoffm.	navel lichen	Umbilicariaceae	Ascomycota
Umbilicaria mammulata (Ach.) Tuck.	navel lichen	Umbilicariaceae	Ascomycota
Urtica dioica L. ssp. *dioica*	stinging nettle*	Urticaceae	Magnoliophyta
Uvularia perfoliata L.	perfoliate bellwort	Liliaceae	Magnoliophyta
Uvularia sessilifolia L.	sessileleaf bellwort	Liliaceae	Magnoliophyta
Vaccinium pallidum Ait.	Blue Ridge blueberry	Ericaceae	Magnoliophyta
Vaccinium stamineum L.	deerberry	Ericaceae	Magnoliophyta
Verbascum thapsus L.	common mullein*	Scrophulariaceae	Magnoliophyta
Verbena urticifolia L.	white vervain	Verbenaceae	Magnoliophyta
Verbena urticifolia L. var. *urticifolia*	white vervain	Verbenaceae	Magnoliophyta
Verbesina alternifolia (L.) Britt. ex Kearney	wingstem	Asteraceae	Magnoliophyta
Verbesina occidentalis (L.) Walt.	yellow crownbeard	Asteraceae	Magnoliophyta
Vernonia gigantea (Walt.) Trel. ssp. *gigantea*	giant ironweed	Asteraceae	Magnoliophyta
Vernonia noveboracensis (L.) Michx.	New York ironweed	Asteraceae	Magnoliophyta
Veronica americana Schwein. ex Benth.	American speedwell	Scrophulariaceae	Magnoliophyta
Veronica arvensis L.	corn speedwell*	Scrophulariaceae	Magnoliophyta
Veronica officinalis L. var. *officinalis*	common gypsyweed*	Scrophulariaceae	Magnoliophyta
Veronicastrum virginicum (L.) Farw.	Culver's root	Scrophulariaceae	Magnoliophyta
Viburnum acerifolium L.	mapleleaf viburnum	Caprifoliaceae	Magnoliophyta
Viburnum dentatum L. var. *dentatum*	southern arrowwood	Caprifoliaceae	Magnoliophyta
Viburnum prunifolium L.	blackhaw	Caprifoliaceae	Magnoliophyta
Viburnum rafinesquianum J.A. Schultes	downy arrowwood	Caprifoliaceae	Magnoliophyta
Vicia caroliniana Walt.	Carolina vetch	Fabaceae	Magnoliophyta
Vicia L.	vetch	Fabaceae	Magnoliophyta

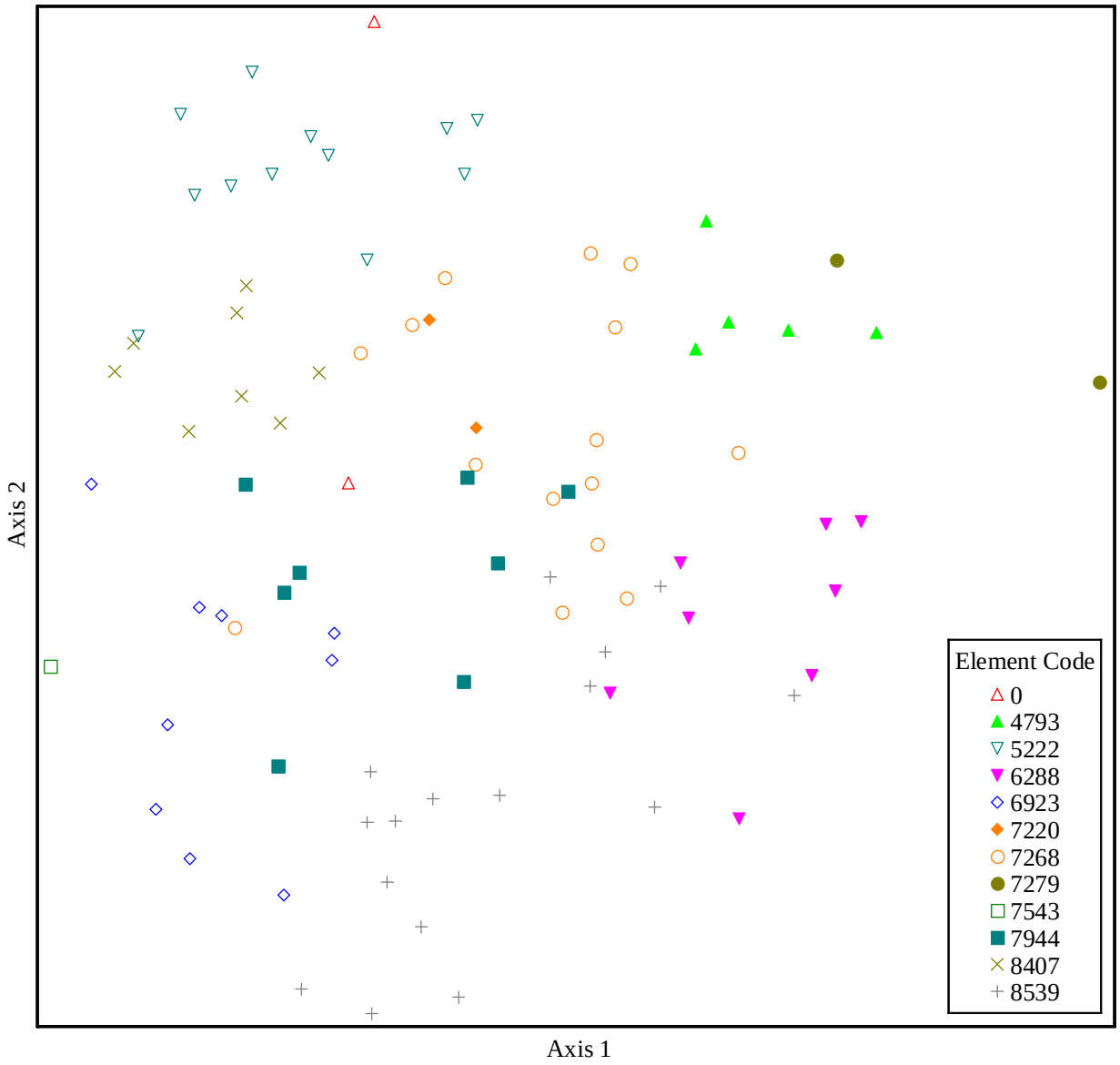
Scientific Name	Common Name	Family	Division
Viola ×*palmata* L.	early blue violet	Violaceae	Magnoliophyta
Viola canadensis L.	Canadian white violet	Violaceae	Magnoliophyta
Viola cucullata Ait.	marsh blue violet	Violaceae	Magnoliophyta
Viola hastata Michx.	halberdleaf yellow violet	Violaceae	Magnoliophyta
Viola L.	violet	Violaceae	Magnoliophyta
Viola pubescens Ait. var. pubescens	downy yellow violet	Violaceae	Magnoliophyta
Viola sororia Willd.	common blue violet	Violaceae	Magnoliophyta
Viola striata Ait.	striped cream violet	Violaceae	Magnoliophyta
Vitis aestivalis Michx. var. *aestivalis*	summer grape	Vitaceae	Magnoliophyta
Vitis aestivalis Michx. var. *bicolor* Deam	summer grape	Vitaceae	Magnoliophyta
Vitis L.	grape	Vitaceae	Magnoliophyta
Vitis riparia Michx.	riverbank grape	Vitaceae	Magnoliophyta
Vitis rupestris Scheele	sand grape	Vitaceae	Magnoliophyta
Vitis vulpina L.	frost grape	Vitaceae	Magnoliophyta
Xanthium strumarium L.	rough cockleburr	Asteraceae	Magnoliophyta
Zizia aurea (L.) W.D.J. Koch	golden zizia	Apiaceae	Magnoliophyta
Zizia trifoliata (Michx.) Fern.	meadow alexanders	Apiaceae	Magnoliophyta

*Taxa which are not native to North America north of Mexico (Harmon et al. 2006).

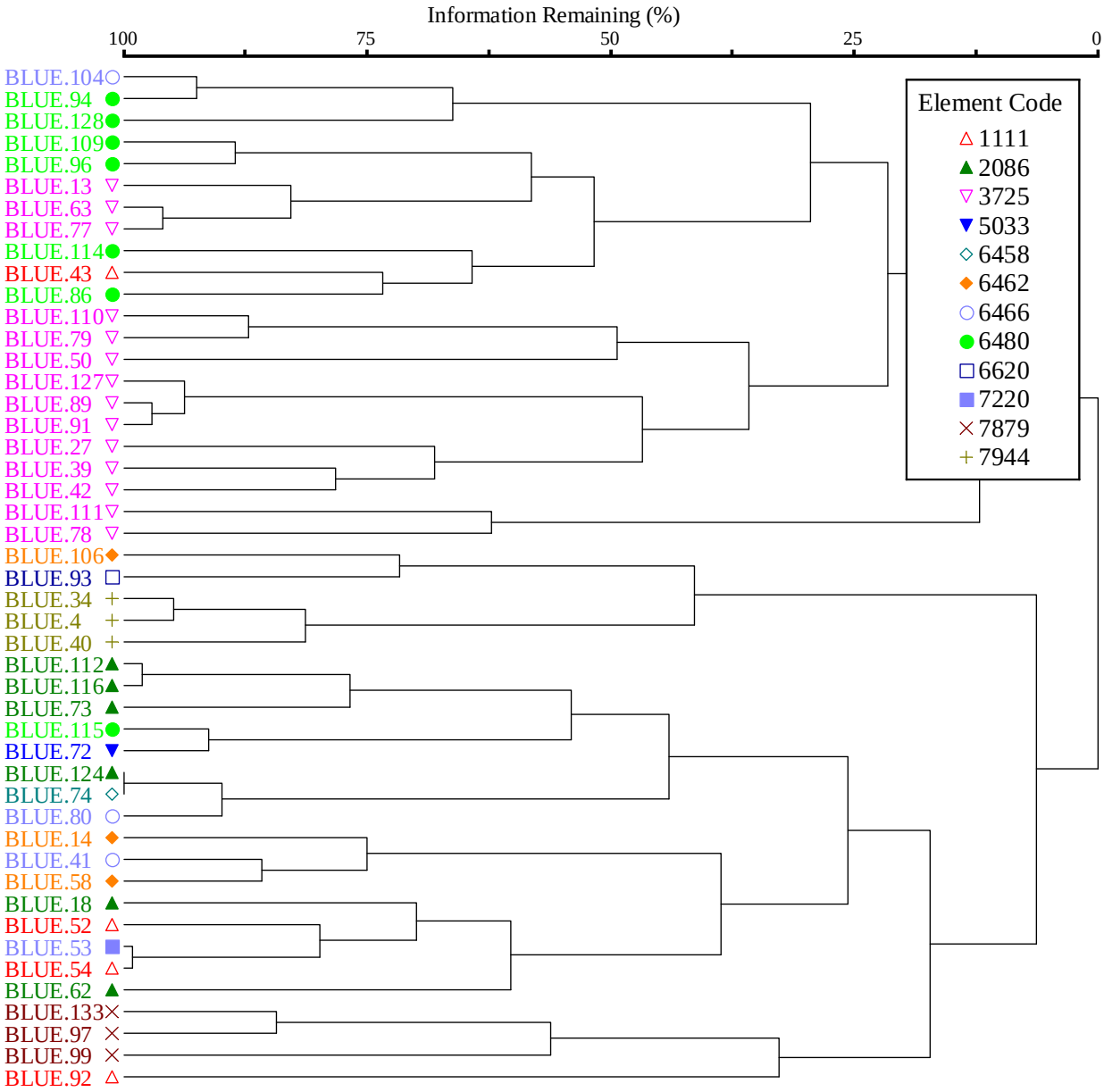
Appendix G. Cluster dendrograms and ordination graphs.



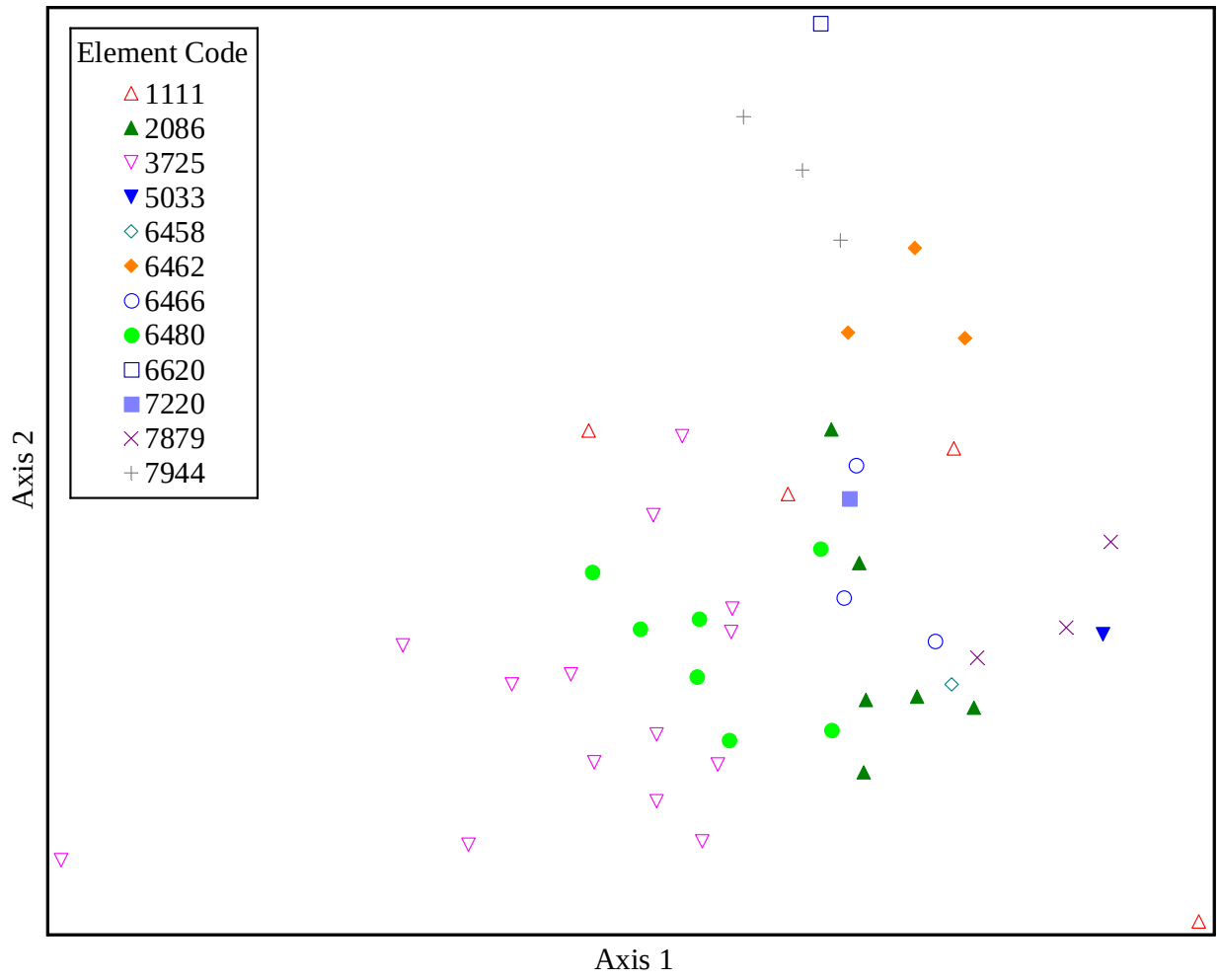
Dendrogram 1. Hierarchical agglomerative cluster analysis of upland forest and woodland plots. Symbology indicates USNVC association element codes. 0 = unclassified upland forest, 4793 = Calcareous Oak Forest, 5222 = Sugar Maple - Yellow Buckeye - American Basswood Forest, 6288 = Virginia Pine - Oak Shale Woodland, 6923 = Eastern Hemlock - Chesnut Oak Forest, 7220 = Successional Tuliptree / Northern Spicebush Forest, 7268 = Oak - Hickory - Sugar Maple Forest, 7279 = Successional Black Locust Woodland, 7543 = Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest, 7944 = Successional Eastern White Pine - Tuliptree Forest, 8407 = Eastern Hemlock - American Basswood Forest, 8539 = Oak - Eastern White Pine / Ericad Forest



Graph 1. Nonmetric Multidimensional Scaling ordination of upland forest and woodland plots in species space. Symbology indicates USNVC association element codes. 0 = unclassified upland forest, 4793 = Calcareous Oak Forest, 5222 = Sugar Maple - Yellow Buckeye - American Basswood Forest, 6288 = Virginia Pine - Oak Shale Woodland, 6923 = Eastern Hemlock - Chesnut Oak Forest, 7220 = Successional Tuliptree / Northern Spicebush Forest, 7268 = Oak - Hickory - Sugar Maple Forest, 7279 = Successional Black Locust Woodland, 7543 = Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest, 7944 = Successional Eastern White Pine - Tuliptree Forest, 8407 = Eastern Hemlock - American Basswood Forest, 8539 = Oak - Eastern White Pine / Ericad Forest



Dendrogram 2. Hierarchical agglomerative cluster analysis of riparian plots. Symbology indicates USNVC association element codes. 1111 = unclassified riparian community, 2086 = River Birch Backwater Floodplain Forest, 3725 = Sycamore - River Birch Riverscour Woodland, 5033 = Successional Box-elder Floodplain Forest, 6458 = Sycamore - Ash Floodplain Forest, 6462 = Oak - Hickory Floodplain Forest, 6466 = Sycamore - Yellow Buckeye Floodplain Forest, 6480 = Riverbank Tall Herbs, 6620 = Eastern Hemlock Floodplain Forest, 7220 = Successional Tuliptree / Northern Spicebush Forest, 7879 = Successional Black Walnut Floodplain Forest, 7944 = Successional Eastern White Pine - Tuliptree Forest.



Graph 2. Nonmetric Multidimensional Scaling (NMS) ordination of riparian plots in species space. Symbology indicates USNVC association element codes. 1111 = unclassified riparian community, 2086 = River Birch Backwater Floodplain Forest, 3725 = Sycamore - River Birch Riverscour Woodland, 5033 = Successional Box-elder Floodplain Forest, 6458 = Sycamore - Ash Floodplain Forest, 6462 = Oak - Hickory Floodplain Forest, 6466 = Sycamore - Yellow Buckeye Floodplain Forest, 6480 = Riverbank Tall Herbs, 6620 = Eastern Hemlock Floodplain Forest, 7220 = Successional Tuliptree / Northern Spicebush Forest, 7879 = Successional Black Walnut Floodplain Forest, 7944 = Successional Eastern White Pine - Tuliptree Forest

Appendix H. Plot floristic cover statistics for associations sampled in Bluestone National Scenic River.

Tables are arranged alphabetically by the BLUE community name for the association. Plant taxa in the tables are sorted in descending order of the number of plots that a taxon occurs in ("N"), then in descending order of mean cover, then in ascending alphabetical order. N divided by the total number of plots for the association is a measure of constancy. The mean statistic is calculated based on the number of plots where the taxon is present (N).

Calcareous Oak Forest (5 plots)

	% Cover			
Species	Mean	Min	Max	N
Quercus muehlenbergii	29.6	18.0	50.0	5
Quercus rubra	20.3	0.5	45.0	5
Fraxinus americana	17.2	10.0	25.0	5
Acer saccharum var. *saccharum*	14.8	5.0	23.0	5
Carya ovata	8.8	1.0	20.0	5
Ageratina altissima var. *altissima*	4.6	0.5	10.0	5
Cercis canadensis var. *canadensis*	1.7	0.5	5.0	5
Oxalis grandis	1.3	0.5	3.0	5
Dichanthelium boscii	1.0	0.5	3.0	5
Galium circaezans	0.6	0.5	1.0	5
Quercus alba	24.0	10.0	40.0	4
Brachyelytrum erectum	2.3	0.5	5.0	4
Eurybia divaricata	1.3	0.5	3.0	4
Parthenocissus quinquefolia	0.8	0.5	1.0	4
Sedum ternatum	0.8	0.5	1.0	4
Amphicarpaea bracteata	0.6	0.5	1.0	4
Desmodium glutinosum	0.6	0.5	1.0	4
Packera obovata	0.6	0.5	1.0	4
Asclepias quadrifolia	0.5	0.5	0.5	4
Dioscorea quaternata	0.5	0.5	0.5	4
Houstonia longifolia	0.5	0.5	0.5	4
Juniperus virginiana var. *virginiana*	15.5	0.5	43.0	3
Aesculus flava	7.8	0.5	13.0	3
Ostrya virginiana var. *virginiana*	2.0	1.0	4.0	3
Festuca subverticillata	1.0	1.0	1.0	3
Carex radiata	0.7	0.5	1.0	3
Monarda fistulosa ssp. *brevis*	0.7	0.5	1.0	3
Solidago caesia	0.7	0.5	1.0	3
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	3
Cynoglossum virginianum var. *virginianum*	0.5	0.5	0.5	3
Helianthus divaricatus	0.5	0.5	0.5	3
Rosa carolina var. *carolina*	0.5	0.5	0.5	3
Sphenopholis nitida	0.5	0.5	0.5	3
Taenidia integerrima	0.5	0.5	0.5	3
Toxicodendron radicans	0.5	0.5	0.5	3
Vicia caroliniana	0.5	0.5	0.5	3
Carya alba	4.0	3.0	5.0	2
Bromus pubescens	2.0	1.0	3.0	2
Lespedeza frutescens	1.8	0.5	3.0	2
Paronychia canadensis	1.5	0.0	3.0	2
Robinia pseudoacacia	1.3	0.5	2.0	2
Carex laxiflora	0.8	0.5	1.0	2
Smallanthus uvedalius	0.8	0.5	1.0	2
Symphyotrichum patens var. *patens*	0.8	0.5	1.0	2
Viburnum prunifolium	0.8	0.5	1.0	2
Viburnum rafinesquianum	0.8	0.5	1.0	2
Vitis aestivalis var. *bicolor*	0.8	0.5	1.0	2
Agrimonia	0.5	0.5	0.5	2
Arabis laevigata	0.5	0.5	0.5	2
Carex blanda	0.5	0.5	0.5	2
Cornus florida	0.5	0.5	0.5	2
Fagus grandifolia	0.5	0.5	0.5	2
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	2
Polystichum acrostichoides	0.5	0.5	0.5	2
Potentilla simplex	0.5	0.5	0.5	2
Rubus	0.5	0.5	0.5	2

Smilax tamnoides	0.5	0.5	0.5	2
Zizia trifoliata	0.5	0.5	0.5	2
Cardamine hirsuta	10.0	10.0	10.0	1
Galium aparine	10.0	10.0	10.0	1
Cardamine concatenata	3.0	3.0	3.0	1
Ulmus rubra	3.0	3.0	3.0	1
Verbesina occidentalis	3.0	3.0	3.0	1
Amelanchier arborea var. *arborea*	1.0	1.0	1.0	1
Antennaria plantaginifolia	1.0	1.0	1.0	1
Carex amphibola	1.0	1.0	1.0	1
Carpinus caroliniana ssp. *virginiana*	1.0	1.0	1.0	1
Carya glabra	1.0	1.0	1.0	1
Dichanthelium dichotomum	1.0	1.0	1.0	1
Solidago arguta var. *caroliniana*	1.0	1.0	1.0	1
Viola	1.0	1.0	1.0	1
Vitis	1.0	1.0	1.0	1
Agrimonia rostellata	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Antennaria	0.5	0.5	0.5	1
Aristolochia serpentaria	0.5	0.5	0.5	1
Asplenium platyneuron	0.5	0.5	0.5	1
Campanulastrum americanum	0.5	0.5	0.5	1
Carex cephalophora	0.5	0.5	0.5	1
Carex communis var. *communis*	0.5	0.5	0.5	1
Carex pensylvanica	0.5	0.5	0.5	1
Carex swanii	0.5	0.5	0.5	1
Carya	0.5	0.5	0.5	1
Celtis occidentalis	0.5	0.5	0.5	1
Conopholis americana	0.5	0.5	0.5	1
Cunila origanoides	0.5	0.5	0.5	1
Danthonia spicata	0.5	0.5	0.5	1
Desmodium	0.5	0.5	0.5	1
Desmodium nudiflorum	0.5	0.5	0.5	1
Draba ramosissima	0.5	0.5	0.5	1
Elymus hystrix var. *hystrix*	0.5	0.5	0.5	1
Erigeron	0.5	0.5	0.5	1
Erigeron annuus	0.5	0.5	0.5	1
Galium triflorum	0.5	0.5	0.5	1
Geranium maculatum	0.5	0.5	0.5	1
Geum	0.5	0.5	0.5	1
Heuchera americana var. *hispida*	0.5	0.5	0.5	1
Lespedeza	0.5	0.5	0.5	1
Myosotis verna	0.5	0.5	0.5	1
Penstemon pallidus	0.5	0.5	0.5	1
Pinus strobus	0.5	0.5	0.5	1
Polygonatum pubescens	0.5	0.5	0.5	1
Polygonum scandens	0.5	0.5	0.5	1
Pycnanthemum incanum var. *incanum*	0.5	0.5	0.5	1
Quercus prinus	0.5	0.5	0.5	1
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	1
Rhus aromatica var. *aromatica*	0.5	0.5	0.5	1
Rosa multiflora	0.5	0.5	0.5	1
Rubus occidentalis	0.5	0.5	0.5	1
Sanicula canadensis	0.5	0.5	0.5	1
Sanicula canadensis var. *canadensis*	0.5	0.5	0.5	1
Sanicula odorata	0.5	0.5	0.5	1
Scutellaria elliptica	0.5	0.5	0.5	1
Silene stellata	0.5	0.5	0.5	1
Sisyrinchium angustifolium	0.5	0.5	0.5	1
Solidago flexicaulis	0.5	0.5	0.5	1
Solidago ulmifolia var. *ulmifolia*	0.5	0.5	0.5	1
Stellaria media	0.5	0.5	0.5	1
Symphyotrichum undulatum	0.5	0.5	0.5	1
Uvularia perfoliata	0.5	0.5	0.5	1
Vicia	0.5	0.5	0.5	1
Viola sororia	0.5	0.5	0.5	1
Vitis vulpina	0.5	0.5	0.5	1
Allium oxyphilum	0.01	0.01	0.01	1

Eastern Hemlock - American Basswood Forest (8 plots)

	% Cover			
Species	Mean	Min	Max	N
Tsuga canadensis	40.9	15.0	80.0	8
Acer saccharum var. *saccharum*	13.9	5.0	41.0	8
Tilia americana	10.4	3.0	20.0	8
Dryopteris marginalis	2.6	0.5	10.0	8
Polystichum acrostichoides	1.9	0.5	3.0	8
Eurybia divaricata	1.8	0.5	5.0	8
Aristolochia macrophylla	0.9	0.5	3.0	8
Viburnum acerifolium	0.7	0.5	1.0	8

Quercus rubra	11.6	0.5	31.0	7
Acer pensylvanicum	2.6	0.5	10.0	7
Dioscorea quaternata	0.9	0.5	3.0	7
Parthenocissus quinquefolia	0.6	0.5	1.0	7
Quercus prinus	7.7	1.0	20.0	6
Fraxinus americana	2.2	0.5	6.0	6
Ageratina altissima var. *altissima*	0.8	0.5	2.0	6
Solidago caesia	0.4	0.0	0.5	6
Thuidium delicatulum	2.1	0.5	5.0	5
Hydrangea arborescens	1.0	0.5	3.0	5
Carya cordiformis	0.4	0.0	0.5	5
Liriodendron tulipifera	4.1	0.5	6.0	4
Acer rubrum var. *rubrum*	2.6	0.5	5.0	4
Hypnum imponens	1.3	0.5	3.0	4
Adiantum pedatum	1.1	0.5	3.0	4
Aesculus flava	0.8	0.5	1.0	4
Toxicodendron radicans	0.6	0.0	1.0	4
Arisaema triphyllum ssp. *triphyllum*	0.6	0.5	1.0	4
Osmorhiza claytonii	0.6	0.5	1.0	4
Sedum ternatum	0.6	0.5	1.0	4
Dryopteris intermedia	0.5	0.0	1.0	4
Hepatica nobilis var. *acuta*	0.5	0.5	0.5	4
Rubus	0.5	0.5	0.5	4
Smilax rotundifolia	0.5	0.5	0.5	4
Ostrya virginiana var. *virginiana*	0.4	0.0	0.5	4
Polygonatum pubescens	0.4	0.0	0.5	4
Ulmus rubra	2.2	0.5	5.0	3
Hamamelis virginiana	1.8	0.5	4.0	3
Rhododendron maximum	1.8	0.5	4.0	3
Vitis aestivalis var. *bicolor*	1.5	0.5	3.0	3
Galium triflorum	0.7	0.5	1.0	3
Polypodium virginianum	0.7	0.5	1.0	3
Conopholis americana	0.5	0.5	0.5	3
Zizia trifoliata	0.5	0.5	0.5	3
Carex laxiflora	0.3	0.0	0.5	3
Panax quinquefolius	0.3	0.0	0.5	3
Prenanthes altissima	0.3	0.0	0.5	3
Prunus serotina var. *serotina*	0.3	0.0	0.5	3
Dicranum fulvum	6.5	5.0	8.0	2
Laportea canadensis	5.0	0.0	10.0	2
Fagus grandifolia	3.5	1.0	6.0	2
Mitella diphylla	1.8	0.5	3.0	2
Amelanchier arborea var. *arborea*	0.8	0.5	1.0	2
Aralia racemosa ssp. *racemosa*	0.8	0.5	1.0	2
Asarum canadense	0.8	0.5	1.0	2
Carya alba	0.8	0.5	1.0	2
Dicranum	0.8	0.5	1.0	2
Asplenium platyneuron	0.5	0.5	0.5	2
Galium circaezans	0.5	0.5	0.5	2
Goodyera pubescens	0.5	0.5	0.5	2
Mitchella repens	0.5	0.5	0.5	2
Prenanthes	0.5	0.5	0.5	2
Sambucus nigra ssp. *canadensis*	0.5	0.5	0.5	2
Sassafras albidum	0.5	0.5	0.5	2
Stellaria media	0.5	0.5	0.5	2
Erechtites hieraciifolia var. *hieraciifolia*	0.3	0.01	0.5	2
Phytolacca americana var. *americana*	0.3	0.01	0.5	2
Pinus strobus	0.3	0.01	0.5	2
Sanguinaria canadensis	0.3	0.01	0.5	2
Solidago flexicaulis	0.3	0.01	0.5	2
Stellaria pubera	0.3	0.01	0.5	2
Boehmeria cylindrica	0.01	0.01	0.01	2
Bryoandersonia illecebra	5.0	5.0	5.0	1
Pylaisiadelpha tenuirostris	5.0	5.0	5.0	1
Magnolia acuminata	3.0	3.0	3.0	1
Vitis	3.0	3.0	3.0	1
Aulacomnium heterostichum	2.0	2.0	2.0	1
Anemone quinquefolia var. *quinquefolia*	1.0	1.0	1.0	1
Carex pensylvanica	1.0	1.0	1.0	1
Lindera benzoin	1.0	1.0	1.0	1
Plagiomnium ciliare	1.0	1.0	1.0	1
Vitis vulpina	1.0	1.0	1.0	1
Alliaria petiolata	0.5	0.5	0.5	1
Amelanchier	0.5	0.5	0.5	1
Aralia nudicaulis	0.5	0.5	0.5	1
Asplenium rhizophyllum	0.5	0.5	0.5	1
Betula lenta	0.5	0.5	0.5	1
Brachyelytrum erectum	0.5	0.5	0.5	1
Brachythecium oxycladon	0.5	0.5	0.5	1
Cardamine angustata	0.5	0.5	0.5	1
Carex albursina	0.5	0.5	0.5	1
Carex platyphylla	0.5	0.5	0.5	1
Carya glabra	0.5	0.5	0.5	1

Carya ovata	0.5	0.5	0.5	1
Cercis canadensis var. *canadensis*	0.5	0.5	0.5	1
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	1
Cornus florida	0.5	0.5	0.5	1
Desmodium glutinosum	0.5	0.5	0.5	1
Galium lanceolatum	0.5	0.5	0.5	1
Geranium maculatum	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Hepatica nobilis var. *obtusa*	0.5	0.5	0.5	1
Hexastylis	0.5	0.5	0.5	1
Hydrophyllum virginianum	0.5	0.5	0.5	1
Hypericum	0.5	0.5	0.5	1
Lactuca canadensis	0.5	0.5	0.5	1
Metzgeria conjugata	0.5	0.5	0.5	1
Metzgeria crassipilis	0.5	0.5	0.5	1
Mnium	0.5	0.5	0.5	1
Nyssa sylvatica	0.5	0.5	0.5	1
Polygonum caespitosum var. *longisetum*	0.5	0.5	0.5	1
Polygonum virginianum	0.5	0.5	0.5	1
Polypodium appalachianum	0.5	0.5	0.5	1
Polytrichum juniperinum	0.5	0.5	0.5	1
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	1
Robinia pseudoacacia	0.5	0.5	0.5	1
Rubus occidentalis	0.5	0.5	0.5	1
Sambucus	0.5	0.5	0.5	1
Solidago curtisii	0.5	0.5	0.5	1
Symphyotrichum cordifolium	0.5	0.5	0.5	1
Thalictrum	0.5	0.5	0.5	1
Thalictrum dioicum	0.5	0.5	0.5	1
Tiarella cordifolia	0.5	0.5	0.5	1
Tussilago farfara	0.5	0.5	0.5	1
Ulmus americana	0.5	0.5	0.5	1
Uvularia perfoliata	0.5	0.5	0.5	1
Viola	0.5	0.5	0.5	1
Viola canadensis	0.5	0.5	0.5	1
Viola sororia	0.5	0.5	0.5	1
Viola striata	0.5	0.5	0.5	1
Arabis	0.01	0.01	0.01	1
Botrychium virginianum	0.01	0.01	0.01	1
Carex plantaginea	0.01	0.01	0.01	1
Caulophyllum thalictroides	0.01	0.01	0.01	1
Euonymus americana	0.01	0.01	0.01	1
Houstonia longifolia	0.01	0.01	0.01	1
Hypericum punctatum	0.01	0.01	0.01	1
Monotropa uniflora	0.01	0.01	0.01	1
Orthotrichum	0.01	0.01	0.01	1
Packera aurea	0.01	0.01	0.01	1
Pilea pumila var. *pumila*	0.01	0.01	0.01	1
Plagiothecium denticulatum	0.01	0.01	0.01	1
Quercus alba	0.01	0.01	0.01	1
Rubus odoratus var. *odoratus*	0.01	0.01	0.01	1
Sanicula canadensis	0.01	0.01	0.01	1
Scutellaria saxatilis	0.01	0.01	0.01	1
Steerecleus serrulatus	0.01	0.01	0.01	1

Eastern Hemlock - Chestnut Oak Forest (9 plots)

	% Cover			
Species	Mean	Min	Max	N
Tsuga canadensis	43.1	20.0	70.0	9
Acer rubrum var. *rubrum*	5.0	0.0	20.0	8
Viburnum acerifolium	1.4	0.0	5.0	8
Quercus prinus	23.4	3.0	50.0	7
Amelanchier arborea var. *arborea*	1.0	0.5	3.0	7
Fagus grandifolia	3.6	0.5	10.0	6
Vaccinium pallidum	0.6	0.5	1.0	6
Quercus alba	11.4	1.0	40.0	5
Quercus rubra	8.6	3.0	16.0	5
Oxydendrum arboreum	6.6	1.0	20.0	5
Parthenocissus quinquefolia	1.7	0.0	5.0	5
Thuidium delicatulum	1.1	0.5	3.0	5
Dioscorea quaternata	0.5	0.0	1.0	5
Pinus strobus	16.3	0.0	40.0	4
Liriodendron tulipifera	6.3	0.0	20.0	4
Rhododendron maximum	5.5	1.0	10.0	4
Acer saccharum var. *saccharum*	4.0	1.0	10.0	4
Leucobryum glaucum	0.9	0.5	1.0	4
Dicranum	0.8	0.5	1.0	4
Dryopteris marginalis	0.6	0.0	1.0	4
Eurybia divaricata	0.6	0.5	1.0	4
Hypnum imponens	0.6	0.5	1.0	4
Smilax rotundifolia	0.6	0.5	1.0	4
Chimaphila maculata	0.5	0.5	0.5	4
Hamamelis virginiana	0.5	0.5	0.5	4

Monotropa uniflora	0.4	0.01	0.5	4
Polygonatum pubescens	0.4	0.01	0.5	4
Goodyera pubescens	0.3	0.01	0.5	4
Betula lenta	12.0	1.0	20.0	3
Quercus coccinea var. *coccinea*	7.0	3.0	13.0	3
Carya alba	1.7	1.0	3.0	3
Nyssa sylvatica	1.2	0.5	2.0	3
Acer pensylvanicum	1.0	1.0	1.0	3
Magnolia acuminata	0.8	0.5	1.0	3
Ostrya virginiana var. *virginiana*	0.8	0.5	1.0	3
Polytrichum	0.8	0.5	1.0	3
Carex pensylvanica	0.7	0.5	1.0	3
Sassafras albidum	0.5	0.01	1.0	3
Leucobryum	0.5	0.5	0.5	3
Polystichum acrostichoides	0.5	0.5	0.5	3
Solidago bicolor	0.3	0.0	0.5	3
Solidago caesia	0.3	0.0	0.5	3
Tilia americana	2.8	0.5	5.0	2
Toxicodendron radicans	1.3	0.5	2.0	2
Robinia pseudoacacia	1.0	1.0	1.0	2
Vaccinium stamineum	0.8	0.5	1.0	2
Carya glabra	0.5	0.0	1.0	2
Fraxinus americana	0.5	0.0	1.0	2
Carya cordiformis	0.5	0.5	0.5	2
Gaultheria procumbens	0.5	0.5	0.5	2
Mitchella repens	0.5	0.5	0.5	2
Rhododendron	0.5	0.5	0.5	2
Smilax glauca	0.5	0.5	0.5	2
Zizia trifoliata	0.5	0.5	0.5	2
Arabis laevigata	0.3	0.01	0.5	2
Asplenium platyneuron	0.3	0.01	0.5	2
Cladina	0.3	0.01	0.5	2
Houstonia longifolia	0.3	0.01	0.5	2
Quercus velutina	20.0	20.0	20.0	1
Polypodium virginianum	3.0	3.0	3.0	1
Antennaria plantaginifolia	1.0	1.0	1.0	1
Aristolochia macrophylla	1.0	1.0	1.0	1
Aureolaria flava	1.0	1.0	1.0	1
Campanula divaricata	1.0	1.0	1.0	1
Mnium	1.0	1.0	1.0	1
Aesculus flava	0.5	0.5	0.5	1
Ageratina altissima var. *altissima*	0.5	0.5	0.5	1
Bromus pubescens	0.5	0.5	0.5	1
Carex communis var. *communis*	0.5	0.5	0.5	1
Carex platyphylla	0.5	0.5	0.5	1
Chionanthus virginicus	0.5	0.5	0.5	1
Cladonia	0.5	0.5	0.5	1
Conopholis americana	0.5	0.5	0.5	1
Coreopsis major	0.5	0.5	0.5	1
Erigeron strigosus var. *strigosus*	0.5	0.5	0.5	1
Eurybia macrophylla	0.5	0.5	0.5	1
Galium lanceolatum	0.5	0.5	0.5	1
Hepatica nobilis var. *acuta*	0.5	0.5	0.5	1
Heuchera	0.5	0.5	0.5	1
Hexastylis	0.5	0.5	0.5	1
Hexastylis virginica	0.5	0.5	0.5	1
Kalmia latifolia	0.5	0.5	0.5	1
Mitella diphylla	0.5	0.5	0.5	1
Monotropa hypopithys	0.5	0.5	0.5	1
Oxalis	0.5	0.5	0.5	1
Poa	0.5	0.5	0.5	1
Prunus serotina var. *serotina*	0.5	0.5	0.5	1
Rosa multiflora	0.5	0.5	0.5	1
Rubus occidentalis	0.5	0.5	0.5	1
Solidago hispida var. *hispida*	0.5	0.5	0.5	1
Stellaria pubera	0.5	0.5	0.5	1
Vitis aestivalis var. *bicolor*	0.5	0.5	0.5	1
Cornus florida	0.01	0.01	0.01	1
Hieracium	0.01	0.01	0.01	1
Poa cuspidata	0.01	0.01	0.01	1
Potentilla canadensis var. *canadensis*	0.01	0.01	0.01	1

Eastern Hemlock Floodplain Forest (1 plot)

	% Cover			
Species	Mean	Min	Max	N
Tsuga canadensis	40.0	40.0	40.0	1
Acer rubrum var. *rubrum*	29.0	29.0	29.0	1
Quercus rubra	27.0	27.0	27.0	1
Rhododendron maximum	15.0	15.0	15.0	1
Liriodendron tulipifera	5.0	5.0	5.0	1
Acer pensylvanicum	1.0	1.0	1.0	1
Aristolochia macrophylla	1.0	1.0	1.0	1
Betula lenta	1.0	1.0	1.0	1
Fraxinus pennsylvanica	1.0	1.0	1.0	1

Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	1
Carya cordiformis	0.5	0.5	0.5	1
Fagus grandifolia	0.5	0.5	0.5	1
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	1
Robinia pseudoacacia	0.5	0.5	0.5	1
Sassafras albidum	0.5	0.5	0.5	1
Thuidium delicatulum	0.5	0.5	0.5	1
Vitis	0.5	0.5	0.5	1
Amphicarpaea bracteata	0.01	0.01	0.01	1
Carex	0.01	0.01	0.01	1
Conopholis americana	0.01	0.01	0.01	1
Cryptotaenia canadensis	0.01	0.01	0.01	1
Eurybia divaricata	0.01	0.01	0.01	1
Galium triflorum	0.01	0.01	0.01	1
Geum	0.01	0.01	0.01	1
Maianthemum canadense	0.01	0.01	0.01	1
Mitchella repens	0.01	0.01	0.01	1
Osmorhiza claytonii	0.01	0.01	0.01	1
Parthenocissus quinquefolia	0.01	0.01	0.01	1
Polygonatum pubescens	0.01	0.01	0.01	1
Polystichum acrostichoides	0.01	0.01	0.01	1
Rudbeckia laciniata var. *laciniata*	0.01	0.01	0.01	1

Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest (1 plot)

	% Cover			
Species	Mean	Min	Max	N
Rhododendron maximum	40.0	40.0	40.0	1
Tsuga canadensis	40.0	40.0	40.0	1
Betula lenta	33.0	33.0	33.0	1
Thuidium delicatulum	25.0	25.0	25.0	1
Acer rubrum var. *rubrum*	10.0	10.0	10.0	1
Liriodendron tulipifera	10.0	10.0	10.0	1
Quercus prinus	10.0	10.0	10.0	1
Magnolia acuminata	5.0	5.0	5.0	1
Nyssa sylvatica	5.0	5.0	5.0	1
Oxydendrum arboreum	5.0	5.0	5.0	1
Prunus serotina var. *serotina*	3.0	3.0	3.0	1
Fagus grandifolia	1.0	1.0	1.0	1
Quercus rubra	1.0	1.0	1.0	1
Aristolochia macrophylla	0.5	0.5	0.5	1
Eurybia divaricata	0.5	0.5	0.5	1
Hamamelis virginiana	0.5	0.5	0.5	1
Mitchella repens	0.5	0.5	0.5	1
Polypodium virginianum	0.5	0.5	0.5	1
Smilax tamnoides	0.5	0.5	0.5	1
Tilia americana	0.5	0.5	0.5	1
Viburnum acerifolium	0.5	0.5	0.5	1
Arisaema triphyllum ssp. *triphyllum*	0.01	0.01	0.01	1
Dioscorea quaternata	0.01	0.01	0.01	1
Dryopteris marginalis	0.01	0.01	0.01	1
Monotropa uniflora	0.01	0.01	0.01	1
Pinus strobus	0.01	0.01	0.01	1
Viola	0.01	0.01	0.01	1

Oak - Eastern White Pine / Ericad Forest (16 plots)

	% Cover			
Species	Mean	Min	Max	N
Pinus strobus	21.4	1.0	60.0	16
Quercus alba	19.3	1.0	60.0	15
Vaccinium pallidum	5.5	0.5	30.0	15
Amelanchier arborea var. *arborea*	2.6	0.5	15.0	15
Quercus prinus	26.8	3.0	70.0	12
Acer rubrum var. *rubrum*	8.1	0.5	23.0	12
Acer saccharum var. *saccharum*	5.4	0.5	15.0	11
Viburnum acerifolium	1.4	0.5	5.0	10
Quercus coccinea var. *coccinea*	22.6	3.0	55.0	9
Quercus rubra	15.2	0.5	45.0	9
Quercus velutina	5.8	0.5	21.0	9
Conopholis americana	0.8	0.5	3.0	9
Dioscorea quaternata	0.4	0.0	0.5	9
Oxydendrum arboreum	12.8	1.0	23.0	8
Fagus grandifolia	2.1	0.5	5.0	8
Fraxinus americana	1.5	0.5	8.0	8
Cornus florida	1.3	0.5	3.0	8
Viburnum rafinesquianum	0.6	0.5	1.0	8
Antennaria plantaginifolia	0.6	0.5	1.0	8
Chimaphila maculata	0.4	0.01	0.5	8
Houstonia longifolia	0.4	0.01	0.5	8
Vaccinium stamineum	4.5	0.5	15.0	7

Tsuga canadensis	3.8	0.5	11.0	7
Ostrya virginiana var. *virginiana*	1.6	0.5	5.0	7
Carex pensylvanica	1.1	0.5	3.0	7
Cunila origanoides	0.7	0.5	1.0	7
Gaultheria procumbens	0.6	0.5	1.0	7
Zizia trifoliata	0.4	0.0	0.5	7
Kalmia latifolia	6.2	0.5	15.0	6
Carya alba	5.5	1.0	15.0	6
Smilax rotundifolia	1.3	0.5	3.0	6
Magnolia acuminata	1.3	0.5	5.0	6
Potentilla simplex	0.6	0.5	1.0	6
Sassafras albidum	0.6	0.5	1.0	6
Nyssa sylvatica	2.4	1.0	3.0	5
Hamamelis virginiana	1.7	0.5	3.0	5
Danthonia spicata	0.9	0.5	1.0	5
Smilax glauca	0.5	0.5	0.5	5
Gaylussacia baccata	10.5	0.5	40.0	4
Juniperus virginiana var. *virginiana*	0.6	0.5	1.0	4
Asplenium platyneuron	0.5	0.5	0.5	4
Eurybia divaricata	0.5	0.5	0.5	4
Hieracium venosum	0.5	0.5	0.5	4
Parthenocissus quinquefolia	0.5	0.5	0.5	4
Rosa carolina var. *carolina*	0.5	0.5	0.5	4
Carya glabra	7.2	0.5	20.0	3
Carya ovata	5.3	1.0	10.0	3
Liriodendron tulipifera	3.3	0.0	10.0	3
Leucobryum	2.3	1.0	5.0	3
Campanula divaricata	0.7	0.5	1.0	3
Dichanthelium boscii	0.7	0.5	1.0	3
Robinia pseudoacacia	0.7	0.5	1.0	3
Packera obovata	0.5	0.0	1.0	3
Carya	0.5	0.5	0.5	3
Helianthus divaricatus	0.5	0.5	0.5	3
Heuchera americana	0.5	0.5	0.5	3
Solidago	0.5	0.5	0.5	3
Uvularia perfoliata	0.5	0.5	0.5	3
Vitis aestivalis var. *bicolor*	0.5	0.5	0.5	3
Geranium maculatum	0.3	0.0	0.5	3
Monotropa uniflora	0.3	0.0	0.5	3
Dicranum scoparium	5.0	5.0	5.0	2
Acer pensylvanicum	2.8	0.5	5.0	2
Leucobryum glaucum	1.0	1.0	1.0	2
Polypodium virginianum	1.0	1.0	1.0	2
Amphicarpaea bracteata	0.8	0.5	1.0	2
Bromus pubescens	0.8	0.5	1.0	2
Dichanthelium dichotomum	0.8	0.5	1.0	2
Prunus serotina var. *serotina*	0.8	0.5	1.0	2
Solidago bicolor	0.8	0.5	1.0	2
Vicia caroliniana	0.8	0.5	1.0	2
Aureolaria flava var. *macrantha*	0.5	0.5	0.5	2
Aureolaria virginica	0.5	0.5	0.5	2
Carex radiata	0.5	0.5	0.5	2
Cercis canadensis var. *canadensis*	0.5	0.5	0.5	2
Crataegus	0.5	0.5	0.5	2
Dryopteris marginalis	0.5	0.5	0.5	2
Epigaea repens	0.5	0.5	0.5	2
Galium latifolium	0.5	0.5	0.5	2
Gleditsia triacanthos	0.5	0.5	0.5	2
Lespedeza	0.5	0.5	0.5	2
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	2
Monarda fistulosa ssp. *brevis*	0.5	0.5	0.5	2
Poa cuspidata	0.5	0.5	0.5	2
Polygala paucifolia	0.5	0.5	0.5	2
Polygonatum biflorum	0.5	0.5	0.5	2
Sedum ternatum	0.5	0.5	0.5	2
Solidago caesia	0.5	0.5	0.5	2
Solidago hispida var. *hispida*	0.5	0.5	0.5	2
Stellaria pubera	0.5	0.5	0.5	2
Symphyotrichum undulatum	0.5	0.5	0.5	2
Taenidia integerrima	0.5	0.5	0.5	2
Viola	0.5	0.5	0.5	2
Cypripedium acaule	0.3	0.01	0.5	2
Polystichum acrostichoides	0.3	0.01	0.5	2
Pteridium aquilinum	0.3	0.01	0.5	2
Cladonia arbuscula	20.0	20.0	20.0	1
Rhododendron maximum	10.0	10.0	10.0	1
Cladonia furcata	5.0	5.0	5.0	1
Carex caroliniana	3.0	3.0	3.0	1
Agrostis perennans	1.0	1.0	1.0	1
Aureolaria flava var. *flava*	1.0	1.0	1.0	1
Carex blanda	1.0	1.0	1.0	1
Chionanthus virginicus	1.0	1.0	1.0	1
Cladina	1.0	1.0	1.0	1
Festuca subverticillata	1.0	1.0	1.0	1

Flavoparmelia baltimorensis	1.0	1.0	1.0	1
Hedwigia ciliata	1.0	1.0	1.0	1
Hypnum imponens	1.0	1.0	1.0	1
Lespedeza frutescens	1.0	1.0	1.0	1
Polytrichum	1.0	1.0	1.0	1
Polytrichum ohioense	1.0	1.0	1.0	1
Rhus aromatica var. *aromatica*	1.0	1.0	1.0	1
Rubus	1.0	1.0	1.0	1
Scutellaria elliptica var. *elliptica*	1.0	1.0	1.0	1
Thuidium delicatulum	1.0	1.0	1.0	1
Aesculus flava	0.5	0.5	0.5	1
Agrostis capillaris	0.5	0.5	0.5	1
Anemone quinquefolia var. *quinquefolia*	0.5	0.5	0.5	1
Aralia nudicaulis	0.5	0.5	0.5	1
Aster	0.5	0.5	0.5	1
Berberis vulgaris	0.5	0.5	0.5	1
Brachyelytrum erectum	0.5	0.5	0.5	1
Carex hirsutella	0.5	0.5	0.5	1
Carya cordiformis	0.5	0.5	0.5	1
Castanea dentata	0.5	0.5	0.5	1
Cornus racemosa	0.5	0.5	0.5	1
Cynoglossum virginianum var. *virginianum*	0.5	0.5	0.5	1
Desmodium	0.5	0.5	0.5	1
Desmodium glabellum	0.5	0.5	0.5	1
Desmodium glutinosum	0.5	0.5	0.5	1
Dichanthelium	0.5	0.5	0.5	1
Dichanthelium commutatum	0.5	0.5	0.5	1
Dichanthelium depauperatum	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *dichotomum*	0.5	0.5	0.5	1
Dicranum	0.5	0.5	0.5	1
Eurybia macrophylla	0.5	0.5	0.5	1
Galium circaezans	0.5	0.5	0.5	1
Hepatica nobilis var. *acuta*	0.5	0.5	0.5	1
Hieracium paniculatum	0.5	0.5	0.5	1
Hypoxis hirsuta	0.5	0.5	0.5	1
Luzula multiflora ssp. *multiflora* var. *multiflora*	0.5	0.5	0.5	1
Mitchella repens	0.5	0.5	0.5	1
Paronychia canadensis	0.5	0.5	0.5	1
Poa	0.5	0.5	0.5	1
Potentilla canadensis var. *canadensis*	0.5	0.5	0.5	1
Rhododendron	0.5	0.5	0.5	1
Rosa multiflora	0.5	0.5	0.5	1
Scutellaria elliptica	0.5	0.5	0.5	1
Silene caroliniana ssp. *pensylvanica*	0.5	0.5	0.5	1
Solidago curtisii	0.5	0.5	0.5	1
Solidago flexicaulis	0.5	0.5	0.5	1
Solidago juncea var. *juncea*	0.5	0.5	0.5	1
Sphenopholis nitida	0.5	0.5	0.5	1
Umbilicaria	0.5	0.5	0.5	1
Uvularia sessilifolia	0.5	0.5	0.5	1
Vitis	0.5	0.5	0.5	1
Cantharellus cibarius	0.01	0.01	0.01	1
Erechtites hieraciifolia var. *hieraciifolia*	0.01	0.01	0.01	1
Monotropa hypopithys	0.01	0.01	0.01	1

Oak - Hickory Floodplain Forest (3 plots)

	% Cover			
Species	Mean	Min	Max	N
Carpinus caroliniana ssp. *virginiana*	21.0	3.0	50.0	3
Hamamelis virginiana	8.3	1.0	21.0	3
Lindera benzoin	5.7	3.0	8.0	3
Sedum ternatum	1.3	0.5	3.0	3
Eurybia divaricata	0.8	0.5	1.0	3
Amphicarpaea bracteata	0.7	0.5	1.0	3
Galium triflorum	0.7	0.5	1.0	3
Verbesina alternifolia	0.5	0.0	1.0	3
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	3
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	3
Smilax tamnoides	0.5	0.5	0.5	3
Quercus rubra	28.0	15.0	41.0	2
Fagus grandifolia	17.5	5.0	30.0	2
Platanus occidentalis	17.5	15.0	20.0	2
Fraxinus pennsylvanica	13.0	8.0	18.0	2
Acer rubrum var. *rubrum*	12.5	10.0	15.0	2
Liriodendron tulipifera	12.5	10.0	15.0	2
Prunus serotina var. *serotina*	6.5	3.0	10.0	2
Quercus alba	4.3	0.5	8.0	2
Rosa multiflora	3.5	2.0	5.0	2

Nyssa sylvatica	3.0	1.0	5.0	2
Cercis canadensis var. *canadensis*	2.8	0.5	5.0	2
Acer saccharum var. *saccharum*	2.0	1.0	3.0	2
Smilax rotundifolia	2.0	1.0	3.0	2
Collinsonia canadensis	1.3	0.5	2.0	2
Carex blanda	0.8	0.5	1.0	2
Cryptotaenia canadensis	0.8	0.5	1.0	2
Oxalis violacea	0.8	0.5	1.0	2
Packera aurea	0.8	0.5	1.0	2
Parthenocissus quinquefolia	0.8	0.5	1.0	2
Polygonum virginianum	0.8	0.5	1.0	2
Ranunculus abortivus	0.8	0.5	1.0	2
Symphyotrichum prenanthoides	0.8	0.5	1.0	2
Ageratina altissima var. *altissima*	0.5	0.5	0.5	2
Aristolochia macrophylla	0.5	0.5	0.5	2
Botrychium virginianum	0.5	0.5	0.5	2
Cardamine impatiens	0.5	0.5	0.5	2
Carex amphibola	0.5	0.5	0.5	2
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	2
Dichanthelium boscii	0.5	0.5	0.5	2
Dirca palustris	0.5	0.5	0.5	2
Geum	0.5	0.5	0.5	2
Laportea canadensis	0.5	0.5	0.5	2
Polygonatum pubescens	0.5	0.5	0.5	2
Polystichum acrostichoides	0.5	0.5	0.5	2
Potentilla simplex	0.5	0.5	0.5	2
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	2
Solidago curtisii	0.5	0.5	0.5	2
Verbesina occidentalis	0.5	0.5	0.5	2
Eupatorium fistulosum	0.3	0.01	0.5	2
Sanguinaria canadensis	0.3	0.01	0.5	2
Uvularia perfoliata	0.3	0.01	0.5	2
Quercus velutina	35.0	35.0	35.0	1
Ulmus americana	15.0	15.0	15.0	1
Carya alba	12.0	12.0	12.0	1
Juglans nigra	10.0	10.0	10.0	1
Tsuga canadensis	10.0	10.0	10.0	1
Carya cordiformis	6.0	6.0	6.0	1
Magnolia acuminata	5.0	5.0	5.0	1
Viburnum prunifolium	5.0	5.0	5.0	1
Vitis aestivalis var. *bicolor*	5.0	5.0	5.0	1
Aesculus flava	4.0	4.0	4.0	1
Climacium americanum	3.0	3.0	3.0	1
Juglans cinerea	3.0	3.0	3.0	1
Sassafras albidum	3.0	3.0	3.0	1
Osmorhiza claytonii	2.0	2.0	2.0	1
Tilia americana	2.0	2.0	2.0	1
Chasmanthium latifolium	1.0	1.0	1.0	1
Fraxinus americana	1.0	1.0	1.0	1
Galium aparine	1.0	1.0	1.0	1
Polytrichum	1.0	1.0	1.0	1
Robinia pseudoacacia	1.0	1.0	1.0	1
Rudbeckia laciniata var. *laciniata*	1.0	1.0	1.0	1
Sanicula canadensis	1.0	1.0	1.0	1
Viola striata	1.0	1.0	1.0	1
Vitis	1.0	1.0	1.0	1
Agrimonia pubescens	0.5	0.5	0.5	1
Agrostis perennans	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Bidens	0.5	0.5	0.5	1
Brachyelytrum erectum	0.5	0.5	0.5	1
Cardamine concatenata	0.5	0.5	0.5	1
Carex albursina	0.5	0.5	0.5	1
Carex laxiflora	0.5	0.5	0.5	1
Carex radiata	0.5	0.5	0.5	1
Carex swanii	0.5	0.5	0.5	1
Chimaphila maculata	0.5	0.5	0.5	1
Claytonia virginica	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *yadkinense*	0.5	0.5	0.5	1
Dioscorea quaternata	0.5	0.5	0.5	1
Elymus	0.5	0.5	0.5	1
Festuca subverticillata	0.5	0.5	0.5	1
Gleditsia triacanthos	0.5	0.5	0.5	1
Goodyera pubescens	0.5	0.5	0.5	1
Hepatica nobilis var. *acuta*	0.5	0.5	0.5	1
Hydrangea arborescens	0.5	0.5	0.5	1
Hydrophyllum virginianum	0.5	0.5	0.5	1
Impatiens	0.5	0.5	0.5	1
Luzula acuminata var. *acuminata*	0.5	0.5	0.5	1
Lysimachia ciliata	0.5	0.5	0.5	1
Lysimachia nummularia	0.5	0.5	0.5	1
Monotropa uniflora	0.5	0.5	0.5	1
Osmunda claytoniana	0.5	0.5	0.5	1
Phegopteris hexagonoptera	0.5	0.5	0.5	1
Phlox stolonifera	0.5	0.5	0.5	1

Pilea pumila var. *pumila*	0.5	0.5	0.5	1
Pinus strobus	0.5	0.5	0.5	1
Podophyllum peltatum	0.5	0.5	0.5	1
Polygonum caespitosum var. *longisetum*	0.5	0.5	0.5	1
Prenanthes	0.5	0.5	0.5	1
Rosa carolina var. *carolina*	0.5	0.5	0.5	1
Rubus	0.5	0.5	0.5	1
Silene stellata	0.5	0.5	0.5	1
Smilax ecirrata	0.5	0.5	0.5	1
Smilax glauca	0.5	0.5	0.5	1
Smilax herbacea	0.5	0.5	0.5	1
Solidago	0.5	0.5	0.5	1
Solidago flexicaulis	0.5	0.5	0.5	1
Staphylea trifolia	0.5	0.5	0.5	1
Stellaria pubera	0.5	0.5	0.5	1
Symphyotrichum lateriflorum	0.5	0.5	0.5	1
Symphyotrichum praealtum	0.5	0.5	0.5	1
Thalictrum	0.5	0.5	0.5	1
Thalictrum thalictroides	0.5	0.5	0.5	1
Thelypteris noveboracensis	0.5	0.5	0.5	1
Tiarella cordifolia	0.5	0.5	0.5	1
Viola sororia	0.5	0.5	0.5	1
Anemone quinquefolia	0.01	0.01	0.01	1
Arnoglossum atriplicifolium	0.01	0.01	0.01	1
Asplenium platyneuron	0.01	0.01	0.01	1
Campanulastrum americanum	0.01	0.01	0.01	1
Cardamine	0.01	0.01	0.01	1
Liparis liliifolia	0.01	0.01	0.01	1
Medeola virginiana	0.01	0.01	0.01	1
Meehania cordata	0.01	0.01	0.01	1
Sanicula odorata	0.01	0.01	0.01	1
Trillium undulatum	0.01	0.01	0.01	1
Vernonia gigantea ssp. *gigantea*	0.01	0.01	0.01	1
Zizia aurea	0.01	0.01	0.01	1

Oak - Hickory - Sugar Maple Forest (15 plots)

	% Cover			
Species	Mean	Min	Max	N
Acer saccharum var. *saccharum*	21.3	1.0	70.0	15
Fraxinus americana	10.5	0.5	70.0	14
Quercus rubra	15.4	1.0	40.0	13
Dioscorea quaternata	0.5	0.0	1.0	13
Cercis canadensis var. *canadensis*	0.9	0.5	3.0	12
Quercus prinus	20.0	3.0	45.0	11
Parthenocissus quinquefolia	1.0	0.5	3.0	11
Polystichum acrostichoides	0.9	0.5	3.0	11
Ageratina altissima var. *altissima*	1.8	0.5	5.0	10
Sedum ternatum	0.7	0.5	2.0	10
Dichanthelium boscii	0.7	0.5	1.0	10
Asplenium platyneuron	0.5	0.0	1.0	10
Quercus alba	27.3	0.5	65.0	9
Ostrya virginiana var. *virginiana*	1.6	0.5	4.0	9
Bromus pubescens	0.7	0.5	1.0	9
Solidago caesia	0.6	0.5	1.0	9
Houstonia longifolia	0.5	0.5	0.5	9
Vicia caroliniana	0.5	0.5	0.5	9
Liriodendron tulipifera	6.3	0.0	20.0	8
Carya ovata	3.2	0.5	11.0	8
Amelanchier arborea var. *arborea*	1.3	0.5	3.0	8
Pinus strobus	1.3	0.5	3.0	8
Eurybia divaricata	0.6	0.5	1.0	8
Carex laxiflora	0.5	0.0	1.0	8
Zizia trifoliata	0.5	0.5	0.5	8
Chimaphila maculata	0.3	0.0	0.5	8
Carya glabra	7.2	0.5	32.0	7
Tilia americana	5.5	0.5	25.0	7
Acer rubrum var. *rubrum*	4.6	1.0	10.0	7
Carya alba	4.2	0.5	10.0	7
Aesculus flava	3.4	0.5	20.0	7
Fagus grandifolia	3.4	0.5	8.0	7
Festuca subverticillata	0.9	0.5	3.0	7
Dryopteris marginalis	0.8	0.0	3.0	7
Viburnum rafinesquianum	0.8	0.5	1.0	7
Rubus	0.6	0.5	1.0	7
Uvularia perfoliata	0.4	0.0	0.5	7

Magnolia acuminata	1.9	0.5	3.0	6
Cornus florida	1.3	0.5	3.0	6
Prunus serotina var. *serotina*	1.2	0.0	5.0	6
Hamamelis virginiana	1.2	1.0	2.0	6
Viburnum acerifolium	1.1	0.5	3.0	6
Potentilla simplex	1.0	0.5	3.0	6
Geranium maculatum	0.8	0.5	2.0	6
Galium triflorum	0.6	0.5	1.0	6
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	6
Galium circaezans	0.5	0.5	0.5	6
Rosa carolina var. *carolina*	0.5	0.5	0.5	6
Smilax tamnoides	0.4	0.0	0.5	6
Quercus velutina	10.1	0.5	20.0	5
Tsuga canadensis	2.9	0.5	5.0	5
Robinia pseudoacacia	1.6	0.5	3.0	5
Monarda fistulosa ssp. *brevis*	1.1	0.5	3.0	5
Brachyelytrum erectum	1.0	0.5	3.0	5
Sassafras albidum	0.8	0.0	3.0	5
Carex radiata	0.7	0.5	1.0	5
Smilax rotundifolia	0.7	0.5	1.0	5
Cunila origanoides	0.6	0.5	1.0	5
Agrimonia	0.5	0.5	0.5	5
Asclepias quadrifolia	0.5	0.5	0.5	5
Hieracium venosum	0.5	0.5	0.5	5
Amphicarpaea bracteata	0.4	0.01	0.5	5
Maianthemum racemosum ssp. *racemosum*	0.4	0.01	0.5	5
Toxicodendron radicans	0.4	0.01	0.5	5
Viburnum prunifolium	2.1	0.5	6.0	4
Vaccinium pallidum	1.8	0.5	5.0	4
Nyssa sylvatica	1.5	1.0	3.0	4
Galium lanceolatum	0.5	0.0	1.0	4
Crataegus	0.5	0.5	0.5	4
Galium circaezans var. *circaezans*	0.5	0.5	0.5	4
Osmorhiza longistylis	0.5	0.5	0.5	4
Packera obovata	0.5	0.5	0.5	4
Prenanthes	0.5	0.5	0.5	4
Sanicula canadensis	0.5	0.5	0.5	4
Vitis aestivalis var. *bicolor*	0.5	0.5	0.5	4
Geum	0.4	0.0	0.5	4
Thalictrum	0.4	0.0	0.5	4
Antennaria plantaginifolia	1.5	0.5	3.0	3
Ulmus rubra	0.8	0.0	2.0	3
Carex pensylvanica	0.8	0.5	1.0	3
Carpinus caroliniana ssp. *virginiana*	0.8	0.5	1.0	3
Stellaria pubera	0.8	0.5	1.0	3
Aristolochia macrophylla	0.7	0.5	1.0	3
Juniperus virginiana var. *virginiana*	0.7	0.5	1.0	3
Lindera benzoin	0.7	0.5	1.0	3
Paronychia canadensis	0.7	0.5	1.0	3
Thuidium delicatulum	0.7	0.5	1.0	3
Vitis	0.7	0.5	1.0	3
Adiantum pedatum	0.5	0.5	0.5	3
Arabis laevigata	0.5	0.5	0.5	3
Carex blanda	0.5	0.5	0.5	3
Carex communis var. *communis*	0.5	0.5	0.5	3
Conopholis americana	0.5	0.5	0.5	3
Cynoglossum virginianum var. *virginianum*	0.5	0.5	0.5	3
Hepatica nobilis var. *acuta*	0.5	0.5	0.5	3
Myosotis macrosperma	0.5	0.5	0.5	3
Poa	0.5	0.5	0.5	3
Smilax glauca	0.5	0.5	0.5	3
Stellaria media	0.5	0.5	0.5	3
Ranunculus abortivus	0.3	0.01	0.5	3
Sanguinaria canadensis	0.3	0.01	0.5	3
Acer pensylvanicum	8.5	2.0	15.0	2
Poa cuspidata	2.8	0.5	5.0	2
Quercus muehlenbergii	2.0	1.0	3.0	2
Carex platyphylla	0.8	0.5	1.0	2
Carex willdenowii	0.8	0.5	1.0	2
Danthonia spicata	0.8	0.5	1.0	2
Galium aparine	0.8	0.5	1.0	2
Galium latifolium	0.8	0.5	1.0	2
Potentilla canadensis var. *canadensis*	0.8	0.5	1.0	2
Solidago curtisii	0.8	0.5	1.0	2
Aristolochia serpentaria	0.5	0.5	0.5	2
Aster	0.5	0.5	0.5	2
Botrychium virginianum	0.5	0.5	0.5	2
Campanula divaricata	0.5	0.5	0.5	2
Carex amphibola	0.5	0.5	0.5	2
Desmodium	0.5	0.5	0.5	2
Dryopteris intermedia	0.5	0.5	0.5	2
Eurybia macrophylla	0.5	0.5	0.5	2
Helianthus divaricatus	0.5	0.5	0.5	2
Heuchera americana var. *americana*	0.5	0.5	0.5	2

Hypericum prolificum	0.5	0.5	0.5	2
Hypericum punctatum	0.5	0.5	0.5	2
Lithospermum latifolium	0.5	0.5	0.5	2
Lysimachia quadrifolia	0.5	0.5	0.5	2
Monotropa uniflora	0.5	0.5	0.5	2
Morus rubra var. *rubra*	0.5	0.5	0.5	2
Oxydendrum arboreum	0.5	0.5	0.5	2
Packera aurea	0.5	0.5	0.5	2
Penstemon pallidus	0.5	0.5	0.5	2
Potentilla	0.5	0.5	0.5	2
Rubus occidentalis	0.5	0.5	0.5	2
Rubus phoenicolasius	0.5	0.5	0.5	2
Sanicula	0.5	0.5	0.5	2
Taenidia integerrima	0.5	0.5	0.5	2
Viola	0.5	0.5	0.5	2
Viola hastata	0.5	0.5	0.5	2
Vitis vulpina	0.5	0.5	0.5	2
Gleditsia triacanthos	0.3	0.01	0.5	2
Polygonatum pubescens	0.3	0.01	0.5	2
Rhus aromatica var. *aromatica*	0.3	0.01	0.5	2
Scutellaria elliptica	0.3	0.01	0.5	2
Goodyera pubescens	0.0	0.01	0.0	2
Acer nigrum	5.0	5.0	5.0	1
Juglans nigra	5.0	5.0	5.0	1
Asimina triloba	4.0	4.0	4.0	1
Mnium	3.0	3.0	3.0	1
Vaccinium stamineum	3.0	3.0	3.0	1
Chionanthus virginicus	2.0	2.0	2.0	1
Cladonia	1.0	1.0	1.0	1
Desmodium glutinosum	1.0	1.0	1.0	1
Dicranum	1.0	1.0	1.0	1
Leucobryum glaucum	1.0	1.0	1.0	1
Lindera benzoin var. *pubescens*	1.0	1.0	1.0	1
Oxalis violacea	1.0	1.0	1.0	1
Phryma leptostachya	1.0	1.0	1.0	1
Polytrichum	1.0	1.0	1.0	1
Pyrus pyrifolia	1.0	1.0	1.0	1
Rhododendron	1.0	1.0	1.0	1
Solidago flexicaulis	1.0	1.0	1.0	1
Acalypha	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Berberis canadensis	0.5	0.5	0.5	1
Cardamine concatenata	0.5	0.5	0.5	1
Cardamine parviflora var. *arenicola*	0.5	0.5	0.5	1
Carex hirsutella	0.5	0.5	0.5	1
Carex jamesii	0.5	0.5	0.5	1
Carex prasina	0.5	0.5	0.5	1
Carya cordiformis	0.5	0.5	0.5	1
Celtis occidentalis	0.5	0.5	0.5	1
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	1
Dichanthelium commutatum ssp. *ashei*	0.5	0.5	0.5	1
Dichanthelium commutatum ssp. *commutatum*	0.5	0.5	0.5	1
Dirca palustris	0.5	0.5	0.5	1
Dodecatheon meadia ssp. *meadia*	0.5	0.5	0.5	1
Elymus hystrix var. *hystrix*	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Hepatica nobilis var. *obtusa*	0.5	0.5	0.5	1
Hydrangea arborescens	0.5	0.5	0.5	1
Lathyrus venosus	0.5	0.5	0.5	1
Lespedeza frutescens	0.5	0.5	0.5	1
Leucobryum	0.5	0.5	0.5	1
Lobelia inflata	0.5	0.5	0.5	1
Maianthemum canadense	0.5	0.5	0.5	1
Monarda clinopodia	0.5	0.5	0.5	1
Oxalis grandis	0.5	0.5	0.5	1
Phegopteris hexagonoptera	0.5	0.5	0.5	1
Pilea pumila var. *pumila*	0.5	0.5	0.5	1
Poa sylvestris	0.5	0.5	0.5	1
Podophyllum peltatum	0.5	0.5	0.5	1
Polygonatum biflorum	0.5	0.5	0.5	1
Polygonum	0.5	0.5	0.5	1
Polygonum scandens	0.5	0.5	0.5	1
Polypodium appalachianum	0.5	0.5	0.5	1
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	1
Rosa multiflora	0.5	0.5	0.5	1
Sanicula canadensis var. *canadensis*	0.5	0.5	0.5	1
Scutellaria	0.5	0.5	0.5	1
Scutellaria nervosa	0.5	0.5	0.5	1
Silene caroliniana ssp. *pensylvanica*	0.5	0.5	0.5	1
Sisyrinchium angustifolium	0.5	0.5	0.5	1
Smilax ecirrata	0.5	0.5	0.5	1
Solidago bicolor	0.5	0.5	0.5	1

Solidago sphacelata	0.5	0.5	0.5	1
Sphenopholis nitida	0.5	0.5	0.5	1
Symphyotrichum	0.5	0.5	0.5	1
Symphyotrichum cordifolium	0.5	0.5	0.5	1
Symphyotrichum lateriflorum	0.5	0.5	0.5	1
Symphyotrichum patens var. *patens*	0.5	0.5	0.5	1
Thalictrum thalictroides	0.5	0.5	0.5	1
Verbascum thapsus	0.5	0.5	0.5	1
Verbesina alternifolia	0.5	0.5	0.5	1
Veronica officinalis var. *officinalis*	0.5	0.5	0.5	1
Viola canadensis	0.5	0.5	0.5	1
Agrostis perennans	0.01	0.01	0.01	1
Carex woodii	0.01	0.01	0.01	1
Clintonia umbellulata	0.01	0.01	0.01	1
Epifagus virginiana	0.01	0.01	0.01	1
Euonymus americana	0.01	0.01	0.01	1
Impatiens capensis	0.01	0.01	0.01	1
Ligusticum canadense	0.01	0.01	0.01	1
Ranunculus fascicularis	0.01	0.01	0.01	1
Smallanthus uvedalius	0.01	0.01	0.01	1
Solidago arguta var. *caroliniana*	0.01	0.01	0.01	1

River Birch Backwater Floodplain Forest (6 plots)

	% Cover			
Species	Mean	Min	Max	N
Betula nigra	47.7	10.0	90.0	6
Lindera benzoin	11.8	1.0	40.0	6
Lysimachia nummularia	8.2	1.0	40.0	6
Polygonum virginianum	2.3	0.5	10.0	6
Verbesina alternifolia	7.1	0.5	20.0	5
Boehmeria cylindrica	3.5	0.5	10.0	5
Rosa multiflora	9.6	0.5	30.0	4
Alliaria petiolata	3.8	2.0	5.0	4
Pilea pumila var. *pumila*	0.6	0.5	1.0	4
Leersia virginica	7.2	0.5	20.0	3
Acer negundo var. *negundo*	4.0	1.0	6.0	3
Urtica dioica ssp. *dioica*	3.7	1.0	5.0	3
Impatiens	2.2	0.5	5.0	3
Onoclea sensibilis	1.3	0.5	3.0	3
Galium triflorum	0.7	0.5	1.0	3
Polygonum caespitosum var. *longisetum*	0.7	0.5	1.0	3
Carex amphibola	0.3	0.01	0.5	3
Platanus occidentalis	32.5	5.0	60.0	2
Acer rubrum var. *rubrum*	10.0	5.0	15.0	2
Agrostis perennans	5.3	0.5	10.0	2
Toxicodendron radicans	4.0	2.0	6.0	2
Ulmus americana	4.0	3.0	5.0	2
Fraxinus pennsylvanica	3.0	1.0	5.0	2
Packera aurea	3.0	1.0	5.0	2
Viola	2.8	0.5	5.0	2
Verbesina occidentalis	2.0	1.0	3.0	2
Vitis	2.0	1.0	3.0	2
Amphicarpaea bracteata	1.8	0.5	3.0	2
Carex	1.8	0.5	3.0	2
Polygonum pensylvanicum	1.8	0.5	3.0	2
Poa alsodes	0.8	0.5	1.0	2
Thalictrum	0.8	0.5	1.0	2
Cryptotaenia canadensis	0.5	0.5	0.5	2
Oxalis	0.5	0.5	0.5	2
Polystichum acrostichoides	0.5	0.5	0.5	2
Sanicula canadensis	0.5	0.5	0.5	2
Viola cucullata	0.5	0.5	0.5	2
Geum canadense var. *canadense*	0.3	0.01	0.5	2
Glyceria striata	20.0	20.0	20.0	1
Vitis aestivalis var. *bicolor*	15.0	15.0	15.0	1
Carpinus caroliniana ssp. *virginiana*	7.0	7.0	7.0	1
Impatiens capensis	5.0	5.0	5.0	1
Juglans nigra	5.0	5.0	5.0	1
Laportea canadensis	5.0	5.0	5.0	1
Acer saccharum var. *saccharum*	3.0	3.0	3.0	1
Carex squarrosa	2.0	2.0	2.0	1
Carex vulpinoidea	2.0	2.0	2.0	1
Juncus effusus	2.0	2.0	2.0	1
Parthenocissus quinquefolia	2.0	2.0	2.0	1
Robinia pseudoacacia	2.0	2.0	2.0	1
Bryhnia novae-angliae	1.0	1.0	1.0	1
Carex caroliniana	1.0	1.0	1.0	1
Carex crinita var. *crinita*	1.0	1.0	1.0	1
Carex stipata var. *stipata*	1.0	1.0	1.0	1
Celtis occidentalis	1.0	1.0	1.0	1
Chasmanthium latifolium	1.0	1.0	1.0	1

Climacium americanum	1.0	1.0	1.0	1
Cornus amomum	1.0	1.0	1.0	1
Dichanthelium clandestinum	1.0	1.0	1.0	1
Galium asprellum	1.0	1.0	1.0	1
Geum vernum	1.0	1.0	1.0	1
Hesperis matronalis	1.0	1.0	1.0	1
Humulus japonicus	1.0	1.0	1.0	1
Lonicera japonica	1.0	1.0	1.0	1
Malus coronaria var. *coronaria*	1.0	1.0	1.0	1
Plagiomnium ciliare	1.0	1.0	1.0	1
Rubus	1.0	1.0	1.0	1
Sicyos angulatus	1.0	1.0	1.0	1
Solidago rugosa	1.0	1.0	1.0	1
Steerecleus serrulatus	1.0	1.0	1.0	1
Thuidium delicatulum	1.0	1.0	1.0	1
Aesculus flava	0.5	0.5	0.5	1
Ageratina altissima var. *altissima*	0.5	0.5	0.5	1
Agrimonia parviflora	0.5	0.5	0.5	1
Allium canadense var. *canadense*	0.5	0.5	0.5	1
Alnus serrulata	0.5	0.5	0.5	1
Ampelopsis arborea	0.5	0.5	0.5	1
Arisaema dracontium	0.5	0.5	0.5	1
Bidens	0.5	0.5	0.5	1
Bromus	0.5	0.5	0.5	1
Cardamine hirsuta	0.5	0.5	0.5	1
Cardamine impatiens	0.5	0.5	0.5	1
Carex gracillima	0.5	0.5	0.5	1
Carex lurida	0.5	0.5	0.5	1
Chelone glabra	0.5	0.5	0.5	1
Cicuta maculata var. *maculata*	0.5	0.5	0.5	1
Clematis virginiana	0.5	0.5	0.5	1
Eleocharis tenuis var. *tenuis*	0.5	0.5	0.5	1
Eupatorium fistulosum	0.5	0.5	0.5	1
Galium aparine	0.5	0.5	0.5	1
Geum	0.5	0.5	0.5	1
Hydrophyllum virginianum	0.5	0.5	0.5	1
Iris	0.5	0.5	0.5	1
Ligustrum vulgare	0.5	0.5	0.5	1
Lysimachia ciliata	0.5	0.5	0.5	1
Mimulus ringens var. *ringens*	0.5	0.5	0.5	1
Oxalis stricta	0.5	0.5	0.5	1
Polygonum convolvulus var. *convolvulus*	0.5	0.5	0.5	1
Polygonum punctatum	0.5	0.5	0.5	1
Potentilla simplex	0.5	0.5	0.5	1
Prunella vulgaris	0.5	0.5	0.5	1
Ranunculus abortivus	0.5	0.5	0.5	1
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	1
Rosa carolina var. *carolina*	0.5	0.5	0.5	1
Rudbeckia laciniata var. *laciniata*	0.5	0.5	0.5	1
Rumex crispus ssp. *crispus*	0.5	0.5	0.5	1
Scutellaria	0.5	0.5	0.5	1
Solidago caesia	0.5	0.5	0.5	1
Ulmus rubra	0.5	0.5	0.5	1
Amblystegium serpens	0.01	0.01	0.01	1
Brachythecium salebrosum	0.01	0.01	0.01	1
Carya cordiformis	0.01	0.01	0.01	1
Hygrohypnum ochraceum	0.01	0.01	0.01	1
Lophocolea heterophylla	0.01	0.01	0.01	1
Pinus strobus	0.01	0.01	0.01	1
Sedum ternatum	0.01	0.01	0.01	1

Riverbank Tall Herbs (7 plots)

	% Cover			
Species	Mean	Min	Max	N
Verbesina alternifolia	17.3	1.0	50.0	7
Dichanthelium clandestinum	4.6	3.0	10.0	7
Solidago gigantea	3.2	1.0	10.0	6
Boehmeria cylindrica	2.5	0.5	10.0	6
Apios americana	1.8	0.5	7.0	6
Chasmanthium latifolium	3.4	1.0	5.0	5
Amphicarpaea bracteata	1.8	0.5	5.0	5
Onoclea sensibilis	1.6	0.5	5.0	5
Packera aurea	1.1	0.5	3.0	5
Galium triflorum	0.5	0.01	1.0	5
Cryptotaenia canadensis	0.4	0.01	0.5	5
Platanus occidentalis	18.0	5.0	35.0	4
Betula nigra	11.4	0.5	30.0	4
Rudbeckia laciniata var. *laciniata*	5.3	0.5	15.0	4
Toxicodendron radicans	3.3	1.0	6.0	4
Elymus riparius	1.6	0.5	3.0	4
Tradescantia ohiensis	1.5	1.0	3.0	4
Leersia virginica	1.4	0.5	3.0	4
Rosa multiflora	0.8	0.01	2.0	4

Verbena urticifolia	0.8	0.5	1.0	4
Glechoma hederacea	0.6	0.0	1.0	4
Liriodendron tulipifera	13.3	5.0	20.0	3
Helenium autumnale var. *autumnale*	4.0	1.0	10.0	3
Verbesina occidentalis	3.0	1.0	5.0	3
Carex emoryi	1.7	0.01	3.0	3
Alliaria petiolata	1.5	0.5	3.0	3
Impatiens capensis	1.5	0.5	3.0	3
Lobelia cardinalis	1.3	0.5	3.0	3
Lobelia siphilitica var. *siphilitica*	1.3	0.5	3.0	3
Robinia pseudoacacia	1.2	0.0	3.0	3
Eupatorium fistulosum	1.0	1.0	1.0	3
Lysimachia nummularia	1.0	1.0	1.0	3
Symphyotrichum prenanthoides	1.0	1.0	1.0	3
Physocarpus opulifolius var. *opulifolius*	0.8	0.0	2.0	3
Thalictrum	0.8	0.0	2.0	3
Lindera benzoin	0.7	0.5	1.0	3
Polygonum caespitosum var. *longisetum*	0.7	0.5	1.0	3
Carex	0.5	0.01	1.0	3
Osmunda regalis var. *spectabilis*	0.5	0.01	1.0	3
Polygonum virginianum	0.5	0.01	1.0	3
Solanum carolinense var. *carolinense*	0.5	0.01	1.0	3
Hesperis matronalis	0.5	0.5	0.5	3
Hypericum prolificum	0.5	0.5	0.5	3
Iris	0.5	0.5	0.5	3
Acer negundo var. *negundo*	0.3	0.0	0.5	3
Fraxinus pennsylvanica	5.3	0.5	10.0	2
Aesculus flava	3.0	1.0	5.0	2
Lolium pratense	1.8	0.5	3.0	2
Andropogon gerardii	1.0	1.0	1.0	2
Coreopsis pubescens	1.0	1.0	1.0	2
Climacium americanum	0.8	0.5	1.0	2
Impatiens	0.8	0.5	1.0	2
Prunella vulgaris	0.8	0.5	1.0	2
Rubus	0.8	0.5	1.0	2
Arnoglossum atriplicifolium	0.5	0.0	1.0	2
Clematis virginiana	0.5	0.5	0.5	2
Daucus carota	0.5	0.5	0.5	2
Humulus japonicus	0.5	0.5	0.5	2
Lespedeza cuneata	0.5	0.5	0.5	2
Potentilla simplex	0.5	0.5	0.5	2
Rumex crispus ssp. *crispus*	0.5	0.5	0.5	2
Smilax tamnoides	0.5	0.5	0.5	2
Viburnum prunifolium	0.5	0.5	0.5	2
Viola	0.5	0.5	0.5	2
Vitis vulpina	0.5	0.5	0.5	2
Carex lupulina	0.3	0.01	0.5	2
Cephalanthus occidentalis	0.3	0.01	0.5	2
Mentha arvensis	0.3	0.01	0.5	2
Polystichum acrostichoides	0.3	0.01	0.5	2
Stachys	0.3	0.01	0.5	2
Urtica dioica ssp. *dioica*	20.0	20.0	20.0	1
Phalaris arundinacea	10.0	10.0	10.0	1
Vernonia gigantea ssp. *gigantea*	7.0	7.0	7.0	1
Pinus strobus	5.0	5.0	5.0	1
Vernonia noveboracensis	5.0	5.0	5.0	1
Acer rubrum var. *rubrum*	4.0	4.0	4.0	1
Juglans nigra	3.0	3.0	3.0	1
Prunus serotina var. *serotina*	3.0	3.0	3.0	1
Spiraea virginiana	2.0	2.0	2.0	1
Ageratina altissima var. *altissima*	1.0	1.0	1.0	1
Asclepias	1.0	1.0	1.0	1
Catalpa speciosa	1.0	1.0	1.0	1
Cercis canadensis var. *canadensis*	1.0	1.0	1.0	1
Coronilla varia	1.0	1.0	1.0	1
Desmodium paniculatum var. *paniculatum*	1.0	1.0	1.0	1
Geum canadense var. *canadense*	1.0	1.0	1.0	1
Gleditsia triacanthos	1.0	1.0	1.0	1
Helianthus strumosus	1.0	1.0	1.0	1
Heliopsis helianthoides	1.0	1.0	1.0	1
Heliopsis helianthoides var. *scabra*	1.0	1.0	1.0	1
Lonicera japonica	1.0	1.0	1.0	1
Poa pratensis ssp. *pratensis*	1.0	1.0	1.0	1
Viola striata	1.0	1.0	1.0	1
Zizia aurea	1.0	1.0	1.0	1
Achillea millefolium var. *occidentalis*	0.5	0.5	0.5	1
Agrimonia parviflora	0.5	0.5	0.5	1
Allium canadense var. *canadense*	0.5	0.5	0.5	1

Artemisia vulgaris var. *vulgaris*	0.5	0.5	0.5	1
Barbarea vulgaris	0.5	0.5	0.5	1
Berberis vulgaris	0.5	0.5	0.5	1
Bidens	0.5	0.5	0.5	1
Carex annectens	0.5	0.5	0.5	1
Carex blanda	0.5	0.5	0.5	1
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	1
Collinsonia canadensis	0.5	0.5	0.5	1
Cyperus strigosus	0.5	0.5	0.5	1
Desmodium glabellum	0.5	0.5	0.5	1
Desmodium glutinosum	0.5	0.5	0.5	1
Dichanthelium dichotomum	0.5	0.5	0.5	1
Elymus hystrix var. *hystrix*	0.5	0.5	0.5	1
Elymus virginicus var. *virginicus*	0.5	0.5	0.5	1
Eragrostis hypnoides	0.5	0.5	0.5	1
Erigeron annuus	0.5	0.5	0.5	1
Eupatorium perfoliatum var. *perfoliatum*	0.5	0.5	0.5	1
Eurybia divaricata	0.5	0.5	0.5	1
Galium asprellum	0.5	0.5	0.5	1
Hackelia virginiana	0.5	0.5	0.5	1
Hypericum mutilum	0.5	0.5	0.5	1
Ligustrum vulgare	0.5	0.5	0.5	1
Lindernia dubia var. *dubia*	0.5	0.5	0.5	1
Lobelia inflata	0.5	0.5	0.5	1
Lythrum salicaria	0.5	0.5	0.5	1
Mnium	0.5	0.5	0.5	1
Oxalis dillenii	0.5	0.5	0.5	1
Oxalis grandis	0.5	0.5	0.5	1
Packera anonyma	0.5	0.5	0.5	1
Parthenocissus quinquefolia	0.5	0.5	0.5	1
Plantago rugelii var. *rugelii*	0.5	0.5	0.5	1
Polygonum punctatum	0.5	0.5	0.5	1
Polygonum sagittatum	0.5	0.5	0.5	1
Quercus velutina	0.5	0.5	0.5	1
Rorippa sylvestris	0.5	0.5	0.5	1
Rubus phoenicolasius	0.5	0.5	0.5	1
Rumex obtusifolius	0.5	0.5	0.5	1
Saponaria officinalis	0.5	0.5	0.5	1
Senna hebecarpa	0.5	0.5	0.5	1
Solidago ulmifolia var. *ulmifolia*	0.5	0.5	0.5	1
Symphyotrichum praealtum	0.5	0.5	0.5	1
Symphyotrichum puniceum var. *puniceum*	0.5	0.5	0.5	1
Teucrium canadense var. *canadense*	0.5	0.5	0.5	1
Trifolium pratense	0.5	0.5	0.5	1
Trifolium repens	0.5	0.5	0.5	1
Xanthium strumarium	0.5	0.5	0.5	1
Zizia trifoliata	0.5	0.5	0.5	1
Acalypha rhomboidea	0.01	0.01	0.01	1
Cardamine impatiens	0.01	0.01	0.01	1
Cinna arundinacea	0.01	0.01	0.01	1
Cornus amomum	0.01	0.01	0.01	1
Lespedeza violacea	0.01	0.01	0.01	1
Lycopus virginicus	0.01	0.01	0.01	1
Passiflora lutea	0.01	0.01	0.01	1
Pilea pumila var. *pumila*	0.01	0.01	0.01	1
Rorippa	0.01	0.01	0.01	1
Rumex acetosella	0.01	0.01	0.01	1
Tsuga canadensis	0.01	0.01	0.01	1
Tussilago farfara	0.01	0.01	0.01	1

Successional Black Locust Woodland (2 plots)

	% Cover			
Species	Mean	Min	Max	N
Robinia pseudoacacia	17.5	15.0	20.0	2
Verbesina alternifolia	10.0	10.0	10.0	2
Juglans nigra	5.5	1.0	10.0	2
Carya ovata	5.3	0.5	10.0	2
Verbesina occidentalis	4.0	3.0	5.0	2
Celtis occidentalis	3.0	1.0	5.0	2
Galium aparine	1.0	1.0	1.0	2
Viola striata	1.0	1.0	1.0	2
Festuca subverticillata	0.5	0.5	0.5	2
Ulmus rubra	20.0	20.0	20.0	1
Lindera benzoin	8.0	8.0	8.0	1
Cercis canadensis var. *canadensis*	5.0	5.0	5.0	1
Myosotis macrosperma	5.0	5.0	5.0	1
Quercus rubra	4.0	4.0	4.0	1
Dichanthelium clandestinum	3.0	3.0	3.0	1
Elymus hystrix var. *hystrix*	3.0	3.0	3.0	1
Fraxinus pennsylvanica	3.0	3.0	3.0	1
Toxicodendron radicans	2.0	2.0	2.0	1

Ageratina altissima var. *altissima*	1.0	1.0	1.0	1
Leersia virginica	1.0	1.0	1.0	1
Rosa multiflora	1.0	1.0	1.0	1
Stellaria media	1.0	1.0	1.0	1
Agrimonia	0.5	0.5	0.5	1
Asplenium platyneuron	0.5	0.5	0.5	1
Carex blanda	0.5	0.5	0.5	1
Carya cordiformis	0.5	0.5	0.5	1
Cerastium glomeratum	0.5	0.5	0.5	1
Crataegus	0.5	0.5	0.5	1
Erigeron annuus	0.5	0.5	0.5	1
Eupatorium fistulosum	0.5	0.5	0.5	1
Galium triflorum	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Glechoma hederacea	0.5	0.5	0.5	1
Hypericum punctatum	0.5	0.5	0.5	1
Osmorhiza longistylis	0.5	0.5	0.5	1
Packera aurea	0.5	0.5	0.5	1
Parthenocissus quinquefolia	0.5	0.5	0.5	1
Poa alsodes	0.5	0.5	0.5	1
Polygonum scandens	0.5	0.5	0.5	1
Polygonum virginianum	0.5	0.5	0.5	1
Rubus phoenicolasius	0.5	0.5	0.5	1
Smilax tamnoides	0.5	0.5	0.5	1
Veronica arvensis	0.5	0.5	0.5	1
Viola sororia	0.5	0.5	0.5	1

Successional Black Walnut Floodplain Forest (3 plots)

	% Cover			
Species	Mean	Min	Max	N
Juglans nigra	40.0	15.0	65.0	3
Verbesina alternifolia	31.0	3.0	50.0	3
Packera aurea	13.8	0.5	40.0	3
Asimina triloba	10.8	0.5	31.0	3
Lindera benzoin	7.3	1.0	20.0	3
Aesculus flava	6.7	2.0	13.0	3
Polygonum virginianum	5.3	1.0	10.0	3
Rosa multiflora	3.0	1.0	6.0	3
Cryptotaenia canadensis	1.8	0.01	5.0	3
Viola striata	20.0	10.0	30.0	2
Polygonum scandens var. *cristatum*	5.5	1.0	10.0	2
Amphicarpaea bracteata	5.3	0.5	10.0	2
Vitis vulpina	4.0	1.0	7.0	2
Juglans cinerea	2.5	0.01	5.0	2
Alliaria petiolata	1.0	1.0	1.0	2
Fraxinus pennsylvanica	0.5	0.0	1.0	2
Galium triflorum	0.5	0.5	0.5	2
Toxicodendron radicans	0.5	0.5	0.5	2
Rudbeckia laciniata var. *laciniata*	30.0	30.0	30.0	1
Acer nigrum	20.0	20.0	20.0	1
Apios americana	10.0	10.0	10.0	1
Dichanthelium clandestinum	10.0	10.0	10.0	1
Hesperis matronalis	10.0	10.0	10.0	1
Platanus occidentalis	10.0	10.0	10.0	1
Ulmus rubra	10.0	10.0	10.0	1
Smilax tamnoides	6.0	6.0	6.0	1
Cercis canadensis var. *canadensis*	4.0	4.0	4.0	1
Agrimonia	3.0	3.0	3.0	1
Corylus americana	3.0	3.0	3.0	1
Elymus riparius	3.0	3.0	3.0	1
Erigeron annuus	3.0	3.0	3.0	1
Vernonia noveboracensis	3.0	3.0	3.0	1
Carex	2.0	2.0	2.0	1
Geum canadense var. *canadense*	2.0	2.0	2.0	1
Parthenocissus quinquefolia	2.0	2.0	2.0	1
Polystichum acrostichoides	1.0	1.0	1.0	1
Robinia pseudoacacia	1.0	1.0	1.0	1
Verbena urticifolia	1.0	1.0	1.0	1
Brachyelytrum erectum	0.5	0.5	0.5	1
Carex amphibola	0.5	0.5	0.5	1
Clematis virginiana	0.5	0.5	0.5	1
Elephantopus carolinianus	0.5	0.5	0.5	1
Galium lanceolatum	0.5	0.5	0.5	1
Glechoma hederacea	0.5	0.5	0.5	1
Impatiens	0.5	0.5	0.5	1
Menispermum canadense	0.5	0.5	0.5	1
Pilea pumila var. *pumila*	0.5	0.5	0.5	1
Sassafras albidum	0.5	0.5	0.5	1
Sedum ternatum	0.5	0.5	0.5	1
Thuidium delicatulum	0.5	0.5	0.5	1
Viola	0.5	0.5	0.5	1
Arisaema triphyllum ssp. *triphyllum*	0.01	0.01	0.01	1
Circaea lutetiana ssp. *canadensis*	0.01	0.01	0.01	1
Festuca subverticillata	0.01	0.01	0.01	1

Hypericum punctatum	0.01	0.01	0.01	1
Oxalis dillenii	0.01	0.01	0.01	1
Prenanthes altissima	0.01	0.01	0.01	1
Ranunculus recurvatus var. *recurvatus*	0.01	0.01	0.01	1
Solidago gigantea	0.01	0.01	0.01	1
Symphyotrichum prenanthoides	0.01	0.01	0.01	1
Thalictrum	0.01	0.01	0.01	1

Successional Box-elder Floodplain Forest (1 plot)

	% Cover			
Species	Mean	Min	Max	N
Acer negundo var. *negundo*	40.0	40.0	40.0	1
Urtica dioica ssp. *dioica*	20.0	20.0	20.0	1
Alliaria petiolata	15.0	15.0	15.0	1
Carya cordiformis	10.0	10.0	10.0	1
Fraxinus pennsylvanica	5.0	5.0	5.0	1
Juglans nigra	3.0	3.0	3.0	1
Lindera benzoin	3.0	3.0	3.0	1
Verbesina alternifolia	3.0	3.0	3.0	1
Cryptotaenia canadensis	1.0	1.0	1.0	1
Impatiens	1.0	1.0	1.0	1
Lysimachia nummularia	1.0	1.0	1.0	1
Polygonum virginianum	1.0	1.0	1.0	1
Sicyos angulatus	1.0	1.0	1.0	1
Toxicodendron radicans	1.0	1.0	1.0	1
Ulmus americana	1.0	1.0	1.0	1
Viola	1.0	1.0	1.0	1
Vitis vulpina	1.0	1.0	1.0	1
Allium canadense var. *canadense*	0.5	0.5	0.5	1
Amphicarpaea bracteata	0.5	0.5	0.5	1
Cardamine hirsuta	0.5	0.5	0.5	1
Carex blanda	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Humulus japonicus	0.5	0.5	0.5	1
Leersia virginica	0.5	0.5	0.5	1
Oxalis stricta	0.5	0.5	0.5	1
Polygonum punctatum	0.5	0.5	0.5	1
Ranunculus abortivus	0.5	0.5	0.5	1
Robinia pseudoacacia	0.5	0.5	0.5	1
Rudbeckia laciniata var. *laciniata*	0.5	0.5	0.5	1
Smilax tamnoides	0.5	0.5	0.5	1
Thalictrum	0.5	0.5	0.5	1
Arisaema dracontium	0.01	0.01	0.01	1
Festuca subverticillata	0.01	0.01	0.01	1
Pilea pumila var. *pumila*	0.01	0.01	0.01	1
Polygonum scandens	0.01	0.01	0.01	1
Stachys tenuifolia	0.01	0.01	0.01	1

Successional Eastern White Pine - Tuliptree Forest (11 plots)

	% Cover			
Species	Mean	Min	Max	N
Pinus strobus	40.7	17.0	60.0	11
Liriodendron tulipifera	19.0	0.5	45.0	11
Parthenocissus quinquefolia	0.7	0.5	1.0	11
Polystichum acrostichoides	0.6	0.0	1.0	11
Acer rubrum var. *rubrum*	4.9	0.5	20.0	10
Galium triflorum	0.6	0.5	1.0	10
Lindera benzoin	7.8	0.5	40.0	9
Toxicodendron radicans	1.1	0.5	3.0	9
Carya cordiformis	0.7	0.5	1.0	9
Acer saccharum var. *saccharum*	4.9	0.5	20.0	8
Smilax rotundifolia	0.8	0.5	1.0	8
Aesculus flava	0.7	0.5	1.0	8
Tsuga canadensis	19.2	0.5	50.0	7
Fraxinus americana	2.3	0.5	5.0	7
Mitchella repens	1.0	0.5	3.0	7
Oxydendrum arboreum	14.7	1.0	23.0	6
Fagus grandifolia	3.2	0.5	10.0	6
Packera aurea	1.8	0.5	5.0	6
Rubus	0.7	0.5	1.0	6
Asimina triloba	4.8	0.5	13.0	5
Robinia pseudoacacia	4.4	0.5	13.0	5
Acer pensylvanicum	4.0	0.5	10.0	5
Ageratina altissima var. *altissima*	2.5	0.01	10.0	5
Cercis canadensis var. *canadensis*	1.0	0.5	3.0	5
Verbesina alternifolia	1.0	0.5	3.0	5
Sassafras albidum	0.7	0.5	1.0	5
Potentilla simplex	0.6	0.5	1.0	5
Asplenium platyneuron	0.5	0.5	0.5	5
Smilax tamnoides	0.5	0.5	0.5	5
Arisaema triphyllum ssp. *triphyllum*	0.4	0.01	0.5	5
Carex amphibola	0.4	0.01	0.5	5

Sanicula canadensis	0.3	0.01	0.5	5
Thuidium delicatulum	0.8	0.5	1.0	4
Brachyelytrum erectum	0.6	0.5	1.0	4
Podophyllum peltatum	0.5	0.5	0.5	4
Polygonatum pubescens	0.5	0.5	0.5	4
Festuca subverticillata	0.4	0.0	0.5	4
Fraxinus pennsylvanica	5.0	2.0	8.0	3
Hamamelis virginiana	3.2	0.5	8.0	3
Magnolia acuminata	2.3	1.0	3.0	3
Platanus occidentalis	2.3	1.0	5.0	3
Quercus rubra	2.0	0.5	5.0	3
Lonicera japonica	1.5	0.5	3.0	3
Prunus serotina var. *serotina*	1.3	0.5	3.0	3
Tilia americana	1.2	0.5	2.0	3
Hypericum prolificum	1.0	0.5	2.0	3
Rosa multiflora	0.8	0.5	1.0	3
Amphicarpaea bracteata	0.7	0.5	1.0	3
Impatiens	0.7	0.5	1.0	3
Leersia virginica	0.7	0.5	1.0	3
Polygonum virginianum	0.7	0.5	1.0	3
Vaccinium pallidum	0.7	0.5	1.0	3
Veronica officinalis var. *officinalis*	0.7	0.5	1.0	3
Viburnum acerifolium	0.7	0.5	1.0	3
Carex laxiflora	0.5	0.5	0.5	3
Carex swanii	0.5	0.5	0.5	3
Dichanthelium dichotomum	0.5	0.5	0.5	3
Dioscorea quaternata	0.5	0.5	0.5	3
Eurybia divaricata	0.5	0.5	0.5	3
Goodyera pubescens	0.5	0.5	0.5	3
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	3
Osmorhiza claytonii	0.5	0.5	0.5	3
Ostrya virginiana var. *virginiana*	0.5	0.5	0.5	3
Prenanthes	0.5	0.5	0.5	3
Salvia lyrata	0.5	0.5	0.5	3
Nyssa sylvatica	10.0	1.0	19.0	2
Pinus virginiana	5.5	1.0	10.0	2
Quercus alba	5.3	0.5	10.0	2
Viburnum prunifolium	3.0	1.0	5.0	2
Carpinus caroliniana ssp. *virginiana*	1.0	1.0	1.0	2
Cornus florida	1.0	1.0	1.0	2
Ulmus americana	1.0	1.0	1.0	2
Acer negundo var. *negundo*	0.8	0.5	1.0	2
Betula lenta	0.8	0.5	1.0	2
Carex gracillima	0.8	0.5	1.0	2
Lycopodium digitatum	0.8	0.5	1.0	2
Pyrularia pubera	0.8	0.5	1.0	2
Rubus phoenicolasius	0.8	0.5	1.0	2
Arnoglossum muehlenbergii	0.5	0.5	0.5	2
Cardamine impatiens	0.5	0.5	0.5	2
Carex blanda	0.5	0.5	0.5	2
Carex communis var. *communis*	0.5	0.5	0.5	2
Carex pensylvanica	0.5	0.5	0.5	2
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	2
Cryptotaenia canadensis	0.5	0.5	0.5	2
Geranium maculatum	0.5	0.5	0.5	2
Hypericum punctatum	0.5	0.5	0.5	2
Juniperus virginiana var. *virginiana*	0.5	0.5	0.5	2
Laportea canadensis	0.5	0.5	0.5	2
Maianthemum canadense	0.5	0.5	0.5	2
Osmorhiza longistylis	0.5	0.5	0.5	2
Polygonum caespitosum var. *longisetum*	0.5	0.5	0.5	2
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	2
Rosa carolina var. *carolina*	0.5	0.5	0.5	2
Smilax glauca	0.5	0.5	0.5	2
Solidago caesia	0.5	0.5	0.5	2
Stellaria media	0.5	0.5	0.5	2
Thalictrum	0.5	0.5	0.5	2
Thalictrum thalictroides	0.5	0.5	0.5	2
Ulmus rubra	0.5	0.5	0.5	2
Viola sororia	0.5	0.5	0.5	2
Vitis vulpina	0.5	0.5	0.5	2
Boehmeria cylindrica	0.3	0.01	0.5	2
Desmodium	0.3	0.01	0.5	2
Hypnum imponens	0.3	0.01	0.5	2
Alliaria petiolata	5.0	5.0	5.0	1
Carya ovata	5.0	5.0	5.0	1
Rhododendron maximum	5.0	5.0	5.0	1
Carya alba	3.0	3.0	3.0	1
Brotherella recurvans	1.0	1.0	1.0	1
Carya glabra	1.0	1.0	1.0	1
Climacium americanum	1.0	1.0	1.0	1
Mnium	1.0	1.0	1.0	1
Potentilla canadensis var. *canadensis*	1.0	1.0	1.0	1

Quercus velutina	1.0	1.0	1.0	1
Vaccinium stamineum	1.0	1.0	1.0	1
Verbesina occidentalis	1.0	1.0	1.0	1
Vitis aestivalis var. *bicolor*	1.0	1.0	1.0	1
Adiantum pedatum	0.5	0.5	0.5	1
Agrimonia parviflora	0.5	0.5	0.5	1
Albizia julibrissin	0.5	0.5	0.5	1
Amelanchier arborea var. *arborea*	0.5	0.5	0.5	1
Anemone quinquefolia var. *quinquefolia*	0.5	0.5	0.5	1
Anomodon	0.5	0.5	0.5	1
Aristolochia macrophylla	0.5	0.5	0.5	1
Asarum canadense	0.5	0.5	0.5	1
Asplenium ×ebenoides	0.5	0.5	0.5	1
Bidens tripartita	0.5	0.5	0.5	1
Carex cephalophora	0.5	0.5	0.5	1
Carex hirsutella	0.5	0.5	0.5	1
Carya	0.5	0.5	0.5	1
Chimaphila maculata	0.5	0.5	0.5	1
Collinsonia canadensis	0.5	0.5	0.5	1
Coreopsis auriculata	0.5	0.5	0.5	1
Cynoglossum virginianum var. *virginianum*	0.5	0.5	0.5	1
Dichanthelium boscii	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *yadkinense*	0.5	0.5	0.5	1
Dryopteris marginalis	0.5	0.5	0.5	1
Elaeagnus umbellata var. *parvifolia*	0.5	0.5	0.5	1
Eupatorium fistulosum	0.5	0.5	0.5	1
Galium circaezans var. *hypomalacum*	0.5	0.5	0.5	1
Galium lanceolatum	0.5	0.5	0.5	1
Geum	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Gleditsia triacanthos	0.5	0.5	0.5	1
Hesperis matronalis	0.5	0.5	0.5	1
Hypoxis hirsuta	0.5	0.5	0.5	1
Ipomoea pandurata	0.5	0.5	0.5	1
Lithospermum latifolium	0.5	0.5	0.5	1
Luzula multiflora ssp. *multiflora* var. *multiflora*	0.5	0.5	0.5	1
Lycopus virginicus	0.5	0.5	0.5	1
Mitella diphylla	0.5	0.5	0.5	1
Onoclea sensibilis	0.5	0.5	0.5	1
Oxalis grandis	0.5	0.5	0.5	1
Oxalis violacea	0.5	0.5	0.5	1
Passiflora lutea	0.5	0.5	0.5	1
Phegopteris hexagonoptera	0.5	0.5	0.5	1
Pilea pumila var. *pumila*	0.5	0.5	0.5	1
Platanthera orbiculata	0.5	0.5	0.5	1
Poa trivialis	0.5	0.5	0.5	1
Polygonatum biflorum	0.5	0.5	0.5	1
Polytrichum	0.5	0.5	0.5	1
Populus grandidentata	0.5	0.5	0.5	1
Prenanthes alba	0.5	0.5	0.5	1
Sambucus nigra ssp. *canadensis*	0.5	0.5	0.5	1
Sanguinaria canadensis	0.5	0.5	0.5	1
Sanicula odorata	0.5	0.5	0.5	1
Scutellaria nervosa	0.5	0.5	0.5	1
Scutellaria ovata ssp. *rugosa*	0.5	0.5	0.5	1
Sedum ternatum	0.5	0.5	0.5	1
Sisyrinchium angustifolium	0.5	0.5	0.5	1
Smilax ecirrata	0.5	0.5	0.5	1
Solidago curtisii	0.5	0.5	0.5	1
Solidago flexicaulis	0.5	0.5	0.5	1
Solidago rugosa	0.5	0.5	0.5	1
Solidago ulmifolia var. *ulmifolia*	0.5	0.5	0.5	1
Symphyotrichum patens var. *patens*	0.5	0.5	0.5	1
Symphyotrichum praealtum	0.5	0.5	0.5	1
Symphyotrichum prenanthoides	0.5	0.5	0.5	1
Trillium undulatum	0.5	0.5	0.5	1
Urtica dioica ssp. *dioica*	0.5	0.5	0.5	1
Uvularia perfoliata	0.5	0.5	0.5	1
Viburnum dentatum var. *dentatum*	0.5	0.5	0.5	1
Viola	0.5	0.5	0.5	1
Zizia aurea	0.5	0.5	0.5	1
Agrimonia pubescens	0.01	0.01	0.01	1
Carex laxiculmis var. *laxiculmis*	0.01	0.01	0.01	1
Carex radiata	0.01	0.01	0.01	1
Dichanthelium clandestinum	0.01	0.01	0.01	1
Liparis	0.01	0.01	0.01	1
Taraxacum officinale ssp. *officinale*	0.01	0.01	0.01	1

Successional Tuliptree / Northern Spicebush Forest (3 plots)

Species	% Cover Mean	Min	Max	N
Liriodendron tulipifera	41.0	23.0	70.0	3
Fraxinus americana	7.0	1.0	10.0	3
Toxicodendron radicans	3.8	0.5	10.0	3
Robinia pseudoacacia	2.3	1.0	5.0	3
Ageratina altissima var. *altissima*	0.7	0.5	1.0	3
Cercis canadensis var. *canadensis*	0.7	0.5	1.0	3
Galium triflorum	0.7	0.5	1.0	3
Parthenocissus quinquefolia	0.7	0.5	1.0	3
Amphicarpaea bracteata	0.5	0.5	0.5	3
Smilax tamnoides	0.5	0.5	0.5	3
Fagus grandifolia	10.0	5.0	15.0	2
Acer saccharum var. *saccharum*	8.0	1.0	15.0	2
Lindera benzoin	8.0	6.0	10.0	2
Quercus rubra	5.5	1.0	10.0	2
Acer rubrum var. *rubrum*	4.5	1.0	8.0	2
Vitis aestivalis var. *bicolor*	4.0	3.0	5.0	2
Magnolia acuminata	2.0	1.0	3.0	2
Polystichum acrostichoides	2.0	1.0	3.0	2
Carpinus caroliniana ssp. *virginiana*	1.8	0.5	3.0	2
Thuidium delicatulum	1.0	1.0	1.0	2
Aesculus flava	0.8	0.5	1.0	2
Solidago caesia	0.8	0.5	1.0	2
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	2
Aristolochia serpentaria	0.5	0.5	0.5	2
Asplenium platyneuron	0.5	0.5	0.5	2
Carex laxiflora	0.5	0.5	0.5	2
Carex radiata	0.5	0.5	0.5	2
Hamamelis virginiana	0.5	0.5	0.5	2
Lobelia inflata	0.5	0.5	0.5	2
Polygonum virginianum	0.5	0.5	0.5	2
Sanicula canadensis	0.5	0.5	0.5	2
Uvularia perfoliata	0.5	0.5	0.5	2
Viburnum acerifolium	0.5	0.5	0.5	2
Viola hastata	0.5	0.5	0.5	2
Viola striata	0.5	0.5	0.5	2
Botrychium virginianum	0.3	0.01	0.5	2
Boehmeria cylindrica	10.0	10.0	10.0	1
Rosa multiflora	10.0	10.0	10.0	1
Betula nigra	5.0	5.0	5.0	1
Platanus occidentalis	5.0	5.0	5.0	1
Tilia americana	5.0	5.0	5.0	1
Carya cordiformis	3.0	3.0	3.0	1
Glechoma hederacea	3.0	3.0	3.0	1
Quercus coccinea var. *coccinea*	3.0	3.0	3.0	1
Brachyelytrum erectum	1.0	1.0	1.0	1
Clematis virginiana	1.0	1.0	1.0	1
Cornus florida	1.0	1.0	1.0	1
Dicranum	1.0	1.0	1.0	1
Impatiens	1.0	1.0	1.0	1
Lysimachia nummularia	1.0	1.0	1.0	1
Nyssa sylvatica	1.0	1.0	1.0	1
Packera aurea	1.0	1.0	1.0	1
Pilea pumila var. *pumila*	1.0	1.0	1.0	1
Polytrichum	1.0	1.0	1.0	1
Quercus alba	1.0	1.0	1.0	1
Quercus velutina	1.0	1.0	1.0	1
Smilax rotundifolia	1.0	1.0	1.0	1
Ulmus americana	1.0	1.0	1.0	1
Ulmus rubra	1.0	1.0	1.0	1
Verbesina alternifolia	1.0	1.0	1.0	1
Vitis riparia	1.0	1.0	1.0	1
Adiantum pedatum	0.5	0.5	0.5	1
Agrimonia rostellata	0.5	0.5	0.5	1
Agrostis perennans	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Amelanchier arborea var. *arborea*	0.5	0.5	0.5	1
Cardamine hirsuta	0.5	0.5	0.5	1
Carex	0.5	0.5	0.5	1
Carex blanda	0.5	0.5	0.5	1
Carex frankii	0.5	0.5	0.5	1
Carex oligocarpa	0.5	0.5	0.5	1
Collinsonia canadensis	0.5	0.5	0.5	1
Cornus amomum	0.5	0.5	0.5	1
Crataegus	0.5	0.5	0.5	1
Cryptotaenia canadensis	0.5	0.5	0.5	1
Danthonia spicata	0.5	0.5	0.5	1
Dichanthelium commutatum ssp. *ashei*	0.5	0.5	0.5	1
Dichanthelium commutatum ssp. *commutatum*	0.5	0.5	0.5	1
Dioscorea quaternata	0.5	0.5	0.5	1
Erechtites hieraciifolia var. *hieraciifolia*	0.5	0.5	0.5	1
Eurybia divaricata	0.5	0.5	0.5	1

Galium circaezans var. *circaezans*	0.5	0.5	0.5	1
Geranium maculatum	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Geum vernum	0.5	0.5	0.5	1
Gleditsia triacanthos	0.5	0.5	0.5	1
Goodyera pubescens	0.5	0.5	0.5	1
Hypericum prolificum	0.5	0.5	0.5	1
Juglans nigra	0.5	0.5	0.5	1
Juncus effusus	0.5	0.5	0.5	1
Lonicera	0.5	0.5	0.5	1
Lonicera japonica	0.5	0.5	0.5	1
Lysimachia ciliata	0.5	0.5	0.5	1
Ostrya virginiana var. *virginiana*	0.5	0.5	0.5	1
Oxalis corniculata	0.5	0.5	0.5	1
Oxalis dillenii	0.5	0.5	0.5	1
Packera obovata	0.5	0.5	0.5	1
Pinus strobus	0.5	0.5	0.5	1
Prenanthes	0.5	0.5	0.5	1
Prunus	0.5	0.5	0.5	1
Rubus	0.5	0.5	0.5	1
Sanicula canadensis var. *canadensis*	0.5	0.5	0.5	1
Sassafras albidum	0.5	0.5	0.5	1
Sedum ternatum	0.5	0.5	0.5	1
Smilax glauca	0.5	0.5	0.5	1
Solidago gigantea	0.5	0.5	0.5	1
Symphyotrichum prenanthoides	0.5	0.5	0.5	1
Thalictrum	0.5	0.5	0.5	1
Thalictrum thalictroides	0.5	0.5	0.5	1
Tsuga canadensis	0.5	0.5	0.5	1
Viburnum prunifolium	0.5	0.5	0.5	1
Viola cucullata	0.5	0.5	0.5	1
Dryopteris marginalis	0.01	0.01	0.01	1
Hypericum punctatum	0.01	0.01	0.01	1
Maianthemum racemosum ssp. *racemosum*	0.01	0.01	0.01	1
Panax quinquefolius	0.01	0.01	0.01	1
Scutellaria elliptica var. *elliptica*	0.01	0.01	0.01	1
Scutellaria saxatilis	0.01	0.01	0.01	1
Veronica officinalis var. *officinalis*	0.01	0.01	0.01	1

Sugar Maple - Yellow Buckeye - American Basswood Forest (12 plots)

	% Cover			
Species	Mean	Min	Max	N
Polystichum acrostichoides	1.8	0.5	5.0	12
Acer saccharum var. *saccharum*	32.6	11.0	63.0	11
Tilia americana	30.7	5.0	54.0	11
Fraxinus americana	3.6	0.5	12.0	11
Parthenocissus quinquefolia	1.1	0.5	3.0	11
Aesculus flava	12.0	1.0	40.0	10
Dryopteris marginalis	1.4	0.5	5.0	10
Liriodendron tulipifera	15.1	0.5	40.0	9
Adiantum pedatum	1.1	0.5	3.0	9
Galium triflorum	0.5	0.5	0.5	9
Aristolochia macrophylla	1.3	0.5	4.0	8
Arisaema triphyllum ssp. *triphyllum*	0.7	0.5	1.0	8
Sedum ternatum	0.6	0.01	1.0	8
Lindera benzoin	5.1	0.5	18.0	7
Ageratina altissima var. *altissima*	2.7	0.5	10.0	7
Thuidium delicatulum	4.6	0.5	10.0	6
Eurybia divaricata	0.7	0.5	1.0	6
Dioscorea quaternata	0.6	0.5	1.0	6
Sanguinaria canadensis	0.5	0.5	0.5	6
Panax quinquefolius	0.4	0.0	0.5	6
Tsuga canadensis	6.1	0.5	12.0	5
Laportea canadensis	3.8	1.0	10.0	5
Osmorhiza claytonii	0.6	0.5	1.0	5
Botrychium virginianum	0.5	0.5	0.5	5
Sanicula canadensis	0.5	0.5	0.5	5
Solidago flexicaulis	0.5	0.5	0.5	5
Asplenium rhizophyllum	0.4	0.01	0.5	5
Smilax tamnoides	0.4	0.01	0.5	5
Quercus rubra	13.9	0.5	25.0	4
Carya cordiformis	5.9	0.5	10.0	4
Magnolia acuminata	2.5	1.0	3.0	4
Vitis aestivalis var. *bicolor*	1.8	1.0	3.0	4
Asarum canadense	1.3	0.5	3.0	4
Brachyelytrum erectum	0.8	0.5	1.0	4
Hepatica nobilis var. *acuta*	0.6	0.5	1.0	4
Pilea pumila var. *pumila*	0.6	0.5	1.0	4
Asplenium platyneuron	0.5	0.5	0.5	4

Acer pensylvanicum	8.2	0.5	20.0	3
Dicranum	6.8	0.5	10.0	3
Carya ovata	2.0	0.5	5.0	3
Hamamelis virginiana	1.0	1.0	1.0	3
Phegopteris hexagonoptera	0.8	0.5	1.0	3
Viburnum acerifolium	0.8	0.5	1.0	3
Geranium maculatum	0.7	0.5	1.0	3
Hydrangea arborescens	0.7	0.5	1.0	3
Stellaria pubera	0.7	0.5	1.0	3
Ulmus rubra	0.7	0.5	1.0	3
Viola	0.7	0.5	1.0	3
Carex laxiflora	0.5	0.5	0.5	3
Cercis canadensis var. *canadensis*	0.5	0.5	0.5	3
Festuca subverticillata	0.5	0.5	0.5	3
Osmorhiza longistylis	0.5	0.5	0.5	3
Packera aurea	0.5	0.5	0.5	3
Polygonatum pubescens	0.5	0.5	0.5	3
Polygonum virginianum	0.5	0.5	0.5	3
Prenanthes	0.5	0.5	0.5	3
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	3
Sambucus nigra ssp. *canadensis*	0.5	0.5	0.5	3
Toxicodendron radicans	0.5	0.5	0.5	3
Viola sororia	0.5	0.5	0.5	3
Acer rubrum var. *rubrum*	11.5	10.0	13.0	2
Asimina triloba	7.5	5.0	10.0	2
Betula lenta	7.5	5.0	10.0	2
Platanus occidentalis	7.5	5.0	10.0	2
Prunus serotina var. *serotina*	5.0	5.0	5.0	2
Fagus grandifolia	3.0	3.0	3.0	2
Brachythecium plumosum	2.8	0.5	5.0	2
Dryopteris intermedia	1.0	1.0	1.0	2
Hydrophyllum virginianum	1.0	1.0	1.0	2
Ulmus americana	1.0	1.0	1.0	2
Amphicarpaea bracteata	0.8	0.5	1.0	2
Galium circaezans	0.8	0.5	1.0	2
Ostrya virginiana var. *virginiana*	0.8	0.5	1.0	2
Robinia pseudoacacia	0.8	0.5	1.0	2
Carex hitchcockiana	0.5	0.5	0.5	2
Carex radiata	0.5	0.5	0.5	2
Galium lanceolatum	0.5	0.5	0.5	2
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	2
Mitella diphylla	0.5	0.5	0.5	2
Polypodium virginianum	0.5	0.5	0.5	2
Rosa multiflora	0.5	0.5	0.5	2
Rubus phoenicolasius	0.5	0.5	0.5	2
Scutellaria saxatilis	0.5	0.5	0.5	2
Solidago caesia	0.5	0.5	0.5	2
Uvularia perfoliata	0.3	0.0	0.5	2
Anomodon attenuatus	10.0	10.0	10.0	1
Hypnum	10.0	10.0	10.0	1
Juglans nigra	10.0	10.0	10.0	1
Carpinus caroliniana ssp. *virginiana*	7.0	7.0	7.0	1
Dicranodontium denudatum	5.0	5.0	5.0	1
Elymus hystrix var. *hystrix*	5.0	5.0	5.0	1
Oxydendrum arboreum	5.0	5.0	5.0	1
Rubus occidentalis	5.0	5.0	5.0	1
Eurybia schreberi	3.0	3.0	3.0	1
Alliaria petiolata	1.0	1.0	1.0	1
Anomodon rostratus	1.0	1.0	1.0	1
Deparia acrostichoides	1.0	1.0	1.0	1
Hepatica nobilis	1.0	1.0	1.0	1
Heuchera villosa var. *villosa*	1.0	1.0	1.0	1
Mnium	1.0	1.0	1.0	1
Polytrichum	1.0	1.0	1.0	1
Quercus muehlenbergii	1.0	1.0	1.0	1
Rubus odoratus var. *odoratus*	1.0	1.0	1.0	1
Thuja occidentalis	1.0	1.0	1.0	1
Umbilicaria mammulata	1.0	1.0	1.0	1
Antennaria virginica	0.5	0.5	0.5	1
Arabis laevigata	0.5	0.5	0.5	1
Aralia racemosa ssp. *racemosa*	0.5	0.5	0.5	1
Asplenium ×ebenoides	0.5	0.5	0.5	1
Bromus pubescens	0.5	0.5	0.5	1
Carex	0.5	0.5	0.5	1
Carex albursina	0.5	0.5	0.5	1
Carex amphibola	0.5	0.5	0.5	1
Carex cephalophora	0.5	0.5	0.5	1
Carex platyphylla	0.5	0.5	0.5	1
Carya	0.5	0.5	0.5	1
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	1
Collinsonia canadensis	0.5	0.5	0.5	1

Cornus florida	0.5	0.5	0.5	1
Cryptotaenia canadensis	0.5	0.5	0.5	1
Dirca palustris	0.5	0.5	0.5	1
Elaeagnus umbellata var. *parvifolia*	0.5	0.5	0.5	1
Galium aparine	0.5	0.5	0.5	1
Galium circaezans var. *circaezans*	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Gleditsia triacanthos	0.5	0.5	0.5	1
Hedwigia ciliata	0.5	0.5	0.5	1
Hydrophyllum canadense	0.5	0.5	0.5	1
Platanthera	0.5	0.5	0.5	1
Podophyllum peltatum	0.5	0.5	0.5	1
Polygonatum biflorum	0.5	0.5	0.5	1
Sanicula canadensis var. *canadensis*	0.5	0.5	0.5	1
Sanicula trifoliata	0.5	0.5	0.5	1
Smilax ecirrata	0.5	0.5	0.5	1
Smilax glauca	0.5	0.5	0.5	1
Smilax rotundifolia	0.5	0.5	0.5	1
Stellaria media ssp. *media*	0.5	0.5	0.5	1
Thalictrum	0.5	0.5	0.5	1
Thalictrum thalictroides	0.5	0.5	0.5	1
Thelypteris noveboracensis	0.5	0.5	0.5	1
Trillium	0.5	0.5	0.5	1
Trillium erectum	0.5	0.5	0.5	1
Trillium undulatum	0.5	0.5	0.5	1
Viburnum dentatum var. *dentatum*	0.5	0.5	0.5	1
Viburnum rafinesquianum	0.5	0.5	0.5	1
Viola canadensis	0.5	0.5	0.5	1
Viola pubescens var. *pubescens*	0.5	0.5	0.5	1
Viola striata	0.5	0.5	0.5	1
Scutellaria ovata	0.01	0.01	0.01	1

Sycamore - Ash Floodplain Forest (1 plot)

	% Cover			
Species	Mean	Min	Max	N
Ulmus americana	80.0	80.0	80.0	1
Lindera benzoin	50.0	50.0	50.0	1
Platanus occidentalis	50.0	50.0	50.0	1
Fraxinus pennsylvanica	5.0	5.0	5.0	1
Boehmeria cylindrica	1.0	1.0	1.0	1
Verbesina alternifolia	1.0	1.0	1.0	1
Verbesina occidentalis	1.0	1.0	1.0	1
Viola	1.0	1.0	1.0	1
Acer negundo var. *negundo*	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Cardamine hirsuta	0.5	0.5	0.5	1
Carex	0.5	0.5	0.5	1
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	1
Cryptotaenia canadensis	0.5	0.5	0.5	1
Elymus hystrix var. *hystrix*	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Impatiens	0.5	0.5	0.5	1
Leersia virginica	0.5	0.5	0.5	1
Lonicera	0.5	0.5	0.5	1
Onoclea sensibilis	0.5	0.5	0.5	1
Oxalis	0.5	0.5	0.5	1
Parthenocissus quinquefolia	0.5	0.5	0.5	1
Pilea pumila var. *pumila*	0.5	0.5	0.5	1
Polygonum pensylvanicum	0.5	0.5	0.5	1
Polygonum virginianum	0.5	0.5	0.5	1
Rosa multiflora	0.5	0.5	0.5	1
Smilax tamnoides	0.5	0.5	0.5	1
Symphyotrichum prenanthoides	0.5	0.5	0.5	1
Toxicodendron radicans	0.5	0.5	0.5	1
Urtica dioica ssp. *dioica*	0.5	0.5	0.5	1

Sycamore - River Birch Riverscour Woodland (14 plots)

	% Cover			
Species	Mean	Min	Max	N
Platanus occidentalis	21.2	3.0	50.0	12
Dichanthelium clandestinum	3.1	0.5	10.0	11
Symphyotrichum prenanthoides	0.6	0.0	3.0	11
Betula nigra	22.1	0.5	45.0	10
Packera aurea	2.0	0.0	10.0	10
Galium triflorum	0.6	0.0	1.0	10
Pilea pumila var. *pumila*	0.4	0.0	0.5	10

Verbesina alternifolia	2.1	0.5	10.0	9
Rudbeckia laciniata var. *laciniata*	0.9	0.5	3.0	9
Cryptotaenia canadensis	0.6	0.0	1.0	9
Chasmanthium latifolium	2.4	0.5	10.0	8
Tradescantia ohiensis	2.1	0.5	10.0	8
Toxicodendron radicans	1.5	0.5	3.0	8
Apios americana	0.8	0.5	1.0	8
Onoclea sensibilis	0.6	0.5	1.0	8
Carex emoryi	20.1	0.0	60.0	7
Andropogon gerardii	14.6	0.5	40.0	7
Solidago gigantea	2.6	0.5	15.0	7
Apocynum cannabinum	1.3	0.5	5.0	7
Cephalanthus occidentalis	0.9	0.0	3.0	7
Prunella vulgaris	0.6	0.0	1.0	7
Plantago rugelii var. *rugelii*	0.5	0.5	0.5	7
Verbesina occidentalis	2.5	0.5	10.0	6
Elymus riparius	2.2	0.5	10.0	6
Coronilla varia	1.2	0.5	3.0	6
Lysimachia nummularia	0.8	0.5	2.0	6
Polygonum caespitosum var. *longisetum*	0.7	0.5	1.0	6
Rosa multiflora	0.7	0.5	1.0	6
Impatiens	0.6	0.5	1.0	6
Potentilla simplex	0.6	0.5	1.0	6
Polygonum virginianum	0.5	0.5	0.5	6
Melilotus officinalis	0.4	0.0	0.5	6
Trifolium pratense	0.4	0.0	0.5	6
Cornus amomum	1.4	0.5	5.0	5
Helianthus strumosus	0.8	0.0	1.0	5
Amphicarpaea bracteata	0.7	0.5	1.0	5
Parthenocissus quinquefolia	0.7	0.5	1.0	5
Vernonia noveboracensis	0.6	0.0	1.0	5
Desmodium glabellum	0.6	0.5	1.0	5
Leersia virginica	0.6	0.5	1.0	5
Boehmeria cylindrica	0.5	0.0	1.0	5
Sedum ternatum	0.5	0.0	1.0	5
Viola	0.5	0.0	1.0	5
Erigeron annuus	0.5	0.5	0.5	5
Salvia lyrata	0.5	0.5	0.5	5
Viola cucullata	0.5	0.5	0.5	5
Lobelia cardinalis	0.4	0.01	0.5	5
Trifolium repens	0.3	0.01	0.5	5
Liriodendron tulipifera	3.4	0.01	10.0	4
Robinia pseudoacacia	1.5	0.5	3.0	4
Symphyotrichum praealtum	1.0	0.0	3.0	4
Lindera benzoin	1.0	1.0	1.0	4
Zizia trifoliata	0.6	0.0	1.0	4
Humulus japonicus	0.6	0.5	1.0	4
Ipomoea pandurata	0.6	0.5	1.0	4
Lysimachia ciliata	0.6	0.5	1.0	4
Lysimachia japonica	0.6	0.5	1.0	4
Rubus	0.6	0.5	1.0	4
Viola striata	0.6	0.5	1.0	4
Vitis riparia	0.6	0.5	1.0	4
Ambrosia artemisiifolia var. *elatior*	0.5	0.5	0.5	4
Clematis virginiana	0.5	0.5	0.5	4
Eupatorium fistulosum	0.5	0.5	0.5	4
Glechoma hederacea	0.5	0.5	0.5	4
Verbena urticifolia	0.5	0.5	0.5	4
Ambrosia trifida var. *trifida*	0.4	0.01	0.5	4
Daucus carota	0.4	0.01	0.5	4
Hypericum mutilum	0.4	0.01	0.5	4
Asimina triloba	1.7	1.0	3.0	3
Carpinus caroliniana ssp. *virginiana*	1.7	1.0	3.0	3
Climacium americanum	1.5	0.5	3.0	3
Lolium pratense	1.3	0.5	3.0	3
Lespedeza cuneata	0.8	0.5	1.0	3
Hypericum prolificum	0.7	0.5	1.0	3
Polygonum punctatum	0.5	0.0	1.0	3
Acalypha virginica	0.5	0.5	0.5	3
Agrimonia	0.5	0.5	0.5	3
Bidens	0.5	0.5	0.5	3
Bidens vulgata	0.5	0.5	0.5	3
Carex	0.5	0.5	0.5	3
Cinna arundinacea	0.5	0.5	0.5	3
Elaeagnus umbellata var. *parvifolia*	0.5	0.5	0.5	3
Eurybia divaricata	0.5	0.5	0.5	3
Hamamelis virginiana	0.5	0.5	0.5	3
Lobelia siphilitica var. *siphilitica*	0.5	0.5	0.5	3
Oxalis grandis	0.5	0.5	0.5	3
Oxalis stricta	0.5	0.5	0.5	3
Sanicula canadensis	0.5	0.5	0.5	3
Smilax rotundifolia	0.5	0.5	0.5	3
Arnoglossum atriplicifolium	0.3	0.0	0.5	3
Brassica nigra	0.3	0.0	0.5	3
Euphorbia corollata	0.3	0.0	0.5	3
Rorippa sylvestris	0.3	0.0	0.5	3
Catalpa bignonioides	3.5	2.0	5.0	2

Fraxinus americana	3.0	1.0	5.0	2
Ulmus americana	2.8	0.5	5.0	2
Impatiens capensis	2.0	1.0	3.0	2
Acer rubrum var. *rubrum*	1.8	0.5	3.0	2
Alnus serrulata	1.8	0.5	3.0	2
Ampelopsis arborea	1.8	0.5	3.0	2
Solidago rugosa	1.8	0.5	3.0	2
Acalypha rhomboidea	0.8	0.5	1.0	2
Aesculus flava	0.8	0.5	1.0	2
Dichanthelium dichotomum	0.8	0.5	1.0	2
Lespedeza frutescens	0.8	0.5	1.0	2
Polygonum hydropiperoides	0.8	0.5	1.0	2
Saponaria officinalis	0.8	0.5	1.0	2
Thaspium barbinode	0.8	0.5	1.0	2
Symphyotrichum lateriflorum	0.5	0.0	1.0	2
Ageratina altissima var. *altissima*	0.5	0.5	0.5	2
Bidens frondosa	0.5	0.5	0.5	2
Bidens tripartita	0.5	0.5	0.5	2
Cardamine bulbosa	0.5	0.5	0.5	2
Carex radiata	0.5	0.5	0.5	2
Carex squarrosa	0.5	0.5	0.5	2
Cicuta maculata var. *maculata*	0.5	0.5	0.5	2
Commelina communis var. *communis*	0.5	0.5	0.5	2
Coreopsis tinctoria var. *tinctoria*	0.5	0.5	0.5	2
Erigeron pulchellus	0.5	0.0	1.0	2
Gleditsia triacanthos	0.5	0.5	0.5	2
Houstonia caerulea	0.5	0.5	0.5	2
Lobelia inflata	0.5	0.5	0.5	2
Lycopus virginicus	0.5	0.5	0.5	2
Mentha arvensis	0.5	0.5	0.5	2
Osmunda regalis var. *spectabilis*	0.5	0.5	0.5	2
Oxalis dillenii	0.5	0.5	0.5	2
Phalaris arundinacea	0.5	0.5	0.5	2
Polygonum pensylvanicum	0.5	0.5	0.5	2
Polygonum sagittatum	0.5	0.5	0.5	2
Rumex crispus ssp. *crispus*	0.5	0.5	0.5	2
Sisyrinchium angustifolium	0.5	0.5	0.5	2
Smilax glauca	0.5	0.5	0.5	2
Solanum carolinense var. *carolinense*	0.5	0.5	0.5	2
Thalictrum	0.5	0.5	0.5	2
Trautvetteria caroliniensis var. *caroliniensis*	0.5	0.5	0.5	2
Veronicastrum virginicum	0.5	0.5	0.5	2
Viburnum dentatum var. *dentatum*	0.5	0.5	0.5	2
Viola sororia	0.5	0.5	0.5	2
Galinsoga quadriradiata	0.3	0.01	0.5	2
Helenium autumnale var. *autumnale*	0.3	0.01	0.5	2
Silphium trifoliatum var. *trifoliatum*	0.3	0.01	0.5	2
Smilax tamnoides	0.3	0.01	0.5	2
Vitis rupestris	0.3	0.01	0.5	2
Alliaria petiolata	0.01	0.01	0.01	2
Pinus strobus	0.01	0.01	0.01	2
Quercus velutina	20.0	20.0	20.0	1
Elymus canadensis	10.0	10.0	10.0	1
Diospyros virginiana	3.0	3.0	3.0	1
Veronica officinalis var. *officinalis*	3.0	3.0	3.0	1
Allium vineale ssp. *vineale*	1.0	1.0	1.0	1
Asclepias syriaca	1.0	1.0	1.0	1
Catalpa speciosa	1.0	1.0	1.0	1
Coreopsis auriculata	1.0	1.0	1.0	1
Coreopsis pubescens	1.0	1.0	1.0	1
Cornus florida	1.0	1.0	1.0	1
Crataegus crus-galli	1.0	1.0	1.0	1
Dactylis glomerata ssp. *glomerata*	1.0	1.0	1.0	1
Desmodium paniculatum var. *paniculatum*	1.0	1.0	1.0	1
Erigeron philadelphicus var. *philadelphicus*	1.0	1.0	1.0	1
Fagus grandifolia	1.0	1.0	1.0	1
Mnium	1.0	1.0	1.0	1
Quercus prinus	1.0	1.0	1.0	1
Rhododendron maximum	1.0	1.0	1.0	1
Rubus phoenicolasius	1.0	1.0	1.0	1
Salix nigra	1.0	1.0	1.0	1
Toxicodendron radicans ssp. *negundo*	1.0	1.0	1.0	1
Acer negundo var. *negundo*	0.5	0.5	0.5	1
Acer saccharum var. *saccharum*	0.5	0.5	0.5	1

Agrostis	0.5	0.5	0.5	1
Agrostis gigantea	0.5	0.5	0.5	1
Agrostis perennans	0.5	0.5	0.5	1
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	1
Arnoglossum muehlenbergii	0.5	0.5	0.5	1
Atrichum	0.5	0.5	0.5	1
Berberis	0.5	0.5	0.5	1
Brachyelytrum erectum	0.5	0.5	0.5	1
Cardamine	0.5	0.5	0.5	1
Cardamine pensylvanica	0.5	0.5	0.5	1
Carex amphibola	0.5	0.5	0.5	1
Carex annectens	0.5	0.5	0.5	1
Carex communis var. *communis*	0.5	0.5	0.5	1
Carya ovata	0.5	0.5	0.5	1
Cercis canadensis var. *canadensis*	0.5	0.5	0.5	1
Chenopodium ambrosioides var. *ambrosioides*	0.5	0.5	0.5	1
Chionanthus virginicus	0.5	0.5	0.5	1
Crataegus	0.5	0.5	0.5	1
Cyperus strigosus	0.5	0.5	0.5	1
Desmodium obtusum	0.5	0.5	0.5	1
Desmodium rotundifolium	0.5	0.5	0.5	1
Dichanthelium depauperatum	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *microcarpon*	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *yadkinense*	0.5	0.5	0.5	1
Echinochloa crus-galli	0.5	0.5	0.5	1
Equisetum hyemale var. *affine*	0.5	0.5	0.5	1
Eupatorium purpureum var. *purpureum*	0.5	0.5	0.5	1
Festuca subverticillata	0.5	0.5	0.5	1
Geranium maculatum	0.5	0.5	0.5	1
Geum	0.5	0.5	0.5	1
Geum canadense var. *canadense*	0.5	0.5	0.5	1
Heliopsis helianthoides var. *helianthoides*	0.5	0.5	0.5	1
Hypericum ellipticum	0.5	0.5	0.5	1
Hypericum punctatum	0.5	0.5	0.5	1
Iris pseudacorus	0.5	0.5	0.5	1
Juncus dichotomus	0.5	0.5	0.5	1
Juncus effusus var. *solutus*	0.5	0.5	0.5	1
Lespedeza	0.5	0.5	0.5	1
Lespedeza procumbens	0.5	0.5	0.5	1
Leucanthemum vulgare	0.5	0.5	0.5	1
Ligustrum vulgare	0.5	0.5	0.5	1
Lindera benzoin var. *pubescens*	0.5	0.5	0.5	1
Lindernia dubia var. *dubia*	0.5	0.5	0.5	1
Lobelia	0.5	0.5	0.5	1
Lolium arundinaceum	0.5	0.5	0.5	1
Luzula multiflora ssp. *multiflora* var. *multiflora*	0.5	0.5	0.5	1
Mimulus	0.5	0.5	0.5	1
Mimulus alatus	0.5	0.5	0.5	1
Mimulus ringens var. *ringens*	0.5	0.5	0.5	1
Myosoton aquaticum	0.5	0.5	0.5	1
Oenothera parviflora	0.5	0.5	0.5	1
Oxalis	0.5	0.5	0.5	1
Panicum virgatum	0.5	0.5	0.5	1
Pennisetum glaucum	0.5	0.5	0.5	1
Phlox maculata ssp. *pyramidalis*	0.5	0.5	0.5	1
Physalis longifolia var. *subglabrata*	0.5	0.5	0.5	1
Plantago	0.5	0.5	0.5	1
Poa	0.5	0.5	0.5	1
Polygonum	0.5	0.5	0.5	1
Polygonum punctatum var. *punctatum*	0.5	0.5	0.5	1
Polystichum acrostichoides	0.5	0.5	0.5	1
Potentilla canadensis var. *canadensis*	0.5	0.5	0.5	1
Quercus rubra	0.5	0.5	0.5	1
Ranunculus	0.5	0.5	0.5	1
Ranunculus hispidus var. *nitidus*	0.5	0.5	0.5	1
Rhododendron arborescens	0.5	0.5	0.5	1
Rosa carolina var. *carolina*	0.5	0.5	0.5	1
Salix caroliniana	0.5	0.5	0.5	1
Salix sericea	0.5	0.5	0.5	1
Sanicula odorata	0.5	0.5	0.5	1
Senna hebecarpa	0.5	0.5	0.5	1
Smilax ecirrata	0.5	0.5	0.5	1
Solidago	0.5	0.5	0.5	1
Solidago bicolor	0.5	0.5	0.5	1

Solidago caesia	0.5	0.5	0.5	1
Stachys tenuifolia	0.5	0.5	0.5	1
Stellaria longifolia var. *longifolia*	0.5	0.5	0.5	1
Stellaria media ssp. *pallida*	0.5	0.5	0.5	1
Tradescantia virginiana	0.5	0.5	0.5	1
Trifolium hybridum	0.5	0.5	0.5	1
Urtica dioica ssp. *dioica*	0.5	0.5	0.5	1
Veronica americana	0.5	0.5	0.5	1
Viburnum prunifolium	0.5	0.5	0.5	1
Vitis vulpina	0.5	0.5	0.5	1
Zizia aurea	0.5	0.5	0.5	1
Carex tribuloides	0.01	0.01	0.01	1
Catalpa	0.01	0.01	0.01	1
Erechtites hieraciifolia var. *hieraciifolia*	0.01	0.01	0.01	1
Medicago lupulina	0.01	0.01	0.01	1
Menispermum canadense	0.01	0.01	0.01	1
Muhlenbergia sylvatica	0.01	0.01	0.01	1
Paulownia tomentosa	0.01	0.01	0.01	1
Rhizomnium	0.01	0.01	0.01	1
Sanicula	0.01	0.01	0.01	1
Xanthium strumarium	0.01	0.01	0.01	1

Sycamore - Yellow Buckeye Floodplain Forest (3 plots)

	% Cover			
Species	Mean	Min	Max	N
Platanus occidentalis	53.3	40.0	60.0	3
Aesculus flava	17.3	5.0	35.0	3
Lindera benzoin	9.7	8.0	11.0	3
Verbesina alternifolia	7.7	3.0	10.0	3
Amphicarpaea bracteata	6.8	0.5	10.0	3
Rudbeckia laciniata var. *laciniata*	3.8	0.5	10.0	3
Dichanthelium clandestinum	2.2	0.5	5.0	3
Leersia virginica	1.5	0.5	3.0	3
Elymus hystrix var. *hystrix*	1.2	0.01	3.0	3
Galium triflorum	0.7	0.5	1.0	3
Prunella vulgaris	0.5	0.5	0.5	3
Acer saccharum var. *saccharum*	6.5	3.0	10.0	2
Carpinus caroliniana ssp. *virginiana*	6.0	2.0	10.0	2
Fraxinus pennsylvanica	5.8	0.5	11.0	2
Packera aurea	3.0	1.0	5.0	2
Cryptotaenia canadensis	2.0	1.0	3.0	2
Liriodendron tulipifera	1.8	0.5	3.0	2
Polygonum virginianum	1.8	0.5	3.0	2
Symphyotrichum prenanthoides	1.8	0.5	3.0	2
Clematis virginiana	0.8	0.5	1.0	2
Parthenocissus quinquefolia	0.8	0.5	1.0	2
Rosa multiflora	0.8	0.5	1.0	2
Toxicodendron radicans	0.8	0.5	1.0	2
Viola striata	0.8	0.5	1.0	2
Circaea lutetiana ssp. *canadensis*	0.5	0.5	0.5	2
Collinsonia canadensis	0.5	0.5	0.5	2
Geum canadense var. *canadense*	0.5	0.5	0.5	2
Polystichum acrostichoides	0.5	0.5	0.5	2
Robinia pseudoacacia	0.5	0.5	0.5	2
Verbesina occidentalis	0.5	0.5	0.5	2
Eupatorium fistulosum	0.3	0.0	0.5	2
Sedum ternatum	0.3	0.0	0.5	2
Cicuta maculata var. *maculata*	0.0	0.0	0.0	2
Acer rubrum var. *rubrum*	10.0	10.0	10.0	1
Boehmeria cylindrica	10.0	10.0	10.0	1
Lindera benzoin var. *pubescens*	10.0	10.0	10.0	1
Pilea pumila var. *pumila*	10.0	10.0	10.0	1
Chasmanthium latifolium	5.0	5.0	5.0	1
Hesperis matronalis	5.0	5.0	5.0	1
Impatiens	5.0	5.0	5.0	1
Lobelia siphilitica var. *siphilitica*	3.0	3.0	3.0	1
Ulmus americana	3.0	3.0	3.0	1
Ulmus rubra	3.0	3.0	3.0	1
Viburnum prunifolium	3.0	3.0	3.0	1
Viola	3.0	3.0	3.0	1
Asimina triloba	2.0	2.0	2.0	1
Lysimachia nummularia	2.0	2.0	2.0	1
Quercus muehlenbergii	2.0	2.0	2.0	1
Alnus serrulata	1.0	1.0	1.0	1
Apios americana	1.0	1.0	1.0	1
Carex	1.0	1.0	1.0	1
Equisetum hyemale var. *affine*	1.0	1.0	1.0	1
Helianthus divaricatus	1.0	1.0	1.0	1
Helianthus strumosus	1.0	1.0	1.0	1

Impatiens capensis	1.0	1.0	1.0	1
Mentha arvensis	1.0	1.0	1.0	1
Onoclea sensibilis	1.0	1.0	1.0	1
Potentilla simplex	1.0	1.0	1.0	1
Solidago gigantea	1.0	1.0	1.0	1
Solidago rugosa ssp. *rugosa* var. *rugosa*	1.0	1.0	1.0	1
Thuidium delicatulum	1.0	1.0	1.0	1
Urtica dioica ssp. *dioica*	1.0	1.0	1.0	1
Achillea millefolium var. *occidentalis*	0.5	0.5	0.5	1
Ageratina altissima var. *altissima*	0.5	0.5	0.5	1
Agrimonia pubescens	0.5	0.5	0.5	1
Alliaria petiolata	0.5	0.5	0.5	1
Ambrosia artemisiifolia var. *elatior*	0.5	0.5	0.5	1
Arisaema dracontium	0.5	0.5	0.5	1
Arisaema triphyllum ssp. *triphyllum*	0.5	0.5	0.5	1
Aristolochia macrophylla	0.5	0.5	0.5	1
Bidens	0.5	0.5	0.5	1
Bromus pubescens	0.5	0.5	0.5	1
Cardamine impatiens	0.5	0.5	0.5	1
Carex blanda	0.5	0.5	0.5	1
Carex prasina	0.5	0.5	0.5	1
Carya cordiformis	0.5	0.5	0.5	1
Cercis canadensis var. *canadensis*	0.5	0.5	0.5	1
Cornus amomum	0.5	0.5	0.5	1
Crataegus	0.5	0.5	0.5	1
Dichanthelium dichotomum ssp. *yadkinense*	0.5	0.5	0.5	1
Dioscorea quaternata	0.5	0.5	0.5	1
Elymus riparius	0.5	0.5	0.5	1
Erigeron philadelphicus var. *philadelphicus*	0.5	0.5	0.5	1
Eupatorium purpureum var. *purpureum*	0.5	0.5	0.5	1
Eurybia divaricata	0.5	0.5	0.5	1
Festuca subverticillata	0.5	0.5	0.5	1
Geranium maculatum	0.5	0.5	0.5	1
Hypericum	0.5	0.5	0.5	1
Hypericum perforatum	0.5	0.5	0.5	1
Juglans nigra	0.5	0.5	0.5	1
Laportea canadensis	0.5	0.5	0.5	1
Lobelia inflata	0.5	0.5	0.5	1
Lysimachia ciliata	0.5	0.5	0.5	1
Menispermum canadense	0.5	0.5	0.5	1
Oxalis dillenii	0.5	0.5	0.5	1
Pinus strobus	0.5	0.5	0.5	1
Polygonum cuspidatum	0.5	0.5	0.5	1
Ranunculus recurvatus var. *recurvatus*	0.5	0.5	0.5	1
Rubus phoenicolasius	0.5	0.5	0.5	1
Salvia lyrata	0.5	0.5	0.5	1
Sanicula canadensis var. *canadensis*	0.5	0.5	0.5	1
Sassafras albidum	0.5	0.5	0.5	1
Smilax herbacea	0.5	0.5	0.5	1
Smilax tamnoides	0.5	0.5	0.5	1
Solidago canadensis	0.5	0.5	0.5	1
Stachys nuttallii	0.5	0.5	0.5	1
Trifolium repens	0.5	0.5	0.5	1
Verbena urticifolia var. *urticifolia*	0.5	0.5	0.5	1
Viola sororia	0.5	0.5	0.5	1
Acalypha	0.01	0.01	0.01	1
Bidens cernua	0.01	0.01	0.01	1
Bidens frondosa	0.01	0.01	0.01	1
Carex emoryi	0.01	0.01	0.01	1
Dryopteris intermedia	0.01	0.01	0.01	1
Erigeron annuus	0.01	0.01	0.01	1
Lobelia cardinalis	0.01	0.01	0.01	1
Plantago rugelii var. *rugelii*	0.01	0.01	0.01	1
Polygonum hydropiperoides	0.01	0.01	0.01	1

Virginia Pine - Oak Shale Woodland (9 plots)

	% Cover			
Species	Mean	Min	Max	N
Pinus virginiana	18.6	4.0	45.0	8
Carex pensylvanica	4.6	0.5	10.0	8
Antennaria plantaginifolia	1.6	0.5	3.0	8
Vaccinium stamineum	1.4	0.5	3.0	8
Quercus rubra	16.7	5.0	28.0	7
Juniperus virginiana var. *virginiana*	8.9	3.0	16.0	7
Cunila origanoides	2.4	0.5	5.0	7
Amelanchier arborea var. *arborea*	1.9	0.5	5.0	7
Helianthus divaricatus	1.3	0.5	3.0	7
Houstonia longifolia	0.4	0.0	0.5	7
Quercus stellata	9.5	3.0	18.0	6

Lespedeza frutescens	1.8	0.5	5.0	6
Vaccinium pallidum	1.0	0.01	3.0	6
Rosa carolina var. *carolina*	0.5	0.5	0.5	6
Symphyotrichum undulatum	0.5	0.5	0.5	6
Taenidia integerrima	0.5	0.5	0.5	6
Quercus prinus	18.9	0.5	50.0	5
Carya glabra	14.4	3.0	30.0	5
Quercus alba	9.1	0.5	20.0	5
Fraxinus americana	4.3	0.5	10.0	5
Carya ovata	3.0	1.0	5.0	5
Ostrya virginiana var. *virginiana*	2.7	0.5	10.0	5
Danthonia spicata	1.7	0.5	3.0	5
Pinus strobus	1.5	0.01	5.0	5
Robinia pseudoacacia	0.5	0.01	1.0	5
Asplenium platyneuron	0.3	0.01	0.5	5
Carya alba	11.0	3.0	20.0	4
Quercus velutina	7.3	1.0	18.0	4
Potentilla canadensis var. *canadensis*	1.3	0.5	3.0	4
Potentilla simplex	1.3	0.5	3.0	4
Phlox subulata	1.1	0.5	3.0	4
Viburnum acerifolium	0.8	0.5	1.0	4
Galium circaezans	0.6	0.5	1.0	4
Symphyotrichum laeve var. *laeve*	0.6	0.5	1.0	4
Arabis laevigata	0.4	0.01	0.5	4
Conopholis americana	0.4	0.01	0.5	4
Zizia trifoliata	0.4	0.01	0.5	4
Solidago bicolor	0.3	0.01	0.5	4
Solidago sphacelata	0.1	0.01	0.5	4
Viburnum rafinesquianum	2.8	0.01	8.0	3
Rhus aromatica var. *aromatica*	2.2	0.5	3.0	3
Cercis canadensis var. *canadensis*	1.3	1.0	2.0	3
Dichanthelium boscii	0.5	0.0	1.0	3
Packera obovata	0.5	0.5	0.5	3
Paronychia fastigiata var. *paleacea*	0.5	0.5	0.5	3
Parthenocissus quinquefolia	0.5	0.5	0.5	3
Penstemon pallidus	0.5	0.5	0.5	3
Acer saccharum var. *saccharum*	0.3	0.0	0.5	3
Vicia caroliniana	0.3	0.0	0.5	3
Quercus muehlenbergii	3.0	1.0	5.0	2
Bromus pubescens	0.8	0.5	1.0	2
Dicranum	0.8	0.5	1.0	2
Solidago arguta var. *caroliniana*	0.8	0.5	1.0	2
Aesculus flava	0.5	0.5	0.5	2
Ceanothus americanus	0.5	0.5	0.5	2
Dichanthelium depauperatum	0.5	0.5	0.5	2
Dioscorea quaternata	0.5	0.5	0.5	2
Eurybia divaricata	0.5	0.5	0.5	2
Festuca subverticillata	0.5	0.5	0.5	2
Hieracium venosum	0.5	0.5	0.5	2
Aureolaria flava	0.3	0.0	0.5	2
Paronychia canadensis	0.3	0.0	0.5	2
Pellaea atropurpurea	0.3	0.0	0.5	2
Penstemon hirsutus	0.3	0.0	0.5	2
Sedum ternatum	0.3	0.0	0.5	2
Viola	0.3	0.0	0.5	2
Cladina	10.0	10.0	10.0	1
Acer rubrum var. *rubrum*	4.0	4.0	4.0	1
Carya	3.0	3.0	3.0	1
Morus rubra var. *rubra*	3.0	3.0	3.0	1
Solidago hispida var. *hispida*	3.0	3.0	3.0	1
Ampelopsis arborea	1.0	1.0	1.0	1
Cladonia arbuscula	1.0	1.0	1.0	1
Dichanthelium commutatum ssp. *commutatum*	1.0	1.0	1.0	1
Dichanthelium dichotomum	1.0	1.0	1.0	1
Lespedeza procumbens	1.0	1.0	1.0	1
Schizachyrium scoparium var. *scoparium*	1.0	1.0	1.0	1
Viburnum prunifolium	1.0	1.0	1.0	1
Vitis riparia	1.0	1.0	1.0	1
Ageratina altissima var. *altissima*	0.5	0.5	0.5	1
Berberis canadensis	0.5	0.5	0.5	1
Carex caroliniana	0.5	0.5	0.5	1
Carex hirsutella	0.5	0.5	0.5	1
Cheilanthes lanosa	0.5	0.5	0.5	1
Crataegus	0.5	0.5	0.5	1
Desmodium rotundifolium	0.5	0.5	0.5	1
Dichanthelium commutatum ssp. *ashei*	0.5	0.5	0.5	1
Draba ramosissima	0.5	0.5	0.5	1
Heuchera americana var. *americana*	0.5	0.5	0.5	1
Hypericum perforatum	0.5	0.5	0.5	1

Lysimachia quadrifolia	0.5	0.5	0.5	1
Maianthemum racemosum ssp. *racemosum*	0.5	0.5	0.5	1
Monarda fistulosa ssp. *brevis*	0.5	0.5	0.5	1
Oxalis grandis	0.5	0.5	0.5	1
Platanus occidentalis	0.5	0.5	0.5	1
Rubus occidentalis	0.5	0.5	0.5	1
Sassafras albidum	0.5	0.5	0.5	1
Solidago	0.5	0.5	0.5	1
Solidago caesia	0.5	0.5	0.5	1
Solidago curtisii	0.5	0.5	0.5	1
Sphenopholis nitida	0.5	0.5	0.5	1
Stellaria pubera	0.5	0.5	0.5	1
Symphyotrichum patens var. *patens*	0.5	0.5	0.5	1
Toxicodendron radicans	0.5	0.5	0.5	1
Uvularia sessilifolia	0.5	0.5	0.5	1
Vitis	0.5	0.5	0.5	1
Acalypha gracilens var. *gracilens*	0.01	0.01	0.01	1
Achillea millefolium var. *occidentalis*	0.01	0.01	0.01	1
Allium oxyphilum	0.01	0.01	0.01	1
Asclepias tuberosa	0.01	0.01	0.01	1
Asclepias verticillata	0.01	0.01	0.01	1
Bidens bipinnata	0.01	0.01	0.01	1
Cladonia	0.01	0.01	0.01	1
Dryopteris marginalis	0.01	0.01	0.01	1
Lespedeza violacea	0.01	0.01	0.01	1
Ligustrum vulgare	0.01	0.01	0.01	1
Liriodendron tulipifera	0.01	0.01	0.01	1
Polygonum scandens var. *cristatum*	0.01	0.01	0.01	1
Symphyotrichum oblongifolium	0.01	0.01	0.01	1
Verbascum thapsus	0.01	0.01	0.01	1
Vitis vulpina	0.01	0.01	0.01	1

Appendix I. Soil chemical analysis: average values in plots by association.

The following table lists average soil chemistry values for plots sampled in Bluestone National Scenic River (BLUE). Soil chemistry analysis was performed by Brookside Laboratories, Inc (2008). Column headings represent the following: Association = BLUE community name for the association, # = number of plots with soil samples, TEC = total exchange capacity (ME/100 g), pH = potential of hydrogen, OM = organic matter (%), ENR = estimated nitrogen release (lb/acre), S = soluble sulfur (ppm), Al = aluminum (ppm), B = boron (ppm), Ca = calcium (ppm), Cu = copper (ppm), Fe = iron (ppm), K = potassium (ppm), Mg = magnesium (ppm), Mn = manganese (ppm), Na = sodium (ppm), P = phosphorus (ppm), Zn = zinc (ppm).

Soil chemical analysis: average values in plots by association

Association	#	TEC	pH	OM	ENR	S	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	Zn
Calcareous Oak Forest	4	14.1	6.0	4.1	91	21	669	0.49	2002	1.77	106	163	173	114	16	22	1.6
Eastern Hemlock - American Basswood Forest	6	20.0	4.7	9.6	113	40	605	0.52	1210	0.59	225	91	116	122	17	22	2.3
Eastern Hemlock - Chestnut Oak Forest	8	17.5	4.4	6.0	101	36	754	0.51	609	0.49	236	61	61	43	17	17	1.7
Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest	1	20.1	3.6	10.0	125	45	301	0.34	408	1.09	160	33	45	26	14	19	1.8
Eastern Hemlock Floodplain Forest	1	10.6	4.9	3.5	85	31	310	0.43	822	0.97	185	74	106	151	17	10	3.9
Oak - Eastern White Pine / Ericad Forest	13	16.7	4.2	5.8	99	36	730	0.49	364	0.46	277	57	60	32	15	14	1.5
Oak - Hickory - Sugar Maple Forest	15	16.7	4.7	6.6	103	32	637	0.45	963	0.73	145	101	119	185	16	27	2.0
Oak - Hickory Floodplain Forest	3	9.3	5.0	2.8	73	33	403	0.58	954	1.37	187	58	125	113	15	20	3.2
River Birch Backwater Floodplain Forest	3	13.2	4.9	5.8	101	47	457	0.59	1221	2.52	252	44	139	105	20	27	4.9
Riverbank Tall Herbs	3	7.2	5.8	3.7	69	30	242	0.43	1197	1.44	175	58	114	151	17	14	5.2
Successional Black Locust Woodland	2	13.4	5.7	5.3	99	36	304	0.61	2137	1.57	234	65	165	110	25	18	3.4
Successional Black Walnut Floodplain Forest	2	13.7	6.1	7.1	111	33	312	0.72	2231	2.29	153	141	194	201	19	23	6.0
Successional Box-elder Floodplain Forest	1	8.2	5.9	2.3	66	38	246	0.60	1417	2.16	196	42	116	130	17	20	6.8

Association	#	TEC	pH	OM	ENR	S	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	Zn
Successional Eastern White Pine - Tuliptree Forest	11	11.9	4.5	3.9	82	40	539	0.44	664	0.88	185	56	88	159	17	22	2.1
Successional Tuliptree / Northern Spicebush Forest	3	13.0	5.0	6.1	104	28	463	0.39	1179	1.22	121	79	128	141	17	16	2.4
Sugar Maple - Yellow Buckeye - American Basswood Forest	8	16.6	5.5	10.4	112	33	439	0.59	2088	0.86	91	102	189	203	18	31	2.7
Sycamore - Ash Floodplain Forest	1	11.4	5.3	8.9	120	61	281	0.68	1651	3.23	228	47	149	196	18	33	10.7
Sycamore - River Birch Riverscour Woodland	11	7.1	5.6	2.0	59	33	280	0.53	938	1.49	255	38	109	97	20	13	4.6
Sycamore - Yellow Buckeye Floodplain Forest	3	6.7	5.9	3.0	76	30	273	0.47	1108	1.45	236	36	117	128	17	17	4.4
Virginia Pine - Oak Shale Woodland	5	18.5	4.6	5.0	98	29	879	0.36	611	0.56	157	97	89	55	15	18	1.2
Grand Mean		14.1	4.9	5.6	93	35	540	0.50	1026	1.02	195	74	111	120	17	21	2.7
Grand Total	104																

Appendix J. Key to vegetation associations of Bluestone National Scenic River.

The following key is designed for field identification of natural and semi-natural vegetation associations within the Bluestone National Scenic River. Cultural vegetation (yards, farmlands, etc…), aquatic features (river, creek, pond), and development features (buildings, parking lots, roads, etc…) are not included in the key. Although semi-natural vegetation types are included, the key it is not designed to apply to all areas which have been repeatedly or significantly impacted by human caused disturbance, such as recently logged areas, abandoned farms, utility corridors, and other disturbed or developed areas. Floodplain forests impacted by reservoir backup are included in the key.

Dominant species are those which have the highest cover values in the community. Canopy cover includes trees in both the upper canopies (T1, T2) and the subcanopy (T3). Indicator species are those which are helpful for distinguishing the association from other similar associations; they may only occur in small amounts or be missing from some stands.

For each final lead, the BLUE community type name (underlined) is listed first followed by the [USNVC association name and element code] (in brackets). Map classes in which each community type occurs are listed following the association information.

1. Upland communities not including riparian jurisdictional uplands. Located on plateaus, ridges, gorge slopes and benches, in coves and ravines, on cliffs, and in positions along streams which are never flooded.
    1.1. Mixed forests and woodlands with a significant conifer component in the stand. Cover by conifers usually > 10% in the canopy layers. If conifer cover is < 10% in the canopy then conifers are more abundant in the surrounding stand and there is generally conifer regeneration in the understory.
        1.1.1. Most abundant conifer is a species of *Pinus* (pine).
            1.1.1.1. Woodlands and forests with *Pinus virginiana* (Virginia pine) the most abundant conifer in the canopy.
                1.1.1.1.1. Forests strongly dominated by *Pinus virginiana* (Virginia pine). Even-aged successional stands on sites previously cleared for agriculture. Successional Virginia Pine Forest [*Pinus virginiana* Successional Forest - CEGL002591] map class: Successional Virginia Pine Forest.
                1.1.1.1.2. *Pinus virginiana* (Virginia pine) codominant with deciduous trees including species of *Quercus* (oaks) and *Carya* (hickories). Stands usually have somewhat open canopies and trees may be stunted due to hot, dry soil conditions on south aspect slopes. Indicator species include *Quercus stellata* (post oak) and *Carex pensylvanica* (Pennsylvania sedge). Virginia Pine - Oak Shale Woodland [*Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum* Woodland - CEGL008540] map class: Virginia Pine - Oak Shale Woodland.
            1.1.1.2. Forests usually lacking *Pinus virginiana* (Virginia pine) in the canopy. Most abundant conifer is *Pinus strobus* (eastern white pine).

1.1.1.2.1. *Pinus strobus* (eastern white pine) dominant in the canopy, typically growing in even-aged stands on sites previously cleared for agriculture. Most common deciduous tree is *Liriodendron tulipifera* (tuliptree), which may be codominant in some stands. Indicator species include *Lonicera japonica* (Japanese honeysuckle) and *Salvia lyrata* (lyreleaf sage). Successional Eastern White Pine - Tuliptree Forest [*Pinus strobus* Successional Forest - CEGL007944] map class: Successional Eastern White Pine - Tuliptree Forest.

1.1.1.2.2. Canopy dominated or codominated by species of *Quercus* (oaks). *Liriodendron tulipifera* (tuliptree) is absent or less abundant. *Oxydendrum arborea* (sourwood) is usually abundant in the subcanopy. Understories are characterized by an abundance of shrubs in the Ericaceae (heath family). Indicator species include *Vaccinium pallidum* (Blue Ridge blueberry), *Kalmia latifolia* (mountain laurel), and *Gaultheria procumbens* (eastern teaberry). Oak - Eastern White Pine / Ericad Forest [*Pinus strobus - Quercus alba - Quercus prinus / Vaccinium stamineum* Forest - CEGL008539] map class: Oak - Eastern White Pine / Ericad Forest.

1.1.2. Most abundant conifer is *Tsuga canadensis* (eastern hemlock).

1.1.2.1. *Tilia americana* (American basswood) with > 2 % cover in the canopy layers along with high constancy of *Quercus rubra* (northern red oak) and *Acer saccharum* var. *saccharum* (sugar maple). Forests in protected positions on colluvial gorge slopes, usually on northerly aspects. The herb layer is relatively diverse and includes some nutrient demanding herbs. Indicator species include *Dryopteris marginalis* (marginal woodfern), *Aristolochia macrophylla* (pipevine), and *Hydrangea arborescens* (wild hydrangea). Eastern Hemlock - American Basswood Forest [*Tsuga canadensis - (Fagus grandifolia, Tilia americana* var. *heterophylla) / Magnolia tripetala* Forest - CEGL008407] map class: Eastern Hemlock - American Basswood Forest.

1.1.2.2. *Tilia americana* (American basswood) absent from the canopy layers. Herb layers have low cover and diversity and usually lack nutrient demanding species.

1.1.2.2.1. Canopies codominated by *Quercus prinus* (chestnut oak) and/or other species of *Quercus* (oaks) or *Oxydendron arborea* (sourwood). *Liriodendron tulipifera* (tuliptree) absent from canopy. Cover by *Rhododendron maximum* (great laurel) < 10%. Indicator species include *Leucobryum glaucum* (leucobryum moss) and *Monotropa uniflora* (Indianpipe). Forests in exposed positions (upper slopes and ridges) with various aspects. Eastern Hemlock - Chestnut Oak Forest [*Tsuga canadensis - Quercus prinus - Betula lenta* Forest - CEGL006923] map class: Eastern Hemlock - Chesnut Oak Forest.

1.1.2.2.2. Canopies codominated by *Betula lenta* (sweet birch) and *Liriodendron tulipifera* (tuliptree). Cover by *Rhododendron maximum* (great laurel) > 10%. Uncommon type at Bluestone, occurring on sandstone derived substrates near heads of ravines. Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest [*Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest - CEGL007543] map class: Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest.

1.2. Deciduous forests without a significant conifer component. Confers with < 10% cover in the canopy layers.

1.2.1. Successional forests and woodlands with strong dominance by a single tree species, either *Liriodendron tulipifera* (tuliptree) or *Robinia pseudoacacia* (black locust). Stands with even-aged canopies on sites previously cleared for agriculture.

1.2.1.1. Forests dominated by *Liriodendron tulipifera* (tuliptree). Successional Tuliptree / Northern Spicebush Forest [*Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin) Forest* - CEGL007220] map class: Successional Tuliptree / Northern Spicebush Forest.

1.2.1.2. Woodlands and forests dominated by *Robinia pseudoacacia* (black locust). Successional Black Locust Woodland [*Robinia pseudoacacia* Forest - CEGL007279] map classes: Successional Black Locust Woodland, Disturbed Area.

1.2.2. Forests without clear dominance by a single species.

1.2.2.1. Forests with canopies dominated by *Quercus* spp. (oaks) and/or *Carya* spp. (hickories). Species of *Quercus* (oaks) or *Carya* (hickories) alone or in combination comprising > 50% of total canopy cover.

1.2.2.1.1. *Quercus muehlenbergii* (chinquapin oak) with > 5% canopy cover. *Quercus prinus* (chestnut oak) usually absent. Forests in small patches on calcium rich soils downslope from outcrops of limestone or calcareous shale. Indicator species include *Oxalis grandis* (great yellow woodsorrel) and *Desmodium glabellum* (Dillenius' ticktrefoil). Calcareous Oak Forest [*Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest - CEGL004793] map class: Calcareous Oak Forest.

1.2.2.1.2. *Quercus muehlenbergii* (chinquapin oak) with < 5% canopy cover, usually absent. *Quercus prinus* (chestnut oak) often present to codominant. Widespread forests on the predominating acidic shale formations of the park. Oak - Hickory - Sugar Maple Forest [*Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest - CEGL007268] map class: Oak - Hickory - Sugar Maple Forest.

1.2.2.2. Forests codominated by a mixture of mesophytic species including *Tilia americana* (American basswood), *Acer saccharum* var. *saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak), and *Aesculus* flava (yellow buckeye). Species of *Quercus* (oaks) or *Carya* (hickories) alone or in combination comprising < 50% of total canopy cover. Forests on gorge slopes with northerly aspects. Sugar Maple - Yellow Buckeye - American Basswood Forest [*Liriodendron tulipifera - Tilia americana* var. *heterophylla - Aesculus flava - Acer saccharum / (Magnolia tripetala)* Forest - CEGL005222] map class: Sugar Maple - Yellow Buckeye - American Basswood Forest.

2. Riparian communities. Vegetation affected by flooding or seepage. Includes jurisdictional wetlands and other areas which are seasonally, temporarily, or occasionally flooded, either naturally or by reservoir backup. Frequency of flooding may range from intervals of decades to semi-permanent. Located in slope bottom and level landscape positions on alluvial landforms.

2.1. Natural vegetation in areas not greatly altered by human activities such as past farming and settlement and/or more recently altered flooding regimes caused by reservoir backup. Includes vegetation along the river edge which is inundated by reservoir backup but

which is also affected by a natural downstream flooding regime. Often occurring in narrow zones on lower floodplains below terraces which were farmed. Also includes areas of higher floodplains beyond the zone of reservoir backup which were not intensively settled or farmed or where natural vegetation has become reestablished after long abandonment.

2.1.1. Woodland and herbaceous communities along the river edge. Canopy cover by trees < 60%.

2.1.1.1. Woodlands along the river edge with relatively short canopies dominated by *Platanus occidentalis* (American sycamore) and/or *Betula nigra* (river birch). Open canopies are maintained by frequent, high energy flooding which removes and damages trees. Sycamore - River Birch Riverscour Woodland [*Platanus occidentalis - (Betula nigra, Salix spp)* Temporarily Flooded Woodland - CEGL003725] map classes: Floodplain Forest and Woodland, Sycamore - River Birch Riverscour Woodland. Note: two phases of this association can be distinguished and are keyed below.

2.1.1.1.1. *Betula nigra* (river birch) usually dominant in the canopy over an herbaceous layer dominated by *Chasmanthium latifolium* (Indian woodoats) and *Dicanthelium clandestinum* (deertoungue). Occurs on relatively fine textured alluvial deposits (sand). river birch / Indian woodoats phase (map class: Floodplain Forest and Woodland).

2.1.1.1.2. *Platanus occidentalis* (American sycamore) dominant or codominant with *Betula nigra* (river birch) in the canopy over an herbaceous layer dominated by *Andropogon gerardii* (big bluestem). Occurs on relatively coarse textured alluvial deposits (boulders, cobbles, and sand). sycamore - river birch / big bluestem phase (map classes: Floodplain Forest and Woodland, Sycamore - River Birch Riverscour Woodland).

2.1.1.2. Herbaceous communities dominated by tall herbs. Common herb species include *Apios americana* (groundnut), *Dicanthelium clandestinum* (deertongue), *Solidago gigantea* (giant goldenrod), and *Verbesina alternifolia* (wingstem). Located on sandy riverbanks which are sunny to partially shaded by overhanging canopies of tall trees. Riverbank Tall Herbs [*Verbesina alternifolia - Teucrium canadense - Elymus riparius - (Solidago gigantea)* Herbaceous Vegetation - CEGL006480] map class: Floodplain Forest and Woodland.

2.1.2. Forests. Canopy cover by trees > 60%.

2.1.2.1. Mixed evergreen-deciduous forests on higher floodplains and terraces with *Tsuga canadensis* (eastern hemlock) codominant in the canopy and/or subcanopy. Associated deciduous trees may include *Quercus rubra* (northern red oak), *Acer rubrum* var. *rubrum* (red maple), and *Liriodendron tulipifera* (tuliptree). Eastern Hemlock Floodplain Forest [*Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia* Forest - CEGL006620] map classes: Floodplain Forest and Woodland, Eastern Hemlock Floodplain Forest.

2.1.2.2. Deciduous forests without significant *Tsuga canadensis* (eastern hemlock) in the canopy.

2.1.2.2.1. Forests with species of *Quercus* (oaks) and/or *Carya* (hickories) having > 15% cover in the canopy layers. Oak - Hickory Floodplain Forest map class: Floodplain Forest and Woodland.

2.1.2.2.2. Forests without significant cover by species of *Quercus* (oaks) or *Carya* (hickories) in the canopy.

2.1.2.2.2.1. Forests with relatively short canopies dominated by flood-battered *Betula nigra* (river birch) over an herbaceous layer dominated by *Chasmanthium latifolium* (Indian woodoats). Shrub layer usually poorly developed (< 10% cover). Occurs in frequently flooded positions on sloping banks along the river edge. Sycamore - River Birch Riverscour Woodland (river birch / river oats phase) [*Platanus occidentalis - (Betula nigra, Salix spp)* Temporarily Flooded Woodland - CEGL003725] map class: Floodplain Forest and Woodland.

2.1.2.2.2.2. Forests with relatively tall canopies dominated by *Platanus occidentalis* (American sycamore). *Aesculus flava* (yellow buckeye) present to dominant in the subcanopy. Shrub layers often well developed (> 10% cover). Occurs on floodplains above the river bank. Sycamore - Yellow Buckeye Floodplain Forest [*Platanus occidentalis / Aesculus flava* Forest - CEGL006466] map class: Floodplain Forest and Woodland.

2.2. Semi-natural vegetation in areas altered by human activities including past farming and settlement and/or by modified flooding regimes caused by reservoir backup. Reservoir backup influence is evident up to about 445 meters (1460 feet) elevation.

2.2.1. Herbaceous communities dominated by tall herbs. Common herb species include *Apios americana* (groundnut), *Dicanthelium clandestinum* (deertongue), *Solidago gigantea* (giant goldenrod), and *Verbesina alternifolia* (wingstem). Degraded examples may have dominance by exotic species including *Humulus japonicus* (Japanese hop) and *Urtica dioica* ssp. *dioica* (stinging nettle). Located in openings which are sunny to partially shaded by overhanging canopies of tall trees. Riverbank Tall Herbs [*Verbesina alternifolia - Teucrium canadense - Elymus riparius - (Solidago gigantea)* Herbaceous Vegetation - CEGL006480] map class: Modified Successional Floodplain Forest and Woodland.

2.2.2. Forests and woodlands.

2.2.2.1. Forests and woodlands with a significant conifer component in the stand. Cover by conifers > 10% in the canopy layers.

2.2.2.1.1. Forests dominated by *Pinus strobus* (eastern white pine). *Liriodendron tulipifera* (tuliptree) may be codominant. Successional Eastern White Pine - Tuliptree Forest Successional Forest [*Pinus strobus* Successional Forest - CEGL007944] map classes: Successional Eastern White Pine - Tuliptree Forest, Modified Successional Floodplain Forest and Woodland.

2.2.2.1.2. Woodlands and Forests with a significant component of *Juniperus virginiana* var. virginiana (eastern redcedar) in the canopy. Successional Eastern Red-cedar Woodland [*Juniperus virginiana* Forest - CEGL006024] map class: Successional Eastern Red-cedar Woodland.

2.2.2.2. Forests and woodlands without a significant conifer component.

2.2.2.2.1. Forests dominated by *Platanus occidentalis* (American sycamore) in association with *Ulmus americana* (American elm) and/or *Fraxinus*

pennsylvanica (green ash). Occurs on levees subject to flooding from downstream flows and occasional reservoir backup. Sycamore - Ash Floodplain Forest [*Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest - CEGL006458] map class: Modified Successional Floodplain Forest and Woodland.

2.2.2.2.2. Forests and woodlands not dominated by *Platanus occidentalis* (American sycamore). Even-aged successional stands usually dominated by single shade-intolerant tree species.

2.2.2.2.2.1. Forests and woodlands in backwater positions strongly dominated by *Betula nigra* (river birch). Standing water and wetland indicator species such as *Glyceria* spp. (mannagrasses) are often present. Confined to areas affected by flooding from reservoir backup. River Birch Backwater Floodplain Forest [*Betula nigra - Platanus occidentalis* Forest - CEGL002086] map class: Modified Successional Floodplain Forest and Woodland.

2.2.2.2.2.2. Forests and woodlands not strongly dominated by *Betula nigra* (river birch). If present, *Betula nigra* contributes less than 50% of canopy cover. Occurs in areas previously cleared for agriculture or settlement, affected by reservoir backup or not.

2.2.2.2.2.2.1. Forests and woodlands strongly dominated by *Acer negundo* var. *negundo* (boxelder). Successional Box-elder Floodplain Forest [*Acer negundo* Forest - CEGL005033] map class: Modified Successional Floodplain Forest and Woodland.

2.2.2.2.2.2.2. Forests and woodlands not strongly dominated by *Acer negundo* var. *negundo* (boxelder). If present, *Acer negundo* var. *negundo* contributes less than 50% of total canopy cover.

2.2.2.2.2.2.2.1. Forests and woodlands strongly dominated by *Juglans nigra* (black walnut). Successional Black Walnut Floodplain Forest [*Juglans nigra / Verbesina alternifolia* Forest - CEGL007879] map class: Modified Successional Floodplain Forest and Woodland.

2.2.2.2.2.2.2.2. Forests strongly dominated by *Liriodendron tulipifera* (tuliptree). Successional Tuliptree / Northern Spicebush Forest [*Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest - CEGL007220] map class: Modified Successional Floodplain Forest and Woodland.

Appendix K. Local and global vegetation association descriptions for Bluestone National Scenic River .

INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD:

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS U.S. NATIONAL VEGETATION CLASSIFICATION

Bluestone National Scenic River

19 February 2008

by

NatureServe

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

11 Avenue de Lafayette, 5th Floor
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This subset of the International Ecological Classification Standard covers vegetation associations attributed to Bluestone National Scenic River. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Sue Gawler, Regional Ecologist, Boston, MA <sue_gawler@natureserve.org>.

NatureServe
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Citations:

The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:

NatureServe. 2008. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 19 February 2008.

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This document may be generally cited as follows:

NatureServe[1]. 2008. International Ecological Classification Standard: Terrestrial Ecological Classifications. U.S. National Vegetation Classification. Associations of Bluestone National Scenic River. NatureServe Central Databases. Arlington, VA. Data current as of 19 February 2008.

Table of Contents

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

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

LOCAL INFORMATION

Environmental Description: This successional forest occurs in small patches (0–9.5 ha) on gentle topography in areas previously cleared for agriculture. Most sites are mapped as unforested (white) on the 1912 Big Bend and 1929 Flattop USGS 15' topographic maps. It occurs on higher floodplains and alluvial terraces, lower slopes, midslope benches, and plateau and spur ridgetops. Slopes in mapped polygons range from 0 to 37 degrees (mean = 13.8). Elevations in mapped polygons range from 436 to 711 m (mean = 492). Unvegetated ground cover is strongly dominated by litter. Low cover by rocks is an indication of site selection and removal of rocks for agriculture. Rock walls and scattered rock piles are common. Soils in plots are described as dry to moist sand, sandy loam, silt loam, and loam derived from alluvium, sandstone, and shale. Soils from plots tested strongly to extremely acidic (mean pH = 4.5) with relatively high levels of S, Al, Mn, and P, and relatively low levels of organic matter, estimated N release, B, Ca, Cu, Fe, K, Mg, Na, and Zn compared to average values in the park. This association often occupies the highest ground on alluvial terraces adjacent to natural and semi-natural floodplain forest types which occupy lower, more frequently flooded positions. In uplands this association is often adjacent to or imbedded within polygons of the natural matrix upland forest types, including Sugar Maple - Yellow Buckeye - American Basswood Forest (CEGL005222) and Oak - Hickory - Sugar Maple Forest (CEGL007268).
Vegetation Description: Stands of this association are typically closed-canopy evergreen and mixed evergreen-deciduous forests with even-aged canopies strongly dominated by *Pinus strobus* (eastern white pine) or codominated by *Pinus strobus* (eastern white pine) with *Liriodendron tulipifera* (tuliptree). Additional canopy trees with lower constancy and cover in plots include *Quercus alba* (white oak), *Fagus grandifolia* (American beech), *Pinus virginiana* (Virginia pine), *Robinia pseudoacacia* (black locust), *Fraxinus pennsylvanica* (green ash), *Magnolia acuminata* (cucumber-tree), and other deciduous species. Abundant subcanopy trees include *Tsuga canadensis* (eastern hemlock), *Oxydendrum arboreum* (sourwood), *Acer rubrum* var. (red maple), and *Acer saccharum* var. *saccharum* (sugar maple). Regeneration of the shade-tolerant conifer *Tsuga canadensis* (eastern hemlock) is also abundant in the shrub layers of several plots and may reflect succession of some stands on high floodplains towards Eastern Hemlock Floodplain Forest (CEGL006620). Total cover in the shrub layers of plots (including shrubs, vines, and tree saplings) ranges from 10–50%. Common shrubs include *Lindera benzoin* (northern spicebush), *Asimina triloba* (pawpaw), and *Acer pensylvanicum* (striped maple). Common vines include *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), and *Parthenocissus quinquefolia* (Virginia creeper). Common tree saplings include *Carya cordiformis* (bitternut hickory), *Aesculus flava* (yellow buckeye), *Fraxinus americana* (white ash), and *Fagus grandifolia* (American beech). Total cover in the herb layer of plots ranges from 3–30%. Common herbs, in decreasing order of constancy, include *Polystichum acrostichoides* (Christmas fern), *Galium triflorum* (fragrant bedstraw), *Mitchella repens*

(partridgeberry), *Packera aurea* (golden ragwort), *Verbesina alternifolia* (wingstem), *Sanicula canadensis* (Canadian blacksnakeroot), *Ageratina altissima* var. *altissima* (white snakeroot), *Potentilla simplex* (common cinquefoil), *Carex amphibola* (eastern narrowleaf sedge), *Asplenium platyneuron* (ebony spleenwort), and *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit). Vascular plant species richness in 11 plots ranges from 32 to 66 (mean = 45.6) species per 400-square-meter plot. Total bryophyte cover in plots ranges from 0–3%. Characteristic mosses include *Thuidium delicatulum* (delicate thuidium moss) and *Hypnum imponens* (hypnum moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)
Tree subcanopy	Broad-leaved deciduous tree	*Oxydendrum arboreum* (sourwood)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)

Characteristic Species: *Galium triflorum* (fragrant bedstraw), *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern).

Other Noteworthy Species:

Species	GRank	Type	Note
Carex cumberlandensis (Cumberland sedge)	-	plant	WV state-critically imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst 2001b

Local Range: A total of 94 polygons covering 72 hectares are mapped in the park. The majority of stands are scattered on terraces and lower slopes along the length of the Bluestone River and larger tributaries in the park. A few stands occur on midslopes and plateau tops.

Classification Comments: Plots of this association in the Bluestone National Scenic River have greater cover by *Liriodendron tulipifera* (tuliptree) and greater cover and diversity in the shrub and herb layers compared to plots sampled at New River Gorge National River (Vanderhorst et al. 2007). This may reflect more fertile soils derived from shale and alluvium at Bluestone compared to sterile soils derived from sandstone at New River.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Eleven plots were sampled: BLUE.4, BLUE.11, BLUE.34, BLUE.40, BLUE.46, BLUE.64, BLUE.65, BLUE.68, BLUE.81, BLUE.82, and BLUE.135.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	*Pinus strobus* Forest Alliance (A.128)
Alliance (English name)	Eastern White Pine Forest Alliance
Association	*Pinus strobus* Successional Forest
Association (English name)	Eastern White Pine Successional Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593). Northeastern Interior Dry-Mesic Oak Forest (CES202.592).

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 redcedar), *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 redcedar), 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:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)

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

Other Noteworthy Species:

Species	GRank	Type	Note
Achillea millefolium (common yarrow)	-	plant	exotic
Agrostis gigantea (redtop)	-	plant	exotic
Anthoxanthum odoratum (sweet vernalgrass)	-	plant	exotic
Berberis thunbergii (Japanese barberry)	-	plant	exotic
Daucus carota (Queen Anne's lace)	-	plant	exotic
Elaeagnus umbellata (autumn olive)	-	plant	exotic
Elymus repens (quackgrass)	-	plant	exotic
Lonicera morrowii (Morrow's honeysuckle)	-	plant	exotic
Rosa multiflora (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) B
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.

Plot BLUE.108. Successional Eastern White Pine - Tuliptree Forest.

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

SYNONYMS
NVC English Name: **Virginia Pine Successional Forest**
NVC Scientific Name: ***Pinus virginiana* Successional Forest**
NVC Identifier: **CEGL002591**

LOCAL INFORMATION

Environmental Description: This small-patch successional forest occurs on gentle topography on plateau tops in areas previously cleared for agriculture. One site is mapped as unforested (white) on the 1929 Flattop USGS 15' topographic map. Slopes in mapped polygons range from 6 to 28 degrees (mean = 13.7). Elevations in mapped polygons range from 650 to 668 m (mean = 659). Soils are derived from shales and/or sandstones of the Mauch Chunk Group and are likely to be dry, acidic, and infertile. Adjacent associations include Oak - Eastern White Pine / Ericad Forest (CEGL008539) and Oak - Hickory - Sugar Maple Forest (CEGL007268).
Vegetation Description: Stands of this successional association are even-aged evergreen or mixed evergreen-deciduous forests strongly dominated by *Pinus virginiana* (Virginia pine). One stand observed in the park is composed of relatively short, widely branched trees, possibly reflecting stress caused by soil conditions. Cover and diversity in the understory of the observed stand are depauperate. No plots were sampled but associated tree species listed from two accuracy assessment points include *Acer rubrum* var. *rubrum* (red maple), *Fraxinus americana* (white ash), *Nyssa sylvatica* (blackgum), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* var. *serotina* (black cherry), *Tsuga canadensis* (eastern hemlock), and *Pinus strobus* (eastern white pine).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus virginiana* (Virginia pine)

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

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst 2001b

Local Range: A total of 4 polygons (2 stands) covering 1.31 hectares are mapped in the park. It occurs on plateau tops near the park boundary on both sides of the gorge above Mountain Creek Lodge.
Classification Comments: Information not available.
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: No plots were sampled.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	*Pinus virginiana* Forest Alliance (A.131)
Alliance (English name)	Virginia Pine Forest Alliance
Association	*Pinus virginiana* Successional Forest
Association (English name)	Virginia Pine Successional Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591). Northeastern Interior Dry-Mesic Oak Forest (CES202.592). Southern Appalachian Low-Elevation Pine Forest (CES202.332).

GLOBAL DESCRIPTION

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

Environmental Description: This community occurs in areas where canopy removal has created open conditions and bare mineral soil, allowing for the establishment of *Pinus virginiana* (Virginia pine). These conditions can include old fields, old pastures, clearcuts, and burned or eroded areas. In the Ridge and Valley of Tennessee, northeastern Monroe County, early successional forests with *Pinus virginiana* (Virginia pine) dominance were found on low slopes in areas that were cleared for agriculture prior to the 1970s, when Tellico Lake was created (Andreu and Tukman 1995). In the Central Appalachians, this vegetation occurs where soft shales have been farmed (in valleys or on plateaus), resulting in stands with nothing but successional species in the understory. Soils underlying these communities are of two general types, i.e., those derived in residuum from calcareous shale and calcareous sandstone of the Middle Ordovician and those of some other origin. Series of the former type include Dandridge (Lithic Ruptic-Alfic Eutrochrepts), Tellico (Typic Rhododults), and Steekee (Ruptic-Ultic Dystrochrepts). Other soil series that this forest type may occur on include Litz, Dewey, Alcoa, Bland, Etowah, Lobdell and Neubert. All of these soils are well-drained and range in pH from moderate acid to very strongly acidic.

Vegetation Description: This forest typically has a very dense canopy of *Pinus virginiana* (Virginia pine) and little understory vegetation. *Pinus taeda* (loblolly pine), *Pinus echinata* (shortleaf pine), or *Pinus strobus* (eastern white pine) may co-occur with *Pinus virginiana* (Virginia pine) in the canopy. The canopy can also have significant admixtures of early-successional deciduous trees (e.g., *Acer rubrum* (red maple), *Liquidambar styraciflua*

(sweetgum), *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), *Nyssa sylvatica* (blackgum)). Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species; *Lonicera japonica* (Japanese honeysuckle) and *Rosa multiflora* (multiflora rose) are common. Shrub and herb strata are absent to sparse in coverage. In eastern Tennessee, the subcanopy may contain *Acer saccharum* (sugar maple) and *Cornus florida* (flowering dogwood); other associated species may include *Cercis canadensis* (eastern redbud), *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Nepalese browntop) (Andreu and Tukman 1995). In the Central Appalachians, associates include *Pinus strobus* (eastern white pine), *Pinus echinata* (shortleaf pine), and *Pinus rigida* (pitch pine). Some stands may have a dense ericaceous shrub stratum containing *Vaccinium* (blueberry) spp., *Gaylussacia* (huckleberry) spp., *Kalmia latifolia* (mountain laurel), and *Rhododendron* (rhododendron) spp.

Most Abundant Species:

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

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

Other Noteworthy Species:

Species	GRank	Type	Note
Albizia julibrissin (silktree)	-	plant	exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Pueraria montana var. *lobata* (kudzu)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

Federal Lands: BIA (Eastern Band of Cherokee); NPS (Appomattox Court House, Big South Fork, Blue Ridge Parkway?, Bluestone, Booker T. Washington, C&O Canal?, Cumberland Gap, Fredericksburg-Spotsylvania, Gettysburg, Great Smoky Mountains, Kings Mountain, Lincoln

Birthplace, Little River Canyon, Mammoth Cave, Natchez Trace, National Capital-East?, New River Gorge, Obed, Shenandoah, Shiloh, Thomas Stone); TVA (Tellico); USFS (Bankhead, Chattahoochee, Chattahoochee (Piedmont), Chattahoochee (Southern Blue Ridge), Cherokee, Daniel Boone, George Washington, Jefferson, Monongahela, Sumter, Sumter (Mountains), Sumter (Piedmont), Uwharrie?).

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 - Strong.

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

Similar Associations:

Pinus echinata Early-Successional Forest (CEGL006327)--occurs in similar environments but is dominated (>50% of canopy) by *Pinus echinata* instead of *Pinus virginiana*.

Pinus taeda - Liquidambar styraciflua Semi-natural Forest (CEGL008462)--is commonly found in the same area as CEGL002591 in the Piedmont. CEGL008462 contains at least 50% *Pinus taeda* in the canopy, whereas CEGL002591 is mostly *Pinus virginiana*.

Pinus taeda / Liquidambar styraciflua - Acer rubrum var. *rubrum / Vaccinium stamineum* Forest (CEGL006011)--occurs in similar environments with similar disturbance histories but is dominated by (>50% of canopy) *Pinus taeda* instead of *Pinus virginiana*.

Pinus virginiana - Juniperus virginiana var. *virginiana - Ulmus alata* Forest (CEGL007121)--on more calcareous or circumneutral substrates.

Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum Forest (CEGL007119)--can have a very similar canopy in the Piedmont and Blue Ridge ecoregions, but CEGL007119 is generally created and maintained by fire and/or logging but not heavy plowing and/or erosion. CEGL002591 generally has signs of heavy agricultural use such as sparse herbaceous or shrub layers, large percentage of invasive exotics such as *Lonicera japonica* in the herbaceous layer, old plowlines, human debris, and extremely even-aged canopy, whereas CEGL007119 generally has a more intact herbaceous/shrub layer (especially *Vaccinium pallidum*) and less signs of severe human disturbance.

Related Concepts:

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

SOURCES

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

References: Allard 1990, Ambrose 1990a, Andreu and Tukman 1995, Collins and Anderson 1994, Coxe 2007, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Hall and Mathews 1974, Nelson 1986, Patterson et al. 1999, Pyne 1994, Schmalzer and DeSelm 1982, Schotz pers. comm., Shreve et al. 1910, Southeastern Ecology Working Group n.d., TDNH unpubl. data, TNC 1998, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008, Young et al. 2006.

Accuracy assessment point BLUE.213. Successional Virginia Pine Forest.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL EASTERN RED-CEDAR WOODLAND

SYNONYMS
NVC English Name: **Eastern Red-cedar Forest**
NVC Scientific Name: ***Juniperus virginiana* Forest**
NVC Identifier: **CEGL006024**

LOCAL INFORMATION

Environmental Description: This successional woodland occurs on a high floodplain, alluvial terrace, and lower gorge slope previously cleared for agriculture. The site is mapped as unforested (white) on the 1912 Big Bend USGS 15' topographic map. Part of the stand is temporarily flooded by reservoir backup from Bluestone Lake. Slopes in the one mapped polygon range from 7 to 19 degrees (mean = 10.9). Elevations in the mapped polygon range from 445 to 471 m (mean = 457.3). The topographic position of the stand and canopy dominance by *Juniperus virginiana* var. *virginiana* (eastern redcedar) probably reflect the influence of calcareous bedrock on soil chemistry. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Box-elder Floodplain Forest (CEGL005033), Successional Black Walnut Floodplain Forest (CEGL007879), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), River Birch Backwater Floodplain Forest (CEGL002086), and Sycamore - Ash Floodplain Forest (CEGL006458).

Vegetation Description: The stand is composed of short, widely spaced *Juniperus virginiana* var. *virginiana* (eastern redcedar) with deciduous saplings, shrubs, and vines forming a dense thicket, with openings occupied by weedy herbs. No plots were sampled but associated species recorded at two accuracy assessment points include the native tree *Liriodendron tulipifera* (tuliptree), the native shrub *Lindera benzoin* (northern spicebush), and the exotic shrubs *Ligustrum vulgare* (European privet) and *Rosa multiflora* (multiflora rose).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana* var. *virginiana* (eastern redcedar)
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ligustrum vulgare* (European privet), *Lindera benzoin* (northern spicebush), *Rosa multiflora* (multiflora rose)

Characteristic Species: Information not available.

Other Noteworthy Species:

Species	GRank	Type	Note
Ligustrum vulgare (European privet)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst et al. 2008

Local Range: One 1.61-hectare polygon of this association is mapped on the floodplain of the Bluestone River, river right, in the northern section of the park.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.
Plots: The single stand was observed but not plot sampled.
Bluestone National Scenic River Inventory Notes: Accuracy assessment points BLUE.1113 and BLUE.1114 were sampled in the mapped polygon of this association. One additional accuracy assessment point, BLUE.1343, located within a polygon of the Floodplain Forest map class at the mouth of Mountain Creek, was attributed to this association, but *Juniperus virginiana* var. *virginiana* (eastern redcedar) is not listed in the species table for this point.

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

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

Most Abundant Species:

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

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

Other Noteworthy Species:

Species	GRank	Type	Note
Achillea millefolium (common yarrow)	-	plant	exotic
Agrostis gigantea (redtop)	-	plant	exotic
Alliaria petiolata (garlic mustard)	-	plant	exotic
Allium vineale (wild garlic)	-	plant	exotic
Anthoxanthum odoratum (sweet vernalgrass)	-	plant	exotic
Daucus carota (Queen Anne's lace)	-	plant	exotic
Elaeagnus umbellata (autumn olive)	-	plant	exotic
Elymus repens (quackgrass)	-	plant	exotic
Lonicera morrowii (Morrow's honeysuckle)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

States/Provinces: MA, NJ, NY, PA, VA, WV.
Federal Lands: NPS (Appomattox Court House, Bluestone, Boston Harbor Islands, C&O Canal?, Cape Cod, Delaware Water Gap, Fire Island, Fredericksburg-Spotsylvania, George Washington Birthplace, Richmond); USFS (Monongahela).

CONSERVATION STATUS
Rank: GNA (ruderal) (10-Oct-2001).
Reasons: This forest represents early-successional, modified, or silviculturally managed vegetation and is thus not of high conservation concern and does not receive a conservation status rank. This vegetation may be easily restorable by either management, time, or restoration of ecological processes.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 - Weak.
Comments: This association is currently very generally defined.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. R. E. Zaremba, M. Pyne, S. C. Gawler.
References: Clark 1986, Eastern Ecology Working Group n.d., Sneddon and Lundgren 2001, Vanderhorst et al. 2008.

Accuracy assessment point BLUE.1113. Successional Eastern Red-cedar Woodland.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK FLOODPLAIN FOREST

SYNONYMS

NVC English Name: **Eastern Hemlock - Northern Red Oak - (Sycamore, River Birch) / Great Laurel / Nightcaps Forest**

NVC Scientific Name: ***Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia*** **Forest [Provisional]**

NVC Identifier: **CEGL006620**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches on higher floodplains of medium-sized streams which are infrequently flooded. Along smaller streams, stands may occur in positions subject to more frequent, low-energy floods. It was probably more abundant prior to development of upper floodplains for agriculture starting in the in the late 1700s continuing through the mid-1900s. Mature stands along rivers may represent late-successional vegetation on stabilized terraces, but succession may be reversed by renewed scouring and bank erosion as rivers migrate across their floodplains. Microtopography is characterized by fluvial features including levees and swales. Slopes in mapped polygons range from 1 to 23 degrees (mean = 8.2). Elevations in mapped polygons range from 457 to 490 m (mean = 471). Unvegetated ground cover is typically dominated by litter but may also include coarse woody debris (flotsam) and exposed sand and rock in more recently flooded examples. Soils from one plot are described as temporarily flooded, well-drained, deep, stone-free sand with a thin surficial duff layer. Soils tested strongly acidic (mean pH = 4.9) with relatively high levels of K, Mn, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, B, Ca, Cu, Fe, Mg, Na, and P compared to average values in the park. Adjacent associations in the Floodplain Forest and Woodland map class may include Oak - Hickory Floodplain Forest (CEGL006462), Sycamore - Yellow Buckeye Floodplain Forest (CEGL006466), Sycamore - River Birch Riverscour Woodland (CEGL003725), and Riverbank Tall Herbs (CEGL006480). Adjacent, previously farmed terraces are often occupied by Successional Eastern White Pine - Tuliptree Forest (CEGL007944), some stands of which appear to be succeeding towards Eastern Hemlock Floodplain Forest.

Vegetation Description: This association is a mixed evergreen-deciduous floodplain forest codominated by *Tsuga canadensis* (eastern hemlock) in the canopy and/or subcanopy. Canopy cover in the one plot is 40% and subcanopy cover is 50%. Codominant trees in the plot include *Tsuga canadensis* (eastern hemlock), *Acer rubrum* var. *rubrum* (red maple), and *Quercus rubra* (northern red oak). Mature stands have *Tsuga canadensis* (eastern hemlock) codominant in the canopy layer, but younger stands (represented by the single plot at Bluestone) may have dominance by this shade-tolerant species in the lower strata. Additional trees in the plot include *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Robinia pseudoacacia* (black locust), and *Sassafras albidum* (sassafras). Additional tree species which characterize this association as a floodplain forest, including *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch), usually occur at low cover. Shrub layers may have moderate to dense cover and are dominated by *Rhododendron maximum* (great laurel). Herb layers are sparse and species-poor but usually include a few species more typical of floodplains than of upland hemlock forests. Herbs in the

plot include *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), *Aristolochia macrophylla* (pipevine), *Conopholis americana* (American squawroot), *Cryptotaenia canadensis* (Canadian honewort), *Eurybia divaricata* (white wood aster), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Parthenocissus quinquefolia* (Virginia creeper), *Polygonatum pubescens* (hairy Solomon's seal), *Polystichum acrostichoides* (Christmas fern), and *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower). Vascular plant species richness in the plot is 32 species per 400 square meters.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* var. *rubrum* (red maple), *Quercus rubra* (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Rhododendron maximum* (great laurel)

Characteristic Species: *Amphicarpaea bracteata* (American hogpeanut), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Refere nce
WV	SNR	=	1	*Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia* Forest	Vanderhorst et al. 2008

Local Range: A total of 12 polygons covering 2.93 hectares are mapped in the park. Stands occur along the Little Bluestone River, Mountain Creek (see inventory notes), and along the Bluestone River upstream from Pilot Ridge.

Classification Comments: This new association is classified based on data from seven plots from the Bluestone, Gauley, and Shavers Fork rivers in West Virginia. It has also been observed along the Greenbrier River and some of its tributaries (e.g., Anthony Creek) and from tributaries of the Shavers Fork River (e.g., Pheasant Run). It is floristically similar to upland mixed deciduous-hemlock forests (e.g., Tuliptree - Sweet Birch - Eastern Hemlock / Great Laurel Forest (CEGL007543)), but the presence of floodplain species and contrasting disturbance and successional dynamics support its recognition as a distinct association. Additional characteristic species found in plots outside Bluestone include *Betula nigra* (river birch), *Liquidambar styraciflua* (sweetgum), *Platanus occidentalis* (American sycamore), *Anemone quinquefolia* (nightcaps), and *Carex plantaginea* (plantainleaf sedge).

Other Comments: *Tsuga canadensis* (eastern hemlock) is currently threatened by the exotic insect hemlock woolly adelgid (*Adelges tsugae*). This pest was first discovered in the park in 2000 and NPS has since initiated insecticide treatment and monitoring of individual trees (J. Perez pers. comm.). Many hemlocks in the park appear stressed, but large scale mortality was not observed during the 2003–2006 vegetation surveys. This association helps maintain cool microclimates along streams which are important for cold-water fishes and other aquatic life.

Local Description Authors: J. P. Vanderhorst.

Plots: One plot was sampled: BLUE.93.

Bluestone National Scenic River Inventory Notes: One accuracy assessment point along Mountain Creek attributed to this association was originally mismapped as Successional Eastern White Pine - Tuliptree Forest. Attribution of polygons of this stand were corrected following accuracy assessment. This error could be repeated elsewhere due to the difficulty of distinguishing aerial photo signatures of *Tsuga canadensis* (eastern hemlock) and *Pinus strobus* (eastern white pine).

GLOBAL INFORMATION

NVC 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	Temporarily flooded temperate or subpolar needle-leaved evergreen forest (I.A.8.N.e.)
Alliance	*Tsuga canadensis - (Pinus strobus)* Temporarily Flooded Forest Alliance (A.171)
Alliance (English name)	Eastern Hemlock - (Eastern White Pine) Temporarily Flooded Forest Alliance
Association	*Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia* Forest [Provisional]
Association (English name)	Eastern Hemlock - Northern Red Oak - (Sycamore, River Birch) / Great Laurel / Nightcaps Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association is a mixed evergreen-deciduous floodplain forest, usually with a somewhat open canopy, with *Tsuga canadensis* (eastern hemlock) prominent in the canopy and/or subcanopy. It occurs in small patches on higher floodplains of medium-sized streams which are infrequently flooded. Along smaller streams, stands may occur in positions subject to more frequent, low-energy floods. Mature stands along rivers may represent late-successional vegetation on stabilized terraces, but succession may be reversed by renewed scouring and bank erosion as rivers migrate across their floodplains. Microtopography is characterized by fluvial features including levees and swales. Codominant trees include *Tsuga canadensis* (eastern hemlock), *Acer rubrum* var. *rubrum* (red maple), and *Quercus rubra* (northern red oak). Mature stands have *Tsuga canadensis* (eastern hemlock) codominant in the canopy layer, but younger stands may have dominance by this shade-tolerant species in the lower strata. Additional trees include *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Robinia pseudoacacia* (black locust), and *Sassafras albidum* (sassafras). Tree species that characterize this association as a floodplain forest, including *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch), usually occur at low cover. Shrub layers may have moderate to dense cover and are dominated by *Rhododendron maximum* (great laurel). Herb layers are sparse and species-poor but usually include a few species more typical of floodplains than of upland hemlock forests, such as *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Cryptotaenia canadensis* (Canadian honewort), and *Rudbeckia laciniata* (cutleaf coneflower).

Environmental Description: This association occurs in small patches on higher floodplains of medium-sized streams which are infrequently flooded. Along smaller streams, stands may occur in positions subject to more frequent, low-energy floods. Mature stands along rivers may

represent late-successional vegetation on stabilized terraces, but succession may be reversed by renewed scouring and bank erosion as rivers migrate across their floodplains. Microtopography is characterized by fluvial features including levees and swales. In Bluestone National Scenic River in West Virginia, this association occurs at elevations ranging from 457–490 m (1485–1600 feet). Unvegetated ground cover is typically dominated by litter but may also include coarse woody debris (flotsam) and exposed sand and rock in more recently flooded examples. Based on limited fieldwork, soils are described as temporarily flooded, well-drained, deep, stone-free sand with a thin surficial duff layer, and tested strongly acidic (mean pH = 4.9).

Vegetation Description: This association is a mixed evergreen-deciduous floodplain forest, usually with a somewhat open canopy, codominated by *Tsuga canadensis* (eastern hemlock) in the canopy and/or subcanopy. Trees along the river's edge often lean towards and eventually topple into the river as the banks are undercut. Codominant trees include *Tsuga canadensis* (eastern hemlock), *Acer rubrum* var. *rubrum* (red maple), and *Quercus rubra* (northern red oak). Mature stands have *Tsuga canadensis* (eastern hemlock) codominant in the canopy layer, but younger stands may have dominance by this shade-tolerant species in the lower strata. Additional trees include *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Robinia pseudoacacia* (black locust), and *Sassafras albidum* (sassafras). Tree species that characterize this association as a floodplain forest, including *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch), usually occur at low cover. Shrub layers may have moderate to dense cover and are dominated by *Rhododendron maximum* (great laurel). Herb layers are sparse and species-poor but usually include a few species more typical of floodplains than of upland hemlock forests. Herbs include *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Aristolochia macrophylla* (pipevine), *Conopholis americana* (American squawroot), *Cryptotaenia canadensis* (Canadian honewort), *Eurybia divaricata* (white wood aster), *Galium triflorum* (fragrant bedstraw), *Maianthemum canadense* (Canada mayflower), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Parthenocissus quinquefolia* (Virginia creeper), *Polygonatum pubescens* (hairy Solomon's seal), *Polystichum acrostichoides* (Christmas fern), and *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Rhododendron maximum* (great laurel)
Herb (field)	Vine/Liana	*Aristolochia macrophylla* (pipevine)
Herb (field)	Forb	*Arisaema triphyllum* (Jack in the pulpit)

Characteristic Species: *Anemone quinquefolia* (nightcaps), *Betula nigra* (river birch), *Carex plantaginea* (plantainleaf sedge), *Liquidambar styraciflua* (sweetgum), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Platanus occidentalis* (American sycamore), *Thuidium delicatulum* (delicate thuidium moss), *Xanthorhiza simplicissima* (yellowroot).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is currently known from floodplains of medium-sized streams west of the Eastern Continental Divide in West Virginia, including the Bluestone, Gauley, Greenbrier, and Shavers Fork rivers and their tributaries.
States/Provinces: WV.
Federal Lands: NPS (Bluestone); USFS (Monongahela).

CONSERVATION STATUS

Rank: GNR (14-Nov-2007).
Reasons: The area of this association has probably been greatly decreased by conversion of upper floodplains for agriculture and other human uses from the late 1700s through the mid-1900s. *Tsuga canadensis* (eastern hemlock) is currently threatened by the exotic insect hemlock woolly adelgid (*Adelges tsugae*). Many hemlocks are already dead in floodplains along the Greenbrier River, and this insect pest is known from the Bluestone River, while trees along the Shavers Fork still appear healthy. There are currently insufficient data to assign a numeric rank.

CLASSIFICATION INFORMATION

Status: Provisional.
Confidence: 3 - Weak.
Comments: This new association is classified based on data from seven plots from the Bluestone, Gauley, and Shavers Fork rivers in West Virginia. It has also been observed along the Greenbrier River and some of its tributaries (e.g., Anthony Creek) and from tributaries of the Shavers Fork River (e.g., Pheasant Run). It is floristically similar to upland mixed deciduous-hemlock forests (e.g., *Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest (CEGL007543)), but the presence of floodplain species and contrasting disturbance and successional dynamics support its recognition as a distinct association. Additional characteristic species found in plots outside Bluestone include *Betula nigra* (river birch), *Liquidambar styraciflua* (sweetgum), *Platanus occidentalis* (American sycamore), *Anemone quinquefolia* (nightcaps), and *Carex plantaginea* (plantainleaf sedge).
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d., Perez pers. comm., Vanderhorst et al. 2008.

Plot BLUE.93. Eastern Hemlock Floodplain Forest.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL BLACK WALNUT FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **Black Walnut / Wingstem Forest**
NVC Scientific Name: ***Juglans nigra / Verbesina alternifolia* Forest**
NVC Identifier: **CEGL007879**

LOCAL INFORMATION

Environmental Description: This successional forest or woodland occurs in small patches on floodplains and alluvial terraces in areas previously cleared for agriculture. Most known sites are mapped as unforested (white) on the 1912 Big Bend and 1929 Flattop USGS 15' topographic maps. Stands at lower elevations are temporarily flooded by reservoir backup from Bluestone Lake, and all stands may be subject to flooding from overbank flow and seepage from upslope. Slopes in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class, which includes patches of this association, range from 0 to 30 degrees (mean = 6.5). Elevations in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class range from 436 to 476 m (mean = 442). Soils from plots tested slightly acidic (mean pH = 6.1) with relatively high levels of organic matter, estimated N release, B, Ca, Cu, K, Mg, Mn, Na, P, and Zn, and relatively low levels of S, Al, and Fe compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Box-elder Floodplain Forest (CEGL005033), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), River Birch Backwater Floodplain Forest (CEGL002086), and Sycamore - Ash Floodplain Forest (CEGL006458).

Vegetation Description: This association is a successional deciduous forest or woodland dominated by *Juglans nigra* (black walnut). Canopy cover in plots ranges from 20–70% and subcanopy cover in plots ranges from 10–30%. Associated trees include *Acer nigrum* (black maple), *Aesculus flava* (yellow buckeye), *Juglans nigra* (black walnut), *Platanus occidentalis* (American sycamore), and *Ulmus rubra* (slippery elm). Vines include *Vitis vulpina* (frost grape) and *Smilax tamnoides* (bristly greenbrier). Shrub cover in plots ranges from 6–33%. Common shrubs include *Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush), *Corylus americana* (American hazelnut), and the exotic invasive *Rosa multiflora* (multiflora rose). Cover of herbs ranges from 10–100% and is higher in stands with open canopies. Herbs with high constancy and/or cover in plots include *Amphicarpaea bracteata* (American hogpeanut), *Apios americana* (groundnut), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Packera aurea* (golden ragwort), *Polygonum scandens* var. *cristatum* (climbing false buckwheat), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Verbesina alternifolia* (wingstem), and *Viola striata* (striped cream violet). Vascular plant species richness in three plots ranges from 26 to 33 (mean = 30.3) species per 400-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Juglans nigra* (black walnut)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Asimina triloba* (pawpaw), *Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Verbesina alternifolia* (wingstem)

Characteristic Species: *Juglans cinerea* (butternut), *Viola striata* (striped cream violet).

Other Noteworthy Species:

Species	GRank	Type	Note
Rosa multiflora (multiflora rose)	-	plant	exotic invasive

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst et al. 2008

Local Range: This association is included as one of several within the Modified Successional Floodplain Forest and Woodland map class. A total of 25 polygons (81.34 hectares) of this map class are mapped in the park. Twelve accuracy assessment points in the Modified Successional Floodplain Forest and Woodland map class were attributed to this association. This represents 35% of the accuracy assessment points in this map class and is an indication of the relative abundance of this association within the map class. Known stands of Black Walnut Successional Floodplain Forest are concentrated along lower elevation floodplains of the Bluestone River which are affected by occasional reservoir backup from Bluestone Lake, but small patches also occur in previously farmed areas upstream to the mouth of Mountain Creek.

Classification Comments: Elsewhere in West Virginia (Randolph and Preston counties), this association is known from uplands on soils derived from limestone. Species composition in upland stands is remarkably similar to the plots sampled on floodplains at Bluestone, with high cover by *Lindera benzoin* (northern spicebush) and *Verbesina alternifolia* (wingstem). Occurrence in both upland and riparian habitats is consistent with the newest revision of the global description. Composition and occurrence of some black walnut stands may be the result of selection and or planting by people for nuts and/or wood, and these stands may be difficult to distinguish from natural successional stands.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Three plots were sampled: BLUE.97, BLUE.99, and BLUE.133.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	*Juglans nigra* Forest Alliance (A.1932)
Alliance (English name)	Black Walnut Forest Alliance
Association	*Juglans nigra / Verbesina alternifolia* Forest
Association (English name)	Black Walnut / Wingstem Forest
Ecological System(s):	South-Central Interior Large Floodplain (CES202.705). Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). Central Appalachian River Floodplain (CES202.608).

GLOBAL DESCRIPTION

Concept Summary: This successional black walnut forest of the eastern United States occurs largely on floodplains and alluvial terraces that were cleared for agriculture or homesites, usually having a neutral to basic pH. It has been documented from various-sized drainages. The community was originally defined from former homesites in Great Smoky Mountains National

Park, where this association is an open, successional forest. It has since been found on some old pasture sites, associated with former settlements, from Georgia northeast to Pennsylvania, and is potentially a wide-ranging type. The canopy can be closed to somewhat open. *Juglans nigra* (black walnut) forms at least half of the canopy and is often the sole canopy tree. Associated canopy trees vary from site to site and can include *Liriodendron tulipifera* (tuliptree), *Juglans cinerea* (butternut), *Robinia pseudoacacia* (black locust), *Fraxinus americana* (white ash), *Ulmus americana* (American elm), *Platanus occidentalis* (American sycamore), *Acer saccharum* (sugar maple), *Acer nigrum* (black maple), *Morus rubra* (red mulberry), and *Aesculus flava* (yellow buckeye). Additional tree species in the subcanopy can include *Carya cordiformis* (bitternut hickory) and *Celtis occidentalis* (common hackberry). *Sassafras albidum* (sassafras) and/or *Carpinus caroliniana* (American hornbeam) may be present as small trees. The shrub layer may or may not be well-developed; common species include *Asimina triloba* (pawpaw), *Viburnum prunifolium* (blackhaw), *Lindera benzoin* (northern spicebush), *Corylus americana* (American hazelnut), and the exotic invasive *Rosa multiflora* (multiflora rose). The herb layer is variable, often with one or a few species providing most of the cover. *Verbesina alternifolia* (wingstem) (within its range) and *Ageratina altissima* (white snakeroot) are characteristic and may be dominant; other herbs include *Amphicarpaea bracteata* (American hogpeanut), *Agrimonia pubescens* (soft agrimony), *Apios americana* (groundnut), *Cryptotaenia canadensis* (Canadian honewort), *Galium triflorum* (fragrant bedstraw), *Osmorhiza longistylis* (longstyle sweetroot), *Dichanthelium clandestinum* (deertongue), *Packera aurea* (golden ragwort), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (cutleaf coneflower), *Podophyllum peltatum* (mayapple), *Impatiens capensis* (jewelweed), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Viola striata* (striped cream violet), and *Ambrosia trifida* (great ragweed). The invasive exotics *Microstegium vimineum* (Nepalese browntop), *Alliaria petiolata* (garlic mustard), and *Polygonum caespitosum* (oriental ladysthumb) can be common in this community.

Environmental Description: This community often occurs on floodplains and alluvial terraces that were cleared for agriculture or homesites along streams or on slopes, possibly in association with circumneutral soils. This community was sampled on former homesites along streams at 460–610 m (1500–2000 feet) elevation in the Smokies, as well as on ridgetops, slopes, and stream areas in the Cumberlands, Alleghenies, and Central Appalachians at 430–1070 m (1400–3500 feet). In addition, the association was sampled from the Piedmont of South Carolina in low-lying, poor-drainage areas from approximately 170–200 m (550–650 feet) in elevation. Along the Delaware River and nearby waters, the substrate varies from silt loam to gravelly sandy loams.

Vegetation Description: The canopy can be closed to somewhat open. *Juglans nigra* (black walnut) forms at least half of the canopy and is often the sole canopy tree. Associated canopy trees vary from site to site and can include *Liriodendron tulipifera* (tuliptree), *Juglans cinerea* (butternut), *Robinia pseudoacacia* (black locust), *Fraxinus americana* (white ash), *Ulmus americana* (American elm), *Platanus occidentalis* (American sycamore), *Acer saccharum* (sugar maple), *Acer nigrum* (black maple), *Morus rubra* (red mulberry), and *Aesculus flava* (yellow buckeye). Additional tree species in the subcanopy can include *Carya cordiformis* (bitternut hickory) and *Celtis occidentalis* (common hackberry). *Sassafras albidum* (sassafras) and/or *Carpinus caroliniana* (American hornbeam) may be present as small trees. The shrub layer may or may not be well-developed; common species include *Asimina triloba* (pawpaw), *Viburnum prunifolium* (blackhaw), *Lindera benzoin* (northern spicebush), *Corylus americana* (American

hazelnut), and the exotic invasive *Rosa multiflora* (multiflora rose). The herb layer is variable, often with one or a few species providing most of the cover. *Verbesina alternifolia* (wingstem) (within its range) and *Ageratina altissima* (white snakeroot) are characteristic and may be dominant; other herbs include *Amphicarpaea bracteata* (American hogpeanut), *Agrimonia pubescens* (soft agrimony), *Apios americana* (groundnut), *Cryptotaenia canadensis* (Canadian honewort), *Galium triflorum* (fragrant bedstraw), *Osmorhiza longistylis* (longstyle sweetroot), *Dichanthelium clandestinum* (deertongue), *Packera aurea* (golden ragwort), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (cutleaf coneflower), *Podophyllum peltatum* (mayapple), *Impatiens capensis* (jewelweed), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Viola striata* (striped cream violet), and *Ambrosia trifida* (great ragweed). The invasive exotics *Microstegium vimineum* (Nepalese browntop), *Alliaria petiolata* (garlic mustard), and *Polygonum caespitosum* (oriental ladysthumb) can be common in this community.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Juglans nigra* (black walnut)
Herb (field)	Forb	*Verbesina alternifolia* (wingstem)

Characteristic Species: *Cercis canadensis* (eastern redbud), *Juglans nigra* (black walnut), *Rosa multiflora* (multiflora rose), *Verbesina alternifolia* (wingstem).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	invasive exotic
Microstegium vimineum (Nepalese browntop)	-	plant	invasive exotic
Polygonum caespitosum (oriental ladysthumb)	-	plant	invasive exotic
Rosa multiflora (multiflora rose)	-	plant	invasive exotic

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is currently known from Georgia and the Carolinas to Tennessee and Kentucky, north to Pennsylvania and New Jersey where *Juglans nigra* (black walnut) is near the northern end of its range. It may range into adjacent states.

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

Federal Lands: BIA (Eastern Band of Cherokee); NPS (Appomattox Court House, Big South Fork, Blue Ridge Parkway, Bluestone, C&O Canal?, Chickamauga-Chattanooga, Colonial, Cumberland Gap, Delaware Water Gap, Great Smoky Mountains, Kings Mountain, Mammoth Cave, Ninety Six, Richmond).

CONSERVATION STATUS

Rank: GNA (ruderal) (2-Apr-2001).

Reasons: This vegetation represents vegetation created by anthropogenic disturbance and is thus not a conservation priority. Grank changed from GW to GD 2001-04-02 MP.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: This association was originally described from Great Smoky Mountains National Park where this association can be distinguished with aerial photography.

Similar Associations:

Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana - (Robinia pseudoacacia) Forest (CEGL006599)--is a modified successional forest that may also have a large component of *Juglans nigra* and occurs on disturbed sites, but it is largely dominated by early-successional trees in the canopy.

Related Concepts: Information not available.

SOURCES

Description Authors: K. D. Patterson, mod. R. White and S. C. Gawler.

References: NatureServe Ecology - Southeastern U.S. unpubl. data, Peet et al. unpubl. data 2002, Podniesinski et al. 2006, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst et al. 2008.

Plot BLUE.97. Successional Black Walnut Floodplain Forest.

COMMON NAME (PARK-SPECIFIC): SUGAR MAPLE - YELLOW BUCKEYE - AMERICAN BASSWOOD FOREST

SYNONYMS

NVC English Name: **Tuliptree - Appalachian Basswood - Yellow Buckeye - Sugar Maple / (Umbrella Magnolia) Forest**

NVC Scientific Name: ***Liriodendron tulipifera - Tilia americana*** var. ***heterophylla - Aesculus flava - Acer saccharum / (Magnolia tripetala)*** **Forest**

NVC Identifier: **CEGL005222**

LOCAL INFORMATION

Environmental Description: This association occurs in small to large patches (0.04–26.5 ha) predominantly in concave positions on colluvial gorge slopes with northerly aspects. One stand occurs along the sides of a ravine which cuts through an alluvial terrace. Slopes in mapped polygons range from 0 to 49 degrees (mean = 27). Elevations in mapped polygons range from 436 to 718 m (mean = 536). Unvegetated ground cover is dominated by litter and rock. Underlying geology is predominantly shale of the Hinton Formation, including calcareous strata, but sandstone colluvium dominates ground cover in many stands. Soils in plots are described as somewhat moist to moist, well-drained sandy loams, silt loams, and clay loams. Soils from plots tested strongly to slightly acidic (mean pH = 5.5) with relatively high levels of organic matter, estimated N release, B, Ca, K, Mg, Mn, Na, and P, and relatively low levels of S, Al, Cu, Fe, and Zn compared to average values in the park. Adjacent associations on cool-aspect gorge slopes with somewhat less fertile soils often include Eastern Hemlock - American Basswood Forest (CEGL008407). Where aspects become warmer and drier, this association is often adjacent to and grades towards Oak - Hickory - Sugar Maple Forest (CEGL007268).

Vegetation Description: This association is a closed-canopy deciduous forest composed of a diverse mixture of tree species adapted to mesic conditions. Canopy cover in plots ranges from 40–90% and subcanopy cover ranges from 20–70%. Dominant species in the canopy include (in decreasing order of constancy in plots) *Tilia americana* (American basswood), *Acer saccharum* var. *saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Aesculus flava* (yellow buckeye), and *Quercus rubra* (northern red oak). Additional important trees in the canopy and subcanopy include *Fraxinus americana* (white ash), *Tsuga canadensis* (eastern hemlock), *Carya cordiformis* (bitternut hickory), *Acer rubrum* var. *rubrum* (red maple), *Betula lenta* (sweet birch), and *Magnolia acuminata* (cucumber-tree). Vines, which may reach into the canopy, include *Aristolochia macrophylla* (pipevine), *Parthenocissus quinquefolia* (Virginia creeper), and *Vitis aestivalis* var. *bicolor* (summer grape). Shrub cover in plots ranges from 2–40%. Common species in the shrub layers include *Lindera benzoin* (northern spicebush), *Hamamelis virginiana* (American witchhazel), *Acer pensylvanicum* (striped maple), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Hydrangea arborescens* (wild hydrangea). There is typically a lush, diverse herb layer dominated by shade-tolerant, nutrient-demanding species. Common herbs include (in decreasing order of constancy in plots) *Polystichum acrostichoides* (Christmas fern), *Dryopteris marginalis* (marginal woodfern), *Adiantum pedatum* (northern maidenhair), *Galium triflorum* (fragrant bedstraw), *Sedum ternatum* (woodland stonecrop), *Arisaema triphyllum* (Jack in the pulpit), *Prosartes lanuginosa* (yellow fairybells), *Ageratina altissima* var. *altissima* (white snakeroot), *Actaea racemosa* var. *racemosa* (black bugbane), *Sanguinaria canadensis* (bloodroot), *Panax*

quinquefolius (American ginseng), *Eurybia divaricata* (white wood aster), *Dioscorea quaternata* (fourleaf yam), *Solidago flexicaulis* (zigzag goldenrod), *Asplenium rhizophyllum* (walking fern), *Botrychium virginianum* (rattlesnake fern), *Sanicula canadensis* (Canadian blacksnakeroot), *Osmorhiza claytonii* (Clayton's sweetroot), and *Laportea canadensis* (Canadian woodnettle). Spring ephemeral herbs which bloom before tree leaf-out may be abundant in this community but were probably under-represented in plots due to timing of sampling. Spring ephemerals recorded in a small number of plots include *Mitella diphylla* (twoleaf miterwort), *Hydrophyllum canadense* (bluntleaf waterleaf), *Trillium erectum* (red trillium), *Trillium undulatum* (painted trillium), *Viola canadensis* (Canadian white violet), *Viola pubescens* var. *pubescens* (downy yellow violet), and *Viola striata* (striped cream violet). State-rare species found in plots include *Carex cumberlandensis* (Cumberland sedge), *Scutellaria saxatilis* (smooth rock skullcap), *Thuja occidentalis* (arborvitae), and *Viburnum rafinesquianum* (downy arrowwood). Vascular plant species richness in 12 plots ranges from 13 to 52 (mean = 36.3) species per 400-square-meter plot. Bryophyte cover in plots ranges from 1–40%. Moss species identified from plots include *Thuidium delicatulum* (delicate thuidium moss), *Brachythecium plumosum* (brachythecium moss), *Anomodon rostratus* (anomodon moss), *Hedwigia ciliata* (ciliate hedwigia moss), *Dicranodontium denudatum* (denuded dicranodontium moss), and *Anomodon attenuatus* (anomodon moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* var. *saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak), *Tilia americana* (American basswood)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Actaea racemosa* var. *racemosa* (black bugbane), *Ageratina altissima* var. *altissima* (white snakeroot)
Herb (field)	Fern or fern ally	*Adiantum pedatum* (northern maidenhair), *Dryopteris marginalis* (marginal woodfern), *Polystichum acrostichoides* (Christmas fern)
Nonvascular	Vine/Liana	*Parthenocissus quinquefolia* (Virginia creeper)

Characteristic Species: *Asarum canadense* (Canadian wildginger), *Botrychium virginianum* (rattlesnake fern), *Galium triflorum* (fragrant bedstraw), *Sanguinaria canadensis* (bloodroot), *Solidago flexicaulis* (zigzag goldenrod).

Other Noteworthy Species:

Species	GRank	Type	Note
Carex cumberlandensis (Cumberland sedge)	-	plant	WV state-critically imperiled
Panax quinquefolius (American ginseng)	G3G4	plant	WV state-vulnerable
Scutellaria saxatilis (smooth rock skullcap)	G3	plant	WV state-imperiled
Thuja occidentalis (arborvitae)	-	plant	WV state-imperiled
Viburnum rafinesquianum (downy arrowwood)	-	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst 2001b

Local Range: A total of 47 polygons covering 212.11 hectares are mapped in the park. This association is found on northerly facing slopes in the gorges of the Bluestone River and its tributaries throughout the park.

Classification Comments: In West Virginia, the varieties of *Tilia americana* (American basswood) are sympatric and intergrade and are not very useful for circumscribing vegetation types. Another nominal tree species in the global name of this association, *Magnolia tripetala* (umbrella-tree), was absent from all plots and is uncommon in the park. This association is most similar to the "white ash - basswood - northern red oak" community classified by Rentch et al.'s (2005) study of upland forests in the Bluestone River gorge.
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: Twelve plots were sampled: BLUE.6, BLUE.23, BLUE.35, BLUE.48, BLUE.55, BLUE.67, BLUE.75, BLUE.102, BLUE.117, BLUE.122, BLUE.126, and BLUE.132.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Liriodendron tulipifera - Tilia americana* var. *heterophylla - Aesculus flava - Acer saccharum* Forest Alliance (A.235)
Alliance (English name)	Tuliptree - Appalachian Basswood - Yellow Buckeye - Sugar Maple Forest Alliance
Association	*Liriodendron tulipifera - Tilia americana* var. *heterophylla - Aesculus flava - Acer saccharum / (Magnolia tripetala)* Forest
Association (English name)	Tuliptree - Appalachian Basswood - Yellow Buckeye - Sugar Maple / (Umbrella Magnolia) Forest
Ecological System(s):	South-Central Interior Mesophytic Forest (CES202.887).

GLOBAL DESCRIPTION

Concept Summary: This mixed mesophytic forest type is found primarily in the Central Appalachians, Western Allegheny Plateau, and Cumberland Plateau ecoregions of the United States. Stands occur on cool, moist slopes and steep ravines or bottoms. The tree canopy is often tall, closed and contains a variety of tree species, including *Acer saccharum* (sugar maple), *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* (black cherry), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). Trees indicative of the type include *Aesculus flava* (yellow buckeye) and *Tilia americana* var. *heterophylla* (American basswood). *Magnolia acuminata* (cucumber-tree) occurs locally. *Acer rubrum* (red maple) and *Betula lenta* (sweet birch) may be common in areas with a more recent harvest history. Frequent vines and shrubs include *Aristolochia macrophylla* (pipevine), *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis aestivalis* var. *bicolor* (summer grape), *Asimina triloba* (pawpaw), *Carpinus caroliniana* (American hornbeam), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Staphylea trifolia* (American bladdernut), and more locally *Magnolia tripetala* (umbrella-tree) and *Rhododendron maximum* (great laurel). The herbaceous layer is extremely rich, including *Actaea racemosa* (black bugbane), *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Actaea racemosa* (black bugbane), *Botrychium virginianum* (rattlesnake fern), *Caulophyllum thalictroides* (blue cohosh), *Claytonia virginica*

(Virginia springbeauty), *Cryptotaenia canadensis* (Canadian honewort), *Dicentra canadensis* (squirrel corn), *Dryopteris marginalis* (marginal woodfern), *Erythronium americanum* (dogtooth violet), *Galium triflorum* (fragrant bedstraw), *Geranium maculatum* (spotted geranium), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Hydrophyllum canadense* (bluntleaf waterleaf), *Hydrophyllum virginianum* (Shawnee salad), *Osmorhiza* (sweetroot) spp., *Laportea canadensis* (Canadian woodnettle), *Prosartes lanuginosa* (yellow fairybells), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop), *Tiarella cordifolia* (heartleaf foamflower), *Trillium erectum* (red trillium), *Trillium grandiflorum* (snow trillium), and many others. Spring ephemeral herbs which bloom before tree leaf-out may be abundant.

Environmental Description: Stands occur on cool, moist slopes and steep ravines or bottoms, often on colluvium. They occur from lower to upper slopes on northerly aspects but are confined to lower slopes and concave positions on more southerly aspects or may be absent on the warmest aspects. They may also occur on alluvial terraces along streams and on abandoned river terraces. Soils are derived from sandstones or shales, sometimes calcareous. Soils in plots from Bluestone National Scenic River, West Virginia, are described as somewhat moist to moist, well-drained sandy loams, silt loams, and clay loams, and tested strongly to slightly acidic (mean pH = 5.5) with relatively high levels of organic matter, estimated N release, B, Ca, K, Mg, Mn, Na, and P, and relatively low levels of S, Al, Cu, and Zn compared to average values in the park.

Vegetation Description: The tree canopy is often tall, closed and contains a variety of tree species, including *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* (black cherry), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak). Trees indicative of the type include *Aesculus flava* (yellow buckeye) and *Tilia americana* var. *heterophylla* (American basswood). *Magnolia acuminata* (cucumber-tree) occurs locally, and *Tsuga canadensis* (eastern hemlock) and *Carya cordiformis* (bitternut hickory) may also be present. *Acer rubrum* (red maple) and *Betula lenta* (sweet birch) may be common in areas with a more recent harvest history. Frequent vines include *Aristolochia macrophylla* (pipevine), *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis aestivalis* var. *bicolor* (summer grape); shrubs include *Asimina triloba* (pawpaw), *Carpinus caroliniana* (American hornbeam), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Staphylea trifolia* (American bladdernut), and more locally *Magnolia tripetala* (umbrella-tree), *Halesia tetraptera* (mountain silverbell), *Hydrangea arborescens* (wild hydrangea), *Cercis canadensis* (eastern redbud), and *Rhododendron maximum* (great laurel). The herbaceous layer is extremely rich and dominated by shade-tolerant, nutrient-demanding species, including *Actaea racemosa* (black bugbane), *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Actaea racemosa* (black bugbane), *Botrychium virginianum* (rattlesnake fern), *Caulophyllum thalictroides* (blue cohosh), *Claytonia virginica* (Virginia springbeauty), *Cryptotaenia canadensis* (Canadian honewort), *Dicentra canadensis* (squirrel corn), *Dryopteris marginalis* (marginal woodfern), *Erythronium americanum* (dogtooth violet), *Galium triflorum* (fragrant bedstraw), *Geranium maculatum* (spotted geranium), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Hydrophyllum canadense* (bluntleaf waterleaf), *Hydrophyllum virginianum* (Shawnee salad), *Osmorhiza* (sweetroot) spp., *Laportea canadensis* (Canadian woodnettle), *Prosartes lanuginosa* (yellow fairybells), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop), *Tiarella cordifolia* (heartleaf foamflower), *Trillium erectum* (red trillium), *Trillium grandiflorum* (snow trillium), and many others. Spring ephemeral herbs which bloom before tree

leaf-out may be abundant. In 12 plots at Bluestone National Scenic River in West Virginia, vascular plant richness ranged from 13 to 52 (mean = 36.3) species per 400-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Hydrophyllum canadense* (bluntleaf waterleaf)

Characteristic Species: *Acer saccharum* (sugar maple), *Actaea racemosa* (black bugbane), *Aesculus flava* (yellow buckeye), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Hydrophyllum canadense* (bluntleaf waterleaf), *Laportea canadensis* (Canadian woodnettle), *Lindera benzoin* (northern spicebush), *Liriodendron tulipifera* (tuliptree), *Magnolia acuminata* (cucumber-tree), *Osmorhiza longistylis* (longstyle sweetroot), *Sedum ternatum* (woodland stonecrop), *Stellaria pubera* (star chickweed), *Tiarella cordifolia* (heartleaf foamflower), *Tilia americana* var. *heterophylla* (American basswood).

Other Noteworthy Species:

Species	GRank	Type	Note
Ailanthus altissima (tree of heaven)	-	plant	invasive exotic
Alliaria petiolata (garlic mustard)	-	plant	invasive exotic
Panax quinquefolius (American ginseng)	G3G4	plant	globally vulnerable

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This type is found primarily in the Central Appalachian, Western Allegheny Plateau, and Cumberland Plateau regions of the United States, ranging from southern Pennsylvania and eastern Ohio south to West Virginia and Tennessee, with outliers in Indiana.

States/Provinces: IN, KY, OH, PA, TN, WV.

Federal Lands: NPS (Bluestone, Cumberland Gap, Mammoth Cave, New River Gorge); USFS (Daniel Boone, Monongahela, Wayne).

CONSERVATION STATUS

Rank: G4? (30-Sep-2004).

Reasons: There are still issues with the precise geographic limits of this type and its relationship to similar types in adjacent regions. It represents the typical mesic cove forest of a fairly large area of the central interior eastern United States (from southern Pennsylvania and eastern Ohio south to West Virginia and Tennessee, with outliers in Indiana). Within this range, it only occurs in protected concave topographic positions. Although relatively secure and not highly threatened today, many stands have recovered from past episodes of timber removal and remain threatened by future timber harvests because of excellent site productivity. Much of the remaining acreage which is not formally protected is not of high quality. There are some protected stands on Federal lands (national parks, national forests) in the region. Forests of the region are vulnerable to decline from: (1) aluminum toxicity, related to acidification (from sulfates, exceeding 30 pounds per year per acre); (2) nitrogen deposition, which reduces the capacity of trees on the northern slopes to resist fungal infections; and (3) ozone deposition, which diminishes the photosynthetic capacity of trees, which in turn diminishes their roots. Invasive exotics, especially *Alliaria petiolata* (garlic mustard) (a shade-tolerant herb) and *Ailanthus altissima* (tree of

heaven) (a tree which can become established in canopy gaps, mimicking the niche of *Liriodendron* (tuliptree)), pose a serious threat to the integrity of this community's flora.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Trees indicative of the type include *Aesculus flava* (yellow buckeye) and *Tilia americana* var. *heterophylla* (American basswood). In Ohio, however, these are restricted to the more southern parts of Ohio, which, depending on the definition of the type, may restrict its concept. Stands strongly dominated by beech and maple go with the Beech - Maple Unglaciated Forest, *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera* Unglaciated Forest (CEGL002411); by beech and white oak with the White Oak - Beech Western Allegheny Forest, *Quercus alba - Fagus grandifolia* Western Allegheny Plateau Forest (CEGL006144); and by at least 25% hemlock with the East-Central Hemlock Hardwood Forest, *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043). In Indiana this type occurs in the southeastern part of the Bluegrass Region, where it is found on calcareous substrates, though further review is needed to determine whether these Indiana stands could be placed in CEGL002411. Mike Homoya of the Indiana Heritage Program has species lists, and stand information should be compiled for review. More information is needed to distinguish these more northern (Central Appalachian) mixed mesophytic forests from similar forests in the southern Appalachians. Further division may be warranted.

Similar Associations:

Fagus grandifolia - Acer saccharum - Liriodendron tulipifera Unglaciated Forest (CEGL002411).

Fraxinus americana - Carya ovata / Frangula caroliniana / Helianthus hirsutus Woodland (CEGL008458)--also does not generally have high cover of either *Aesculus flava* or *Tilia americana*, and it tends to be on drier mid- to upper slopes instead of ravine areas.

Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana) / Actaea racemosa - Laportea canadensis Forest (CEGL007710).

Liriodendron tulipifera - Tilia americana var. *heterophylla - (Aesculus flava) / Actaea racemosa* Forest (CEGL007291).

Quercus alba - Fagus grandifolia Western Allegheny Plateau Forest (CEGL006144).

Quercus alba - Quercus rubra - Quercus prinus / Collinsonia canadensis - Podophyllum peltatum - Amphicarpaea bracteata Forest (CEGL007692)--does not have any *Aesculus flava* or *Tilia americana* in it.

Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia) Forest (CEGL005043).

Related Concepts:

Acer saccharum - Aesculus flava / Laportea canadensis forest (Vanderhorst 2001b) =

IA5d. Typic Mesophytic Forest (Allard 1990) ?

Mixed Mesophytic Forest (Braun 1950) B

White Ash - Basswood - Northern Red Oak (Rentch et al. 2005) ?

SOURCES

Description Authors: D. Faber-Langendoen, L. Sneddon, M. Pyne, mod. R. White and S. C. Gawler.

References: Allard 1990, Anderson 1982, Braun 1950, Evans 1991, Fike 1999, Midwestern Ecology Working Group n.d., Rentch et al. 2005, TDNH unpubl. data, Vanderhorst 2001a, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.102. Sugar Maple - Yellow Buckeye - American Basswood Forest.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL TULIPTREE / NORTHERN SPICEBUSH FOREST

SYNONYMS
NVC English Name: **Tuliptree / (Eastern Redbud) / (Northern Spicebush) Forest**
NVC Scientific Name: ***Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest**
NVC Identifier: **CEGL007220**

LOCAL INFORMATION

Environmental Description: This successional forest occurs in small patches (0–4.1 ha) on gentle topography in areas previously cleared for agriculture. Polygons of the Successional Tuliptree / Northern Spicebush Forest map class are most common on lower slopes, midslope benches, and plateau tops, but this association may also occur in small patches on floodplains within polygons of the broader Modified Successional Floodplain Forest and Woodland map class. Most sites are mapped as unforested (white) on the 1912 Big Bend and 1929 Flattop USGS 15' topographic maps. Slopes in mapped polygons range from 2 to 35 degrees (mean = 17.8). Elevations in mapped polygons range from 444 to 695 m (mean = 560). Unvegetated ground cover is strongly dominated by litter. Low cover by rocks is an indication of site selection and removal of rocks for agriculture. Rock walls and scattered rock piles are common. Soils in plots are described as somewhat moist, moderately well- to well-drained sandy loam and silt loam. Soils from plots tested extremely to slightly acidic (mean pH = 5.0) with relatively high levels of organic matter, estimated N release, Ca, Cu, K, Mg, and Mn, and relatively low levels of S, Al, B, Fe, P, and Zn compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Box-elder Floodplain Forest (CEGL005033), Successional Black Walnut Floodplain Forest (CEGL007879), River Birch Backwater Floodplain Forest (CEGL002086), and Sycamore - Ash Floodplain Forest (CEGL006458). In uplands this association is often adjacent to Oak - Hickory - Sugar Maple Forest (CEGL007268).
Vegetation Description: This association represents successional deciduous forests dominated by *Liriodendron tulipifera* (tuliptree) with a large component of nutrient-demanding associates. Canopy cover in plots ranges from 30–70% and subcanopy cover ranges from 10–60%. Associated tree species, which are highly variable among stands, include *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Platanus occidentalis* (American sycamore), *Quercus rubra* (northern red oak), *Acer rubrum* var. *rubrum* (red maple), and *Acer saccharum* var. *saccharum* (sugar maple). Cover in the shrub layers of plots (including tree saplings and vines) ranges from 15–50%. *Lindera benzoin* (northern spicebush) is the most common shrub. Additional saplings and shrubs that may indicate enriched soils include *Aesculus flava* (yellow buckeye), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), and *Cercis canadensis* var. *canadensis* (eastern redbud). The woody vine *Smilax tamnoides* (bristly greenbrier) is constant in plots. The invasive exotic shrub *Rosa multiflora* (multiflora rose) is abundant in one floodplain plot. Herb cover in plots ranges from 20–40%. Common herbs include *Galium triflorum* (fragrant bedstraw), *Amphicarpaea bracteata* (American hogpeanut), *Ageratina altissima* var. *altissima* (white snakeroot), *Solidago caesia* (wreath goldenrod), *Polystichum acrostichoides* (Christmas fern), *Parthenocissus quinquefolia* (Virginia creeper), *Carex digitalis* var. *digitalis* (slender woodland sedge), *Actaea racemosa* var. *racemosa* (black bugbane), and

Clematis virginiana (devil's darning needles). Vascular plant species richness ranges from 53 to 58 (mean = 56.3) species per 400-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Actaea racemosa* var. *racemosa* (black bugbane)

Characteristic Species: *Aesculus flava* (yellow buckeye), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Cercis canadensis* var. *canadensis* (eastern redbud).

Other Noteworthy Species:

Species	GRank	Type	Note
Panax quinquefolius (American ginseng)	G3G4	plant	WV state-vulnerable
Rosa multiflora (multiflora rose)	-	plant	invasive exotic
Scutellaria saxatilis (smooth rock skullcap)	G3	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst et al. 2007

Local Range: A total of 13 polygons (20.15 ha) of the Successional Tuliptree / Northern Spicebush Forest map class are mapped in the park. This association may also occur in small patches within the Modified Successional Floodplain Forest and Woodland map class. A total of 23 polygons (81.34 ha) of this map class are mapped in the park. Three accuracy assessment points in the Modified Successional Floodplain Forest and Woodland map class are attributed to this association. This represents 8.6% of the accuracy assessment points in this map class and is an indication of the relative abundance of this association within the map class. Stands are widely scattered in all sections of the park in areas previously cleared for agriculture.

Classification Comments: Another successional tuliptree association, *Liriodendron tulipifera* - *Quercus* spp. Forest (CEGL007221), which was classified from New River Gorge National River (Vanderhorst et al. 2007), was not found in this park. This is probably a reflection of the higher fertility soils derived primarily from shales which prevail at Bluestone. This association is most similar to the "yellow poplar - sugar maple - cucumber" community classified by Rentch et al.'s (2005) study of upland forests in the Bluestone River gorge.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Three plots were sampled: BLUE.51, BLUE.53, and BLUE.83.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Liriodendron tulipifera* Forest Alliance (A.236)
Alliance (English name)	Tuliptree Forest Alliance
Association	*Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest
Association (English name)	Tuliptree / (Eastern Redbud) / (Northern Spicebush) Forest

Ecological System(s): Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).
Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898).
South-Central Interior Mesophytic Forest (CES202.887).

GLOBAL DESCRIPTION

Concept Summary: This semi-natural or successional community dominated by *Liriodendron tulipifera* (tuliptree) occurs in the Ridge and Valley of Tennessee and Virginia, the Interior Low Plateau of Kentucky, and the Central Appalachians, Piedmont and inner Coastal Plain regions of Virginia, West Virginia, and Maryland. It may also occur in similar regions of Pennsylvania and Delaware. It is distinguished from other upland communities dominated by *Liriodendron tulipifera* (tuliptree) by the presence of species associated with soils with moderately high base saturation levels (rich soils). Species found in stands attributable to this type may be fairly diverse and result in a varied composition. In addition to *Liriodendron tulipifera* (tuliptree), other canopy species may include *Liquidambar styraciflua* (sweetgum), *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Platanus occidentalis* (American sycamore), *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *Robinia pseudoacacia* (black locust), *Juglans nigra* (black walnut), *Halesia tetraptera* (mountain silverbell), *Fraxinus americana* (white ash), *Fagus grandifolia* (American beech), *Magnolia acuminata* (cucumber-tree), *Ulmus rubra* (slippery elm), *Quercus imbricaria* (shingle oak), *Quercus muehlenbergii* (chinkapin oak), and *Carya ovata* (shagbark hickory). Species often found in the subcanopy include *Acer saccharum* (sugar maple), *Cercis canadensis* (eastern redbud), *Ulmus alata* (winged elm), *Fraxinus americana* (white ash), *Morus rubra* (red mulberry), and *Cornus florida* (flowering dogwood). Shrubs include saplings of the subcanopy and canopy species, as well as *Lindera benzoin* (northern spicebush), *Symphoricarpos orbiculatus* (coralberry), *Asimina triloba* (pawpaw), *Staphylea trifolia* (American bladdernut), *Acer negundo* (boxelder), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). Exotic shrubs, including *Rosa multiflora* (multiflora rose), *Rubus phoenicolasius* (wine raspberry), and *Lonicera japonica* (Japanese honeysuckle), are present at some sites. Herb-layer species include the exotics *Microstegium vimineum* (Nepalese browntop), *Alliaria petiolata* (garlic mustard), and *Veronica hederifolia* (ivyleaf speedwell), as well as *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax tamnoides* (bristly greenbrier), *Actaea racemosa* (black bugbane), *Caulophyllum thalictroides* (blue cohosh), *Laportea canadensis* (Canadian woodnettle), *Impatiens pallida* (pale touch-me-not), *Hydrophyllum canadense* (bluntleaf waterleaf), *Adiantum pedatum* (northern maidenhair), *Polygonatum pubescens* (hairy Solomon's seal), *Verbesina alternifolia* (wingstem), *Amphicarpaea bracteata* (American hogpeanut), and *Polystichum acrostichoides* (Christmas fern).

Environmental Description: These forests are found on disturbed mesic areas underlain by rich soils with moderately high base saturation levels. It occurs on abandoned farmland and townsites, old strip mines, old clearcuts, burned areas, and other areas where the canopy was removed or heavily disturbed in the past. Small patches may occur in areas where canopy disturbance has resulted from natural causes such as windfall or landslides. Soils may be underlain by a variety of geologic strata that weather to base-rich soils including limestone, dolomite, calcareous shale, shell deposits, metabasalts and granitic complexes. In Kentucky this association may occur on calcareous substrates in the Dripping Springs Escarpment. At Shenandoah National Park in Virginia, this community is underlain by Catoctin metabasalt or a pyroxene-bearing granitic complex. In West Virginia, parent materials include sandstone, shale, and alluvium. Soils in plots were described as moderately well-drained to well-drained clay, silt loam, and sandy loam with pH ranging from 5.0 to 7.5, with relatively high levels of organic

matter, estimated N release, Ca, Cu, K, Mg, and Mn, and relatively low levels of S, Al, B, Fe, P, and Zn compared to average values in the area.

Vegetation Description: Stands are dominated by *Liriodendron tulipifera* (tuliptree) but also include various other species, including ones indicative of nutrient-rich or circumneutral environments. Other species include *Liquidambar styraciflua* (sweetgum), *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Platanus occidentalis* (American sycamore), *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *Robinia pseudoacacia* (black locust), *Juglans nigra* (black walnut), *Halesia tetraptera* (mountain silverbell), *Fraxinus americana* (white ash), *Fagus grandifolia* (American beech), *Magnolia acuminata* (cucumber-tree), *Ulmus rubra* (slippery elm), *Quercus imbricaria* (shingle oak), *Quercus muehlenbergii* (chinkapin oak), and *Carya ovata* (shagbark hickory) (NatureServe Ecology unpubl. data, VDNH unpubl. data, WVNHP unpubl. data.). Species often found in the subcanopy include *Acer saccharum* (sugar maple), *Cercis canadensis* (eastern redbud), *Ulmus alata* (winged elm), *Morus rubra* (red mulberry), *Sassafras albidum* (sassafras), and *Cornus florida* (flowering dogwood). *Cercis canadensis* (eastern redbud) is often abundant on soils underlain by carbonate strata. Shrubs include saplings of the subcanopy and canopy species, as well as *Symphoricarpos orbiculatus* (coralberry), *Lindera benzoin* (northern spicebush), *Asimina triloba* (pawpaw), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). *Lindera benzoin* (northern spicebush) is often abundant in occurrences of this community in the Central Appalachians, Piedmont and inner Coastal Plain regions of Virginia, West Virginia, and Maryland. Exotic shrubs, including *Rosa multiflora* (multiflora rose), *Rubus phoenicolasius* (wine raspberry), and *Lonicera japonica* (Japanese honeysuckle), are present at some sites. Vines, which may be abundant, include *Aristolochia macrophylla* (pipevine), *Toxicodendron radicans* (eastern poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), *Smilax tamnoides* (bristly greenbrier), and *Vitis aestivalis* var. *bicolor* (summer grape). Herbaceous species include the exotics *Microstegium vimineum* (Nepalese browntop), *Alliaria petiolata* (garlic mustard), and *Veronica hederifolia* (ivyleaf speedwell), as well as *Actaea racemosa* (black bugbane), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Cryptotaenia canadensis* (Canadian honewort), *Galium triflorum* (fragrant bedstraw), *Laportea canadensis* (Canadian woodnettle), *Impatiens pallida* (pale touch-me-not), *Hydrophyllum canadense* (bluntleaf waterleaf), *Osmorhiza longistylis* (longstyle sweetroot), *Adiantum pedatum* (northern maidenhair), *Polygonatum pubescens* (hairy Solomon's seal), *Polystichum acrostichoides* (Christmas fern), *Verbesina alternifolia* (wingstem), *Amphicarpaea bracteata* (American hogpeanut), *Solidago caesia* (wreath goldenrod), and *Polystichum acrostichoides* (Christmas fern). (Andreu and Tukman 1995, NatureServe Ecology unpubl. data, VDNH unpubl. data, WVNHP unpubl. data). Examples at Fort Donelson that have been very heavily disturbed may have local dominance by *Celtis laevigata* (sugarberry) and *Juglans nigra* (black walnut).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree)

Characteristic Species: *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Aristolochia macrophylla* (pipevine), *Asarum canadense* (Canadian wildginger), *Asimina triloba* (pawpaw), *Carya ovata* (shagbark hickory), *Cercis canadensis* (eastern redbud), *Cryptotaenia canadensis* (Canadian honewort), *Galium triflorum* (fragrant bedstraw), *Lindera benzoin* (northern spicebush), *Osmorhiza longistylis* (longstyle sweetroot), *Parthenocissus quinquefolia* (Virginia

creeper), *Polystichum acrostichoides* (Christmas fern), *Toxicodendron radicans* (eastern poison ivy), *Ulmus rubra* (slippery elm).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Rubus phoenicolasius (wine raspberry)	-	plant	exotic
Veronica hederifolia (ivyleaf speedwell)	-	plant	exotic

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This type occurs in the Ridge and Valley and Cumberland Plateau of Tennessee, the Interior Low Plateau of Kentucky, the Upper East Gulf Coastal Plain of Mississippi, and the Central Appalachian, Piedmont and Inner Coastal Plain regions of Virginia, West Virginia, Maryland and possibly Pennsylvania and Delaware. Its full range has not been documented.

States/Provinces: DC, DE?, KY, MD, MS, PA?, TN, VA, WV.

Federal Lands: NPS (Antietam, Big South Fork, Blue Ridge Parkway, Bluestone, C&O Canal, Catoctin Mountain, Chickamauga-Chattanooga, Cumberland Gap, Fort Donelson, George Washington Parkway, Harpers Ferry, Lincoln Birthplace, Mammoth Cave, Natchez Trace, National Capital-East, New River Gorge, Obed, Rock Creek, Shenandoah, Thomas Stone, Vicksburg); TVA (Tellico); USFS (Cherokee?, Monongahela).

CONSERVATION STATUS

Rank: GNA (ruderal) (28-Oct-2003).

Reasons: This forest represents successional vegetation and is thus not of high conservation concern. It is composed largely of native species, though exotics may be locally abundant. Its conservation value is limited, but mature examples could provide buffer for communities of greater conservation value.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: This type was originally described from the work of Andreu and Tukman (1995) but was later modified to emphasize stands with moderately high base saturation levels. It is apparently a widespread successional forest of relatively fertile substrates in all provinces of the Mid-Atlantic states and in parts of the Southeast.

Similar Associations:

Liriodendron tulipifera - Pinus taeda Forest (CEGL007521)--supports a significant pine component.

Liriodendron tulipifera - Quercus rubra - Fraxinus americana / Asimina triloba / Actaea racemosa - Uvularia perfoliata Forest (CEGL006186).

Liriodendron tulipifera - Quercus spp. Forest (CEGL007221)--lacks species affiliated with circumneutral conditions.

Liriodendron tulipifera Forest (CEGL007218)--is less diverse and earlier successional.

Related Concepts:

Liriodendron tulipifera / Lindera benzoin Forest (Lea 2000) F
Oak-Hickory Association of the Western Shore District (Shreve et al. 1910) B
Successional forest of low-elevation plateaus (Vanderhorst 2001a) B
Tulip Poplar Type (Schmalzer and DeSelm 1982) B
Yellow Poplar - Sugar Maple - Cucumber (Rentch et al. 2005) ?

SOURCES

Description Authors: R. E. Evans, mod. M. Pyne, J. Teague, C. W. Nordman, R. White, S. C. Gawler.

References: Andreu and Tukman 1995, Hall and Mathews 1974, Lea 2000, Lea 2003, Martin 1989, NatureServe Ecology - Southeastern U.S. unpubl. data, Rentch et al. 2005, Schmalzer and DeSelm 1982, Shreve et al. 1910, Southeastern Ecology Working Group n.d., TDNH unpubl. data, VDNH unpubl. data, Vanderhorst 2001a, Vanderhorst et al. 2007, Vanderhorst et al. 2008, WVNHP unpubl. data b, Young et al. 2006.

Plot BLUE.83. Successional Tuliptree / Northern Spicebush Forest.

COMMON NAME (PARK-SPECIFIC): CALCAREOUS OAK FOREST

SYNONYMS

NVC English Name:	**Chinquapin Oak - (White Oak, Northern Red Oak) - Bitternut Hickory / Smooth Blackhaw Forest**
NVC Scientific Name:	***Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest**
NVC Identifier:	**CEGL004793**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches (0.5–5.7 ha) confined to lower gorge slopes with warm aspects and soils derived from calcareous bedrock. Outcrops which support this association in the park probably belong to the Stony Gap Member of the Avis Limestone, part of the Mississippian-age Hinton Formation. Average Beers transformed aspect of plots (0.90) is second highest for associations in the park, reflecting its strong affinity for south to southwest aspects. Slopes in mapped polygons range from 19 to 45 degrees (mean = 26). Elevations in mapped polygons range from 449 to 635 m (mean = 509). Unvegetated ground cover is dominated by litter, but there is also above average exposed soil due to runoff on steep slopes. Soils in plots are described as well-drained, somewhat moist to dry silt loam and sandy loam, with pH measured in the field ranging from 6.0 to 7.5. Soils tested in the lab range from medium to very slightly acidic (pH = 5.95) with relatively high levels of Al, Ca, Cu, K, Mg, and P and relatively low levels of organic matter, estimated N release, S, Fe, Mn, Na, and Zn compared to average values in the park. Stands of this association usually occur adjacent to and may grade towards stands of Oak - Eastern White Pine / Ericad Forest (CEGL008539) and Oak - Hickory - Sugar Maple Forest (CEGL007268) which are the prevalent matrix communities on warm-aspect gorge slopes in the park. Some stands are adjacent to small patches of Virginia Pine - Oak Shale Woodland (CEGL006288) which occur upslope in xeric sites on contrasting acidic geology.

Vegetation Description: This association is a somewhat open- to closed-canopy deciduous forest with a large component of species adapted to calcareous soils. Canopy cover in plots ranges from 60–70%, dominated by *Quercus alba* (white oak), *Quercus rubra* (northern red oak), and *Quercus muehlenbergii* (chinkapin oak). Additional canopy trees include *Fraxinus americana* (white ash), *Acer saccharum* var. *saccharum* (sugar maple), *Carya ovata* (shagbark hickory), and *Juniperus virginiana* var. *virginiana* (eastern redcedar). Subcanopy cover in plots ranges from 40–60%. Subcanopy trees, in addition to species in the canopy, include *Ulmus rubra* (slippery elm), *Aesculus flava* (yellow buckeye), and *Carya alba* (mockernut hickory). Shrub cover in plots ranges from 8–20% (including small trees, vines, and shrubs). Common species in the shrub layers include *Cercis canadensis* var. *canadensis* (eastern redbud), *Ostrya virginiana* var. *virginiana* (hophornbeam), *Cornus florida* (flowering dogwood), *Viburnum prunifolium* (blackhaw), and saplings of the canopy and subcanopy trees. The herb layer has relatively high cover (20–60% in plots) and diversity. Herbs with highest constancy include *Oxalis grandis* (great yellow woodsorrel), *Galium circaezans* (licorice bedstraw), *Ageratina altissima* var. *altissima* (white snakeroot), *Dichanthelium boscii* (Bosc's panicgrass), *Viola X palmata* (early blue violet), *Sedum ternatum* (woodland stonecrop), *Parthenocissus quinquefolia* (Virginia creeper), *Packera obovata* (roundleaf ragwort), *Amphicarpaea bracteata* (American hogpeanut), *Houstonia longifolia* (longleaf summer bluet), *Eurybia divaricata* (white wood aster), *Dioscorea*

quaternata (fourleaf yam), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Brachyelytrum erectum* (bearded shorthusk), and *Asclepias quadrifolia* (fourleaf milkweed). State-rare species found in plots include *Viburnum rafinesquianum* (downy arrowwood), *Monarda fistulosa* ssp. *brevis* (Smoke Hole bergamot), and *Allium oxyphilum* (lillydale onion). Vascular plant species richness ranges 38 to 65 (mean = 51.4) species per 400-square-meter plot. Cover by nonvascular plants is negligible.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* var. *saccharum* (sugar maple), *Fraxinus americana* (white ash), *Quercus alba* (white oak), *Quercus muehlenbergii* (chinkapin oak), *Quercus rubra* (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cercis canadensis* var. *canadensis* (eastern redbud)

Characteristic Species: *Amphicarpaea bracteata* (American hogpeanut), *Asclepias quadrifolia* (fourleaf milkweed), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Oxalis grandis* (great yellow woodsorrel), *Viburnum prunifolium* (blackhaw).

Other Noteworthy Species:

Species	GRank	Type	Note
Allium oxyphilum (lillydale onion)	G2Q	plant	globally imperiled
Monarda fistulosa ssp. *brevis* (smoke hole bergamot)	G5T1	plant	globally critically imperiled
Viburnum rafinesquianum (downy arrowwood)	-	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2007

Local Range: A total of 9 polygons covering 19.33 hectares are mapped in the park. The distribution of this association seems to be constrained to a single calcareous geological formation where it outcrops on south to southwest aspects. Small patches are widely scattered along a narrow elevational zone throughout the length of the park.

Classification Comments: The nominal tree *Carya cordiformis* (bitternut hickory) was not found in plots of this association from Bluestone, although the species does occur in the park.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Five plots were sampled: BLUE.1, BLUE.3, BLUE.5, BLUE.24, and BLUE.129.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus muehlenbergii - (Acer saccharum)* Forest Alliance (A.1912)
Alliance (English name)	Chinquapin Oak - (Sugar Maple) Forest Alliance
Association	*Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest
Association (English name)	Chinquapin Oak - (White Oak, Northern Red Oak) - Bitternut Hickory / Smooth Blackhaw Forest

Ecological System(s): Southern Appalachian Oak Forest (CES202.886).
Central Appalachian Alkaline Glade and Woodland (CES202.602).

GLOBAL DESCRIPTION

Concept Summary: These are rich forests of moderately steep slopes in the Ridge and Valley and adjacent provinces over various limestone and dolomitic formations. The canopy ranges from closed to partly open and is dominated by a mixture of *Quercus muehlenbergii* (chinkapin oak), other oaks (particularly *Quercus alba* (white oak) and *Quercus rubra* (northern red oak)), and several hickories (*Carya cordiformis* (bitternut hickory), *Carya glabra* (pignut hickory), and *Carya ovalis* (red hickory)). *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Acer saccharum* (sugar maple), *Quercus velutina* (black oak), *Ulmus rubra* (slippery elm), *Tilia americana* (American basswood), and *Juglans nigra* (black walnut) may also be present in the canopy. Disturbed stands may have a higher proportion of *Fraxinus americana* (white ash), *Celtis occidentalis* (common hackberry), and other early-successional species in the overstory. The relatively open subcanopy may contain *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), and *Juniperus virginiana* var. *virginiana* (eastern redcedar), as well as smaller individuals of *Fraxinus americana* (white ash) and *Carya* (hickory) spp. *Viburnum prunifolium* (blackhaw), *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Ulmus rubra* (slippery elm), *Ostrya virginiana* (hophornbeam), *Viburnum prunifolium* (blackhaw), and *Asimina triloba* (pawpaw) are present as tall shrubs or small trees. Low shrubs include *Rhus aromatica* var. *aromatica* (fragrant sumac), *Dirca palustris* (eastern leatherwood), *Staphylea trifolia* (American bladdernut), and *Toxicodendron radicans* (eastern poison ivy). Herbs present include *Ageratina altissima* (white snakeroot), *Amphicarpaea bracteata* (American hogpeanut), *Asclepias quadrifolia* (fourleaf milkweed), *Bromus pubescens* (hairy woodland brome), *Brachyelytrum erectum* (bearded shorthusk), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Collinsonia canadensis* (richweed), *Dichanthelium boscii* (Bosc's panicgrass), *Dioscorea quaternata* (fourleaf yam), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Euphorbia mercurialina* (mercury spurge), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Geranium maculatum* (spotted geranium), *Hexastylis arifolia* var. *ruthii* (Ruth's littlebrownjug), *Houstonia longifolia* (longleaf summer bluet), *Hydrophyllum virginianum* (Shawnee salad), *Maianthemum racemosum* (feathery false lily of the valley), *Oxalis grandis* (great yellow woodsorrel), *Packera obovata* (roundleaf ragwort), *Polystichum acrostichoides* (Christmas fern), *Sanicula odorata* (clustered blacksnakeroot), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop), *Thaspium barbinode* (hairyjoint meadowparsnip), *Viola X palmata* (early blue violet), and *Viola pubescens* (downy yellow violet). Some small patches of *Arundinaria gigantea* (giant cane) are also present in stands at the southern end of the range.

Environmental Description: This type is strongly associated with carbonate rock substrates and calcareous soils of the Ridge and Valley province. A few rare, disjunct Piedmont stands also occur in the northern Virginia Triassic (Culpeper) Basin in association with bluffs of calcareous siltstone. Examples of this community in Tennessee and southwestern Virginia occur on gentle to steep, south- to east-facing slopes underlain by limestone. Sites are submesic, with locally shallow soils over flat-lying limestones. Plot-sampled stands in Virginia, West Virginia, and Maryland are located on gentle to steep slopes with variable aspects. Underlying bedrock in all but one case is limestone or dolomite. Middle and upper slope topographic positions are prevalent, but stands also occur on lower gorge slopes. Most sites have been disturbed in the past

by cutting, clearing, and/or grazing. Surface substrate at sampling sites are not very rocky (mean cover of bedrock and loose rocks = 6%), have an average of 17% bare mineral soil, and are mostly covered by leaf litter and other organic matter. Soil samples collected from plots are nearly circumneutral (mean pH = 6.6) with very high calcium (mean = 3374 ppm) and magnesium (mean = 408 ppm) content, as well as nearly complete (97%) total base saturation. Habitats are subjectively assessed as submesic to mesic.

Vegetation Description: Stands are dominated by a mixture of *Quercus muehlenbergii* (chinkapin oak), other oaks (particularly *Quercus alba* (white oak) and *Quercus rubra* (northern red oak)), and several hickories (*Carya cordiformis* (bitternut hickory), *Carya glabra* (pignut hickory), and *Carya ovalis* (red hickory)). *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Acer saccharum* (sugar maple), *Quercus velutina* (black oak), *Ulmus rubra* (slippery elm), *Tilia americana* (American basswood), and *Juglans nigra* (black walnut) may also be present in the canopy. Disturbed stands may have a higher proportion of *Fraxinus americana* (white ash), *Celtis occidentalis* (common hackberry), and other early-successional species in the overstory. The relatively open subcanopy may contain *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), and *Juniperus virginiana* var. *virginiana* (eastern redcedar), as well as smaller individuals of *Fraxinus americana* (white ash) and *Carya* (hickory) spp. *Viburnum prunifolium* (blackhaw), *Cercis canadensis* var. *canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Ulmus rubra* (slippery elm), *Ostrya virginiana* (hophornbeam), *Viburnum prunifolium* (blackhaw), and *Asimina triloba* (pawpaw) are present as tall shrubs or small trees. Low shrubs include *Rhus aromatica* var. *aromatica* (fragrant sumac), *Dirca palustris* (eastern leatherwood), *Staphylea trifolia* (American bladdernut), and *Toxicodendron radicans* (eastern poison ivy). Herbs present include *Ageratina altissima* (white snakeroot), *Amphicarpaea bracteata* (American hogpeanut), *Asclepias quadrifolia* (fourleaf milkweed), *Bromus pubescens* (hairy woodland brome), *Brachyelytrum erectum* (bearded shorthusk), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Collinsonia canadensis* (richweed), *Dichanthelium boscii* (Bosc's panicgrass), *Dioscorea quaternata* (fourleaf yam), *Desmodium glutinosum* (pointedleaf ticktrefoil), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Euphorbia mercurialina* (mercury spurge), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Geranium maculatum* (spotted geranium), *Hexastylis arifolia* var. *ruthii* (Ruth's littlebrownjug), *Houstonia longifolia* (longleaf summer bluet), *Hydrophyllum virginianum* (Shawnee salad), *Maianthemum racemosum* (feathery false lily of the valley), *Oxalis grandis* (great yellow woodsorrel), *Packera obovata* (roundleaf ragwort), *Polystichum acrostichoides* (Christmas fern), *Sanicula odorata* (clustered blacksnakeroot), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop), *Thaspium barbinode* (hairyjoint meadowparsnip), *Viola X palmata* (early blue violet), and *Viola pubescens* (downy yellow violet). Some small patches of *Arundinaria gigantea* (giant cane) are also present in stands at the southern end of the range. Additional species characteristic of plot samples at the northern end of the range are *Festuca subverticillata* (nodding fescue), *Viola sororia* (common blue violet), *Cardamine concatenata* (cutleaf toothwort), *Geum canadense* (white avens), *Arisaema triphyllum* (Jack in the pulpit), *Actaea racemosa* (black bugbane), *Dicentra cucullaria* (Dutchman's breeches), *Claytonia virginica* (Virginia springbeauty), *Polygonum virginianum* (jumpseed), *Corydalis flavula* (yellow fumewort), *Eurybia divaricata* (white wood aster), *Podophyllum peltatum* (mayapple), and *Viola striata* (striped cream violet). Several species that are more typical of basic mesic forests (e.g., *Asarum canadense* (Canadian wildginger), *Jeffersonia diphylla* (twinleaf), *Hybanthus concolor* (eastern greenviolet), and

Dicentra canadensis (squirrel corn)) occasionally exhibit strong patch-dominance in this community, although none of these species occurs with high constancy. In Lee County, VA, *Hydrastis canadensis* (goldenseal) frequently forms large clones in this forest. Additional, relatively inconstant herbs that occasionally cover >1% of an individual stand include *Sanicula odorata* (clustered blacksnakeroot), *Bromus pubescens* (hairy woodland brome), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Sanguinaria canadensis* (bloodroot), *Galium concinnum* (shining bedstraw), *Hepatica nobilis* var. *obtusa* (roundlobe hepatica), *Polymnia canadensis* (whiteflower leafcup), *Stellaria pubera* (star chickweed), and *Carex jamesii* (James' sedge). Many additional herbs occur at low cover and constancy.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus muehlenbergii* (chinkapin oak)

Characteristic Species: *Bromus pubescens* (hairy woodland brome), *Cercis canadensis* (eastern redbud), *Quercus muehlenbergii* (chinkapin oak).

Other Noteworthy Species:

Species	GRank	Type	Note
Monarda fistulosa ssp. brevis (smoke hole bergamot)	G5T1	plant	globally critically imperiled

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is found in the Ridge and Valley and adjacent areas of Tennessee, Virginia, West Virginia, and Maryland, with small disjunct occurrences in the northern Virginia Triassic (Culpeper) Basin.

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

Federal Lands: NPS (Antietam, Big South Fork, Bluestone, C&O Canal, Cumberland Gap, Harpers Ferry, Manassas, New River Gorge).

CONSERVATION STATUS

Rank: G3G4 (1-Oct-2006)

Reasons: This association is potentially widespread across the Ridge and Valley province of four states. However, this region has a long and extensive history of settlement and agriculture. As a result, few high-quality occurrences of this community exist, and most contemporary stands have been impacted by multiple disturbances, including clearing, cutting, and grazing. Moreover, the fertile soils occupied by this community are particularly prone to invasion by aggressive introduced weeds, whose abundance degrades the quality of many existing stands.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: This association has been observed on The Nature Conservancy's Powell River Preserve and in Cumberland Gap National Historical Park, both in Claiborne County, Tennessee, as well as in a number of Virginia sites in the Ridge and Valley province. Quantitative data from northwestern Virginia, eastern and southern West Virginia, and western Maryland have been analyzed for the National Park Service.

Similar Associations:

Acer saccharum - Quercus muehlenbergii / Cercis canadensis Forest (CEGL006017)--clearly related but more xeric and without oak dominance.

Related Concepts:

IA6j. Interior Calcareous Oak-Hickory Forest (Allard 1990) ?

SOURCES

Description Authors: M. Pyne and R. White, mod. G. P. Fleming and S. C. Gawler.

References: Allard 1990, NatureServe Ecology - Southeastern U.S. unpubl. data, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.129. Calcareous Oak Forest.

COMMON NAME (PARK-SPECIFIC): OAK - HICKORY - SUGAR MAPLE FOREST

SYNONYMS

NVC English Name:	**Chestnut Oak - Shagbark Hickory - Northern Red Oak / Sugar Maple Forest**
NVC Scientific Name:	***Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest**
NVC Identifier:	**CEGL007268**

LOCAL INFORMATION

Environmental Description: This association, the most abundant in the park, is the matrix forest which predominates on gorge slopes with intermediate soil moisture and fertility. It ranges from concave positions (coves) on the warmest aspects (south-southwest) to convex positions (ridges) on the coolest aspects (north-northeast). Average Beers transformed aspect in plots (0.61) is somewhat above average, indicating overall affinity for warmer aspects. Slopes in mapped polygons range from 1 to 46 degrees (mean = 27). Elevations in mapped polygons range from 438 to 733 m (mean = 561). Unvegetated ground cover is usually dominated by litter, but some areas also have high cover of exposed rock and soil. Soils in plots are described as dry to somewhat moist, well-drained, stony, or less often nearly stone-free loam, sandy loam, and silt loam. Soils from plots tested extremely to strongly acidic (mean pH = 4.7) with relatively high levels of organic matter, estimated N release, Al, K, Mg, Mn, and P, and relatively low levels of S, B, Ca, Cu, Fe, Na, and Zn compared to average values in the park. Soils in most areas are mapped as Calvin, high base substratum-Berks stony silt loams, on 30 to 70% slopes (Sponaugle et al. 1984). Polygons of this association on warm aspects are often adjacent to and grade towards polygons of Oak - Eastern White Pine / Ericad Forest (CEGL008539) and Virginia Pine - Oak Shale Woodland (CEGL006288), both of which occupy more xeric sites, and Calcareous Oak Forest (CEGL004793), which occupies areas with Ca-enriched soils. Polygons on cool aspects are often adjacent to and grade towards polygons of Sugar Maple - Yellow Buckeye - American Basswood Forest (CEGL005222), which occupies more mesic sites.

Vegetation Description: This association represents somewhat open- or, more often, closed-canopy forests dominated by a mixture of oaks and other deciduous tree species with a large component of sugar maple in the subcanopy. Canopy cover in plots ranges from 30–90%. Dominant canopy species include (in decreasing order of constancy in plots) *Quercus rubra* (northern red oak), *Quercus prinus* (chestnut oak), *Quercus alba* (white oak), *Fraxinus americana* (white ash), *Quercus velutina* (black oak), and *Carya glabra* (pignut hickory). Additional canopy species include *Acer saccharum* var. *saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Tilia americana* (American basswood), *Carya ovata* (shagbark hickory), and *Carya alba* (mockernut hickory). Subcanopy cover in plots ranges from 20–60% and is usually dominated by *Acer saccharum* var. *saccharum* (sugar maple). Cover in the shrub layers of plots ranges from 2–70%, often dominated by *Acer saccharum* var. *saccharum* (sugar maple) and other tree saplings. Common shrubs and small trees include *Hamamelis virginiana* (American witchhazel), *Cornus florida* (flowering dogwood), *Viburnum rafinesquianum* (downy arrowwood), *Amelanchier arborea* var. *arborea* (common serviceberry), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Ostrya virginiana* var. *virginiana* (hophornbeam). Herb cover in plots ranges from 5–30%. Common herbs include (in decreasing order of constancy in plots) *Dioscorea quaternata* (fourleaf yam), *Polystichum acrostichoides* (Christmas fern), *Sedum*

ternatum (woodland stonecrop), *Dichanthelium boscii* (Bosc's panicgrass), *Asplenium platyneuron* (ebony spleenwort), *Ageratina altissima* var. *altissima* (white snakeroot), *Vicia caroliniana* (Carolina vetch), *Solidago caesia* (wreath goldenrod), *Houstonia longifolia* (longleaf summer bluet), *Bromus pubescens* (hairy woodland brome), *Zizia trifoliata* (meadow alexanders), *Parthenocissus quinquefolia* (Virginia creeper), *Eurybia divaricata* (white wood aster), *Chimaphila maculata* (striped prince's pine), and *Carex laxiflora* (broad looseflower sedge). State-rare plants found in plots include *Viburnum rafinesquianum* (downy arrowwood), *Berberis canadensis* (American barberry), *Monarda fistulosa* ssp. *brevis* (Smoke Hole bergamot), *Myosotis macrosperma* (largeseed forget-me-not), and *Carex cumberlandensis* (Cumberland sedge). Vascular plant species richness ranges from 36 to 73 (mean = 53.6) species per 400-square-meter plot. Nonvascular cover in plots ranges from 0–5%. Mosses in plots include *Thuidium delicatulum* (delicate thuidium moss), *Leucobryum glaucum* (leucobryum moss), and species of *Dicranum* (dicranum moss), *Mnium* (mnium calcareous moss), and *Polytrichum* (polytrichum moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* var. *saccharum* (sugar maple), *Carya glabra* (pignut hickory), *Fraxinus americana* (white ash), *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)

Characteristic Species: *Asplenium platyneuron* (ebony spleenwort), *Bromus pubescens* (hairy woodland brome), *Cercis canadensis* var. *canadensis* (eastern redbud), *Dichanthelium boscii* (Bosc's panicgrass), *Solidago caesia* (wreath goldenrod), *Vicia caroliniana* (Carolina vetch).

Other Noteworthy Species:

Species	GRank	Type	Note
Berberis canadensis (American barberry)	G3	plant	WV state-critically imperiled
Bromus pubescens (hairy woodland brome)	-	plant	WV state-critically imperiled
Carex cumberlandensis (Cumberland sedge)	-	plant	WV state-critically imperiled
Monarda fistulosa ssp. *brevis* (Smoke Hole bergamot)	G5T1	plant	globally critically imperiled
Myosotis macrosperma (largeseed forget-me-not)	-	plant	WV state-imperiled
Viburnum rafinesquianum (downy arrowwood)	-	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2007

Local Range: This association occupies large areas in the gorges of the Bluestone River and it tributaries throughout the park. A total of 142 polygons covering 622.53 hectares are mapped in the park.

Classification Comments: This association is most similar to the "white oak - northern red oak - black oak" community classified by Rentch et al.'s (2005) study of upland forests in the Bluestone River gorge; this type is represented by the highest number of plots in their study (to be expected for a matrix forest type), and sugar maple is also an important tree, especially in the smaller size classes.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Fifteen plots were sampled: BLUE.8, BLUE.9, BLUE.10, BLUE.16, BLUE.21, BLUE.25, BLUE.33, BLUE.38, BLUE.56, BLUE.57, BLUE.71, BLUE.76, BLUE.85, BLUE.95, and BLUE.105.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus prinus - Quercus (alba, falcata, rubra, velutina)* Forest Alliance (A.249)
Alliance (English name)	Chestnut Oak - (White Oak, Southern Red Oak, Northern Red Oak, Black Oak) Forest Alliance
Association	*Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest
Association (English name)	Chestnut Oak - Shagbark Hickory - Northern Red Oak / Sugar Maple Forest
Ecological System(s):	Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898). Southern Appalachian Oak Forest (CES202.886).

GLOBAL DESCRIPTION

Concept Summary: These dry-mesic forests of the Ridge and Valley and adjacent sedimentary ecoregions (Cumberlands, Interior Low Plateau) occur on ridges, gorge slopes, spurs, and knobs. Elevations range from 250–1000 m (800–3250 feet). Soils are very well-drained, acidic to circumneutral, and derived from sandstone and shales. The canopy is dominated by *Quercus prinus* (chestnut oak) with other oaks and hickories, typically with *Acer saccharum* (sugar maple) as a canopy associate and/or subcanopy dominant. Some examples are strongly dominated by *Quercus prinus* (chestnut oak). Other examples with more diverse canopies include *Quercus rubra* (northern red oak), *Carya ovata* (shagbark hickory), *Carya glabra* (pignut hickory), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), and *Quercus velutina* (black oak). The canopy is generally closed (greater than 75% cover). The subcanopy may be dominated by *Acer saccharum* (sugar maple) in some examples. Other subcanopy species may include *Carya ovata* (shagbark hickory), *Carya glabra* (pignut hickory), *Quercus rubra* (northern red oak), *Quercus muehlenbergii* (chinkapin oak), *Aesculus flava* (yellow buckeye), and *Juniperus virginiana* (eastern redcedar). The subcanopy is relatively sparse with cover less than 25%. The shrub and herbaceous layers are sparse with small stems of canopy and subcanopy species along with herbaceous species such as *Actaea racemosa* (black bugbane), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Asplenium platyneuron* (ebony spleenwort), *Bromus pubescens* (hairy woodland brome), *Carex albursina* (white bear sedge), *Carex cumberlandensis*, *Carex laxiflora* (broad looseflower sedge), *Campanulastrum americanum* (American bellflower), *Chimaphila maculata* (striped prince's pine), *Dichanthelium boscii* (Bosc's panicgrass), *Dioscorea quaternata* (fourleaf yam), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Geranium maculatum* (spotted geranium), *Houstonia longifolia* (longleaf summer bluet), *Polystichum acrostichoides* (Christmas fern), *Prosartes lanuginosa* (yellow fairybells), *Sanicula canadensis* (Canadian blacksnakeroot), *Sedum ternatum* (woodland stonecrop), *Solidago caesia* (wreath goldenrod), *Vicia caroliniana* (Carolina vetch), *Viola* (violet) spp., and *Zizia trifoliata* (meadow alexanders).

Environmental Description: In the Ridge and Valley of Tennessee, these forests occur near the tops of calcareous ridges and knobs with northerly aspects that range from 250–1000 m (800–3250 feet) elevation, on very well-drained, gravelly, sandy soils (Andreu and Tukman 1995). The sites are characterized by very well-drained, gravely, sandy soils and exposed topographical positions. On the Tellico Pilot Project study site, many stands were found on the Dandridge, Tellico, and Steekee soil series. The Tellico series is an Ultisol, while the others are Inceptisols; all can be described as well- to excessively well-drained soils. The Tellico and Steekee soils are strongly or very strongly acidic. The Dandridge soils are slightly acidic neutral or mildly alkaline. At New River Gorge and the nearby Bluestone River in West Virginia, this association is the predominant upland forest type on lower to upper colluvial gorge slopes of intermediate soil moisture and fertility with relatively warm, dry aspects. It also occurs in smaller patches on plateaus, ridge spurs and convex upper slopes, often north-facing. Stands occur both on sandstones of the Pottsville Group and on shales of the Mauch Chunk Group. Elevations of mapped stands range from 249 to 985 m. Slopes range from flat to very steep (0 to 51 degrees, mean = 25 degrees). Soils are mostly well-drained sandy to clay loams mapped in the Calvin, Dekalb, and Gilpin series. Soil chemistry analyzed from 10 plots indicates extremely acidic to slightly acidic soils (mean pH = 4.92) with relatively high levels of organic matter, and intermediate levels of most nutrients and somewhat higher levels of some nutrients (K, Mg, Mn, P) compared to other community types nearby.

Vegetation Description: This association is a closed-canopy (or occasionally somewhat open-canopy) deciduous forest dominated by species of *Quercus* (oak), often with *Carya* (hickory) spp., and characteristically with an abundance of *Acer saccharum* (sugar maple) in the canopy and/or shrub layers. *Quercus prinus* (chestnut oak) is the most typical canopy dominant; other dominants can include *Quercus rubra* (northern red oak), *Acer saccharum* (sugar maple), *Quercus alba* (white oak), *Quercus velutina* (black oak), *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), and *Carya ovata* (shagbark hickory). *Liriodendron tulipifera* (tuliptree) may be a canopy associate. Subcanopy species include *Carya ovata* (shagbark hickory), *Carya glabra* (pignut hickory), *Quercus rubra* (northern red oak), *Quercus muehlenbergii* (chinkapin oak), *Acer saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Tilia americana* (American basswood), and *Juniperus virginiana* (eastern redcedar). The subcanopy may be dominated by *Acer saccharum* (sugar maple) in some examples. The subcanopy is typically relatively sparse with less than 25% cover. Vines, which may occur in the understory or reach into the canopy, include *Aristolochia macrophylla* (pipevine), *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis aestivalis* var. *bicolor* (summer grape). Common tall shrubs or short trees include *Amelanchier arborea* var. *arborea* (common serviceberry), *Cercis canadensis* (eastern redbud), *Cornus florida* (flowering dogwood), *Halesia tetraptera* (mountain silverbell), *Hamamelis virginiana* (American witchhazel), *Ostrya virginiana* (hophornbeam), and *Viburnum rafinesquianum* (downy arrowwood). The shrub and herbaceous layers are sparse with small stems of canopy and subcanopy species along with herbaceous species. The most common shrubs are *Viburnum acerifolium* (mapleleaf viburnum) and *Smilax rotundifolia* (roundleaf greenbrier). Common herbs include *Actaea racemosa* (black bugbane), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Asplenium platyneuron* (ebony spleenwort), *Bromus pubescens* (hairy woodland brome), *Carex albursina* (white bear sedge), *Carex cumberlandensis*, *Carex laxiflora* (broad looseflower sedge), *Campanulastrum americanum* (American bellflower), *Chimaphila maculata* (striped prince's pine), *Dichanthelium boscii* (Bosc's panicgrass),

Dioscorea quaternata (fourleaf yam), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Geranium maculatum* (spotted geranium), *Houstonia longifolia* (longleaf summer bluet), *Polystichum acrostichoides* (Christmas fern), *Prosartes lanuginosa* (yellow fairybells), *Sanicula canadensis* (Canadian blacksnakeroot), *Sedum ternatum* (woodland stonecrop), *Solidago caesia* (wreath goldenrod), *Vicia caroliniana* (Carolina vetch), *Viola* (violet) spp., and *Zizia trifoliata* (meadow alexanders). Vascular plant species richness in 26 West Virginia sampled plots (New River) ranged from 27 to 54 taxa (mean = 42).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Carya glabra* (pignut hickory)
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple)
Shrub/sapling (tall & short)	Vine/Liana	*Smilax rotundifolia* (roundleaf greenbrier)
Short shrub/sapling	Broad-leaved deciduous tree	*Quercus prinus* (chestnut oak)
Herb (field)	Fern or fern ally	*Pleopeltis polypodioides* ssp. *polypodioides* (resurrection fern)

Characteristic Species: *Actaea racemosa* (black bugbane), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Carex albursina* (white bear sedge), *Dioscorea quaternata* (fourleaf yam), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Geranium maculatum* (spotted geranium), *Parthenocissus quinquefolia* (Virginia creeper), *Polystichum acrostichoides* (Christmas fern), *Prosartes lanuginosa* (yellow fairybells), *Quercus rubra* (northern red oak), *Sanicula canadensis* (Canadian blacksnakeroot), *Sedum ternatum* (woodland stonecrop), *Solidago caesia* (wreath goldenrod), *Viburnum acerifolium* (mapleleaf viburnum).

Other Noteworthy Species:

Species	GRank	Type	Note
Berberis canadensis (American barberry)	G3	plant	globally vulnerable
Monarda fistulosa ssp. *brevis* (Smoke Hole bergamot)	G5T1	plant	globally critically imperiled

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: These dry-mesic forests are found in the Ridge and Valley and adjacent sedimentary ecoregions (Cumberlands, Interior Low Plateau) of the southeastern United States, ranging from Kentucky and Tennessee to West Virginia and perhaps Virginia.

States/Provinces: AL, KY?, TN, VA?, WV.

Federal Lands: DOE (Oak Ridge); NPS (Bluestone, New River Gorge, Russell Cave); TVA (Tellico); USFS (Cherokee?).

CONSERVATION STATUS

Rank: G4? (9-Oct-2001).

Reasons: This community is believed to be relatively common and secure, although good mature examples of large size may be uncommon. Additional information is needed relative to its distribution and relation to other similar communities. The rank was formerly G3G5, and changing it to G4? (which is equivalent) makes it clear that this is not to be considered a rare community type.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Two variants of this association (14 stands sampled; 19 stands sampled) were described from Tellico Pilot Project (Ridge and Valley of Tennessee, northeast Monroe County). It has also been sampled at New River Gorge and Bluestone River in West Virginia. This may be similar to vegetation reported from limestone in the Ridge and Valley of Virginia.

Similar Associations:

Quercus prinus - Quercus rubra - Carya (ovata, glabra) - Pinus virginiana Forest (CEGL007269).

Quercus prinus - Quercus spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700).

Related Concepts:

Quercus prinus - Quercus rubra - (Quercus alba) - Liriodendron tulipifera - Acer rubrum / Parthenocissus quinquefolia forest (Vanderhorst 2001b) B

Chestnut Oak Forest (Oberholster 1993) B

Chestnut Oak, RV (Pyne 1994) B

Chestnut Oak: 44 (Eyre 1980) B

IA6d. Chestnut Oak Slope and Ridge Forest (Allard 1990) ?

White Oak - Northern Red Oak - Black Oak (Rentch et al. 2005) ?

SOURCES

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

References: Allard 1990, Andreu and Tukman 1995, Evans 1991, Eyre 1980, Oberholster 1993, Pyne 1994, Rentch et al. 2005, Schotz pers. comm., Southeastern Ecology Working Group n.d., Sponaugle et al. 1984, TDNH unpubl. data, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.85. Oak - Hickory - Sugar Maple Forest.

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

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

LOCAL INFORMATION

Environmental Description: This successional woodland or forest occurs in small patches (0.25–2.15 ha) on gentle topography in areas previously cleared for agriculture. It is known from two sites in lower slope positions just above the floodplains of the Bluestone and Little Bluestone rivers. Both sites are mapped as unforested (white) on the 1912 Big Bend and 1929 Flattop USGS 15' topographic maps, and part of one site is mapped as unforested on a more recent 1968 Flattop USGS 7.5' topographic map. Stands of this association appear to be more recently abandoned from agriculture compared to other successional forest types in the park. Slopes in mapped polygons range from 6 to 24 degrees (mean = 14.4). Elevations in mapped polygons range from 453 to 485 m (mean = 473). Soil in one plot is described as moist, moderately well-drained, somewhat stony sandy loam. Underlying geology is shale of the Hinton Formation. Soils from plots tested medium acidic (mean pH = 5.7) with relatively high levels of estimated N release, S, B, Ca, Cu, Fe, Mg, Mn, Na, and Zn, and relatively low levels of organic matter, Al, K, Mn, and P compared to average values in the park. Adjacent upland associations include Oak - Hickory - Sugar Maple Forest (CEGL007268) and Oak - Eastern White Pine / Ericad Forest (CEGL008539).

Vegetation Description: This association is a successional deciduous woodland or forest dominated by *Robinia pseudoacacia* (black locust). Cover in the canopy of plots ranges from 40–50%. Associated trees include *Carya ovata* (shagbark hickory), *Celtis occidentalis* (common hackberry), *Juglans nigra* (black walnut), *Quercus rubra* (northern red oak), and *Ulmus rubra* (slippery elm). Shrubs and vines in one plot include *Lindera benzoin* (northern spicebush), *Rosa multiflora* (multiflora rose), *Rubus phoenicolasius* (wine raspberry), and *Toxicodendron radicans* (eastern poison ivy). Common herbs include (in decreasing order of cover in plots) *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), *Viola striata* (striped cream violet), *Galium aparine* (stickywilly), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Leersia virginica* (whitegrass), *Stellaria media* (common chickweed), and *Festuca subverticillata* (nodding fescue). The state-rare herb *Myosotis macrosperma* (largeseed forget-me-not) is abundant in one plot. Vascular plant species richness in one completely sampled plot is 41 species per 400 square meters.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Juglans nigra* (black walnut), *Robinia pseudoacacia* (black locust), *Ulmus rubra* (slippery elm)
Herb (field)	Forb	*Verbesina alternifolia* (wingstem)

Characteristic Species: Information not available.

Other Noteworthy Species:

Species	GRank	Type	Note
Myosotis macrosperma (largeseed forget-me-not)	-	plant	WV state-imperiled
Rosa multiflora (multiflora rose)	-	plant	exotic
Rubus phoenicolasius (wine raspberry)	-	plant	exotic
Stellaria media (common chickweed)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNA	=	1	[gname]	Vanderhorst et al. 2007

Local Range: A total of 3 polygons covering 2.87 hectares are mapped in the park. It is mapped at one site along the Little Bluestone River and one site along the Bluestone River on the south side of Pilot Ridge. Additional small patches are likely to occur within the Disturbed Area map class.

Classification Comments: Information not available.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Two plots were sampled: BLUE.44, BLUE.108. Plot BLUE.108 has incomplete floristic data.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

Rosa multiflora (multiflora rose) may be present as a shrub, along with the nonnative bramble *Rubus phoenicolasius* (wine raspberry). Nonnative species such as *Alliaria petiolata* (garlic mustard), *Chelidonium majus* (celandine), *Glechoma hederacea* (ground ivy), and *Convallaria majalis* (European lily of the valley) can characterize the herb layer, 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 redcedar), *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 nonnatives *Rosa multiflora* (multiflora rose) and *Elaeagnus umbellata* (autumn olive) are typically the most common shrubs, along with the nonnative bramble *Rubus phoenicolasius* (wine raspberry). *Cornus florida* (flowering dogwood) may be present in the subcanopy. Nonnative species such as *Alliaria petiolata* (garlic mustard), *Chelidonium majus* (celandine), *Glechoma hederacea* (ground ivy), *Dactylis glomerata* (orchardgrass), *Daucus carota* (Queen Anne's lace), and *Convallaria majalis* (European lily of the valley) can characterize the herb layer, which may have a native component as well, for example with (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:

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

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

Other Noteworthy Species:

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

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) B

SOURCES

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

References: Baalman 1965, CAP pers. comm. 1998, Ehrenfeld 1977, Elias 1980, Fleming and Coulling 2001, Gaertner 1955, Hoagland 2000, INAI unpubl. data, McDonald 1938, NRCS 2004, Rabie 2000, Rawinski et al. 1996, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.108. Successional Black Locust Woodland.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL BOX-ELDER FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **Box-elder Forest**
NVC Scientific Name: ***Acer negundo* Forest**
NVC Identifier: **CEGL005033**

LOCAL INFORMATION

Environmental Description: This successional forest occurs in small patches on floodplains and terraces previously cleared for agriculture. Today, stands are temporarily flooded by reservoir backup from Bluestone Lake. Slopes in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class, which includes patches of this association, range from 0 to 30 degrees (mean = 6.5). Elevations in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class range from 436 to 476 m (mean = 442). Soil in the one plot sampled is described as well-drained, sandy silt loam derived from alluvium. Soil from the plot tested slightly acidic (pH = 5.9) with relatively high levels of S, B, Ca, Cu, Mg, Mn, and Zn and relatively low levels of organic matter, estimated N release, Al, and K compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Black Walnut Floodplain Forest (CEGL007879), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), River Birch Backwater Floodplain Forest (CEGL002086), and Sycamore - Ash Floodplain Forest (CEGL006458).

Vegetation Description: This association is a successional deciduous forest or woodland dominated by *Acer negundo* var. *negundo* (boxelder). Canopy cover in the one sampled plot is 50%. Canopy associates include *Carya cordiformis* (bitternut hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), and the vine *Vitis vulpina* (frost grape). Cover in the shrub layers of the plot is 10%, composed of tree saplings, the shrub *Lindera benzoin* (northern spicebush), and vines *Smilax tamnoides* (bristly greenbrier) and *Toxicodendron radicans* (eastern poison ivy). Cover in the herb layer of the plot is 50%, with a large component of exotic species. The most abundant herbs in the plot are *Urtica dioica* ssp. *dioica* (stinging nettle), *Alliaria petiolata* (garlic mustard), *Verbesina alternifolia* (wingstem), *Polygonum virginianum* (jumpseed), *Lysimachia nummularia* (creeping jenny), and *Cryptotaenia canadensis* (Canadian honewort). Vascular plant species richness in the plot is 36 species per 400 square meters.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer negundo* var. *negundo* (boxelder)
Herb (field)	Forb	*Alliaria petiolata* (garlic mustard), *Urtica dioica* ssp. *dioica* (stinging nettle)

Characteristic Species: Information not available.

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst 2001b

Local Range: This association is included as one of several associations within the Modified Successional Floodplain Forest and Woodland map class. A total of 25 polygons (81.34 ha) of this map class are mapped in the park. Three accuracy assessment points in the Modified Successional Floodplain Forest and Woodland map class are attributed to this association. These represent 8.6% of the accuracy assessment points in this map class and are an indication of the relative abundance of this association within the map class. Known stands of Successional Box-elder Floodplain Forest are concentrated along lower elevation floodplains of the Bluestone River which are affected by occasional reservoir backup from Bluestone Lake.
Classification Comments: Information not available.
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: One plot was sampled: BLUE.72.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer negundo* Temporarily Flooded Forest Alliance (A.278)
Alliance (English name)	Box-elder Temporarily Flooded Forest Alliance
Association	*Acer negundo* Forest
Association (English name)	Box-elder Forest
Ecological System(s):	Central Appalachian River Floodplain (CES202.608). East Gulf Coastal Plain Large River Floodplain Forest (CES203.489). Mississippi River Riparian Forest (CES203.190). South-Central Interior Large Floodplain (CES202.705). Atlantic Coastal Plain Large River Floodplain Forest (CES203.066).

GLOBAL DESCRIPTION

Concept Summary: This semi-open to closed-canopy forest is found on floodplains in the southern, eastern, and midwestern United States. Stands occur on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for agriculture or habitation. They are typically temporarily flooded in the spring. These early-successional forests are dominated by *Acer negundo* (boxelder). Other characteristic species include *Platanus occidentalis* (American sycamore), *Celtis laevigata* (sugarberry), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Robinia pseudoacacia* (black locust), *Liquidambar styraciflua* (sweetgum), *Acer saccharinum* (silver maple), *Ulmus alata* (winged elm), *Ulmus rubra* (slippery elm), *Carya cordiformis* (bitternut hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Carpinus caroliniana* (American hornbeam), *Morus rubra* (red mulberry), and *Populus deltoides* (eastern cottonwood). The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. The herb layer consists of a mixture of weedy exotics and native floodplain species.

Environmental Description: Stands occur on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. Occurrences are mostly on higher floodplain terraces with less rocky soils which were used for agriculture or habitation. They are typically temporarily flooded in the spring and have sandy soils. In Kentucky, these forests may also occur in old fields.

Vegetation Description: These early-successional forests (sometimes woodlands) are dominated by *Acer negundo* (boxelder). Other characteristic species include *Platanus occidentalis* (American sycamore), *Celtis laevigata* (sugarberry), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Robinia pseudoacacia* (black locust), *Liquidambar styraciflua* (sweetgum), *Acer saccharinum* (silver maple), *Ulmus alata* (winged elm), *Ulmus rubra* (slippery elm), *Carya cordiformis* (bitternut hickory), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Carpinus caroliniana* (American hornbeam), *Morus rubra* (red mulberry), and *Populus deltoides* (eastern cottonwood). The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. *Lindera benzoin* (northern spicebush) may be dominant in the shrub layer. The herb layer consists of a mixture of weedy exotics and native floodplain species, including *Ageratina altissima* (white snakeroot), *Alliaria petiolata* (garlic mustard), *Boehmeria cylindrica* (smallspike false nettle), *Carex grayi* (Gray's sedge), *Cryptotaenia canadensis* (Canadian honewort), *Glechoma hederacea* (ground ivy), *Lysimachia nummularia* (creeping jenny), *Mertensia virginica* (Virginia bluebells), *Polygonum virginianum* (jumpseed), *Prunella vulgaris* (common selfheal), *Urtica dioica* ssp. *dioica* (stinging nettle), and *Verbesina alternifolia* (wingstem). The range, dynamics, and variability of this type are complicated by the "weedy" nature of *Acer negundo* (boxelder), e.g., in Kentucky, *Acer negundo* (boxelder) may be dominant in old fields, with *Dichanthelium clandestinum* (deertongue) and *Carex* (sedge) spp. in the ground layer. Elsewhere in the Midwest, logged and grazed stands of *Fraxinus pennsylvanica* (green ash) and *Ulmus americana* (American elm) may be dominated by *Acer negundo* (boxelder).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer negundo* (boxelder)

Characteristic Species: *Acer negundo* (boxelder), *Acer saccharinum* (silver maple), *Ageratina altissima* (white snakeroot), *Boehmeria cylindrica* (smallspike false nettle), *Carex grayi* (Gray's sedge), *Lindera benzoin* (northern spicebush), *Liquidambar styraciflua* (sweetgum), *Mertensia virginica* (Virginia bluebells), *Platanus occidentalis* (American sycamore), *Prunella vulgaris* (common selfheal), *Robinia pseudoacacia* (black locust), *Ulmus americana* (American elm), *Verbesina alternifolia* (wingstem).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Glechoma hederacea (ground ivy)	-	plant	exotic
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This *Acer negundo* (boxelder) floodplain forest is found sporadically on floodplains in the southern, eastern, and midwestern United States, ranging from New York and New Jersey west to Iowa (and possibly southeastern South Dakota), south to Louisiana and possibly Texas,

and east to Georgia. It occurs in the Piedmont region in Pennsylvania and in the Coastal Plain and Piedmont regions in New Jersey and Delaware.
States/Provinces: AL, AR, DC, DE, GA, IA, KY, LA, MD, MO, MS, NJ, NY, OK, PA, SC, SD?, TN, TX?, VA, WV.
Federal Lands: NPS (Bluestone, Buffalo River, C&O Canal?, Chickamauga-Chattanooga, Mammoth Cave, Natchez Trace, National Capital-East?, New River Gorge, Ozark, Saratoga, Shiloh, Vicksburg); USFS (Daniel Boone, St. Francis); USFWS (Little River).

CONSERVATION STATUS
Rank: G4G5 (28-Mar-2003).
Reasons: As currently defined, this is a broad-ranging community type. However, the range, dynamics, and variability of this type are complicated by the "weedy" nature of *Acer negundo* (boxelder). More information may be needed to clarify the extent to which this type represents purely natural vegetation. Some stands may develop following disturbance of other natural bottomland communities.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 - Moderate.
Comments: The range, dynamics, and variability of this type is complicated by the 'weedy' nature of *Acer negundo* (boxelder). For example, disturbed stands in the *Fraxinus pennsylvanica - Ulmus americana - Celtis (occidentalis, laevigata)* Temporarily Flooded Forest Alliance (A.286) often become dominated by *Acer negundo* (boxelder). And in the upper Midwest *Acer negundo* (boxelder)-dominated stands are treated as part of the *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088). Thus, some consistency is needed in the application of this type across its range. In Arkansas, these forests can be pure *Acer negundo* (boxelder) or have *Acer rubrum* (red maple) and *Platanus occidentalis* (American sycamore) as associates (T. Foti pers. comm. 1999). Composition is variable. This type occurs along the Arkansas River in Arkansas (D. Zollner pers. comm. 1999). In Missouri, stands would probably be combined with *Betula nigra - Platanus occidentalis* Forest (CEGL002086) (M. Leahy pers. comm. 1999). In Kentucky, this may be found at the Licking River impoundment (Cave Run Lake). Narrower floodplains of smaller rivers and streams are not included in this association but are treated instead under *Acer negundo - (Platanus occidentalis, Populus deltoides)* Forest (CEGL004690).
Similar Associations:
Acer negundo - (Platanus occidentalis, Populus deltoides) Forest (CEGL004690).
Betula nigra - Platanus occidentalis Forest (CEGL002086).
Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis Forest (CEGL002088).
Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana) Northern Forest (CEGL002089).
Fraxinus pennsylvanica - Ulmus spp. - *Celtis occidentalis* Forest (CEGL002014).
Related Concepts:
Acer negundo riparian woodland (Vanderhorst 2001b) =

SOURCES

Description Authors: E. Largay and S. C. Gawler.

References: Blair 1938, Campbell pers. comm., Fleming et al. 2001, Foti pers. comm., Harrison 2004, Hoagland 2000, INAI unpubl. data, Leahy pers. comm., NRCS 2004, Patterson and DeSelm 1989, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008, Zollner pers. comm.

Plot BLUE.72. Successional Box-elder Floodplain Forest.

COMMON NAME (PARK-SPECIFIC) **OAK - HICKORY FLOODPLAIN FOREST**

SYNONYMS

NVC English Name:	**(Northern Red Oak, Black Oak, White Oak) / American hornbeam - (Mountain Silverbell) / Feathery False Lily-of-the-Valley Forest**
NVC Scientific Name:	***Quercus (rubra, velutina, alba) / Carpinus caroliniana - (Halesia tetraptera) / Maianthemum racemosum* Forest**
NVC Identifier:	**CEGL006462**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches and linear zones in higher positions of river floodplains that are infrequently flooded, and possibly on alluvial terraces that are no longer flooded. Remaining stands are often tightly constricted between successional forests on previously farmed land uphill and more frequently flooded associations downhill. It was probably much more abundant prior to development of upper floodplains and alluvial terraces for agriculture starting in the in the late 1700s continuing through the mid-1900s. Slopes in mapped polygons of the Floodplain Forest and Woodland map class, which includes patches of this association, range from 0 to 34 degrees (mean = 8). Elevations in mapped polygons of the Floodplain Forest and Woodland map class range from 436 to 506 m (mean = 460). Ground cover is dominated by litter or may have a large component of bare soil or sand if the site was recently flooded. Flotsam piles are common. Soils in plots are described as stone-free or somewhat stony, moderately well- to well-drained sand and sandy loam derived from alluvium. Soils from plots tested very to medium acidic (mean pH = 5.0) with relatively high levels of B, Cu, Mg, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, Ca, Cu, Fe, K, Mn, and Na compared to average values in the park. Adjacent associations in the Floodplain Forest and Woodland map class may include Sycamore - Yellow Buckeye Floodplain Forest (CEGL006466), Sycamore - River Birch Riverscour Woodland (CEGL003725), Eastern Hemlock Floodplain Forest (CEGL006620), and Riverbank Tall Herbs (CEGL006480). Adjacent, previously farmed, higher terraces are often occupied by Successional Eastern White Pine - Tuliptree Forest (CEGL007944).

Vegetation Description: This association is a somewhat open- to closed-canopy deciduous floodplain forest dominated by species more typical of uplands. Canopy cover in plots ranges from 10–70%. Canopy dominants include *Quercus rubra* (northern red oak) and *Quercus velutina* (black oak), or stands may be codominated by a mixture of trees, including some upland *Quercus* (oak) or *Carya* (hickory) species. Additional canopy trees in plots include *Carya alba* (mockernut hickory), *Carya cordiformis* (bitternut hickory), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore), *Prunus serotina* var. *serotina* (black cherry), *Quercus alba* (white oak), and *Ulmus americana* (American elm). Subcanopy cover in plots ranges from 40–60%. Additional trees found in the subcanopy include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Nyssa sylvatica* (blackgum), and *Acer rubrum* var. *rubrum* (red maple). Shrub cover in plots ranges from 20–80%. Shrubs in plots include *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Viburnum prunifolium* (blackhaw), *Dirca palustris* (eastern leatherwood), and *Smilax rotundifolia* (roundleaf greenbrier). Herb cover in plots ranges from 20–50%. Herbs with high constancy in

plots include *Verbesina alternifolia* (wingstem), *Sedum ternatum* (woodland stonecrop), *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Galium triflorum* (fragrant bedstraw), *Eurybia divaricata* (white wood aster), *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), and *Amphicarpaea bracteata* (American hogpeanut). Additional common herbs include *Actaea racemosa* var. *racemosa* (black bugbane), *Symphyotrichum prenanthoides* (crookedstem aster), *Ranunculus abortivus* (littleleaf buttercup), *Carex blanda* (eastern woodland sedge), *Polygonum virginianum* (jumpseed), *Packera aurea* (golden ragwort), *Oxalis violacea* (violet woodsorrel), *Collinsonia canadensis* (richweed), and *Cryptotaenia canadensis* (Canadian honewort). Vascular plant species richness ranges from 62 to 79 (mean = 69) species per 400-square-meter plot. Cover by nonvascular plants is usually low but may include *Climacium americanum* (American climacium moss), *Polytrichum* (polytrichum moss) spp., and other mosses.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera* (tuliptree), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana* ssp. *virginiana* (American hornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Hamamelis virginiana* (American witchhazel)

Characteristic Species: *Maianthemum racemosum* ssp. *racemosum* (feathery false lily of the valley), *Sedum ternatum* (woodland stonecrop).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2007

Local Range: This association is included as one of several associations within the Floodplain Forest and Woodland map class. A total of 48 polygons (57.11 ha) of this map class are mapped in the park. Eleven accuracy assessment points in the Floodplain Forest and Woodland map class are attributed to this association. These represent 33% of the accuracy assessment points in this map class and are an indication of the relative abundance of this association within the map class. Known stands of Oak - Hickory Floodplain Forest are scattered along the Bluestone River and are concentrated along the Little Bluestone River.

Classification Comments: This association was first described from the New River Gorge (Vanderhorst et al. 2007), but the original name has been changed and the concept broadened to encompass similar forests along the Bluestone and Gauley rivers. *Halesia tetraptera* (mountain silverbell) has high constancy in stands along the New River but is absent from stands along the Bluestone and Gauley rivers.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Three plots were sampled: BLUE.14, BLUE.58, and BLUE.106.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer saccharum - Carya cordiformis* Temporarily Flooded Forest Alliance (A.302)
Alliance (English name)	Sugar Maple - Bitternut Hickory Temporarily Flooded Forest Alliance
Association	*Quercus (rubra, velutina, alba) / Carpinus caroliniana - (Halesia tetraptera) / Maianthemum racemosum* Forest
Association (English name)	(Northern Red Oak, Black Oak, White Oak) / American hornbeam - (Mountain Silverbell) / Feathery False Lily-of-the-Valley Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association is a closed-canopy to somewhat open-canopy deciduous floodplain forest on the highest positions of river floodplains. These alluvial terraces are infrequently flooded and some are possibly no longer flooded. Low frequency and low energy of flooding is evidenced by the development of litter layers and organic-enriched soil horizons. Soils are well-drained sands and sandy loams, and soil moisture regime may be somewhat dry. The soils are slightly acidic and have relatively high cation levels. Slopes range from level to steep. The canopy is frequently composed of very large-diameter, tall trees, with species more typical of uplands. Dominant trees in the canopy include *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), *Liriodendron tulipifera* (tuliptree), and *Acer saccharum* (sugar maple). Additional trees which may occur in the canopy and subcanopy include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya cordiformis* (bitternut hickory), *Carya ovata* (shagbark hickory), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Magnolia acuminata* (cucumber-tree), *Magnolia tripetala* (umbrella-tree), *Nyssa sylvatica* (blackgum), *Platanus occidentalis* (American sycamore), *Prunus serotina* var. *serotina* (black cherry), and *Ulmus americana* (American elm). The small tree *Halesia tetraptera* (mountain silverbell) is dominant in some areas as a well-developed tall-shrub layer and may extend into the tree subcanopy. Additional shrubs include *Carpinus caroliniana* (American hornbeam), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Smilax rotundifolia* (roundleaf greenbrier), and *Viburnum prunifolium* (blackhaw). Characteristic herbs include *Ageratina altissima* (white snakeroot), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Cynoglossum virginianum* (wild comfrey), *Dichanthelium boscii* (Bosc's panicgrass), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Hydrastis canadensis* (goldenseal), *Maianthemum racemosum* (feathery false lily of the valley), *Packera aurea* (golden ragwort), *Sedum ternatum* (woodland stonecrop), and *Verbesina alternifolia* (wingstem).

Environmental Description: This association occurs in small patches on the highest positions of river floodplains which are infrequently flooded and possibly on alluvial terraces which are no longer flooded. The largest patches occur on large point bars which have developed along inside bends of large meanders. Evidence of flooding includes fluvial topography, accumulations of rocks on the upstream side of tree bases, and some flotsam. Low frequency and low energy of

flooding is evidenced by the development of litter layers and organic-enriched soil horizons. Soils are stone-free or somewhat stony, moderately well- to well-drained sands and sandy loams derived from alluvium, and soil moisture regime may be somewhat dry. Soil chemistry analyzed from six plots indicates slightly acidic soils (mean pH = 5.8 at New River and 5.0 at Bluestone) and relatively high levels of some nutrients (Ca, Mg, Zn) and relatively low levels of organic matter compared to soils of most upland forests in the area. Slopes range from level to steep. Elevations of mapped stands range from 267 to 506 m.

Vegetation Description: This association is a closed-canopy to somewhat open-canopy deciduous floodplain forest dominated by tree species more typical of uplands. Many of the stands are composed of very large-diameter, tall trees. Dominant trees in the canopy include *Quercus rubra* (northern red oak), *Quercus velutina* (black oak), *Quercus alba* (white oak), *Liriodendron tulipifera* (tuliptree), and *Acer saccharum* (sugar maple). Additional trees which may occur in the canopy and subcanopy include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya cordiformis* (bitternut hickory), *Carya ovata* (shagbark hickory), *Fagus grandifolia* (American beech), *Fraxinus pennsylvanica* (green ash), *Juglans nigra* (black walnut), *Magnolia acuminata* (cucumber-tree), *Magnolia tripetala* (umbrella-tree), *Nyssa sylvatica* (blackgum), *Platanus occidentalis* (American sycamore), *Prunus serotina* var. *serotina* (black cherry), and *Ulmus americana* (American elm). The small tree *Halesia tetraptera* (mountain silverbell) is dominant in some areas as a well-developed tall-shrub layer and may extend into the tree subcanopy. Additional shrubs include *Carpinus caroliniana* (American hornbeam), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Smilax rotundifolia* (roundleaf greenbrier), and *Viburnum prunifolium* (blackhaw). Characteristic herbs include *Ageratina altissima* (white snakeroot), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema triphyllum* (Jack in the pulpit), *Cynoglossum virginianum* (wild comfrey), *Dichanthelium boscii* (Bosc's panicgrass), *Eurybia divaricata* (white wood aster), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Hydrastis canadensis* (goldenseal), *Maianthemum racemosum* (feathery false lily of the valley), *Packera aurea* (golden ragwort), *Sedum ternatum* (woodland stonecrop), and *Verbesina alternifolia* (wingstem). Vascular plant species richness in the 7 sampled plots (200 square meters) ranges from 16 to 79 (mean at New River = 32; mean at Bluestone = 69).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Halesia tetraptera* (mountain silverbell)

Characteristic Species: *Acer rubrum* (red maple), *Ageratina altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Carpinus caroliniana* (American hornbeam), *Carya ovata* (shagbark hickory), *Cynoglossum virginianum* (wild comfrey), *Dichanthelium boscii* (Bosc's panicgrass), *Dirca palustris* (eastern leatherwood), *Fagus grandifolia* (American beech), *Galium circaezans* (licorice bedstraw), *Galium triflorum* (fragrant bedstraw), *Halesia tetraptera* (mountain silverbell), *Hamamelis virginiana* (American witchhazel), *Hydrastis canadensis* (goldenseal), *Lindera benzoin* (northern spicebush), *Magnolia acuminata* (cucumber-tree), *Magnolia tripetala* (umbrella-tree), *Maianthemum racemosum* (feathery false lily of the valley), *Nyssa sylvatica* (blackgum), *Packera aurea* (golden ragwort), *Parthenocissus quinquefolia* (Virginia creeper).

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

DISTRIBUTION
Range: This association is currently known only from West Virginia along the New, Bluestone, and Gauley rivers.
States/Provinces: WV.
Federal Lands: NPS (Bluestone, Gauley River, New River Gorge).

CONSERVATION STATUS
Rank: GNR (5-Jun-2006).
Reasons: More information is needed to determine a global rank. This association is likely to have been reduced from its original extent by clearing for agriculture or houses.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 - Weak.
Comments: This association has canopy composition similar to *Quercus prinus - (Quercus rubra) - Carya* spp. / *Oxydendrum arboreum - Cornus florida* Forest (CEGL007267), but it is differentiated by its occurrence on floodplains and by the abundance of *Halesia tetraptera* (mountain silverbell) and other mesophytic species in the understory.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: J. P. Vanderhorst, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.58. Oak - Hickory Floodplain Forest.

COMMON NAME (PARK-SPECIFIC): RIVER BIRCH BACKWATER FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **River Birch - Sycamore Forest**
NVC Scientific Name: ***Betula nigra - Platanus occidentalis* Forest**
NVC Identifier: **CEGL002086**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches in backwater positions of floodplains in areas previously cleared for agriculture. Most known sites are mapped as unforested (white) on the 1912 Big Bend and 1929 Flattop USGS 15' topographic maps. Today, stands are temporarily flooded by reservoir backup from Bluestone Lake and may also be subject to occasional low-energy flooding from downstream overbank flow and seepage from upslope. Low-energy reservoir backup is responsible for heavy fine sediment deposits visible on the ground and sometimes on plant foliage. There is often shallow standing water and sometimes deeper backwater ponds or sloughs are embedded within this community. Most areas would qualify as jurisdictional wetlands. Slopes in plots range from 0 to 3 degrees. Elevations range from 436 to 445 m. Unvegetated ground cover is dominated by litter and areas of bare soil where litter has washed away. There is essentially no ground cover by rocks. Soils in plots are described as temporarily flooded, deep, dark-colored, poorly to well-drained silty loam and sandy loam derived from alluvium. Hydric soil indicators noted in plots include saturated soil, high water table, low soil chroma, and oxidation-reduction features. Soils from plots tested extremely to strongly acidic (mean pH = 4.87) with relatively high levels of organic matter, estimated N release, S, B, Ca, Cu, Fe, Mg, Na, P, and Zn, and relatively low levels of Al, K, and Mn compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Box-elder Floodplain Forest (CEGL005033), Successional Black Walnut Floodplain Forest (CEGL007879), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), and Sycamore - Ash Floodplain Forest (CEGL006458).
Vegetation Description: This association is an open- to closed-canopy floodplain forest typically dominated by *Betula nigra* (river birch) in association with other disturbance-tolerant, wetland indicator species. Canopy cover in plots ranges from 20–90%, strongly dominated by *Betula nigra* (river birch) in most plots. One plot with canopy cover dominated by *Platanus occidentalis* (American sycamore) (with *Betula nigra* (river birch) in the subcanopy) occurs on slightly higher ground adjacent to lower areas dominated by *Betula nigra* (river birch). Additional canopy associates include the trees *Acer rubrum* var. *rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), and *Ulmus americana* (American elm), and vines *Toxicodendron radicans* (eastern poison ivy) and *Vitis aestivalis* var. *bicolor* (summer grape). Subcanopy cover in plots ranges from 5–30%, composed of the canopy trees with *Betula nigra* (river birch) most abundant. Shrub cover in plots ranges from 1–100%. Highest shrub cover occurs in a plot with dense growth of the exotic invasive *Rosa multiflora* (multiflora rose). Native species in the shrub layers include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Alnus serrulata* (hazel alder), and *Cornus amomum* (silky dogwood), in addition to vines and saplings of trees already listed. Herb cover in plots ranges from 20–90%. Common native herbs include *Polygonum virginianum* (jumpseed), *Verbesina alternifolia*

(wingstem), *Boehmeria cylindrica* (smallspike false nettle), *Pilea pumila* var. *pumila* (Canadian clearweed), *Onoclea sensibilis* (sensitive fern), *Leersia virginica* (whitegrass), *Impatiens capensis* (jewelweed), *Galium triflorum* (fragrant bedstraw), *Carex amphibola* (eastern narrowleaf sedge), *Verbesina occidentalis* (yellow crownbeard), *Agrostis perennans* (upland bentgrass), *Amphicarpaea bracteata* (American hogpeanut), *Packera aurea* (golden ragwort), and *Glyceria striata* (fowl mannagrass). Exotic herbs are also abundant and include *Lysimachia nummularia* (creeping jenny), *Alliaria petiolata* (garlic mustard), and *Urtica dioica* ssp. *dioica* (stinging nettle). Vascular plant species richness in three plots with complete floristics ranges from 33 to 62 (mean = 44) species per 400-square-meter plot. Cover by nonvascular plants in plots ranges from 0–10%. Nonvascular species identified from one plot include *Amblystegium serpens* (amblystegium moss), *Brachythecium salebrosum* (brachythecium moss), *Bryhnia novae-angliae* (New England bryhnia moss), *Climacium americanum* (American climacium moss), *Hygrohypnum ochraceum* (hygrohypnum moss), *Lophocolea heterophylla*, *Plagiomnium ciliare* (plagiomnium moss), *Steerecleus serrulatus* (steerecleus moss), and *Thuidium delicatulum* (delicate thuidium moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* var. *rubrum* (red maple), *Fraxinus pennsylvanica* (green ash), *Platanus occidentalis* (American sycamore)
Tree subcanopy	Broad-leaved deciduous tree	*Betula nigra* (river birch)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush), *Rosa multiflora* (multiflora rose)
Herb (field)	Forb	*Lysimachia nummularia* (creeping jenny), *Polygonum virginianum* (jumpseed), *Verbesina alternifolia* (wingstem)

Characteristic Species: *Arisaema dracontium* (green dragon), *Boehmeria cylindrica* (smallspike false nettle), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Carex amphibola (eastern narrowleaf sedge)	-	plant	WV state-critically imperiled
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2008

Local Range: This association is included as one of several within the Modified Successional Floodplain Forest and Woodland map class. A total of 25 polygons (81.34 ha) of this map class are mapped in the park. No accuracy assessment points are attributed to this association, possibly indicating that it does not cover much area within the map class. This association appears to be entirely restricted to areas affected by occasional reservoir backup from Bluestone Lake, which is most evident at elevations below about 445 m (1460 feet).

Classification Comments: The global description treats this association as a natural vegetation type, but its occurrence at Bluestone appears to be dependent on an artificial flooding regime created by reservoir backup from Bluestone Lake. Otherwise, the local description from Bluestone is consistent with the global concept. Backwater stands of *Betula nigra* (river birch) have also been observed along other West Virginia waterways (e.g., Muddelty Creek in Nicholas

County), but the natural status of hydroperiods affecting these stands has not been determined. Along the Bluestone, Gauley, and New rivers, *Betula nigra* (river birch) is also an important component of the natural Sycamore - River Birch Riverscour Woodland (CEGL003725), which occurs along river shorelines subject to frequent high-energy flooding.
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: Six plots were sampled: BLUE.18, BLUE.62, BLUE.73, BLUE.112, BLUE.116, and BLUE.124.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Betula nigra - (Platanus occidentalis)* Temporarily Flooded Forest Alliance (A.280)
Alliance (English name)	River Birch - (Sycamore) Temporarily Flooded Forest Alliance
Association	*Betula nigra - Platanus occidentalis* Forest
Association (English name)	River Birch - Sycamore Forest
Ecological System(s):	Central Appalachian River Floodplain (CES202.608). Ozark-Ouachita Riparian (CES202.703). North-Central Interior Floodplain (CES202.694). South-Central Interior Small Stream and Riparian (CES202.706).

GLOBAL DESCRIPTION

Concept Summary: This river birch - sycamore forest community is found throughout the east-central United States. Stands commonly occur along stream and small riverbanks, shores of ponds, and in swampy forests. Alluvial soils which support this natural community are relatively deep, moist, well-drained, and often sandy on the surface. *Betula nigra* (river birch) and *Platanus occidentalis* (American sycamore) are the typical dominants. They are fast-growing, relatively short-lived, and do not tolerate excessive shade at any stage of growth. *Betula nigra* (river birch) prefers acidic soils and is often the dominant tree found along streams affected by acidic mine drainage. A wide range of canopy species are present, both common bottomland species (e.g., *Ulmus americana* (American elm), *Acer rubrum* (red maple), *Acer negundo* (boxelder), *Fraxinus pennsylvanica* (green ash), *Quercus* (oak) spp., and *Celtis laevigata* (sugarberry)) and mesophytic species from nearby uplands and terraces (e.g., *Juglans nigra* (black walnut), *Prunus serotina* (black cherry), and *Fraxinus americana* (white ash)). Vines that may reach into the canopy include *Toxicodendron radicans* (eastern poison ivy) and *Vitis aestivalis* var. *bicolor* (summer grape). A variety of wetland species may be found on more poorly drained sites. Stands are subjected to frequent, fast, short-duration flooding, which contributes to a typically thin understory. Native species in the shrub layer include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Alnus serrulata* (hazel alder), and *Cornus amomum* (silky dogwood); the exotic *Rosa multiflora* (multiflora rose) may be prevalent at some sites. Commonly encountered herbaceous species include *Saururus cernuus* (lizard's tail), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema dracontium* (green dragon), *Boehmeria cylindrica* (smallspike false nettle), *Carex amphibola* (eastern narrowleaf sedge),

Glyceria striata (fowl mannagrass), *Impatiens capensis* (jewelweed), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern), *Symphyotrichum ontarionis* (bottomland aster), *Pilea pumila* (Canadian clearweed), *Polygonum virginianum* (jumpseed), *Verbesina alternifolia* (wingstem), and *Verbesina occidentalis* (yellow crownbeard). Exotic herbs are abundant at some sites and include *Lysimachia nummularia* (creeping jenny), *Alliaria petiolata* (garlic mustard), and *Urtica dioica* ssp. *dioica* (stinging nettle).

Environmental Description: *Betula nigra* (river birch) requires soils near field capacity throughout the year but is relatively intolerant of flooding. *Platanus occidentalis* (American sycamore) is also intolerant of flooding during the growing season and will die if the entire tree is inundated for more than two weeks. The absence of this community in the lower Mississippi River Alluvial Plain is attributed to this intolerance, as is its most common location on levees of smaller rivers. Depending on hydroperiod, the community may be found on natural levees or on flats behind the levee. The community is more common along small streams and blackwater streams than along alluvial floodplains, largely because of the higher sustained flow rates of these larger rivers. It is also found along flowages of larger rivers. Along the Bluestone River in West Virginia, where the community is influenced by reservoir backup as well as the usual seasonal flooding, soils in plots are described as temporarily flooded, deep, dark-colored, poorly to well-drained silty loam and sandy loam derived from alluvium. Hydric soil indicators include saturated soil, high water table, low soil chroma, and oxidation-reduction features. Soils from plots tested extremely to strongly acidic (mean pH = 4.87) with relatively high levels of organic matter, estimated N release, S, B, Ca, Cu, Fe, Mg, Na, P, and Zn, and relatively low levels of Al, K, and Mn, compared to average values in the area.

Vegetation Description: *Betula nigra* (river birch) and *Platanus occidentalis* (American sycamore) are the typical dominants in this association with other disturbance-tolerant, wetland indicator species. They are fast-growing (especially as young trees), relatively short-lived, and do not tolerate excessive shade at any stage of growth. *Betula nigra* (river birch) prefers acidic soils and is often the dominant tree found along streams affected by acidic mine drainage. A wide range of canopy species are present, both common bottomland species (e.g., *Ulmus americana* (American elm), *Acer rubrum* (red maple), *Acer negundo* (boxelder), *Fraxinus pennsylvanica* (green ash), *Quercus* (oak) spp., and *Celtis laevigata* (sugarberry)) and mesophytic species from nearby uplands and terraces (e.g., *Juglans nigra* (black walnut), *Prunus serotina* (black cherry), and *Fraxinus americana* (white ash)). Vines that may reach into the canopy include *Toxicodendron radicans* (eastern poison ivy) and *Vitis aestivalis* var. *bicolor* (summer grape). A variety of wetland species may be found on more poorly drained sites. Stands are subjected to frequent, fast, short-duration flooding, which contributes to a typically thin understory. Native species in the shrub layer include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Lindera benzoin* (northern spicebush), *Alnus serrulata* (hazel alder), and *Cornus amomum* (silky dogwood); the exotic *Rosa multiflora* (multiflora rose) may be prevalent at some sites. Commonly encountered herbaceous species include *Saururus cernuus* (lizard's tail), *Amphicarpaea bracteata* (American hogpeanut), *Arisaema dracontium* (green dragon), *Boehmeria cylindrica* (smallspike false nettle), *Carex amphibola* (eastern narrowleaf sedge), *Glyceria striata* (fowl mannagrass), *Impatiens capensis* (jewelweed), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern), *Symphyotrichum ontarionis* (bottomland aster), *Pilea pumila* (Canadian clearweed), *Polygonum virginianum* (jumpseed), *Verbesina alternifolia* (wingstem), and *Verbesina occidentalis* (yellow crownbeard). Exotic herbs are abundant at some sites and include *Lysimachia nummularia* (creeping jenny), *Alliaria petiolata* (garlic mustard),

and *Urtica dioica* ssp. *dioica* (stinging nettle). This forest harbors a number of ubiquitous species and tends to extend into and mix with adjacent communities, resulting in numerous transitional variants. Occurrences may have a rather high percentage of standing dead trees. There may be remnant snags from previous earlier successional communities of cottonwood - black willow forests (TNC 1995a).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula nigra* (river birch), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore), *Populus deltoides* (eastern cottonwood)
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana* (American hornbeam), *Salix nigra* (black willow)
Shrub/sapling (tall & short)	Vine/Liana	*Berchemia scandens* (Alabama supplejack), *Campsis radicans* (trumpet creeper), *Toxicodendron radicans* (eastern poison ivy), *Vitis riparia* (riverbank grape)
Tall shrub/sapling	Broad-leaved deciduous tree	*Asimina triloba* (pawpaw)
Herb (field)	Forb	*Boehmeria cylindrica* (smallspike false nettle), *Geranium maculatum* (spotted geranium), *Impatiens capensis* (jewelweed), *Laportea canadensis* (Canadian woodnettle)

Characteristic Species: Information not available.

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Ambystoma maculatum (spotted salamander)	-	animal	
Buteo lineatus (red-shouldered hawk)	-	animal	
Corythucha ciliata (sycamore lace bug)	-	animal	
Dryocopus pileatus (pileated woodpecker)	-	animal	
Empidonax virescens (Acadian flycatcher)	-	animal	
Ligustrum sinense (Chinese privet)	-	plant	exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	exotic
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Neovison vison (American mink)	-	animal	
Nerodia erythrogaster erythrogaster (redbelly watersnake)	-	animal	
Nerodia erythrogaster flavigaster (yellowbelly watersnake)	-	animal	
Parula americana (northern parula)	-	animal	
Procyon lotor (raccoon)	-	animal	
Rosa multiflora (multiflora rose)	-	plant	exotic
Seiurus motacilla (Louisiana waterthrush)	-	animal	
Triadica sebifera (tallowtree)	-	plant	exotic
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This river birch - sycamore forest community is found throughout the east-central United States, ranging from south-central Ohio west to Iowa, south to Arkansas and Mississippi, and east to West Virginia.

States/Provinces: AR, IA:SU, IL, IN, KY, MO, OH:S4, OK, ON?, TN, WV.

Federal Lands: NPS (Bluestone, Buffalo River?); USFS (Daniel Boone, Ouachita, Ouachita (Mountains), Ozark, Shawnee?, Wayne).

CONSERVATION STATUS
Rank: G5 (22-Jun-1998).
Reasons: The community is widespread and common.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 - Moderate.
Comments: As currently described, this association and *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312) appear to be conceptually overlapping regional variants (north versus south). These two defined associations need to be reconciled. In Kentucky, this association (CEGL002086) would be found on the northern part of Daniel Boone National Forest, in contrast to CEGL007312, which is more southern. Other bottomland hardwood communities contain river birch in the canopy but at lower densities. It may be helpful to require that *Betula nigra* (river birch) contribute at least 50% (80%?) of the tree density to be placed in this community. This forest harbors a number of ubiquitous species and tends to extend into and mix with adjacent communities, resulting in numerous transitional variants. Both *Betula nigra* (river birch) and *Platanus occidentalis* (American sycamore) are also associated with highly disturbed sites: the former with coal mine drainage, and the latter with strip mine sites. The community described herein is naturally occurring on largely undisturbed sites, although it may occur under an artificial flooding regime created by reservoir backup (e.g., the Bluestone River in West Virginia). Backwater stands of *Betula nigra* (river birch) have also been observed along other West Virginia waterways, but the natural status of hydroperiods affecting these stands has not been determined. Along the Bluestone, Gauley, and New rivers, *Betula nigra* (river birch) is also an important component of *Platanus occidentalis - Betula nigra / Cornus amomum / (Andropogon gerardii, Chasmanthium latifolium)* Woodland (CEGL003725), which occurs along river shorelines subject to frequent high-energy flooding.
Similar Associations:
Acer negundo Forest (CEGL005033).
Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica Forest (CEGL007312).
Betula nigra - Platanus occidentalis / Impatiens capensis Forest (CEGL006184).
Platanus occidentalis - Betula nigra / Cornus amomum / (*Andropogon gerardii, Chasmanthium latifolium*) Woodland (CEGL003725).
Related Concepts:
Acer negundo - Platanus / Rhus [Toxicodendron] radicans community (Voigt and Mohlenbrock 1964) ?
Betula nigra - Acer saccharinum / Pilea community (Voigt and Mohlenbrock 1964) =
Platanus occidentalis - Betula nigra Forest (Walton et al. 1997) ?
Eastern Broadleaf Forests (Kuchler 1964) B
IIA7b. River Birch - Sycamore Riverfront Forest (Allard 1990) =
Palustrine: Forested Wetland: Riparian (TNC 1985) B
Palustrine: Palustrine Forested Wetland (Cowardin et al. 1979) B
R13cII4a. *Betula nigra - Platanus occidentalis* (Foti 1994a) ?
River Birch - Red Maple, HR (Pyne 1994) ?
River Birch - Sycamore: 61 (Eyre 1980) =

River Birch Floodplain Forests (Anderson 1996) =
UNESCO FORMATION CODE: I.B.3d (UNESCO 1973) B

SOURCES

Description Authors: S. Landaal, mod. S. C. Gawler.

References: Allard 1990, Anderson 1996, Blair and Hubbell 1938, Braun 1950, Bruner 1931, Burns and Honkala 1990b, Campbell 1988, Campbell 1989a, Clark and Benforado 1980, Clark and Hutchinson 1994, Cowardin et al. 1979, Dickson and Segelquist 1978, Duever and Brinson 1984a, Evans 1991, Eyre 1980, Faulkner and Patrick n.d., Flinchum 1977, Foti 1994a, Foti 1994b, Foti et al. 1994, Fralish 1987, Fralish 1988b, Fralish et al. 1991, Gettman 1974, Hoagland 2000, INAI unpubl. data, Illinois Nature Preserve Commission 1973, Klimas et al. 1981, Kuchler 1964, McNab and Avers 1994, McWilliams and Rosson 1990, Merz 1958, Midwestern Ecology Working Group n.d., Miller and Tehon 1929, Nelson 1985, ONHD unpubl. data, Pell and Rettig 1983, Powell 1985, Putnam 1951, Putnam et al. 1960, Pyne 1994, SAF 1967, Schafale and Weakley 1990, TDNH unpubl. data, TNC 1985, TNC 1995a, Thornbury 1965, UNESCO 1973, Vanderhorst et al. 2008, Voigt and Mohlenbrock 1964, Walton et al. 1997, Wharton 1978, Wharton et al. 1982, White and Madany 1978, Wistendahl 1980.

Plot BLUE.62. River Birch Backwater Floodplain Forest.

COMMON NAME (PARK-SPECIFIC): SYCAMORE - ASH FLOODPLAIN FOREST

SYNONYMS

NVC English Name: **Sycamore - Green Ash / American Hornbeam / Wingstem Forest**

NVC Scientific Name: ***Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia*** **Forest**

NVC Identifier: **CEGL006458**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches on floodplains along the lower reaches of the Bluestone River in the park. Stands are flooded by natural overbank flows and by reservoir backup from Bluestone Lake. One plot was sampled on the backside of a levee not far from the river's edge. Slopes in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class, which may include patches of this association, range from 0 to 30 degrees (mean = 6.5). Elevations in mapped polygons of the Modified Successional Floodplain Forest and Woodland map class range from 436 to 476 m (mean = 442). Unvegetated ground cover in the plot is dominated by litter with lesser amounts of bare soil and wood. Soil was described as temporarily flooded, moderately poorly drained, stone-free silt loam. Soils tested strongly acidic (pH = 5.3) with relatively high levels of organic matter, estimated N release, S, B, Ca, Cu, Fe, Mg, Mn, Na, P, and Zn, and relatively low levels of Al and K compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Riverbank Tall Herbs (CEGL006480), Successional Box-elder Floodplain Forest (CEGL005033), Successional Black Walnut Floodplain Forest (CEGL007879), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), and River Birch Backwater Floodplain Forest (CEGL002086).

Vegetation Description: This association is a closed-canopy deciduous floodplain forest. Canopy cover in the plot is 60% and subcanopy cover is 70%. Trees in the plot include (in decreasing order of cover) *Platanus occidentalis* (American sycamore), *Ulmus americana* (American elm), and *Fraxinus pennsylvanica* (green ash). Cover in the shrub layers is 50%, strongly dominated by *Lindera benzoin* (northern spicebush). Cover in the herb layer of the plot is only 5% due to heavy shading by the canopy and shrub layers. Native herbs include *Boehmeria cylindrica* (smallspike false nettle), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Cryptotaenia canadensis* (Canadian honewort), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Geum canadense* var. *canadense* (white avens), *Leersia virginica* (whitegrass), *Onoclea sensibilis* (sensitive fern), *Parthenocissus quinquefolia* (Virginia creeper), *Pilea pumila* var. *pumila* (Canadian clearweed), *Polygonum pensylvanicum* (Pennsylvania smartweed), *Polygonum virginianum* (jumpseed), and *Symphyotrichum prenanthoides* (crookedstem aster). Exotic herbs include *Urtica dioica* ssp. *dioica* (stinging nettle), *Alliaria petiolata* (garlic mustard), and *Cardamine hirsuta* (hairy bittercress). Vascular plant species richness in the plot is 31 species per 400 square meters.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus pennsylvanica* (green ash), *Platanus occidentalis* (American sycamore), *Ulmus americana* (American elm)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)

Characteristic Species: *Boehmeria cylindrica* (smallspike false nettle), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Cardamine hirsuta (hairy bittercress)	-	plant	exotic
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2007

Local Range: This association is included as one of several within the Modified Successional Floodplain Forest and Woodland map class. A total of 25 polygons (81.34 ha) of this map class are mapped in the park. Ten accuracy assessment points in the Modified Successional Floodplain Forest and Woodland map class which were attributed to Unclassified Floodplain Forest appear to represent this association. These represent 29% of the accuracy assessment points in this map class and may be an indication of the relative abundance of this association within the map class.

Classification Comments: This association is more abundant downstream along the New River (Vanderhorst et al. 2007), and its definitive classification at Bluestone is obscured by a long history of agriculture and current flooding by reservoir backup from Bluestone Lake. It is distinguished from Sycamore - Yellow Buckeye Floodplain Forest (CEGL006466), which occurs along the Bluestone River upstream beyond the range of reservoir backup, by lacking *Aesculus flava* (yellow buckeye), a species only somewhat tolerant of flooding. It is uncertain whether lack of *Aesculus flava* (yellow buckeye) can be attributed to reservoir backup or to natural flooding regime characterizing larger rivers. The vegetation key developed for accuracy assessment did not include this association but included a lead to Unclassified Floodplain Forest within the Modified Successional Floodplain Forest and Woodland map class. Floristic data from several accuracy assessment points attributed to Unclassified Floodplain Forest match this association and were used as evidence, along with one plot, for recognizing it within the park.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: One plot was sampled: BLUE.74.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Platanus occidentalis - (Liquidambar styraciflua, Liriodendron tulipifera)* Temporarily Flooded Forest Alliance (A.289)
Alliance (English name)	Sycamore - (Sweetgum, Tuliptree) Temporarily Flooded Forest Alliance
Association	*Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest
Association (English name)	Sycamore - Green Ash / American Hornbeam / Wingstem Forest
Ecological System(s):	Information not available.

GLOBAL DESCRIPTION

Concept Summary: This association represents closed-canopy deciduous floodplain forests along the New River and nearby rivers in West Virginia, occurring in small to medium-sized patches (<0.1–13 ha) on the wider floodplains which are associated with point bars along the inside bends of large river meanders. It also occurs on alluvial fans at the mouths of tributaries, and at knickpoints created by rapids and waterfalls. These positions are temporarily inundated by low- to medium-energy floods which may occur at any time of year but are more frequent in the winter and spring. Substrates are alluvium, including boulders, cobbles, gravel, and sand. Soils are well-drained, slightly acidic to neutral sand and sandy loam. Elevations of mapped stands range from 259 to 476 m. The tree canopy is dominated by *Platanus occidentalis* (American sycamore), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Liriodendron tulipifera* (tuliptree). Additional important trees in the canopy include *Betula nigra* (river birch), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Nyssa sylvatica* (blackgum), *Quercus rubra* (northern red oak), *Robinia pseudoacacia* (black locust), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). The subcanopy includes canopy species and *Acer saccharum* (sugar maple), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Cercis canadensis* (eastern redbud), *Chionanthus virginicus* (white fringetree), *Cornus florida* (flowering dogwood), *Halesia tetraptera* (mountain silverbell), *Sassafras albidum* (sassafras), and *Zanthoxylum americanum* (common pricklyash). Species in the shrub layers not included in the canopy include *Asimina triloba* (pawpaw), *Campsis radicans* (trumpet creeper), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Toxicodendron radicans* (eastern poison ivy), and *Viburnum recognitum* (southern arrowwood). Cover in the diverse herb layer ranges from 5 to 90% depending on the degree of canopy shading, and includes species typical of mesic forests as well as those of floodplains.

Environmental Description: This association occurs in small to medium-sized patches (<0.1–13 ha) on floodplains of the New and Bluestone rivers. The best developed stands occur on the wider floodplains which are associated with point bars along the inside bends of large river meanders. It also occurs on alluvial fans at the mouths of tributaries, and at knickpoints created by rapids and waterfalls. These positions are temporarily inundated by low- to medium-energy floods which may occur at any time of year but are more frequent in the winter and spring. Substrates are alluvium, including boulders, cobbles, gravel, and sand. Soils in plots are described as well-drained, slightly acidic to neutral sand and sandy loam. Soil chemistry analyzed from 6 plots at New River Gorge and the Bluestone River indicates slightly to strongly acidic soils (mean pH = 5.82) with relatively low levels of organic matter, S, Al and K, and relatively high levels of Ca, Cu, Mg, and Zn compared to average values in the area. Soils along the Bluestone River, where this association is somewhat influenced by reservoir backup, are more poorly drained, higher in organic matter, and finer textured (silt loam). Slopes range from level to steep (mapping unit values range from 0 to 35 degrees, mean = 8 degrees). Elevations of mapped stands range from 259 to 476 m.

Vegetation Description: This association represents closed-canopy deciduous floodplain forests along the New River and nearby rivers including the Bluestone. The tree canopy is usually tall (20–35 m) with cover in plots ranging from 40 to 80% dominated by *Platanus occidentalis* (American sycamore), *Fraxinus pennsylvanica* (green ash), *Ulmus americana* (American elm), and *Liriodendron tulipifera* (tuliptree). Additional important trees in the canopy include *Betula nigra* (river birch), *Fraxinus americana* (white ash), *Juglans nigra* (black

walnut), *Nyssa sylvatica* (blackgum), *Quercus rubra* (northern red oak), *Robinia pseudoacacia* (black locust), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). Subcanopy cover ranges from 10 to 80% and may include canopy species and *Acer saccharum* (sugar maple), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Cercis canadensis* (eastern redbud), *Chionanthus virginicus* (white fringetree), *Cornus florida* (flowering dogwood), *Halesia tetraptera* (mountain silverbell), *Sassafras albidum* (sassafras), and *Zanthoxylum americanum* (common pricklyash). Cover in the tall-shrub layer of plots ranges from 10 to 80%, and cover in the short-shrub layer ranges from 10 to 50%. Additional species in the shrub layers not included in the canopy include *Asimina triloba* (pawpaw), *Campsis radicans* (trumpet creeper), *Dirca palustris* (eastern leatherwood), *Hamamelis virginiana* (American witchhazel), *Lindera benzoin* (northern spicebush), *Toxicodendron radicans* (eastern poison ivy), and *Viburnum recognitum* (southern arrowwood). Cover in the diverse herb layer ranges from 5 to 90% in plots, depending on the degree of canopy shading. Herbs with highest constancy and/or cover in plots include *Ageratina altissima* (white snakeroot), *Allium cernuum* (nodding onion), *Amphicarpaea bracteata* (American hogpeanut), *Arabis laevigata* (smooth rockcress), *Aristolochia macrophylla* (pipevine), *Asarum canadense* (Canadian wildginger), *Boehmeria cylindrica* (smallspike false nettle), *Brachyelytrum erectum* (bearded shorthusk), *Cardamine impatiens* (narrowleaf bittercress), *Chasmanthium latifolium* (Indian woodoats), *Cinna arundinacea* (sweet woodreed), *Circaea lutetiana* ssp. *canadensis* (broadleaf enchanter's nightshade), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Dioscorea villosa* (wild yam), *Elymus hystrix* (eastern bottlebrush grass), *Elymus virginicus* (Virginia wildrye), *Eurybia divaricata* (white wood aster), *Festuca subverticillata* (nodding fescue), *Galium aparine* (stickywilly), *Geum canadense* (white avens), *Iris cristata* (dwarf crested iris), *Laportea canadensis* (Canadian woodnettle), *Lysimachia ciliata* (fringed loosestrife), *Maianthemum racemosum* (feathery false lily of the valley), *Packera aurea* (golden ragwort), *Parthenocissus quinquefolia* (Virginia creeper), *Phlox paniculata* (fall phlox), *Pilea pumila* (Canadian clearweed), *Polygonatum biflorum* (smooth Solomon's seal), *Polygonum pensylvanicum* (Pennsylvania smartweed), *Polygonum virginianum* (jumpseed), *Polystichum acrostichoides* (Christmas fern), *Rudbeckia laciniata* (cutleaf coneflower), *Sanicula odorata* (clustered blacksnakeroot), *Sedum ternatum* (woodland stonecrop), *Silene stellata* (widowsfrill), *Silphium perfoliatum* var. *connatum* (cup plant), *Solidago flexicaulis* (zigzag goldenrod), *Symphyotrichum cordifolium* (common blue wood aster), *Symphyotrichum prenanthoides* (crookedstem aster), *Tradescantia virginiana* (Virginia spiderwort), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), *Viola striata* (striped cream violet), *Zizia aptera* (meadow zizia), *Zizia aurea* (golden zizia), and *Zizia trifoliata* (meadow alexanders). Exotic plant species which invade this community include *Alliaria petiolata* (garlic mustard), *Glechoma hederacea* (ground ivy), *Cardamine hirsuta* (hairy bittercress), *Lonicera japonica* (Japanese honeysuckle), *Microstegium vimineum* (Nepalese browntop), *Polygonum cuspidatum* (Japanese knotweed), *Prunella vulgaris* (common selfheal), *Urtica dioica* ssp. *dioica* (stinging nettle), and *Rosa multiflora* (multiflora rose). Vascular plant species richness in the 17 sampled plots ranges from 26 to 70 per 200 square meters (mean = 51.9).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Fraxinus pennsylvanica* (green ash), *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore)
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana* ssp. *virginiana* (American hornbeam)

Characteristic Species: *Ageratina altissima* (white snakeroot), *Allium cernuum* (nodding onion), *Amphicarpaea bracteata* (American hogpeanut), *Arabis laevigata* (smooth rockcress), *Aristolochia macrophylla* (pipevine), *Asarum canadense* (Canadian wildginger), *Asimina triloba* (pawpaw), *Betula nigra* (river birch), *Boehmeria cylindrica* (smallspike false nettle), *Brachyelytrum erectum* (bearded shorthusk), *Campsis radicans* (trumpet creeper), *Cardamine impatiens* (narrowleaf bittercress), *Cercis canadensis* (eastern redbud), *Chasmanthium latifolium* (Indian woodoats), *Chionanthus virginicus* (white fringetree), *Cinna arundinacea* (sweet woodreed), *Cornus florida* (flowering dogwood), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Dioscorea villosa* (wild yam), *Dirca palustris* (eastern leatherwood), *Elymus hystrix* (eastern bottlebrush grass), *Elymus virginicus* (Virginia wildrye), *Eurybia divaricata* (white wood aster), *Festuca subverticillata* (nodding fescue), *Fraxinus americana* (white ash), *Galium aparine* (stickywilly), *Halesia tetraptera* (mountain silverbell), *Hamamelis virginiana* (American witchhazel), *Iris cristata* (dwarf crested iris), *Juglans nigra* (black walnut), *Laportea canadensis* (Canadian woodnettle), *Lindera benzoin* (northern spicebush), *Lysimachia ciliata* (fringed loosestrife), *Maianthemum racemosum* (feathery false lily of the valley), *Nyssa sylvatica* (blackgum), *Packera aurea* (golden ragwort), *Parthenocissus quinquefolia* (Virginia creeper), *Phlox paniculata* (fall phlox), *Pilea pumila* (Canadian clearweed), *Polygonatum biflorum* (smooth Solomon's seal), *Polygonum virginianum* (jumpseed), *Polystichum acrostichoides* (Christmas fern), *Quercus rubra* (northern red oak), *Robinia pseudoacacia* (black locust), *Rudbeckia laciniata* (cutleaf coneflower), *Sanicula odorata* (clustered blacksnakeroot), *Sassafras albidum* (sassafras), *Sedum ternatum* (woodland stonecrop), *Silene stellata* (widowsfrill), *Solidago flexicaulis* (zigzag goldenrod), *Symphyotrichum cordifolium* (common blue wood aster), *Toxicodendron radicans* (eastern poison ivy), *Tradescantia virginiana* (Virginia spiderwort), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), *Viburnum recognitum* (southern arrowwood), *Viola striata* (striped cream violet), *Zanthoxylum americanum* (common pricklyash), *Zizia aptera* (meadow zizia), *Zizia aurea* (golden zizia), *Zizia trifoliata* (meadow alexanders).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Cardamine flagellifera (Blue Ridge bittercress)	G3	plant	vulnerable
Cardamine hirsuta (hairy bittercress)	-	plant	exotic
Cardamine impatiens (narrowleaf bittercress)	-	plant	exotic
Glechoma hederacea (ground ivy)	-	plant	exotic
Lonicera japonica (Japanese honeysuckle)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Polygonum cuspidatum (Japanese knotweed)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Silphium perfoliatum var. *connatum* (cup plant)	G5T3T4	plant	vulnerable
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is currently documented from the New River and nearby rivers in West Virginia but is presumably wider ranging.

States/Provinces: WV.

Federal Lands: NPS (Bluestone, New River Gorge).

CONSERVATION STATUS

Rank: GNR (2-Aug-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: Information not available.

Similar Associations:

Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica Forest (CEGL004073)--occurs on richer floodplains in the central Appalachians, usually on calcareous substrates.

Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra Forest (CEGL007334)--occurs on richer floodplains in the southern Appalachians, Cumberlands, and adjacent regions, usually on calcareous substrates.

Platanus occidentalis - Liquidambar styraciflua / Carpinus caroliniana - Asimina triloba Forest (CEGL007340)--has Coastal Plain affinity.

Related Concepts:

Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana riparian forest (Vanderhorst 2001b) =

mesic upland forest (Suiter 1995) B

SOURCES

Description Authors: J. P. Vanderhorst, mod. S. C. Gawler.

References: Eastern Ecology Working Group n.d., Suiter 1995, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.74. Sycamore - Ash Floodplain Forest.

COMMON NAME (PARK-SPECIFIC) **SYCAMORE - YELLOW BUCKEYE FLOODPLAIN FOREST**

SYNONYMS
NVC English Name: **Sycamore / Yellow Buckeye Forest**
NVC Scientific Name: ***Platanus occidentalis / Aesculus flava* Forest**
NVC Identifier: **CEGL006466**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches on floodplains with a natural hydroperiod characteristic of medium-sized rivers of West Virginia's west slope (Ohio River basin). Stands are probably flooded multiple times (in any season) in most years, but floods are probably of relatively low energy and short duration. Stands occur on islands, riverfront levees, undulating terraces, and in backchannel positions. Slopes in mapped polygons of the Floodplain Forest and Woodland map class, which includes patches of this association, range from 0 to 34 degrees (mean = 8). Elevations in mapped polygons of the Floodplain Forest and Woodland map class range from 436 to 506 m (mean = 460). Microtopography is characterized by fluvial features such as swales, berms, washouts, and elevated root clumps. Unvegetated ground cover is dominated by litter but also includes significant wood flotsam piles, bare soil, and standing water in depressions. Soils in plots are described as temporarily flooded, somewhat poorly to well-drained, deep sand and sandy loam derived from alluvium. Soils from plots tested medium to slightly acidic (mean pH = 5.9) with relatively high levels of Ca, Cu, Fe, Mg, Mn, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, B, K, and P compared to average values in the park. Adjacent associations in the Floodplain Forest and Woodland map class may include Oak - Hickory Floodplain Forest (CEGL006462), Sycamore - River Birch Riverscour Woodland (CEGL003725), Eastern Hemlock Floodplain Forest (CEGL006620), and Riverbank Tall Herbs (CEGL006480). Adjacent, previously farmed, higher terraces are often occupied by Successional Eastern White Pine - Tuliptree Forest (CEGL007944).

Vegetation Description: This association is a somewhat open- to closed-canopy deciduous floodplain forest characterized by a tall canopy of *Platanus occidentalis* (American sycamore) over a subcanopy of *Aesculus flava* (yellow buckeye). Canopy cover in plots ranges from 30–70%. In addition to the dominant *Platanus occidentalis* (American sycamore), which often form a line of large trees along the riverbank, canopies in plots include *Acer rubrum* var. *rubrum* (red maple), *Acer saccharum* var. *saccharum* (sugar maple), *Fraxinus pennsylvanica* (green ash), and *Liriodendron tulipifera* (tuliptree). Subcanopy cover in plots ranges from 20–50%, usually strongly dominated by *Aesculus flava* (yellow buckeye). Abundance of *Aesculus flava* (yellow buckeye), a species only moderately tolerant of flooding, may be attributed to short duration of floods and/or availability of well-drained microsites where it can become established and persist. The spring aspect of this forest can be striking, with early leaf-out by *Aesculus flava* (yellow buckeye) prominent under a tall, still-leafless canopy of *Platanus occidentalis* (American sycamore). Cover in the shrub layers of plots ranges from 15–60%, including saplings of tree species. Common species in the shrub layers include *Asimina triloba* (pawpaw), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Lindera benzoin* (northern spicebush), and *Viburnum prunifolium* (blackhaw). This community may be especially susceptible to invasion by the exotic shrub *Rosa multiflora* (multiflora rose). Herb cover in plots ranges from 60–70%, but

some observed areas have lower herb cover associated with heavy shading or long standing water. Common native herbs include *Verbesina alternifolia* (wingstem), *Amphicarpaea bracteata* (American hogpeanut), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Leersia virginica* (whitegrass), *Galium triflorum* (fragrant bedstraw), *Packera aurea* (golden ragwort), *Cryptotaenia canadensis* (Canadian honewort), *Chasmanthium latifolium* (Indian woodoats), *Boehmeria cylindrica* (smallspike false nettle), and *Pilea pumila* var. *pumila* (Canadian clearweed). Exotic herbs in plots include *Alliaria petiolata* (garlic mustard), *Hesperis matronalis* (dames rocket), *Hypericum perforatum* (common St. Johnswort), and *Prunella vulgaris* (common selfheal). Vascular plant species richness ranges from 40 to 65 (mean = 54.6) species per 400-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis* (American sycamore)
Tree subcanopy	Broad-leaved deciduous tree	*Aesculus flava* (yellow buckeye)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin* (northern spicebush)
Herb (field)	Forb	*Amphicarpaea bracteata* (American hogpeanut), *Boehmeria cylindrica* (smallspike false nettle), *Pilea pumila* var. *pumila* (Canadian clearweed), *Verbesina alternifolia* (wingstem)

Characteristic Species: *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Packera aurea* (golden ragwort).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Hesperis matronalis (dames rocket)	-	plant	exotic
Hypericum perforatum (common St. Johnswort)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2008

Local Range: This association is included as one of several associations within the Floodplain Forest and Woodland map class. A total of 48 polygons (57.11 ha) of this map class are mapped in the park. Ten accuracy assessment points in the Floodplain Forest and Woodland map class are attributed to this association. This represents 30% of the accuracy assessment points in this map class and is an indication of the relative abundance of this association within the map class. Stands of this association are scattered along the Bluestone River at elevations above 445 m, upstream from areas affected by reservoir backup from Bluestone Lake.

Classification Comments: This association has now been documented in West Virginia along the Bluestone, Cheat, Greenbrier and Tygart Valley rivers, a range spanning over 200 air km. Its occurrence along other west slope (Ohio drainage) West Virginia rivers is expected, but it will not occur on the east slope (Atlantic drainage) of the mountains because *Aesculus flava* (yellow buckeye) does not occur there. It is most similar to Sycamore - Ash Floodplain Forest (CEGL006458) which occurs downstream along the New River. Differences between these two associations are best explained by river size, duration of flooding, and availability of well-drained microsites which can support *Aesculus flava* (yellow buckeye) and other species less tolerant of flooding. Floristic differences, other than abundance of *Aesculus flava* (yellow buckeye), are subtle, and plots from Bluestone ordinate and cluster in intermediate species space between plots of Sycamore - Ash Floodplain Forest from New River and plots of Sycamore -

Yellow Buckeye Floodplain Forest from the other rivers. In a two-group analysis, species with highest indicator value for the Sycamore - Yellow Buckeye Floodplain Forest throughout its range include *Prunus serotina* var. *serotina* (black cherry), *Carya cordiformis* (bitternut hickory), *Leersia virginica* (whitegrass), and *Symphyotrichum prenanthoides* (crookedstem aster). Species with highest indicator value for the Sycamore - Ash Floodplain Forest include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), *Halesia tetraptera* (mountain silverbell), *Robinia pseudoacacia* (black locust), and *Fraxinus pennsylvanica* (green ash).
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: Three plots were sampled: BLUE.41, BLUE.80, and BLUE.104.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Platanus occidentalis - (Liquidambar styraciflua, Liriodendron tulipifera)* Temporarily Flooded Forest Alliance (A.289)
Alliance (English name)	Sycamore - (Sweetgum, Tuliptree) Temporarily Flooded Forest Alliance
Association	*Platanus occidentalis / Aesculus flava* Forest
Association (English name)	Sycamore / Yellow Buckeye Forest
Ecological System(s):	Central Appalachian River Floodplain (CES202.608).

GLOBAL DESCRIPTION

Concept Summary: This floodplain forest community has been documented from rivers of West Virginia's Ohio River drainage (the western slope), including the Cheat, Greenbrier, Tygart Valley, and Bluestone rivers. It occupies stabilized terraces and levees subject to periodic overbank flooding. The microtopography is complex, with levee development along the river's edge, and swales and flatter terraces behind the levees. The alluvial soils are derived primarily from acidic sandstones and shales and range from silt to sandy loams. Measured soil pH is 4.5–6.3. The vegetation is characterized by a tall canopy of *Platanus occidentalis* (American sycamore) with *Liriodendron tulipifera* (tuliptree) and/or *Fagus grandifolia* (American beech) over a subcanopy of *Aesculus flava* (yellow buckeye). *Prunus serotina* (black cherry) and *Acer saccharum* (sugar maple) are common codominants. *Platanus occidentalis* (American sycamore) is often concentrated as a line along the immediate river's edge. *Carpinus caroliniana* (American hornbeam) is a typical small tree and *Lindera benzoin* (northern spicebush) a typical shrub. *Asimina triloba* (pawpaw) and *Viburnum prunifolium* (blackhaw) are associated shrubs. *Hydrophyllum virginianum* (Shawnee salad), *Mertensia virginica* (Virginia bluebells), *Elymus hystrix* (eastern bottlebrush grass), *Packera aurea* (golden ragwort), *Symphyotrichum prenanthoides* (crookedstem aster), and *Viola cucullata* (marsh blue violet) are characteristic herbs. *Verbesina alternifolia* (wingstem), *Amphicarpaea bracteata* (American hogpeanut), *Boehmeria cylindrica* (smallspike false nettle), and *Pilea pumila* var. *pumila* (Canadian clearweed) are frequent and may be abundant in the herb layer. The exotic herbs *Microstegium vimineum* (Nepalese browntop) and *Glechoma hederacea* (ground ivy) are sometimes locally

abundant, and *Alliaria petiolata* (garlic mustard), *Hesperis matronalis* (dames rocket), *Hypericum perforatum* (common St. Johnswort), and *Prunella vulgaris* (common selfheal) may also be present.

Environmental Description: This association occurs in small patches on floodplains with a natural hydroperiod characteristic of medium-sized rivers of West Virginia's west slope (Ohio River basin). Stands are probably flooded multiple times (in any season) in most years, but floods are probably of relatively low energy and short duration. Stands occur on islands, riverfront levees, undulating terraces, and in backchannel positions. Microtopography is characterized by fluvial features such as swales, berms, washouts, and elevated root clumps. Unvegetated ground cover is dominated by litter but also includes significant wood flotsam piles, bare soil, and standing water in depressions. Soils in Bluestone River plots are described as temporarily flooded, somewhat poorly to well-drained, deep sand and sandy loam derived from alluvium. Soils from plots tested medium to slightly acidic (mean pH = 5.9) with relatively high levels of Ca, Cu, Fe, Mg, Mn, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, B, K, Na, and P, compared to average values in the area.

Vegetation Description: This association is a somewhat open- to closed-canopy deciduous floodplain forest characterized by a tall canopy of *Platanus occidentalis* (American sycamore) over a subcanopy of *Aesculus flava* (yellow buckeye). Canopy cover in three plots along the Bluestone River is 30–70%. In addition to the dominant *Platanus occidentalis* (American sycamore), which often forms a line of large trees along the riverbank, canopies include *Acer rubrum* var. *rubrum* (red maple), *Acer saccharum* var. *saccharum* (sugar maple), *Fraxinus pennsylvanica* (green ash), and *Liriodendron tulipifera* (tuliptree). The subcanopy is usually strongly dominated by *Aesculus flava* (yellow buckeye). Abundance of *Aesculus flava* (yellow buckeye), a species only moderately tolerant of flooding, may be attributed to short duration of floods and/or availability of well-drained microsites where it can become established and persist. The spring aspect of this forest can be striking, with early leaf-out by *Aesculus flava* (yellow buckeye) prominent under a tall, still-leafless canopy of *Platanus occidentalis* (American sycamore). Common species in the shrub layers include *Asimina triloba* (pawpaw), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Lindera benzoin* (northern spicebush), and *Viburnum prunifolium* (blackhaw). This community may be especially susceptible to invasion by the exotic shrub *Rosa multiflora* (multiflora rose). The herb layer is usually well-developed, but some areas have lower herb cover associated with heavy shading or long standing water. Common native herbs include *Verbesina alternifolia* (wingstem), *Amphicarpaea bracteata* (American hogpeanut), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Dichanthelium clandestinum* (deertongue), *Elymus hystrix* var. *hystrix* (eastern bottlebrush grass), *Leersia virginica* (whitegrass), *Galium triflorum* (fragrant bedstraw), *Packera aurea* (golden ragwort), *Cryptotaenia canadensis* (Canadian honewort), *Chasmanthium latifolium* (Indian woodoats), *Boehmeria cylindrica* (smallspike false nettle), and *Pilea pumila* var. *pumila* (Canadian clearweed). Exotic herbs in plots include *Alliaria petiolata* (garlic mustard), *Hesperis matronalis* (dames rocket), *Hypericum perforatum* (common St. Johnswort), and *Prunella vulgaris* (common selfheal). Vascular plant species richness in 12 West Virginia plots ranges from 19 to 80 (mean = 42) species per 200-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis* (American sycamore)
Tree subcanopy	Broad-leaved deciduous tree	*Aesculus flava* (yellow buckeye)

Characteristic Species: *Acer rubrum* var. *rubrum* (red maple), *Acer saccharum* var. *saccharum* (sugar maple), *Aesculus flava* (yellow buckeye), *Asimina triloba* (pawpaw), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Fraxinus pennsylvanica* (green ash), *Lindera benzoin* (northern spicebush), *Platanus occidentalis* (American sycamore), *Viburnum prunifolium* (blackhaw).

Other Noteworthy Species:

Species	GRank	Type	Note
Alliaria petiolata (garlic mustard)	-	plant	exotic
Glechoma hederacea (ground ivy)	-	plant	exotic
Hesperis matronalis (dames rocket)	-	plant	exotic
Hypericum perforatum (common St. Johnswort)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is currently documented only from West Virginia but is probably more extensive.

States/Provinces: WV.

Federal Lands: NPS (Bluestone).

CONSERVATION STATUS

Rank: GNR (18-Jul-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 - Weak.

Comments: At Camp Dawson, the overstory composition is similar to the mixed mesophytic forests on adjacent upland colluvial slopes, but *Prunus serotina* (black cherry) is more abundant and *Tilia americana* (American basswood) less abundant or absent in this type. Understory differences are more distinct, with weedy species reflecting the flooding disturbance regime. More documentation of this type is needed. This association has now been documented in West Virginia along the Bluestone, Cheat, Greenbrier and Tygart Valley rivers, a range spanning over 200 air km. Its occurrence along other west slope (Ohio River drainage) West Virginia rivers is expected, but it will not occur on the east slope (Atlantic drainage) of the mountains because *Aesculus flava* (yellow buckeye) does not occur there. It is most similar to *Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest (CEGL006458) which occurs downstream along the New River. Differences between these two associations are best explained by river size, duration of flooding, and availability of well-drained microsites which can support *Aesculus flava* (yellow buckeye) and other species less tolerant of flooding. Floristic differences, other than abundance of *Aesculus flava* (yellow buckeye), are subtle. In a two group analysis, species with highest indicator value for this association (CEGL006466) throughout its range include *Prunus serotina* var. *serotina* (black cherry), *Carya cordiformis* (bitternut hickory), *Leersia virginica* (whitegrass), and *Symphyotrichum prenanthoides* (crookedstem aster). Species with highest indicator value for CEGL006458 include *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Smilax rotundifolia* (roundleaf greenbrier), *Toxicodendron radicans* (eastern poison ivy), *Halesia tetraptera* (mountain silverbell), *Robinia pseudoacacia* (black locust), and *Fraxinus pennsylvanica* (green ash).

Similar Associations: Information not available.
Related Concepts:
Mature floodplain forest (Vanderhorst 2001a) B

SOURCES
Description Authors: J. Vanderhorst and S. C. Gawler.
References: Eastern Ecology Working Group n.d., Vanderhorst 2001a, Vanderhorst and Streets 2006, Vanderhorst et al. 2008.

Plot BLUE.104. Sycamore - Yellow Buckeye Floodplain Forest.

COMMON NAME (PARK-SPECIFIC): OAK - EASTERN WHITE PINE / ERICAD FOREST

SYNONYMS

NVC English Name: **Eastern White Pine - White Oak - Chestnut Oak / Deerberry Forest**

NVC Scientific Name: ***Pinus strobus - Quercus alba - Quercus prinus / Vaccinium stamineum* Forest**

NVC Identifier: **CEGL008539**

LOCAL INFORMATION

Environmental Description: This association, the second most abundant in the park, predominates on gorge slopes with high solar exposure and low soil moisture and fertility. Patch size ranges from 0–98.4 hectares (mean = 2.18 hectares). It occurs in large patches in all slope positions on southwesterly aspects and becomes restricted to smaller patches on ridge spurs and convex upper slopes on cooler aspects. Slopes in mapped polygons range from 0 to 44 degrees (mean = 23.6). Elevations in mapped polygons range from 447 to 734 m (mean = 577). Unvegetated ground cover in plots is usually dominated by litter but also includes significant rock and lesser amounts of bare soil and wood. Soils in plots are described as well-drained, dry, somewhat to very stony sandy loam, or less commonly silt loam, loam, or silty clay. Soils are mapped in the Calvin, Gilpin, and Berks series (Sponaugle et al. 1984) and are derived from shales and sandstones of the Mauch Chunk Group. Soils from plots tested extremely to very strongly acidic (mean pH = 4.2) with relatively high levels of organic matter, estimated N release, S, Al, and Fe, and relatively low levels of B, Ca, Cu, K, Mg, Mn, Na, P, and Zn compared to average values in the park. Polygons of this association are usually adjacent to and may grade towards polygons of Oak - Hickory - Sugar Maple Forest (CEGL007268), which occur on somewhat less dry, more fertile soils.

Vegetation Description: This association is a somewhat open- to closed-canopy mixed deciduous-evergreen forest dominated by *Quercus* (oak) spp., in association with *Pinus strobus* (eastern white pine) in the canopy and/or understories, over shrub layers dominated by species in the Ericaceae (heath family). *Pinus strobus* (eastern white pine) has highest total cover of any species across all plots, but this is considerably less than combined cover by *Quercus* (oak) spp. Canopy cover in plots ranges from 40–80%. Codominant canopy trees include (in decreasing order of constancy in plots) *Quercus prinus* (chestnut oak), *Quercus alba* (white oak), *Pinus strobus* (eastern white pine), *Quercus coccinea* var. *coccinea* (scarlet oak), *Quercus velutina* (black oak), and *Quercus rubra* (northern red oak). Additional canopy trees with low constancy include *Carya glabra* (pignut hickory), *Carya alba* (mockernut hickory), and *Liriodendron tulipifera* (tuliptree). Subcanopy cover in plots ranges from 10–60%. Important tree species in the subcanopy, in addition to those listed for the canopy, include *Acer rubrum* var. *rubrum* (red maple) and *Oxydendrum arboreum* (sourwood). The subcanopy and understory may also include some shade-tolerant, mesophytic trees such as *Acer saccharum* var. *saccharum* (sugar maple), *Tsuga canadensis* (eastern hemlock), and *Fagus grandifolia* (American beech), which may indicate successional trends in some stands; however, there is also evidence of abundant oak regeneration in several plots. Cover in the shrub layers of plots ranges from 6–60% including tree saplings, shrubs, and vines. Important shrubs and vines include *Vaccinium pallidum* (Blue Ridge blueberry), *Amelanchier arborea* var. *arborea* (common serviceberry), *Viburnum*

acerifolium (mapleleaf viburnum), *Vaccinium stamineum* (deerberry), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), *Kalmia latifolia* (mountain laurel), and *Gaylussacia baccata* (black huckleberry). The herb layer has relatively low cover (1–20% in plots) compared to deciduous forests in the park and is characterized by species tolerant of dry, acidic soils. Common herbs include (in decreasing order of constancy in plots) *Dioscorea quaternata* (fourleaf yam), *Conopholis americana* (American squawroot), *Houstonia longifolia* (longleaf summer bluet), *Chimaphila maculata* (striped prince's pine), *Antennaria plantaginifolia* (woman's tobacco), *Zizia trifoliata* (meadow alexanders), *Gaultheria procumbens* (eastern teaberry), *Cunila origanoides* (common dittany), *Carex pensylvanica* (Pennsylvania sedge), *Potentilla simplex* (common cinquefoil), *Viola X palmata* (early blue violet), and *Danthonia spicata* (poverty oatgrass). Vascular plant species richness ranges from 20 to 53 (mean = 33.5) species per 400-square-meter plot. Two state-rare species, the shrub *Viburnum rafinesquianum* (downy arrowwood) and the herb *Monarda fistulosa* ssp. *brevis* (Smokehole bergamot), are found in plots of this association; however, both these species are more typical of calcareous soils and their presence here is peripheral to larger populations in adjacent habitats. Cover by nonvascular species in plots ranges from 0–40%. Mosses identified in plots include *Leucobryum glaucum* (leucobryum moss), *Dicranum scoparium* (dicranum moss), *Hedwigia ciliata* (ciliate hedwigia moss), *Hypnum imponens* (hypnum moss), *Polytrichum ohioense* (Ohio polytrichum moss), and *Thuidium delicatulum* (delicate thuidium moss). Lichens identified in plots include *Cladonia furcata* (cup lichen), *Cladina arbuscula* (reindeer lichen), and *Flavoparmelia baltimorensis*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak), *Quercus coccinea* var. *coccinea* (scarlet oak), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Quercus velutina* (black oak)
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum* var. *rubrum* (red maple), *Oxydendrum arboreum* (sourwood)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Amelanchier arborea* var. *arborea* (common serviceberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Antennaria plantaginifolia* (woman's tobacco), *Chimaphila maculata* (striped prince's pine), *Conopholis americana* (American squawroot), *Cunila origanoides* (common dittany), *Houstonia longifolia* (longleaf summer bluet), *Potentilla simplex* (common cinquefoil), *Zizia trifoliata* (meadow alexanders).

Other Noteworthy Species:

Species	GRank	Type	Note
Monarda fistulosa ssp. brevis (Smoke Hole bergamot)	G5T1	plant	globally critically imperiled
Viburnum rafinesquianum (downy arrowwood)	-	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2008

Local Range: A total of 184 polygons covering 396.83 hectares are mapped in the park. This association is concentrated on gorge slopes with southwesterly aspects and is scattered in convex positions on other aspects throughout the park.
Classification Comments: This association is similar to both the "white pine - mixed oak" and the "chestnut oak - northern red oak - red maple" communities classified by Rentch et al.'s (2005) study of upland forests in the Bluestone River gorge. Their study distinguished these two types based on canopy dominance by *Pinus strobus* (eastern white pine); in the later type, *Pinus strobus* (eastern white pine) is mostly confined to the lower strata. An 8000-acre virgin tract near the Bluestone River in Mercer County with a large component of *Pinus strobus* (eastern white pine) was described by Brooks (1910) as consisting of "white pine...60%, white oak...25%, hemlock...5%, yellow poplar...5%, chestnut, hickory, and others...5%." Elsewhere in West Virginia, this association is abundant in the Ridge and Valley, especially in areas with predominantly shale geology. One small virgin stand representing this association is known from the Monongahela National Forest near Neola, Pocahontas County (Abrams et al. 1995), where it is protected as a designated botanical site. A small patch of this association was recently identified in Babcock State Park, part of the New River Gorge National River (S. Perles pers. comm.), where it was previously mismapped as Successional Eastern White Pine Forest (Vanderhorst et al. 2007).
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: Sixteen plots were sampled: BLUE.7, BLUE.12, BLUE.15, BLUE.17, BLUE.19, BLUE.29, BLUE.45, BLUE.49, BLUE.60, BLUE.61, BLUE.88, BLUE.90, BLUE.103, BLUE.113, BLUE.119, and BLUE.121.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	*Pinus strobus - Quercus (coccinea, prinus)* Forest Alliance (A.402)
Alliance (English name)	Eastern White Pine - (Scarlet Oak, Chestnut Oak) Forest Alliance
Association	*Pinus strobus - Quercus alba - Quercus prinus / Vaccinium stamineum* Forest
Association (English name)	Eastern White Pine - White Oak - Chestnut Oak / Deerberry Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591).

GLOBAL DESCRIPTION

Concept Summary: The known range of this community includes the Central Appalachian region of Virginia, Maryland, and West Virginia, and the northern and central Piedmont of Virginia. The type is particularly abundant and widespread on low shale mountains and hills in west-central Virginia and adjacent West Virginia. Sites are underlain primarily by shale and similar sedimentary rocks (siltstone, metasiltstone, phyllite) or, less commonly, sandstone in the mountains and by a variety of acidic metamorphic and igneous rocks in the Piedmont. Stands occupy middle and upper slopes, ridge crests, dry ravines, and bluffs, mostly below 760 m (2500 feet) elevation in the mountains and above 75 m (240 feet) in the Piedmont. Aspect is variable,

and site moisture is typically assessed as subxeric or submesic. Vegetation is a mixed forest, with canopies varying from closed to somewhat open, codominated by *Pinus strobus* (eastern white pine) (25–75% canopy cover) and various oaks, particularly *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus rubra* (northern red oak), and *Quercus prinus* (chestnut oak). Minor canopy associates include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech) (mostly Piedmont), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Pinus virginiana* (Virginia pine), *Quercus falcata* (southern red oak) (mostly Piedmont), *Quercus velutina* (black oak), and *Tsuga canadensis* (eastern hemlock). *Acer rubrum* (red maple), *Oxydendrum arboreum* (sourwood), and *Nyssa sylvatica* (blackgum) are abundant understory trees, along with *Cornus florida* (flowering dogwood). The shrub layer is predominantly ericaceous and varies from sparse and patchy to occasionally dense. *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Gaylussacia baccata* (black huckleberry), and *Kalmia latifolia* (mountain laurel) are characteristic ericads. Other frequent but lower-cover shrub-layer species include *Amelanchier arborea* (common serviceberry), *Viburnum acerifolium* (mapleleaf viburnum), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), *Sassafras albidum* (sassafras), and *Diospyros virginiana* (common persimmon). The herb layer is characterized by species tolerant of dry, acidic soils; it is usually sparse but occasionally contains dense graminoid patches of *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge).

Environmental Description: Sites are underlain primarily by shale and similar sedimentary rocks (siltstone, metasiltstone, phyllite) or, less commonly, sandstone in the mountains and by a variety of acidic metamorphic and igneous rocks in the Piedmont. Stands occupy middle and upper slopes, ridge crests, dry ravines, and bluffs, mostly below 760 m (2500 feet) elevation in the mountains and above 75 m (240 feet) in the Piedmont. At least in West Virginia, it occurs in large patches in all slope positions on southwesterly aspects and becomes restricted to smaller patches on ridge spurs and convex upper slopes on cooler aspects. Aspect is variable, and site moisture is typically assessed as subxeric or submesic. Soils are extremely acidic (mean pH = 4.2) with very low base cation levels. Chemical analysis of soils from 16 sites near the Bluestone River in West Virginia showed soils with relatively high levels of organic matter, estimated N release, S, Al, and Fe, and relatively low levels of B, Ca, Cu, K, Mg, Mn, Na, P, and Zn compared to average values in the area.

Vegetation Description: Vegetation is a mixed forest, with canopies varying from closed to somewhat open, codominated by *Pinus strobus* (eastern white pine) (25–75% canopy cover) and various oaks, particularly *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus rubra* (northern red oak), and *Quercus prinus* (chestnut oak). Minor canopy associates include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Carya glabra* (pignut hickory), *Fagus grandifolia* (American beech) (mostly Piedmont), *Liriodendron tulipifera* (tuliptree), *Nyssa sylvatica* (blackgum), *Pinus virginiana* (Virginia pine), *Quercus falcata* (southern red oak) (mostly Piedmont), *Quercus velutina* (black oak), and *Tsuga canadensis* (eastern hemlock). *Acer rubrum* (red maple), *Oxydendrum arboreum* (sourwood), and *Nyssa sylvatica* (blackgum) are abundant understory trees, along with *Cornus florida* (flowering dogwood). The shrub layer is predominantly ericaceous and varies from sparse and patchy to occasionally dense. *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Gaylussacia baccata* (black huckleberry), and *Kalmia latifolia* (mountain laurel) are characteristic ericads. Other frequent but lower-cover shrub-layer species include

Amelanchier arborea (common serviceberry), *Viburnum acerifolium* (mapleleaf viburnum), *Smilax rotundifolia* (roundleaf greenbrier), *Smilax glauca* (cat greenbrier), *Sassafras albidum* (sassafras), and *Diospyros virginiana* (common persimmon). The herb layer is typically sparse and characterized by species tolerant of dry, acidic soils. It consists mostly of woody seedlings and scattered individuals of *Chimaphila maculata* (striped prince's pine), *Polygonatum biflorum* (smooth Solomon's seal), *Mitchella repens* (partridgeberry), *Cypripedium acaule* (moccasin flower), *Dioscorea quaternata* (fourleaf yam), *Conopholis americana* (American squawroot), *Houstonia longifolia* (longleaf summer bluet), *Antennaria plantaginifolia* (woman's tobacco), *Zizia trifoliata* (meadow alexanders), *Gaultheria procumbens* (eastern teaberry), *Cunila origanoides* (common dittany), *Potentilla simplex* (common cinquefoil), and *Viola X palmata* (early blue violet). Occasional stands, especially on shale substrates, contain dense graminoid patches of *Danthonia spicata* (poverty oatgrass), *Deschampsia flexuosa* (wavy hairgrass), or *Carex pensylvanica* (Pennsylvania sedge). Species richness of plot-sampled stands ranged from 16 to 65 taxa per 400 square meters (mean = 36) in the VA and MD plots and from 20 to 53 (mean = 33.5) species per 200 square meters in the WV plots.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba* (white oak)

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

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

CONSERVATION STATUS

Rank: G4 (21-Sep-2001).

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

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: The circumscription of this type is based on analysis of 16 plot samples from the Virginia Piedmont and Blue Ridge, and Maryland Ridge and Valley, with an additional 16 plots from the environs of the Bluestone River, West Virginia. Additional data, particularly from

Central Appalachian regions where white pine is prevalent, would assist in making the classification more robust and identifying potential regional patterns of variation. Central Appalachian white pine - hardwood forests are distinguished from similar vegetation of the Southern Appalachians, e.g., *Pinus strobus - Quercus alba - (Carya alba) / Gaylussacia ursina* Forest (CEGL007517) and *Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum)* Forest (CEGL007519) by the absence of Southern Appalachian species such as *Gaylussacia ursina* (bear huckleberry), *Leucothoe recurva* (redtwig doghobble), *Rhododendron minus* (piedmont rhododendron), *Arundinaria gigantea* (giant cane), and *Hydrangea radiata* (silverleaf hydrangea).

Similar Associations:

Liriodendron tulipifera - Pinus strobus - Tsuga canadensis - Quercus (rubra, alba) / Polystichum acrostichoides Forest (CEGL006304)--of more mesic habitats (e.g., acidic coves) in Maryland, Virginia, and West Virginia.

Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum) Forest (CEGL007519)--of the Southern Appalachians.

Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia Forest (CEGL006293).

Pinus strobus - Quercus alba - (Carya alba) / Gaylussacia ursina Forest (CEGL007517)--of the Southern Appalachians.

Related Concepts:

Pinus strobus - Quercus alba - Quercus (coccinea, prinus) / Vaccinium stamineum Forest (VDNH 2003) =

Pinus strobus - Quercus alba - Quercus coccinea / Vaccinium stamineum Forest (Fleming and Coulling 2001) =

Quercus montana - Pinus strobus / Ostrya virginiana Forest (Fleming and Moorhead 2000) F

Chestnut Oak - Northern Red Oak - Red Maple (Rentch et al. 2005) ?

White Pine - Chestnut Oak: 51 (Eyre 1980) B

White Pine - Mixed Oak (Rentch et al. 2005) ?

SOURCES

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

References: Abrams et al. 1995, Brooks 1910, Eyre 1980, Fleming 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Perles pers. comm., Rentch et al. 2005, Rhoades 1995, VDNH 2003, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.61. Oak - Eastern White Pine / Ericad Forest.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK - SWEET BIRCH - TULIPTREE / GREAT LAUREL FOREST

SYNONYMS
NVC English Name: **Tuliptree - Sweet Birch - Eastern Hemlock / Great Laurel Forest**
NVC Scientific Name: ***Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest**
NVC Identifier: **CEGL007543**

LOCAL INFORMATION

Environmental Description: One small (0.1–ha) patch of this association is known in the park in a boulder strewn, headwater ravine bottom. The sandstone boulders, which form a "rock river," were mass wasted from upslope bedrock and accumulated in the stream bottom. This sandstone colluvium represents an atypical substrate for mesic habitats in the park, which are predominantly underlain by shale. Slope in the single mapped polygon is about 24 degrees. Elevation of the mapped polygon is about 659 m. Unvegetated ground cover is dominated by litter and large rocks with a smaller amount of coarse woody debris. Soil in the plot is described as a moist, well-drained, extremely rocky silt loam with a thick surficial layer of litter and duff. Soil tested extremely acidic (pH = 3.6) with relatively high levels of organic matter, estimated N release, and S, and relatively low levels of Al, B, Ca, Fe, K, Mg, Mn, Na, P, and Zn compared to average values in the park. The mapped polygon is adjacent to a larger polygon of Eastern Hemlock - American Basswood Forest (CEGL008407), a more abundant association in the park which occurs on residual, shale-derived soils.

Vegetation Description: This association is a closed canopy mixed deciduous-evergreen forest dominated by *Tsuga canadensis* (eastern hemlock) and *Betula lenta* (sweet birch). Canopy cover in the plot is 80%. Additional canopy trees in the plot include *Liriodendron tulipifera* (tuliptree), *Quercus prinus* (chestnut oak), *Magnolia acuminata* (cucumber-tree), *Acer rubrum* var. *rubrum* (red maple), and *Nyssa sylvatica* (blackgum). Subcanopy cover in the plot is 40%, consisting of canopy species and *Oxydendrum arboreum* (sourwood), *Prunus serotina* var. *serotina* (black cherry), *Fagus grandifolia* (American beech), and a trace of *Tilia americana* (American basswood). Cover in the tall-shrub layer of the plot is 40%, strongly dominated by *Rhododendron maximum* (great laurel). The short-shrub and herb layers are sparse and have low species diversity. Short shrubs include *Smilax tamnoides* (bristly greenbrier) and *Viburnum acerifolium* (mapleleaf viburnum). Herbs include *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), *Dioscorea quaternata* (fourleaf yam), *Eurybia divaricata* (white wood aster), *Mitchella repens* (partridgeberry), *Monotropa uniflora* (Indianpipe), *Polypodium virginianum* (rock polypody), and a species of *Viola* (violet). Vascular plant species richness is 27 species per 400-square-meter plot. Cover in the bryophyte layer is 30%, with high cover by *Thuidium delicatulum* (delicate thuidium moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Rhododendron maximum* (great laurel)

Characteristic Species: *Mitchella repens* (partridgeberry), *Polypodium virginianum* (rock polypody).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst 2001b

Local Range: One polygon covering 0.10 hectare is mapped near the park boundary at the head of Tony Hollow. Additional small patches may occur in the headwaters of tributary streams near their initial descent into the gorge.

Classification Comments: This association is abundant at New River Gorge (Vanderhorst et al. 2007) where sandstone geology is more prevalent. This association differs from Eastern Hemlock - American Basswood Forest (CEGL008407), a more abundant association at Bluestone National Scenic River, by scarcity or absence of nutrient-demanding species, including *Tilia americana* (American basswood) in the canopy, by abundance of *Rhododendron maximum* (great laurel) in the tall-shrub layer, and by its low herbaceous diversity. Occurrence of trace amounts of *Tilia americana* (American basswood) and *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit) in the single plot may be attributed to edge effect. This association differs from Eastern Hemlock - Chestnut Oak Forest (CEGL006923), also more abundant in the park, by lacking a large oak component in the canopy, and by its occurrence in a mesic drainage bottom.

Other Comments: *Tsuga canadensis* (eastern hemlock) is currently threatened by the exotic insect hemlock woolly adelgid (*Adelges tsugae*). This pest was first discovered in the park in 2000 and NPS has since initiated insecticide treatment and monitoring of individual trees (J. Perez pers. comm.). Many hemlocks in the park appear stressed, but large scale mortality was not observed during the 2003–2006 vegetation surveys.

Local Description Authors: J. P. Vanderhorst.

Plots: One plot was sampled: BLUE.87.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Tsuga canadensis - Liriodendron tulipifera* Forest Alliance (A.413)
Alliance (English name)	Eastern Hemlock - Tuliptree Forest Alliance
Association	*Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest
Association (English name)	Tuliptree - Sweet Birch - Eastern Hemlock / Great Laurel Forest
Ecological System(s):	Southern and Central Appalachian Cove Forest (CES202.373).

GLOBAL DESCRIPTION

Concept Summary: This association includes hemlock-hardwood forests and acidic cove forests of lower to intermediate elevations in the Southern Blue Ridge, upper Piedmont, Cumberlands, and adjacent areas, ranging from southwestern Virginia and southern West Virginia, south and west to northwestern Georgia. The concept for this association is intended to be broad and cover both mixed stands of evergreen and deciduous hardwoods as well as stands dominated exclusively by deciduous trees in mesic, acidic environments. These communities occur at low to middle elevations (260–1060 m [850–3500 feet]) in the mountains and foothills,

generally in coves, gorges or sheltered slopes, over acidic soils. The canopy is usually dominated by *Liriodendron tulipifera* (tuliptree) or *Betula lenta* (sweet birch) mixed with *Tsuga canadensis* (eastern hemlock), but substantial portions may be comprised mainly of *Tsuga canadensis* (eastern hemlock) and the occasional *Acer rubrum* (red maple), while other sites may have little or no *Tsuga* (hemlock) in the canopy. Other deciduous species more typical of "rich" coves may occur as scattered individuals, including *Tilia americana* var. *heterophylla* (American basswood), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), and *Fagus grandifolia* (American beech). Other canopy/subcanopy species often include *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Magnolia fraseri* (mountain magnolia), and *Pinus strobus* (eastern white pine). *Rhododendron maximum* (great laurel) is usually dominant in the shrub stratum, often forming impenetrable thickets. South of Virginia, woody associates may also include *Ilex opaca* var. *opaca* (American holly), *Calycanthus floridus* (eastern sweetshrub), *Halesia tetraptera* var. *tetraptera* (mountain silverbell), and *Leucothoe fontanesiana* (highland doghobble). Herbaceous cover is sparse but can be diverse and is composed of acid-loving species. Typical herbs include *Polystichum acrostichoides* (Christmas fern), *Dryopteris intermedia* (intermediate woodfern), *Dennstaedtia punctilobula* (eastern hayscented fern), *Goodyera pubescens* (downy rattlesnake plantain), *Mitchella repens* (partridgeberry), *Thelypteris noveboracensis* (New York fern), *Galax urceolata* (beetleweed), *Viola rotundifolia* (roundleaf yellow violet), and *Tiarella cordifolia* (heartleaf foamflower).

Environmental Description: This association is typically found at lower to intermediate elevations (260–1060 m [850–3500 feet]) in the southern Appalachians and adjacent foothills. Habitats are mesic and located on gentle to steep, lower slopes along creeks in ravines, in coves or gorges, and in concave positions on protected slopes with cool aspects and acidic soils. In situations where midslopes are in protected north-facing positions, this community can range very high up straight or even convex slopes. The type often occurs in linear patches along stream bottoms and in steep ravines in complexes with rich cove communities. Although frequently associated with streams, it is not a wetland. Soils collected from plots are extremely acidic (mean pH = 4.0) and infertile, with high iron and aluminum levels and very low total base saturation. They are usually well-drained sandy loam, silt loam, loam, clay loam, or clay.

Vegetation Description: This association encompasses hemlock-hardwood forests and acidic cove forests with canopies dominated by mixtures of *Tsuga canadensis* (eastern hemlock), *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), *Quercus rubra* (northern red oak), and *Acer rubrum* (red maple). The concept for this association is intended to be broad and cover both mixed stands of evergreen and deciduous hardwoods as well as stands dominated exclusively by deciduous trees. Presumably because of past logging, *Tsuga canadensis* (eastern hemlock) is absent or confined to the understory in some stands, which have mixed canopies of *Liriodendron tulipifera* (tuliptree), *Betula lenta* (sweet birch), *Acer rubrum* (red maple), *Magnolia acuminata* (cucumber-tree), *Quercus rubra* (northern red oak), and/or *Nyssa sylvatica* (blackgum). Other deciduous species more typical of fertile coves, including *Tilia americana* var. *heterophylla* (American basswood), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), and *Fagus grandifolia* (American beech), may occur as scattered individuals. Minor overstory and understory species include *Quercus alba* (white oak), *Quercus prinus* (chestnut oak), *Magnolia fraseri* (mountain magnolia), *Magnolia tripetala* (umbrella-tree), *Prunus serotina* (black cherry), and *Pinus strobus* (eastern white pine). *Rhododendron maximum* (great laurel) is scattered to dominant in the shrub stratum often forming nearly impenetrable colonies. *Kalmia latifolia* (mountain laurel) is also a typical, but less abundant, shrub. In the southern

portion of this type's range, *Ilex opaca* (American holly), *Calycanthus floridus* (eastern sweetshrub), *Halesia tetraptera* (mountain silverbell), and *Leucothoe fontanesiana* (highland doghobble) may be common; these are lacking in Virginia and West Virginia occurrences, where *Hamamelis virginiana* (American witchhazel) and *Acer pensylvanicum* (striped maple) may be minor associates. Herbaceous cover is sparse but can be diverse and is composed of acid-loving species. Frequent low-cover species of this layer include *Arisaema triphyllum* (Jack in the pulpit), *Chimaphila maculata* (striped prince's pine), *Dioscorea quaternata* (fourleaf yam), *Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern), *Eurybia divaricata* (white wood aster), *Galax urceolata* (beetleweed), *Gaultheria procumbens* (eastern teaberry), *Goodyera pubescens* (downy rattlesnake plantain), *Hexastylis* (heartleaf) spp., *Luzula echinata* (hedgehog woodrush), *Monotropa uniflora* (Indianpipe), *Medeola virginiana* (Indian cucumber), *Mitchella repens* (partridgeberry), *Polypodium virginianum* (rock polypody), *Polystichum acrostichoides* (Christmas fern), *Thelypteris noveboracensis* (New York fern), *Tiarella cordifolia* (heartleaf foamflower), and *Waldsteinia fragarioides* (Appalachian barren strawberry). The spectacular sedge *Cymophyllus fraserianus* (Fraser's cymophyllus) is often associated with this forest.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree)
Tall shrub/sapling	Broad-leaved evergreen tree	*Rhododendron maximum* (great laurel)

Characteristic Species: *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern), *Galax urceolata* (beetleweed), *Leucothoe fontanesiana* (highland doghobble), *Liriodendron tulipifera* (tuliptree), *Luzula echinata* (hedgehog woodrush), *Mitchella repens* (partridgeberry), *Polystichum acrostichoides* (Christmas fern), *Quercus rubra* (northern red oak), *Rhododendron maximum* (great laurel), *Thelypteris noveboracensis* (New York fern), *Tiarella cordifolia* (heartleaf foamflower), *Tsuga canadensis* (eastern hemlock), *Waldsteinia fragarioides* (Appalachian barren strawberry).

Other Noteworthy Species:

Species	GRank	Type	Note
Ageratina altissima var. roanensis (white snakeroot)	G5T3T4	plant	vulnerable
Betula uber (Virginia roundleaf birch)	G1Q	plant	Federally listed threatened
Botrychium jenmanii (Dixie grapefern)	G3G4	plant	vulnerable
Diervilla rivularis (mountain bush honeysuckle)	G3	plant	vulnerable
Hexastylis contracta (mountain heartleaf)	G3	plant	vulnerable
Hexastylis naniflora (dwarfflower heartleaf)	G3	plant	Federally listed threatened
Hexastylis rhombiformis (North Fork heartleaf)	G2	plant	imperiled
Isotria medeoloides (green fiveleaf orchid)	G2	plant	Federally listed threatened
Malaxis bayardii (Bayard's adder's-mouth orchid)	G1G2	plant	imperiled
Monotropsis odorata (pygmypipes)	G3	plant	vulnerable
Shortia galacifolia var. brevistyla (Oconee bells)	G2G3T2	plant	imperiled
Shortia galacifolia var. galacifolia (Oconee bells)	G2G3T2T3		vulnerable
Trillium persistens (persistent wakerobin)	G1	plant	Federally listed endangered
Trillium pusillum var. 1 (interior least trillium)	G3T2Q	plant	imperiled
Waldsteinia lobata (Piedmont barren strawberry)	G2G3	plant	vulnerable

USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This community occurs in the Southern Blue Ridge and Cumberlands and peripherally in the upper Piedmont and southern Central Appalachians, ranging from southwestern Virginia and southeastern West Virginia south and west to northwestern Georgia.
States/Provinces: GA, NC, SC, TN, VA:S5, WV.
Federal Lands: BIA (Eastern Band of Cherokee); NPS (Blue Ridge Parkway, Bluestone, Carl Sandburg Home, Great Smoky Mountains, New River Gorge, Obed); USFS (Chattahoochee, Chattahoochee (Piedmont), Chattahoochee (Southern Blue Ridge), Cherokee, Jefferson, Nantahala, Pisgah, Sumter, Sumter (Mountains), Sumter (Piedmont)).

CONSERVATION STATUS
Rank: G5 (27-Sep-2004).
Reasons: Within its range, this community type occurs extensively in suitable mesic habitats. Occurrences are subject to compositional modification by outbreaks of hemlock woolly adelgid (*Adelges tsugae*), an exotic insect pest that causes decline and eventual mortality of *Tsuga canadensis* (eastern hemlock).

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 1 - Strong.
Comments: Deciduous trees more typical of "rich" coves, such as *Aesculus flava* (yellow buckeye), *Tilia americana* var. *heterophylla* (American basswood), and *Acer saccharum* (sugar maple), are present in this forest only as minor components, if at all. Likewise, rich-site herbs, such as *Actaea racemosa* (black bugbane), *Caulophyllum thalictroides* (blue cohosh), *Actaea pachypoda* (white baneberry), and *Adiantum pedatum* (northern maidenhair), are absent or nearly so. This forest is distinguished from "northern hardwood forests" by the lack of or near absence of *Fagus grandifolia* (American beech), *Betula alleghaniensis* (yellow birch), *Aesculus flava* (yellow buckeye), and the presence of low-elevation species, such as *Betula lenta* (sweet birch) and *Liriodendron tulipifera* (tuliptree), and generally by a more depauperate herb layer. An interesting example from the Piedmont/Blue Ridge transition of Georgia (Cedar Creek Canyon, Chattahoochee National Forest) has high coverage of *Rhododendron minus* (piedmont rhododendron) and other foothills/Piedmont species such as *Liquidambar styraciflua* (sweetgum) and *Aesculus sylvatica* (painted buckeye).

This community type is grossly under-represented by Virginia plot data considering its extensive distribution in southwestern Virginia. In the 900–1060 m (3000–3500 feet) elevation range, the type becomes transitional to *Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / (Leucothoe fontanesiana)* Forest (CEGL007861), which lacks lower-elevation species such as *Liriodendron tulipifera* (tuliptree) and *Galax urceolata* (beetleweed), and contains many species characteristic of higher elevations and northern latitudes.

Similar vegetation has been observed in coves of the Cumberland Mountains of southwestern Virginia (e.g., Clinch Ranger District: Dark Hollow, Roaring Branch, Pick Breeches and Flannery Ridges,) but comprehensive data are needed to determine whether these stands are part of this forest types or transitional to *Tsuga canadensis - (Fagus grandifolia, Tilia americana* var. *heterophylla) / Magnolia tripetala* Forest (CEGL008407). The latter unit apparently has an extensive distribution in the Cumberland Plateau of Kentucky and Tennessee, the Southern

Ridge and Valley of Tennessee, and the Central Appalachians of West Virginia and southwestern Pennsylvania.

Similar Associations:

Acer rubrum var. *rubrum - Betula (alleghaniensis, lenta) - Magnolia fraseri / (Rhododendron maximum, Kalmia latifolia)* Forest (CEGL008558).

Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / (Leucothoe fontanesiana) Forest (CEGL007861).

Tsuga canadensis - (Fagus grandifolia, Tilia americana var. *heterophylla) / Magnolia tripetala* Forest (CEGL008407).

Tsuga canadensis - (Pinus strobus) Temporarily Flooded Forest (CEGL007143).

Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia) Forest (CEGL005043).

Tsuga canadensis - Halesia tetraptera - (Fagus grandifolia, Magnolia fraseri) / Rhododendron maximum / Dryopteris intermedia Forest (CEGL007693).

Tsuga canadensis - Quercus prinus - Liriodendron tulipifera / Kalmia latifolia - (Rhododendron catawbiense) Forest (CEGL008512).

Related Concepts:

Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum Forest (Fleming and Coulling 2001) ?

Tsuga canadensis - Betula lenta / Rhododendron maximum forest (Vanderhorst 2001b) =

Acidic Cove Forest (Typic Subtype) (Schafale 1998b) ?

Cove Forest (Patterson et al. 1994) B

IA5b. Southern Appalachian Hemlock Cove Forest (Allard 1990) B

Mixed Mesophytic Coves (Gettman 1974) ?

Sweet Birch - Hemlock Type (Schmalzer and DeSelm 1982) =

Type 5 (Newell and Peet 1995) ?

Yellow-Poplar - Eastern Hemlock: 58 (Eyre 1980) B

SOURCES

Description Authors: K. D. Patterson, mod. G. Fleming and P. Coulling, mod. T. Govus and S. C. Gawler.

References: Allard 1990, Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Gettman 1974, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 1986, Newell and Peet 1995, Patterson 1994, Patterson et al. 1994, Peet et al. unpubl. data 2002, Perez pers. comm., Schafale 1998b, Schafale and Weakley 1990, Schmalzer and DeSelm 1982, Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008, Wood 1999.

Plot BLUE.87. Eastern Hemlock - Sweet Birch - Tuliptree / Great Laurel Forest.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK - AMERICAN BASSWOOD FOREST

SYNONYMS

NVC English Name: **Eastern Hemlock - (American Beech, Appalachian Basswood) / Umbrella Magnolia Forest**

NVC Scientific Name: ***Tsuga canadensis* - (*Fagus grandifolia, Tilia americana* var. *heterophylla*) / *Magnolia tripetala* Forest**

NVC Identifier: **CEGL008407**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches (0–11.7 ha) on gorge slopes with low solar exposure. Aspects are usually northerly to northeasterly but may range to southerly in lower positions shaded by opposing gorge slopes. Slopes in mapped polygons range from 1 to 47 degrees (mean = 27). Elevations in mapped polygons range from 439 to 718 m (mean = 572). Bedrock geology is predominantly shale of the Mauch Chunk Group. Surficial rock types noted in plots include both shale (presumably residual) and sandstone (probably colluvial in part). Unvegetated ground cover in plots is dominated by litter, with significant cover by large rocks in several plots, and lesser amounts of bare soil and coarse woody debris. Soils in plots are described as somewhat moist to moist, well-drained, stony silt loam and sandy loam. Soils from plots tested extremely to medium acidic (mean pH = 4.7) with relatively high levels of organic matter, estimated N release, S, Al, B, Ca, Fe, K, Mg, Mn, and P, and relatively low levels of Cu, Na, and Zn compared to average values in the park. Polygons of this association are often adjacent to polygons of Sugar Maple - Yellow Buckeye - American Basswood Forest (CEGL005222), the dominant deciduous forest of cool-aspect gorge slopes in the park. These two associations share many environmental attributes, but Eastern Hemlock - American Basswood Forest has overall higher slope position, and lower solar exposure, pH, and soil cations. Polygons of this association may also border and grade towards polygons of Eastern Hemlock - Chestnut Oak Forest (CEGL006923), which occur in drier slope positions, often upslope, with less fertile soils. As aspects become warmer polygons of this association may also be adjacent to polygons of Oak - Hickory - Sugar Maple Forest (CEGL007268).

Vegetation Description: This association is a closed-canopy mixed evergreen-deciduous forest codominated by *Tsuga canadensis* (eastern hemlock) with deciduous trees including *Tilia americana* (American basswood). Total canopy cover in plots ranges from 30–80%, with cover by *Tsuga canadensis* (eastern hemlock) ranging from 10–60% and cover by *Tilia americana* (American basswood) ranging from 0–20%. Additional canopy trees in plots include (in decreasing order of constancy) *Quercus rubra* (northern red oak), *Quercus prinus* (chestnut oak), *Acer saccharum* var. *saccharum* (sugar maple), *Liriodendron tulipifera* (tuliptree), *Acer rubrum* var. *rubrum* (red maple), *Aesculus flava* (yellow buckeye), *Fraxinus americana* (white ash), and *Fagus grandifolia* (American beech). Subcanopy cover in plots ranges from 5–60%, composed primarily of the species listed for the canopy. Additional species in the subcanopy of plots include *Ulmus rubra* (slippery elm), *Amelanchier arborea* var. *arborea* (common serviceberry), *Magnolia acuminata* (cucumber-tree), *Carya ovata* (shagbark hickory), and *Carya alba* (mockernut hickory). Vines which reach the canopy layers include *Aristolochia macrophylla* (pipevine) and *Vitis aestivalis* var. *bicolor* (summer grape). Cover in the shrub layers of plots ranges from 6–40%, including tree saplings, shrubs, and vines. Regeneration of *Tsuga*

canadensis (eastern hemlock), *Acer saccharum* var. *saccharum* (sugar maple), and *Tilia americana* (American basswood) in the shrub layer is often evident. Common shrubs in plots include (in decreasing order of constancy) *Viburnum acerifolium* (mapleleaf viburnum), *Acer pensylvanicum* (striped maple), *Hydrangea arborescens* (wild hydrangea), *Rhododendron maximum* (great laurel) (4% cover), and *Hamamelis virginiana* (American witchhazel). Herb cover in plots ranges 5–30% and its composition is usually diverse and includes some nutrient demanding species. Common herbs in plots include (in decreasing order of constancy) *Polystichum acrostichoides* (Christmas fern), *Eurybia divaricata* (white wood aster), *Dryopteris marginalis* (marginal woodfern), *Prosartes lanuginosa* (yellow fairybells), *Dioscorea quaternata* (fourleaf yam), *Solidago caesia* (wreath goldenrod), *Ageratina altissima* var. *altissima* (white snakeroot), *Parthenocissus quinquefolia* (Virginia creeper), *Sedum ternatum* (woodland stonecrop), *Polygonatum pubescens* (hairy Solomon's seal), *Osmorhiza claytonii* (Clayton's sweetroot), *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Dryopteris intermedia* (intermediate woodfern), *Adiantum pedatum* (northern maidenhair), and *Carex digitalis* var. *digitalis*. Additional herbs indicative of enriched soils include *Actaea racemosa* var. *racemosa* (black bugbane), *Sanguinaria canadensis* (bloodroot), *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), and *Laportea canadensis* (Canadian woodnettle). Vascular plant species richness ranges from 37 to 58 (mean = 42.8) species per 400-square-meter plot. Nonvascular cover in plots ranges from 0–20%. Nonvascular species identified in plots include *Thuidium delicatulum* (delicate thuidium moss), *Hypnum imponens* (hypnum moss), *Dicranum fulvum* (dicranum moss), *Aulacomnium heterostichum* (aulacomnium moss), *Bryoandersonia illecebra* (bryoandersonia moss), *Brachythecium oxycladon* (brachythecium moss), *Metzgeria conjugata*, *Metzgeria crassipilis*, *Plagiomnium ciliare* (plagiomnium moss), *Plagiothecium denticulatum* (toothed plagiothecium moss), *Polytrichum juniperinum* (juniper polytrichum moss), *Pylaisiadelpha tenuirostris* (pylaisiadelpha moss), and *Steerecleus serrulatus* (steerecleus moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum* var. *saccharum* (sugar maple), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Tilia americana* (American basswood)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer pensylvanicum* (striped maple)
Herb (field)	Vine/Liana	*Aristolochia macrophylla* (pipevine)
Herb (field)	Fern or fern ally	*Dryopteris marginalis* (marginal woodfern), *Polystichum acrostichoides* (Christmas fern)

Characteristic Species: *Actaea racemosa* var. *racemosa* (black bugbane), *Adiantum pedatum* (northern maidenhair), *Arisaema triphyllum* ssp. *triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Hydrangea arborescens* (wild hydrangea), *Laportea canadensis* (Canadian woodnettle), *Osmorhiza claytonii* (Clayton's sweetroot), *Prosartes lanuginosa* (yellow fairybells), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop)

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2008

Local Range: A total of 38 polygons covering 69.62 hectares are mapped in the park. Stands are scattered on gorge slopes throughout the southern 8/10 of the park, becoming more abundant in the southern third.

Classification Comments: In West Virginia, the varieties of *Tilia americana* (American basswood) are sympatric and intergrade and are not very useful for circumscribing vegetation types. Another nominal tree species in the global name of this association, *Magnolia tripetala* (umbrella-tree), is absent from all plots and is not common in the park; however, this species is known from the association elsewhere in the state. In the park, this association often borders and grades towards Eastern Hemlock - Chestnut Oak Forest (CEGL006923). These two associations are best distinguished by abundance of *Tilia americana* (American basswood) and rich-site herbs in Eastern Hemlock - American Basswood Forest and their scarcity or absence in Eastern Hemlock - Chestnut Oak Forest. This association is most similar to the "sugar maple - northern red oak - eastern hemlock" type classified by Rentch et al.'s (2005) study of upland forests in the Bluestone River gorge; this type has relatively high importance value for *Tilia americana* (American basswood) and a number of rich-site herbs. This association has also been sampled in southern West Virginia at Panther State Forest (McDowell County) and Cabwaylingo State Forest (Wayne County). Similar rich hemlock communities have also been observed on cool aspects on limestone bedrock in water gaps of the Ridge and Valley in eastern West Virginia, but their relationship to this association has not been determined.

Other Comments: *Tsuga canadensis* (eastern hemlock) is currently threatened by the exotic insect hemlock woolly adelgid (*Adelges tsugae*). This pest was first discovered in the park in 2000 and NPS has since initiated insecticide treatment and monitoring of individual trees (J. Perez pers. comm.). Many hemlocks in the park appear stressed, but large scale mortality was not observed during the 2003–2006 vegetation surveys.

Local Description Authors: J. P. Vanderhorst.

Plots: Eight plots were sampled: BLUE.28, BLUE.47, BLUE.69, BLUE.98, BLUE.100, BLUE.101, BLUE.120, and BLUE.123.

Bluestone National Scenic River Inventory Notes: Estimated thematic accuracy of the vegetation map class representing this association (86.7% estimated user's accuracy) is slightly lower than overall estimated accuracy of the vegetation map for the park (92.6%). This reflects three accuracy assessment points identified in the field as Eastern Hemlock - Chestnut Oak Forest which were mapped as Eastern Hemlock - American Basswood Forest. This is an indication of both the overall validity and minor pitfalls of splitting these related communities.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Tsuga canadensis - Liriodendron tulipifera* Forest Alliance (A.413)
Alliance (English name)	Eastern Hemlock - Tuliptree Forest Alliance
Association	*Tsuga canadensis - (Fagus grandifolia, Tilia americana* var. *heterophylla) / Magnolia tripetala* Forest
Association (English name)	Eastern Hemlock - (American Beech, Appalachian Basswood) / Umbrella Magnolia Forest
Ecological System(s):	Southern and Central Appalachian Cove Forest (CES202.373).

GLOBAL DESCRIPTION

Concept Summary: This association represents mixed forests of lower slopes, coves, etc. dominated by *Tsuga canadensis* (eastern hemlock) and mesic hardwood species, occurring in the Cumberland Mountains and Cumberland Plateau of Kentucky, Tennessee, and West Virginia, the Southern Ridge and Valley of Tennessee, and the Western Allegheny Plateau of West Virginia and potentially southwestern Pennsylvania. It may range into extreme northwestern Georgia and northeastern Alabama, Deciduous associates, which may vary widely in relative frequency, include *Fagus grandifolia* (American beech), *Tilia americana* var. *heterophylla* (American basswood), *Liriodendron tulipifera* (tuliptree), *Betula alleghaniensis* (yellow birch), *Betula lenta* (sweet birch), *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), *Carya ovata* (shagbark hickory), and *Magnolia acuminata* (cucumber-tree). The relative proportion of *Tsuga* (hemlock) and the various hardwood species may vary greatly; individual stands may be strongly dominated by *Tsuga* (hemlock), or *Tsuga* (hemlock) may share dominance with one or more of the hardwoods. *Aesculus flava* (yellow buckeye) and/or *Magnolia tripetala* (umbrella-tree) may be present in the canopy or subcanopy, respectively, but these characteristic species may not be dominant in the particular stratum. Some important shrubs include *Rhododendron maximum* (great laurel) (which may dominate shrub layers of some stands), *Rhododendron catawbiense* (Catawba rosebay) (within its range), *Ribes cynosbati* (eastern prickly gooseberry), *Asimina triloba* (pawpaw), *Hydrangea arborescens* (wild hydrangea), *Viburnum acerifolium* (mapleleaf viburnum), and the lianas *Aristolochia macrophylla* (pipevine) and *Smilax rotundifolia* (roundleaf greenbrier). Ferns are diverse and abundant. Mesic herbaceous components include *Dryopteris marginalis* (marginal woodfern), *Dryopteris intermedia* (intermediate woodfern), *Thelypteris noveboracensis* (New York fern), *Polystichum acrostichoides* (Christmas fern), *Asplenium rhizophyllum* (walking fern), *Athyrium filix-femina* (common ladyfern), *Arisaema triphyllum* (Jack in the pulpit), *Asarum canadense* (Canadian wildginger), *Carex plantaginea* (plantainleaf sedge), *Chimaphila maculata* (striped prince's pine), *Goodyera pubescens* (downy rattlesnake plantain), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Maianthemum racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Phacelia bipinnatifida* (fernleaf phacelia), *Sanguinaria canadensis* (bloodroot), *Tiarella cordifolia* (heartleaf foamflower), and *Trillium* (trillium) spp.

Environmental Description: This forest occurs in coves, valleys, bases of cliffs, and lower slopes, usually in somewhat protected settings. Soils are typically derived from slope alluvium and colluvium, composed of acidic shales, siltstones, and sandstones; the soils typically have a high stone content (Martin 1975). Soils in eight West Virginia plots near the Bluestone River are described as somewhat moist to moist, well-drained, stony silt loam and sandy loam. They tested extremely to medium acidic (mean pH = 4.7) with relatively high levels of organic matter, estimated N release, S, Al, B, Ca, Fe, K, Mg, Mn, and P, and relatively low levels of Cu, Na, and Zn compared to average values in the area.

Vegetation Description: This association is dominated by *Tsuga canadensis* (eastern hemlock) and mesic hardwood species, often including *Tilia americana* (American basswood). Deciduous associates, which may vary widely in relative frequency, include *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Betula alleghaniensis* (yellow birch), *Betula lenta* (sweet birch), *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), *Carya ovata* (shagbark hickory), *Magnolia acuminata* (cucumber-tree), *Quercus prinus* (chestnut oak), *Acer saccharum* (sugar maple), and *Acer rubrum* (red maple). The relative proportion of *Tsuga canadensis* (eastern hemlock) and the various hardwood species may vary greatly; individual

stands may be strongly dominated by *Tsuga* (hemlock), or *Tsuga* (hemlock) may share dominance with one or more of the hardwoods. *Aesculus flava* (yellow buckeye) and/or *Magnolia tripetala* (umbrella-tree) may be present in the canopy or subcanopy, respectively, but these characteristic species may not be dominant in the particular stratum. Vines which may reach the canopy include *Aristolochia macrophylla* (pipevine) and *Vitis aestivalis* var. *bicolor* (summer grape). Regeneration of *Tsuga canadensis* (eastern hemlock), *Acer saccharum* (sugar maple), and *Tilia americana* (American basswood) in the shrub layer is often evident. Some important shrubs include *Rhododendron maximum* (great laurel) (which may dominate shrub layers of some stands but be very low in others), *Rhododendron catawbiense* (Catawba rosebay) (within its range), *Ribes cynosbati* (eastern prickly gooseberry), *Asimina triloba* (pawpaw), *Viburnum acerifolium* (mapleleaf viburnum), *Acer pensylvanicum* (striped maple), *Hydrangea arborescens* (wild hydrangea), and *Hamamelis virginiana* (American witchhazel), and the lianas *Parthenocissus quinquefolia* (Virginia creeper) and *Smilax rotundifolia* (roundleaf greenbrier). Ferns are diverse and abundant. The herbaceous component includes some nutrient-demanding plants such as *Actaea racemosa* var. *racemosa* (black bugbane), *Adiantum pedatum* (northern maidenhair), *Sanguinaria canadensis* (bloodroot), *Asarum canadense* (Canadian wildginger), *Caulophyllum thalictroides* (blue cohosh), and *Laportea canadensis* (Canadian woodnettle). Additional herbaceous species include *Dryopteris marginalis* (marginal woodfern), *Dryopteris intermedia* (intermediate woodfern), *Thelypteris noveboracensis* (New York fern), *Polystichum acrostichoides* (Christmas fern), *Asplenium rhizophyllum* (walking fern), *Athyrium filix-femina* (common ladyfern), *Ageratina altissima* var. *altissima* (white snakeroot), *Arisaema triphyllum* (Jack in the pulpit), *Carex digitalis* var. *digitalis*, *Carex plantaginea* (plantainleaf sedge), *Chimaphila maculata* (striped prince's pine), *Dioscorea quaternata* (fourleaf yam), *Goodyera pubescens* (downy rattlesnake plantain), *Hepatica nobilis* var. *acuta* (sharplobe hepatica), *Maianthemum racemosum* (feathery false lily of the valley), *Mitchella repens* (partridgeberry), *Osmorhiza claytonii* (Clayton's sweetroot), *Phacelia bipinnatifida* (fernleaf phacelia), *Polygonatum pubescens* (hairy Solomon's seal), *Prosartes lanuginosa* (yellow fairybells), *Sanguinaria canadensis* (bloodroot), *Sedum ternatum* (woodland stonecrop), *Solidago caesia* (wreath goldenrod), *Tiarella cordifolia* (heartleaf foamflower), and *Trillium* (trillium) spp. Across eight plots sampled in West Virginia, vascular plant richness ranged from 37 to 58 species (mean = 42.8) per 400-square-meter plot. At the northern limit of this association, some more southern species will be absent (e.g., *Rhododendron catawbiense* (Catawba rosebay), *Phacelia bipinnatifida* (fernleaf phacelia), *Halesia tetraptera* (mountain silverbell)) (J. Fike pers. comm.). One variant of this association is apparently dominated by *Tsuga canadensis* (eastern hemlock) and *Betula alleghaniensis* (yellow birch), with *Tilia americana* var. *heterophylla* (American basswood) and *Oxydendrum arboreum* (sourwood) (Caplenor 1965).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Betula alleghaniensis* (yellow birch), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Tilia americana* var. *heterophylla* (American basswood)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Rhododendron maximum* (great laurel)
Herb (field)	Fern or fern ally	*Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern)

Characteristic Species: *Aesculus flava* (yellow buckeye), *Arisaema triphyllum* (Jack in the pulpit), *Dryopteris intermedia* (intermediate woodfern), *Dryopteris marginalis* (marginal woodfern), *Fagus grandifolia* (American beech), *Magnolia tripetala* (umbrella-tree), *Rhododendron maximum* (great laurel), *Tilia americana* var. *heterophylla* (American basswood), *Tsuga canadensis* (eastern hemlock).

Other Noteworthy Species:

Species	GRank	Type	Note
Panax quinquefolius (American ginseng)	G3G4	plant	vulnerable

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in the Cumberland Mountains and Cumberland Plateau of Kentucky, Tennessee, and West Virginia, the Southern Ridge and Valley of Tennessee, and the Western Allegheny Plateau of West Virginia and possibly southwestern Pennsylvania. It may range into extreme northwestern Georgia and northeastern Alabama. Occurrences in the Interior Low Plateau are rare and of limited extent.

States/Provinces: AL?, GA?, KY, PA, TN, VA, WV.

Federal Lands: NPS (Allegheny Portage Railroad, Big South Fork, Bluestone, Cumberland Gap, Obed); USFS (Daniel Boone).

CONSERVATION STATUS

Rank: G4 (5-Apr-2000).

Reasons: Occurrences are threatened by the hemlock woolly adelgid (*Adelges tsugae*), an exotic insect pest.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: This forest is known from the Rock Creek Research Natural Area in the Daniel Boone National Forest, Kentucky (Winstead and Nicely 1976). It is also found at Lilley Cornet Woods in eastern Kentucky (Martin 1975). Some Tennessee occurrences include Fall Creek Falls State Park (Caplenor 1965) and Savage Gulf in the South Cumberland Recreation Area (Quarterman et al. 1972). There is at least one disjunct occurrence of a mesic ravine with *Tsuga canadensis* (eastern hemlock) in the Eastern Highland Rim of DeKalb County, Tennessee (222Eb), which would be accommodated here. The substrate at this site is siliceous limestone of the Mississippian Fort Payne Formation, immediately underlain by upper Ordovician limestones. This association is better defined in the southern part of its range. In the Western Allegheny Plateau of West Virginia, there is some conceptual overlap with *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana*, *Kalmia latifolia)* Forest (CEGL005043), in particular a subtype of this "(1) steep-walled sandstone gorges and talus, where *Hydrangea arborescens* (wild hydrangea), *Kalmia latifolia* (mountain laurel), and *Dryopteris marginalis* (marginal woodfern) may be indicative." Classification difficulties may be encountered where the potential ranges of these two types could overlap (e.g., in parts of Kentucky, Pennsylvania, and West Virginia).

Similar Associations:

Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum Forest (CEGL007543).

Tsuga canadensis - (Liriodendron tulipifera, Fagus grandifolia) / (Magnolia macrophylla, Ilex opaca) / Polystichum acrostichoides Forest (CEGL004767).

Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia) Forest (CEGL005043).

Related Concepts:

Hemlock Type (Schmalzer and DeSelm 1982) B

Hemlock-basswood Community (Caplenor 1965) ?

Hemlock-yellow birch Community (Caplenor 1965) ?

Rich hemlock - mesic hardwoods forest (Fike 1999) ?

Sugar Maple - Northern Red Oak - Eastern Hemlock (Rentch et al. 2005) ?

SOURCES

Description Authors: M. Pyne, mod. R. White and S. C. Gawler.

References: Caplenor 1965, Fike 1999, Fike pers. comm., Martin 1975, Perez pers. comm., Perles et al. 2007, Quarterman et al. 1972, Rentch et al. 2005, Schmalzer and DeSelm 1982, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, Vanderhorst et al. 2008, Winstead and Nicely 1976.

Plot BLUE.69. Eastern Hemlock - American Basswood Forest.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK - CHESTNUT OAK FOREST

SYNONYMS
NVC English Name: **Eastern Hemlock - Chestnut Oak - Sweet Birch Forest**
NVC Scientific Name: ***Tsuga canadensis* - *Quercus prinus* - *Betula lenta* Forest**
NVC Identifier: **CEGL006923**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches (0–5.3 ha) primarily on convex upper slopes with northerly aspects which have low solar exposure. A few stands also occur on warmer aspects and on convex lower and midslope positions. Slopes are often very steep, and stands often occur above and below cliff bands. Slopes in mapped polygons range from 4 to 47 degrees (mean = 27.3). Elevations in mapped polygons range from 446 to 687 m (mean = 610). Bedrock geology is mapped as shales and sandstones in the Mauch Chunk Group, and both shale and sandstone surficial deposits were observed in plots. Unvegetated ground cover in plots is dominated by litter, with significant cover by large rocks in a few plots. There is higher mean ground cover by coarse woody debris (7.4%) compared to plots of all other upland forest associations in the park. Soils in plots are described as dry to somewhat moist, well-drained, stone-free to very stony sandy loam, silt loam, sandy silt loam, and sandy clay loam. Soils from plots tested extremely to medium acidic (mean pH = 4.4) with relatively high levels of organic matter, estimated N release, S, Al, B, and Fe and relatively low levels of Ca, Cu, K, Mg, Mn, P, and Zn compared to average values in the park. Polygons of this association often border and grade towards polygons of Eastern Hemlock - American Basswood Forest (CEGL008407), which occur in more moist, concave slope positions, often downslope, with more fertile soils. Polygons of this association may also border larger polygons of the predominant upland forest types of the park, including Oak - Eastern White Pine / Ericad Forest (CEGL008539) in positions with higher solar exposure, Oak - Hickory - Sugar Maple Forest (CEGL007268) in positions with higher solar exposure and soil fertility, and Sugar Maple - Yellow Buckeye - American Basswood Forest (CEGL005222) in positions with higher soil moisture and fertility.

Vegetation Description: This association is a closed-canopy mixed evergreen-deciduous forest codominated by *Tsuga canadensis* (eastern hemlock) in association with species of *Quercus* (oak) and other deciduous trees indicative of relatively dry, infertile soils. Canopy cover in plots ranges from 50–80%. Important canopy species in plots include (in decreasing order of constancy) *Tsuga canadensis* (eastern hemlock), *Quercus prinus* (chestnut oak), *Quercus alba* (white oak), *Quercus rubra* (northern red oak), *Pinus strobus* (eastern white pine), *Quercus coccinea* var. *coccinea* (scarlet oak), *Acer rubrum* var. *rubrum* (red maple), and *Betula lenta* (sweet birch). Subcanopy cover in plots ranges from 5–60%. Important trees in the subcanopy, in addition to those listed for the canopy, include *Oxydendrum arboreum* (sourwood) and *Acer saccharum* var. *saccharum* (sugar maple). Cover in the shrub layers of plots ranges from 6–30%, including tree saplings, shrubs, and vines. Tree regeneration in the shrub layers is dominated by shade-tolerant species, including *Tsuga canadensis* (eastern hemlock), *Fagus grandifolia* (American beech), and *Acer saccharum* var. *saccharum* (sugar maple), but regeneration by *Quercus prinus* (chestnut oak) is significant in a few plots. Common shrubs and vines in plots include (in decreasing order of constancy) *Viburnum acerifolium* (mapleleaf viburnum),

Amelanchier arborea var. *arborea* (common serviceberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Rhododendron maximum* (great laurel) (about 10% cover), and *Smilax rotundifolia* (roundleaf greenbrier). Cover in the herb layer of plots ranges from 1–20%, with high representation of species tolerant of shade and dry, infertile soils. Common herbs in plots include (in decreasing order of constancy) *Parthenocissus quinquefolia* (Virginia creeper), *Dioscorea quaternata* (fourleaf yam), *Polygonatum pubescens* (hairy Solomon's seal), *Monotropa uniflora* (Indianpipe), *Goodyera pubescens* (downy rattlesnake plantain), *Eurybia divaricata* (white wood aster), *Dryopteris marginalis* (marginal woodfern), and *Chimaphila maculata* (striped prince's pine). Additional characteristic herbs with lower constancy include *Gaultheria procumbens* (eastern teaberry), *Mitchella repens* (partridgeberry), *Hexastylis virginica* (Virginia heartleaf), and *Monotropa hypopithys* (pinesap). Vascular plant species richness ranges from 16 to 43 (mean = 26.5) species per 400-square-meter plot. Nonvascular cover in plots ranges from 0–5%. Mosses identified in plots include *Leucobryum glaucum* (leucobryum moss), *Thuidium delicatulum* (delicate thuidium moss), and *Hypnum imponens* (hypnum moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock)
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum* var. *rubrum* (red maple), *Betula lenta* (sweet birch), *Quercus alba* (white oak), *Quercus coccinea* var. *coccinea* (scarlet oak), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak)
Tree subcanopy	Broad-leaved deciduous tree	*Oxydendrum arboreum* (sourwood)

Characteristic Species: *Chimaphila maculata* (striped prince's pine), *Gaultheria procumbens* (eastern teaberry), *Goodyera pubescens* (downy rattlesnake plantain), *Hexastylis virginica* (Virginia heartleaf), *Leucobryum glaucum* (leucobryum moss), *Mitchella repens* (partridgeberry), *Monotropa hypopithys* (pinesap), *Monotropa uniflora* (Indianpipe), *Vaccinium pallidum* (Blue Ridge blueberry), *Viburnum acerifolium* (mapleleaf viburnum).

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2008

Local Range: A total of 38 polygons covering 43.09 hectares are mapped in the park.

Classification Comments: In the park, this association often borders and grades towards Eastern Hemlock - American Basswood Forest (CEGL008407). These two associations are best distinguished by abundance of *Tilia americana* (American basswood) and rich-site herbs in Eastern Hemlock - American Basswood Forest and their scarcity or absence in Eastern Hemlock - Chestnut Oak Forest. Strong indicator species for this association include *Leucobryum glaucum* (leucobryum moss) and *Monotropa uniflora* (Indianpipe).

Other Comments: *Tsuga canadensis* (eastern hemlock) is currently threatened by the exotic insect hemlock woolly adelgid (*Adelges tsugae*). This pest was first discovered in the park in 2000 and NPS has since initiated insecticide treatment and monitoring of individual trees (J. Perez pers. comm.). Many hemlocks in the park appear stressed, but large scale mortality was not observed during the 2003–2006 vegetation surveys.

Local Description Authors: J. P. Vanderhorst.

Plots: Nine plots were sampled: BLUE.20, BLUE.31, BLUE.32, BLUE.37, BLUE.36, BLUE.59, BLUE.66, BLUE.70, and BLUE.125.

Bluestone National Scenic River Inventory Notes: Estimated thematic accuracy of the vegetation map class representing this association (90.3% estimated user's accuracy) is slightly lower than overall estimated accuracy of the vegetation map for the park (92.6%). This reflects two accuracy assessment points identified in the field as Eastern Hemlock - American Basswood Forest which were mapped as Eastern Hemlock - Chestnut Oak Forest. This is an indication of both the overall validity and minor pitfalls of splitting these related communities.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	*Tsuga canadensis - Liriodendron tulipifera* Forest Alliance (A.413)
Alliance (English name)	Eastern Hemlock - Tuliptree Forest Alliance
Association	*Tsuga canadensis - Quercus prinus - Betula lenta* Forest
Association (English name)	Eastern Hemlock - Chestnut Oak - Sweet Birch Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591).

GLOBAL DESCRIPTION

Concept Summary: This association is a hemlock - mixed oak forest which often occurs on steep northeastern to northwestern exposures. It ranges from the New Jersey Highlands south to the Blue Ridge, Ridge and Valley, Cumberlands, and Piedmont provinces (Maryland, West Virginia, and Virginia). Occurrences in West Virginia are known from the Bluestone River Gorge and are likely elsewhere. Stands occur at elevations from 150 m to about 750 m (500–2500 feet) on moderately to very steep, sheltered slopes. Northerly aspects and middle slope positions prevail among documented examples. Some sites are "boulderfields" with up to 60% cover by large rocks. Geologic substrate is variable. Soils are usually very stony to extremely stony sandy loams, consistently oligotrophic, with very low pH and base status. Stands of this association are typically floristically depauperate and generally dominated by variable combinations of *Quercus prinus* (chestnut oak) and *Tsuga canadensis* (eastern hemlock). *Betula lenta* (sweet birch) and, less commonly, *Quercus velutina* (black oak), *Quercus coccinea* (scarlet oak), and *Quercus rubra* (northern red oak) are major overstory associates, each attaining codominance in a subset of stands. *Quercus alba* (white oak), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Pinus strobus* (eastern white pine), *Sassafras albidum* (sassafras), and *Fagus grandifolia* (American beech) are minor overstory associates. Small trees and shrubs can be absent or sparse due to dense shading by hemlock, with *Hamamelis virginiana* (American witchhazel) most consistently providing moderate cover. Less frequently, *Kalmia latifolia* (mountain laurel), *Rhododendron maximum* (great laurel), and *Viburnum acerifolium* (mapleleaf viburnum) are shrub components. At some New Jersey sites, a single dense stratum or multiple open strata of ericaceous species can develop, including *Rhododendron maximum* (great laurel), *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), and *Vaccinium pallidum* (Blue Ridge blueberry). The herb layer of this community is typically very sparse or absent; typical scattered species include *Maianthemum canadense* (Canada

mayflower), *Dennstaedtia punctilobula* (eastern hayscented fern), *Chimaphila maculata* (striped prince's pine), *Deschampsia flexuosa* (wavy hairgrass), *Carex swanii* (Swan's sedge), and *Aralia nudicaulis* (wild sarsaparilla).

Environmental Description: Stands occur at elevations from 150 m to about 750 m (500–2500 feet) on moderately to very steep, sheltered slopes. Northern to northwestern aspects and middle slope positions prevail among documented examples. Some sites are "boulderfields" with up to 60% cover by large rocks; some appear above or below cliff bands. Geologic substrate is variable but includes shales and sandstone. Soils are usually very stony to extremely stony sandy loams, consistently oligotrophic, with very low pH and base status. Soils in eight West Virginia plots in the environs of Bluestone National Scenic River are described as dry to somewhat moist, well-drained, stone-free to very stony sandy loam, silt loam, sandy silt loam, and sandy clay loam; they tested extremely to medium acidic (mean pH = 4.4) with relatively high levels of organic matter, estimated N release, S, Al, B, and Fe and relatively low levels of Ca, Cu, K, Mg, Mn, P, and Zn compared to average values in the area.

Vegetation Description: This association is a hemlock - mixed oak forest dominated by *Tsuga canadensis* (eastern hemlock) in association with species of *Quercus* (oak) and other deciduous trees indicative of relatively dry, infertile soils. Stands are typically floristically depauperate and generally dominated by variable combinations of *Quercus prinus* (chestnut oak) and *Tsuga canadensis* (eastern hemlock). *Betula lenta* (sweet birch) and, less commonly, *Quercus velutina* (black oak), *Quercus coccinea* (scarlet oak), *Quercus alba* (white oak), and *Quercus rubra* (northern red oak) are major overstory associates, each attaining codominance in a subset of stands. *Acer rubrum* (red maple), *Liriodendron tulipifera* (tuliptree), *Pinus strobus* (eastern white pine), *Sassafras albidum* (sassafras), and *Fagus grandifolia* (American beech) are very minor overstory associates. *Oxydendrum arboreum* (sourwood) and *Acer saccharum* (sugar maple), along with overstory species, may be present in the subcanopy. Small trees and shrubs are often absent or sparse due to dense shading by hemlock, with *Hamamelis virginiana* (American witchhazel) most consistently providing moderate cover. Less frequently, *Kalmia latifolia* (mountain laurel), *Rhododendron maximum* (great laurel), *Vaccinium pallidum* (Blue Ridge blueberry), *Amelanchier arborea* (common serviceberry), and *Viburnum acerifolium* (mapleleaf viburnum) are shrub components. At some New Jersey sites, a single dense stratum or multiple open strata of ericaceous species can develop, including *Rhododendron maximum* (great laurel), *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), and *Vaccinium pallidum* (Blue Ridge blueberry). The herb layer of this community is typically very sparse or absent with scattered individuals of a few species; typical species vary somewhat with geography and include *Maianthemum canadense* (Canada mayflower), *Dennstaedtia punctilobula* (eastern hayscented fern), *Dioscorea quaternata* (fourleaf yam), *Chimaphila maculata* (striped prince's pine), *Deschampsia flexuosa* (wavy hairgrass), *Dryopteris marginalis* (marginal woodfern), *Chimaphila maculata* (striped prince's pine), *Carex swanii* (Swan's sedge), *Eurybia divaricata* (white wood aster), *Goodyera pubescens* (downy rattlesnake plantain), *Gaultheria procumbens* (eastern teaberry), *Mitchella repens* (partridgeberry), *Monotropa hypopithys* (pinesap), *Monotropa uniflora* (Indianpipe), *Parthenocissus quinquefolia* (Virginia creeper), and *Aralia nudicaulis* (wild sarsaparilla). In nine West Virginia plots, vascular plant richness ranged from 16 to 43 (mean = 26.5) species per 400-square-meter plot.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis* (eastern hemlock)
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus prinus* (chestnut oak)
Tree subcanopy	Broad-leaved deciduous tree	*Betula lenta* (sweet birch)
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana* (American witchhazel)
Tall shrub/sapling	Broad-leaved evergreen shrub	*Rhododendron maximum* (great laurel)
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (Blue Ridge blueberry)

Characteristic Species: *Chimaphila maculata* (striped prince's pine), *Quercus prinus* (chestnut oak), *Tsuga canadensis* (eastern hemlock).
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association ranges from the New Jersey Highlands south to the Blue Ridge, Ridge and Valley, and Piedmont provinces of Pennsylvania, Maryland, and Virginia and the Cumberlands in West Virginia.
States/Provinces: MD, NJ, PA, VA, WV.
Federal Lands: NPS (Allegheny Portage Railroad, Bluestone, C&O Canal?, Catoctin Mountain, Delaware Water Gap, Shenandoah); USFS (George Washington).

CONSERVATION STATUS
Rank: G3 (4-Oct-2006).
Reasons: While this association does not appear to be intrinsically rare, it occurs in small patches in very specific habitats, and its viability is critically threatened by the spread of hemlock woolly adelgid.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 - Moderate.
Comments: The original description was based on A. Windisch's (1993) Picatinny Arsenal Hemlock-Mixed Oak-(Heath) Cool Sub-Mesic forest description (TcQf). An expanded circumscription is based on analysis of data from 20 Maryland and Virginia plots, data from Delaware Water Gap, and nine West Virginia plots.
Similar Associations: Information not available.
Related Concepts:
Picatinny Arsenal Hemlock-Mixed Oak-(Heath) Cool Sub-Mesic forest description (TcQf) (Windisch 1993) F

SOURCES
Description Authors: A. Windisch, mod. S.C. Gawler and G.P. Fleming
References: Eastern Ecology Working Group n.d., Fike 1999, Perez pers. comm., Perles et al. 2007, Vanderhorst et al. 2008, Windisch 1993.

Plot BLUE.70. Eastern Hemlock - Chestnut Oak Forest.

COMMON NAME (PARK-SPECIFIC): SYCAMORE - RIVER BIRCH RIVERSCOUR WOODLAND

SYNONYMS

NVC English Name: **Sycamore - River Birch / Silky Dogwood / (Big Bluestem, River-oats) Woodland**

NVC Scientific Name: ***Platanus occidentalis - Betula nigra* / *Cornus amomum* / (*Andropogon gerardii, Chasmanthium latifolium*) Woodland**

NVC Identifier: **CEGL003725**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches (0.13–0.77 ha in polygons of the map class) and linear zones on deposition bars along river shorelines subject to frequent high-energy flooding. Floods damage and remove trees, maintaining a short, open canopy. Stands of this association below about 445 m (1460 feet) elevation are occasionally flooded by reservoir backup from Bluestone Lake; however, high-energy, downstream flooding remains a dominant disturbance force. Slopes in mapped polygons range from 0 to 22 degrees (mean = 3.9). Elevations in mapped polygons range from 436 to 483 m (mean = 446). Variation in this community related to flooding frequency and intensity is expressed in sediment particle size, ranging from boulders and cobbles in areas subject to the most frequent, highest energy floods to stone-free silty sand in areas subject to less frequent, lower energy floods. Unvegetated ground cover in plots is dominated by various mixtures of boulders, cobbles, and sand, with significant cover by coarse woody debris (flotsam) and standing water in some plots. Soils in plots are described as temporarily flooded, poorly to well-drained, stone-free to very stony sand and sandy loam. Soils from plots tested medium to slightly acidic (mean pH = 5.6) with relatively high levels of B, Cu, Fe, Na, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, Ca, K, Mg, Mn, and P compared to average values in the park. During low water, unvegetated boulder and cobble bars are exposed downslope from this association. Upslope, this association is usually bordered by and grades towards less frequently flooded associations in the Floodplain Forest and Woodland map class and Modified Successional Floodplain Forest and Woodland map class. Adjacent associations in these map classes include Eastern Hemlock Floodplain Forest (CEGL006620), Oak - Hickory Floodplain Forest (CEGL006462), Sycamore - Yellow Buckeye Floodplain Forest (CEGL006466), Riverbank Tall Herbs (CEGL006480), Successional Black Walnut Floodplain Forest (CEGL007879), Successional Box-elder Floodplain Forest (CEGL005033), and Successional Tuliptree / Northern Spicebush Forest (CEGL007220), and Sycamore - Ash Floodplain Forest (CEGL006458).

Vegetation Description: This association is a deciduous woodland dominated by flood-battered *Platanus occidentalis* (American sycamore) and/or *Betula nigra* (river birch). Variation in physiognomy and species composition is related to flooding frequency and intensity. Stands subject to the most frequent, highest energy floods usually have open canopies over sparse understories, with herbs and shrubs restricted to protected microsites. Stands subject to less frequent, lower energy floods often have more closed canopies, usually dominated by *Betula nigra* (river birch), over a lush tall herb layer. Canopy cover in plots ranges from 0–50%. (note: 0% canopy cover represents one plot with trees <6 m, which are included in the tall-shrub layer, and another plot which was confined to a narrow herbaceous zone dominated by *Carex emoryi* (Emory's sedge), which extends beyond the woodland canopy). Subcanopy cover ranges from

0–30%, dominated by the two canopy species. Subcanopies cannot be distinguished in many stands due to low canopy height. Additional trees in plots which are tolerant of heavy flooding include *Ulmus americana* (American elm), *Carpinus caroliniana* ssp. *virginiana* (American hornbeam), *Diospyros virginiana* (common persimmon), and *Catalpa bignonioides* (southern catalpa). Presence of tree species less tolerant of flooding (e.g., *Quercus velutina* (black oak), *Liriodendron tulipifera* (tuliptree)) in plots is due to overhanging canopies or inclusion of ecotones. Cover in the shrub layers of plots ranges from 0–80%, with highest cover representing stands dominated by short (<6 m) *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch). Common shrubs in plots include *Cephalanthus occidentalis* (common buttonbush), *Lindera benzoin* (northern spicebush), *Cornus amomum* (silky dogwood), and the invasive exotic *Rosa multiflora* (multiflora rose). Herb cover in plots ranges from 1–80%. The herb layer is usually exceptionally diverse and includes a large number of species with high constancy. Common native herbs in plots include (in decreasing order of constancy) *Dichanthelium clandestinum* (deertongue), *Symphyotrichum prenanthoides* (crookedstem aster), *Packera aurea* (golden ragwort), *Galium triflorum* (fragrant bedstraw), *Pilea pumila* var. *pumila* (Canadian clearweed), *Verbesina alternifolia* (wingstem), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Cryptotaenia canadensis* (Canadian honewort), *Chasmanthium latifolium* (Indian woodoats), *Tradescantia ohiensis* (bluejacket), *Apios americana* (groundnut), *Onoclea sensibilis* (sensitive fern), *Carex emoryi* (Emory's sedge), *Andropogon gerardii* (big bluestem), *Solidago gigantea* (giant goldenrod), and *Apocynum cannabinum* (Indianhemp). Exotic herbs which are common in trace amounts include *Prunella vulgaris* (common selfheal), *Plantago rugelii* var. *rugelii* (blackseed plantain), *Trifolium pratense* (red clover), *Melilotus officinalis* (yellow sweetclover), *Lysimachia nummularia* (creeping jenny), and *Coronilla varia* (purple crownvetch). State and globally rare plant species known from this association in the park include *Carex emoryi* (Emory's sedge), *Juncus dichotomus* (forked rush), *Vitis rupestris* (sand grape), *Spiraea virginiana* (Virginia meadowsweet), and *Stachys tenuifolia* (smooth hedgenettle). Vascular plant species richness ranges from 15 to 87 (mean = 54.69) species per 400-square-meter plot. Nonvascular cover in plots ranges from 0–5%. The most abundant moss in plots is *Climacium americanum* (American climacium moss).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula nigra* (river birch), *Platanus occidentalis* (American sycamore)
Herb (field)	Forb	*Packera aurea* (golden ragwort), *Solidago gigantea* (giant goldenrod), *Tradescantia ohiensis* (bluejacket), *Verbesina alternifolia* (wingstem)
Herb (field)	Graminoid	*Andropogon gerardii* (big bluestem), *Carex emoryi* (Emory's sedge), *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium clandestinum* (deertongue), *Elymus riparius* (riverbank wildrye)

Characteristic Species: *Apios americana* (groundnut), *Cephalanthus occidentalis* (common buttonbush), *Galium triflorum* (fragrant bedstraw), *Pilea pumila* var. *pumila* (Canadian clearweed), *Symphyotrichum prenanthoides* (crookedstem aster).

Other Noteworthy Species:

Species	GRank	Type	Note
Carex emoryi (Emory's sedge)	-	plant	WV state-imperiled
Coronilla varia (purple crownvetch)	-	plant	exotic
Juncus dichotomus (forked rush)	-	plant	WV state-critically imperiled
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Melilotus officinalis (yellow sweetclover)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Spiraea virginiana (Virginia meadowsweet)	G2	plant	Federally listed threatened
Trifolium pratense (red clover)	-	plant	exotic
Vitis rupestris (sand grape)	G3	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst 2001b

Local Range: A total of 11 polygons of the Sycamore - River Birch Riverscour Woodland map class, covering 3.17 hectares, are mapped in the park. Small patches and linear zones of this association are also included as one of several associations within the Floodplain Forest and Woodland map class. A total of 48 polygons (57.11 ha) of this map class are mapped in the park. Eight accuracy assessment points in the Floodplain Forest and Woodland map class were attributed to this association. These represent 24% of the accuracy assessment points in this map class and are an indication of the relative abundance of this association within the map class. Stands are scattered along the Bluestone River throughout its length in the park, and small patches may also occur along the Little Bluestone and other large tributaries in the park.

Classification Comments: Two phases of this association can be recognized at Bluestone. Stands on cobble and boulder substrate, which are subject to more frequent, higher energy floods, have more open canopies and relatively sparse herb layers, with *Andropogon gerardii* (big bluestem) prominent in late season. Stands on sand substrate, which are subject to less frequent, lower energy floods, have taller, more closed canopies, often dominated by *Betula nigra* (river birch), over lush, tall herb layers with abundant *Dichanthelium clandestinum* (deertongue) and *Chasmanthium latifolium* (Indian woodoats). The tough rooted, flood-tolerant *Carex emoryi* (Emory's sedge) often grows in a line along the riverside edge of this association, sometimes beyond the woodland canopy. These zones are included within the association concept presented here, although purely herbaceous stands could be recognized as a distinct community analogous to Twisted Sedge Rocky Creekbed (*Carex torta* (twisted sedge) Herbaceous Vegetation (CEGL004103)) which occurs along tributaries of the New River (Vanderhorst et al. 2007).

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Thirteen plots were sampled: BLUE.13, BLUE.27, BLUE.39, BLUE.42, BLUE.63, BLUE.77, BLUE.78, BLUE.79, BLUE.89, BLUE.91, BLUE.110, BLUE.111, and BLUE.127.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	Temporarily flooded cold-deciduous woodland (II.B.2.N.b.)

Alliance	*Platanus occidentalis - (Betula nigra, Salix* spp.) Temporarily Flooded Woodland Alliance (A.633)
Alliance (English name)	Sycamore - (River Birch, Willow species) Temporarily Flooded Woodland Alliance
Association	*Platanus occidentalis - Betula nigra* / *Cornus amomum* / (*Andropogon gerardii, Chasmanthium latifolium*) Woodland
Association (English name)	Sycamore - River Birch / Silky Dogwood / (Big Bluestem, River-oats) Woodland
Ecological System(s):	Cumberland Riverscour (CES202.036).

GLOBAL DESCRIPTION

Concept Summary: These woodlands occur along high-energy Appalachian rivershores, such as along the New, Bluestone, and Gauley rivers in West Virginia. They maintain an open canopy due to mechanical disturbance (flooding and scouring). The coarse-textured substrates are potentially well-drained, but fluvial topography and proximity to the water table often result in a mixture of well-drained and poorly drained microsites. The usually short, open canopy is composed mostly of flood-battered trees, typically codominated by *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch). The tallest trees are often the younger ones which have not yet been subjected to damage by severe floods. Additional important trees include *Acer saccharinum* (silver maple), *Carpinus caroliniana* (American hornbeam), *Catalpa speciosa* (northern catalpa), *Diospyros virginiana* (common persimmon), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), *Robinia pseudoacacia* (black locust), *Salix nigra* (black willow), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). Common shrubs include *Alnus serrulata* (hazel alder), *Cephalanthus occidentalis* (common buttonbush), *Chionanthus virginicus* (white fringetree), *Cornus amomum* (silky dogwood), *Hypericum prolificum* (shrubby St. Johnswort), *Lindera benzoin* (northern spicebush), and *Salix caroliniana* (coastal plain willow). There is often a large component of woody vines, including *Campsis radicans* (trumpet creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis rupestris* (sand grape). The herb layer is composed of a mixture of warm-season grasses and forbs adapted to frequent flooding and high light exposure. Characteristic herbs include *Andropogon gerardii* (big bluestem), *Apocynum cannabinum* (Indianhemp), *Baptisia australis* (blue wild indigo), *Chasmanthium latifolium* (Indian woodoats), *Conoclinium coelestinum* (blue mistflower), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Eupatorium fistulosum* (trumpetweed), *Galium triflorum* (fragrant bedstraw), *Justicia americana* (American water-willow), *Lobelia cardinalis* (cardinalflower), *Lysimachia ciliata* (fringed loosestrife), *Onoclea sensibilis* (sensitive fern), *Packera aurea* (golden ragwort), *Panicum virgatum* (switchgrass), *Pilea pumila* (Canadian clearweed), *Rudbeckia laciniata* (cutleaf coneflower), *Solidago gigantea* (giant goldenrod), *Solidago juncea* (early goldenrod), *Symphyotrichum prenanthoides* (crookedstem aster), *Tradescantia ohiensis* (bluejacket), *Tripsacum dactyloides* (eastern gamagrass), *Verbesina alternifolia* (wingstem), and *Viola cucullata* (marsh blue violet).

Environmental Description: These woodlands occur along high-energy Appalachian rivershores, such as the New River in West Virginia. They maintain an open canopy due to mechanical disturbance (flooding and scouring). This association occurs as relatively continuous linear zones (sometimes in small patches), commonly on deposition bars, in positions that are subject to frequent high-energy flooding. These floods damage and remove trees, maintaining an open canopy. Variation in this community related to flooding frequency and intensity is expressed in sediment particle size, ranging from boulders and cobbles in areas subject to the most frequent, highest energy floods to stone-free silty sand in areas subject to less frequent, lower energy floods. There is no soil horizon development. These coarse-textured substrates are

potentially well-drained, but fluvial topography and proximity to the water table often result in a mixture of well-drained and poorly drained microsites. Unvegetated ground cover is dominated by various mixtures of boulders, cobbles, and sand, with significant cover by coarse woody debris (flotsam) and standing water in some plots. Soil chemistry analyzed from four plots indicates low levels of macronutrients (N, P, K) and organic matter, and high levels of several micronutrients (Fe, Mg, Mn, Zn). Plots along the New River have soils with relatively high pH (mean = 6.73), while those along the Bluestone are more acidic (mean pH = 5.6). Slopes range from level to steep but are generally gentle. Known elevations range from 250 to 485 m (810–1575 feet).

Vegetation Description: This association is a deciduous woodland with a short, open canopy typically codominated by flood-battered *Platanus occidentalis* (American sycamore) and *Betula nigra* (river birch). (One atypical stand on the New River has a canopy codominated by *Pinus virginiana* (Virginia pine).) Additional important trees include *Acer saccharinum* (silver maple), *Carpinus caroliniana* (American hornbeam), *Catalpa speciosa* (northern catalpa), *Diospyros virginiana* (common persimmon), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), *Robinia pseudoacacia* (black locust), *Salix nigra* (black willow), *Ulmus americana* (American elm), and *Ulmus rubra* (slippery elm). The tallest trees are often the younger ones which have not yet been subjected to damage by severe floods. Common shrubs include *Alnus serrulata* (hazel alder), *Cephalanthus occidentalis* (common buttonbush), *Chionanthus virginicus* (white fringetree), *Cornus amomum* (silky dogwood), *Hypericum prolificum* (shrubby St. Johnswort), *Lindera benzoin* (northern spicebush), and *Salix caroliniana* (coastal plain willow). The invasive exotic shrub *Rosa multiflora* (multiflora rose) is sometimes present. There is often a large component of woody vines in the short-shrub layer, including *Campsis radicans* (trumpet creeper), *Toxicodendron radicans* (eastern poison ivy), and *Vitis rupestris* (sand grape). The herb layer is composed of a mixture of warm-season grasses and forbs adapted to frequent flooding and high light exposure. Characteristic herbs include *Andropogon gerardii* (big bluestem), *Apocynum cannabinum* (Indianhemp), *Baptisia australis* (blue wild indigo), *Chasmanthium latifolium* (Indian woodoats), *Conoclinium coelestinum* (blue mistflower), *Cryptotaenia canadensis* (Canadian honewort), *Dichanthelium clandestinum* (deertongue), *Eupatorium fistulosum* (trumpetweed), *Galium triflorum* (fragrant bedstraw), *Justicia americana* (American water-willow), *Lobelia cardinalis* (cardinalflower), *Lysimachia ciliata* (fringed loosestrife), *Onoclea sensibilis* (sensitive fern), *Packera aurea* (golden ragwort), *Panicum virgatum* (switchgrass), *Pilea pumila* (Canadian clearweed), *Rudbeckia laciniata* (cutleaf coneflower), *Solidago gigantea* (giant goldenrod), *Solidago juncea* (early goldenrod), *Symphyotrichum prenanthoides* (crookedstem aster), *Tradescantia ohiensis* (bluejacket), *Tripsacum dactyloides* (eastern gamagrass), *Verbesina alternifolia* (wingstem), and *Viola cucullata* (marsh blue violet). Exotic herbs which are common in small amounts include *Prunella vulgaris* (common selfheal), *Plantago rugelii* (blackseed plantain), *Trifolium pratense* (red clover), *Melilotus officinalis* (yellow sweetclover), *Lysimachia nummularia* (creeping jenny), and *Coronilla varia* (purple crownvetch). Plants tracked as rare in West Virginia by the Natural Heritage Program include *Baptisia australis* (blue wild indigo), *Carex emoryi* (Emory's sedge), *Coreopsis pubescens* var. *robusta* (star tickseed), *Juncus dichotomus* (forked rush), *Solidago simplex* var. *racemosa* (Rand's goldenrod), *Spiraea virginiana* (Virginia meadowsweet), *Stachys tenuifolia* (smooth hedgenettle), and *Vitis rupestris* (sand grape). Vascular plant species richness in the 28 sampled plots ranged from 15 to 87 (mean = 46.7). The bryophyte layer is usually poorly developed; crustose lichens may occur on large rocks.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Betula nigra* (river birch), *Platanus occidentalis* (American sycamore)

Characteristic Species: *Acer saccharinum* (silver maple), *Alnus serrulata* (hazel alder), *Andropogon gerardii* (big bluestem), *Apocynum cannabinum* (Indianhemp), *Baptisia australis* (blue wild indigo), *Campsis radicans* (trumpet creeper), *Catalpa speciosa* (northern catalpa), *Cephalanthus occidentalis* (common buttonbush), *Chasmanthium latifolium* (Indian woodoats), *Chionanthus virginicus* (white fringetree), *Conoclinium coelestinum* (blue mistflower), *Cornus amomum* (silky dogwood), *Dichanthelium clandestinum* (deertongue), *Diospyros virginiana* (common persimmon), *Eupatorium fistulosum* (trumpetweed), *Hypericum prolificum* (shrubby St. Johnswort), *Justicia americana* (American water-willow), *Lobelia cardinalis* (cardinalflower), *Lysimachia ciliata* (fringed loosestrife), *Panicum virgatum* (switchgrass), *Robinia pseudoacacia* (black locust), *Salix caroliniana* (coastal plain willow), *Salix nigra* (black willow), *Solidago juncea* (early goldenrod), *Toxicodendron radicans* (eastern poison ivy), *Tripsacum dactyloides* (eastern gamagrass), *Ulmus americana* (American elm), *Ulmus rubra* (slippery elm), *Viola cucullata* (marsh blue violet), *Vitis rupestris* (sand grape).

Other Noteworthy Species:

Species	GRank	Type	Note
Baptisia australis (blue wild indigo)	-	plant	WV state-rare plant
Carex emoryi (Emory's sedge)	-	plant	WV state-rare plant
Coreopsis pubescens var. *robusta* (star tickseed)	-	plant	WV state-rare plant
Coronilla varia (purple crownvetch)	-	plant	exotic
Lysimachia nummularia (creeping jenny)	-	plant	exotic
Melilotus officinalis (yellow sweetclover)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Solidago simplex var. *racemosa* (Rand's goldenrod)	G5T3?	plant	WV state-rare plant
Spiraea virginiana (Virginia meadowsweet)	G2	plant	Federally listed threatened
Trifolium pratense (red clover)	-	plant	exotic
Vitis rupestris (sand grape)	G3	plant	WV state-rare plant

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This type is currently documented from high-energy Appalachian rivers, such as the New, Bluestone, and Gauley rivers in West Virginia. Its range may include some of western Virginia as well.

States/Provinces: VA, WV.

Federal Lands: NPS (Bluestone, New River Gorge).

CONSERVATION STATUS

Rank: GNR (1-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: Along the New River, this association is ecologically and floristically intermediate between *Andropogon gerardii - Panicum virgatum - Baptisia australis* Herbaceous Vegetation (CEGL006283), which is more open and occurs on sites which are more severely impacted by flooding, and *Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest (CEGL006458), which has a more closed canopy, usually lacking *Betula*

nigra (river birch), and occurs on sites less severely impacted by flooding. It is also similar to *Salix nigra - Betula nigra / Schoenoplectus pungens* Wooded Herbaceous Vegetation [Provisional] (CEGL006463), which occurs on finer textured alluvium in riverside positions along lower energy reaches. Similar vegetation was described from the New River Gorge by Suiter (1995) as *Platanus occidentalis - Betula nigra* forest. Two phases of this association can be recognized along the Bluestone River and its tributaries. Stands on cobble and boulder substrate, which are subject to more frequent, higher energy floods, have more open canopies and relatively sparse herb layers with *Andropogon gerardii* (big bluestem) prominent in late season. Stands on sand substrate, which are subject to less frequent, lower energy floods, have taller, more closed canopies, often dominated by *Betula nigra* (river birch), over lush, tall herb layers with abundant *Dichanthelium clandestinum* (deertongue) and *Chasmanthium latifolium* (Indian woodoats). The tough-rooted, flood-tolerant *Carex emoryi* (Emory's sedge) often grows in a line along the riverside edge of this association, sometimes beyond the woodland canopy. These zones are included within the association concept presented here. Recent classification studies in the National Park Service National Capitol Region have shown this association to be distinct from similar vegetation in the Potomac drainage, which is classified as *Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra)* Woodland (CEGL003896).

Similar Associations:

Betula nigra - Platanus occidentalis Forest (CEGL002086)--with a more-or-less closed canopy.

Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra) Woodland (CEGL003896).

Quercus bicolor - Fraxinus pennsylvanica - (Platanus occidentalis) / Chasmanthium latifolium - Dichanthelium clandestinum - Zizia aurea Woodland (CEGL006218).

Salix nigra - Betula nigra / Schoenoplectus pungens Wooded Herbaceous Vegetation [Provisional] (CEGL006463)--occurs in similar riverside positions along lower energy reaches, often just downstream from rapids.

Related Concepts:

Platanus occidentalis - Betula nigra / Cornus amomum riparian woodland (Vanderhorst 2001b) =

Platanus occidentalis - Betula nigra forest (Suiter 1995) ?

SOURCES

Description Authors: M. Pyne, mod. S. C. Gawler.

References: Fleming et al. 2001, Mitchem 2004, Southeastern Ecology Working Group n.d., Suiter 1995, Vanderhorst 2000b, Vanderhorst 2001b, Vanderhorst et al. 2007, Vanderhorst et al. 2008, Vanderhorst pers. comm.

Plot BLUE.89. Sycamore - River Birch Riverscour Woodland (sycamore - river birch / big bluestem phase).

Plot BLUE.77. Sycamore - River Birch Riverscour Woodland (river birch / Indian woodoats phase).

COMMON NAME (PARK-SPECIFIC): VIRGINIA PINE - OAK SHALE WOODLAND

SYNONYMS

NVC English Name:	**Chestnut Oak - Virginia Pine - (Table Mountain Pine) / Little Bluestem - Starved Witchgrass Woodland**
NVC Scientific Name:	***Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum* Woodland**
NVC Identifier:	**CEGL008540**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches (0.1–6.6 ha) on hot, dry gorge slopes with infertile soils. It is restricted to south-southwest aspects on steep convex slopes, ridge spurs, and clifftops which have the highest solar exposure of all sites in the park. Slopes in mapped polygons range from 12 to 43 degrees (mean = 32). Elevations in mapped polygons range from 469 to 676 m (mean = 567). Bedrock geology is mapped as shales and sandstones of the Hinton Formation in the Mauch Chunk Group. Both shale and sandstone surficial rocks, including outcrops of sandstone bedrock, were noted in plots. Unvegetated ground cover in plots includes significant portions of litter, bare soil, and rock. Soils in plots are described as dry to very dry, well-drained to rapidly drained, stony to extremely stony sandy loam and silt loam. Soils from plots tested extremely to strongly acidic (mean pH = 4.6) with relatively high levels of estimated N release, Al, and K, and relatively low levels of organic matter, S, B, Ca, Cu, Fe, Mg, Mn, Na, P, and Zn compared to average values in the park. Polygons of this association are usually adjacent to larger polygons of Oak - Eastern White Pine / Ericad Forest (CEGL008539), which occur in slightly less xeric positions, and Oak - Hickory - Sugar Maple Forest (CEGL007268), which occur in more mesic positions with more fertile soils. Sometimes polygons of this association are uphill from small polygons of Calcareous Oak Forest (CEGL004793), which occur on southerly aspects with limestone-influenced soils.

Vegetation Description: This association represents mixed evergreen-deciduous woodlands and open-canopy forests codominated by *Pinus virginiana* (Virginia pine) and *Quercus* (oak) spp. Canopy cover in plots ranges from 20–70%. Important canopy species in plots include (in decreasing order of constancy) *Pinus virginiana* (Virginia pine), *Quercus rubra* (northern red oak), *Quercus prinus* (chestnut oak), *Carya glabra* (pignut hickory), *Quercus stellata* (post oak), *Quercus alba* (white oak), *Fraxinus americana* (white ash), and *Carya alba* (mockernut hickory). Subcanopy cover in plots ranges from 10–60%, consisting of the canopy species, with high constancy of *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Quercus stellata* (post oak). Cover in the shrub layers of plots ranges from 1–70%, dominated by regeneration of the canopy and subcanopy tree species. Common shrubs in plots include *Amelanchier arborea* var. *arborea* (common serviceberry), *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (Blue Ridge blueberry), *Rosa carolina* var. *carolina* (Carolina rose), and *Rhus aromatica* var. *aromatica* (fragrant sumac). Herb cover in plots ranges from 10–50%, dominated by species tolerant of dry, acidic soils. Common herbs include (in decreasing order of constancy in plots) *Carex pensylvanica* (Pennsylvania sedge), *Antennaria plantaginifolia* (woman's tobacco), *Houstonia longifolia* (longleaf summer bluet), *Helianthus divaricatus* (woodland sunflower), *Cunila origanoides* (common dittany), *Taenidia integerrima* (yellow pimpernel), *Symphyotrichum undulatum* (waxyleaf aster), *Lespedeza frutescens* (shrubby lespedeza),

Danthonia spicata (poverty oatgrass), and *Asplenium platyneuron* (ebony spleenwort). State and globally rare plant species found in this association in the park include *Allium oxyphilum* (lillydale onion), *Monarda fistulosa* ssp. *brevis* (Smoke Hole bergamot), and *Viburnum rafinesquianum* (downy arrowwood). The latter two of these species are more typical of calcareous soils, and their presence here is peripheral to larger populations in adjacent habitats. Vascular plant species richness ranges from 23 to 56 (mean = 42.13) species per 400-square-meter plot. Nonvascular cover in plots ranges from 0–10%, often dominated by fruticose lichens including *Cladina arbuscula* (reindeer lichen).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus stellata* (post oak)
Tree canopy	Needle-leaved tree	*Pinus virginiana* (Virginia pine)
Tree canopy	Broad-leaved deciduous tree	*Carya glabra* (pignut hickory), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak)
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana* var. *virginiana* (eastern redcedar)
Herb (field)	Graminoid	*Carex pensylvanica* (Pennsylvania sedge)

Characteristic Species: *Antennaria plantaginifolia* (woman's tobacco), *Cunila origanoides* (common dittany), *Danthonia spicata* (poverty oatgrass), *Helianthus divaricatus* (woodland sunflower), *Houstonia longifolia* (longleaf summer bluet), *Lespedeza frutescens* (shrubby lespedeza), *Rosa carolina* var. *carolina* (Carolina rose), *Symphyotrichum undulatum* (waxyleaf aster), *Taenidia integerrima* (yellow pimpernel), *Vaccinium pallidum* (Blue Ridge blueberry), *Vaccinium stamineum* (deerberry).

Other Noteworthy Species:

Species	GRank	Type	Note
Allium oxyphilum (lillydale onion)	G2Q	plant	globally and WV state-imperiled
Monarda fistulosa ssp. *brevis* (Smoke Hole bergamot)	G5T1	plant	globally critically imperiled
Viburnum rafinesquianum (downy arrowwood)	-	plant	WV state-imperiled

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	WVNHP unpubl. data b

Local Range: A total of 23 polygons covering 26.10 hectares are mapped in the park.

Classification Comments: This community at Bluestone resembles open communities in the Ridge and Valley which occur on both sandstone and shale. Stands at Bluestone are centered on thin bands of sandstone bedrock which outcrop on predominantly shale slopes. Both sandstone and shale surficial rocks were noted in plots. It is similar to shale barrens but lacks the endemics (Braunschweig et al. 1999) which characterize those communities as cohesive evolutionary units. The association has not been documented elsewhere on shale, but this difference is probably related to contrasting geology of stacked, gently dipping strata at Bluestone compared to dramatically folded and faulted strata of the Ridge and Valley. The community at Bluestone also differs from the main range of the association by having higher canopy cover, probably reflecting somewhat more mesic climate and soils. In multivariate analysis of upland forests at Bluestone, plots of this association consistently cluster and ordinate together as an outlying group. In statewide analysis, plots of this association from Bluestone cluster and ordinate as a group separate from shale barrens in the Ridge and Valley. Presence of the calciphilic species *Monarda fistulosa* ssp. *brevis* (Smoke Hole bergamot), *Viburnum rafinesquianum* (downy arrowwood), and *Quercus muehlenbergii* (chinkapin oak) in plots of this association probably

reflects an ecotone between this association and Calcareous Oak Forest which occurs downslope on limestone bedrock.
Other Comments: Information not available.
Local Description Authors: J. P. Vanderhorst.
Plots: Eight plots were sampled: BLUE.2, BLUE.22, BLUE.26, BLUE.30, BLUE.84, BLUE.118, BLUE.130, and BLUE.131.
Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Mixed evergreen - deciduous woodland (II.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous woodland (II.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous woodland (II.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous woodland (II.C.3.N.a.)
Alliance	*Pinus (rigida, pungens, virginiana)* - *Quercus prinus* Woodland Alliance (A.677)
Alliance (English name)	(Pitch Pine, Table Mountain Pine, Virginia Pine) - Chestnut Oak Woodland Alliance
Association	*Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum* Woodland
Association (English name)	Chestnut Oak - Virginia Pine - (Table Mountain Pine) / Little Bluestem - Starved Witchgrass Woodland
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600).

GLOBAL DESCRIPTION

Concept Summary: This community is a mixed oak-pine woodland with a canopy of stunted, often gnarled trees, varying from semi-open to very open. It occurs on steep convex slopes, ridge spurs, and clifftops which have high solar exposure. Most are on moderate to steep slopes with much exposed mineral soil. Sites are confined to lower elevations (<770 m [2500 feet]), are distinctly xeric, and usually have southeast to southwest aspects. Underlying bedrock includes quartzite, metasandstone and sandstone, granite, shale, and other acidic rocks. Surface cover of outcrops and loose stones is relatively high. Soils are extremely acidic. The canopy is typically codominated by *Quercus prinus* (chestnut oak) and *Pinus virginiana* (Virginia pine) in variable proportions; in some slightly more mesic occurrences, *Quercus rubra* (northern red oak) may occur with or in place of *Quercus prinus* (chestnut oak). *Pinus pungens* (Table Mountain pine) is an important, even dominant, associate in a minority of stands. Minor but relatively constant tree associates include *Carya glabra* (pignut hickory), *Amelanchier arborea* (common serviceberry), and *Sassafras albidum* (sassafras). Minor, inconstant tree associates include *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus stellata* (post oak), *Quercus marilandica* (blackjack oak), *Quercus alba* (white oak), *Carya alba* (mockernut hickory), *Carya ovata* (shagbark hickory), *Juniperus virginiana* (eastern redcedar), *Pinus strobus* (eastern white pine), and *Fraxinus americana* (white ash). The shrub layer varies from moderately dense to sparse, with *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium stamineum* (deerberry) the most constant and abundant species. *Quercus ilicifolia* (bear oak), *Kalmia latifolia* (mountain laurel), *Rhus copallinum* (flameleaf sumac), *Rhus aromatica* (fragrant sumac), *Rosa carolina* (Carolina rose), *Castanea pumila* (chinkapin), *Viburnum acerifolium* (mapleleaf viburnum), and *Toxicodendron pubescens* (Atlantic poison oak) are inconstant, but occasionally common, in the type. Herbaceous composition and density vary with shrub density. Graminoid-rich openings

dominated by *Schizachyrium scoparium* (little bluestem), *Dichanthelium depauperatum* (starved panicgrass), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), and *Dichanthelium commutatum* (variable panicgrass) are frequent. Also present is a surprising variety of low-cover forbs, among the most characteristic of which are *Hieracium venosum* (rattlesnakeweed), *Solidago erecta*, *Potentilla canadensis* (dwarf cinquefoil), *Campanula divaricata* (small bonny bellflower), *Viola sagittata* (arrowleaf violet), *Houstonia longifolia* (longleaf summer bluet), *Antennaria plantaginifolia* (woman's tobacco), *Aureolaria laevigata* (entireleaf yellow false foxglove), *Helianthus divaricatus* (woodland sunflower), *Cunila origanoides* (common dittany), *Symphyotrichum undulatum* (waxyleaf aster), *Coreopsis verticillata* (whorled tickseed), *Tephrosia virginiana* (Virginia tephrosia), *Lespedeza frutescens* (shrubby lespedeza), *Polygonatum biflorum* var. *biflorum* (smooth Solomon's-seal), *Taenidia integerrima* (yellow pimpernel), *Asplenium platyneuron* (ebony spleenwort), and *Clitoria mariana* (Atlantic pigeonwings).

Environmental Description: This association occurs on steep convex slopes, ridge spurs, and clifftops which have high solar exposure. Most habitats are characterized by moderate to steep (mean = 24 degrees) slopes with much exposed mineral soil. Sites are confined to lower elevations (<770 m [2500 feet]), are distinctly xeric, and usually have southeast to southwest aspects. Underlying bedrock at plot-sampling sites in VA, MD, and WV includes Antietam quartzite, ferruginous metasandstone of the Harper's Formation, acidic granites, acidic phases of Catoctin metabasalt, schistose metasedimentary rocks of the Mather Gorge Formation, shales and sandstones of the Hinton formation in the Mauch Chunk group, and ancient alluvium composed of quartzitic cobbles. Surface cover of outcrops and loose stones is relatively high (mean = 38% in MD and VA plots). Soils are extremely acidic (mean pH = 4.4) and very low in base status, except for high aluminum levels and sometimes relatively high potassium levels. One somewhat anomalous site is located on massive alluvial fans that overlie the floor of the Great Valley of Virginia along the foot of the Blue Ridge in Augusta County. Here, stands occupy barren, elevated cobble terraces bordering a stream and representing the floodplain level of an earlier erosional cycle.

Vegetation Description: The canopy cover of stunted, often gnarled trees varies from semi-open to very open. *Quercus prinus* (chestnut oak) and *Pinus virginiana* (Virginia pine) are usually codominant in variable proportions; in some slightly more mesic occurrences, *Quercus rubra* (northern red oak) may occur with or in place of *Quercus prinus* (chestnut oak). *Pinus pungens* (Table Mountain pine) is an important, even dominant, associate in a minority of stands. Minor but relatively constant tree associates include *Carya glabra* (pignut hickory), *Amelanchier arborea* (common serviceberry), and *Sassafras albidum* (sassafras). Minor, inconstant tree associates include *Quercus coccinea* (scarlet oak), *Quercus velutina* (black oak), *Quercus stellata* (post oak), *Quercus marilandica* (blackjack oak), *Quercus alba* (white oak), *Carya alba* (mockernut hickory), *Carya ovata* (shagbark hickory), *Juniperus virginiana* (eastern redcedar), *Pinus strobus* (eastern white pine), and *Fraxinus americana* (white ash). The shrub layer varies from moderately dense to sparse, with *Vaccinium pallidum* (Blue Ridge blueberry) and *Vaccinium stamineum* (deerberry) the most constant and abundant species. *Quercus ilicifolia* (bear oak), *Kalmia latifolia* (mountain laurel), *Rhus copallinum* (flameleaf sumac), *Rhus aromatica* (fragrant sumac), *Rosa carolina* (Carolina rose), *Castanea pumila* (chinkapin), *Viburnum acerifolium* (mapleleaf viburnum), and *Toxicodendron pubescens* (Atlantic poison oak) are inconstant, but occasionally common, in the type. Herbaceous composition and density vary with shrub density. Graminoid-rich openings dominated by *Schizachyrium scoparium* (little

bluestem), *Dichanthelium depauperatum* (starved panicgrass), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), and *Dichanthelium commutatum* (variable panicgrass) are frequent. Also present is a surprising variety of low-cover forbs, among the most characteristic of which are *Hieracium venosum* (rattlesnakeweed), *Solidago erecta*, *Potentilla canadensis* (dwarf cinquefoil), *Campanula divaricata* (small bonny bellflower), *Viola sagittata* (arrowleaf violet), *Houstonia longifolia* (longleaf summer bluet), *Antennaria plantaginifolia* (woman's tobacco), *Aureolaria laevigata* (entireleaf yellow false foxglove), *Helianthus divaricatus* (woodland sunflower), *Cunila origanoides* (common dittany), *Symphyotrichum undulatum* (waxyleaf aster), *Coreopsis verticillata* (whorled tickseed), *Tephrosia virginiana* (Virginia tephrosia), *Lespedeza frutescens* (shrubby lespedeza), *Polygonatum biflorum* var. *biflorum* (smooth Solomon's-seal), *Taenidia integerrima* (yellow pimpernel), *Asplenium platyneuron* (ebony spleenwort), and *Clitoria mariana* (Atlantic pigeonwings). Additional herbs occurring less frequently include *Lespedeza hirta* (hairy lespedeza), *Solidago odora* (anisescented goldenrod), *Deschampsia flexuosa* (wavy hairgrass), *Coreopsis major* (greater tickseed), *Solidago puberula* var. *puberula* (downy goldenrod), *Solidago bicolor* (white goldenrod), *Solidago arguta* var. *caroliniana* (Atlantic goldenrod), *Solidago sphacelata* (autumn goldenrod), *Hypericum hypericoides* ssp. *multicaule* (St. Andrew's cross), *Lysimachia quadrifolia* (whorled yellow loosestrife), *Asclepias amplexicaulis* (clasping milkweed), *Sericocarpus asteroides* (toothed whitetop aster), *Dicentra eximia* (turkey corn), *Paronychia fastigiata* (hairy forked nailwort), *Sericocarpus linifolius* (narrowleaf whitetop aster), *Ionactis linariifolius* (flaxleaf whitetop aster), *Symphyotrichum laeve* (smooth blue aster), *Phlox subulata* (moss phlox), *Pellaea atropurpurea* (purple cliffbrake), *Polygonum scandens* var. *cristatum* (climbing false buckwheat), *Viola X palmata* (early blue violet), *Arabis laevigata* (smooth rockcress), and *Zizia trifoliata* (meadow alexanders). Vascular plant species richness of plot-sampled stands ranges from 17 to 56 taxa per 400 square meters (mean = 37). Nonvascular cover tends to be sparse and characterized by fruticose lichens, including *Cladina arbuscula* (reindeer lichen).

Most Abundant Species: Information not available.

Characteristic Species: *Carex umbellata* (parasol sedge), *Castanea pumila* (chinkapin), *Dichanthelium commutatum* (variable panicgrass), *Dichanthelium depauperatum* (starved panicgrass), *Hieracium venosum* (rattlesnakeweed), *Lespedeza hirta* (hairy lespedeza), *Pinus virginiana* (Virginia pine), *Quercus marilandica* (blackjack oak), *Rhus copallinum* (flameleaf sumac), *Solidago odora* (anisescented goldenrod), *Tephrosia virginiana* (Virginia tephrosia), *Toxicodendron pubescens* (Atlantic poison oak).

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: The known range of this community is limited to the northern Blue Ridge, Ridge and Valley, Cumberlands, and Piedmont in Virginia, West Virginia, and Maryland, but geologic substrates and site conditions similar to those supporting the known examples occur elsewhere in the Central Appalachians, and a broader geographic range seems likely.

States/Provinces: MD, VA:S2, WV.

Federal Lands: NPS (Blue Ridge Parkway, Bluestone, C&O Canal, Catoctin Mountain, Harpers Ferry, Shenandoah); USFS (Jefferson).

CONSERVATION STATUS

Rank: G3? (8-Feb-2008).

Reasons: Although this community is likely to have a broader distribution in the Central Appalachians than present documentation suggests, it is a small-patch vegetation type restricted to special habitat conditions.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 - Moderate.

Comments: The classification of this type is supported by analysis of 12 Virginia, 3 Maryland, and 8 West Virginia plot samples. Additional inventory and data collection are needed to clarify the geographic range, classification, and environmental context of this type. The known range of this community is limited to the northern Blue Ridge, Ridge and Valley, Cumberlands, and Piedmont in Virginia, West Virginia, and Maryland, but geologic substrates and site conditions similar to those supporting the known examples occur elsewhere in the Central Appalachians, and a broader geographic range seems likely.

Similar Associations:

Pinus virginiana / Vaccinium pallidum / Schizachyrium scoparium - Carex pensylvanica Woodland (CEGL003624)--on dry shale slopes of the Southern Appalachians.

Quercus prinus - Juniperus virginiana - (Pinus virginiana) / Philadelphus hirsutus - Celtis occidentalis Woodland (CEGL007720)--on steep, rocky, riverine bluffs in the Southern Blue Ridge with exposed and eroding shale.

Quercus prinus / Quercus ilicifolia / Danthonia spicata Woodland [Provisional] (CEGL008526)--on dry shale slopes of the Central Appalachians.

Related Concepts:

Pinus pungens - Pinus rigida / Quercus ilicifolia / Gaylussacia baccata Association: *Andropogon scoparius - Coreopsis verticillata - Dichanthelium depauperatum* Subassociation, *pro parte* (Rawinski et al. 1996) F

Quercus prinus - Pinus virginiana - Quercus (marilandica, stellata) / Dichanthelium depauperatum Woodland (Fleming and Coulling 2001) =

SOURCES

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

References: Braunschweig et al. 1999, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Fleming et al. 2007, Rawinski et al. 1996, WVNHP unpubl. data b.

Plot BLUE.84. Virginia Pine - Oak Shale Woodland.

COMMON NAME (PARK-SPECIFIC): RIVERBANK TALL HERBS

SYNONYMS

NVC English Name: **Wingstem - Riverbank Wild Rye - Giant Goldenrod - (American Germander) Herbaceous Vegetation**

NVC Scientific Name: ***Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)*** **Herbaceous Vegetation**

NVC Identifier: **CEGL006480**

LOCAL INFORMATION

Environmental Description: This association occurs in small patches on sunny riverbanks and floodplains. It is included as one of several associations in both the Floodplain Forest and Woodland map class and the Modified Successional Floodplain Forest and Woodland map class. Patches in the former are affected by a natural flooding regime, those in the latter may be occasionally flooded by reservoir backup from Bluestone Lake. In natural settings, this association occurs on sandy riverbanks where heavy annual deposits of alluvial sediments inhibit tree establishment. The rate and extent of sedimentation have been greatly increased by flooding of Bluestone Lake, probably increasing the extent of this association. It can also occur as successional vegetation on floodplains previously cleared for agriculture. Slopes in mapped polygons of Floodplain Forest and Woodland and Modified Successional Floodplain Forest and Woodland range from 0 to 34 degrees. Elevations in mapped polygons of these two map classes range from 436 to 506 m. Unvegetated ground cover in plots is dominated by litter and exposed sand. Soils in plots are described as temporarily flooded, deep, moderately well-drained to well-drained, stone-free or slightly stony sand and loamy sand. Soils from plots tested medium to slightly acidic (mean pH = 5.8) with relatively high levels of Ca, Cu, Mg, Mn, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, B, Fe, K, Na, and P compared to average values in the park. Adjacent associations in the Modified Successional Floodplain Forest and Woodland map class may include Successional Black Walnut Floodplain Forest (CEGL007879), Successional Box-elder Floodplain Forest (CEGL005033), Successional Tuliptree / Northern Spicebush Forest (CEGL007220), River Birch Backwater Floodplain Forest (CEGL002086), and Sycamore - Ash Floodplain Forest (CEGL006458). Adjacent associations in the Floodplain Forest and Woodland map class may include Oak - Hickory Floodplain Forest (CEGL006462), Sycamore - River Birch Riverscour Woodland (CEGL003725), Sycamore - Yellow Buckeye Floodplain Forest (CEGL006466), and Eastern Hemlock Floodplain Forest (CEGL006620).

Vegetation Description: This association represents herbaceous vegetation or wooded herbaceous vegetation dominated by rank growth of tall herbs. Canopy cover in plots ranges from 0–40% and subcanopy cover ranges from 0–30%. Common trees include *Platanus occidentalis* (American sycamore), *Liriodendron tulipifera* (tuliptree), *Betula nigra* (river birch), and *Fraxinus pennsylvanica* (green ash). Cover in the shrub layers of plots ranges from 0–15%, including tree saplings, shrubs, and vines. Common shrubs include *Physocarpus opulifolius* var. *opulifolius* (common ninebark), *Lindera benzoin* (northern spicebush), *Viburnum prunifolium* (blackhaw), *Hypericum prolificum* (shrubby St. Johnswort), and the exotic invasive *Rosa multiflora* (multiflora rose). The shrub *Spiraea virginiana* (Virginia meadowsweet) is a federally listed threatened species which was found in one plot. Vines include *Toxicodendron radicans* (eastern poison ivy), *Smilax tamnoides* (bristly greenbrier), and *Vitis vulpina* (frost grape). Herb

cover in plots ranges from 40–100%. Common native herbs include (in decreasing order of constancy in plots) *Verbesina alternifolia* (wingstem), *Dichanthelium clandestinum* (deertongue), *Solidago gigantea* (giant goldenrod), *Boehmeria cylindrica* (smallspike false nettle), *Apios americana* (groundnut), *Packera aurea* (golden ragwort), *Onoclea sensibilis* (sensitive fern), *Amphicarpaea bracteata* (American hogpeanut), *Chasmanthium latifolium* (Indian woodoats), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Verbena urticifolia* (white vervain), *Leersia virginica* (whitegrass), *Tradescantia ohiensis* (bluejacket), *Elymus riparius* (riverbank wildrye), *Verbesina occidentalis* (yellow crownbeard), and *Helenium autumnale* var. *autumnale* (common sneezeweed). *Teucrium canadense* var. *canadense* (Canada germander), a nominal species in the association name, occurs in one plot. The state-rare *Carex emoryi* (Emory's sedge) may grow in a line along the river's edge. The exotic herbs *Humulus japonicus* (Japanese hop) and *Urtica dioica* ssp. *dioica* (stinging nettle) may out-compete the native herbs in this association and form large monospecific patches in floodplain openings, especially those affected by reservoir backup. Vascular plant species richness in floristically complete plots ranges from 41 to 80 (mean = 44.57) species per 400 square meters.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula nigra* (river birch), *Liriodendron tulipifera* (tuliptree), *Platanus occidentalis* (American sycamore)
Herb (field)	Vine/Liana	*Toxicodendron radicans* (eastern poison ivy)
Herb (field)	Forb	*Boehmeria cylindrica* (smallspike false nettle), *Helenium autumnale* var. *autumnale* (common sneezeweed), *Rudbeckia laciniata* var. *laciniata* (cutleaf coneflower), *Solidago gigantea* (giant goldenrod), *Verbesina alternifolia* (wingstem)
Herb (field)	Graminoid	*Chasmanthium latifolium* (Indian woodoats), *Dichanthelium clandestinum* (deertongue)

Characteristic Species: *Amphicarpaea bracteata* (American hogpeanut), *Apios americana* (groundnut), *Elymus riparius* (riverbank wildrye), *Onoclea sensibilis* (sensitive fern), *Teucrium canadense* var. *canadense* (Canada germander).

Other Noteworthy Species:

Species	GRank	Type	Note
Carex emoryi (Emory's sedge)	-	plant	WV state-imperiled
Humulus japonicus (Japanese hop)	-	plant	exotic
Rosa multiflora (multiflora rose)	-	plant	exotic
Spiraea virginiana (Virginia meadowsweet)	G2	plant	Federally listed threatened
Urtica dioica ssp. *dioica* (stinging nettle)	-	plant	exotic

Subnational Distribution with Crosswalk Data:

State	SRank	Rel	Conf	SName	Reference
WV	SNR	=	1	[gname]	Vanderhorst et al. 2007

Local Range: This association is included as one of several within two natural/semi-natural map classes: the Floodplain Forest and Woodland and the Modified Successional Floodplain Forest and Woodland. A total of 73 polygons (138.45 ha) of the two map classes are mapped in the park. Only one accuracy assessment point in the Floodplain Forest and Woodland map class is attributed to this association, probably indicating low abundance and/or small patch size of the association in these map classes. Patches may also occur in the Disturbed Area map class (total

33 polygons, 25.3 ha). Known stands are scattered along the floodplain of the Bluestone River throughout its length in the park.

Classification Comments: At Bluestone, this association occurs adjacent to and is floristically similar to several natural and semi-natural floodplain forest associations. It is best characterized by combining an open canopy with deep alluvial sediments which promote rank growth of tall herbs adapted to full sunlight. Elsewhere, this association occurs adjacent to floodplain forest associations different from those at Bluestone; this supports its recognition as a distinct association rather than an ecotone.

Other Comments: Information not available.

Local Description Authors: J. P. Vanderhorst.

Plots: Seven plots were sampled: BLUE.86, BLUE.94, BLUE.96, BLUE.109, BLUE.114, BLUE.115, and BLUE.128.

Bluestone National Scenic River Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC 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	Temporarily flooded temperate perennial forb vegetation (V.B.2.N.d.)
Alliance	*Eupatorium* spp. - *Polygonum* spp. Temporarily Flooded Depositional Shore and Bar Herbaceous Alliance (A.3038)
Alliance (English name)	Thoroughwort species - Knotweed species Temporarily Flooded Depositional Shore and Bar Herbaceous Alliance
Association	*Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)* Herbaceous Vegetation
Association (English name)	Wingstem - Riverbank Wild Rye - Giant Goldenrod - (American Germander) Herbaceous Vegetation
Ecological System(s):	Central Appalachian Stream and Riparian (CES202.609). Central Appalachian River Floodplain (CES202.608).

GLOBAL DESCRIPTION

Concept Summary: This tall herb-dominated association is known from the shores of rivers and large streams in the Piedmont and mountain regions of Maryland, Virginia, and West Virginia. It occupies well-drained riverbanks and, less commonly, depositional bars or alluvial fans of medium-sized to large rivers that experience low rates of sediment erosion and turnover during small to moderate floods. Heavy annual deposits of alluvial sediments inhibit tree establishment. The type typically occurs as a narrow, linear strip along the outer edge of a floodplain forest. Occurrences have high solar exposure, though they may experience partial shading from adjacent (landward) forests. Vegetation is characterized by a dense growth of tall (1–3 m), light-demanding, native perennial herbs. The most characteristic species across the range are *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium clandestinum* (deertongue), *Verbesina alternifolia* (wingstem), *Elymus* (wildrye) spp. (*Elymus riparius* (riverbank wildrye), *Elymus canadensis* (Canada wildrye), *Elymus villosus* (hairy wildrye), *Elymus virginicus* (Virginia wildrye)), *Conoclinium coelestinum* (blue mistflower), several species of *Eupatorium* (thoroughwort) (*Eupatorium fistulosum* (trumpetweed), *Eupatorium perfoliatum* (common boneset), *Eupatorium serotinum* (lateflowering thoroughwort)), *Rudbeckia laciniata* (cutleaf coneflower), *Solidago gigantea* (giant goldenrod), *Calystegia sepium* (hedge

false bindweed), and *Verbena urticifolia* (white vervain). Along the Potomac in the Great Valley of Virginia downstream to the fall line, *Teucrium canadense* (Canada germander) and *Scrophularia marilandica* (carpenter's square) are also abundant; less abundant species include *Ageratina altissima* (white snakeroot), *Helianthus decapetalus* (thinleaf sunflower), *Oenothera biennis* (common evening-primrose), *Phytolacca americana* (American pokeweed), and *Monarda fistulosa* (wild bergamot).. Along the New and Bluestone rivers in West Virginia, additional characteristic species include *Amphicarpaea bracteata* (American hogpeanut), *Apios americana* (groundnut), *Helenium autumnale* (common sneezeweed), *Helianthus strumosus* (paleleaf woodland sunflower), *Heliopsis helianthoides* (smooth oxeye), *Packera aurea* (golden ragwort), *Phlox paniculata* (fall phlox), *Polygonum scandens* (climbing false buckwheat), *Polygonum virginianum* (jumpseed), *Senna hebecarpa* (American senna), *Solanum carolinense* (Carolina horsenettle), *Solidago canadensis* (Canada goldenrod), *Symphyotrichum lanceolatum* (white panicle aster), *Symphyotrichum lateriflorum* (calico aster), *Tradescantia ohiensis* (bluejacket), *Tripsacum dactyloides* (eastern gamagrass), *Verbesina occidentalis* (yellow crownbeard), and *Vernonia noveboracensis* (New York ironweed). Tall annual species characteristically dominant on less stabilized bars may be present but generally do not dominate. Woody vines are often common and include *Toxicodendron radicans* (eastern poison ivy), *Vitis riparia* (riverbank grape), and *Vitis vulpina* (frost grape). Scattered shrubby or occasionally full-sized trees of flood-tolerant species may occur, with *Acer saccharinum* (silver maple), *Platanus occidentalis* (American sycamore), *Fraxinus pennsylvanica* (green ash), *Betula nigra* (river birch), and *Acer negundo* (boxelder) the most frequent. *Lindera benzoin* (northern spicebush) may be present as a shrub. This type often has a number of invasive exotic weeds, including *Polygonum cuspidatum* (Japanese knotweed), *Polygonum perfoliatum* (Asiatic tearthumb), *Lolium arundinaceum* (tall fescue), *Phalaris arundinacea* (reed canarygrass), *Humulus japonicus* (Japanese hop), *Glechoma hederacea* (ground ivy), *Microstegium vimineum* (Nepalese browntop), and *Stellaria media* (common chickweed).

Environmental Description: This community occupies well-drained riverbanks and, less commonly, depositional bars of medium-sized to large rivers that experience low rates of sediment erosion and turnover during small to moderate floods. The type typically occurs as a narrow, linear strip along the outer edge of a floodplain forest, where heavy annual deposits of alluvial sediments inhibit tree establishment. Along the Potomac River in the Potomac River Gorge west of Washington, DC, habitats are inundated for 1–4% of the full year and are generally exposed for nearly all of the growing season in most years (Lea 2000). Hydrologic regime is best described as temporarily flooded. Substrates in the Potomac River Gorge are sandy loams or loamy sands (Lea 2000). Samples collected from 10 plots in the Potomac drainage had 100% total base saturation, high pH, and very high calcium levels. Along the New and Bluestone rivers, West Virginia, patches typically occur along slow, straight reaches of river with high banks, as well as on eroded alluvial fans at the mouths of small drainages. Soils are deep alluvial sands with little horizon development. Soils in seven plots along the Bluestone River are described as temporarily flooded, deep, moderately well-drained to well-drained, stone-free or slightly stony sand and loamy sand. They tested medium to slightly acidic (mean pH = 5.8) with relatively high levels of Ca, Cu, Mg, Mn, and Zn, and relatively low levels of organic matter, estimated N release, S, Al, B, Fe, K, Na, and P compared to average values in the area. Elevations range from near sea level on the Potomac River to 506 m on the Bluestone River.

Vegetation Description: This association represents vegetation consisting of a dense growth (90% cover) of tall (1–3 m), light-demanding, native perennial herbs. Scattered shrubby or occasionally full-sized trees of flood-tolerant species may occur, with *Acer saccharinum* (silver maple), *Platanus occidentalis* (American sycamore), *Betula nigra* (river birch), *Liriodendron tulipifera* (tuliptree), *Fraxinus pennsylvanica* (green ash), and *Acer negundo* (boxelder) the most frequent. Along the Potomac River in the Great Valley of Virginia downstream to the fall line, the most abundant herbs are *Verbesina alternifolia* (wingstem), *Teucrium canadense* (Canada germander), *Elymus riparius* (riverbank wildrye), *Verbena urticifolia* (white vervain), *Conoclinium coelestinum* (blue mistflower), several species of *Eupatorium* (thoroughwort) (*Eupatorium fistulosum* (trumpetweed), *Eupatorium perfoliatum* (common boneset), *Eupatorium serotinum* (lateflowering thoroughwort)), *Dichanthelium clandestinum* (deertongue), *Scrophularia marilandica* (carpenter's square), and *Chasmanthium latifolium* (Indian woodoats). Less abundant species include *Ageratina altissima* (white snakeroot), *Elymus villosus* (hairy wildrye), *Elymus virginicus* (Virginia wildrye), *Helianthus decapetalus* (thinleaf sunflower), *Oenothera biennis* (common evening-primrose), *Phytolacca americana* (American pokeweed), *Monarda fistulosa* (wild bergamot), *Rudbeckia laciniata* (cutleaf coneflower), *Calystegia sepium* (hedge false bindweed), and *Solidago gigantea* (giant goldenrod). Tall annual species characteristically dominant on less stabilized bars may be present but generally do not dominate. Woody vines are often common and include *Toxicodendron radicans* (eastern poison ivy), and *Vitis riparia* (riverbank grape). Along the New and Bluestone rivers in West Virginia, herbs with high constancy and/or cover include *Amphicarpaea bracteata* (American hogpeanut), *Apios americana* (groundnut), *Boehmeria cylindrica* (smallspike false nettle), *Chasmanthium latifolium* (Indian woodoats), *Conoclinium coelestinum* (blue mistflower), *Dichanthelium clandestinum* (deertongue), *Elymus canadensis* (Canada wildrye), *Elymus riparius* (riverbank wildrye), *Elymus virginicus* (Virginia wildrye), *Eupatorium fistulosum* (trumpetweed), *Eupatorium serotinum* (lateflowering thoroughwort), *Helenium autumnale* (common sneezeweed), *Helianthus strumosus* (paleleaf woodland sunflower), *Heliopsis helianthoides* (smooth oxeye), *Leersia virginica* (whitegrass), *Packera aurea* (golden ragwort), *Phlox paniculata* (fall phlox), *Polygonum scandens* (climbing false buckwheat), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (cutleaf coneflower), *Senna hebecarpa* (American senna), *Solanum carolinense* (Carolina horsenettle), *Solidago canadensis* (Canada goldenrod), *Solidago gigantea* (giant goldenrod), *Symphyotrichum lanceolatum* (white panicle aster), *Symphyotrichum lateriflorum* (calico aster), *Tradescantia ohiensis* (bluejacket), *Tripsacum dactyloides* (eastern gamagrass), *Verbena urticifolia* (white vervain), *Verbesina alternifolia* (wingstem), *Verbesina occidentalis* (yellow crownbeard), and *Vernonia noveboracensis* (New York ironweed). Vascular plant richness is generally high: in West Virginia plots, values range from 41–80 species per 400 square meters, averaging 44.6 (Vanderhorst et al. 2008). This type often has a number of invasive exotic weeds, including *Polygonum cuspidatum* (Japanese knotweed), *Polygonum perfoliatum* (Asiatic tearthumb), *Lolium arundinaceum* (tall fescue), *Phalaris arundinacea* (reed canarygrass), *Humulus japonicus* (Japanese hop), *Glechoma hederacea* (ground ivy), *Microstegium vimineum* (Nepalese browntop), *Urtica dioica* (stinging nettle), and *Stellaria media* (common chickweed). In some locations, nonnative species may out-compete the native herbs in this association and form large monospecific patches in floodplain openings, especially those affected by reservoir backup. On the Potomac River above the Great Valley, on the Monocacy River, and on smaller streams outside the Great Valley, several of the more characteristic species for the Shenandoah River, Antietam Creek, and the rest of the Potomac are

apparently rare or absent, particularly *Rudbeckia laciniata* (cutleaf coneflower) and *Solidago gigantea* (giant goldenrod). These differences may reflect the influence of more calcareous substrates and/or stream order on the communities. *Hasteola suaveolens* (false Indian plaintain), *Sida hermaphrodita* (Virginia fanpetals), *Iresine rhizomatosa* (Juda's bush), *Rumex altissimus* (pale dock), and *Ruellia strepens* (limestone wild petunia) are Maryland rare species known from this type.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Verbesina alternifolia* (wingstem)
Herb (field)	Graminoid	*Chasmanthium latifolium* (Indian woodoats), *Dichanthelium clandestinum* (deertongue)

Characteristic Species: *Chasmanthium latifolium* (Indian woodoats), *Dichanthelium clandestinum* (deertongue), *Elymus canadensis* (Canada wildrye), *Elymus riparius* (riverbank wildrye), *Elymus virginicus* (Virginia wildrye), *Eupatorium fistulosum* (trumpetweed), *Eupatorium serotinum* (lateflowering thoroughwort), *Helianthus strumosus* (paleleaf woodland sunflower), *Heliopsis helianthoides* (smooth oxeye), *Leersia virginica* (whitegrass), *Packera aurea* (golden ragwort), *Polygonum virginianum* (jumpseed), *Rudbeckia laciniata* (cutleaf coneflower), *Scrophularia marilandica* (carpenter's square), *Solanum carolinense* (Carolina horsenettle), *Solidago canadensis* (Canada goldenrod), *Solidago gigantea* (giant goldenrod), *Verbena urticifolia* (white vervain), *Verbesina alternifolia* (wingstem), *Vernonia noveboracensis* (New York ironweed).

Other Noteworthy Species:

Species	GRank	Type	Note
Carex emoryi (Emory's sedge)	-	plant	WV state-rare plant
Glechoma hederacea (ground ivy)	-	plant	exotic
Hasteola suaveolens (false Indian plaintain)	-	plant	MD state-rare plant
Humulus japonicus (Japanese hop)	-	plant	exotic
Iresine rhizomatosa (Juda's bush)	-	plant	MD state-rare plant
Lolium arundinaceum (tall fescue)	-	plant	exotic
Microstegium vimineum (Nepalese browntop)	-	plant	exotic
Polygonum cuspidatum (Japanese knotweed)	-	plant	exotic
Polygonum perfoliatum (Asiatic tearthumb)	-	plant	exotic
Ruellia strepens (limestone wild petunia)	-	plant	WV & MD state-rare plant
Rumex altissimus (pale dock)	-	plant	MD state-rare plant
Sida hermaphrodita (Virginia fanpetals)	G3	plant	WV & MD state-rare plant
Spiraea virginiana (Virginia meadowsweet)	G2	plant	Federally listed threatened
Stellaria media (common chickweed)	-	plant	exotic
Urtica dioica (stinging nettle)	-	plant	exotic

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This community is known from the shores of rivers and large streams in the Piedmont and mountain regions of Maryland, Virginia, and West Virginia. It has been documented by plots or observed on the Potomac, Shenandoah, New, Bluestone, and Monocacy rivers and Antietam Creek (Maryland). Small-stream analogues or variants have been observed on Fifteen Mile Creek (Maryland) and on the South Fork of Quantico Creek (Virginia). Potential habitat for this association is widespread, and the type is likely to have a wider geographic range than current documentation indicates.

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

Federal Lands: NPS (Antietam, Bluestone, C&O Canal, Harpers Ferry, New River Gorge, Prince William).

CONSERVATION STATUS

Rank: GNR (2-Aug-2006).

Reasons: More data on the global distribution are needed to determine a conservation rank for this community.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 - Strong.

Comments: The classification of this type was based, in part, on analysis of data from 10 plots collected during the National Capital Region Parks project, with an additional 10 plots from the New River Gorge and Bluestone River in West Virginia. Although some plots of this type performed convincingly as a discrete group in the National Capital Region analysis, others could not be separated from a group representing the Central Appalachian silver maple floodplain forest, with which this type frequently co-occurs. These results suggest that this type is weakly distinct floristically, sharing many species with the silver maple forest and varying from it along a gradual cline of (presumed) light exposure and increased stress from flooding near the channel. Because the type also tends to occur in small patches, it might, therefore, be considered an ecotonal expression of the silver maple forest. However, it also has similar classification issues with other floodplain forest and woodland types, and the distinctiveness of its physiognomy and habitat (open canopy which promotes rank growth of herbs adapted to full sunlight), its occurrence adjacent to various floodplain forest associations, as well as floristic similarity of stands across a broad range, and certain conservation issues supports its recognition.

Similar Associations:

Eupatorium serotinum - Polygonum (lapathifolium, punctatum, pensylvanicum) Herbaceous Vegetation (CEGL006481).

Related Concepts:

Rudbeckia laciniata - Solidago gigantea - Teucrium canadense Wooded Herbaceous Vegetation (Lea 2000) =

Verbesina alternifolia - Teucrium canadense - Verbena urticifolia - (Rudbeckia laciniata - Solidago gigantea) Wooded Herbaceous Vegetation (Lea 2003) =

SOURCES

Description Authors: C. Lea and G. P. Fleming, mod. S. C. Gawler.

References: Eastern Ecology Working Group n.d., Lea 2000, Lea 2003, Vanderhorst et al. 2007, Vanderhorst et al. 2008.

Plot BLUE.94. Riverbank Tall Herbs.

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

Abrams, M. D. 1992. Fire and the development of oak forests. BioScience 42(5):346–353.

Abrams, M. D., D. A. Orwig, and T. E. Demeo. 1995. Dendroecological analysis of successional dynamics for a presettlement-origin white-pine-mixed-oak forest in the Southern Appalachians, USA. Journal of Ecology 83(1):123–133.

Allard, D. J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office. Chapel Hill, NC. 96 pp.

Ambrose, J. 1990a. Georgia's natural communities—A preliminary list. Unpublished document. Georgia Natural Heritage Inventory. 5 pp.

Anderson, D. M. 1982. Plant communities of Ohio: A preliminary classification and description. Division of Natural Areas and Preserves, Ohio Department of Natural Resources. Columbus, OH. 182 pp.

Anderson, D. M. 1996. The vegetation of Ohio: Two centuries of change. Draft. Ohio Biological Survey.

Andreu, M. G., and M. L. Tukman. 1995. Forest communities of the Tellico Lake Area, East Tennessee . M.F. project report. Duke University, School of the Environment. Durham, NC. 66 pp. plus appendices.

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

Blair, W. F. 1938. Ecological relationships of the mammals of the Bird Creek region, northeastern Oklahoma. The American Midland Naturalist 20:473–526.

Blair, W. F., and T. H. Hubbell. 1938. The biotic districts of Oklahoma. The American Midland Naturalist 20:425–454.

Braun, E. L. 1950. Deciduous forests of eastern North America. Hafner Press. NY. 596 pp.

Braunschweig, S. H., E. T. Nilsen, and T. F. Wieboldt. 1999. The mid-Appalachian shale barrens. Pages 83–98 *in*: R. C. Anderson, J. S. Fralish, and J. M. Baskin. Savannas, barrens, and rock outcrop plant communities of North America. Cambridge University Press. NY.

Brooks, A. B. 1910. Forestry and Wood Industries, West Virginia. Volume 5. West Virginia Geological and Economic Survey. Acme Publishing Company. Morgantown, WV. 481 pp.

Bruner, W. E. 1931. The vegetation of Oklahoma. Ecological Monographs 1:99–188.

Burns, R. M., and B. H. Honkala, technical coordinators. 1990b. Silvics of North America. Volume 2: Hardwoods. Agriculture Handbook 654. USDA Forest Service. Washington, DC. 877 pp.

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

Campbell, J. J. N. 1988. Natural vegetation types. Pages 153–171 *in*: B. Palmer-Ball, Jr., J. N. N. Campbell, M. E. Medley, D. T. Towles, J. R. MacGregor, and R. R. Cicerello. Cooperative inventory of endangered, threatened, sensitive and rare species, Daniel Boone National Forest, Somerset Ranger District. USDA Forest Service. Winchester, KY.

Campbell, J. J. N. 1989a. Natural vegetation types. Pages 185–200 *in*: J. J. N. Campbell, D. T. Towles, J. R. MacGregor, R. R. Cicerello, B. Palmer-Ball, Jr., M. E. Medley, and S. Olson. Cooperative inventory of endangered, sensitive, and rare species, Daniel Boone National Forest, Stanton Ranger District. USDA Forest Service. Winchester, KY.

Campbell, Julian J. N. Personal communication. Kentucky Field Office. The Nature Conservancy.

Caplenor, D. 1965. The vegetation of the gorges of the Fall Creek Falls State Park in Tennessee. Journal of the Tennessee Academy of Science 40:27–39.

Clark, B. F., and J. G. Hutchinson, editors. 1994. Central hardwood notes. USDA Forest Service: Northeastern Area State and Private Forestry, Northeastern Forest Experiment Station, Southern Forest Experiment Station.

Clark, J. R., and J. Benforado, editors. 1980. Wetlands of bottomland hardwood forests: Proceedings of a Workshop on Bottomland Hardwood Forest Wetlands of the S.E. U.S. (1980: Lake Lanier, GA). Elsevier Scientific Publishing Company. Amsterdam. 1981.

Clark, J. S. 1986. Vegetation and land-use history of the William Floyd Estate, Fire Island National Seashore, Long Island, New York. USDI. National Park Service. North Atlantic Region. Office of Scientific Studies. 126 pp.

Collins, B. R., and K. H. Anderson. 1994. Plant communities of New Jersey. Rutgers University Press. New Brunswick, NJ. 287 pp.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe. Arlington, VA.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Service Program. FWS/OBS-79/31. Washington, DC. 103 pp.

Coxe, R. 2007. Guide to Delaware vegetation communities. Unpublished document. Delaware Natural Heritage Program. Smyrna.

Delcourt, H. R., and P. A. Delcourt. 1997. Pre-Columbian Native American use of fire on southern Appalachian landscapes. Conservation Biology 11(4):1010–1014.

Dickson, J. G., and C. A. Segelquist. 1978. Winter bird populations in pine and pine-hardwood forest stands in east Texas. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 31:134–137.

Duever, L. C., and S. Brinson. 1984a. Community element abstracts. Florida Game and Freshwater Fish Commission, Nongame Wildlife Program, Natural Areas Inventory. Tallahassee. 200 pp.

Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe. Boston, MA.

Ehrenfeld, J. G. 1977. Vegetation of Morristown National Historical Park: Ecological analysis and management alternatives. Final Report. USDI. National Park Service. Contract No. 1600-7-0004. 166 pp.

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

Evans, M. 1991. Kentucky ecological communities. Draft report to the Kentucky Nature Preserves Commission. 19 pp.

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

Faulkner, S. P., and W. H. Patrick, Jr. No date. Characterization of bottomland hardwood wetland transition zones in the lower Mississippi Valley. Unpublished document.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.

Fike, Jean. Personal communication. Ecologist. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA.

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

Fleming, G. P., A. Belden, Jr., K. E. Heffernan, A. C. Chazal, N. E. Van Alstine, and E. M. Butler. 2007. A natural heritage inventory of the rock outcrops of Shenandoah National Park. Unpublished report submitted to the National Park Service. Natural Heritage Technical Report 07-01. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond. 433 pp. plus appendixes.

Fleming, G. P., P. P. Coulling, D. P. Walton, K. M. McCoy, and M. R. Parrish. 2001. The natural communities of Virginia: Classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. Unpublished report. January 2001. 76 pp.

Fleming, G. P., P. P. Coulling, K. D. Patterson, and K. M. McCoy. 2004. The natural communities of Virginia: Classification of ecological community groups. Second approximation. Natural Heritage Technical Report 04-01. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. http://www.dcr.virginia.gov/dnh/ncintro.htm.

Fleming, G. P., and P. P. Coulling. 2001. Ecological communities of the George Washington and Jefferson national forests, Virginia. Preliminary classification and description of vegetation types. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA. 317 pp.

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

Flinchum, D. M. 1977. Lesser vegetation as indicators of varying moisture regimes in bottomland and swamp forests of northeastern North Carolina. Ph.D. dissertation. North Carolina State University. Raleigh. 105 pp.

Foti, T. 1994a. Natural communities of Arkansas (terrestrial and palustrine). Unpublished document. Arkansas Natural Heritage Commission. Little Rock. 2 pp.

Foti, T., M. Blaney, X. Li, and K. G. Smith. 1994. A classification system for the natural vegetation of Arkansas. Proceedings of the Arkansas Academy of Science 48:50–53.

Foti, T., compiler. 1994b. Natural vegetation classification system of Arkansas, draft five. Unpublished document. Arkansas Natural Heritage Commission. Little Rock. 8 pp.

Foti, Tom. Personal communication. Ecologist. Arkansas Natural Heritage Commission. Little Rock.

Fralish, J. S. 1987. Forest stand basal area and its relationship to individual soil and topographic factors in the Shawnee Hills. Transactions of the Illinois Academy of Science 80(3 and 4):183–194.

Fralish, J. S. 1988b. Predicting potential stand composition from site characteristics in the Shawnee Hills Forest of Illinois. The American Midland Naturalist 120(1):79–101.

Fralish, J. S., F. B. Crooks, J. L. Chambers, and F. M. Harty. 1991. Comparison of presettlement, second-growth and old-growth forest on six site types in the Illinois Shawnee Hills. The American Midland Naturalist 125:294–309.

Gaertner, F. 1955. Honeylocust (*Gleditsia triacanthos* L.) in field shelterbelts of western Oklahoma. Unpublished M.S. thesis. Oklahoma State University. Stillwater.

Gettman, R. W. 1974. A floristic survey of Sumter National Forest—The Andrew Pickens Division. M.S. thesis. Clemson University. Clemson, SC. 131 pp.

Greller, A. M. 1988. Deciduous forest. Pages 288–316 *in*: M. G. Barbour and W. D. Billings, editors. North American terrestrial vegetation. Cambridge University Press. NY.

Hall, R. L., and E. D. Mathews. 1974. Soil survey of Charles County, Maryland. U.S. Department of Agriculture Soil Conservation Service. Washington, DC.

Harrison, J. W., compiler. 2004. Classification of vegetation communities of Maryland: First iteration. A subset of the International Classification of Ecological Communities: Terrestrial Vegetation of the United States, NatureServe. Maryland Natural Heritage Program, Maryland Department of Natural Resources. Annapolis. 243 pp.

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

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

Illinois Nature Preserve Commission. 1973. Comprehensive plan for the Illinois nature preserves system, part 2: The natural divisions of Illinois. J. E. Schwegman, principal author. 32 pp.

Keener, C. S. 1970. The natural history of the mid- Appalachian shale barren flora. Pages 215–248 *in*: P. C. Holt, editor. The distributional history of the biota of the southern Appalachians. Part II. Research Divivision Monogram 2. Blacksburg, VA.

Klimas, C. V., C. O. Martin, and J. W. Teaford. 1981. Impacts of flooding regime modification on wildlife habitats of bottomland hardwood forests in the lower Mississippi. U.S. Army Corps of Engineers. Waterways Experimental Station and Environmental Lab. Technical Report EL-81-13. Vicksburg, MS. 137 pp. plus appendix.

Kuchler, A. W. 1964. Potential natural vegetation of the conterminous United States. American Geographic Society Special Publication 36. New York, NY. 116 pp.

Lea, C. 2000. Plant communities of the Potomac Gorge and their relationship to fluvial factors. M.S. thesis. George Mason University. Fairfax, VA. 219 pp.

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

Leahy, Mike. Personal communication. Missouri Natural Heritage Database, Missouri Department of Conservation. Jefferson City.

Martin, W. H. 1975. The Lilley Cornett Woods: A stable mixed mesophytic forest in Kentucky. Botanical Gazette 136:171–183.

Martin, W. H. 1989. Forest patterns in the Great Valley of Tennessee. Journal of the Tennessee Academy of Science 64:137–144.

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

McNab, W. H., and P. E. Avers, compilers. 1994. Ecological subregions of the United States: Section descriptions. USDA Forest Service. Administrative Publication WO-WSA-5. Washington, DC. 267 pp.

McWilliams, W. H., and J. F. Rosson, Jr. 1990. Composition and vulnerability of bottomland hardwood forests of the Coastal Plain province in the south central United States. Forest Ecology and Management 33/34:485–501.

Merz, R. W. 1958. Silvicultural characteristics of American sycamore. Central States Forest Experiment Station. Mississippi. USDA Forest Service Release 26.

Midwestern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe. Minneapolis, MN.

Miller, R. B., and L. R. Tehon. 1929. The native and naturalized trees of Illinois. Volume XVIII, Article I. State of Illinois Department of Registration and Education, Division of the Natural History Survey. Urbana. 339 pp.

Mitchem, D. O. 2004. Characterization of the vegetation and soils of the forest communities at Camp Brookside in Summers County, West Virginia. Major paper. Virginia Polytechnic Institute and State University. Blacksburg.

NRCS [Natural Resources Conservation Service]. 2004. Soil survey of Saratoga County, New York. USDA Natural Resources Conservation Service. 590 pp.

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

Nelson, J. B. 1986. The natural communities of South Carolina: Initial classification and description. South Carolina Wildlife and Marine Resources Department, Division of Wildlife and Freshwater Fisheries. Columbia, SC. 55 pp.

Nelson, P. W. 1985. The terrestrial natural communities of Missouri. Missouri Natural Areas Committee. Jefferson City. 197 pp. Revised edition. 1987.

Newell, C. L., and R. K. Peet. 1995. Vegetation of Linville Gorge Wilderness, North Carolina. Unpublished report. To USDA Forest Service. University of North Carolina. Department of Biology. Chapel Hill. 211 pp.

ONHD [Ohio Natural Heritage Database]. No date. Vegetation classification of Ohio and unpublished data. Ohio Natural Heritage Database. Division of Natural Areas and Preserves. Ohio Department of Natural Resources. Columbus.

Oberholster, C. 1993. Preliminary list of natural communities of Alabama. Unpublished document. Alabama Department Conservation and Natural Resources. Natural Heritage Section. Montgomery, AL. 6 pp.

Patterson, K. D. 1994. Classification of vegetation in Ellicott Rock Wilderness, Southeastern Blue Ridge Escarpment. M.S. thesis. North Carolina State University. Raleigh. 91 pp.

Patterson, K. D., C. J. Ulrey, and J. Drake. 1999. Vegetation classification of Great Smoky Mountains National Park: Cades Cove and Mount Le Conte quadrangles. Unpublished report submitted to BRD-NPS Vegetation Mapping Program. The Nature Conservancy. Chapel Hill, NC.

Patterson, K. D., D. J. Allard, and S. Landaal. 1994. Rare plant communities of the conterminous United States: Southeastern region. Pages 105–210 *in*: D. H. Grossman, K. Lemon Goodin, and C. L. Reuss, editors. Rare plant communities of the conterminous United States: An initial survey. The Nature Conservancy. Arlington, VA.

Patterson, W. B., and H. R. DeSelm. 1989. Classification of forest vegetation of the bottomlands of west Tennessee. University of Tennessee, Department of Biological Sciences, Knoxville, and Tennessee Department of Conservation, Ecological Services Division. Report for Contract No. 89-3347. Nashville. 151 pp.

Peet, R. K., T. R. Wentworth, M. P. Schafale, and A.S. Weakley. 2002. Unpublished data of the North Carolina Vegetation Survey. University of North Carolina. Chapel Hill.

Pell, W. F., and J. H. Rettig, compiler. 1983. Arkansas natural community abstracts. Arkansas Natural Heritage Commission. Little Rock. 37 pp.

Perez, John. Personal communication. Biologist. USDI National Park Service. Glen Jean, WV.

Perles, S. J., G. S. Podniesinski, E. Eastman, L. A. Sneddon, and S. C. Gawler. 2007. Classification and mapping of vegetation and fire fuel models at Delaware Water Gap National Recreation Area: Volume 2 of 2 -Appendix G. Technical Report NPS/NER/NRTR—2007/076. National Park Service. Philadelphia, PA.

Perles, Stephanie. Personal communication. Ecologist. Pennsylvania Natural Heritage Program (PNHP-East). Harrisburg.

Platt, R. B. 1951. An ecological study of the mid-Appalachian shale barrens and of the plants endemic to them. Ecological Monographs 23:339–358.

Podniesinski, G. S., S. J. Perles, W. A. Millinor, and L. A. Sneddon. 2006. Vegetation classification and mapping at Delaware Water Gap National Recreation Area. Technical Report NPS/NER/NRTR—XXXX/XXX. National Park Service. Philadelphia, PA.

Powell, J. W. 1985. Physiographic regions of the United States. National Geographic Society. Monograph 3. Pages 65–100.

Putnam, J. A. 1951. Management of bottomland hardwoods. USDA Forest Service. Southern Forest Experiment Station. Occasional Paper No. 116. New Orleans, LA.

Putnam, J. A., G. M. Furnival, and J. S. McKnight. 1960. Management and inventory of southern hardwoods. USDA Forest Service. Handbook 181. Washington, DC. 102 pp.

Pyne, M. 1994. Tennessee natural communities. Unpublished document. Tennessee Department of Conservation. Ecology Service Division. Nashville. 7 pp.

Quarterman, E., B. H. Turner, and T. E. Hemmerly. 1972. Analysis of virgin mixed mesophytic forests in Savage Gulf, Tennessee. Bulletin of the Torrey Botanical Club 99:228–232.

Rabie, P. A. 2000. Invasive nitrogen fixers. Restoration and Reclamation Review 6:6.3. http://horticulture.coafes.umn.edu/vd/h5015/rrr.htm.

Rawinski, T. J., K. N. Hickman, J. Waller-Eling, G. P. Fleming, C. S. Austin, S. D. Helmick, C. Huber, G. Kappesser, F. C. Huber, Jr., T. Bailey, and T. K. Collins. 1996. Plant communities and ecological land units of the Glenwood Ranger District, George Washington and Jefferson national forests, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 96-20. Richmond. 65 pp. plus appendices.

Rentch, J. S., R. H. Forney, S. L. Stephenson, H. S. Adams, W. N. Grafton, R. B. Coxe, and H. H. Mills. 2005. Vegetation patterns within the lower Bluestone River gorge in southern West Virginia. Castanea 70:170–183.

Rhoades, R. W. 1995. Succession in a mature oak forest in southwest Virginia. Castanea 60:98–106.

SAF (Society of American Foresters). 1967. Forest cover types of North America. Society of American Foresters. Washington, DC. 67 pp.

Schafale, M. 1998b. Fourth approximation guide. High mountain communities. March 1998 draft. North Carolina Natural Heritage Program. Raleigh.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina. Third approximation. North Carolina Department of Environment, Health, and Natural Resources. Division of Parks and Recreation. Natural Heritage Program. Raleigh. 325 pp.

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

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

Shreve, F., M. A. Chrysler, F. H. Blodgett, and F. W. Besley. 1910. The plant life of Maryland. Maryland Weather Service. Special Publication, Volume III. Johns Hopkins Press. Baltimore, MD.

Sneddon, L., and J. Lundgren. 2001. Vegetation classification of Fire Island National Seashore and William Floyd Estate. Final Draft. TNC/ABI Vegetation Mapping Program. 87 pp.

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

Sponaugle, K. N., D. E. McKinney, L. Wright, Jr., C. E. Nelson, R. E. Pyle, and C. L. Marra. 1984. Soil survey of Mercer and Summers counties, West Virginia. USDA Conservation Service. Washington, DC.

Suiter, D. W. 1995. The vascular flora, rare species and plant migrations of New River Gorge National River, West Virginia. Master's thesis. Marshal University. Huntington, WV. 174 pp.

TDNH (Tennessee Division of Natural Heritage). Unpublished data. Tennessee Division of Natural Heritage, 14th Floor, L&C Tower, 401 Church Street, Nashville, TN 37243-0447. 615-532-0431

TNC (The Nature Conservancy). 1985. Global Vertebrate Characterization Abstract Habitats. Unpublished document. The Nature Conservancy. Arlington, VA.

TNC (The Nature Conservancy). 1995a. A classification and description of plant communities in southern Illinois. Report by the Southern Illinois Field Office, Ullin, IL, and the Midwest Regional Office, Minneapolis, MN.

TNC (The Nature Conservancy). 1998c. Vegetation Classification of Rock Creek Park. Report for the NBS/NPS Vegetation Mapping Program. The Nature Conservancy. Boston. 50 pp.

Thornbury, W. D. 1965. Regional geomorphology of the United States. John Wiley and Sons, Inc. NY. 609 pp.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 1973. International classification and mapping of vegetation. Series 6, Ecology and Conservation. United Nations Educational, Scientific, and Cultural Organization. Paris. 93 pp.

VDNH (Virginia Division of Natural Heritage). 2003. The natural communities of Virginia: Hierarchical classification of community types. Unpublished document, working list of November 2003. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Ecology Group. Richmond.

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

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

Vanderhorst, J. 2001a. Plant community classification and mapping of the Camp Dawson Collective Training Area, Preston County, West Virginia. West Virginia Natural Heritage Program. West Virginia Division of Natural Resources. Elkins. 101 pp.

Vanderhorst, J. 2001b. Plant communities of the New River Gorge National River, West Virginia: Northern and southern thirds. Non-game Wildlife and Natural Heritage Program. West Virginia Division of Natural Resources. Elkins. 146 pp.

Vanderhorst, J. 2002a. Classification of West Virginia shale barrens. Draft report. West Virginia Natural Heritage Program. 13 pp.

Vanderhorst, J. P., B. P. Streets, J. Jeuck, and S. C. Gawler. 2008. Vegetation classification and mapping of Bluestone National Scenic River, West Virginia. Technical Report NPS/NER/NRTR-2008/106. National Park Service. Philadelphia, PA.

Vanderhorst, J. P., J. Jeuck, and S. C. Gawler. 2007. Vegetation classification and mapping of New River Gorge National River, West Virginia. Technical Report NPS/NER/NRTR-2007/092. USDI National Park Service. Philadelphia, PA.

Vanderhorst, J., and B. P. Streets. 2006. Vegetation classification and mapping of Camp Dawson Army Training Site, West Virginia: Second approximation. Natural Heritage Program. West Virginia Division of Natural Resources. Elkins. 83 pp.

Vanderhorst, Jim. Personal communication. Ecologist. West Virginia Natural Heritage Program. West Virginia Division of Natural Resources. Elkins, WV.

Voigt, J. W., and R. H. Mohlenbrock. 1964. Plant communities of southern Illinois. Southern Illinois University Press. Carbondale. 202 pp.

WVNHP (West Virginia Natural Heritage Program). No date. Unpublished data. West Virginia Natural Heritage Program. Elkins.

Wharton, C. H. 1978. The natural environments of Georgia. Georgia Department of Natural Resources. Atlanta. 227 pp.

Wharton, C. H., W. M. Kitchens, E. C. Pendleton, and T. W. Sipe. 1982. The ecology of bottomland hardwood swamps of the Southeast: A community profile. U.S. Fish and Wildlife Service. Office of Biological Services. FWS/OBS-81/37. Washington, DC.

White, J., and M. Madany. 1978. Classification of natural communities in Illinois. Pages 311–405 *in*: Natural Areas Inventory technical report: Volume I, survey methods and results. Illinois Natural Areas Inventory. Urbana, IL.

Windisch, A. G. 1993. Natural community inventory of Picatinny Arsenal, New Jersey. Unpublished report prepared for Picatinny Arsenal, U.S. Department of Defense. The Nature Conservancy. Eastern Heritage Task Force. Trenton, NJ.

Winstead, J. E., and K. A. Nicely. 1976. A preliminary study of a virgin forest tract of the Cumberland Plateau in Laurel County, Kentucky. Transactions of the Kentucky Academy of Science 37:29–32.

Wistendahl, W. A. 1980. River birch - sycamore. Pages 47 *in*: F. H. Eyre, editor. Forest cover types of the United States and Canada. Society of American Foresters. Washington, DC. 148 pp.

Wood, J. 1999. Final report: Hemlock ecosystem inventory and monitoring project of the New River Gorge National River and Gauley River National Recreation Area. Unpublished report prepared for USDI. National Park Service. Glen Jean, WV.

Woods, A. J., J. M. Omernik, W. H. Martin, G. J. Pond, W. M. Andrews, S. M. Call, J. A. Comstock, and D. D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey. Reston, VA. Map scale 1:1,000,000.

Young, J., G. Fleming, P. Townsend, and J. Foster. 2006. Vegetation of Shenandoah National Park in relation to environmental gradients. Final Report v.1.1. Research technical report prepared for USDI. National Park Service. USGS/NPS Vegetation Mapping Program. 92 pp. plus appendices.

Zollner, Douglas. Personal communication. Ecologist. The Nature Conservancy. Arkansas Field Office. Little Rock.

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