INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD:

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

Associations of Shenandoah National Park

21 December 2005

by

NatureServe

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

This subset of the International Ecological Classification Standard covers vegetation associations attributed to Shenandoah National Park. 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 Lesley A. Sneddon, Senior Regional Ecologist, Boston, MA <lesley_sneddon@natureserve.org>.

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NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 21 December 2005.

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These data are extracted from:

NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 21 December 2005.

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Common Name (Park-specific): Virginia Pine Successional Forest

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

LOCAL DESCRIPTION

Environmental Description: This type is a pioneering forest that invades dry, eroded, and/or depleted soils of abandoned fields and pastures. Most of these areas are underlain by the more base-rich metabasaltic and granitic rocks and are located both on broad crests and relatively gentle sideslopes. In the park and elsewhere on the northern Blue Ridge, Virginia pine forests are elevation-limited and generally occur only below 915 m (3000 feet) and most frequently below 610 m (2000 feet). Suitable old-field habitats for this community have decreased dramatically during the seven decades since the park was established.
Vegetation Description: Composition varies from nearly monospecific stands of *Pinus virginiana* to decadent stands in which *Pinus virginiana* is co-dominant with other pines and/or emergent hardwoods. *Pinus rigida* and *Pinus strobus* are associates in some stands. The most frequent hardwood associates appear to be *Quercus* spp., *Carya* spp., *Liriodendron tulipifera, Acer rubrum, Fraxinus americana*, and *Robinia pseudoacacia*. Characteristic understory species include *Sassafras albidum, Cornus florida, Parthenocissus quinquefolia, Rubus* spp., and *Smilax rotundifolia*. Both woody understory and herbaceous composition vary widely with site conditions and land-use history; herbs may be very sparse under dense pine canopies. Exotics, including *Lonicera japonica, Rosa multiflora, Celastrus orbiculatus, Alliaria petiolata, Microstegium vimineum*, and *Polygonum caespitosum var. longisetum*, may be rampant in some stands. Because *Pinus virginiana* is a short-lived, brittle tree, most contemporary stands in the park are highly decadent, susceptible to wind-throw and breakage and nearing complete replacement by hardwoods.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
Local Range: This community type occurs very locally in the park at low to middle elevations. Stands are widely scattered and have been documented in both the northern and southern districts.
Classification Comments: This type is the least common of the three early-successional communities defined for the park. It was not encountered during the field data collection phase of the project but is described from subsequent qualitative observations and NPS plot data that were used in accuracy assessment procedures.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: *Information not available.*
Shenandoah National Park 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 Mountain Pine Forest (CES202.332)

GLOBAL DESCRIPTION

Concept Summary: This community occurs in areas where canopy removal has created dry, open conditions and bare mineral soil, allowing for the establishment of *Pinus virginiana*. These habitats include old fields, old pastures, clearcuts, and burned or eroded areas. This forest typically has a very dense canopy of *Pinus virginiana* and little understory vegetation. The dense canopy may also include admixtures of other *Pinus* species (e.g., *Pinus taeda, Pinus echinata*) or other early successional deciduous trees (e.g., *Acer*

rubrum, Liquidambar styraciflua, Liriodendron tulipifera). 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*. 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* dominance were found on low slopes in areas that were cleared for agriculture prior to the 1970s, when Tellico Lake was created (Andreu and Tukman 1995). In the Central Appalachians, this vegetation occurs where soft shales have been farmed (primarily in valleys), resulting in stands with nothing but successional species in the understory. Soils underlying these communities are of two general types, i.e., those derived in residuum from calcareous shale and calcareous sandstone of the Middle Ordovician and those of some other origin. Series of the former type include Dandridge (Lithic Ruptic-Alfic Eutrochrepts), Tellico (Typic Rhododults), and Steekee (Ruptic-Ultic Dystrochrepts). Other soil series that this forest type may occur on include Litz, Dewey, Alcoa, Bland, Etowah, Lobdell and Neubert. All of these soils are well-drained and range in pH from moderate acid to very strongly acidic.

Vegetation Description: This forest typically has a very dense canopy of *Pinus virginiana* and little understory vegetation. *Pinus taeda* or *Pinus echinata* may co-occur with *Pinus virginiana* in the canopy. The canopy can also have significant admixtures of early successional deciduous trees (e.g., *Acer rubrum, Liquidambar styraciflua, Liriodendron tulipifera*). Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species. Shrub and herb strata are absent to sparse in coverage. In eastern Tennessee the subcanopy may contain *Acer saccharum* and *Cornus florida*; other associated species may include *Cercis canadensis, Parthenocissus quinquefolia, Lonicera japonica,* and *Microstegium vimineum* (Andreu and Tukman 1995). In the Central Appalachians, associates include *Pinus taeda, Pinus echinata*, and *Pinus rigida*. The dense ericaceous shrub stratum contains *Vaccinium* spp., *Gaylussacia* spp., *Kalmia latifolia*, and *Rhododendron* spp.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus virginiana*
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Cornus florida, Nyssa sylvatica, Oxydendrum arboreum*
Tall shrub/sapling	Broad-leaved deciduous tree	*Cornus florida, Nyssa sylvatica, Oxydendrum arboreum*
Tall shrub/sapling	Broad-leaved evergreen tree	*Vaccinium arboreum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium stamineum*
Short shrub/sapling	Broad-leaved deciduous tree	*Cercis canadensis, Cornus florida, Oxydendrum arboreum, Quercus alba, Sassafras albidum*
Herb (field)	Vine/Liana	*Lonicera japonica, Smilax glauca, Toxicodendron radicans*

Characteristic Species: *Information not available.*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

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

States/Provinces: AL, GA, IN, KY, MD, NC, NJ, PA, SC, TN, VA, WV

Federal Lands: NPS (Big South Fork, Blue Ridge Parkway?, Cumberland Gap, Gettysburg, Great Smoky Mountains, Kings Mountain, Lincoln Birthplace, Little River Canyon?, Mammoth Cave, Natchez Trace, Obed, Shenandoah, Shiloh); TVA (Tellico); USFS (Bankhead, Chattahoochee, Cherokee, Daniel Boone, George Washington, Jefferson, Sumter, Uwharrie?)

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 1 - Strong

Comments: Early successional *Pinus virginiana* 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:
- IA7c. Xeric Virginia Pine Ridge Forest (Allard 1990) B
- Unclassified Old-Field Successional Forest (Fleming and Moorhead 2000) ?
- Virginia Pine - Oak: 78 (Eyre 1980) B
- Virginia Pine, RV (Pyne 1994) B
- Virginia Pine: 79 (Eyre 1980) B Xeric Pine Forest (Ambrose 1990a) B

SOURCES

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

References: Allard 1990, Ambrose 1990a, Andreu and Tukman 1995, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Nelson 1986, Patterson et al. 1999, Pyne 1994, Schmalzer and DeSelm 1982, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data

Common Name (Park-specific): Central Appalachian High-Elevation Boulderfield Forest

SYNONYMS:

NVC English Name: Yellow Birch / American Mountain-ash - Mountain Maple / Appalachian Rockcap Fern Forest

NVC Scientific Name: *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest

NVC Identifier: CEGL008504

LOCAL DESCRIPTION

Environmental Description: See Global Environment. In Shenandoah National Park, this community occurs only on metabasalt (greenstone) and granitic boulderfields from about 975 to 1180 m (3200-3900 feet) elevation. Mean elevation of stands plot-sampled in the park is about 1070 m (3500 feet).

Vegetation Description: See Global Vegetation description.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer spicatum*, *Betula alleghaniensis*, *Dryopteris marginalis*, *Menziesia pilosa*, *Oclemena acuminata*, *Polypodium appalachianum*, *Prunus pensylvanica*, *Rubus idaeus* ssp. *strigosus*, *Sedum telephioides*, *Sorbus americana*

Other Noteworthy Species: *Information not available.*

Local Range: This very distinct type is restricted to high-elevation, mostly west- to north-facing boulderfields of both metabasalt and granitic rubble. The physiognomy is mostly that of a woodland. Large, outstanding examples occur on the north flanks of Hawksbill, Stony Man, and The Pinnacle.

Classification Comments: This type intergrades with the northern hardwood forest *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (CEGL008502), which occurs in the same elevation zone but occupies habitats with somewhat lower boulder cover and greater soil development.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP032, SHNP033, SHNP037, SHNP049.

Shenandoah National Park Inventory Notes: Represented by four plots from the park.

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	*Acer saccharum - Betula alleghaniensis - (Fagus grandifolia)* Forest Alliance (A.216)
Alliance (English name)	Sugar Maple - Yellow Birch - (American Beech) Forest Alliance
Association	*Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest
Association (English name)	Yellow Birch / American Mountain-ash - Mountain Maple / Appalachian Rockcap Fern Forest
Ecological System(s):	Central and Southern Appalachian Montane Oak Forest (CES202.596)

GLOBAL DESCRIPTION

Concept Summary: This community type is known from high elevations of the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains in Virginia and West Virginia. It occupies steep, boulder-strewn slopes at elevations from 1000 m (3300 feet) to over 1250 m (4100 feet). The type is most frequent and extensive on straight or concave, middle to upper slopes with northerly aspects, but is found occasionally on slopes with other aspects. Surface substrate is characterized by a surface cover of angular boulders weathered from granite, metabasalt (greenstone), quartzite, and sandstone. This vegetation type has a closed to open canopy overwhelmingly dominated by *Betula alleghaniensis*. The canopy trees are usually stunted and gnarled, exhibiting the effects of frequent ice and wind damage. Tree density is typically less than that of the surrounding forests. *Sorbus americana* and *Prunus pensylvanica* are minor canopy associates. Small tree and shrub densities are variable; *Sorbus americana* and *Acer spicatum* often have high cover in these layers. *Menziesia pilosa, Sambucus racemosa (= Sambucus pubens), Rubus idaeus ssp. strigosus*, and *Ribes cynosbati* are frequent shrubs. Herbaceous cover is often limited by the rocky substrate.

Environmental Description: This community occupies steep (up to 38 degrees), boulder-strewn slopes at elevations from 1000 m (3300 feet) to over 1250 m (4100 feet). Mean elevation of plot-sampled Virginia sites is 1119 m (3672 feet). The type is most frequent and extensive on straight or concave, middle to upper slopes with northerly aspects, but is found occasionally on slopes with other aspects. Surface substrate is characterized by surface cover >75% of angular boulders weathered from granite, metabasalt (greenstone), quartzite, and sandstone. Surface cover of bryophytes and lichens on rocks is typically >60%. Mineral soil samples could not be extracted from any of the Virginia plot-sampling sites. Surficial groundwater seepage is very rare in these habitats, although perched, subsurface groundwater may be present in some localities. Extreme winter temperatures, high winds, and ice storms are frequent, and strongly influence the physiognomy of forests on the boulderfields.

Vegetation Description: This vegetation type has a closed to open canopy overwhelmingly dominated by *Betula alleghaniensis*. The canopy trees are usually stunted and gnarled, exhibiting the effects of frequent ice and wind damage. Tree density is typically less than that of the surrounding forests. *Sorbus americana* and *Prunus pensylvanica* are minor canopy associates. Small tree and shrub densities are variable; *Sorbus americana* and *Acer spicatum* often have high cover in these layers. *Menziesia pilosa, Sambucus racemosa (= Sambucus pubens), Rubus idaeus ssp. strigosus*, and *Ribes cynosbati* are frequent shrubs. Herbaceous cover is often limited by the rocky substrate, but lithophytic species such as *Polypodium appalachianum* may abundantly cover mossy rock surfaces. Additional characteristic herbs include *Oclemena acuminata (= Aster acuminatus), Dryopteris marginalis, Hylotelephium telephioides (= Sedum telephioides), Carex brunnescens ssp. sphaerostachya, Carex aestivalis, Arisaema triphyllum, Dryopteris intermedia, Gymnocarpium appalachianum, Maianthemum canadense*, and *Polygonatum pubescens*. Mean species richness of plot-sampled stands is 17 taxa per 400 m2.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer spicatum*, *Betula alleghaniensis*, *Menziesia pilosa*, *Oclemena acuminata*, *Polypodium appalachianum*, *Rubus idaeus* ssp. *strigosus*, *Sorbus americana*

Other Noteworthy Species: *Gymnocarpium appalachianum*, *Plethodon shenandoah*

USFWS Wetland System:

DISTRIBUTION

Range: This community type is known from high elevations of the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains in Virginia and West Virginia.

States/Provinces: VA:S2, WV

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS

Rank: G2 (21-Jun-2001)

Reasons: This is a small-patch community type occupying very restricted habitats within a narrow geographic range. There are less than 20 known occurrences of the type in Virginia.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: On the landscape, *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (CEGL008504) grades into fully exposed, lichen-dominated boulderfields at one extreme, and into rocky northern hardwood, red oak, or cove forests at the other. It has not been formally documented from West Virginia but has been observed by Virginia DCR-DNH ecologists at several sites, including Reddish Knob and Panther Knob, Pendleton County, and Black Mountain, Pocahontas County. It is probably widely but locally distributed at high elevations throughout the extreme western Ridge and Valley and Allegheny Mountains of West Virginia.

Similar Associations:

- *Betula alleghaniensis / Ribes glandulosum / Polypodium appalachianum* Forest (CEGL006124)--has a number of typical southern Appalachian species and occupies more mesic boulderfields.

Related Concepts:

- *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (Fleming and Coulling 2001) =

SOURCES

Description Authors: G. Fleming

References: Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Fleming et al. 2004

Common Name (Park-specific): Central Appalachian Rich Cove Forest

SYNONYMS:

NVC English Name: Sugar Maple - White Ash - American Basswood - Tuliptree / Black Cohosh Forest

NVC Scientific Name: *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa*

Forest

NVC Identifier: CEGL006237

LOCAL DESCRIPTION

Environmental Description: Habitats supporting this community in Shenandoah National Park are located in the middle and upper part of the global elevation range, from about 640 to 1070 m (2100-3500 feet). All plot-sampled stands are located on sites underlain by Catoctin metabasalt (greenstone), although accuracy assessment data indicates that additional stands occur in areas underlain by pyroxene-rich rocks of the granitic complex. Habitats in the park are in bouldery ravines and concavities at middle and upper-slope topographic positions. Slope inclination averages 17 degrees, and aspects range from north-northwest to northeast. Soil samples collected from plots are extremely acidic but have moderately high calcium, magnesium, and manganese levels.

Vegetation Description: The overstory of most stands in the park tends to have mixed dominance by *Acer saccharum, Tilia americana, Fraxinus americana,* and *Quercus rubra,* varying occasionally to nearly pure stands of *Acer saccharum*. *Acer saccharum* is usually dominant in the subcanopy. *Liriodendron tulipifera* is an important overstory tree in some lower-elevation stands, while *Betula alleghaniensis* is important at higher elevations. Minor tree associates include *Carya cordiformis, Carya ovalis, Carya ovata, Betula lenta,* and *Prunus serotina var. serotina*. *Acer pensylvanicum* tends to be the most common understory species, with associates of *Hamamelis virginiana, Ostrya virginiana, Acer spicatum, Sambucus racemosa (= Sambucus pubens),* and *Prunus virginiana*. The herb layer is very lush and patch-dominated by forbs, primarily *Laportea canadensis, Impatiens pallida, Caulophyllum thalictroides,* and *Osmorhiza claytonii*. Other characteristic or locally abundant herbs include *Adiantum pedatum, Angelica triquinata, Aconitum reclinatum, Viola canadensis, Asarum canadense, Thalictrum coriaceum, Actaea racemosa (= Cimicifuga racemosa), Ageratina altissima, Galium triflorum, Hydrophyllum virginianum, Trillium grandiflorum,* and *Deparia acrostichoides*. *Alliaria petiolata* is a significant invasive herb that has high cover in some stands.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Acer saccharum, Aconitum reclinatum, Actaea racemosa, Ageratina altissima, Angelica triquinata, Asarum canadense, Betula alleghaniensis, Caulophyllum thalictroides, Fraxinus americana, Hydrophyllum virginianum, Impatiens pallida, Laportea canadensis, Osmorhiza claytonii, Tilia americana*

Other Noteworthy Species: *Information not available.*

Local Range: Sampled or documented in accuracy assessment primarily in coves of the central section of the park (on both flanks) and near Loft Mountain in the southern section; additional stands may occur in other areas. Occupies middle- to upper-slope ravines and northerly slopes (often very bouldery) underlain by metabasalt and base-rich granites from about 640 to 1070 m (2100-3500 feet).

Classification Comments: Compared to examples of this vegetation type found over most of the central Appalachians, many stands in Shenandoah National Park contain a component of higher elevation species such as *Betula alleghaniensis, Acer pensylvanicum,* and *Angelica triquinata*. Some stands also occur above the elevational limits of common, low-elevation components such as *Liriodendron tulipifera* and *Lindera benzoin*. Nevertheless, this community in the park may intergrade with a lower elevation rich cove forest, *Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana) / Actaea racemosa* Forest (CEGL007710), at intermediate elevations or along a seral gradient.

Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP014, SHNP016, SHNP020, SHNP026, SHNP031.
Shenandoah National Park Inventory Notes: Represented by five plots from the park.

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	*Acer saccharum - Fraxinus americana - Tilia americana* Forest Alliance (A.217)
Alliance (English name)	Sugar Maple - White Ash - American Basswood Forest Alliance
Association	*Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest
Association (English name)	Sugar Maple - White Ash - American Basswood - Tuliptree / Black Cohosh Forest
Ecological System(s):	Southern and Central Appalachian Cove Forest (CES202.373)

GLOBAL DESCRIPTION

Concept Summary: This is a rich mesic, deciduous forest of the High Alleghenies, Western Allegheny Plateau, and Central Appalachians south to the Cumberlands of eastern Kentucky. Stands occur in coves, slope bases, lower slopes, and moderate slopes. Soils are typically deep, fertile, moderately to well-drained and are often derived from calcareous parent materials, with textures including sands, loams, and silt loams. The canopy is dominated by *Acer saccharum* with *Fraxinus americana, Liriodendron tulipifera*, and *Tilia americana* being very characteristic. Associated canopy trees include *Quercus rubra, Ostrya virginiana, Ulmus rubra, Acer rubrum, Betula alleghaniensis, Betula lenta, Fagus grandifolia, Juglans nigra, Carya cordiformis*, and *Prunus serotina*. The shrub layer is of variable composition, characterized by *Cornus alternifolia, Hamamelis virginiana, Lindera benzoin, Asimina triloba, Lonicera canadensis, Rhododendron periclymenoides (= Rhododendron nudiflorum)*, and *Viburnum acerifolium*. The herb layer is diverse and made up of *Adiantum pedatum, Asarum canadense, Actaea racemosa (= Cimicifuga racemosa), Cardamine* spp. (= *Dentaria* spp.), *Hepatica nobilis var. obtusa (= Hepatica americana), Hydrophyllum virginianum, Elymus hystrix (= Hystrix patula), Osmorhiza* spp., *Trillium grandiflorum, Viola* spp., *Dryopteris marginalis, Botrychium virginianum, Anemone quinquefolia, Geranium maculatum, Caulophyllum thalictroides, Sanguinaria canadensis, Claytonia virginica, Allium tricoccum, Cardamine concatenata, Arisaema triphyllum*, and *Laportea canadensis*.
Environmental Description: This community type occupies cool (northwest- to east-facing), mesic, lower to middle slopes, ravines, and coves at elevations from 425 to about 1050 m (1400-3450 feet). Sites may be underlain by a number of bedrock types, including limestone, dolomite, metabasalt (greenstone), granitic rocks, and sandstone. Slopes are typically steep (mean in plots = 23 degrees) and concave in at least one direction. Soils are deep, dark, and fertile, although frequently stony or bouldery. Samples collected from plots range from very strongly acidic to circumneutral (pH range = 4.2-6.8, mean pH = 5.3) but consistently have high calcium levels (mean = 1978 ppm) and moderately high magnesium and manganese levels.
Vegetation Description: The canopy is dominated by *Acer saccharum* with *Fraxinus americana* and *Tilia americana* being very characteristic. Associated canopy trees include *Quercus rubra, Ostrya virginiana, Ulmus rubra, Acer rubrum, Betula alleghaniensis, Betula lenta, Fagus grandifolia, Juglans nigra, Liriodendron tulipifera, Magnolia acuminata, Carya cordiformis*, and *Prunus serotina*. The shrub layer is of variable composition, characterized by *Cornus alternifolia, Hamamelis virginiana, Lindera benzoin, Asimina triloba, Lonicera canadensis, Rhododendron periclymenoides*, and *Viburnum acerifolium*. The herb layer is diverse and made up of *Adiantum pedatum, Asarum canadense, Actaea racemosa, Cardamine* spp., *Hepatica nobilis var. obtusa, Hydrophyllum virginianum, Elymus hystrix, Osmorhiza* spp., *Trillium grandiflorum, Viola* spp., *Dryopteris marginalis, Botrychium virginianum, Anemone quinquefolia, Geranium maculatum, Caulophyllum thalictroides, Sanguinaria canadensis, Claytonia virginica, Allium tricoccum, Cardamine concatenata, Arisaema triphyllum*, and *Laportea canadensis*. More eastern stands in Kentucky contain *Aesculus flava, Aesculus glabra*, or *Tilia americana var. heterophylla* (Campbell 2001). In 15 plot-sampled Virginia stands, *Acer saccharum* and *Tilia americana* (including both *var. americana* and *var. heterophylla*) are consistently the most important canopy trees in mixed stands with *Fraxinus americana, Carya cordiformis, Quercus rubra*, and *Liriodendron tulipifera* (lower elevations only). Minor canopy associates vary with site conditions and geography. South of the James River, *Aesculus flava* is an occasional canopy tree. On higher and cooler sites, *Betula lenta, Fagus grandifolia*, and *Tsuga canadensis* may be present. *Juglans nigra* and *Ulmus rubra* occur occasionally at lower elevations. Understory layers usually contain a good representation of the canopy species, particularly *Acer saccharum*. The shrub layer is typically sparse to absent and no shrub species attained a constancy >47% or mean cover >5% in plots. The herb layer is lush and often exhibits patch dominance by a small number of species, particularly the spring-flowering forbs *Caulophyllum thalictroides* and *Osmorhiza claytonii*. Other characteristic aestival herbs include *Arisaema triphyllum, Asarum canadense, Dicentra* spp., *Galearis spectabilis, Hydrophyllum virginianum, Maianthemum racemosum, Podophyllum peltatum, Prosartes lanuginosa (= Disporum lanuginosum), Sanguinaria canadensis, Trillium grandiflorum, Uvularia grandiflora,*

and *Viola canadensis*. The summer aspect is often dominated by large colonies of *Actaea racemosa, Impatiens pallida,* and/or *Laportea canadensis.* Species richness of plot-sampled stands ranges from 27 to 62 taxa per 400 square meters (mean = 41).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer saccharum, Actaea racemosa, Asarum canadense, Carya cordiformis, Caulophyllum thalictroides, Dicentra cucullaria, Fraxinus americana, Hydrophyllum virginianum, Impatiens pallida, Laportea canadensis, Lindera benzoin, Liriodendron tulipifera, Osmorhiza claytonii, Sanicula trifoliata, Tilia americana, Uvularia grandiflora, Viola canadensis*

Other Noteworthy Species: *Aconitum reclinatum*

USFWS Wetland System:

DISTRIBUTION

Range: This forest is found in the High Alleghenies, Western Allegheny Plateau, Central Appalachians, and Cumberlands from New York and New Jersey south to West Virginia, Virginia, and eastern Kentucky.

States/Provinces: KY, MD, NJ, NY, OH?, PA, VA, WV

Federal Lands: NPS (Blue Ridge Parkway, Fort Necessity, Shenandoah); USFS (Daniel Boone, George Washington, Jefferson)

CONSERVATION STATUS

Rank: G4? (28-Sep-2001)

Reasons: This unit has a fairly wide geographic range, within which it is regularly distributed as a small- to large-patch vegetation type in suitably fertile habitats. Because of excellent site conditions for tree growth, stands are very vulnerable to logging and are further threatened by shade-tolerant exotic weeds.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Despite considerable compositional variation, this unit appears to be a widespread and robust vegetation type. Damman and Kershner (1977) describe similar vegetation from gneissic areas of western Connecticut, with key species including *Acer saccharum, Tilia americana, Fraxinus americana, Liriodendron tulipifera, Lindera benzoin, Carpinus caroliniana, Ulmus rubra, Carya cordiformis, Osmorhiza claytonii, Asarum canadense, Caulophyllum thalictroides, Hepatica nobilis var. obtusa (= Hepatica americana), Galearis spectabilis, Viola pubescens,* and *Deparia acrostichoides*. The Sugar Maple - Basswood - Tulip Poplar Community described by Martin (1975) from southeastern Kentucky, and the *Acer saccharum - Liriodendron tulipifera - Fraxinus americana* Community described by Andreu and Tuckman (1995) from the Tellico Lake area of eastern Tennessee are similar, but not fully comparable because only woody vegetation was analyzed in these studies.

In extreme southwestern Virginia, this community type is gradational to *Aesculus flava - Acer saccharum - (Fraxinus americana, Tilia americana var. heterophylla) / Hydrophyllum canadense - Solidago flexicaulis* Forest (CEGL007695) of high-elevation coves in the Southern Appalachians. However, CEGL006237 may be distinguished by generally occurring at much lower elevations, having lower species richness, and lacking (or nearly lacking) a number of primarily southern species prominent in CEGL007695, including *Actaea podocarpa, Aesculus flava, Hydrophyllum canadense, Phacelia fimbriata, Phlox stolonifera, Sanicula odorata, Stachys nuttallii,* and *Trillium sulcatum.* A few occurring frequently in CEGL006237 (especially its high-elevation subtype), including *Aconitum reclinatum, Betula alleghaniensis, Piptatherum racemosum,* and *Sanicula trifoliata,* are absent or uncommon in CEGL007695.

The exotic weed *Alliaria petiolata* is a rampant invader of some stands of this vegetation on the Northern Blue Ridge.

Similar Associations:

- *Acer saccharum - Liriodendron tulipifera - Fraxinus americana / Staphylea trifolia* Forest (CEGL006201)
- *Aesculus flava - Acer saccharum - (Fraxinus americana, Tilia americana* var. *heterophylla) / Hydrophyllum canadense - Solidago flexicaulis* Forest (CEGL007695)

Related Concepts:

- *Acer saccharum - Betula alleghaniensis / Acer pensylvanicum / Laportea canadensis - Angelica triquinata* Forest (Fleming and Coulling 2001) ?
- *Acer saccharum - Tilia americana / Caulophyllum thalictroides - Laportea canadensis - Osmorhiza claytonii* Forest (Fleming and Coulling 2001) ?
- *Acer saccharum - Tilia americana / Laportea canadensis - Caulophyllum thalictroides - Deparia acrostichoides* Forest (Coulling and Rawinski 1999) ?
- *Acer saccharum var. saccharum - Tilia americana / Laportea canadensis - Caulophyllum thalictroides - Trillium grandiflorum* Forest (type 1.3) (Fleming 1999) ?
- *Liriodendron tulipifera - Acer saccharum - Tilia americana / Laportea canadensis - Impatiens pallida* Association, *pro parte* (Rawinski et al. 1996) ?
- Sugar Maple - Basswood: 26 (Eyre 1980) B

- Sugar maple-white ash-basswood cove forest (matrix/large patch) (CAP pers. comm. 1998) ?

SOURCES

Description Authors: G. Fleming and P. Coulling
References: Anderson et al. 1998, Breden et al. 2001, CAP pers. comm. 1998, Campbell 2001, Coulling and Rawinski 1999, Damman and Kershner 1977, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fike 1999, Fleming 1999, Fleming and Coulling 2001, Fleming et al. 2001, Lundgren 2000, Martin 1975, Rawinski et al. 1996

Common Name (Park-specific): Northern Hardpan Basic Oak - Hickory Forest

SYNONYMS:

NVC English Name: White Oak - Pignut Hickory - White Ash / Redbud / Rock Muhly - Bottlebrush Grass Forest
NVC Scientific Name: *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest
NVC Identifier: CEGL006216

LOCAL DESCRIPTION

Environmental Description: The type is known in Shenandoah National Park only from gently sloping to sublevel, upper-slope benches on Dickey Ridge at the north end of the park. Geologic substrate is metabasalt of the Catoctin Formation. Sites are southeast- to west-facing at elevations between 550 and 690 m (1820-2250 feet) and were subjectively assessed as subxeric to submesic. Slopes are generally convex in at least one direction, and surface cover of boulders and stones averages 17%. Soils appear to be relatively shallow over horizontally bedded metabasalt. Soil samples collected from three plot samples were moderately acidic (mean pH = 6.0) with high calcium, magnesium, manganese, and total base saturation levels.
Vegetation Description: *Carya ovalis, Quercus prinus, Quercus alba, Fraxinus americana,* and *Quercus rubra* are the most important overstory trees in Shenandoah National Park stands. Minor overstory associates include *Carya glabra, Carya alba, Quercus velutina, Ulmus rubra, Juglans nigra,* and *Prunus serotina*. *Carya* spp., *Fraxinus americana,* and *Ulmus rubra* comprise much of the understory. *Cercis canadensis* and/or *Ostrya virginiana* dominate the shrub layer. The herb layer is patchy but diverse, with the following grasses prominent in dominance patches: *Elymus hystrix var. hystrix, Muhlenbergia sobolifera, Dichanthelium boscii,* and *Brachyelytrum erectum*. *Bromus pubescens* and *Festuca subverticillata* may also be locally common. Many low-cover forbs also co-occur; some of the most characteristic include *Amphicarpaea bracteata, Galium circaezans, Geum virginianum, Hackelia virginiana, Helianthus divaricatus, Osmorhiza longistylis, Phryma leptostachya, Polygonum scandens var. cristatum, Scutellaria elliptica, Solidago caesia, Solidago ulmifolia var. ulmifolia, Uvularia perfoliata,* and *Viola triloba var. triloba*. Mean species richness of three plot samples was 68 species per 400 square meters, considerably lower than that of all Virginia plots sampled.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
Local Range: Known occurrences of this association in Shenandoah National Park are restricted to local areas on the upper slopes of Dickey Ridge. The type could potentially occur in similar habitats over metabasalt at low elevations elsewhere in the park. Regardless of its overall distribution, this forest is at the western edge of its geographic range and is almost certainly a localized, small-patch community in the park.
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP101, SHNP102, SHNP103.
Shenandoah National Park Inventory Notes: Represented by three plots from the park.

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	*Carya (glabra, ovata) - Fraxinus americana - Quercus (alba, rubra)* Forest Alliance (A.258)

Alliance (English name)	(Pignut Hickory, Shagbark Hickory) - White Ash - (White Oak, Northern Red Oak) Forest Alliance
Association	*Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest
Association (English name)	White Oak - Pignut Hickory - White Ash / Redbud / Rock Muhly - Bottlebrush Grass Forest

Ecological System(s):

GLOBAL DESCRIPTION

Concept Summary: Found in the Triassic Basin and western Piedmont foothills of Virginia and Maryland, this subxeric to submesic oak-hickory forest occurs in association with soils weathered from fine-grained mafic rocks (diabase and metabasalt). These soils often have a plastic, hardpan subsoil or are shallow over bedrock, and some have pronounced shrink-swell properties. Forest canopies can be open to closed, sometimes stunted, with variable combinations of oaks (especially *Quercus alba* and *Quercus rubra)*, hickories (*Carya glabra, Carya ovalis, Carya alba),* and *Fraxinus americana*. Subcanopy tree layers are usually dominated by young hickories and *Fraxinus americana*. Characteristic species in the shrub and small-tree layers are *Cercis canadensis var. canadensis, Juniperus virginiana var. virginiana, Cornus florida, Ulmus rubra, Celtis occidentalis,* and *Rosa carolina*. Less constant, but sometimes locally important, understory species include *Ostrya virginiana, Carpinus caroliniana* (on more mesic sites), and *Chionanthus virginicus*. The herb layer of this community is frequently characterized by patch-dominance of the dry-site forest grasses *Muhlenbergia sobolifera, Dichanthelium boscii, Elymus hystrix var. hystrix,* and *Danthonia spicata*. Co-occurring among the dominant grasses are a large number of low-cover forbs and graminoids. In 50 Virginia plot samples, this unit has a mean species richness of 82 taxa per 400 square meters, one of the highest among all classified upland types in Virginia. This community is distinguished from other Mid-Atlantic region oak-hickory forests by its patch-dominance of forest grasses and its strong association with sub-level topography and soils with an impermeable hardpan or shallow bedrock.

Environmental Description: In the main, Piedmont portion of its range, this oak-hickory forest community occurs primarily on soils weathered from Triassic diabase but occasionally on soils weathered from siltstone. Outlying occurrences on western Piedmont foothills and the Blue Ridge are associated with metabasalt of the Catoctin Formation. Large stands occupy low, gentle ridges and rolling to flat uplands (mean slope = 4 degrees) of the Mesozoic Basin. In submontane, foothill settings, stands are usually confined to relatively gentle slope benches with shallow underlying bedrock. Fifty plot-sampled sites in Virginia ranged from subxeric to submesic. Surface substrate of most sites consisted of thin leaf litter, with small patches of bare mineral soil exposed in places. Many plots had at least 1% surface cover of spheroidal diabase or metabasalt boulders or stones, and a few were extremely rocky. Soils collected from plots are very strongly to moderately acidic clay loams with moderately high calcium and magnesium, and very high manganese levels. Most soils occupied by this community have a plastic, hardpan subsoil or are shallow over bedrock, and some have pronounced shrink-swell properties.

Vegetation Description: Vegetation of this unit is an open- to closed-canopy, mixed hardwood forest dominated by oaks, hickories, and white ash. Stands over hardpans or shallow soils over bedrock have a somewhat stunted canopy. *Quercus alba, Quercus rubra, Carya glabra, Carya ovalis, Carya alba,* and *Fraxinus americana* are the leading overstory dominants in variable combinations. *Quercus velutina, Quercus stellata, Quercus prinus, Ulmus rubra,* and *Juglans nigra* are occasional overstory associates.

Subcanopy tree layers are usually dominated by young hickories and *Fraxinus americana*. Characteristic species in the shrub and small-tree layers are *Cercis canadensis var. canadensis* (dominant with up to 850 stems/ha in some areas), *Juniperus virginiana var. virginiana, Cornus florida, Ulmus rubra, Celtis occidentalis,* and *Rosa carolina*. Less constant, but sometimes locally important, understory species include *Ostrya virginiana, Carpinus caroliniana* (on more mesic sites), and *Chionanthus virginicus*. The herb layer of this community is frequently characterized by patch-dominance of the dry-site forest grasses *Muhlenbergia sobolifera, Dichanthelium boscii, Elymus hystrix var. hystrix,* and *Danthonia spicata*. Co-occurring among the dominant grasses are a large number of low-cover forbs and graminoids, among the most characteristic of which are *Agrimonia rostellata, Amphicarpaea bracteata, Aristolochia serpentaria, Bromus pubescens, Carex hirsutella (= Carex complanata var. hirsuta), Carex digitalis, Desmodium nudiflorum, Festuca subverticillata, Galium circaezans, Geum virginianum, Houstonia purpurea var. purpurea, Maianthemum racemosum ssp. racemosum, Phryma leptostachya, Polygonatum biflorum, Sanicula canadensis, Scutellaria elliptica, Solidago caesia, Solidago ulmifolia var. ulmifolia, Thalictrum thalictroides, Uvularia perfoliata,* and *Viola triloba var. triloba* (all of these with constancy in 50 plots). Less constant species that are nevertheless locally abundant or characteristic include *Antennaria plantaginifolia* (2 vars.), *Brachyelytrum erectum, Carex albicans var. australis, Carex pensylvanica, Carex planispicata, Clematis ochroleuca, Dichanthelium linearifolium, Galium concinnum, Helianthus divaricatus, Melica mutica, Piptochaetium avenaceum,* and *Pycnanthemum incanum*. Patches of exposed mineral soil around tree bases are frequently occupied by a suite of diminutive annuals including *Acalypha virginica, Hedeoma pulegioides,* and *Paronychia canadensis*. Many additional species occur at low cover and/or constancy. In 50 Virginia plot samples, this unit has a mean species richness of 82 taxa per 400 square meters, one of the highest among all classified upland types in Virginia. Additionally, a plot of this vegetation containing 125 taxa represents the most species-rich upland sample among >3300 plots in the VDNH database.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Carya ovalis, Cercis canadensis, Dichanthelium boscii, Elymus hystrix, Fraxinus americana, Muhlenbergia sobolifera, Ostrya virginiana, Quercus alba, Quercus prinus, Ulmus rubra*

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

DISTRIBUTION
Range: This association is widespread in the northern Virginia Mesozoic (Culpeper) Basin and locally in the extension of that basin in Montgomery County, Maryland. Small patches also occur on western Piedmont foothills and low elevations of the Blue Ridge in Virginia and possibly Maryland. The global range of this community needs further investigation and may include parts of the Frederick Basin in Maryland, local areas around Gettysburg, Pennsylvania, and possibly other Mesozoic basins north to New Jersey or lower New England.
States/Provinces: MD, PA?, VA:S3
Federal Lands: NPS (Catoctin Mountain?, Manassas, Monocacy?, Shenandoah)

CONSERVATION STATUS
Rank: G3 (5-Aug-2004)
Reasons: The known distribution of this type is confined to a six-county area in northern Virginia and adjacent Maryland. Moreover, the environmental conditions under which it occurs are naturally uncommon to rare in the Mid-Atlantic region. Although it may locally form sizeable patches in the northern Virginia Culpeper Basin, many stands have been destroyed by suburban development and virtually all stands have been impacted by timber removal and other anthropogenic disturbances.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 1 - Strong
Comments: This vegetation type has been well-documented by 50 plot samples in Virginia and has been observed in a large diabase sill near Boyds, Montgomery County, Maryland. Similar vegetation also occurs on metabasalt at low elevations of Catoctin Mountain, Maryland. It is generally distinguished from other Mid-Atlantic region oak-hickory forests by its patch-dominance of forest grasses and its strong association with sub-level topography and soils with an impermeable hardpan or shallow bedrock. This unit is largely confined to Piedmont soils weathered from fine-grained mafic rocks (diabase and metabasalt). *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683) occurs in small patches around mafic outcrops on the northern Blue Ridge and Piedmont, is a true woodland with a stunted and less diverse tree layer that usually lacks a significant oak component, is also largely montane in distribution, almost always associated with abundant surface rock cover, and has a larger suite of montane and light-demanding shrubs and herbs that are rarely or never found in this association (CEGL006216).
Similar Associations:
- *Carya glabra - Quercus (rubra, prinus) - Fraxinus americana / Viburnum rafinesquianum / Melica mutica* Forest (CEGL006209)
- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683)
- *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest (CEGL008516)
- *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest (CEGL008514)

Related Concepts:

SOURCES
Description Authors: G. Fleming
References: Eastern Ecology Working Group n.d., Fleming et al. 2004

Common Name (Park-specific): Central Appalachian Montane Oak - Hickory Forest (Acidic Type)

SYNONYMS:
NVC English Name: Rock Chestnut Oak - Northern Red Oak - Red Hickory / (Elmleaf Goldenrod, Atlantic Goldenrod) - Purple

Bedstraw Forest

NVC Scientific Name: *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest

NVC Identifier: CEGL008516

LOCAL DESCRIPTION
Environmental Description: See Global Environment.
Vegetation Description: See Global Vegetation.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Carya ovalis, Galium latifolium, Helianthus divaricatus, Houstonia longifolia, Ostrya virginiana, Penstemon canescens, Quercus prinus, Quercus rubra, Scrophularia lanceolata, Solidago arguta, Solidago ulmifolia, Vaccinium stamineum*

Other Noteworthy Species: *Information not available.*

Local Range: This forest community is widely but patchily distributed on the metasedimentary (Chilhowee Group) ridges in the southern section of the park and occasionally on metabasalt elsewhere.

Classification Comments: This association is similar to both *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest (CEGL008514) and *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216), which occur at lower elevations on Catoctin metabasalt. It can be distinguished floristically by the absence of *Cercis canadensis* and the presence of montane species lacking or unimportant in CEGL008514 and CEGL006216, including *Eurybia macrophylla (= Aster macrophyllus), Solidago arguta var. arguta, Scrophularia lanceolata, Spiraea betulifolia var. corymbosa*, and *Thalictrum coriaceum*.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP047, SHNP081, SHNP092, SHNP094, SHNP096, SHNP124, SHNP125, SHNP126, SHNP127, SHNP128, SHNP130, SHNP133.

Shenandoah National Park Inventory Notes: Represented by 12 plots from the park.

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	*Carya (glabra, ovata) - Fraxinus americana - Quercus (alba, rubra)* Forest Alliance (A.258)
Alliance (English name)	(Pignut Hickory, Shagbark Hickory) - White Ash - (White Oak, Northern Red Oak) Forest Alliance
Association	*Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest
Association (English name)	Rock Chestnut Oak - Northern Red Oak - Red Hickory / (Elmleaf Goldenrod, Atlantic Goldenrod) - Purple Bedstraw Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This community type is currently known from scattered locations on the northern Virginia Blue Ridge. Occurrences on the Maryland Blue Ridge and in the Ridge and Valley of Virginia, West Virginia, and Maryland are possible. Optimal sites are middle-elevation mountain slopes and summits underlain by metasiltstone and phyllite of the Harper's Formation. Elevation ranges from 390-995 m (1280-3260 feet), but the type is most common between 700 and 900 m (2400-3000 feet). A few sites occur over Catoctin metabasalt. The type usually occupies middle to upper slopes and narrow ridge crests. The moisture potential of plot-sampling sites was assessed as submesic or subxeric. Slopes vary from steep to sublevel, with aspects ranging from northeast to west. This association has an open, mixed canopy dominated by several oaks and hickories. Trees tend to be slightly stunted (often <20 m tall) on the drier and more exposed sites. *Quercus prinus* and *Carya ovalis* are the most abundant canopy species, but *Quercus rubra* is a constant, sometimes co-dominant associate. *Carya ovata, Carya glabra*, and *Quercus alba* each attain co-dominance in a subset of stands. *Fraxinus americana* and *Quercus velutina* are minor overstory associates. Understory layers tend to be open or sparse with scattered *Ostrya virginiana, Crataegus flabellata*, and tree saplings. *Vaccinium stamineum, Vaccinium pallidum, Rosa carolina*, and *Spiraea betulifolia var. corymbosa* commonly form a patchy low-shrub layer. The herb layer is open but moderately diverse with drought-tolerant graminoids and forbs.

Environmental Description: Optimal sites are middle-elevation mountain slopes and summits underlain by metasiltstone and phyllite of the Harper's Formation. A few sites occur over Catoctin metabasalt. Elevation ranges from 390 to 995 m (1280-3260 feet), but the type is most common between 700 and 900 m (2400-3000 feet). The type usually occupies middle to upper slopes and narrow ridge crests. The moisture potential of plot-sampling sites was assessed as submesic or subxeric. Slopes vary from steep to sublevel (mean = 14 degrees), with aspects ranging from northeast to west. Surface cover of outcrops and boulders averages about 10%, and loose channery is abundant at sites underlain by metasiltstone. Substantial areas of exposed mineral soil are often present. Soil samples collected from plots are strongly to very strongly acidic, with moderately low base cation levels, except manganese.

Vegetation Description: This association has an open, mixed canopy dominated by several oaks and hickories. Trees tend to be slightly stunted (often <20 m tall) on the drier and more exposed sites. *Quercus prinus* and *Carya ovalis* are the most abundant canopy species, but *Quercus rubra* is a constant, sometimes co-dominant associate. *Carya ovata, Carya glabra*, and *Quercus alba*

each attain co-dominance in a subset of stands. *Fraxinus americana* and *Quercus velutina* are minor overstory associates. Understory layers tend to be open or sparse with scattered *Ostrya virginiana, Crataegus flabellata*, and tree saplings. *Vaccinium stamineum, Vaccinium pallidum, Rosa carolina*, and *Spiraea betulifolia var. corymbosa* commonly form a patchy, low-shrub layer. The herb layer is open but moderately diverse with drought-tolerant graminoids and forbs. Among the most abundant forbs are *Solidago ulmifolia, Solidago arguta var. arguta, Houstonia longifolia*, and *Galium latifolium*, while *Carex pensylvanica* is the most characteristic graminoid. *Actaea racemosa (= Cimicifuga racemosa)* is occasionally an abundant herb but is absent from many stands. Additional herbs occurring more-or-less frequently include *Symphyotrichum undulatum (= Aster undulatus), Eurybia macrophylla (= Aster macrophyllus), Agrostis perennans, Helianthus divaricatus, Heuchera americana, Scrophularia lanceolata, Doellingeria infirma (= Aster infirmus), Eupatorium sessilifolium, Asclepias quadrifolia, Penstemon canescens, Arabis laevigata, Cunila origanoides, Carex virescens, Silene stellata, Carex laxiflora, Festuca subverticillata, Polygonatum biflorum, Paronychia canadensis, Thalictrum coriaceum, Pycnanthemum incanum, Potentilla canadensis, Symphyotrichum cordifolium (= Aster cordifolius), Ageratina altissima, Muhlenbergia sobolifera, Muhlenbergia tenuiflora*, and *Taenidia integerrima*. Many other herbs occur at low constancy and cover. Species richness of plot-sampled stands ranges from 48 to 103 taxa per 400 square meters (mean = 70).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Carya ovalis, Galium latifolium, Helianthus divaricatus, Houstonia longifolia, Ostrya virginiana, Penstemon canescens, Quercus prinus, Quercus rubra, Scrophularia lanceolata, Solidago arguta, Solidago ulmifolia, Vaccinium stamineum*

Other Noteworthy Species: *Elymus trachycaulus*

USFWS Wetland System:

DISTRIBUTION

Range: This community type is currently known from scattered locations on the northern Virginia Blue Ridge, from Warren County south to Bedford County. Occurrences on the Maryland Blue Ridge and in the Ridge and Valley of Virginia, West Virginia, and Maryland are possible and should be sought. Within the known range, this unit can be a large-patch or matrix community type in localities of optimal habitat.

States/Provinces: MD?, VA:S3?, WV?

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS

Rank: G3G4 (21-Sep-2001)

Reasons: Although currently known from a relatively small geographic range, this community type covers substantial areas at low to middle elevations on the northern Blue Ridge.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Although it has a similar canopy, this association differs significantly from *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest (CEGL008514) in its understory and herbaceous composition. It occupies drier, steeper sites and lacks (or nearly so) many characteristic low-elevation and mesophytic species of CEGL008514, e.g., *Liriodendron tulipifera, Quercus alba, Cercis canadensis, Asimina triloba, Actaea racemosa (= Cimicifuga racemosa), Solidago caesia, Desmodium glutinosum*, etc. Conversely, this type contains a number of montane and xerophytic species that are absent or unimportant in CEGL008514.

Similar Associations:

- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216)
- *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest (CEGL008514)

Related Concepts:

- *Quercus prinus - Quercus rubra - Carya ovalis / Cornus florida / Desmodium nudiflorum* Association: *Helianthus divaricatus - Carex pensylvanica - Dichanthelium boscii - Arabis laevigata* Subassociation, *pro parte* (Rawinski et al. 1996) ?
- *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest (Fleming and Coulling 2001) =
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming

References: Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Rawinski et al. 1996

Common Name (Park-specific): Central Appalachian Basic Oak - Hickory Forest (Submontane / Foothills Type)

SYNONYMS:

NVC English Name: Northern Red Oak - Rock Chestnut Oak - Red Hickory / Redbud / Wreath Goldenrod Forest

NVC Scientific Name: *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest

NVC Identifier: CEGL008514

LOCAL DESCRIPTION

Environmental Description: Shenandoah National Park stands of this association occur on lower- to middle-elevation slopes from 425 to 815 m (1400-2675 feet) elevation. Middle-slope topographic positions are typical, but stands occasionally occur on lower and upper slopes. Geologic substrate at most sites is Catoctin metabasalt. One plot-sampled stand occurs on charnockite, and one anomalous stand occurs in a mesic mountain-base floodplain on colluvium and alluvium derived from Chilhowee Group metasedimentary rocks. Plot-sampled sites were assessed as submesic or mesic and averaged about 10% surface cover of loose boulders and stones.

Vegetation Description: Composition of Shenandoah National Park stands is very similar to that described in the Global Vegetation description. However, because these stands are located in the upper elevation range of the type, they often lack *Cercis canadensis* and other elevation-limited species such as *Asimina triloba*. On the other hand, a few species typical of montane habitats, e.g., *Acer pensylvanicum* and *Solidago curtisii*, may be present, though rarely important.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Actaea racemosa, Amphicarpaea bracteata, Carya ovalis, Cornus florida, Desmodium nudiflorum, Festuca subverticillata, Fraxinus americana, Galium circaezans, Galium latifolium, Quercus prinus, Quercus rubra, Sassafras albidum, Solidago caesia, Stellaria pubera, Uvularia perfoliata, Viburnum acerifolium*

Other Noteworthy Species: *Information not available.*

Local Range: This association occurs throughout the park on submesic lower- and middle-elevation (to 815 m) sites underlain by Catoctin metabasalt (greenstone) and rarely by other substrates.

Classification Comments: This community occupies somewhat more mesic sites than either *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216) of dry metabasalt upper-slope benches or *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest (CEGL008516) of subxeric metasiltstone and phyllite (rarely metabasalt) on upper slopes and crests. It also occurs at lower average elevations that does CEGL008516, which ranges above 950 m (3100 feet).

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP085, SHNP093, SHNP098, SHNP509, SHNP556, SHNP591, SHNP613, SHNP666.

Shenandoah National Park Inventory Notes: Represented by seven plots from the park.

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	*Carya (glabra, ovata) - Fraxinus americana - Quercus (alba, rubra)* Forest Alliance (A.258)
Alliance (English name)	(Pignut Hickory, Shagbark Hickory) - White Ash - (White Oak, Northern Red Oak) Forest Alliance
Association	*Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest
Association (English name)	Northern Red Oak - Rock Chestnut Oak - Red Hickory / Redbud / Wreath Goldenrod Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This community type is currently known from a narrow range in the northern Blue Ridge and adjacent inner Piedmont of Virginia and Maryland. It is restricted to the western Piedmont foothills and lower-elevation slopes and spurs of the main Blue Ridge. Elevation ranges from 104 to 815 m (340-2675 feet). Habitats are more-or-less rocky, gentle to steep, submesic slopes with a wide range of aspects. Middle-slope topographic positions are typical, but stands occasionally occur on lower or upper slopes and crests. This association is a true oak-hickory forest with mixed canopy dominance by several *Quercus* spp. and *Carya* spp. *Carya*

ovalis, Quercus rubra, and *Quercus prinus* are consistent co-dominants and have the highest importance values based on standard forestry statistics generated from stem-diameter measurements. *Quercus alba, Quercus velutina, Carya alba, Carya glabra, Fraxinus americana*, and *Liriodendron tulipifera* are less constant canopy species but achieve co-dominance in some stands. *Quercus velutina* is a minor canopy associate. *Carya* spp., *Quercus* spp., *Acer rubrum, Nyssa sylvatica, Fraxinus americana*, and *Sassafras albidum* are well-represented in lower tree strata. *Cercis canadensis* and, to a lesser extent, *Cornus florida* dominate the shrub and lowest tree layers, while *Viburnum acerifolium* is a common low shrub. A large number of herbaceous species occur with low cover in the type.
Environmental Description: This association is restricted to the western Piedmont foothills and lower-elevation slopes and spurs of the main Blue Ridge. Most stands are associated with metabasalt substrates of the Catoctin Formation, but the type has also been documented on metasiltstone, phyllite, and flaggy quartzite of the adjacent Weaverton Formation. In 27 plot-sampled stands, elevation ranges from 104 to 745 m (340-2440 feet), with a mean of 346 m (1135 feet). Habitats are more-or-less rocky, gentle to steep (mean = 17 degrees), submesic slopes with a wide range of aspects. Middle-slope topographic positions are typical, but stands occasionally occur on lower or upper slopes and crests. Surficial cover of outcrops and boulders in plots averages about 15%. Soils are dark, very stony, clay loams or silty-clay loams. Although pH ranges from very strongly acidic to moderately acidic, these soils have moderately high levels of calcium, magnesium, and manganese.
Vegetation Description: This association is a true oak-hickory forest with mixed canopy dominance by several *Quercus* spp. and *Carya* spp. *Carya ovalis, Quercus rubra*, and *Quercus prinus* are consistent co-dominants and have the highest importance values (IV) based on standard forestry statistics generated from stem-diameter measurements. *Quercus alba, Quercus velutina, Carya alba, Carya glabra, Fraxinus americana*, and *Liriodendron tulipifera* are less constant canopy species but achieve co-dominance in some stands. *Carya* spp., *Quercus* spp., *Acer rubrum, Nyssa sylvatica, Fraxinus americana*, and *Sassafras albidum* are well-represented in lower tree strata. *Cercis canadensis* and, to a lesser extent, *Cornus florida* dominate the shrub and lowest tree layers, while *Viburnum acerifolium* is a common low shrub. Small patches of *Vaccinium pallidum* and *Vaccinium stamineum* may be present, but as a rule, ericads are sparse. Additional shrubs and small trees of irregular but local importance include *Ostrya virginiana, Asimina triloba, Ulmus rubra, Amelanchier arborea*, and *Hamamelis virginiana*. Climbing lianas of *Toxicodendron radicans, Parthenocissus quinquefolia*, and *Vitis* spp. are common. A large number of herbaceous species occur with low cover in the type, but *Desmodium nudiflorum, Solidago caesia, Dioscorea quaternata, Galium circaezans, Circaea lutetiana ssp. canadensis, Amphicarpaea bracteata, Botrychium virginianum, Geum virginianum, Phryma leptostachya, Actaea racemosa (= Cimicifuga racemosa), Aristolochia serpentaria*, and *Cardamine concatenata* are particularly constant and characteristic. The latter species, *Thalictrum thalictroides*, and *Claytonia virginica* completely dominate the early spring herbaceous aspect, carpeting the ground with their small white flowers. Herbs that may be locally common or abundant include *Dryopteris marginalis, Desmodium glutinosum*, and *Aralia nudicaulis*. Species richness of plot-sampled stands ranges from 43 to 90 taxa per 400 square meters (mean = 68).
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Actaea racemosa, Amphicarpaea bracteata, Aristolochia serpentaria, Carya alba, Carya glabra, Carya ovalis, Cercis canadensis, Cornus florida, Desmodium nudiflorum, Fraxinus americana, Galium circaezans, Liriodendron tulipifera, Maianthemum racemosum, Phryma leptostachya, Quercus prinus, Quercus rubra, Solidago caesia, Uvularia perfoliata, Viburnum acerifolium*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION

Range: This community type is currently known from a narrow range in the northern Blue Ridge and adjacent inner Piedmont of Virginia and Maryland. The type appears to be co-extensive with Catoctin Formation metabasalt (greenstone), a mafic metamorphic rock, but also occurs on metasiltstone, phyllite, and flaggy quartzite of the adjacent Weaverton Formation.
States/Provinces: MD, VA:S3
Federal Lands: NPS (Blue Ridge Parkway, Cumberland Gap, Shenandoah); USFS (George Washington?)

CONSERVATION STATUS

Rank: G3G4 (23-Feb-2004)
Reasons: Although currently known from a relatively small geographic range, this community type covers large areas at low elevations on the northern Blue Ridge and some of its Piedmont foothills. In recent years, the abundance of *Cornus florida* has been significantly reduced by mortality resulting from dogwood anthracnose. Stands are threatened by removal of commercially valuable timber species (e.g., *Quercus rubra, Quercus prinus, Quercus alba, Carya* spp.). Some stands of this association have been modified by repeated cutting and are now heavily dominated by *Liriodendron tulipifera*. *Symphoricarpos orbiculatus, Polygonum caespitosum var. longisetum*, and exotics such as *Ailanthus altissima, Rubus phoenicolasius*, and *Celastrus orbiculata* often become established in canopy gaps following timber harvests or gypsy moth damage.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate

Comments: In the context of the VAHP George Washington / Jefferson National Forest dataset, *Desmodium nudiflorum* has the highest unscaled adjusted Indicator Value among herbs of this community type. However, plots representing this association were also analyzed in a 477-plot dataset of Piedmont and Inner Coastal Plain vegetation, where *Desmodium nudiflorum* attained much higher indicator status in other vegetation types. Because of these results, *Solidago caesia* was chosen as a nominal herb for this community, instead of *Desmodium nudiflorum*.

Similar Associations:

- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216)
- *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest (CEGL008516)--occurs on drier sites and at lower elevations and usually lacks tulip poplar.

Related Concepts:

- *Quercus rubra - Quercus prinus - Carya ovalis / Cercis canadensis / Solidago caesia* Forest (Fleming and Coulling 2001) =
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming

References: Eyre 1980, Fleming 2002a, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Lea 2003

Common Name (Park-specific): Mid-Atlantic Mesic Mixed Hardwood Forest

SYNONYMS:

NVC English Name: American Beech - (White Oak, Northern Red Oak) - Tuliptree / Christmas Fern Forest

NVC Scientific Name: *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / Polystichum acrostichoides* Forest

NVC Identifier: CEGL006075

LOCAL DESCRIPTION

Environmental Description: This association has been plot-sampled in the park from a single site in a mesic, north-facing ravine at 320 m (1050 feet) elevation. This site is located at the foot of the western Blue Ridge flank bordering the Shenandoah Valley and has deep soils, weathered from metasedimentary colluvium, with moderate fertility levels. Several additional patches of this vegetation have been observed or documented in accuracy assessment; most of these are in low-elevation hollows underlain by granitic rocks on the eastern periphery of the park bordering the Piedmont region where this type is widespread.

Vegetation Description: The single plot-sampled stand in Shenandoah National Park has an overstory co-dominated by *Fagus grandifolia* and *Liriodendron tulipifera*. Overstory associates include *Carya ovalis* and *Quercus velutina*. Understory tree layers are dominated by *Fagus grandifolia* and also contain *Acer rubrum* and *Nyssa sylvatica*. The shrub layer is patchy and consists largely of tree saplings (*Fagus grandifolia, Quercus prinus, Acer rubrum, Nyssa sylvatica, Carya ovalis*), *Cornus florida*, and woody vines (*Parthenocissus quinquefolia, Vitis aestivalis, Smilax rotundifolia*). The herb layer is patchy and characterized by *Desmodium nudiflorum, Polystichum acrostichoides, Goodyera pubescens, Maianthemum racemosum*, and *Collinsonia canadensis*, as well as many woody seedlings.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Carya ovalis, Cornus florida, Desmodium nudiflorum, Fagus grandifolia, Liriodendron tulipifera, Nyssa sylvatica, Parthenocissus quinquefolia, Polystichum acrostichoides, Smilax rotundifolia, Vitis aestivalis*

Other Noteworthy Species: *Information not available.*

Local Range: This community is known from scattered sites at very low elevations on both flanks of the park. It appears to be most frequent in granitic terrain along the foot of the eastern slope bordering the Piedmont region where this type is widely distributed.

Classification Comments: This association should be distinct, as beech-dominated vegetation is quite rare in the park and confined to the lowest elevations.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP647.

Shenandoah National Park Inventory Notes: Represented by one plot in the park.

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	*Fagus grandifolia - Quercus rubra - Quercus alba* Forest Alliance (A.229)
Alliance (English name)	American Beech - Northern Red Oak - White Oak Forest Alliance
Association	*Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / Polystichum acrostichoides* Forest
Association (English name)	American Beech - (White Oak, Northern Red Oak) - Tuliptree / Christmas Fern Forest
Ecological System(s):	Atlantic Coastal Plain Mesic Hardwood and Mixed Forest (CES203.242) Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)

GLOBAL DESCRIPTION

Concept Summary: This forest of mesic to submesic, well-drained soils occurs in the Piedmont and Coastal Plain of Virginia and Maryland, extending north to southern New England on the Coastal Plain. It also occurs occasionally at low elevations of the Blue Ridge and adjacent Ridge and Valley in Virginia and Maryland. It is characteristically a mixed forest dominated by *Fagus grandifolia, Quercus alba, Quercus rubra*, and *Liriodendron tulipifera* in various proportions. Overstory associates over the range include *Quercus velutina, Quercus falcata, Quercus coccinea, Liquidambar styraciflua, Acer rubrum, Nyssa sylvatica, Carya alba, Carya glabra*, and *Fraxinus americana*. The subcanopy is characterized by young *Fagus grandifolia, Acer rubrum, Carpinus caroliniana, Cornus florida*, and *Sassafras albidum*. *Ilex opaca* is particularly characteristic on the Coastal Plain. The shrub layer varies from very sparse to well-developed and can include *Asimina triloba, Viburnum acerifolium, Viburnum dentatum*, and *Euonymus americana*. Heath shrubs, such as *Vaccinium corymbosum* and *Vaccinium pallidum*, may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia, Smilax glauca*, and *Toxicodendron radicans*. In the southern part of the range, *Oxydendrum arboreum* and *Vitis rotundifolia* may be conspicuous members of the understory. The herb layer is comprised of *Polystichum acrostichoides, Thelypteris noveboracensis, Uvularia perfoliata, Cypripedium acaule, Mitchella repens, Tipularia discolor, Goodyera pubescens, Eurybia divaricata (= Aster divaricatus), Chimaphila maculata, Carex swanii, Medeola virginiana, Athyrium filix-femina, Carex digitalis, Carex willdenowii, Epifagus virginiana, Maianthemum canadense, Desmodium nudiflorum, Polygonatum biflorum, Podophyllum peltatum, Arisaema triphyllum*, and *Maianthemum racemosum (= Smilacina racemosa).*

Environmental Description: This forest association occurs on mesic to submesic slopes or gentle gradients. Ravines in dissected topography are particularly typical sites in the Piedmont and parts of the Inner Coastal Plain. The type also occupies rolling uplands with deep soils. Soils are typically well-drained, acidic sandy and silt loams derived from parent material of low to moderate fertility. This association is found throughout the Piedmont from south-central Virginia to New Jersey and Pennsylvania, and on the Mid-Atlantic Coastal Plain from northern Virginia northward.

Vegetation Description: Rangewide, this vegetation type is characteristically a mixed mesophytic forest dominated by *Fagus grandifolia, Quercus alba, Quercus rubra*, and *Liriodendron tulipifera* in various proportions. Overstory associates over the range include *Carya alba, Carya glabra, Quercus velutina, Quercus falcata, Quercus coccinea, Liquidambar styraciflua, Acer rubrum, Nyssa sylvatica*, and *Fraxinus americana*. The subcanopy is characterized by young *Fagus grandifolia, Acer rubrum, Carpinus caroliniana, Cornus florida, Ilex opaca*, and *Sassafras albidum*. The shrub layer varies from very sparse to well-developed and can include *Asimina triloba, Viburnum acerifolium, Viburnum dentatum*, and *Euonymus americana*. Heath shrubs, such as *Vaccinium corymbosum* and *Vaccinium pallidum*, may be common but not abundant. Vines are common, including *Parthenocissus quinquefolia, Smilax glauca*, and *Toxicodendron radicans*. The herb layer is comprised of *Polystichum acrostichoides, Uvularia perfoliata, Cypripedium acaule, Mitchella repens, Tipularia discolor, Goodyera pubescens, Eurybia divaricata (= Aster divaricatus), Chimaphila maculata, Carex swanii, Medeola virginiana, Athyrium filix-femina, Carex digitalis, Carex willdenowii, Epifagus virginiana, Maianthemum canadense, Desmodium nudiflorum, Polygonatum biflorum. Podophyllum peltatum, Arisaema triphyllum*, and *Maianthemum racemosum (= Smilacina racemosa).*

Several intergrading compositional variants have been noted in regional and local landscape analyses. On more submesic, convex slopes, *Fagus grandifolia, Quercus alba, Cornus florida*, and *Vaccinium pallidum* tend to be prominent, while pronounced mesophytes such as *Carpinus caroliniana* and herbaceous species in general are usually sparse. Coastal Plain stands tend to have understories heavily dominated by *Ilex opaca*, while Piedmont stands generally have only scattered *Ilex opaca* as well as slightly higher herbaceous richness.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fagus grandifolia, Liriodendron tulipifera, Quercus alba*
Tree subcanopy	Broad-leaved deciduous tree	*Cornus florida*
Tree subcanopy	Broad-leaved evergreen tree	*Ilex opaca*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Viburnum acerifolium*
Shrub/sapling (tall & short)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Podophyllum peltatum, Polygonatum biflorum*

Herb (field) Fern *Polystichum acrostichoides*
Characteristic Species: *Fagus grandifolia, Ilex opaca, Quercus alba, Viburnum acerifolium*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION
Range: This association is currently described from Virginia northward to southern New England. The type is characteristic of the Coastal Plain throughout its range and of the Piedmont from south-central Virginia through much of Maryland. Small outliers of this vegetation occur at low elevations on both flanks of the Blue Ridge in Virginia and Maryland.
States/Provinces: CT, DC, DE:S5, MD, NJ:S3, NY, PA:S1, VA:S5
Federal Lands: NPS (C&O Canal, George Washington Parkway, National Capital-East, Prince William, Rock Creek, Shenandoah)

CONSERVATION STATUS
Rank: G5 (24-Jan-2005)
Reasons: This association is common and widespread on the eastern Coastal Plain.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: The regional circumscription of this type is very robust and supported by an analysis of 132 plots from Virginia, Maryland, and the District of Columbia conducted by VANHP for NatureServe.
Similar Associations:
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921)
- *Fagus grandifolia - Quercus alba - (Acer barbatum)* / Mixed Herbs Forest (CEGL007206)
- *Fagus grandifolia - Quercus alba - Quercus rubra* Forest (CEGL006377)
- *Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica* Forest (CEGL008465)
- *Quercus alba - Carya glabra* / Mixed Herbs Coastal Plain Forest (CEGL007226)

Related Concepts:
- *Fagus grandifolia - Liriodendron tulipifera - Quercus (alba, rubra) / Polystichum acrostichoides - Aster divaricatus* Forest (Fleming 2001) ?
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / Ilex opaca var. opaca - (Asimina triloba)* Forest (Patterson pers. comm.) ?
- *Quercus* spp. - *Carya* spp. / *Cornus florida - Ilex opaca* Mesic Forest (Clancy 1993b) ?
- CNE Mesic hardwood Forest on acidic bedrock / till (Rawinski 1984) ?
- Coastal Plain Forest (Smith 1983) B
- Maritime forest (Rawinski 1984) ?
- Mesic Coastal Plain mixed oak forest, mixed oak - beech forest subtype (Breden 1989) ?
- Mixed oak forest of the south Jersey mesic uplands (Robichaud and Buell 1973) ?
- Southern New England oak / pine forest on sandy / gravelly soils (Rawinski 1984) ?

SOURCES
Description Authors: S.L. Neid, mod. G. Fleming and L.A. Sneddon
References: Berdine 1998, Bernard and Bernard 1971, Bowman 2000, Breden 1989, Breden et al. 2001, Clancy 1993b, Clancy 1996, Davis et al. 1992, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fleming 2001, Fleming et al. 2001, Fleming pers. comm., Lea 2003, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Robichaud and Buell 1973, Smith 1983

Common Name (Park-specific): Southern Appalachian Cove Forest (Typic Montane Type)

SYNONYMS:
NVC English Name: Tuliptree - Yellow Buckeye - (White Ash, American Basswood) / Black Cohosh - Wood Nettle Forest
NVC Scientific Name: *Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana) / Actaea racemosa - Laportea*

***canadensis* Forest**
NVC Identifier: CEGL007710

LOCAL DESCRIPTION

Environmental Description: This community type occurs at lower to middle elevations of Shenandoah National Park on substrates weathered from metabasalt and pyroxene-bearing granites. Many or all sites supporting this vegetation were cleared or cut-over in the past. Elevation range of plot samples is 300 to 860 m (1020-2830 feet) (mean = 630 m [2065 feet]), with lower-slope topographic positions and easterly aspects prevalent. Slopes are concave in one or both directions, and sites have relatively high moisture potential (TRMI). Soil samples are moderately acidic with moderately high Ca, Mg, Mn, and total base saturation levels.

Vegetation Description: Shenandoah National Park expressions of this type are lush mesophytic forests with mixed overstories of *Liriodendron tulipifera, Fraxinus americana,* and *Tilia americana* (*var. americana* and *var. heterophylla*). Less frequent or abundant overstory species include *Carya cordiformis, Carya ovalis, Quercus rubra, Ulmus rubra, Juglans nigra,* and *Betula lenta*. *Acer saccharum* is only rarely an overstory component but is a common subcanopy tree in about a third of the sampled stands, perhaps indicative of ongoing successional change. Characteristic understory and shrub species are *Lindera benzoin* (usually dominant), *Acer rubrum, Ostrya virginiana, Acer pensylvanicum, Ulmus rubra,* and *Cornus alternifolia*. The herb layer of this community is lush with patch-clonal forbs, including *Actaea racemosa (= Cimicifuga racemosa), Laportea canadensis, Hydrophyllum virginianum,* and *Caulophyllum thalictroides*. The most constant herbs among sampled stands are *Actaea racemosa, Arisaema triphyllum, Osmorhiza claytonii, Circaea lutetiana ssp. canadensis, Galium triflorum, Laportea canadensis, Stellaria pubera,* and *Amphicarpaea bracteata*. Many other herbs occur at low cover and/or constancy. *Alliaria petiolata* is a problematic invasive weed in many stands.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer saccharum, Actaea racemosa, Adiantum pedatum, Arisaema triphyllum, Caulophyllum thalictroides, Circaea lutetiana* ssp. *canadensis, Fraxinus americana, Galearis spectabilis, Hydrophyllum virginianum, Laportea canadensis, Lindera benzoin, Liriodendron tulipifera, Osmorhiza claytonii, Tilia americana, Ulmus rubra, Viola pubescens*

Other Noteworthy Species: *Information not available.*

Local Range: This community is widely but somewhat locally distributed below 850 m (2800 feet) elevation in the park in mesic, fertile habitats underlain by metabasalt and granitic rocks.

Classification Comments: The assignment of this vegetation to the primarily southern CEGL007710 is a bit problematic, but it seems to fit fairly well, if a gradual shift in species composition and elevation is accepted. In the park, this community intergrades with nearly monospecific successional forests of *Liriodendron tulipifera* along a seral gradient. It also may intergrade with the park's higher-elevation rich cove forest, *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest (CEGL006237), which occurs at a higher mean elevation but overlaps CEGL007710 at 640 to 860 m (2100-2830 feet) elevation. This type differs from the *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest (CEGL006237) in its generally lower-elevation, east-facing (vs. north-facing) habitats; by the abundance of *Liriodendron tulipifera* and *Lindera benzoin*; by the absence or unimportance of *Acer saccharum* in the overstory; and by the absence or rarity of species most closely associated with higher, cooler habitats (e.g., *Betula alleghaniensis, Angelica triquinata, Aconitum reclinatum*).

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP097, SHNP099, SHNP523, SHNP526, SHNP557, SHNP572, SHNP574, SHNP576, SHNP587, SHNP590, SHNP593, SHNP626, SHNP630, SHNP631, SHNP640, SHNP644, SHNP652.

Shenandoah National Park Inventory Notes: Represented by 17 plots from the park.

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 (A.235) saccharum* Forest Alliance
Alliance (English name)	Tuliptree - Appalachian Basswood - Yellow Buckeye - Sugar Maple Forest Alliance
Association	*Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana) / Actaea racemosa - Laportea canadensis* Forest
Association (English name)	Tuliptree - Yellow Buckeye - (White Ash, American Basswood) / Black Cohosh - Wood Nettle Forest
Ecological System(s):	Southern and Central Appalachian Cove Forest (CES202.373)

GLOBAL DESCRIPTION

Concept Summary: This association represents deciduous forests of concave lower slopes and flats at middle elevations (600-1370 m [2000-4500 feet]) in the southern Blue Ridge and at low to middle elevations (300 to 900 m [1000-3000 feet]) in the northern Blue Ridge and adjacent Ridge and Valley. The canopy is dominated by some mixture of rich-site mesophytic species such as *Aesculus*

flava, Fraxinus americana, Tilia americana var. heterophylla, and *Magnolia acuminata*, occurring with more widely tolerant tree species such as *Liriodendron tulipifera, Acer rubrum, Tsuga canadensis*, and *Betula lenta*. The herbaceous stratum is diverse and often very lush. Typical herbaceous species include *Actaea racemosa (= Cimicifuga racemosa), Caulophyllum thalictroides, Prosartes lanuginosa (= Disporum lanuginosum), Aruncus dioicus, Adiantum pedatum, Collinsonia canadensis, Osmorhiza claytonii*, and *Laportea canadensis*. This association is distinguished by the absence or scarcity of calciphilic species, such as *Diplazium pycnocarpon, Asplenium rhizophyllum, Dryopteris goldiana, Aquilegia canadensis, Solidago flexicaulis, Deparia acrostichoides*, and *Cystopteris protrusa*, by generally occurring at elevations above 600 m (2000 feet) (300 m at the northern end of the range), and by lacking species typical of lower elevation forests.
Environmental Description: This association is characteristic of concave lower slopes and flats at middle elevations (600-1200 m [2000-4500 feet]) in the southern Blue Ridge and at low to middle elevations (300-900 m) in the northern Blue Ridge and adjacent Ridge and Valley. At the northern end of the range in Virginia, elevation of the few known occurrences decreases from 760 m (2500 feet) in the southern Blue Ridge to as low as 300 m (1000 feet) at the extreme north end of the Blue Ridge in Clarke County. In Virginia, stands occupy sites underlain by base-rich substrates, including metabasalt (greenstone), pyroxene-bearing granites, amphibolite, and dolomite. These sites are mostly situated on moderately steep (mean slope = 17 degrees), straight or concave slopes with east to northeast aspects. Soils are deep, dark, and fertile, with the highest mean pH, calcium, and magnesium levels.
Vegetation Description: In the heart of its southern Blue Ridge range, canopies of this community type are dominated by variable mixtures of nutrient-demanding mesophytic species such as *Aesculus flava*, *Fraxinus americana*, and *Tilia americana var. heterophylla*, in association with more wide-ranging tree species such as *Liriodendron tulipifera, Acer rubrum, Tsuga canadensis*, and *Betula lenta*. Herb layers are diverse and often very lush. Typical herbaceous species include *Actaea racemosa (= Cimicifuga racemosa), Caulophyllum thalictroides, Aruncus dioicus, Adiantum pedatum, Collinsonia canadensis, Laportea canadensis, Osmorhiza claytonii*, and *Prosartes lanuginosa (= Disporum lanuginosum)*. In the southern Blue Ridge, this association is distinguished by the scarcity of calciphilic species such as *Diplazium pycnocarpon, Asplenium rhizophyllum, Dryopteris goldiana, Aquilegia canadensis, Solidago flexicaulis, Deparia acrostichoides*, and *Cystopteris protrusa*; by generally occurring at elevations above 600 m (2000 feet); and by lacking species typical of lower elevation forests.

Virginia examples may represent somewhat transitional or depauperate variants in the northern periphery of the association's range. *Aesculus sylvatica* is entirely absent from the documented stands, in which *Liriodendron tulipifera, Fraxinus americana, Tilia americana*, and *Quercus rubra* are the most important canopy species. *Acer saccharum, Betula lenta, Carya glabra*, and *Carya cordiformis* are minor canopy associates. *Ulmus rubra* is a constant understory tree that occasionally reaches the overstory. All occurrences have a moderately dense shrub layer dominated exclusively by *Lindera benzoin* (25-50% cover in plots). The herbaceous flora is extremely lush and forb-rich throughout the entire growing season, with constantly changing suites of patch-dominants flowering, fruiting, and evanescing. At some sites, *Trillium grandiflorum* is characteristically abundant in the vernal herbaceous complex, which also includes *Arisaema triphyllum, Maianthemum racemosum, Galearis spectabilis, Viola pubescens, Sanguinaria canadensis, Stellaria pubera, Podophyllum peltatum, Asarum canadense, Hybanthus concolor*, and *Thalictrum dioicum*. During the summer, prevalent herbs are *Actaea racemosa, Impatiens pallida, Circaea lutetiana ssp. canadensis, Monarda clinopodia, Sanicula odorata*, and *Collinsonia canadensis*. Species richness of plot-sampled stands ranges from 46 to 59 taxa per 400 square meters (mean = 52).
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Aconitum reclinatum, Ageratina altissima* var. *roanensis, Cardamine flagellifera*
USFWS Wetland System:

DISTRIBUTION
Range: This association occurs in the southern Appalachian Mountains of eastern Tennessee, western North Carolina, northeastern Georgia, and southwestern Virginia. Scattered outliers occur on the northern Virginia Blue Ridge and in the southwestern Virginia Ridge and Valley region adjacent to the Blue Ridge.
States/Provinces: GA, NC, TN, VA:S3
Federal Lands: NPS (Blue Ridge Parkway, Great Smoky Mountains, Shenandoah); USFS (Chattahoochee, Cherokee, Jefferson, Nantahala, Pisgah)

CONSERVATION STATUS
Rank: G4 (30-Apr-1998)
Reasons: This community is uncommon due to specialized habitat requirements, but it is not rare. It is secure throughout its range, but susceptible to impacts by logging due to its location in accessible topographic positions.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate

Comments: Deciduous cove forests are perhaps the most complex group of communities to classify in the Southern Blue Ridge, due to a combination of wide environmental range, high species richness, and high biogeographic variability. The recognition of associations based on fertility and elevation is provisional and will likely need further refinement. This association is distinguished by the absence or scarcity of calciphilic species, such as *Diplazium pycnocarpon, Asplenium rhizophyllum, Dryopteris goldiana, Aquilegia canadensis, Solidago flexicaulis, Deparia acrostichoides,* and *Cystopteris protrusa*, by generally occurring at elevations above 610 m (2000 feet), and by lacking species typical of lower elevation forests.

Although represented only by a few geographically disparate examples, this community type seems to have a remarkably consistent composition over nearly the entire length of the Blue Ridge in Virginia. These stands have all recovered from logging in the past, but remain threatened by future timber harvests because of excellent site productivity. Shade-tolerant, invasive exotics, especially *Alliaria petiolata*, pose a serious threat to the integrity of this community's herbaceous flora.

Similar Associations:

- *Quercus rubra - Tilia americana* var. *heterophylla - Halesia tetraptera* var. *monticola / Collinsonia canadensis - Tradescantia subaspera* Forest (CEGL007878)--is strongly dominated by *Quercus rubra*.

Related Concepts:

- *Liriodendron tulipifera - Fraxinus americana - Tilia americana / Lindera benzoin / Actaea racemosa - Laportea canadensis* Forest (Fleming pers. comm.) =
- *Liriodendron tulipifera - Tilia americana - Fraxinus americana / Lindera benzoin / Trillium grandiflorum - Impatiens pallida* Forest (Fleming and Coulling 2001) ?
- Rich Cove Forest (Montane Intermediate Subtype) (Schafale 1998b) ?
- Yellow-poplar - White Oak - Northern Red Oak: 59 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming pers. comm., Major et al. 1999, NatureServe Ecology - Southeastern U.S. unpubl. data, Peet et al. unpubl. data 2002, Schafale 1998b, Schafale and Weakley 1990, Schafale pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, VDNH 2003

Common Name (Park-specific): Successional Tuliptree Forest (Circumneutral Type)

SYNONYMS:

NVC English Name: Tuliptree / (Redbud) / (Northern Spicebush) Forest

NVC Scientific Name: *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest

NVC Identifier: CEGL007220

LOCAL DESCRIPTION

Environmental Description: In Shenandoah National Park, this vegetation type occupies low- to middle-elevation (<823 m [2700 feet]) mesic ravines and lower slopes that were cleared prior to 1936. Underlying bedrock at all sampling sites is either Catoctin metabasalt or a member of the pyroxene-bearing granitic complex. Mean slope inclination of plot samples is 18 degrees and aspects range from northeast to southeast. Surface substrate is free of loose rocks or nearly so. Soil samples collected from plots were moderately acidic, with moderately high calcium, magnesium, and total base saturation levels.

Vegetation Description: In Shenandoah National Park, and elsewhere in the mid-Atlantic region, this type is characterized by monospecific or heavily dominant *Liriodendron tulipifera* overstories, and usually by dense shrub layers dominated by *Lindera benzoin*. *Cercis canadensis, Acer rubrum, Cornus florida, Fraxinus americana, Carya* spp., *Magnolia tripetala*, and *Carpinus caroliniana* are also common in the understory, at least at some sites. Vines such as *Parthenocissus quinquefolia, Toxicodendron radicans*, and *Smilax rotundifolia* are common. Stands contain a wide variety of nutrient-demanding herbs, among the frequent of which are *Galium triflorum, Arisaema triphyllum, Polystichum acrostichoides, Phryma leptostachya,* and *Dioscorea quaternata*. Invasive exotics such as *Rubus phoenicolasius, Celastrus orbiculata, Lonicera japonica, Alliaria petiolata, Microstegium vimineum,* and *Veronica hederifolia* are often abundant.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Alliaria petiolata, Arisaema triphyllum, Cercis canadensis, Cornus florida, Lindera benzoin, Liriodendron tulipifera*

Other Noteworthy Species: *Information not available.*

Local Range: Occurs locally throughout the park in suitable habitats at lower and middle elevations. However, because it is apparently restricted to the relatively base-rich metabasalt and granitic substrates, it is probably far more common on the eastern flank of the park than the western flank.

Classification Comments: In Shenandoah National Park, this successional forest, though long-lived, appears to be a precursor of rich cove forests with a similar but more mixed composition [see *Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana) / Actaea racemosa - Laportea canadensis* Forest (CEGL007710)].
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP520, SHNP535, SHNP588.
Shenandoah National Park Inventory Notes: Represented by four plots from the park.

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 / (Redbud) / (Northern Spicebush) Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
	Southern Interior Low Plateau Dry Oak Forest (CES202.898)

GLOBAL DESCRIPTION

Concept Summary: This semi-natural or successional community dominated by *Liriodendron tulipifera* occurs in the Cumberland Plateau, Ridge and Valley, and Interior Low Plateau of Tennessee, Upper East Gulf Coastal Plain of Mississippi, and the Central Appalachian, Piedmont and Inner Coastal Plain regions of Virginia, West Virginia, and Maryland. It may also occur in similar regions of Pennsylvania, Kentucky and Delaware. It is distinguished from other upland communities dominated by *Liriodendron tulipifera* 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*, other canopy species may include *Liquidambar styraciflua, Acer saccharum, Robinia pseudoacacia, Juglans nigra, Fraxinus americana, Ulmus rubra, Quercus imbricaria, Quercus muehlenbergii*, and *Carya ovata*. Species often found in the subcanopy include *Acer saccharum, Cercis canadensis, Ulmus alata, Morus rubra*, and *Cornus florida*. Shrubs include saplings of the subcanopy and canopy species, as well as *Lindera benzoin, Symphoricarpos orbiculatus, Asimina triloba, Staphylea trifolia, Acer negundo*, and *Juniperus virginiana var. virginiana*. Common herbaceous species include the exotics *Microstegium vimineum, Rubus phoenicolasius, Alliaria petiolata, Veronica hederifolia*, and *Lonicera japonica*, as well as *Toxicodendron radicans, Parthenocissus quinquefolia*, and *Polystichum acrostichoides*. Examples in Fort Donelson that have been very heavily disturbed may have local dominance by *Celtis laevigata* and *Juglans nigra*.
Environmental Description: These forests are found on disturbed mesic areas underlain by rich soils with moderately high base saturation levels. 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.
Vegetation Description: Stands are dominated by *Liriodendron tulipifera* but also include various other species, including ones indicative of rich or circumneutral environments. Other species include *Liquidambar styraciflua, Acer saccharum, Robinia pseudoacacia, Juglans nigra, Fraxinus americana, Ulmus rubra, Quercus imbricaria, Quercus muehlenbergii*, and *Carya ovata* (NatureServe Ecology unpubl. data, VDNH unpubl. data). Species often found in the subcanopy include *Acer saccharum, Cercis canadensis, Ulmus alata, Morus rubra*, and *Cornus florida*. *Cercis canadensis* is often abundant on soils underlain by carbonate strata. Shrubs include saplings of the subcanopy and canopy species, as well as *Symphoricarpos orbiculatus, Lindera benzoin, Asimina triloba*, and *Juniperus virginiana var. virginiana*. *Lindera benzoin* is often abundant in occurrences of this community in the Central Appalachian, Piedmont and Inner Coastal Plain regions of Virginia, West Virginia, and Maryland. Common herbaceous species include the exotics *Microstegium vimineum, Rubus phoenicolasius, Alliaria petiolata, Veronica hederifolia*, and *Lonicera japonica*, as well as *Toxicodendron radicans, Parthenocissus quinquefolia*, and *Polystichum acrostichoides* (Andreu and Tukman 1995, NatureServe Ecology unpubl. data, VDNH unpubl. data).
Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera*

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION
Range: This type occurs in the Ridge and Valley of Tennessee, 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, Kentucky and Delaware. Its full range is unknown.
States/Provinces: DC, DE?, KY?, MD, MS, PA?, TN, VA, WV
Federal Lands: NPS (Antietam, Blue Ridge Parkway, C&O Canal, Catoctin Mountain, Cumberland Gap, Fort Donelson, George Washington Parkway, Harpers Ferry, Lincoln Birthplace, Natchez Trace, National Capital-East, Obed, Rock Creek, Shenandoah, Vicksburg); TVA (Tellico); USFS (Cherokee?)

CONSERVATION STATUS
Rank: GNA (ruderal) (28-Oct-2003)
Reasons: This forest represents early-successional vegetation and is thus not of 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* spp. Forest (CEGL007221)--lacks species affiliated with circumneutral conditions.
- *Liriodendron tulipifera* Forest (CEGL007218)--is less diverse and earlier successional.

Related Concepts:

SOURCES
Description Authors: R.E. Evans, mod. M. Pyne, J. Teague, C.W. Nordman
References: Andreu and Tukman 1995, Lea 2003, Martin 1989, NatureServe Ecology - Southeastern U.S. unpubl. data, Southeastern Ecology Working Group n.d., TDNH unpubl. data

Common Name (Park-specific): Central Appalachian Montane Oak - Hickory Forest (Basic Type)

SYNONYMS:
NVC English Name: Northern Red Oak - White Oak - White Ash - (Shagbark Hickory, Red Hickory) / Black Cohosh Forest
NVC Scientific Name: *Quercus rubra - Quercus alba - Fraxinus americana - Carya (ovata, ovalis) / Actaea racemosa* Forest
NVC Identifier: CEGL008518

LOCAL DESCRIPTION
Environmental Description: This community occupies gentle (mean slope = 10 degrees) upper slopes and ridge crests at elevations from about 700 to 1070 m (2300-3500 feet). It is an extensive forest community at 820 to 1020 m (2700-3300 feet) elevation on sites underlain by Catoctin metabasalt (greenstone). A few exceptional sites in the park are underlain by charnockite and metasiltstone. Aspect is variable, and sites were subjectively assessed as mesic in most cases. At 18 plot-sampling sites, surface substrate consisted primarily of leaf litter, with an average of only 3% cover of boulders and stones. Soil samples collected from these sites were very strongly to extremely acidic, with moderately low base status, excepting high manganese levels.
Vegetation Description: The typical expression of this community in the park is that of an oak or oak-hickory forest with an herb layer that resembles that of a rich cove forest. *Quercus rubra* is the most constant and important overstory tree. *Quercus alba, Carya ovalis, Carya ovata, Carya cordiformis, Betula lenta,* and *Fraxinus americana* are less constant but are at least locally important overstory associates in various combinations. The overstories of young stands may be heavily dominated by *Fraxinus americana*. Understory and shrub layers are typically sparse but usually contain young *Carya* spp. and *Fraxinus americana,* along with *Acer pensylvanicum, Prunus virginiana, Ostrya virginiana, Ribes rotundifolium, Rubus allegheniensis, Rubus occidentalis,* and *Hamamelis virginiana*. The herb layer is characteristically lush and continuous, with patch-dominance by one or more large, leafy, clonal forbs. The most constant and abundant species of this layer in the park are *Ageratina altissima, Actaea racemosa (= Cimicifuga racemosa),*

Thalictrum coriaceum, Asclepias exaltata, and *Hydrophyllum virginianum*. Relatively constant, low-cover herbaceous associates include *Galium triflorum, Viola X palmata, Festuca subverticillata, Circaea lutetiana ssp. canadensis, Geranium maculatum, Stellaria pubera, Uvularia perfoliata, Osmorhiza claytonii,* and *Monarda clinopodia*. Additional herbs that may be locally abundant include *Caulophyllum thalictroides, Laportea canadensis, Collinsonia canadensis, Eurybia macrophylla (= Aster macrophyllus),* and *Osmunda claytoniana*. Many other species occur at low cover and constancy. Species richness of 18 sampled stands is 66 species per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Actaea racemosa, Ageratina altissima, Carya cordiformis, Carya ovalis, Carya ovata, Fraxinus americana, Hydrophyllum virginianum, Prunus virginiana, Quercus alba, Quercus rubra, Rubus allegheniensis, Thalictrum coriaceum*

Other Noteworthy Species: *Information not available.*

Local Range: Widespread on middle- to high-elevation upper slopes and ridge crests, primarily over Catoctin metabasalt, in the central section of the park, and adjacent portions of the northern and southern sections.

Classification Comments: Good-quality stands are not likely to be confused with other community types in the park. At the highest elevations, this type grades into the more depauperate and much less lush *Quercus rubra - Quercus alba / Ilex montana / Dennstaedtia punctilobula - Carex pensylvanica - Deschampsia flexuosa* Forest (CEGL008506). At lower elevations it grades into other oak and oak-hickory communities, all of which occupy less mesic sites and lack the continuous, lush herb layer characteristic of this type.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP028, SHNP077, SHNP079, SHNP086, SHNP087, SHNP088, SHNP111, SHNP129, SHNP132, SHNP516, SHNP518, SHNP548, SHNP605, SHNP619, SHNP650, SHNP659, SHNP661, SHNP663.

Shenandoah National Park Inventory Notes: Represented by 18 plots from the park.

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 alba - (Quercus rubra, Carya* spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	*Quercus rubra - Quercus alba - Fraxinus americana - Carya (ovata, ovalis) / Actaea racemosa* Forest
Association (English name)	Northern Red Oak - White Oak - White Ash - (Shagbark Hickory, Red Hickory) / Black Cohosh Forest
Ecological System(s):	Central and Southern Appalachian Montane Oak Forest (CES202.596) Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This community type is known primarily from the northern Blue Ridge, where it occupies extensive areas on upper slopes and ridge crests underlain by mafic parent material. Additional, outlying occurrences have been documented from the northern part of the southern Blue Ridge and two sites in the western Ridge and Valley. This community type occurs under two rather different sets of site conditions. In the Blue Ridge stands occupy gentle to moderately steep, upper slopes and ridge crests, primarily over Catoctin metabasalt (greenstone) or, in the southern Blue Ridge occurrences, amphibolite. Occurrences span a broad range of elevations, from 800-1160 m (2650-3820 feet). Aspect varies considerably, but a majority of stands are located on sites with southwestern to northwestern exposures. In the Ridge and Valley, mesic, low-relief crests are underlain by clastic sedimentary and metasedimentary parent material, comprising sandstone, siltstone, shale and quartzite. *Quercus rubra* is the single constant member of the overstory. It often shares dominance with *Quercus alba* and *Fraxinus americana*, but both of these species, while present in nearly all stands, are occasionally confined to the understory. *Carya* spp. are virtually absent from the Ridge and Valley stands, but either *Carya ovalis* or *Carya ovata* (and frequently both) typically attain importance in the canopy or subcanopy in the Blue Ridge. Associate tree species include *Betula lenta, Carya cordiformis, Prunus serotina, Acer rubrum, Quercus prinus,* and *Tilia americana*. The shrub layer is typically sparse. A consistent feature is a lush and generally diverse herb layer, although the species richness of the Blue Ridge stands is more than twice that of the Ridge and Valley occurrences.

Environmental Description: This community type occurs under two rather different sets of site conditions. In the Blue Ridge, stands occupy gentle to moderately steep, upper slopes and ridge crests, over Catoctin metabasalt (greenstone) or, in the Southern Blue Ridge occurrences, amphibolite. Aspect varies considerably, but a majority of stands are located on sites with southwestern to northwestern exposures. Soils are moderately to strongly acidic, with varying base status (calcium concentrations range from 316-

2033 ppm, with a mean of 1157 ppm) but uniformly high manganese levels (mean = 216 ppm). In Alleghany County, in the Ridge and Valley, mesic, low-relief crests are underlain by clastic sedimentary and metasedimentary parent material, comprising sandstone, siltstone, shale and quartzite. Soils here, while similarly acidic and rich in manganese, have much lower base status overall (mean calcium = 368 ppm), reflecting the absence of mafic minerals. Blue Ridge sites tend to have somewhat rockier soils and higher cover of exposed boulders. All stands have likely experienced a long history of disturbance, including the loss of *Castanea dentata* as an overstory constituent in the early 20th century, logging, and occasional fire and wind and ice storms. Many occurrences also experienced moderate to severe defoliation by gypsy moth (*Lymantria dispar*) during the last two decades.

Vegetation Description: *Quercus rubra* is the single constant member of the overstory. It often shares dominance with *Quercus alba* and *Fraxinus americana*, but both of these species, while present in nearly all stands, are occasionally confined to the understory. *Carya* spp. are virtually absent from the Ridge and Valley stands, but either *Carya ovalis* or *Carya ovata* (and frequently both) typically attain importance in the canopy or subcanopy in the Blue Ridge. Associate tree species include *Betula lenta, Carya cordiformis, Prunus serotina, Acer rubrum, Quercus prinus*, and *Tilia americana*. The shrub layer is typically sparse; *Ostrya virginiana, Acer pensylvanicum, Prunus virginiana, Sassafras albidum*, and *Cornus florida* attain high cover in at least one stand, but none is characteristic of this type. A consistent feature is a lush and generally diverse herb layer, although the richness of the Blue Ridge stands (mean = 72 taxa per 400 square meters) is more than twice that of the Ridge and Valley occurrences (mean = 33 taxa). Although *Actaea racemosa (= Cimicifuga racemosa), Ageratina altissima, Festuca subverticillata*, and *Geranium maculatum* are the most frequent herbs, several other species (in addition to the first two) abound (cover >10%) in one or more stands, including *Collinsonia canadensis, Caulophyllum thalictroides, Laportea canadensis, Thalictrum coriaceum, Asclepias exaltata, Osmunda claytoniana, Impatiens capensis*, and *Solidago caesia*. *Actaea racemosa, Ageratina altissima*, and *Osmunda claytoniana* are the only high-cover herbaceous species in the Ridge and Valley occurrences.

Most Abundant Species

Stratum	Lifeform	Species
Herb (field)	Forb	*Actaea racemosa*

Characteristic Species: *Actaea racemosa*, *Ageratina altissima*, *Carya cordiformis*, *Carya ovalis*, *Carya ovata*, *Fraxinus americana*, *Quercus alba*, *Quercus rubra*, *Thalictrum coriaceum*

Other Noteworthy Species: *Euphorbia purpurea*

USFWS Wetland System:

DISTRIBUTION

Range: This community type is known primarily from the northern Blue Ridge, where it occupies extensive areas on upper slopes and ridge crests underlain by mafic parent material. Additional, outlying occurrences have been documented from the northern part of the southern Blue Ridge and two sites in the western Ridge and Valley in Alleghany County, Virginia. Additional stands may occur on base-rich sandstone ridges in the Ridge and Valley. It is possible that this type may extend into Maryland on the Catoctin Formation, but low relief almost certainly limits, if not precludes, its distribution north of Virginia.

States/Provinces: MD?, VA:S3

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS

Rank: G3 (21-Sep-2001)

Reasons: This vegetation type appears to be largely restricted to metabasalt in the Northern Blue Ridge, where it constitutes a large-patch community, and to likely few unusually base-rich sedimentary ridges in the Ridge and Valley. Extensive occurrences north of Virginia are unlikely.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Canopy composition suggests similarity to *Carya (glabra, ovata) - Fraxinus americana - Quercus* spp. Forest (CEGL006236), which ostensibly ranges from New York south to Virginia and West Virginia. The concept of this type, however, is poorly developed and does not seem to represent a single, cohesive vegetation type.

The Blue Ridge and Ridge and Valley occurrences emerged as separate groups in cluster analysis but were merged, somewhat uncomfortably, because the latter were clearly not related to any other vegetation type represented by quantitative data from the Virginia mountains, and the recognition of a unique but compositionally similar unit from only two sites in a single landscape seemed unwarranted. As noted above, a common characteristic of all occurrences is relatively high concentrations of soil manganese. Several recent studies of montane forest vegetation (Newell and Peet 1996, Newell 1997, Coulling and Rawinski 1999) have identified a strong positive relationship between manganese levels and species richness. In this community type, however, abundant manganese may explain the total cover and, in part, the composition of the herb layer, but total herb diversity may be more a function of total base saturation and the abundance of other soil cations. The higher base status of the Blue Ridge sites on greenstone likely explains the greater importance of *Carya* spp. in these stands. The unusually high manganese concentrations of the Ridge and Valley stands are

unexplained. Additional examples of this type on sandstone and other clastic substrates with relatively high base status should be priorities for further inventory.

The strong association of this type with metabasalt in the northern Blue Ridge is likely a real phenomenon and reflects the considerably higher base status of soils derived from this mafic parent material than from felsic granitic (principally charnockite and granulite gneiss) rock. Oak and oak-hickory forests underlain by the latter type of substrate contain less substantial components of *Fraxinus americana* and support generally lower total species richness. Although exceptions occur on extraordinarily fertile sites on porphyritic leucocharnockite and charnockite gneiss in Amherst and Rockbridge counties, Virginia, where *Quercus rubra* and *Carya ovalis* co-dominate over a diverse herb layer, even these stands consistently contain fewer species than the richest forests underlain by metabasalt. Moreover, *Quercus alba* is seldom a dominant species in montane oak-hickory stands at moderate to high elevations in the granitic Blue Ridge. Its importance on metabasalt sites may be a function of the low local relief caused by weathering of this parent material, which tends to form narrow but distinct benches and flat columnar features.

Several stands of this type, particularly those in northern Shenandoah National Park, experienced severe oak mortality following sustained defoliation by gypsy moth and coincident drought in the late 1980s and early 1990s.

Similar Associations:
- *Carya (glabra, ovata) - Fraxinus americana - Quercus* spp. Forest (CEGL006236)
- *Quercus rubra - Carya ovalis / Collinsonia canadensis - Impatiens pallida* Forest (CEGL008519)
- *Quercus rubra - Quercus alba / Ilex montana / Dennstaedtia punctilobula - Carex pensylvanica - Deschampsia flexuosa* Forest (CEGL008506)

Related Concepts:
- *Quercus rubra - Quercus alba - Fraxinus americana - Carya (ovata, ovalis) / Actaea racemosa* Forest (Fleming and Coulling 2001) =
- *Quercus rubra - Quercus alba / Cimicifuga racemosa - Hydrophyllum virginianum* Forest (Fleming and Moorhead 2000) ?
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Coulling and Rawinski 1999, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Fleming et al. 2004, Newell 1997, Newell and Peet 1996b

Common Name (Park-specific): Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest

SYNONYMS:

NVC English Name: Rock Chestnut Oak - (Scarlet Oak, Black Oak) / Mountain Laurel / Hillside Blueberry Forest

NVC Scientific Name: *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest

NVC Identifier: CEGL006299

LOCAL DESCRIPTION

Environmental Description: In Shenandoah National Park, this community is generally associated with dry, infertile slopes from the lowest elevations commonly up to about 850 m (2800 feet), and more locally to 985 m (3230 feet). Although it may occur on all geological substrates, topographic positions and aspects, middle slope positions with south to west aspects and quartzite substrates prevail among 22 plot samples. Slopes range from moderate to very steep (mean = 19 degrees), and average about 10% cover of bedrock and loose rocks. Occasional sites may have much higher boulder cover. Soil samples collected from plots are moderately organic-rich (mean %OM = 19%) and extremely acidic with low levels of calcium and magnesium and high levels of iron. Evidence of past fires (e.g., charcoal, burn scars on trees) was noted at several sites.

Vegetation Description: Shenandoah National Park stands have overstories that vary from very open to closed. Overstory trees are often somewhat stunted and gnarled. *Quercus prinus* is generally the sole canopy dominant, often in nearly pure stands. Less frequent mixed stands may be co-dominated by *Quercus coccinea, Quercus velutina*, and/or *Quercus rubra*. Minor overstory associates include *Betula lenta, Pinus strobus, Pinus rigida*, and *Tsuga canadensis* (in protected situations). Understory tree layers are usually dominated by *Acer rubrum* and/or *Nyssa sylvatica*, along with *Sassafras albidum*, small trees of the overstory species, and root-sprouts of *Castanea dentata*. The high frequency and occasional abundance of the latter is indicative of its importance in these forests prior to the arrival of the chestnut blight fungus in the early years of the 20th century. The ericaceous species *Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium pallidum* heavily dominate the shrub layer in variable combinations, usually covering 25-75%

(occasionally nearly 100%) of a given area. Additional shrub species occurring less constantly but sometimes abundantly include *Vaccinium stamineum, Lyonia ligustrina, Quercus ilicifolia, Hamamelis virginiana, Menziesia pilosa, Rhododendron periclymenoides, Rhododendron prinophyllum,* and *Rhododendron catawbiense*. The herb layer is generally sparse but usually contains scattered individuals or patches of *Chimaphila maculata, Epigaea repens, Gaultheria procumbens, Pteridium aquilinum var. latiusculum, Dioscorea quaternata, Iris verna, Polypodium appalachianum* (on rocks), *Cypripedium acaule, Baptisia tinctoria,* and a few other species. Mean species richness of 22 plot-sampled stands was 22 taxa per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Chimaphila maculata, Epigaea repens, Gaylussacia baccata, Kalmia latifolia, Nyssa sylvatica, Pteridium aquilinum* var. *latiusculum, Quercus prinus, Sassafras albidum, Vaccinium pallidum*

Other Noteworthy Species: *Information not available.*

Local Range: The type occurs in suitable habitats throughout the park but is especially prevalent from Smith Mountain southward on the metasedimentary ridges that form the western flank of the Blue Ridge.

Classification Comments: As site moisture and/or soil fertility increase, this type can intergrade with *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057), which generally has *Quercus rubra* as a co-dominant, a greater number of tree and shrub associates, a more patchy ericad component, and significantly higher herb richness. A few stands at higher elevations are also transitional to the more northern *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282) but are best retained in CEGL006299. At the xeric end of the site gradient, it may intergrade with *Pinus (pungens, rigida) / Quercus ilicifolia / Gaylussacia baccata* Woodland (CEGL004996).

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP131, SHNP503, SHNP519, SHNP539, SHNP544, SHNP546, SHNP560, SHNP561, SHNP562, SHNP563, SHNP569, SHNP575, SHNP579, SHNP582, SHNP584, SHNP595, SHNP597, SHNP598, SHNP599, SHNP670, SHNP671, SHNP677.

Shenandoah National Park Inventory Notes: Represented by 22 plots from the park.

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 coccinea, Quercus velutina)* Forest Alliance (A.248)
Alliance (English name)	Rock Chestnut Oak - (Scarlet Oak, Black Oak) Forest Alliance
Association	*Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest
Association (English name)	Rock Chestnut Oak - (Scarlet Oak, Black Oak) / Mountain Laurel / Hillside Blueberry Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This chestnut oak forest occurs at relatively low elevations (mostly <900 m) in the central Appalachians and adjacent northern Piedmont and adjacent areas occurring on dry, acidic, infertile soils on mid and upper slopes. The canopy is strongly dominated by *Quercus prinus*. The most frequent canopy associate is *Quercus coccinea*, which varies from sparse to co-dominant. Minor associates frequently include *Quercus velutina* plus *Quercus alba, Quercus rubra, Nyssa sylvatica, Sassafras albidum*, and *Robinia pseudoacacia*. *Acer rubrum* and *Nyssa sylvatica* are usually abundant in the understory tree layers. Tall shrubs include *Kalmia latifolia* (usually dominant), *Viburnum acerifolium*, with *Rhododendron periclymenoides*, which occurs with high frequency and occasional high cover. The dwarf- or short-shrub layer is well-developed and includes *Vaccinium pallidum, Vaccinium stamineum*, and *Gaylussacia baccata*, any one of which can exhibit patch-dominance. The herb layer generally has sparse cover and includes *Aureolaria laevigata, Chimaphila maculata, Comandra umbellata, Cypripedium acaule, Danthonia spicata, Epigaea repens, Hieracium venosum, Lysimachia quadrifolia, Medeola virginiana, Monotropa uniflora, Pteridium aquilinum*, and *Uvularia puberula*. Strong dominance of *Quercus prinus* in the canopy, frequent and sometimes abundant *Rhododendron periclymenoides* in the tall-shrub layer, and *Vaccinium pallidum* present and often abundant as a dwarf-shrub are diagnostics for this type.

Environmental Description: This association is found on acidic, infertile soils on low-elevation (mostly <900 m), mid and upper slopes (occasionally on lower slopes). Site moisture potential is typically subxeric to xeric. Some exposed bedrock is often present.

Vegetation Description: The canopy is strongly dominated by *Quercus prinus*. The most frequent canopy associate is *Quercus coccinea*, which varies from sparse to co-dominant. *Quercus coccinea, Quercus alba*, and *Quercus velutina* are frequent associates or co-dominants in the canopy. Minor associates frequently include *Quercus velutina* plus *Quercus alba, Quercus rubra, Nyssa sylvatica*, and *Sassafras albidum*. *Acer rubrum* and *Nyssa sylvatica* are usually abundant in the understory tree layers. Tall shrubs

Kalmia latifolia (usually dominant), *Viburnum acerifolium*, and *Rhododendron periclymenoides* are often associated, sometimes at low cover. The dwarf- or short-shrub layer is well-developed and includes *Vaccinium pallidum*, *Vaccinium stamineum*, and *Gaylussacia baccata*, any one of which can exhibit patch-dominance. The herb layer generally has sparse cover and includes *Aureolaria laevigata, Chimaphila maculata, Comandra umbellata, Cypripedium acaule, Danthonia spicata, Epigaea repens, Hieracium venosum, Lysimachia quadrifolia, Medeola virginiana, Monotropa uniflora, Pteridium aquilinum,* and *Uvularia puberula*. Strong dominance of *Quercus prinus* in the canopy, frequent and sometimes abundant *Rhododendron periclymenoides* in the tall-shrub layer, and *Vaccinium pallidum* present and often abundant as a dwarf-shrub are diagnostics for this type.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Tsuga caroliniana*
USFWS Wetland System:

DISTRIBUTION

Range: This association is currently described from the northern Piedmont and central Appalachians in Pennsylvania, Virginia, Maryland and West Virginia.
States/Provinces: MD, PA, VA, WV
Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Catoctin Mountain, George Washington Parkway, Harpers Ferry, Shenandoah); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G5 (29-Jan-2004)
Reasons: Abundant examples occur in Virginia, Maryland, and West Virginia.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: This chestnut oak forest type (CEGL006299) is distinguished from *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282) by the unimportance of *Quercus rubra* and the infrequence or absence of northern and higher elevation Appalachian species such as *Vaccinium angustifolium, Kalmia angustifolia, Aralia nudicaulis, Ilex montana,* and *Acer pensylvanicum*. It is distinguished from *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271) by the infrequence or absence of southern Appalachian species such as *Galax urceolata, Oxydendrum arboreum, Rhododendron maximum, Gaylussacia ursina, Leucothoe recurva, Magnolia fraseri*, and *Symplocos tinctoria*. This type differs from *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) in its more xeric settings and lack of more mesic species such as *Cornus florida* and *Viburnum acerifolium*.
Similar Associations:

- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271)--of southern Appalachians.
- *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521)
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282)--northern and high elevation at the southern edge of its range.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)--occurs on subxeric to submesic sites.
- *Quercus prinus - Quercus velutina / Oxydendrum arboreum - Cornus florida* Forest (CEGL008522)
- *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523)

Related Concepts:

- *Quercus montana - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (Fleming 2002a) =
- *Quercus montana / Kalmia latifolia / Gaultheria procumbens* Association (Rawinski et al. 1994) ?
- *Quercus montana / Kalmia latifolia / Gaylussacia baccata* Forest (Fleming and Moorhead 2000) ?
- *Quercus montana / Kalmia latifolia / Vaccinium pallidum* Association, *pro parte* (Rawinski et al. 1996) ?
- *Quercus prinus / Kalmia latifolia - Rhododendron periclymenoides* Forest (Fleming and Coulling 2001) F
- *Quercus prinus / Smilax rotundifolia - Polypodium virginianum* Subassociation (Fleming and Moorhead 1996) ?

SOURCES

Description Authors: S. Neid and G. Fleming, mod. E. Largay
References: Allard and Leonard 1943, Eastern Ecology Working Group n.d., Fleming 2002a, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming and Moorhead 2000, Fleming et al. 2001, Lea 2003, Rawinski et al. 1994, Rawinski et al. 1996

Common Name (Park-specific): Central Appalachian Acidic Oak - Hickory Forest

SYNONYMS:

NVC English Name: White Oak - Rock Chestnut Oak - Pignut Hickory / Flowering Dogwood / Hillside Blueberry / Pennsylvania Sedge Forest

NVC Scientific Name: *Quercus alba - Quercus prinus - Carya glabra / Cornus florida / Vaccinium pallidum / Carex pensylvanica* Forest

NVC Identifier: CEGL008515

LOCAL DESCRIPTION

Environmental Description: This association is apparently restricted (or nearly so) in the park to low-elevation slopes of the metasedimentary terrain on the western Blue Ridge flank bordering the Shenandoah Valley. In most cases, geologic substrate is presumed to be metasiltstone or phyllite of the Harpers Formation. Sites are usually subxeric middle and upper slopes with extremely acidic, infertile soils. Slope inclination in plot samples averages 18 degrees, while aspect ranges from southeast to west. Strong compositional differences between this and the various oak/heath types cannot be explained by topography or soil chemistry, and are assumed to be related to soil texture, depth, and moisture-holding capacity. This vegetation probably occupies less fertile sites on the same shaley soils that support *Quercus prinus - Quercus rubra - Carya ovalis / Solidago (ulmifolia, arguta) - Galium latifolium* Forest (CEGL008516) at higher elevations.

Vegetation Description: Composition of this type in Shenandoah National Park samples is very similar to that in the Global Vegetation description. *Quercus alba, Quercus prinus*, and *Carya glabra* are the most important overstory trees in mixed stands, occasionally varying to nearly pure stands of *Quercus alba*. *Pinus virginiana* is an important associate in two stands and present at low cover in the remainder. *Quercus velutina, Quercus rubra, Quercus marilandica, Quercus stellata*, and *Quercus coccinea* are minor overstory associates. *Acer rubrum, Amelanchier arborea, Sassafras albidum*, and *Cornus florida* are the principal understory trees. *Vaccinium pallidum* dominates a patchy low-shrub layer, with *Rosa carolina* a constant, low-cover associate. The herb layer varies from sparse to patch-dominated by graminoids. The most constant and characteristic species are *Carex pensylvanica, Danthonia spicata, Houstonia longifolia, Polygonatum biflorum, Dichanthelium boscii*, and *Hieracium venosum*. Many additional dry-site herbs occur at low cover and constancy. Species richness of five plot-sampled stands is 47 species per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum*, *Amelanchier arborea*, *Carex pensylvanica*, *Carya glabra*, *Cornus florida*, *Danthonia spicata*, *Hieracium venosum*, *Houstonia longifolia*, *Pinus virginiana*, *Quercus alba*, *Quercus prinus*, *Rosa carolina*, *Sassafras albidum*, *Vaccinium pallidum*, *Vaccinium stamineum*

Other Noteworthy Species: *Information not available.*

Local Range: Very widely scattered in small patches at low elevations near the western edge of the park bordering the Shenandoah Valley.

Classification Comments: Distinguished from other oak-hickory forests in the park by its occurrence on metasedimentary substrates at very low elevations and by the presence of low-elevation xerophytes such as *Pinus virginiana, Quercus stellata*, and *Quercus marilandica*.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP540, SHNP551, SHNP564, SHNP649, SHNP675.

Shenandoah National Park Inventory Notes: Represented by five plots from the park.

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)	Rock Chestnut Oak - (White Oak, Southern Red Oak, Northern Red Oak, Black Oak) Forest Alliance
Association	*Quercus alba - Quercus prinus - Carya glabra / Cornus florida / Vaccinium pallidum / Carex pensylvanica* Forest
Association (English name)	White Oak - Rock Chestnut Oak - Pignut Hickory / Flowering Dogwood / Hillside Blueberry / Pennsylvania Sedge Forest

Ecological System(s): Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)
Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This community type is associated with substrates weathered from shale and similar metasedimentary rocks in the central Appalachian region. It appears to be widespread at low elevations of the Ridge and Valley province in Virginia, south at least to the New River, and more local on the western flank of the northern Blue Ridge, and may extend into the Ridge and Valley of West Virginia and/or Maryland. Sites in the Ridge and Valley are distributed on low shale knobs and ridges, or at the base of higher sandstone ridges, where local shale strata have been exposed by stream incision. On the Blue Ridge, stands are confined to a belt of metasedimentary rocks that overlie the plutonic basement complex on the western side of the anticlinorium. Habitats encompass dry, mostly east- to south-facing slopes, hollows, and broad, sub-level ridge crests at low elevations (mostly <600 m [2000 feet]). Slope shape is generally convex in at least one direction. The characteristic vegetation of this unit is an open oak-hickory or oak-hickory-pine forest dominated by *Quercus prinus* and *Quercus alba*, with high cover of *Carya* spp., especially *Carya glabra*. *Quercus velutina* and *Quercus rubra* are less frequent but locally co-dominant trees. Total canopy cover is usually in the 60-80% range, and dominant canopy trees typically do not much exceed, and in some situations do not reach, 20 m in height. Minor canopy associates include *Carya alba, Carya ovalis, Pinus echinata, Pinus strobus, Pinus virginiana, Quercus coccinea,* and *Quercus stellata*. Young representatives of most canopy species are common in the understory, along with *Cornus florida* and *Amelanchier arborea*. Generally, there is a moderate to sparse representation of ericaceous (heath family) shrubs in this community type. However, on gentle ridge crests, where litter and humus tend to accumulate, *Vaccinium pallidum* may dominate the herb layer in low colonies. On the more extensive steep, convex slopes, where litter accumulations are thin and patchy, ericads are sparse and herbaceous richness tends to be moderately high, although total herb cover is usually quite sparse.

Environmental Description: Sites in the Ridge and Valley are distributed on low shale knobs and ridges, or at the base of higher sandstone ridges, where local shale strata have been exposed by stream incision. On the Blue Ridge, stands are confined to a belt of metasedimentary rocks that overlie the plutonic basement complex on the western side of the anticlinorium. Habitats encompass dry, mostly east- to south-facing slopes, hollows, and broad, sublevel ridge crests at low elevations (mostly <600 m [2000 feet]). Slope shape is generally convex in at least one direction. The prevalent soils are loams of the Weikert-Berks-Rough complex. Although ranging from strongly to extremely acidic, soil samples collected from plots have higher mean pH (4.8) and calcium (489 ppm) values than most comparable soils weathered from sandstone. On steep slopes, the surface cover of mineral soil may be significant (up to 57% in plots) due to erosional processes.

Vegetation Description: The characteristic vegetation of this unit is an open oak-hickory or oak-hickory-pine forest dominated by *Quercus prinus* and *Quercus alba*, with high cover of *Carya* spp., especially *Carya glabra*. *Quercus velutina* and *Quercus rubra* are less frequent but locally co-dominant trees. Total canopy cover is usually in the 60-80% range, and dominant canopy trees typically do not much exceed, and in some situations do not reach, 20 m in height. Minor canopy associates include *Carya alba, Carya ovalis, Pinus echinata, Pinus strobus, Pinus virginiana, Quercus coccinea*, and *Quercus stellata*. Young representatives of most canopy species are common in the understory, along with *Cornus florida* and *Amelanchier arborea*. Generally, there is a moderate to sparse representation of ericaceous (heath family) shrubs in this community type. However, on gentle ridge crests, where litter and humus tend to accumulate, *Vaccinium pallidum* may dominate the herb layer in low colonies. On the more extensive steep, convex slopes, where litter accumulations are thin and patchy, ericads are sparse and herbaceous richness tends to be moderately high, although total herb cover is usually quite sparse. The most constant and characteristic graminoids are *Carex pensylvanica, Danthonia spicata,* and *Dichanthelium boscii*. Characteristic forbs are *Antennaria plantaginifolia, Chimaphila maculata, Desmodium rotundifolium, Galium circaezans, Houstonia longifolia, Potentilla canadensis, Scutellaria elliptica, Vicia caroliniana,* and several *Lespedeza* spp. The low shrub *Rosa carolina* is also frequent in the herb layer. Species richness of plot-sampled stands ranges from 33 to 54 taxa per 400 square meters (mean = 48).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Antennaria plantaginifolia*, *Carex pensylvanica*, *Carya glabra, Cornus florida, Danthonia spicata, Dichanthelium boscii*, *Houstonia longifolia*, *Lespedeza hirta*, *Lespedeza frutescens* (= *Lespedeza intermedia*), *Lespedeza procumbens*, *Lespedeza repens*, *Lespedeza virginica*, *Pinus virginiana, Potentilla canadensis*, *Quercus alba*, *Quercus prinus, Vaccinium pallidum*

Other Noteworthy Species: *Onosmodium virginianum*

USFWS Wetland System:

DISTRIBUTION

Range: This community type is associated with substrates weathered from shale and similar metasedimentary rocks (e.g., metasiltstone) in the central Appalachian region. It appears to be widespread at low elevations of the Ridge and Valley province in Virginia, south at least to the New River, and more local on the western flank of the northern Blue Ridge. Although not documented in either West Virginia or Maryland, its occurrence in the Ridge and Valley portions of these states seems probable. Within its known distribution, this unit is a matrix community type in localities of optimal habitat.

States/Provinces: MD?, VA:S4?, WV?

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

CONSERVATION STATUS
Rank: G4? (21-Sep-2001)
Reasons: Although currently known from a relatively small geographic range, this community type covers extensive areas at low elevations in the Central Appalachians of Virginia. It is very likely that this vegetation is similarly distributed in the Ridge and Valley regions of West Virginia and Maryland.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: The global range and status of this community type need further investigation. It may occur on a wider variety of substrates, and cover a much larger geographic area, than current documentation indicates.

Increment cores taken from old trees in the Peters Mountain area of Alleghany County (James River Ranger District) - e.g., a 44 cm (17 in.) dbh *Quercus alba* ca. 225 years old, a 49 cm (19 in.) dbh *Quercus alba* ca. 155 years old, and a 46 cm (18 in.) dbh coppice sprout of *Quercus prinus* ca. 175 years old - indicate slow growth rates in stands of this type (Fleming and Moorhead 2000). Data collected from throughout the Peters Mountain study area also indicate that *Castanea dentata* was much less important in pre-blight forests on shale compared to those on the area's sandstone ridges (Fleming and Moorhead 2000).
Similar Associations:
Related Concepts:
- *Quercus alba - Quercus montana - Carya glabra / Carex pensylvanica* Forest (Fleming and Moorhead 2000) ?
- *Quercus alba - Quercus prinus - Carya glabra / Cornus florida / Vaccinium pallidum / Carex pensylvanica* Forest (Fleming and Coulling 2001) =
- *Quercus prinus - Quercus rubra - Carya ovalis / Cornus florida / Desmodium nudiflorum* Association: *Helianthus divaricatus - Carex pensylvanica - Dichanthelium boscii - Arabis laevigata* Subassociation, *pro parte* (Rawinski et al. 1996) ?
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES
Description Authors: G. Fleming and P. Coulling
References: Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Fleming et al. 2004, Rawinski et al. 1996

Common Name (Park-specific): Central Appalachian Dry-Mesic Chestnut Oak - Northern Red Oak Forest

SYNONYMS:
NVC English Name: Rock Chestnut Oak - Northern Red Oak / Witch-hazel Forest
NVC Scientific Name: *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest
NVC Identifier: CEGL006057

LOCAL DESCRIPTION
Environmental Description: In Shenandoah National Park, this oak forest community occurs from the lowest elevations to at least 1000 m (3300 feet). It occurs on all geological substrates, slope positions and aspects, with slope inclination varying from flat to >30 degrees. Although generally a community of sideslopes, stands also occur frequently in mountain-base floodplains filled with bouldery colluvium and alluvium of quartzite. Site moisture potential among 31 plot samples was generally assessed as submesic or mesic. Although average rock cover among plot samples was about 13%, many sites occupied by this community have substantial (15 to 60%) boulder or stone cover. Soil pH varies from strongly to extremely acidic, but samples collected from plots have lower organic matter content and somewhat higher base status (particularly high magnesium levels) compared to soils of the park's chestnut oak and mixed oak/heath forests. Because this vegetation type represents a matrix forest of the park and lies near the centrum of environmental gradients, it exhibits relatively low environmental specificity in its distribution. In general, it has a broad distribution in the metabasalt and granitic districts, but tends to occur at lower slope positions on warm aspects and poor metasedimentary substrates.
Vegetation Description: Like the habitats occupied by this type, Shenandoah National Park stands are quite variable in composition. However, *Quercus prinus* and *Quercus rubra* are consistently present and co-dominant in the overstory, although each may dominate small areas within stands. Many overstory associates occur and may occasionally rival the dominant oaks in importance over small areas. These include *Acer rubrum, Betula lenta, Carya glabra, Carya ovalis, Fraxinus americana, Liriodendron tulipifera* (lower elevations), *Nyssa sylvatica, Pinus strobus, Quercus alba, Quercus velutina*, and *Tsuga canadensis* (protected habitats). *Quercus alba* and *Pinus strobus* are particularly common associates in the bouldery quartzitic floodplains at the western foot of the Blue Ridge. Understory trees include small individuals of the overstory species, along with *Acer pensylvanicum, Amelanchier arborea, Castanea dentata, Cornus florida, Prunus serotina*, and *Sassafras albidum*. Shrub cover varies from sparse to fairly dense. The shrub

composition of this community is more diverse than that of dry chestnut oak and oak/heath forests, commonly containing some ericads along with *Viburnum acerifolium, Hamamelis virginiana, Parthenocissus quinquefolia, Rubus allegheniensis*, and less frequently *Corylus americana* or *Corylus cornuta var. cornuta*. *Kalmia latifolia, Rhododendron periclymenoides, Vaccinium pallidum,* and *Gaylussacia baccata* are the most characteristic ericads, though none is highly constant in plots. Only rarely does an individual ericaceous species cover more than 25% in a plot sample, and total ericad cover in a plot rarely reaches 50%; average total ericad cover among 31 plot samples is about 10-15%. A large number of low-cover herbs occur in the types, although *Dioscorea quaternata, Polygonatum biflorum, Asplenium platyneuron*, and *Eurybia divaricata (= Aster divaricatus)* were the only species that occurred in >50% of the plot samples. Less constant herbaceous species that occasionally achieved up to 10% cover in an individual plot include *Actaea racemosa (= Cimicifuga racemosa), Ageratina altissima, Amphicarpaea bracteata, Aureolaria virginica, Bromus pubescens, Carex pensylvanica, Circaea lutetiana ssp. canadensis, Dennstaedtia punctilobula, Desmodium nudiflorum, Dryopteris marginalis, Galium triflorum, Hieracium venosum, Lysimachia quadrifolia, Maianthemum racemosum ssp. racemosum, Polymnia canadensis, Polypodium appalachianum, Polystichum acrostichoides, Potentilla canadensis*, and *Viola sororia*. Many additional species occur at low cover and constancy. Mean species richness of 31 plot samples was 50 taxa per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Acer rubrum, Cornus florida, Dioscorea quaternata, Hamamelis virginiana, Kalmia latifolia, Parthenocissus quinquefolia, Quercus prinus, Quercus rubra, Sassafras albidum, Viburnum acerifolium*

Other Noteworthy Species: *Information not available.*

Local Range: Widely and extensively distributed at lower and middle elevations of the park.

Classification Comments: Because this type is widespread and adaptable to a range of site conditions, it can intergrade with several other oak and oak-hickory forests in the park. It can be distinguished from *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299) by its more mesic habitats, more diverse woody composition, lower density/cover of ericaceous species, and much greater diversity of low-cover herbaceous species. Alternatively, compared to most of the park's oak-hickory associations, it has a more prominent ericaceous component, and *Carya* spp. and *Fraxinus americana* are less abundant in the overstory and understory tree layers. Additionally, all of the park's oak-hickory forests have a more diverse and, in most cases, denser herbaceous stratum. This community also intergrades with *Quercus prinus - Betula lenta / Parthenocissus quinquefolia* Talus Woodland (CEGL006565), and on some sites may gradually replace this talus woodland as a boulderfield weathers and interstitial spaces fill with organic matter and soil.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP528, SHNP533, SHNP537, SHNP538, SHNP541, SHNP542, SHNP545, SHNP549, SHNP550, SHNP552, SHNP553, SHNP554, SHNP555, SHNP558, SHNP559, SHNP565, SHNP571, SHNP580, SHNP583, SHNP585, SHNP589, SHNP594, SHNP596, SHNP611, SHNP614, SHNP634, SHNP635, SHNP657, SHNP667, SHNP674, SHNP676.

Shenandoah National Park Inventory Notes: Represented by 31 plots from the park.

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 rubra* Forest Alliance (A.250)
Alliance (English name)	Rock Chestnut Oak - Northern Red Oak Forest Alliance
Association	*Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest
Association (English name)	Rock Chestnut Oak - Northern Red Oak / Witch-hazel Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591)
	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This closed-canopy, dry-mesic oak forest of the central Appalachian Mountains is a montane forest of somewhat protected rocky slopes. The canopy is co-dominated by *Quercus prinus* and *Quercus rubra*. Associated canopy species include *Liriodendron tulipifera, Acer rubrum, Carya glabra, Carya ovalis, Carya alba,* and *Betula lenta*. The tall-shrub layer is characterized by *Hamamelis virginiana* and *Acer pensylvanicum*. The lower shrub layer is often dense and contains a mixture of ericaceous and non-ericaceous species. The herbaceous layer is usually sparse but may include *Gaultheria procumbens, Lysimachia quadrifolia, Thelypteris noveboracensis, Sanicula trifoliata, Prenanthes altissima, Dichanthelium boscii, Dichanthelium commutatum, Dichanthelium dichotomum, Carex pensylvanica, Polystichum acrostichoides, Chimaphila maculata, Desmodium nudiflorum, Galium latifolium, Houstonia purpurea,* and *Maianthemum racemosum*. This association is more-or-less intermediate in

site conditions and composition between oak / heath forests of exposed, xeric, infertile sites and montane oak-hickory or *Quercus rubra*-dominated forests of sheltered or fertile, high-elevation sites.

Environmental Description: Sites occupied by this dry-mesic oak forest are mostly protected rocky mountain slopes. In Virginia, the type occurs at low and middle elevations, from <300 m (1000 feet) to about 1000 m (3300 feet), reaching optimal development at 610-915 m (2000-3000 feet). Habitats are underlain by a variety of bedrock types, including metabasalt (greenstone), pyroxene-rich granitic rocks, Antietam and Tuscarora quartzites, metasiltstone and phyllite, shale, and sedimentary material (interbedded sandstone, siltstone, and shale). Among 50 plot-sampled Virginia stands, lower to middle-slope topographic positions predominate, along with steep (mean = 27 degrees), usually concave slopes, and relatively high surface cover of outcrops, boulders, and stones (up to 78%; mean = 32%). Slope aspect is variable, but the majority of aspects range from north to southeast. Soil samples collected from plots were strongly to very strongly acidic (mean pH = 4.8) but had moderately high levels of calcium (mean = 1019 ppm), reflecting the frequent occurrence of this community on moderately base-rich substrates.

Vegetation Description: The vegetation is usually a closed-canopy forest co-dominated by *Quercus prinus* and *Quercus rubra* in variable proportions. Over the full geographic range, overstory associates are reported to include *Liriodendron tulipifera, Tilia americana, Betula lenta, Acer rubrum, Magnolia acuminata, Nyssa sylvatica, Robinia pseudoacacia, Carya glabra, Carya ovalis*, and *Carya alba*. A tall-shrub layer is occasionally absent but usually characterized by *Cornus florida* and *Hamamelis virginiana* and, less frequently, *Acer pensylvanicum*. The lower shrub layer is sometimes dense and ericaceous, with species such as *Rhododendron maximum, Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium* spp. but also commonly contains *Viburnum acerifolium*. The herbaceous layer is usually sparse but may include a large number of low-cover species such as *Gaultheria procumbens, Lysimachia quadrifolia, Thelypteris noveboracensis, Prenanthes altissima, Dichanthelium boscii, Dichanthelium commutatum, Dichanthelium dichotomum, Carex pensylvanica, Polystichum acrostichoides, Chimaphila maculata, Desmodium nudiflorum, Galium latifolium, Houstonia purpurea*, and *Maianthemum racemosum*. This association is more-or-less intermediate in site conditions and composition between oak / heath forests of exposed, xeric, infertile sites and montane oak-hickory or *Quercus rubra*-dominated forests of sheltered or fertile, high-elevation sites.

In Virginia stands of this association, *Quercus rubra* and *Quercus prinus* are consistently prevalent canopy trees, while *Acer rubrum, Cornus florida, Sassafras albidum*, and *Acer pensylvanicum* are relatively constant understory trees. *Hamamelis virginiana* is an abundant tall shrub throughout, but dense ericaceous shrubs are generally lacking. *Vaccinium pallidum* and/or *Kalmia latifolia* are present in the majority of plot-sampled stands but rarely contribute more than 5% cover each. *Vaccinium stamineum, Gaylussacia baccata, Pieris floribunda, Rhododendron periclymenoides*, and *Rhododendron catawbiense* are infrequent, low-cover ericaceous associates. *Carya glabra* and *Carya ovalis* are important (occasionally co-dominant) overstory associates in a subset of lower elevation plots on base-rich substrates; at higher elevations, where the type usually occurs on quartzite or sandstone, *Carya* spp. are absent and *Acer pensylvanicum* becomes much more abundant. Climbing and scrambling vines of *Parthenocissus quinquefolia* and *Vitis aestivalis* are abundant at all elevations. Although a large number of herbaceous plants occur in plots of the type, very rocky substrates tend to limit herbaceous cover, and only *Dioscorea quaternata* has a constancy >75%. Additional herbs with constancy >30% are *Eurybia divaricata (= Aster divaricatus), Dryopteris marginalis, Polygonatum biflorum, Carex virescens*, and *Carex pensylvanica*.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Acer rubrum, Carya glabra, Cornus florida, Hamamelis virginiana, Parthenocissus quinquefolia, Quercus prinus, Quercus rubra, Sassafras albidum, Viburnum acerifolium, Vitis aestivalis*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

Range: This association occurs throughout the central Appalachian region of Virginia, West Virginia, Maryland, Pennsylvania, and possibly farther north. In Virginia, it is a large-patch to matrix community type in both the northern Blue Ridge and Ridge and Valley provinces. A few small-patch outliers of this type occur in rocky, sheltered ravines of the northern Virginia and Maryland Piedmont.

States/Provinces: MD, NJ?, PA, VA:S5, WV

Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Catoctin Mountain, Harpers Ferry, Shenandoah); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G5 (1-Oct-2001)

Reasons: This is a widespread oak forest of the central Appalachian Mountains found on intermediate rocky slopes. It is secure within its range.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Placement of this vegetation type in the Virginia Ecological Group classification is somewhat arbitrary, since it has relatively fertile soils and a relatively sparse ericaceous shrub component compared to other members of the Mixed Oak / Heath Forests group. Although it has some affinities to the Montane Oak - Hickory Forests and the Low-Elevation Boulderfield Forests, placement in either of these groups would be just as imperfect. Therefore, we have followed the results of cluster analysis, which placed the cluster of plots forming this type in a larger group with other oak / heath forests.

Wind and ice damage to tree crowns, damage to *Cornus florida* from dogwood anthracnose (*Discula destructiva*), and a few small fire scars were disturbances noted in plots. Although *Castanea dentata* logs and wood were not abundant in plots, frequent sprouts indicate that *Castanea dentata* was at least an associate tree in this unit prior to the arrival of chestnut blight. The northwest slopes of Peters Mountain in Alleghany County, Virginia, contains old-growth examples of the type with large, widely spaced canopy trees in the 43- to 72-cm (17-28 inches) dbh range. Representative old-age trees include a 59-cm (23 inches) dbh *Quercus prinus* >220 years old; a 63-cm (25 inches) dbh *Quercus prinus* about179 years old; a 67-cm (26 inches) dbh *Quercus prinus* 265 years old; and a 71-cm (28 inches) dbh *Quercus rubra* >247 years old (Fleming and Moorhead 2000).

Similar Associations:
- *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299)
- *Quercus prinus - (Quercus rubra) - Carya* spp. / *Oxydendrum arboreum - Cornus florida* Forest (CEGL007267)
- *Quercus prinus - Betula lenta / Parthenocissus quinquefolia* Talus Woodland (CEGL006565)
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282)
- *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523)

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

SOURCES

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

References: Breden et al. 2001, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming and Moorhead 2000, Fleming et al. 2001, Lea 2003, Rawinski et al. 1994, Rawinski et al. 1996, Stephenson and Adams 1991, VDNH 2003, Vanderhorst 2000b

Common Name (Park-specific): Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type)

SYNONYMS:

NVC English Name: Yellow Birch - Northern Red Oak / (Striped Maple, Mountain Maple) / Fancy Fern - Whorled Wood Aster Forest

NVC Scientific Name: *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest

NVC Identifier: CEGL008502

LOCAL DESCRIPTION

Environmental Description: Habitats occupied by this type in Shenandoah National Park are consistent with the Global Environment description, except that a few stands occupy less rocky, south- or west-facing, gentle slopes near the highest elevations (>1158 m [3800 feet]) of Hawksbill.

Vegetation Description: See Global Vegetation. Shenandoah National Park stands are more-or-less typical but differ in a few minor ways. *Ilex montana* and *Hamamelis virginiana* tend to be as important in the understory as the *Acer* spp. *Dryopteris intermedia* is only locally important in Shenandoah National Park stands.

Most Abundant Species

Stratum **Lifeform** **Species**

Characteristic Species: *Acer pensylvanicum, Acer spicatum, Aralia nudicaulis, Betula alleghaniensis, Carex aestivalis, Hamamelis virginiana, Ilex montana, Oclemena acuminata, Quercus rubra*

Other Noteworthy Species: *Information not available.*

Local Range: This community has a very local distribution in the park and occurs in small, often isolated patches. It is restricted to cool high-elevation sites (mostly on the upper west flank of the Blue Ridge) from near Big Meadows to The Pinnacle in the central section, and on North Marshall in the northern section of the park.

Classification Comments: In Shenandoah National Park, the type grades into both *Quercus rubra*-dominated forests and high-elevation boulderfield forests dominated by *Betula alleghaniensis* and *Sorbus americana*.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP002, SHNP022, SHNP036, SHNP048, SHNP104, SHNP108, SHNP109, SHNP606.

Shenandoah National Park Inventory Notes: Represented by eight plots from the park.

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 rubra - (Acer saccharum)* Forest Alliance (A.251)
Alliance (English name)	Northern Red Oak - (Sugar Maple) Forest Alliance
Association	*Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest
Association (English name)	Yellow Birch - Northern Red Oak / (Striped Maple, Mountain Maple) / Fancy Fern - Whorled Wood Aster Forest
Ecological System(s):	Central and Southern Appalachian Montane Oak Forest (CES202.596)

GLOBAL DESCRIPTION

Concept Summary: The global range of this community is poorly known but probably includes high-elevation areas of the central Appalachians in Virginia, West Virginia, Maryland, and Pennsylvania. In Virginia, this association is almost exclusively associated with cool, rocky, northwest- to northeast-facing slopes at elevations from about 975 m (3000 feet) to more than 1300 m (4300 feet). Habitats occur on various geologic substrates, including sandstone, metabasalt (greenstone), amphibolite, and granitic formations. *Betula alleghaniensis* and *Quercus rubra* are constant, high-cover, usually co-dominant canopy trees. Minor canopy associates include *Acer saccharum, Betula lenta, Tsuga canadensis, Tilia americana*, and *Fraxinus americana*. *Acer pensylvanicum* and *Acer spicatum* are the most abundant and characteristic understory trees, although *Ilex montana* may be locally abundant. More-or-less frequent shrubs include *Hamamelis virginiana, Sambucus racemosa (= Sambucus pubens)*, and *Hydrangea arborescens*. *Rhododendron maximum* is a dominant shrub at the two southernmost sites (Floyd and Scott counties, Virginia) but is absent elsewhere. The herb layer varies from moderately sparse to very dense.

Environmental Description: In Virginia, this association is almost exclusively associated with cool, rocky, northwest- to northeast-facing slopes at elevations from about 975 m (3000 feet) to more than 1300 m (4300 feet). Habitats occur on various geologic substrates, including sandstone, metabasalt (greenstone), amphibolite, and granitic formations. With one exception, soils collected at plot-sampling sites are very strongly to extremely acidic (mean pH = 4.2), with low base status. Sites are mesic to submesic and are often exposed to severe winter temperatures, wind, and ice. Bedrock and boulders typically cover more than 30% of the ground surface. Surface cover of bryophytes and lichens is usually greater than 10%.

Vegetation Description: *Betula alleghaniensis* and *Quercus rubra* are constant, high-cover, usually co-dominant canopy trees. Minor canopy associates include *Acer saccharum, Betula lenta, Tsuga canadensis, Tilia americana*, and *Fraxinus americana*. *Acer pensylvanicum* and *Acer spicatum* are the most abundant and characteristic understory trees, although *Ilex montana* may be locally abundant. More-or-less frequent shrubs include *Hamamelis virginiana, Sambucus racemosa (= Sambucus pubens)*, and *Hydrangea arborescens*. *Rhododendron maximum* is a dominant shrub at the two southernmost sites (Floyd and Scott counties, Virginia) but is absent elsewhere. The herb layer varies from moderately sparse to very dense. *Dryopteris intermedia, Oclemena acuminata (= Aster acuminatus), Angelica triquinata, Athyrium filix-femina ssp. asplenioides, Maianthemum canadense, Arisaema triphyllum*, and *Eurybia divaricata (= Aster divaricatus)* are the most constant and/or abundant herbaceous species. A large number of low-cover and/or low-constancy herbs also occur in the type. A few of the most characteristic include *Dryopteris marginalis, Viola blanda, Dennstaedtia punctilobula, Solidago curtisii, Impatiens pallida, Clintonia borealis, Ageratina altissima, Trillium undulatum, Circaea alpina, Carex aestivalis*, and *Carex debilis var. rudgei*. Species richness of plot-sampled stands ranges from 16 to 63 taxa per 400 square meters (mean = 32).

Most Abundant Species

Stratum **Lifeform** **Species**
Characteristic Species: *Acer pensylvanicum, Acer spicatum, Angelica triquinata, Athyrium filix-femina* ssp. *asplenioides, Betula alleghaniensis, Dryopteris intermedia, Hamamelis virginiana, Oclemena acuminata, Sambucus racemosa*
Other Noteworthy Species: *Aconitum reclinatum, Certhia americana, Poa saltuensis, Sphyrapicus varius*
USFWS Wetland System:

DISTRIBUTION
Range: The global range of this community is poorly known but probably includes high-elevation areas of the Central Appalachians in Virginia, West Virginia, Maryland, and Pennsylvania. In Virginia, this vegetation type is widely but locally distributed at higher elevations of the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains. It is very rare and local on the Blue Ridge south of Roanoke Gap, and in the Cumberland Mountains of southwestern Virginia.
States/Provinces: MD?, PA?, VA:S3, WV?
Federal Lands: NPS (Shenandoah); USFS (George Washington, Jefferson)

CONSERVATION STATUS
Rank: G3G4 (20-Jun-2001)
Reasons: Given potential range. Potentially found throughout the central Appalachians.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This association is somewhat intermediate between high-elevation *Quercus rubra*-dominated forests and `classic' (beech - birch - maple) northern hardwood forests. It can be readily distinguished from the two units referenced above (CEGL006045 and CEGL007285) by the complete absence of *Fagus grandifolia* and the infrequency of *Acer saccharum* and *Prunus serotina*.

On the northern Blue Ridge and higher ridges of the Ridge and Valley province, *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (CEGL008502) is the main `northern hardwood' forest in Virginia. This community appears to be absent from Allegheny Mountain in Highland County and the Mount Rogers - Whitetop Mountain area of the southern Blue Ridge, where *Acer saccharum - Betula alleghaniensis - Prunus serotina* Forest (CEGL006045) and *Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Eurybia chlorolepis - Dryopteris intermedia* Forest (CEGL007285) are prevalent, respectively.
Similar Associations:
- *Acer saccharum - Betula alleghaniensis - Prunus serotina* Forest (CEGL006045)
- *Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Eurybia chlorolepis - Dryopteris intermedia* Forest (CEGL007285)

Related Concepts:
- *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (Fleming and Coulling 2001) =
- *Quercus rubra - Betula alleghaniensis / Rhododendron catawbiense / Angelica triquinata - Aster acuminatus* Association (Rawinski et al. 1996) ?
- Northern Red Oak: 55 (Eyre 1980) B
- Yellow Birch - Red Oak Community (Johnson and Ware 1982) ?

SOURCES
Description Authors: G. Fleming
References: Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Johnson and Ware 1982, Rawinski et al. 1996

Common Name (Park-specific): Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type)

SYNONYMS:
NVC English Name: Northern Red Oak - White Oak / Mountain Holly / Hayscented Fern - Pennsylvania Sedge - Wavy Hairgrass

Forest

NVC Scientific Name: *Quercus rubra - Quercus alba / Ilex montana / Dennstaedtia punctilobula - Carex pensylvanica - Deschampsia*

***flexuosa* Forest**

NVC Identifier: CEGL008506

LOCAL DESCRIPTION

Environmental Description: See Global Environment.
Vegetation Description: See Global Vegetation description.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Amianthium muscitoxicum, Carex pensylvanica, Castanea dentata, Corylus cornuta, Dennstaedtia punctilobula, Deschampsia flexuosa, Hamamelis virginiana, Ilex montana, Kalmia latifolia, Lysimachia quadrifolia, Quercus alba, Quercus rubra, Vaccinium pallidum*
Other Noteworthy Species: *Information not available.*
Local Range: In Shenandoah National Park, this type is limited to gentle, mostly convex slopes and crests on the highest metabasalt and granitic ridges. It forms an extensive, almost continuous patch from the vicinity of Big Meadows north to the vicinity of The Pinnacle and Marys Rock. Smaller, outlying patches occur on Hightop, Stony Mountain, The Sag, Mount Marshall, Hogback and other high-elevation ridges.
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP105, SHNP106, SHNP107, SHNP110, SHNP113, SHNP114, SHNP115, SHNP116, SHNP118, SHNP119, SHNP120, SHNP121, SHNP122, SHNP123, SHNP517, SHNP522, SHNP531, SHNP532, SHNP543, SHNP568, SHNP602, SHNP603, SHNP604, SHNP621, SHNP658.
Shenandoah National Park Inventory Notes: Represented by 25 plots from the park.

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 rubra* Montane Forest Alliance (A.272)
Alliance (English name)	Northern Red Oak Montane Forest Alliance
Association	*Quercus rubra - Quercus alba / Ilex montana / Dennstaedtia punctilobula - Carex pensylvanica - Deschampsia flexuosa* Forest
Association (English name)	Northern Red Oak - White Oak / Mountain Holly / Hayscented Fern - Pennsylvania Sedge - Wavy Hairgrass Forest
Ecological System(s):	Central and Southern Appalachian Montane Oak Forest (CES202.596)

GLOBAL DESCRIPTION

Concept Summary: This community type is known primarily from the northern Blue Ridge of Virginia, with one documented occurrence in the western Ridge and Valley. Stands are restricted to elevations above 975 m (3000 feet). Prevailing aspect varies, but most examples are located on gentle to only moderately steep ridge crests and upper slopes. Soils are frequently bouldery and moderately to strongly infertile, with low base status. *Quercus rubra* is the principal dominant species in the overstory, with *Quercus alba* as a conspicuous, but usually low-cover, associate often in a subcanopy layer. Many stands have a stunted, somewhat open canopy. The abundance of *Castanea dentata* in the understory suggests its former importance in stands of this type. In localized stands, *Quercus velutina* or *Tsuga canadensis* share overstory dominance with *Quercus rubra*. The shrub layer is generally sparse to patchy, although an uncommon variant contains a dense ericaceous shrub layer. Composition of the herb layer varies considerably and usually features patch-dominance by one or more ferns and graminoids.
Environmental Description: Stands are primarily restricted to elevations above 975 m (3000 feet). Prevailing aspect varies, but most examples are located on gentle to only moderately steep ridge crests and upper slopes. Soils are frequently bouldery and moderately to strongly infertile, with low base status. In the Blue Ridge stands are underlain by mafic and felsic parent material, including metabasalt, layered pyroxene granulite, charnockite, and charnockite gneiss. The Ridge and Valley example occurs on a complex of clastic metasedimentary formations. Most stands likely experience frequent high winds and ice damage.
Vegetation Description: *Quercus rubra* is the principal dominant species in the overstory, with *Quercus alba* as a conspicuous, but usually low-cover, associate often in a subcanopy layer. Many stands have a stunted, somewhat open canopy. The abundance of *Castanea dentata* in the understory suggests its former importance in stands of this type. In localized stands, *Quercus velutina* or *Tsuga canadensis* share overstory dominance with *Quercus rubra*. Minor tree associates include *Betula alleghaniensis, Betula lenta, Pinus strobus, Acer saccharum,* and *Quercus prinus,* which is mostly restricted to elevations lower than those at which this type prevails. The shrub layer is generally sparse to patchy; *Acer pensylvanicum, Ilex montana,* and *Hamamelis virginiana* are the most

frequent species. Other tall shrubs occurring with lower cover and/or frequency include *Kalmia latifolia, Ribes rotundifolium, Rubus allegheniensis, Rhododendron prinophyllum, Corylus cornuta var. cornuta,* and *Prunus virginiana*. *Vaccinium pallidum* and *Vaccinium stamineum* are frequent low shrubs, sometimes comprising 10% or more of the herb layer. An uncommon variant of this community type, usually occupying sharply convex landforms with soils shallow to bedrock, contains a dense shrub layer composed largely of *Kalmia latifolia*. Herbaceous composition varies considerably and usually features patch-dominance by one or more of the following: *Dennstaedtia punctilobula, Carex pensylvanica, Lysimachia quadrifolia,* and *Deschampsia flexuosa*. *Calamagrostis porteri* is a patch-dominant grass in a very small percentage of stands. Other characteristic herbs of this community are *Ageratina altissima, Agrostis perennans, Amianthium muscitoxicum, Aralia nudicaulis, Asclepias exaltata, Dioscorea quaternata, Eurybia divaricata (= Aster divaricatus), Hieracium paniculatum, Maianthemum canadense, Pedicularis canadensis, Potentilla canadensis, Prenanthes altissima, Prenanthes trifoliolata, Smilax herbacea, Solidago arguta var. arguta,* and *Solidago curtisii*. Many additional herbs occur at low cover and constancy. Species richness of plot-sampled stands ranges from 13 to 61 taxa per 400 square meters (mean = 43).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Amianthium muscitoxicum, Carex pensylvanica, Castanea dentata, Corylus cornuta, Dennstaedtia punctilobula, Deschampsia flexuosa, Hamamelis virginiana, Ilex montana, Kalmia latifolia, Lysimachia quadrifolia, Quercus alba, Quercus rubra, Vaccinium pallidum*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

Range: In Virginia this community type is known primarily from the northern Blue Ridge, with one documented occurrence in the western Ridge and Valley. Most sampled stands are in Shenandoah National Park, with a few scattered stands located to the south, between the Roanoke and James rivers. It is likely that this type is more widespread than existing data suggest, and additional examples should be sought on gently sloping ridge crests and adjacent upper slopes in the Ridge and Valley. This community type is not believed to occur in the southern Appalachians. Lack of suitable high-elevation habitat may restrict the distribution north of Virginia.

States/Provinces: VA:S3

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

CONSERVATION STATUS

Rank: G3? (21-Jun-2001)

Reasons: Documentation of this type is almost entirely limited to high elevations of the northern Virginia Blue Ridge, where appropriate habitats are limited and patchy. Should additional examples be located north of Virginia, a revision to the global rank may be warranted.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Because of similarities between this and several similar types (especially CEGL008505), additional rangewide study and analysis of *Quercus rubra*-dominated montane forests is warranted.

Similar Associations:

- *Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest (CEGL006301)--higher diversity, more fertile soils, and a significant component of *Carya*.
- *Quercus rubra - Quercus alba - Fraxinus americana - Carya (ovata, ovalis) / Actaea racemosa* Forest (CEGL008518)--higher diversity, more fertile soils, and a significant component of *Carya*.
- *Quercus rubra - Quercus alba / Vaccinium pallidum* Forest [Provisional] (CEGL008507)--has more ericaceous shrubs, but lower overall species richness.
- *Quercus rubra - Quercus prinus / Deschampsia flexuosa - Danthonia compressa - Calamagrostis porteri* Woodland (CEGL004714)--additional data and quantitative sampling needed, i.e., importance of *Calamagrostis porteri*.
- *Quercus rubra / Ilex montana - Menziesia pilosa / Dennstaedtia punctilobula* Forest (CEGL008505)

Related Concepts:

- *Quercus rubra - Quercus alba / Rhododendron prinophyllum - Ilex montana / Calamagrostis porteri* Forest (Fleming and Coulling 2001) =
- *Quercus rubra / Ilex montana / Dennstaedtia punctilobula - Melanthium parviflorum* Association, *pro parte* (Rawinski et al. 1996) ?
- Northern Red Oak: 55 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming

References: Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Rawinski et al. 1996, VDNH 2003

Common Name (Park-specific): Mixed Oak / Heath Forest (Piedmont / Central Appalachian Low-Elevation Type)

SYNONYMS:

NVC English Name: White Oak - (Scarlet Oak, Black Oak, Rock Chestnut Oak) / Black Huckleberry Forest

NVC Scientific Name: *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest

NVC Identifier: CEGL008521

LOCAL DESCRIPTION

Environmental Description: Habitats occupied by this type in Shenandoah National Park are consistent with the Global Environment description. All park sites are gentle (0- to 10-degree slope) lower slopes and flats at very low elevations (<494 m [1620 feet]) at the western foot of the Blue Ridge, adjacent to the Shenandoah Valley. One site was documented on the upper slope of a low spur ridge in this setting. Underlying bedrock (principally shale and limestone of the Waynesboro Formation) is well covered by deep colluvial and alluvial fan deposits weathered from upslope Chilhowee Group quartzite. Site moisture potential generally appears to be in the subxeric or xeric classes. Soils collected from plots are extremely acidic and infertile sandy loams, with high iron levels. Evidence of past fires (charcoal, scars) was noted at several sites.

Vegetation Description: Composition of Shenandoah National Park stands is very similar to that described under Global Vegetation, except that the southern species *Oxydendrum arboreum* is absent, and stands contain a few species that are more characteristically montane in Virginia, e.g., *Pinus rigida, Quercus ilicifolia,* and *Gaultheria procumbens.* However, the same stands contain a number of low-elevation species that are otherwise rare in the park, e.g., *Quercus falcata, Quercus stellata, Castanea pumila, Gentiana villosa,* etc.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Amelanchier arborea, Gaylussacia baccata, Isotria verticillata, Nyssa sylvatica, Pteridium aquilinum* var. *latiusculum, Quercus alba, Quercus coccinea, Quercus prinus, Quercus velutina, Vaccinium pallidum*

Other Noteworthy Species: *Information not available.*

Local Range: This is the principal forest cover on gentle slopes and alluvial fan terrain at the western foot of the park, primarily in the southern section.

Classification Comments: See Global Classification Comments.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP083, SHNP084, SHNP089, SHNP091, SHNP508, SHNP581, SHNP646, SHNP672, SHNP673, SHNP679.

Shenandoah National Park Inventory Notes: Represented by ten plots from the park.

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 velutina - Quercus alba - (Quercus coccinea)* Forest Alliance (A.1911)
Alliance (English name)	Black Oak - White Oak - (Scarlet Oak) Forest Alliance
Association	*Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest
Association (English name)	White Oak - (Scarlet Oak, Black Oak, Rock Chestnut Oak) / Black Huckleberry Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This community is a matrix forest of dry, nutrient-poor uplands of the Mid-Atlantic Piedmont Plateau, extending into similar low-elevation landscapes of the northern Blue Ridge and Ridge and Valley, Cumberland Plateau and Inner Coastal Plain provinces. The type is well-documented across Virginia, and to a lesser extent in Tennessee and Maryland, but probably also occurs at similar sites in West Virginia and Pennsylvania. Stands are located between 30 and 700 m (100-2300 feet) elevation on rolling to sublevel sites of Piedmont and Inner Coastal Plain uplands, mountain valleys and lower mountain slope benches. In the mountains, many documented occurrences are located on ancient alluvial fan deposits, which are especially extensive along the

western foot of the Blue Ridge. The vegetation is a closed to very open oak forest with mixed and variable canopy dominance by *Quercus alba, Quercus velutina, Quercus coccinea*, and *Quercus prinus*. Various *Pinus* spp., including *Pinus virginiana, Pinus echinata, Pinus strobus*, and *Pinus rigida*, are frequent overstory associates, particularly following fire or logging disturbances. *Quercus falcata, Quercus stellata, Carya glabra*, and *Carya alba* are infrequent canopy trees. *Nyssa sylvatica, Amelanchier arborea* and, in the southern part of the range, *Oxydendrum arboreum* attain exceptional abundance and stature in these forests, dominating the subcanopy layers and occasionally reaching the overstory. *Acer rubrum* and *Sassafras albidum* are other common understory trees. In typical stands, the shrub layer is dominated by deciduous ericaceous species, herbaceous species are sparse, and species-richness is moderate to very low.

Environmental Description: Stands are located between 30 and 700 m (100-2300 feet) elevation on rolling to sublevel sites of Piedmont and Inner Coastal Plain uplands, mountain valleys and lower mountain slope benches. The type is generally distributed in nutrient-poor soils of the Piedmont uplands. In the mountains, many documented occurrences are located on ancient alluvial fan deposits, which are especially extensive along the western foot of the Blue Ridge from Page County south to Rockbridge County. Similar but smaller fans are common where incising streams drain "piedmont" landforms at the foot of Ridge and Valley strike ridges (Harbor 1996). Slopes of plot-sampled stands range from 1-13 degrees (mean = 6 degrees), with aspects essentially flat to westerly. Soils of these sites are deep, very oligotrophic, gravelly loams with low pH and base status. Exposed rocks of any kind (outcrops, boulders, or stones) are usually sparse to absent. Most sites appear to have a history of fires.

Vegetation Description: The vegetation is a closed to very open oak forest with mixed and variable canopy dominance by *Quercus alba, Quercus coccinea*, and *Quercus prinus*. Various *Pinus* spp., including *Pinus virginiana, Pinus echinata, Pinus strobus*, and *Pinus rigida*, are frequent overstory associates, particularly following fire or logging disturbances. *Quercus falcata, Quercus stellata, Carya glabra*, and *Carya alba* are infrequent canopy trees. *Nyssa sylvatica, Amelanchier arborea* and, in the southern part of the range, *Oxydendrum arboreum* attain exceptional abundance and stature in these forests, dominating the subcanopy layers and occasionally reaching the overstory. *Acer rubrum* and *Sassafras albidum* are other common understory trees. The shrub layer is typically dominated by deciduous ericaceous species, with *Gaylussacia baccata, Vaccinium pallidum*, and/or *Vaccinium stamineum* consistently forming dense colonies. Less abundant or constant shrubs and vines include *Castanea pumila, Quercus ilicifolia, Kalmia latifolia, Rhododendron periclymenoides, Lyonia ligustrina, Vaccinium stamineum, Smilax glauca, Smilax rotundifolia*, and *Cornus florida*. Despite high shrub densities, a number of low-cover herbs and subshrubs occur in the type, including *Chimaphila maculata, Isotria verticillata, Uvularia puberula, Epigaea repens, Pteridium aquilinum var. latiusculum, Cypripedium acaule, Gentiana villosa, Comandra umbellata, Angelica venenosa*, and *Iris verna*. Mean species richness of 40 Virginia plot samples is 25 taxa per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Amelanchier arborea*, *Castanea pumila*, *Gaylussacia baccata*, *Isotria verticillata*, *Nyssa sylvatica*, *Oxydendrum arboreum*, *Quercus alba*, *Quercus coccinea*, *Quercus velutina*, *Rhododendron periclymenoides*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

Range: This community is a matrix forest of dry, nutrient-poor uplands of the Mid-Atlantic Piedmont Plateau, extending into similar low-elevation landscapes of the northern Blue Ridge and Ridge and Valley provinces of the Central Appalachians, and the Cumberland Plateau in Tennessee. In Maryland and northern Virginia, the type also occurs on uplands of the dissected Inner Coastal Plain. The type is well-documented through quantitative analysis in Virginia, and qualitatively in Maryland, but probably also occurs at similar sites in West Virginia and Pennsylvania.

States/Provinces: KY?, MD, PA?, TN, VA:S5, WV?

Federal Lands: DOD (Fort Belvoir); NPS (Big South Fork, Fredericksburg-Spotsylvania, Obed, Prince William, Shenandoah); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G5 (24-Jan-2005)

Reasons: This community is a matrix-forming vegetation type in the Virginia and Maryland Piedmont and is probably more widespread at low elevations of the central Appalachian Mountains than documentation indicates.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This unit is distinct among Virginia's oak/heath forests in its occurrence on low-elevation, rolling to sub-level, usually non-rocky terrain of the Piedmont and mountains. *Quercus alba*, normally a minor tree in montane oak/heath forests, is characteristic and usually co-dominant, while the prevalence of deciduous ericads and the presence of the low-elevation oaks *Quercus falcata* and *Quercus stellata* further distinguish the type. *Quercus prinus* and *Kalmia latifolia*, although present and occasionally abundant, are not as important in this unit as in related Central Appalachian oak/heath vegetation types, particularly *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299). The latter is generally associated with

relatively steep, often rocky terrain of the Central Appalachians and dissected topography in the Piedmont. Originally, the concept of this type was restricted to "Piedmont"-like landscapes in the mountains. However, additional quantitative data analysis of a statewide (Virginia) set of 180 oak/heath plots led to a broader conceptual interpretation that includes both montane and Piedmont stands. The type is represented by more than 50 plots from Virginia. Attempts to split this unit based on the presence or absence of *Quercus prinus* have proven unworkable because significant environmental or floristic differences between the putative groups are lacking.

Similar Associations:

- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271)--of southern Appalachians.
- *Quercus alba - Quercus falcata - (Pinus taeda) / Gaylussacia frondosa* Forest (CEGL006269)--of the Mid-Atlantic Coastal Plain.
- *Quercus alba - Quercus falcata / Vaccinium (arboreum, hirsutum, pallidum)* Forest (CEGL008567)--described from southeastern Tennessee, with similar understory and associated species but with prominent *Quercus falcata*.
- *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299)--of the Central Appalachians and northern Piedmont.

Related Concepts:

- *Quercus alba - Quercus falcata - Carya tomentosa / Cornus florida* Association (Rawinski et al. 1996) ?
- *Quercus coccinea - Quercus velutina - Quercus alba / Amelanchier arborea / Gaylussacia baccata* Forest (Fleming and Coulling 2001) ?
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES

Description Authors: G.P. Fleming and P. Coulling, mod. L.A. Sneddon

References: Eyre 1980, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Harbor 1996, Rawinski et al. 1996, Schmalzer and DeSelm 1982, TDNH unpubl. data

Common Name (Park-specific): Black Locust Successional Forest

SYNONYMS:

NVC English Name: Black Locust Forest

NVC Scientific Name: *Robinia pseudoacacia* Forest

NVC Identifier: CEGL007279

LOCAL DESCRIPTION

Environmental Description: This semi-natural forest is found in formerly cleared pastures and old homesites throughout the park. Although it is scattered at all elevations, this type extends to higher topographic positions and higher elevations (up to at least 1000 m [3300 feet]) than *Liriodendron tulipifera*-dominated successional forests of the lower slopes. Underlying bedrock is mostly metabasalt or granitic, and soils are intermediate in fertility.

Vegetation Description: Most Shenandoah National Park stands represent decadent successional forests that were once dominated by *Robinia pseudoacacia* but are now mixed forests of *Fraxinus americana, Robinia pseudoacacia*, and sometimes *Prunus serotina, Liriodendron tulipifera*, or *Sassafras albidum*. Later-successional trees such as *Quercus rubra, Carya* spp., and *Pinus strobus* are usually established in the stands. Shrub growth can be dense and contains both native species, such as *Lindera benzoin* and *Rubus allegheniensis*, and exotics such as *Lonicera morrowii, Celastrus orbiculata*, and *Rubus phoenicolasius*. A wide variety of more-or-less mesophytic forest herbs occur, but the invasive exotics *Alliaria petiolata* and/or *Polygonum caespitosum var. longisetum* frequently dominate.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Alliaria petiolata, Fraxinus americana, Lindera benzoin, Osmorhiza claytonii, Robinia pseudoacacia, Rubus allegheniensis*

Other Noteworthy Species: *Information not available.*

Local Range: Although plot samples are basically from just two sites, similar vegetation has been observed or documented by NPS data in many places in the park, e.g., Milam Gap, Big Meadows, South River picnic area, Loft Mountain, etc.

Classification Comments: Most Shenandoah National Park examples represent vegetation successionally transitional between pioneering forests once dominated by *Robinia pseudoacacia* and one or more of the montane or basic oak-hickory forests. This vegetation extends to middle to higher elevations where *Liriodendron* is absent (or at least not dominant) and has a prominent component of invasive exotics such as *Alliaria petiolata*.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP510, SHNP513, SHNP515, SHNP524, SHNP527, SHNP529.

Shenandoah National Park Inventory Notes: Represented by six plots from the park.

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 Oak Forest (CES202.898)
	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

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 home sites. The vegetation is dominated by *Robinia pseudoacacia*. Associated woody species vary from site to site and include *Prunus serotina, Ulmus americana*, and in some areas *Acer platanoides*. Understory vegetation is highly variable depending on site history and can include *Toxicodendron radicans*. Non-native species such as *Alliaria petiolata, Chelidonium majus*, and *Convallaria majalis* can characterize the herb layer.

Environmental Description: This type often establishes on old fields abandoned after agricultural cropping or pasturing or around old home sites.

Vegetation Description: The vegetation is dominated by *Robinia pseudoacacia*. Associated woody species vary from site to site and include *Prunus serotina, Ulmus americana*, and in some areas *Acer platanoides*. Understory vegetation is highly variable depending on site history and can include *Toxicodendron radicans*. Non-native species such as *Alliaria petiolata, Chelidonium majus*, and *Convallaria majalis* can characterize the herb layer.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Robinia pseudoacacia*

Characteristic Species: *Robinia pseudoacacia*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

Range: This black locust semi-natural forest is found locally throughout the eastern United States. Its distribution is not completely known because many states have not developed lists of semi-natural types in their states.

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

Federal Lands: NPS (Blue Ridge Parkway, Cape Cod, Cumberland Gap, Marsh-Billings-Rockefeller, Minute Man, Morristown, Shenandoah, Vicksburg); USFS (George Washington, Jefferson, Ouachita, Ozark)

CONSERVATION STATUS

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

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

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments:

Similar Associations:

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

Related Concepts:

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

SOURCES

Description Authors: D. Faber-Langendoen, mod. S.C. Gawler
References: Baalman 1965, CAP pers. comm. 1998, Elias 1980, Fleming and Coulling 2001, Gaertner 1955, Hoagland 2000, INAI unpubl. data, McDonald 1938, Rawinski et al. 1996, Southeastern Ecology Working Group n.d., TDNH unpubl. data

Common Name (Park-specific): Northern Blue Ridge Montane Alluvial Forest

SYNONYMS:

NVC English Name: Tuliptree - Sycamore - Sweet Birch / Northern Spicebush / Broadleaf Enchanter's-nightshade Forest

NVC Scientific Name: *Liriodendron tulipifera - Platanus occidentalis - Betula lenta / Lindera benzoin / Circaea lutetiana* ssp. *canadensis* Forest

NVC Identifier: CEGL006255

LOCAL DESCRIPTION

Environmental Description: See Global Environment description.
Vegetation Description: See Global Vegetation. The most constant and abundant trees among 13 plot-sampled stands in the park are *Liriodendron tulipifera, Quercus rubra, Acer rubrum, Betula lenta, Tilia americana, Fraxinus americana,* and *Platanus occidentalis*. *Lindera benzoin* dominates the shrub layer of most stands. *Toxicodendron radicans* and *Parthenocissus quinquefolia* are common climbing and scrambling vines. The most frequent herbs are *Viola sororia, Circaea lutetiana ssp. canadensis, Osmorhiza claytonii,* and *Galium triflorum.* More locally abundant herbs include *Amphicarpaea bracteata, Alliaria petiolata, Laportea canadensis, Polygonum caespitosum var. longisetum,* and *Microstegium vimineum.*
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Amphicarpaea bracteata, Circaea lutetiana* ssp. *canadensis, Lindera benzoin, Liriodendron tulipifera, Parthenocissus quinquefolia, Platanus occidentalis, Quercus rubra, Toxicodendron radicans, Viola sororia*
Other Noteworthy Species: *Information not available.*
Local Range: This type is apparently confined to the more fertile mountain-foot floodplains and is therefore most frequent on the eastern flank of the park. At the foot of the western flank, this type does not occur in sterile floodplains filled with alluvium from Chilhowee Group quartzites but is restricted to local floodplains filled with metabasalt alluvium (e.g., Jeremy's Run).
Classification Comments: This community is probably best identified in the field by its floodplain habitat rather than specific floristic composition.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP521, SHNP525, SHNP536, SHNP592, SHNP610, SHNP615, SHNP616, SHNP627, SHNP628, SHNP641, SHNP642, SHNP643, SHNP645.
Shenandoah National Park Inventory Notes: Represented by 13 plots from the park.

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 (A.289)	*Platanus occidentalis - (Liquidambar styraciflua, Liriodendron tulipifera)* Temporarily Flooded Forest Alliance
Alliance (English name)	Sycamore - (Sweetgum, Tuliptree) Temporarily Flooded Forest Alliance
Association	*Liriodendron tulipifera - Platanus occidentalis - Betula lenta / Lindera benzoin / Circaea lutetiana* ssp. *canadensis* Forest
Association (English name)	Tuliptree - Sycamore - Sweet Birch / Northern Spicebush / Broadleaf Enchanter's-nightshade Forest

Ecological System(s):

GLOBAL DESCRIPTION

Concept Summary: This community type occupies montane alluvial floodplains along more-or-less high-gradient streams and small rivers at the foot of the Blue Ridge. It appears to be confined to floodplains with relatively fertile alluvial deposits derived from

metabasalt (greenstone), pyroxene-rich granites, or metasiltstone/phyllite. These habitats are typically narrow, nearly flat, and have complex, coarse, bouldery or cobbly microtopography and rocky streambeds. Soils are well-drained and moderately fertile. Most of the lower streamside terraces are probably flooded briefly at least annually. Larger floods are rare. However, periodic catastrophic floods associated with hurricanes or exceptionally large rainfall events may be very destructive to stream channels and vegetation. Many of these sites were probably cleared and/or subjected to multiple historical disturbances, including grazing and cultivation . This forest is composed primarily of mesophytic upland species with some admixture of species characteristic of alluvial and wetland habitats. Vegetation is generally species-rich and heterogeneous, with composition frequently shifting in association with microhabitat conditions and disturbance histories. The overstory typically contains many tree species. However, *Liriodendron tulipifera* is generally a constant co-dominant, while *Platanus occidentalis* is usually scattered and occasionally abundant. Other species that are important in some stands include *Acer negundo, Acer rubrum, Acer saccharum, Betula alleghaniensis, Betula lenta, Betula nigra, Carya cordiformis, Carya ovata, Fagus grandifolia, Fraxinus americana, Fraxinus pennsylvanica, Juglans nigra, Nyssa sylvatica, Quercus alba, Quercus prinus, Quercus rubra, Tilia americana, Tsuga canadensis, Ulmus americana,* and *Ulmus rubra*. The understory contains saplings of the overstory species, along with *Asimina triloba, Carpinus caroliniana, Cornus florida, Corylus* spp., *Hamamelis virginiana, Lindera benzoin, Ostrya virginiana*, and *Viburnum prunifolium*. The herb layer is very diverse and dominated by numerous upland mesophytic species. Wet microhabitats typically support *Impatiens capensis, Carex intumescens, Carex tribuloides, Glyceria striata, Thalictrum pubescens, Viola cucullata,* and few other wetland plants.

Environmental Description: This community type occupies montane alluvial floodplains along more-or-less high-gradient streams and small rivers at the foot of the Blue Ridge. It appears to be confined to floodplains with relatively fertile alluvial deposits derived from metabasalt (greenstone), pyroxene-rich granites, or metasiltstone/phyllite. These habitats are typically narrow, nearly flat, and have complex, coarse, bouldery or cobbly microtopography and rocky streambeds. Soils are well-drained and moderately fertile. Most of the lower streamside terraces are probably flooded briefly at least annually. Larger floods are rare. However, periodic catastrophic floods associated with hurricanes or exceptionally large rainfall events may be very destructive to stream channels and vegetation. Many of these sites were probably cleared and/or subjected to multiple historical disturbances, including grazing and cultivation.

Vegetation Description: This forest is composed primarily of mesophytic upland species with some admixture of species characteristic of alluvial and wetland habitats. Vegetation is generally species-rich and heterogeneous, with composition frequently shifting in association with microhabitat conditions and disturbance histories. The overstory typically contains many tree species. However, *Liriodendron tulipifera* is generally a constant co-dominant, while *Platanus occidentalis* is usually scattered and occasionally abundant. Other species that are important in some stands include *Acer negundo, Acer rubrum, Acer saccharum, Betula alleghaniensis, Betula lenta, Betula nigra, Carya cordiformis, Carya ovata, Fagus grandifolia, Fraxinus americana, Fraxinus pennsylvanica, Juglans nigra, Nyssa sylvatica, Quercus alba, Quercus prinus, Quercus rubra, Tilia americana, Tsuga canadensis, Ulmus americana,* and *Ulmus rubra*. The understory contains saplings of the overstory species, along with *Asimina triloba, Carpinus caroliniana, Cornus florida, Corylus* spp., *Hamamelis virginiana, Lindera benzoin, Ostrya virginiana*, and *Viburnum prunifolium*. The herb layer is very diverse and dominated by numerous upland mesophytic species. Wet microhabitats typically support Impatiens capensis, *Carex intumescens, Carex tribuloides, Glyceria striata, Thalictrum pubescens, Viola cucullata,* and few other wetland plants.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Amphicarpaea bracteata, Arisaema triphyllum, Betula lenta, Carpinus caroliniana, Circaea lutetiana* ssp. *canadensis, Impatiens capensis, Lindera benzoin, Liriodendron tulipifera, Platanus occidentalis, Polystichum acrostichoides, Thelypteris noveboracensis, Toxicodendron radicans*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION

Range: The type likely occurs along the foot of the northern Blue Ridge from near Roanoke, Virginia, to the north end of Catoctin Mountain, Maryland.

States/Provinces: MD, VA

Federal Lands: NPS (Blue Ridge Parkway, Catoctin Mountain, Shenandoah)

CONSERVATION STATUS

Rank: G3? (5-Aug-2004)

Reasons: There are probably hundreds of occurrences of this community along the length of the northern Blue Ridge. However, patches are relatively small and high-quality stands are uncommon.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 3 - Weak

Comments: Montane floodplain forests of the Appalachians are poorly inventoried. Based on existing data, this vegetation appears to represent a relatively cohesive, if variable, association-level unit.

Similar Associations:

- *Liquidambar styraciflua - Liriodendron tulipifera - (Platanus occidentalis) / Carpinus caroliniana - Halesia tetraptera / Amphicarpaea bracteata* Forest (CEGL007880)--occurs in similar southern Appalachian floodplains.
- *Liriodendron tulipifera - Pinus strobus - (Tsuga canadensis) / Carpinus caroliniana / Amphicarpaea bracteata* Forest (CEGL008405)--similar Central Appalachian montane floodplain forest (primarily of shale and metasedimentary substrates) with a prominent coniferous component.
- *Platanus occidentalis - Liriodendron tulipifera - Betula (alleghaniensis, lenta) / Alnus serrulata - Leucothoe fontanesiana* Forest (CEGL004691)--occurs in similar southern Appalachian floodplains.

Related Concepts:

SOURCES

Description Authors: G. Fleming
References: Eastern Ecology Working Group n.d., Fleming et al. 2004, Lea 2003

Common Name (Park-specific): Central Appalachian Acidic Seepage Swamp

SYNONYMS:

NVC English Name: Red Maple - Blackgum / Winterberry - Black Highbush Blueberry / Cinnamon Fern Forest
NVC Scientific Name: *Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest
NVC Identifier: CEGL007853

LOCAL DESCRIPTION

Environmental Description: Shenandoah National Park examples of this association occur along low-elevation headwaters streams on the acidic, metasedimentary terrain of the western flank. All known examples are at very low elevations (<520 m [1700 feet]) on ancient alluvial fans bordering the Shenandoah Valley. Habitats typically feature braided streams with Sphagnum-covered hummocks. Soils are extremely acidic and infertile, with high iron levels.
Vegetation Description: The few known stands in the park conform closely to the Global Vegetation description, although one stand (plot SHNP632) is a marginal, somewhat disturbed example. Documented park stands are dominated by *Acer rubrum, Nyssa sylvatica, Vaccinium fuscatum* and *Vaccinium corymbosum, Rubus hispidus,* and *Osmunda cinnamomea*. *Symplocarpus foetidus* and *Veratrum viride* are absent, although they could possibly occur in stands that have not been inventoried.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Alnus serrulata, Amelanchier arborea, Carex atlantica* ssp. *atlantica, Ilex verticillata, Nyssa sylvatica, Osmunda cinnamomea, Rubus hispidus, Smilax glauca, Smilax rotundifolia, Vaccinium corymbosum, Vaccinium fuscatum, Viola cucullata*
Other Noteworthy Species: *Information not available.*
Local Range: Known examples in Shenandoah National Park are confined to seepage areas along streams in the low-elevation alluvial fans at the western foot of the park.
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP082, SHNP612, SHNP632.
Shenandoah National Park Inventory Notes: Represented by three plots from the park.

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	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	*Acer rubrum - Nyssa sylvatica* Saturated Forest Alliance (A.348)
Alliance (English name)	Red Maple - Blackgum Saturated Forest Alliance
Association	*Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest
Association (English name)	Red Maple - Blackgum / Winterberry - Black Highbush Blueberry / Cinnamon Fern Forest

Ecological System(s): North-Central Appalachian Acidic Swamp (CES202.604)
Piedmont Seepage Wetland (CES202.298)

GLOBAL DESCRIPTION

Concept Summary: This community occurs on groundwater-saturated flats and low slopes along streams in the Ridge and Valley, northern Blue Ridge, and western Piedmont at elevations of 200-360 m (700-1200 feet). The canopy is usually closed and consists of *Acer rubrum, Nyssa sylvatica,* and *Liriodendron tulipifera*. *Pinus rigida* is a frequent overstory associate in some Ridge and Valley and Blue Ridge stands, although its numbers have been recently reduced by southern pine beetle outbreaks. Other tree species may include *Magnolia acuminata* (especially at higher elevations), *Betula lenta* (especially at higher elevations), and *Pinus strobus* (especially at higher elevations). The shrub stratum is usually well-developed and includes *Ilex verticillata, Vaccinium fuscatum, Vaccinium corymbosum, Kalmia latifolia, Alnus serrulata, Viburnum nudum var. cassinoides, Viburnum dentatum, Menziesia pilosa, Chionanthus virginicus, Smilax* spp., and, less consistently, *Carpinus caroliniana, Lindera benzoin, Gaylussacia frondosa, Gaylussacia baccata, Viburnum nudum var. nudum, Rhododendron catawbiense, Rhododendron periclymenoides, Rhododendron viscosum,* and *Toxicodendron vernix*. *Rubus hispidus* is an abundant creeping vine in many stands. Typical herbaceous plants are *Osmunda cinnamomea, Carex gynandra, Helonias bullata, Thelypteris noveboracensis, Medeola virginiana, Lycopodium obscurum, Osmunda regalis var. spectabilis, Parnassia asarifolia, Symplocarpus foetidus, Veratrum viride,* and *Viola cucullata*. The recognition of segregate associations, subassociations, or variants may be warranted following additional assessment, ideally based on wider geographic sampling. Lower elevation sites are characterized by *Amianthium muscitoxicum, Brachyelytrum erectum, Carex debilis, Carex intumescens, Cypripedium acaule, Gaylussacia frondosa, Lindera benzoin, Platanthera ciliaris, Platanthera clavellata, Uvularia sessilifolia, Viburnum nudum var. nudum,* and *Viola X primulifolia*. Middle-elevation sites are characterized by *Oclemena acuminata (= Aster acuminatus), Betula lenta, Magnolia acuminata, Pinus strobus, Rhododendron catawbiense,* and *Rhododendron viscosum*. A single site (Magnolia Swamp), possibly with boggier or more organic soils, is characterized by *Magnolia virginiana, Arethusa bulbosa, Dulichium arundinaceum, Juncus effusus, Parthenocissus quinquefolia, Triadenum virginicum,* and *Woodwardia areolata*.

Environmental Description: This community occurs on groundwater-saturated flats along low- to middle-elevation streams and headwaters seeps in areas underlain by acidic sedimentary and metamorphic rocks. It is a small-patch type that is particularly frequent and well-developed in the large alluvial fans along the western foot of the northern Blue Ridge and in small-stream valleys of the Ridge and Valley province. Outliers occur throughout the western Piedmont, particularly in districts underlain by acidic metasedimentary rocks. Habitats are usually more-or-less narrow and elongate, with hummock-and-hollow microtopography. Soils are predominantly mineral, but local areas of organic muck sometimes accumulate in depressions. The ground surface is slightly sloping, and drainage is usually via small, intricately braided channels with interspersed hummocks. Moss mats, predominantly of *Sphagnum* spp., are usually abundant and provide a rooting medium for herbaceous species. Soils collected from plot samples were very strongly acidic with moderately low to very low base status.

Vegetation Description: This forest association has an open to closed canopy of *Acer rubrum, Nyssa sylvatica,* and *Liriodendron tulipifera*. *Pinus rigida* is a frequent overstory associate in some Ridge and Valley and Blue Ridge stands, although its numbers have been recently reduced by southern pine beetle outbreaks. Minor tree species, especially at the higher elevations, include *Magnolia acuminata, Betula lenta,* and *Pinus strobus*. A single, anomalous stand in Augusta County, Virginia, contains an abundance of the disjunct Coastal Plain tree *Magnolia virginiana* (Carr 1939). *Amelanchier arborea* is usually common in the understory, along with reproduction of *Acer rubrum* and *Nyssa sylvatica*. The shrub stratum is often well-developed and includes *Vaccinium fuscatum, Ilex verticillata, Kalmia latifolia, Alnus serrulata, Viburnum dentatum, Photinia pyrifolia (= Aronia arbutifolia), Vaccinium corymbosum,* and *Smilax* spp. Less frequent, but locally important, shrubs include *Toxicodendron vernix, Viburnum nudum var. nudum, Viburnum nudum var. cassinoides, Menziesia pilosa, Carpinus caroliniana, Chionanthus virginicus, Lindera benzoin, Gaylussacia frondosa, Rhododendron catawbiense, Rhododendron periclymenoides,* and *Rhododendron viscosum*. *Rubus hispidus* is an abundant creeping vine in many stands. The most characteristic herbaceous plants are *Osmunda cinnamomea, Osmunda regalis var. spectabilis, Platanthera clavellata, Chelone glabra, Rubus hispidus, Viola cucullata, Carex gynandra, Oxypolis rigidior, Carex atlantica, Thelypteris noveboracensis,* and *Carex debilis*. Less frequent but typical herbs include *Parnassia asarifolia, Carex intumescens, Carex leptalea, Symplocarpus foetidus, Veratrum viride, Maianthemum canadense, Lycopodium obscurum,* and *Dryopteris cristata*. Many additional herbaceous species occur at low constancy and cover. Mean species richness of 17 plot-sampled stands is 53 taxa per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Alnus serrulata, Carex debilis, Chelone glabra, Dichanthelium dichotomum, Heteromeles arbutifolia, Ilex verticillata, Liriodendron tulipifera, Nyssa sylvatica, Osmunda cinnamomea, Rubus hispidus, Vaccinium fuscatum*

Other Noteworthy Species: *Eriocaulon decangulare, Helonias bullata*

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: The probable range of this community type encompasses the Central Appalachian region of Pennsylvania, Maryland, Virginia, and West Virginia, and possibly the Cumberland Mountains. In Virginia it is scattered throughout the mountains and, more locally, the western Piedmont (Allard and Leonard 1943).

States/Provinces: MD, PA?, VA:S3?, WV?
Federal Lands: NPS (Blue Ridge Parkway, Catoctin Mountain, Shenandoah); USFS (George Washington)

CONSERVATION STATUS

Rank: G3G4 (1-Oct-2001)
Reasons: This association has a narrow geographic range and is further limited by its requirement for special, localized wetlands. The type is confined to groundwater-saturated, nutrient-poor habitats that are large enough to support forest vegetation.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Examples occur near the Maple Flats pond complex (Augusta County, Virginia). This community is also known from Massanutten Mountain (Lee District, George Washington National Forest), elsewhere along the foot of the Blue Ridge (north of Maple Flats), a site on the northern Blue Ridge in Loudoun County, Virginia (owned by The Appalachian Trail Club), and in the Bull Run Mountains of Virginia, an isolated Piedmont foothill in Fauquier and Prince William counties, Virginia; occurrences in the latter two areas do not have *Pinus rigida* (or much of it) but are otherwise very similar (Fleming 1998). Quantitative analysis of a 1300-plot regional dataset for the National Capital Region Parks Vegetation Mapping Project Phase I indicated that a portion of Gould and Berdine's (1998) "circumneutral" seepage swamp community from Catoctin Mountain, Maryland, also corresponds into this type.

There are unresolved issues regarding conceptual overlap between this type and *Acer rubrum - Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest (CEGL006132). The latter type is a broadly defined community type that encompasses both seepage wetlands and poorly drained depressions. The community classified and described here for Virginia is limited conceptually to flow-through, groundwater-seepage wetlands. Communities with similar *Acer - Nyssa* canopies but occurring in saturated to seasonally flooded depression wetlands without apparent seepage inputs have been documented in Virginia but are not treated due to insufficient data. Nevertheless, they appear to warrant segregation from the seepage wetland communities because of their hydrologic regime, distinctly different herbaceous composition, and much lower species richness.

This type is currently under-represented by plot data, but observations suggest that it is relatively consistent in its composition and environmental affiliations. However, community characterization and nomenclature are subject to change pending further data collection and analysis, ideally based on wider geographic sampling. The recognition of segregate associations, subassociations, or variants may also be warranted following additional assessment. This type is similar in many respects to, and intergrades with, Montane Basic Seepage Swamps that are situated on calcareous soils derived from metabasalt (greenstone) and carbonate rock substrates [see *Acer rubrum - Fraxinus americana - Fraxinus nigra - Liriodendron tulipifera / Carex bromoides - Caltha palustris* Forest (CEGL008416)]. These environmentally disparate swamps share a surprising number of prominent species including *Acer rubrum, Symplocarpus foetidus, Veratrum viride, Osmunda cinnamomea, Osmunda regalis var. spectabilis, Carex leptalea*, etc. Acidic seepage swamps, however, have lower species richness and mostly lack distinctly base-loving species such as *Fraxinus americana, Fraxinus nigra, Caltha palustris, Carex bromoides, Saxifraga pensylvanica*, etc. *Sphagnum* mosses, as well as many vascular plants that characterize Acidic Seepage Swamps, are absent or unimportant in the calcareous swamps. Examples include *Pinus rigida, Nyssa sylvatica, Viburnum nudum, Parnassia asarifolia, Platanthera ciliaris, Platanthera clavellata, Rubus hispidus, Lycopodium obscurum, Carex debilis*, and *Carex folliculata* (Fleming and Van Alstine 1999).

Formerly a common canopy tree of this community type in certain localities (e.g., Maple Flats, Augusta County), *Pinus rigida* has been nearly eliminated from many stands by a recent outbreak of southern pine beetles (*Dendroctonus frontalis*).
Similar Associations:
- *Acer rubrum - Fraxinus americana - Fraxinus nigra - Liriodendron tulipifera / Carex bromoides - Caltha palustris* Forest (CEGL008416)
- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum* var. *nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238)
- *Acer rubrum - Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest (CEGL006132)

Related Concepts:
- *Acer rubrum - Fraxinus pennsylvanica - Betula (alleghaniensis, lenta) / Ilex verticillata / Symplocarpus foetidus* Forest (Gould and Berdine 1998) I
- *Acer rubrum - Liriodendron tulipifera / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea - Symplocarpus foetidus* Forest (Fleming 2002a) =
- *Acer rubrum - Nyssa sylvatica - Pinus rigida / Ilex verticillata / Osmunda cinnamomea* community (Fleming and Van Alstine 1999) ?
- *Acer rubrum - Nyssa sylvatica / Vaccinium fuscatum - Ilex verticillata / Osmunda cinnamomea* Forest (Fleming and Coulling 2001) ?

SOURCES

Description Authors: G. Fleming and P. Coulling
References: Allard and Leonard 1943, Carr 1939, Fleming 1998, Fleming 2002a, Fleming and Coulling 2001, Fleming and Van Alstine 1999, Fleming et al. 2001, Fleming pers. comm., Gould and Berdine 1998, Southeastern Ecology Working Group n.d., VDNH 2003

Common Name (Park-specific): Central Appalachian Basic Seepage Swamp

SYNONYMS:

NVC English Name: Red Maple - White Ash - Black Ash - Tuliptree / Brome-like Sedge - Yellow Marsh-marigold Forest

NVC Scientific Name: *Acer rubrum - Fraxinus americana - Fraxinus nigra - Liriodendron tulipifera / Carex bromoides - Caltha palustris* Forest

NVC Identifier: CEGL008416

LOCAL DESCRIPTION

Environmental Description: In Shenandoah National Park, this community type occurs at lower to middle elevations in linear patches along groundwater-saturated bottoms of streams and in headwaters seepage areas. Plot-sampled sites range from 420 to 940 m (1380-3080 feet) elevation (mean = 823 m [2700 feet]) and are confined to substrates weathered from metabasalt and base-rich granites. Habitats are generally very bouldery and gravelly, with pronounced hummock-and-hollow microtopography and braided streams. Soils collected from plots have relatively high pH, calcium, magnesium, iron, and total base saturation levels.
Vegetation Description: See Global Vegetation description. Most documented stands in the park represent the higher-elevation variant, in which *Betula alleghaniensis* is a co-dominant overstory tree with *Acer rubrum* and *Fraxinus americana*. At elevations below 760 m (2500 feet), *Liriodendron tulipifera* is usually a co-dominant. *Fraxinus nigra* is somewhat sporadic in the park but is locally common at all elevations. *Lindera benzoin* is the dominant shrub in all sampled stands. The most frequent and abundant herbs are *Viola cucullata, Arisaema triphyllum, Veratrum viride, Packera aurea (= Senecio aureus), Carex bromoides*, and *Impatiens capensis*. Less constant but locally abundant herbs include *Carex prasina, Thalictrum pubescens, Chelone glabra, Saxifraga micranthidifolia, Caltha palustris*, and *Chrysosplenium americanum*.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Betula alleghaniensis, Carex bromoides, Deparia acrostichoides, Fraxinus americana, Fraxinus nigra, Impatiens capensis, Lindera benzoin, Packera aurea, Veratrum viride*
Other Noteworthy Species: *Information not available.*
Local Range: Stands of this type are scattered in low- and middle-elevation seepage areas of the park. Known occurrences are all in the central and northern sections of the park.
Classification Comments: In the park, this type exhibits compositional variation related to topography (particularly increased importance of *Betula alleghaniensis* and *Tsuga canadensis* as elevation increases). At middle elevations (>760 m [2500 feet]) it grades into *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533), and several plots could be assigned almost equally well to either type. *Fraxinus nigra*, which is considered "diagnostic" of this type, reaches its southern limits in Virginia, is quite sporadic in the park (it is present in only half of the plots), and also occurs in CEGL008533.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP011, SHNP034, SHNP078, SHNP617, SHNP620, SHNP623, SHNP629, SHNP639.
Shenandoah National Park Inventory Notes: Represented by eight plots from the park.

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	Saturated cold-deciduous forest (I.B.2.N.g.)
Alliance	*Fraxinus nigra - Acer rubrum* Saturated Forest Alliance (A.347)
Alliance (English name)	Black Ash - Red Maple Saturated Forest Alliance
Association	*Acer rubrum - Fraxinus americana - Fraxinus nigra - Liriodendron tulipifera / Carex bromoides - Caltha palustris* Forest

Association (English name) Red Maple - White Ash - Black Ash - Tuliptree / Brome-like Sedge - Yellow Marsh-marigold Forest
Ecological System(s): North-Central Interior and Appalachian Rich Swamp (CES202.605)

GLOBAL DESCRIPTION

Concept Summary: This community type occupies groundwater-saturated stream headwaters, large spring seeps and runs, and lateral areas in ravine and stream bottoms where groundwater emerges at the base of slopes. Overstory composition is mixed, with *Liriodendron tulipifera, Acer rubrum,* and *Fraxinus americana* the most abundant species. Frequent associates are *Fraxinus nigra, Betula alleghaniensis, Betula lenta,* and *Tilia americana*. *Fraxinus nigra* is more abundant and sometimes dominant in the understory, along with *Acer rubrum* and *Fraxinus americana*. With increasing elevation, *Fraxinus nigra* becomes less frequent and *Betula alleghaniensis* becomes increasingly important, co-dominating most stands above 762 m (2500 feet). Canopy closure is often incomplete (mean stratum cover = 60-80%), most evidently because of blowdowns. Very wet microhabitats that impede the establishment and firm rooting of trees may also contribute to a somewhat open canopy. Shrub stratum diversity is moderately high; *Lindera benzoin* is usually the most abundant species, and considerable stratum cover is contributed by tree saplings. Other frequently occurring true shrubs are *Alnus serrulata, Carpinus caroliniana, Hamamelis virginiana, Ilex verticillata,* and *Sambucus canadensis*. Except in local areas where shrubs are dense, herbaceous cover is high (mean stratum cover = 90%). One or both of the early-maturing forbs *Symplocarpus foetidus* (mostly at lower elevations) and *Veratrum viride* are usually dominant over substantial areas. Because of microtopographic diversity (see below), herbaceous patch-mosaics are typical in this vegetation. More-or-less constant (50% constancy), sometimes locally abundant species include *Eurybia schreberi (= Aster schreberi), Caltha palustris, Carex bromoides, Carex gynandra, Carex prasina, Chelone glabra, Chrysosplenium americanum, Cinna arundinacea, Dryopteris carthusiana, Dryopteris goldiana, Glyceria striata, Impatiens capensis, Osmunda cinnamomea, Osmunda regalis var. spectabilis, Ranunculus recurvatus, Saxifraga pensylvanica, Packera aurea (= Senecio aureus), Sphenopholis pensylvanica, Thalictrum pubescens,* and *Viola cucullata*. Moss cover is often significant but only rarely includes *Sphagnum* spp. (not recorded in Virginia plots). Typical upland mesophytes commonly occur in well-drained hummock microhabitats and contribute to relatively high species-richness values for this type of wetland.

Environmental Description: This community type occupies groundwater-saturated stream headwaters, large spring seeps and runs, and lateral areas in ravine and stream bottoms where groundwater emerges at the base of slopes. Hydrologically, these habitats are classified as "groundwater slope wetlands," where seepage discharged at the ground surface is drained away as streamflow (Golet et al. 1993). Habitats are usually more-or-less narrow and elongate, with considerable exposed bouldery and cobble alluvium. Soils are predominantly mineral, but local areas of organic muck sometimes accumulate in depressions. The ground surface is slightly sloping (mean slope = 3 degrees), and drainage is usually via small, intricately braided channels with intervening hummocks. Moss mats on boulders and cobble deposits commonly provide a rooting medium for herbaceous species, and "sedge tussocks" (especially of *Carex bromoides* and *Carex prasina*) are conspicuous features of these swamps. Soils collected from plot samples ranged from strongly acid to neutral in pH, with only moderately high calcium levels (mean = 1813 ppm). In Virginia, this community is most frequent and best developed on Catoctin Formation metabasalt (greenstone) of the northern Virginia Blue Ridge. There, it occurs locally in small patches (<12 hectares [30 acres]) at elevations from about 275 to 850 m (900-2800 feet) and occasionally up to 975 m (3200 feet) (Ludwig et al. 1993). It has also been documented in northwestern Virginia in the Massanutten Mountains and western Ridge and Valley region. A somewhat isolated and disjunct occurrence is documented from the Dismal Creek valley in Giles County, in the southwestern Virginia Ridge and Valley. This is probably one of the southernmost occurrences for both the community type and *Fraxinus nigra*, a tree of pronounced northern distribution. The few known Ridge and Valley occurrences are associated with sites where Devonian or Silurian limestones are interbedded with sandstone and shale. While surficial outcrops of limestone are not evident at these sites, it is clear from both soil samples and floristic evidence that the wetlands are being supplied with calcium by groundwater.

Vegetation Description: Overstory composition is mixed, with *Liriodendron tulipifera, Acer rubrum,* and *Fraxinus americana* the most abundant species. Frequent associates are *Fraxinus nigra, Betula alleghaniensis, Betula lenta,* and *Tilia americana*. *Fraxinus nigra* is more abundant and sometimes dominant in the understory, along with *Acer rubrum* and *Fraxinus americana*. With increasing elevation, *Fraxinus nigra* becomes less frequent and *Betula alleghaniensis* becomes increasingly important, co-dominating most stands above 760 m (2500 feet). Almost all trees in plot-sampled stands were <50 cm dbh and most were <40 cm dbh; but scattered *Liriodendron* specimens >80 cm dbh occur, and in one plot such an individual tree accounts for the high canopy cover of this species. Canopy closure is often incomplete (mean stratum cover = 60-80%), most evidently because of blowdowns. Very wet microhabitats that impede the establishment and firm rooting of trees may also contribute to a somewhat open canopy. Shrub stratum diversity is moderately high; *Lindera benzoin* is usually the most abundant species, and considerable stratum cover is contributed by tree saplings. Other frequently occurring true shrubs are *Alnus serrulata, Carpinus caroliniana, Hamamelis virginiana, Ilex verticillata,* and *Sambucus canadensis*. Except in local areas where shrubs are dense, herbaceous cover is high (mean stratum cover = 90%). One or both of the early-maturing forbs *Symplocarpus foetidus* (mostly at lower elevations) and *Veratrum viride* are usually dominant over substantial areas. Because of microtopographic diversity, herbaceous patch-mosaics are typical in this vegetation. More-or-less constant (50% constancy), sometimes locally abundant species include *Eurybia schreberi (= Aster schreberi), Caltha palustris, Carex bromoides, Carex gynandra, Carex prasina, Chelone glabra, Chrysosplenium americanum, Cinna arundinacea, Dryopteris carthusiana, Dryopteris goldiana, Glyceria striata, Impatiens capensis, Osmunda cinnamomea, Osmunda regalis var. spectabilis, Ranunculus recurvatus, Saxifraga pensylvanica, Packera aurea (= Senecio aureus), Sphenopholis pensylvanica, Thalictrum pubescens,* and *Viola cucullata*. Moss cover is often significant, but only rarely includes *Sphagnum* spp. (not recorded in Virginia

plots). Typical upland mesophytes commonly occur in well-drained hummock microhabitats and contribute to relatively high species richness values for this type of wetland.

Most Abundant Species

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Fraxinus americana, Liriodendron tulipifera*
Tree subcanopy	Broad-leaved deciduous tree	*Fraxinus nigra*
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Lindera benzoin*
Herb (field)	Forb	*Symplocarpus foetidus, Veratrum viride*

Characteristic Species: *Acer rubrum, Athyrium filix-femina* ssp. *asplenioides, Caltha palustris, Cardamine pensylvanica, Carex bromoides, Carex gynandra, Carex laevivaginata, Carex prasina, Carex scabrata, Carex scoparia, Carex seorsa, Chelone glabra, Chrysosplenium americanum, Cinna arundinacea, Dryopteris carthusiana, Dryopteris cristata, Eurybia schreberi, Fraxinus americana, Fraxinus nigra, Huperzia lucidula, Ilex verticillata, Impatiens capensis, Lindera benzoin, Onoclea sensibilis, Osmunda regalis* var. *spectabilis, Packera aurea, Poa paludigena, Ranunculus hispidus* var. *caricetorum, Rosa palustris, Sambucus nigra* ssp. *canadensis, Saxifraga micranthidifolia, Saxifraga pensylvanica, Sphenopholis pensylvanica, Symplocarpus foetidus, Thalictrum pubescens, Thelypteris noveboracensis, Trautvetteria caroliniensis, Trillium cernuum, Veratrum viride, Veronica americana, Veronica anagallis-aquatica, Viola cucullata, Vitis labrusca*

Other Noteworthy Species: *Euphorbia purpurea, Platanthera grandiflora, Poa paludigena, Symphyotrichum praealtum* var. *angustior*

USFWS Wetland System: Palustrine

DISTRIBUTION

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

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

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

CONSERVATION STATUS

Rank: G3 (17-Apr-2000)

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

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This type needs additional resolution relative to *Fraxinus nigra - Acer rubrum / Carex leptalea* Saturated Forest (CEGL007441), which appears to represent a similar though slightly more "northern" concept. Although the circumneutral seepage swamps described by Gould and Berdine (1998) from the Catoctin Mountains, Maryland, are putatively assigned to CEGL007441 in the USNVC, Lea (2003) felt they were consistent with the association described here.

Liriodendron tulipifera was added to the name to help distinguish this type from more northern and boreal associations in the alliance. Environmentally, this community type is distinguished from other montane wetlands by its saturated or seasonally saturated habitats that are influenced by more-or-less calcareous substrates. Floristically, it is distinguished from calcareous fens and seeps by its forest physiognomy and the absence or scarcity of light-demanding plants. This unit is most similar to forested, acidic seepage wetlands that are situated on soils derived from acidic sandstones, quartzites, and other oligotrophic substrates. These environmentally disparate swamps share a surprising number of prominent species including *Acer rubrum, Symplocarpus foetidus, Veratrum viride, Osmunda cinnamomea, Osmunda regalis var. spectabilis, Carex leptalea*, etc. Mean species richness of stands analyzed in this study (n=52.2), however, is much higher than that of 23 acidic swamps in Augusta County, Virginia (n=27.7) (VANHP unpubl. data). Distinct floristic features of calcareous seepage swamps include the prevalence of *Fraxinus* spp. (especially *Fraxinus nigra*) and nutrient-demanding species, among the most diagnostic of which are *Caltha palustris, Carex bromoides, Carex laevivaginata, Pilea fontana, Poa paludigena, Ranunculus hispidus var. caricetorum, Saxifraga pensylvanica*, and *Trillium cernuum.* These communities lack the *Sphagnum* mosses that characterize acidic groundwater wetlands. Moreover, many vascular plants that are common in or diagnostic of acidic seepage swamps are absent or unimportant (e.g., *Pinus rigida, Nyssa sylvatica, Viburnum nudum var. nudum, Parnassia asarifolia, Platanthera ciliaris, Platanthera clavellata, Rubus hispidus, Lycopodium obscurum, Carex debilis var. debilis*, and *Carex folliculata*) (Fleming and Van Alstine 1999). Observations suggest, however, that the sharp distinctions that can now be drawn from limited existing data may be somewhat illusory, as the two putative "types" of seepage swamp are most likely confluent along a continuum of pH and trophic gradients.

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

Similar Associations:
- *Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest (CEGL007853)
- *Fraxinus nigra - Acer rubrum / Carex leptalea* Saturated Forest (CEGL007441)--reputedly of comparable habitats in Maryland, Pennsylvania, and West Virginia.

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

SOURCES

Description Authors: G.P. Fleming

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

Common Name (Park-specific): Central Appalachian Acidic Cove Forest (White Pine - Mixed Hardwoods Type)

SYNONYMS:

NVC English Name: Eastern White Pine - (Northern Red Oak, White Oak) - Tuliptree Forest

NVC Scientific Name: *Pinus strobus - Quercus (rubra, alba) - Liriodendron tulipifera* Forest

NVC Identifier: CEGL006304

LOCAL DESCRIPTION

Environmental Description: Habitats in Shenandoah National Park are consistent with the Global Environment description. Sites are on the lower slopes and flats of coves and ravines under 600 m (2000 feet) elevation. Slope inclination averages 16 degrees, and aspects are variable among sampled stands. Some sites have significant boulder and stone cover. Bedrock geology at all documented sites is mapped as either Catoctin metabasalt or charnockite. However, it is likely that in most cases, these units are covered to some extent with colluvium from extensive upslope metasedimentary rocks of the Chilhowee Group. Soils collected from plots were moderately to strongly acidic with low to moderate base status.

Vegetation Description: Shenandoah National Park expressions of this community can be characterized as mixed forests of *Quercus alba, Liriodendron tulipifera, Quercus rubra, Acer rubrum*, and *Pinus strobus*. *Pinus strobus* varies in abundance from widely scattered to dominant over small areas. Additional, less important overstory associates include *Tsuga canadensis, Betula lenta, Carya ovalis, Carya glabra, Quercus prinus, Quercus velutina*, and *Tilia americana*. Characteristic understory and shrub species, most typically occurring at low to moderate cover, include *Acer rubrum, Amelanchier arborea, Cercis canadensis, Cornus florida, Corylus americana, Fraxinus americana, Hamamelis virginiana, Lindera benzoin, Nyssa sylvatica, Ostrya virginiana, Sassafras albidum, Tsuga canadensis, Ulmus rubra*, and *Viburnum acerifolium*. Ericaceous species are generally sparse to absent. The herb layer is generally diverse but open to sparse, with few species other than *Polystichum acrostichoides* forming dominance patches. The most frequent herbaceous species in plots were *Actaea racemosa (= Cimifuga racemosa), Botrychium virginianum, Carex laxiflora, Desmodium nudiflorum, Dioscorea quaternata, Eurybia divaricata (= Aster divaricatus), Galium circaezans, Galium triflorum, Geranium maculatum, Hepatica nobilis var. obtusa (= Hepatica americana), Mitchella repens, Osmorhiza claytonii, Polystichum acrostichoides, Sanicula canadensis, Solidago caesia, Stellaria pubera, Uvularia perfoliata, Viola X palmata*, and *Viola sororia*. Species richness of plot sampled stands was 64 taxa per 400 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer rubrum, Dioscorea quaternata, Eurybia divaricata, Geranium maculatum, Hepatica nobilis* var. *obtusa, Lindera benzoin, Liriodendron tulipifera, Mitchella repens, Ostrya virginiana, Pinus strobus, Polystichum acrostichoides, Quercus alba, Solidago caesia, Tsuga canadensis, Ulmus rubra, Viburnum acerifolium*

Other Noteworthy Species: *Information not available.*

Local Range: In Shenandoah National Park, quantitative documentation of this community type is restricted to coves and ravines along the foot of the western Blue Ridge flank bordering the Shenandoah Valley. Although not plot-sampled on the eastern flank of the park, observations indicate that this type forms patches at the lower elevations on that flank as well.

Classification Comments: This community is distinctive among types defined for Shenandoah National Park.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP655, SHNP656, SHNP664, SHNP665, SHNP668, SHNP669, SHNP678.
Shenandoah National Park Inventory Notes: Represented by seven plots from the park.

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 (alba, rubra, velutina)* Forest Alliance (A.401)
Alliance (English name)	Eastern White Pine - (White Oak, Northern Red Oak, Black Oak) Forest Alliance
Association	*Pinus strobus - Quercus (rubra, alba) - Liriodendron tulipifera* Forest
Association (English name)	Eastern White Pine - (Northern Red Oak, White Oak) - Tuliptree Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This mixed white pine - hardwood forest occurs in the southern portion of the Central Appalachian region. It occurs at lower elevations, generally below 900 m (3000 feet) elevation, on middle to lower slopes and in ravines or on sheltered ridges of shale, sandstone, various metasedimentary rocks, and metabasalt. Habitats are submesic to mesic, with acidic, infertile to moderately fertile sandy or silt loam soils. The overstory is dominated by mixtures of *Quercus rubra, Quercus alba, Liriodendron tulipifera*, and *Pinus strobus*, the latter often forming a distinct emergent or supra-canopy tree layer. Less abundant overstory associates include *Acer rubrum, Betula lenta, Carya alba, Carya glabra, Carya ovalis, Liriodendron tulipifera, Quercus velutina, Populus tremuloides, Tsuga canadensis,* and *Quercus prinus*. The subcanopy is of variable cover and may include *Acer pensylvanicum, Amelanchier arborea, Carpinus caroliniana, Cornus florida, Hamamelis virginiana, Ostrya virginiana, Oxydendrum arboreum,* or *Nyssa sylvatica*. The shrub layer is also variable and characterized by *Viburnum acerifolium, Rubus* spp., *Corylus americana, Gaultheria procumbens, Sassafras albidum, Viburnum rafinesquianum,* and *Viburnum prunifolium*. The herbaceous layer is of sparse to moderately dense cover and is characterized by *Ageratina altissima, Amphicarpaea bracteata, Brachyelytrum erectum, Carex communis, Carex platyphylla, Carex woodii, Carex pensylvanica, Chimaphila maculata, Desmodium nudiflorum, Eupatorium purpureum, Galax urceolata, Galium latifolium, Galium circaezans, Geranium maculatum, Goodyera pubescens, Hieracium venosum, Houstonia purpurea, Maianthemum racemosum, Maianthemum canadense, Medeola virginiana, Mitchella repens, Monotropa uniflora, Poa cuspidata, Polygonatum biflorum, Polystichum acrostichoides,* and *Viola hastata*.
Environmental Description: This community type occurs at lower elevations, generally below 900 m (3000 feet), on middle to lower slopes and in ravines or on sheltered ridges of shale, sandstone, various metasedimentary rocks, and metabasalt. Habitats are submesic to mesic, with acidic, infertile to moderately fertile sandy or silt loam soils.
Vegetation Description: The overstory is dominated by mixtures of *Quercus rubra, Quercus alba, Liriodendron tulipifera,* and *Pinus strobus*, the latter often forming a distinct emergent or supra-canopy tree layer. Less abundant overstory associates include *Acer rubrum, Betula lenta, Carya alba, Carya glabra, Carya ovalis, Liriodendron tulipifera, Quercus velutina, Populus tremuloides, Tsuga canadensis*, and *Quercus prinus*. The subcanopy is of variable cover and may include *Acer pensylvanicum, Amelanchier arborea, Carpinus caroliniana, Cornus florida, Hamamelis virginiana, Ostrya virginiana, Oxydendrum arboreum*, or *Nyssa sylvatica*. The shrub layer is also variable and characterized by *Viburnum acerifolium, Rubus* spp., *Corylus americana, Gaultheria procumbens, Sassafras albidum, Viburnum rafinesquianum,* and *Viburnum prunifolium*. The herbaceous layer is of sparse to moderately dense cover and is characterized by *Ageratina altissima, Amphicarpaea bracteata, Brachyelytrum erectum, Carex communis, Carex platyphylla, Carex woodii, Carex pensylvanica, Chimaphila maculata, Desmodium nudiflorum, Eupatorium purpureum, Galax urceolata, Galium latifolium, Galium circaezans, Geranium maculatum, Goodyera pubescens, Hieracium venosum, Houstonia purpurea, Maianthemum racemosum, Maianthemum canadense, Medeola virginiana, Mitchella repens, Monotropa uniflora, Poa cuspidata, Polygonatum biflorum, Polystichum acrostichoides,* and *Viola hastata*.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION

Range: The type occurs in the southern portion of the central Appalachian region in Maryland, West Virginia, and Virginia.
States/Provinces: MD, VA, WV

Federal Lands: NPS (Shenandoah)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: *Information not available.*

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments:
Similar Associations:
- *Liriodendron tulipifera - Pinus strobus - (Tsuga canadensis) / Carpinus caroliniana / Amphicarpaea bracteata* Forest (CEGL008405)--also very similar but currently defined as a montane alluvial forest of small-stream floodplains.
- *Pinus strobus - Quercus alba - Quercus coccinea / Vaccinium stamineum* Forest (CEGL008539)--occurs on drier sites, primarily in the central Appalachian Ridge and Valley province and the Piedmont.
- *Pinus strobus - Tsuga canadensis / Acer pensylvanicum / Polystichum acrostichoides* Forest (CEGL006019)--known from similar habitats in the central Appalachians and Allegheny Mountains, north to Pennsylvania. This type and CEGL006304 are very similar, both compositionally and environmentally. Additional region-wide study and analysis are needed to determine whether they are variants of one broad association.

Related Concepts:
- White pine-oak-tuliptree dry forest (CAP pers. comm. 1998) ?

SOURCES
Description Authors: G. Fleming
References: CAP pers. comm. 1998, Eastern Ecology Working Group n.d.

Common Name (Park-specific): Hemlock - Northern Hardwood Forest

SYNONYMS:
NVC English Name: Eastern Hemlock - Yellow Birch - Sugar Maple / Fancy Fern Forest
NVC Scientific Name: *Tsuga canadensis - Betula alleghaniensis - Acer saccharum / Dryopteris intermedia* Forest
NVC Identifier: CEGL006109

LOCAL DESCRIPTION
Environmental Description: In Shenandoah National Park, this association occupies sheltered, usually north-facing lower slopes, rocky ravines, and flats along streams. The type is distributed primarily at middle elevations, from 760 to 1000 m (2500-3300 feet), but occasionally as low as 380 m (1250 feet). Underlying bedrock at all known sites is either Catoctin metabasalt or a member of the pyroxene-bearing granitic complex. Slopes are usually concave in at least one direction and sites are often bouldery. Some of the sites have small seep inclusions or border large, stream-bottom seepage swamps. Soil samples collected from plots are extremely acidic with relatively high (mean = 20%) organic matter content but have moderately high calcium and magnesium levels.
Vegetation Description: The overstories of Shenandoah National Park stands are generally co-dominated by *Tsuga canadensis* (most abundant), *Betula alleghaniensis*, and/or *Betula lenta*, although the mortality of mature *Tsuga* from adelgid infestation has reached epidemic proportions at most park sites. Minor overstory associates include *Acer rubrum, Acer saccharum, Betula lenta, Fagus grandifolia, Liriodendron tulipifera, Quercus prinus*, and *Quercus rubra*. At least in relatively undisturbed stands, the understory and shrub layers are dominated by *Tsuga canadensis*, with scattered *Acer rubrum, Fraxinus americana, Hamamelis virginiana*, and *Acer pensylvanicum* usually present. *Taxus canadensis* and *Rhododendron maximum* are each dominant shrubs at a single, exceptional site. Herbs are patchy to sparse and include *Maianthemum canadense, Mitchella repens, Eurybia divaricata (= Aster divaricatus), Viola blanda var. blanda*, and many others occurring at low cover and constancy. In heavily disturbed stands with large canopy gaps caused by adelgid-related hemlock mortality, seedlings and shrub-sized sprouts of *Acer pensylvanicum, Acer rubrum, Betula alleghaniensis, Betula lenta*, and/or *Rubus* spp. may be prolific.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum*, *Betula alleghaniensis*, *Eurybia divaricata*, *Hamamelis virginiana*, *Maianthemum canadense*, *Mitchella repens*, *Tsuga canadensis*
Other Noteworthy Species: *Information not available.*
Local Range: This type is scattered in suitable, sheltered habitats throughout the central section of the park and very locally in the northern and southern sections.

Classification Comments: This association often co-occurs and intergrades with *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533), a wetland forest that occupies large, stream-bottom seepage swamps at medium to high elevations.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP029, SHNP030, SHNP600, SHNP601, SHNP608, SHNP653, SHNP660.
Shenandoah National Park Inventory Notes: Represented by seven plots from the park.

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 - Betula alleghaniensis* Forest Alliance (A.412)
Alliance (English name)	Eastern Hemlock - Yellow Birch Forest Alliance
Association	*Tsuga canadensis - Betula alleghaniensis - Acer saccharum / Dryopteris intermedia* Forest
Association (English name)	Eastern Hemlock - Yellow Birch - Sugar Maple / Fancy Fern Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)

GLOBAL DESCRIPTION

Concept Summary: This association comprises hemlock-northern hardwood forests of the northeastern United States. This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams. *Tsuga canadensis* is characteristic and usually dominant in the coniferous to mixed canopy. While hemlock generally forms at least 50% of the canopy, in some cases it may be as low as 25% relative dominance. Hardwood co-dominants include *Betula alleghaniensis* or *Acer saccharum*, with *Fagus grandifolia* common but not usually abundant in all but the very southern portion of the range of this type. *Ostrya virginiana* may be present as a small tree. *Quercus* spp. and *Pinus strobus* tend to be absent or, if present, only occur with low abundance. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* and *Acer pensylvanicum* in addition to *Tsuga canadensis* regeneration. Herbs may be sparse, particularly in dense shade, but include *Dryopteris intermedia, Medeola virginiana, Oxalis montana, Mitchella repens, Maianthemum canadense, Polystichum acrostichoides, Trientalis borealis, Huperzia lucidula (= Lycopodium lucidulum), Eurybia divaricata (= Aster divaricatus),* and *Thelypteris noveboracensis*. Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* and *Acer saccharum* and a lack of abundant *Quercus* spp., *Pinus strobus,* or *Betula lenta*.
Environmental Description: This forest is associated with cool, dry-mesic to mesic sites and acidic soils, often on rocky, north-facing slopes. Soils can have a thick, poorly decomposed duff layer over sandy loams.
Vegetation Description: *Tsuga canadensis* is dominant and forms at least 50% of the canopy. *Betula alleghaniensis* can be co-dominant, with *Fagus grandifolia* and *Acer saccharum* common but not usually abundant in all but the very southern portion of the range for this type. The shrub layer may be dense to fairly open and often includes *Viburnum acerifolium* and *Acer pensylvanicum* in addition to *Tsuga canadensis* regeneration. Herbs may be sparse, particularly in dense shade, but often include *Dryopteris intermedia, Medeola virginiana, Oxalis montana, Mitchella repens, Maianthemum canadense, Trientalis borealis, Huperzia lucidula (= Lycopodium lucidulum), Eurybia divaricata (= Aster divaricatus),* and *Thelypteris noveboracensis*. Nonvascular plants may be well-developed, often characterized by the liverwort *Bazzania trilobata*. Diagnostic characteristics of this forest are the presence of *Betula alleghaniensis* and *Acer saccharum* and a lack of abundant *Quercus* spp., *Pinus strobus*, or *Betula lenta*.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Betula alleghaniensis, Carex albicans, Dryopteris intermedia, Huperzia lucidula, Maianthemum canadense, Medeola virginiana, Mitchella repens, Oclemena acuminata, Tsuga canadensis, Viola rotundifolia*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION

Range: This community is generally distributed in large patches from New Hampshire south through New England, becoming more local in the north Atlantic Piedmont and restricted to local patches at higher elevations of the Central Appalachians in Maryland, West Virginia, and Virginia. In Virginia it is restricted to the northwestern part of the state, where occurrences are rather local but sometimes extensive.
States/Provinces: CT, MA, MD, NH, NJ:S3, NY, PA, RI, VA:S3, VT, WV?
Federal Lands: NPS (Johnstown Flood, Marsh-Billings-Rockefeller, Shenandoah); USFS (George Washington?)

CONSERVATION STATUS
Rank: G4? (31-Dec-1997)
Reasons: This association has a very large geographic distribution and occurs in large patches in the northern part of its range. All stands of this community are now highly threatened by the exotic insect pest hemlock woolly adelgid (*Adelges tsugae*), which causes decline and eventual mortality in *Tsuga canadensis*.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Many stands of this vegetation type in the national forests and Shenandoah National Park have been devastated during the past decade by adelgid-caused tree mortality. In some cases, 100% of the canopy hemlocks have been killed, littering the forest floor with downed wood and stimulating massive increases in understory growth, particularly of *Betula* spp. and *Acer pensylvanicum*. Since there is no practical treatment for the adelgid on a landscape level, one can only hope that natural pathogens will emerge to keep the adelgid in check before all of our examples of this community are severely degraded or lost.
Similar Associations:
- *Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / Leucothoe fontanesiana* Forest (CEGL007861)
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173)
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129)
- *Tsuga canadensis - (Betula alleghaniensis, Quercus rubra) / Ilex montana / Rhododendron catawbiense* Forest (CEGL008513)
- *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088)

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

SOURCES
Description Authors: S.L. Neid, mod. S.C. Gawler
References: Breden 1989, Breden et al. 2001, Coulling and Rawinski 1999, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Rawinski et al. 1994, Smith 1983, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003

Common Name (Park-specific): High-Elevation Hemlock - Yellow Birch Seepage Swamp

SYNONYMS:
NVC English Name: Eastern Hemlock - Yellow Birch / American False Hellebore - Eastern Rough Sedge - Whorled Wood Aster Forest
NVC Scientific Name: *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest
NVC Identifier: CEGL008533

LOCAL DESCRIPTION
Environmental Description: In Shenandoah National Park, this association occurs at middle to high elevations in linear patches along groundwater-saturated bottoms of streams and in headwaters seepage areas. Plot-sampled sites range from 670 to 1040 m (2200-3400 feet) elevation, although most are >900 m (3000 feet). Stands occur on all major substrate types. Habitats are moderately rocky and have pronounced hummock-and-hollow microtopography and braided streams. Soils samples collected from plots have low to intermediate base status.
Vegetation Description: The composition of Shenandoah National Park stands is similar to that described in Global Vegetation. At least in stands that have not been heavily infested with hemlock woolly adelgid, *Tsuga canadensis* and *Betula alleghaniensis* share dominance, although *Tsuga canadensis* is usually well-distributed in different age-classes, while *Betula alleghaniensis* is strictly an

overstory species. *Lindera benzoin* is the most constant and abundant shrub. Herb-layer dominants include *Osmunda cinnamomea, Viola cucullata, Glyceria melicaria, Carex scabrata,* and *Veratrum viride.*

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Betula alleghaniensis, Carex scabrata, Glyceria melicaria, Impatiens capensis, Lindera benzoin, Maianthemum canadense, Oclemena acuminata, Osmunda cinnamomea, Tsuga canadensis, Veratrum viride, Viola cucullata*

Other Noteworthy Species: *Information not available.*

Local Range: Occurrences are scattered at higher elevations (>900 m) of the park, and locally in protected situations at lower elevations. Known stands are concentrated in the central section.

Classification Comments: At middle elevations (600-900 m [2000-3000 feet] elevation) this type intergrades with the *Acer rubrum - Fraxinus americana - Fraxinus nigra - Liriodendron tulipifera / Carex bromoides - Caltha palustris* Forest (CEGL008416), and several plots could be assigned almost equally well to either type. *Fraxinus nigra*, which is usually considered "diagnostic" of the lower elevation CEGL008416 type, also occurs (infrequently) in the *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest. Similarities in shrub- and herb-layer composition between some stands of the two types is probably attributable to the prevalence of base-rich metamorphic and igneous substrates at higher elevations of the park.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP012, SHNP618, SHNP622, SHNP624, SHNP625, SHNP636, SHNP637, SHNP638.

Shenandoah National Park Inventory Notes: Represented by eight plots from the park.

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	Saturated mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.d.)
Alliance	*Tsuga canadensis - Acer rubrum* Saturated Forest Alliance (A.447)
Alliance (English name)	Eastern Hemlock - Red Maple Saturated Forest Alliance
Association	*Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest
Association (English name)	Eastern Hemlock - Yellow Birch / American False Hellebore - Eastern Rough Sedge - Whorled Wood Aster Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) Central and Southern Appalachian Montane Oak Forest (CES202.596)

GLOBAL DESCRIPTION

Concept Summary: This community is currently known from scattered sites in the northern Blue Ridge and Ridge and Valley provinces of Virginia. Similar communities have been observed in the high Allegheny Mountains of Virginia and West Virginia, the Maryland Blue Ridge, and the Ridge and Valley of east-central West Virginia. Occurrences in Pennsylvania also seem likely. The type appears to be limited to high-elevation montane wetlands in a portion of the central Appalachians where *Rhododendron maximum* is infrequent to absent. Sites are usually located in high-elevation valleys or slope concavities, in diffuse stream headwaters and lateral, groundwater-saturated flats along larger streams. Occasionally, stands occupy gentle depressions or basins influenced by seasonally perched groundwater but without flowing streams. Elevation ranges from 700-1170 m (2300-3840 feet), though most occurrences are above 900 m (3000 feet). Habitats are flat to moderately sloping and typically have >20% surface cover of boulders and stones weathered from metabasalt, granitic rocks, or sandstone. Stream-bottom habitats have pronounced hummock-and-hollow microtopography, with moss-covered mounds and intertwining roots of *Betula alleghaniensis*, mucky pools, and braided drainage channels. Canopy dominance is shared by *Tsuga canadensis* and *Betula alleghaniensis* in variable proportions. Minor canopy associates include *Acer rubrum, Fraxinus americana, Pinus strobus, Quercus alba*, and *Quercus rubra*. Small-tree and shrub layers are open to sparse, with *Acer pensylvanicum, Hamamelis virginiana, Ilex verticillata,* and *Kalmia latifolia* the most frequent species. *Alnus incana ssp. rugosa* is a dominant shrub in one sampled plot. *Rhododendron catawbiense* is scattered in some stands of this community in the southern part of the northern Blue Ridge but does not form dense stands. The herb layer is well-developed and usually lush with forbs.

Environmental Description: Sites are usually located in high-elevation valleys or slope concavities, in diffuse stream headwaters and lateral, groundwater-saturated flats along larger streams. Occasionally, stands occupy gentle depressions or basins influenced by seasonally perched groundwater but without flowing streams. Elevation of plot-sampled stands in Virginia ranges from 700 to 1170 m (2300-3840 feet), though most occurrences are above 900 m (3000 feet). Habitats are flat to moderately sloping (0-11 degrees) and typically have >20% surface cover of boulders and stones weathered from metabasalt, granitic rocks, or sandstone. Stream-bottom habitats have pronounced hummock-and-hollow microtopography, with moss-covered mounds and intertwining roots of *Betula*

alleghaniensis, mucky pools, and braided drainage channels. Regardless of underlying bedrock type, soils usually have a shallow organic horizon and are very strongly to extremely acidic (mean pH in plots = 4.4), with low base status. However, there may be some groundwater enrichment of these habitats in Blue Ridge areas underlain by volcanic and plutonic rocks.

Vegetation Description: Canopy dominance is shared by *Tsuga canadensis* and *Betula alleghaniensis* in variable proportions. Minor canopy associates include *Acer rubrum, Fraxinus americana, Pinus strobus, Quercus alba*, and *Quercus rubra*. Small-tree and shrub layers are open to sparse, with *Acer pensylvanicum, Hamamelis virginiana, Ilex verticillata, Kalmia latifolia*, and *Lindera benzoin* the most frequent species. *Alnus incana ssp. rugosa* is a co-dominant shrub in a few areas on the northern Blue Ridge. *Rhododendron catawbiense* is scattered in some stands of this community in the southern part of the northern Blue Ridge but does not form dense stands. The herb layer is well-developed and lush with forbs, including the typically abundant species *Veratrum viride, Oclemena acuminata (= Aster acuminatus), Angelica triquinata, Chelone glabra*, and *Viola cucullata*. *Carex scabrata* and *Glyceria melicaria* are characteristic, colonial graminoids in many stands. *Osmunda cinnamomea* is the most abundant fern. Additional herbs occurring frequently at low cover include *Maianthemum canadense, Athyrium filix-femina ssp. asplenioides, Anemone quinquefolia, Thalictrum pubescens, Trautvetteria caroliniensis, Oxypolis rigidior*, and *Viola macloskeyi ssp. pallens*. Herbs that appear to be less frequent but locally abundant or important in the type include *Aconitum uncinatum, Aconitum reclinatum, Thelypteris noveboracensis, Impatiens capensis, Actaea podocarpa (= Cimicifuga americana), Dryopteris cristata, Chrysosplenium americanum, Saxifraga micranthidifolia*, and *Circaea alpina*. The mean species richness of plot-sampled stands (n = 45 taxa per 400 square meters) probably reflects a diversity of microhabitats supporting both typical wetland plants and upland mesophytes.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum*, *Angelica triquinata*, *Betula alleghaniensis*, *Carex scabrata*, *Chelone glabra*, *Hamamelis virginiana*, *Lindera benzoin*, *Oclemena acuminata*, *Osmunda cinnamomea*, *Tsuga canadensis*, *Veratrum viride*, *Viola cucullata*

Other Noteworthy Species: *Aconitum reclinatum*

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This community is currently known from scattered sites in the northern Blue Ridge and Ridge and Valley provinces of Virginia. Similar communities have been observed by Virginia VANHP ecologists in the high Allegheny Mountains of Virginia and West Virginia, the Maryland Blue Ridge, and the Ridge and Valley of east-central West Virginia (Pendleton County). Based on the description of "Hemlock - mixed hardwood palustrine forest" in Fike (1999), occurrences in Pennsylvania also seem likely. The type appears to be limited to high-elevation montane wetlands in a portion of the central Appalachians where *Rhododendron maximum* is infrequent to absent.

States/Provinces: MD, PA?, VA:S1, WV

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

CONSERVATION STATUS

Rank: G2 (21-Sep-2001)

Reasons: This type appears to be quite rare naturally because of its small patch size, its apparent geographic restriction, and the paucity of suitable, high-elevation seepage wetland habitats. Moreover, within the last decade, several documented stands have undergone rapid degradation and compositional alterations resulting from outbreaks of the exotic insect hemlock woolly adelgid. The long-term integrity of all stands of this vegetation is now considered threatened by the adelgid.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Several formerly outstanding, mature examples of this community type on the Blue Ridge have been devastated by the near-complete removal of *Tsuga canadensis* from the canopy. In these areas, defoliation by the adelgid has resulted in 90-100% hemlock mortality and the release of massive numbers of shrub and birch seedlings in the understory. These sites are now so dense with shrub and sapling thickets and fallen hemlock trees that they can scarcely be traversed on foot. Impacts on the herbaceous flora of the stands has not been fully assessed, but at some sites, the newly opened canopies appear to have stimulated the invasion of exotic weeds such as *Alliaria petiolata*.

Similar Associations:

Related Concepts:

- *Betula alleghaniensis / Oxalis montana* Association: *Betula alleghaniensis / Carex scabrata* Subassociation (Fleming and Moorhead 1996) ?
- *Tsuga canadensis - Betula alleghaniensis / Carex trisperma* Association (Rawinski et al. 1994) ?
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Aconitum uncinatum* Association (Rawinski et al. 1996) ?
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (Fleming and Coulling 2001) =
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata* Association (Rawinski et al. 1996) ?

- Hemlock - Yellow Birch: 24 (Eyre 1980) B

SOURCES

Description Authors: G.P. Fleming and P.P. Coulling
References: Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Fleming et al. 2004, Rawinski et al. 1994, Rawinski et al. 1996

Common Name (Park-specific): Central Appalachian Pine - Oak / Heath Woodland

SYNONYMS:

NVC English Name: (Table Mountain Pine, Pitch Pine) / Bear Oak / Black Huckleberry Woodland

NVC Scientific Name: *Pinus (pungens, rigida) / Quercus ilicifolia / Gaylussacia baccata* Woodland

NVC Identifier: CEGL004996

LOCAL DESCRIPTION

Environmental Description: See Global Environment description. Shenandoah National Park stands are usually located on xeric upper slopes and crests, some of them essentially on clifftops, with south to northwest aspects. Plot-documented stands are all situated in the elevational range of 640 to 850 m (2100-2800 feet), although the type has been observed at both lower and higher elevations. This vegetation covers relatively large areas on quartzitic substrates in the southern section of the park, much less on the granitic suite and metabasalt. Soils collected from plot samples are among the most acidic and infertile in the park.
Vegetation Description: Because of recent depredations by the southern pine beetle, existing plot samples from the park have rather low pine cover, even though they clearly represent this type. Physiognomy of existing stands varies from open shrublands nearly lacking an overstory (because of mortality from pine beetles) to nearly closed forest in fire-suppressed situations. *Pinus rigida* appears to be the dominant pine in the majority of park stands, with fewer stands dominated by *Pinus pungens* or co-dominated by the two species. This may be an artifact of plot selection, since relatively few of the cliff/outcrop habitats preferred by *Pinus pungens* were sampled. *Quercus prinus* is consistently co-dominant with the pines. Minor tree associates include *Quercus coccinea, Quercus marilandica, Castanea dentata, Pinus strobus, Sassafras albidum, Amelanchier arborea*, and *Nyssa sylvatica*. Trees in this type tend to be stunted (generally <10 m tall). Shrub layers are typically dense to very dense, with variable, stratified patch-dominance by *Quercus ilicifolia, Kalmia latifolia, Gaylussacia baccata, Vaccinium pallidum*, and *Vaccinium stamineum*. Minor associates in the shrub complex include *Spiraea betulifolia var. corymbosa, Smilax rotundifolia*, and *Smilax glauca*. Few herbaceous species occur, and *Pteridium aquilinum var. latiusculum* is the only herb with constancy >50% in eight plot samples. However, in a subset of stands, *Xerophyllum asphodeloides* is abundant and often flowers profusely following fires or pine beetle outbreaks. Stands of this community tend to be floristically depauperate, averaging 18 taxa per 400 square meters in plot samples.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Gaylussacia baccata, Kalmia latifolia, Pinus pungens, Pinus rigida, Pteridium aquilinum* var. *latiusculum*, *Quercus ilicifolia, Quercus prinus, Vaccinium pallidum, Vaccinium stamineum, Xerophyllum asphodeloides*
Other Noteworthy Species: *Information not available.*
Local Range: This community is widely distributed and locally extensive on quartzite ridges forming the western flank of the Blue Ridge in the southern section of the park. It appears to be infrequent and local elsewhere in the park.
Classification Comments: On marginal, fire-suppressed sites, this community may be difficult to distinguish from more xeric variants of *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299). In most cases, however, it can be distinguished by its more open, woodland physiognomy, the prominence of *Pinus* spp., and its very dense, multi-tiered shrub layer dominated by *Quercus ilicifolia* and ericads.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP001, SHNP095, SHNP501, SHNP502, SHNP504, SHNP633, SHNP648, SHNP651.
Shenandoah National Park Inventory Notes: Represented by eight plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Evergreen woodland (II.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
Alliance	*Pinus pungens - (Pinus rigida)* Woodland Alliance (A.521)

Alliance (English name)	Table Mountain Pine - (Pitch Pine) Woodland Alliance
Association	*Pinus (pungens, rigida) / Quercus ilicifolia / Gaylussacia baccata* Woodland
Association (English name)	(Table Mountain Pine, Pitch Pine) / Bear Oak / Black Huckleberry Woodland
Ecological System(s):	Southern Appalachian Montane Pine Forest and Woodland (CES202.331)

GLOBAL DESCRIPTION

Concept Summary: This association represents predominantly evergreen woodlands occupying xeric, convex, often rocky south- and west-facing slopes, ridge spurs, crests, and clifftops in the central Appalachians and peripherally in the Southern Blue Ridge. Stands occur at elevations from 450 to 1200 m (1500-4000 feet) on various substrates but most commonly on acidic, sedimentary and metasedimentary substrates (e.g., quartzites, sandstones, and shales). Soils are very infertile, shallow, and droughty. A thick, poorly decomposed duff layer, along with dead wood and highly volatile ericaceous shrubs, create a strongly fire-prone habitat. *Pinus pungens* and *Pinus rigida*, individually or together, dominate the canopy, which can approach forest physiognomy in some situations as a result of fire suppression. Scattered canopy and subcanopy associates may include *Quercus prinus, Quercus coccinea, Quercus rubra, Quercus marilandica, Pinus virginiana, Castanea dentata, Acer rubrum, Sassafras albidum, Nyssa sylvatica,* and *Amelanchier arborea*. *Quercus ilicifolia* dominates a moderately open to very dense tall-shrub layer, while variable combinations of *Kalmia latifolia, Gaylussacia baccata, Vaccinium pallidum, Vaccinium angustifolium, Vaccinium stamineum, Pieris floribunda, Rhododendron catawbiense*, and other ericads form a generally dense low-shrub layer. *Smilax rotundifolia* and *Smilax glauca* may be prominent climbers among the shrubs. Herbaceous species, often very sparse, are rooted in small openings among the shrubs, on rocks, and in disturbed areas where mineral soil is exposed. Typical herbs and subshrubs include *Epigaea repens, Gaultheria procumbens, Xerophyllum asphodeloides, Iris verna, Pteridium aquilinum var. latiusculum, Melampyrum lineare var. latifolium, Stenanthium gramineum var. micranthum, Uvularia puberula, Lycopodium tristachyum, Aralia hispida* (usually on outcrops), and *Carex tonsa*. Periodic fire is an important ecological process which provides opportunities for the regeneration of both canopy pines and less competitive herbaceous species, while setting back successional encroachment of xeric oaks. On many sites (e.g., clifftops, quartzite ledges), the vegetation is self-perpetuating due to extreme edaphic conditions.

Environmental Description: These predominantly evergreen woodlands occupy xeric, convex, often rocky south- and west-facing slopes, ridge spurs, crests, and clifftops in the central Appalachians and peripherally in the Southern Blue Ridge. Stands occur at elevations from 450 to 1200 m (1500-4000 feet) on various substrates but most commonly on acidic, sedimentary and metasedimentary substrates (e.g., quartzites, sandstones, and shales). Soils are very infertile, shallow, and droughty. A thick, poorly decomposed duff layer, along with dead wood and highly volatile ericaceous shrubs, create a strongly fire-prone habitat. On many sites (e.g., clifftops, quartzite ledges), the vegetation is self-perpetuating due to extreme edaphic conditions.

There are significant differences in site conditions associated with the two subtypes of this community in Virginia. The Table-Mountain Pine Subtype (Subtype 1) occurs at low to middle elevations (mean of plot-sampled stands = 647 m [2147 feet]) and tends to occupy steep (mean slope = 23 degrees) sideslopes with significant rock cover (mean = 14%). The Pitch Pine Subtype (Subtype 2) occurs at middle to high elevations (mean of plot-sampled stands = 983 m [3225 feet]) and tends to occupy moderately steep to sublevel (mean slope = 7 degrees) upper slopes and crests with little rock cover (mean = 1%) and very dense duff. Although strongly fire-prone habitats influence vegetation structure and composition of both subtypes, the Table-Mountain Pine Subtype tends to be more influenced by edaphic stresses because of its frequent association with cliffs and outcrop areas.

Vegetation Description: The canopies of stands of this type are dominated by *Pinus pungens* and *Pinus rigida*, either individually or together. Scattered canopy and subcanopy associates may include *Quercus prinus, Quercus coccinea, Quercus rubra, Quercus marilandica, Pinus virginiana, Castanea dentata, Acer rubrum, Sassafras albidum, Nyssa sylvatica,* and *Amelanchier arborea*. *Quercus ilicifolia* dominates a moderately open to very dense tall-shrub layer, while variable combinations of *Kalmia latifolia, Gaylussacia baccata, Vaccinium pallidum, Vaccinium angustifolium, Vaccinium stamineum, Pieris floribunda, Rhododendron catawbiense*, and other ericads form a generally dense low-shrub layer. *Smilax rotundifolia* and *Smilax glauca* may be prominent climbers among the shrubs. Herbaceous species, often very sparse, are rooted in small openings among the shrubs, on rocks, and in disturbed areas where mineral soil is exposed. Typical herbs and subshrubs include *Epigaea repens, Gaultheria procumbens, Xerophyllum asphodeloides, Iris verna, Pteridium aquilinum var. latiusculum, Melampyrum lineare var. latifolium, Stenanthium gramineum var. micranthum, Uvularia puberula, Lycopodium tristachyum, Aralia hispida* (usually on outcrops), and *Carex tonsa*.

Although intergradational at some sites, the two subtypes recognized in Virginia are very distinct in their typical expressions. Both share *Quercus prinus* as a co-dominant canopy tree and have a similar ericaceous shrub layer composed largely of *Kalmia latifolia, Gaylussacia baccata,* and *Vaccinium pallidum*. However, in the Table-Mountain Pine Subtype (Subtype 1), *Pinus pungens* is the most constant and abundant pine, while *Pinus rigida* and *Pinus virginiana* each occur as minor associates in about half the plots. *Quercus coccinea, Nyssa sylvatica, Amelanchier arborea,* and *Sassafras albidum* are frequent tree associates. *Quercus ilicifolia* occurs in about two-thirds of the plots, with relatively low (5-10%) mean cover. There are no herbs with constancy >48% and only *Galax urceolata* (locally abundant) has a mean cover >1%.

In the Pitch Pine Subtype (Subtype 2), *Pinus rigida* is the most constant and abundant pine, with co-dominant *Pinus pungens* in less than one-third of the plots. *Pinus virginiana* and *Quercus coccinea* are absent, but *Pinus strobus* and *Castanea dentata* attain greater importance as minor canopy associates. *Quercus ilicifolia* consistently dominates (100% constancy, 10-25% mean cover) the tall-

shrub layer, with *Hamamelis virginiana* a constant minor associate. The creeping subshrub *Gaultheria procumbens* dominates the herb layer (89% constancy, 10-25% mean cover). This subtype contains a number of species absent from or unimportant in the Table-Mountain Pine Subtype and more characteristic of higher elevations and northern latitudes; these include *Vaccinium angustifolium, Vaccinium myrtilloides, Rhododendron prinophyllum, Aralia nudicaulis*, and *Maianthemum canadense*.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Buckleya distichophylla, Carex polymorpha, Galax urceolata, Gaultheria procumbens, Gaylussacia baccata, Iris verna, Kalmia latifolia, Lycopodium tristachyum, Melampyrum lineare* var. *latifolium, Nyssa sylvatica, Pinus pungens, Pinus rigida, Quercus coccinea, Quercus ilicifolia, Sassafras albidum, Vaccinium pallidum, Xerophyllum asphodeloides*

Other Noteworthy Species: *Buckleya distichophylla, Carex polymorpha, Catocala herodias gerhardi, Pituophis melanoleucus melanoleucus, Tsuga caroliniana, Vaccinium myrtilloides*

USFWS Wetland System:

DISTRIBUTION

Range: This community occurs in the central Appalachian region of Virginia, West Virginia, Maryland, and Pennsylvania, with very local outliers in the western Piedmont of Virginia and Maryland (e.g., Sugarloaf Mountain). In Virginia, the type as a whole ranges through the Blue Ridge and Ridge and Valley provinces north of the New River. Outliers occur on Bull Run Mountain (Fauquier County), Willis Mountain (Buckingham County), and other Piedmont foothills. The Table-Mountain Pine Subtype occurs throughout this range, while the Pitch Pine Subtype is more confined to the northern two-thirds of the state's mountain region.

States/Provinces: MD, PA, VA, WV

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

CONSERVATION STATUS

Rank: G4 (1-Oct-2001)

Reasons: This community is widely but locally distributed in the Central Appalachians, forming large patches at some sites. It is apparently secure, although fire suppression and insect pathogens represent ongoing stand-altering disturbances.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 1 - Strong

Comments: This community type is closely related to other associations classified in the *Pinus pungens - (Pinus rigida)* Woodland Alliance (A.521). It is thought to differ in the shrub layer dominance of *Quercus ilicifolia*, a northern species which is absent in similar communities south of Virginia, as well as the absence of a number of characteristic southern species such as *Gaylussacia ursina, Rhododendron carolinianum, Rhododendron minus, Leiophyllum buxifolium*, and *Fothergilla major*. Long-term, widespread fire suppression is an ongoing problem which may be causing some stands to succeed to closed, mixed oak-pine forest. However, on many sites occupied by this community, edaphic conditions are so stressful that tree oaks are not or marginally competitive, and even long fire-return intervals (e.g., >25 years) are sufficient to maintain pine-dominated vegetation. Within the past ten years, much of this vegetation in Virginia has been devastated by infestations of southern pine beetle (*Dendroctonus frontalis*). These outbreaks have resulted in extensive mortality of the dominant pines and changed physiognomies, at least temporarily, to a shrubland condition.

The recognition of global subtypes equivalent to two distinct state community types is well supported by quantitative analysis of compositional and environmental data. Further study may support the elevation of these subtypes to full association-level status in the USNVC.

Similar Associations:

- *Pinus pungens - Pinus rigida - (Quercus prinus) / Kalmia latifolia - Vaccinium pallidum* Woodland (CEGL007097)
- *Pinus rigida - (Pinus pungens) / Rhododendron catawbiense - Kalmia latifolia / Galax urceolata* Woodland (CEGL004985)
- *Pinus rigida / (Quercus ilicifolia) / Photinia melanocarpa / Deschampsia flexuosa* Woodland (CEGL006116)

Related Concepts:

- *Pinus pungens - Pinus rigida / Quercus ilicifolia / Gaylussacia baccata* Association (Rawinski et al. 1996) ?
- *Pinus pungens - Quercus prinus - (Quercus coccinea) / Kalmia latifolia - Gaylussacia baccata* Woodland (Fleming and Coulling 2001) F
- *Pinus pungens / Quercus ilicifolia / Gaylussacia baccata - Pteridium aquilinum* Woodland (Fleming and Moorhead 2000) ?
- *Pinus rigida / Quercus ilicifolia / Gaylussacia baccata* Association (Rawinski et al. 1994) ?
- *Quercus prinus - Pinus rigida / Quercus ilicifolia - Kalmia latifolia - Gaylussacia baccata / Gaultheria procumbens* Woodland (Fleming and Coulling 2001) F
- Chestnut Oak: 44 (Eyre 1980) B
- Pitch Pine: 45 (Eyre 1980) B

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Eyre 1980, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Fleming pers. comm., Rawinski et al. 1994, Rawinski et al. 1996, Southeastern Ecology Working Group n.d.

Common Name (Park-specific): Central Appalachian Basic Woodland

SYNONYMS:

NVC English Name: White Ash - Pignut Hickory / Rock Muhly - Spreading Sunflower - Elmleaf Goldenrod Woodland

NVC Scientific Name: *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland

NVC Identifier: CEGL003683

LOCAL DESCRIPTION

Environmental Description: In Shenandoah National Park, this community type occurs on steep, southeast- to southwest-facing rocky slopes underlain by Catoctin metabasalt (greenstone), often forming a woodland matrix around large cliffs and outcrops. One putative stand occurs on metasiltstone of the Harpers Formation. Middle-slope topographic positions are typical, but stands also occasionally occur on lower and upper slopes. Fourteen plot-sampling sites range in elevation from 490 to 790 m (1600-2600 feet.), and sites were usually assessed as subxeric. Mean slope inclination was 31 degrees, and surface cover of exposed bedrock and boulders averaged 42%. Soils collected from plots were strongly acidic (mean pH = 5.0) but had high calcium and magnesium levels.
Vegetation Description: The composition of this community type in Shenandoah National Park is very similar to that in the Global Vegetation description. In the spring, the ground is carpeted at many localities with mats of flowering *Phacelia dubia*, but this species quickly dies back once hot weather arrives. The variant of this community (described in Global Vegetation) in which *Chasmanthium latifolium* is the overwhelmingly dominant herb has been found in one locality of the park.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Carya glabra*, *Cercis canadensis*, *Dichanthelium boscii*, *Dichanthelium linearifolium*, *Elymus hystrix* var. *hystrix*, *Fraxinus americana*, *Helianthus divaricatus*, *Muhlenbergia sobolifera*, *Ostrya virginiana*, *Phacelia dubia*, *Quercus prinus*, *Solidago ulmifolia* var. *ulmifolia*
Other Noteworthy Species: *Information not available.*
Local Range: The type occurs in scattered patches throughout the park on suitable low-elevation (490-790 m [1600-2600 feet]) metabasalt habitats.
Classification Comments: See Global Classification Comments. *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216) is floristically similar but is a closed oak-hickory forest containing a larger number of shade-tolerant species.
Other Comments: Because favorable, low-elevation metabasalt exposures are widespread, the park contains one of the largest known concentrations of this community type. Some of the occurrences are exceptionally large and of very high quality.
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP055, SHNP056, SHNP059, SHNP061, SHNP062, SHNP064, SHNP065, SHNP067, SHNP068, SHNP071, SHNP073, SHNP074, SHNP076, SHNP080.
Shenandoah National Park Inventory Notes: Represented by 14 plots from the park. The park supports one of the larger known concentrations of this community type.

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	Cold-deciduous woodland (II.B.2.N.a.)
Alliance	*Fraxinus americana - Carya glabra - (Juniperus virginiana)* Woodland Alliance (A.604)
Alliance (English name)	White Ash - Pignut Hickory - (Eastern Red-cedar) Woodland Alliance
Association	*Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland
Association (English name)	White Ash - Pignut Hickory / Rock Muhly - Spreading Sunflower - Elmleaf Goldenrod Woodland
Ecological System(s):	Southern and Central Appalachian Mafic Glade and Barrens (CES202.348) Southern Piedmont Northern Triassic Basin Dry Forest (CES202.552)

GLOBAL DESCRIPTION

Concept Summary: This association is a woodland dominated by *Fraxinus americana* and *Carya glabra*, occurring in dry, rocky, fertile soils derived from metabasalt of the Catoctin Formation and, less frequently, metasiltstone of the Harpers and Weaverton formations. Stands are found from 60 to 950 m (250-3000 feet) in elevation in the central Blue Ridge and upper Piedmont. Less constant and important canopy species include *Carya ovalis, Quercus prinus, Quercus rubra var. rubra, Juniperus virginiana*, and *Pinus virginiana*. Subcanopy species include *Celtis tenuifolia, Celtis occidentalis, Cercis canadensis var. canadensis, Ostrya virginiana*, and *Ulmus rubra*. The shrub stratum includes *Rhus aromatica var. aromatica, Ptelea trifoliata, Viburnum rafinesquianum (= var. rafinesquianum), Rhus typhina, Toxicodendron radicans*, and *Vaccinium pallidum*. Typical species of the herb stratum include *Muhlenbergia sobolifera, Helianthus divaricatus, Pycnanthemum incanum, Elymus hystrix, Carex pensylvanica, Polygonum tenue, Woodsia ilvensis, Woodsia obtusa, Phacelia dubia, Symphyotrichum oblongifolium (= Aster oblongifolius), Solidago arguta var. harrisii (= Solidago harrisii), Selaginella rupestris, Cheilanthes lanosa, Danthonia spicata, Cardamine parviflora var. arenicola, Draba ramosissima, Sedum glaucophyllum*, and others.

Environmental Description: Stands occupy dry, rocky, thin-soiled slopes over Catoctin metabasalt (greenstone, a mafic metamorphic rock) and rarely other high-base bedrock, such as metasiltstone and phyllitic metasiltstone in the vicinity of Harper's Ferry, calcareous sandstone on Peters Mountain at The Narrows, Giles County, Virginia, hornblende-biotite granite on Point Lookout Mountain (Striped Rock), Grayson County, Virginia, or pyroxene-bearing granites of the northern Blue Ridge. Elevations of 22 plot samples and other observed stands range from 60 to 1012 m (240-3300 feet), with a mean of 562 m (1845 feet). Habitats are usually situated on steep (up to 37 degrees) middle slopes, often on or around large bedrock exposures. Mean surface cover of outcrops and loose rocks is about 40%. Aspect ranges from southeast to northwest, but the majority of sites have south to southwest aspects. Soils are mostly very stony, clay loams that are strongly acidic (mean pH = 5.0) but have relatively high calcium (ca. 1800 ppm) and magnesium (ca. 400 ppm) levels.

Vegetation Description: Stands of this woodlands are generally dominated by *Fraxinus americana* and *Carya glabra*. Less constant and important canopy species include *Carya ovalis, Quercus prinus, Quercus rubra var. rubra, Juniperus virginiana*, and *Pinus virginiana*. Subcanopy species include *Celtis tenuifolia, Celtis occidentalis, Cercis canadensis var. canadensis, Ostrya virginiana*, and *Ulmus rubra*. The shrub stratum includes *Rhus aromatica var. aromatica, Ptelea trifoliata, Viburnum rafinesquianum (= var. rafinesquianum), Rhus typhina, Toxicodendron radicans*, and *Vaccinium pallidum*. Typical species of the herb stratum include *Muhlenbergia sobolifera, Helianthus divaricatus, Pycnanthemum incanum, Elymus hystrix, Carex pensylvanica, Polygonum tenue, Woodsia ilvensis, Woodsia obtusa, Phacelia dubia, Symphyotrichum oblongifolium (= Aster oblongifolius), Solidago arguta var. harrisii (= Solidago harrisii), Selaginella rupestris, Cheilanthes lanosa, Danthonia spicata, Cardamine parviflora var. arenicola, Draba ramosissima, Sedum glaucophyllum*, and others.

In plot-sampled Virginia stands, vegetation consists of open to very open woodlands with stunted canopies of 6- to 15-m tall trees. *Fraxinus americana* is the characteristic, consistently dominant or co-dominant canopy species, usually contributing at least 25% cover. *Carya glabra* and, less frequently, *Carya ovata* and *Carya ovalis* are common, sometimes dominant overstory associates. *Quercus prinus, Quercus rubra, Juniperus virginiana, Pinus virginiana*, and *Juglans nigra* are minor canopy trees. Understory and shrub layers vary in density, with *Ulmus rubra, Celtis occidentalis, Ostrya virginiana, Cercis canadensis*, and *Rosa carolina* the most typical species. The herb layer varies from moderately open to dense and contains a diversity of xerophytic grasses and forbs. Dominant herbs occurring in 73% of plots and attaining a mean cover of 5% are *Muhlenbergia sobolifera, Helianthus divaricatus, Solidago ulmifolia, Carex pensylvanica, Elymus hystrix*, and *Phacelia dubia*. Unusual stands that occur on concave slopes at two sites have herb layers dominated by *Chasmanthium latifolium*. Less abundant but relatively constant (50%) herbs include *Acalypha virginica, Ambrosia artemisiifolia, Antennaria plantaginifolia, Arabis laevigata, Danthonia spicata, Dichanthelium boscii, Dichanthelium linearifolium, Eupatorium sessilifolium, Geum virginianum, Heuchera americana, Lespedeza frutescens (= Lespedeza intermedia), Polygonum scandens var. cristatum, Pycnanthemum incanum, Saxifraga virginiensis*, and *Woodsia obtusa*. Less frequent but locally abundant or important herbaceous species include *Schizachyrium scoparium, Senna marilandica, Symphyotrichum laeve var. concinnum (= Aster laevis var. concinnum), Symphyotrichum oblongifolium*, and *Tradescantia ohiensis*; the last species is prominent at, but confined to, the southernmost sites for this community in Giles and Grayson counties. *Solidago juncea, Carex muehlenbergii var. enervis, Lespedeza virginica*, and *Dichanthelium depauperatum* are important species of a variant of this community type occurring on metasedimentary rocks in Maryland, near Harper's Ferry, West Virginia. Species richness of plot-sampled stands ranges from 46 to 103 taxa per 400 square meters (mean = 66).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Carex pensylvanica, Carya glabra, Dichanthelium linearifolium, Elymus hystrix, Fraxinus americana, Helianthus divaricatus, Muhlenbergia sobolifera, Phacelia dubia, Pycnanthemum incanum, Solidago ulmifolia, Woodsia obtusa*

Other Noteworthy Species: *Cuscuta coryli, Potentilla arguta, Pycnanthemum clinopodioides, Sporobolus compositus*

USFWS Wetland System:

DISTRIBUTION

Range: This community is mostly restricted to areas underlain by Catoctin metabasalt (greenstone) in the Blue Ridge and adjacent Piedmont foothills of northern Virginia. However, scattered outliers have been documented on diabase of the northern Piedmont

Triassic Basin; on calcareous sedimentary substrates (sandstone, shale, metasiltstone, and phyllite) of the Blue Ridge and Ridge and Valley provinces; and on granitic terrain of the Blue Ridge. Occurrences have recently been observed on the northern extension of the Blue Ridge in Maryland and are possible in the Catoctin Mountain area of Maryland. This vegetation type is rare in the George Washington National Forest, where the only known examples are located at the northern end of the Pedlar Ranger District. Excellent Blue Ridge and Piedmont examples of the type are protected in Shenandoah National Park and The Nature Conservancy's Wildcat Mountain Natural Area, respectively.
States/Provinces: MD, VA:S2
Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS
Rank: G2 (30-Mar-2004)
Reasons: This community is naturally rare, geographically restricted, and confined to special edaphic habitats, primarily over metabasalt in the Blue Ridge and upper Piedmont of Virginia. There are few threats to occurrences of this community. Where trails transect or approach these communities, they receive minor trampling damage and introduction of alien species.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This community is associated with outcrops and thin soil areas over metabasalt and, less frequently, other bedrock with high base status.

The exotic herb *Commelina communis* and the shrub *Symphoricarpos orbiculatus*, introduced from farther west, are problematic invasives at some sites. *Symphoricarpos orbiculatus* is particularly aggressive and is capable of covering large areas with dense colonies in a matter of years, once established. As currently circumscribed, this community type does not include related (and often spatially associated) wooded herbaceous vegetation occurring on massive, exposed outcrops, e.g., *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529).
Similar Associations:
- *Carya glabra - Fraxinus americana / Acer leucoderme / Piptochaetium avenaceum* Woodland (CEGL008489)
- *Fraxinus americana / Dryopteris marginalis - Sedum glaucophyllum - Carex communis* Woodland [Provisional] (CEGL008541)
- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529)
- *Juniperus virginiana* var. *virginiana - Celtis tenuifolia - Cercis canadensis / Sporobolus clandestinus - Danthonia sericea* Woodland (CEGL008499)
- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216)

Related Concepts:
- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (Fleming and Coulling 2001) =
- Central Appalachian Basic Ash - Hickory Woodland (Fleming et al. 2004) =
- Greenstone Glade (Fleming 1993) B
- White ash - Shagbark hickory woodlands (CAP pers. comm. 1998) ?

SOURCES
Description Authors: G. Fleming and P. Coulling
References: CAP pers. comm. 1998, Fleming 1993, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Fleming pers. comm., Southeastern Ecology Working Group n.d.

Common Name (Park-specific): Chestnut Oak - Black Birch Wooded Talus Slope

SYNONYMS:
NVC English Name: Rock Chestnut Oak - Sweet Birch / Virginia Creeper Talus Woodland
NVC Scientific Name: *Quercus prinus - Betula lenta / Parthenocissus quinquefolia* Talus Woodland
NVC Identifier: CEGL006565

LOCAL DESCRIPTION
Environmental Description: In Shenandoah National Park, this community is widespread on acidic boulderfields and bouldery colluvial slopes, principally on resistant quartzites of the Chilhowee Group in the southern section of the park. However, additional sites on Catoctin metabasalt and Old Rag granite have been observed. The type frequently invades the edges of the larger, more open quartzite boulderfields that lack vascular plants and covers smaller, more weathered debris fields below cliffs and outcrops. In the

park, the type ranges from the lowest elevations to approximately 975 m (3200 feet). Middle- to upper-slope topographic positions are typical, and exposed rock surfaces in plots average about 50%. Northerly slopes prevail among plot samples, but this is probably an artifact of limited sampling. Soils could not be extracted from all plots; those that could were extremely acidic and infertile, with high iron levels.

Vegetation Description: Shenandoah National Park stands vary from nearly monospecific woodlands of gnarled *Betula lenta* to more closed and mixed forests of *Betula lenta*, *Quercus prinus*, and *Quercus rubra*. Relatively few tree associates occur, but *Betula papyrifera var. cordifolia* and *Tilia americana* are occasionally important. *Acer pensylvanicum, Amelanchier arborea*, and *Acer rubrum* are the most frequent understory trees. Shrub layers vary from sparse to moderately dense. *Menziesia pilosa* is characteristic of most stands in the park and often attains cover of 10-25%; *Hamamelis virginiana, Viburnum acerifolium, Kalmia latifolia, Vaccinium angustifolium*, and *Vaccinium pallidum* are also frequent, though rarely attain significant cover. Climbing and scrambling lianas of *Parthenocissus quinquefolia* are common. Herbs are sparse, with *Dryopteris marginalis* the only species occurring in >50% of plot samples and attaining a mean cover >2%. Additional herbs that are specially adapted to the rocky habitats and occasionally important in stands are *Aralia nudicaulis, Polypodium appalachianum*, and *Gymnocarpium appalachianum*. A number of other shrubs and herbs occur at low constancy and cover, but species richness (mean = 26 in 7 plot samples) is limited by the high rock cover.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Acer rubrum, Amelanchier arborea, Aralia nudicaulis, Betula lenta, Dryopteris marginalis, Hamamelis virginiana, Kalmia latifolia, Menziesia pilosa, Parthenocissus quinquefolia, Quercus prinus, Quercus rubra, Viburnum acerifolium*

Other Noteworthy Species: *Information not available.*

Local Range: This type is widespread on resistant quartzites of the Chilhowee Group in the southern section of the park and less widespread but scattered throughout the remainder of the park on various substrates.

Classification Comments: See Global Classification Comments. These habitats are extremely difficult to plot-sample, which is probably why the type is undersampled in the park. Potential differences in composition between stands on metasedimentary, plutonic, and volcanic rocks have not been examined.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP006, SHNP046, SHNP052, SHNP507, SHNP547, SHNP566, SHNP570.

Shenandoah National Park Inventory Notes: Represented by seven plots from the park.

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	Cold-deciduous woodland (II.B.2.N.a.)
Alliance	*Quercus rubra - Quercus prinus* Woodland Alliance (A.624)
Alliance (English name)	Northern Red Oak - Rock Chestnut Oak Woodland Alliance
Association	*Quercus prinus - Betula lenta / Parthenocissus quinquefolia* Talus Woodland
Association (English name)	Rock Chestnut Oak - Sweet Birch / Virginia Creeper Talus Woodland
Ecological System(s):	North-Central Appalachian Acidic Cliff and Talus (CES202.601)

GLOBAL DESCRIPTION

Concept Summary: This talus or rocky slope woodland community occurs in the central Appalachian Mountains and extends west to the Western Allegheny Plateau in Pennsylvania. The substrate is generally quartzite or sandstone talus and usually sloping, but the type also occurs on benches, ridges, and boulderfields. Soils, where present, are shallow, organic, acidic and infertile. The canopy is of variable cover but generally open with gnarled, widely spaced trees. Characteristic trees are birches, primarily *Betula lenta* but less frequently including *Betula papyrifera, Betula populifolia*, or *Betula alleghaniensis*, as well as *Nyssa sylvatica*. Other tree associates may include *Tsuga canadensis, Acer rubrum, Carya glabra, Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina*, or *Quercus coccinea*. Typical shrubs include *Acer spicatum, Acer pensylvanicum, Amelanchier arborea, Castanea dentata, Kalmia latifolia, Hamamelis virginiana, Menziesia pilosa, Ribes rotundifolium, Vaccinium angustifolium, Vitis* spp., *Toxicodendron radicans, Smilax rotundifolia*, and *Parthenocissus quinquefolia*. Ferns characterize the herb layer and may include *Dryopteris marginalis, Polypodium virginianum, Woodsia obtusa*, or *Asplenium platyneuron*. The forbs *Aralia nudicaulis, Heuchera* spp., and *Scutellaria saxatilis* are also well-adapted to the bouldery habitats. Lichens, especially the rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata*, characterize the nonvascular layer.

Environmental Description: Sites include the edges of very large, unvegetated (except for lichens), scarcely weathered block fields, as well as a variety of more weathered boulderfields and slopes covered by coarse to fine, bouldery colluvium. Much of the bouldery

rubble is weathered from resistant quartzite or sandstone caprock. The elevation range of plot-sampled stands in Virginia is 420 to 1025 m (1380-3360 feet). Slope position and aspect are variable, while associated landforms include landslide scarps, slide masses, concave hollow heads, and incised hollow bottoms. Mean cover of exposed boulders at Virginia sampling sites is 72%. In this very rocky environment, soil is limited to local, interstitial, root-rich duff deposits, or to "pads" of moss and underlying, thin, organic / sandy material that have developed on wide, flat boulder surfaces. Interstitial air spaces between boulders may be prevalent for 1.0 m or more below the surface. Soils are largely organic and usually extremely acidic and infertile. There is often some heterogeneity of boulder depth and weathering, as well as of microclimate and soil moisture, within boulderfields. In general, sites are somewhat xeric and show little evidence of subsurface drainage. However, this regime is ameliorated by higher elevations and north aspects, which probably slow evaporation and increase the moisture-holding capacity of the bouldery substrate.

Vegetation Description: Physiognomy varies from nearly closed forest to open woodland with widely spaced trees. The canopy is dominated by more-or-less gnarled specimens of *Betula lenta* and *Quercus prinus* generally <20 m tall. *Betula lenta* is usually the sole dominant of less weathered, steeper, more unstable boulderfield habitats, while a greater variety of trees is often co-dominant with *Betula lenta* on more weathered and stable habitats. Other overstory associates that may be important on some sites are *Quercus rubra, Nyssa sylvatica, Betula populifolia, Betula papyrifera var. cordifolia, Carya glabra, Tsuga canadensis,* and *Betula alleghaniensis*. The presence of well-preserved, fallen boles indicates that *Castanea dentata* was important on some boulderfields prior to the arrival of chestnut blight (Fleming and Moorhead 2000). *Acer rubrum* and *Nyssa sylvatica* are scattered canopy associates and frequent understory species. The typically open shrub layer contains *Acer pensylvanicum, Acer spicatum, Amelanchier arborea, Castanea dentata* sprouts, *Hamamelis virginiana, Ilex montana, Kalmia latifolia, Menziesia pilosa,* and *Ribes rotundifolium*. The herb layer consists almost entirely of low-statured shrubs, particularly *Menziesia pilosa* and *Vaccinium angustifolium*, and/or scattered to abundant vines of *Parthenocissus quinquefolia, Vitis* spp., *Toxicodendron radicans,* and *Smilax rotundifolia*. Flat, mossy boulders provide rooting habitats for a few specially adapted herbaceous plants such as *Polypodium appalachianum, Dryopteris marginalis, Heuchera* spp., *Aralia nudicaulis*, and *Scutellaria saxatilis*. Bryophyte cover ranges up to 65% in some microhabitats. The rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata* are generally the most conspicuous lichens. The combination of surficial boulder cover and nutrient-poor substrate results in a notably low mean species richness (n = 22 taxa per 400 square meters) in Virginia plot samples of this type.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer spicatum*, *Aralia nudicaulis*, *Betula lenta*, *Betula papyrifera* var. *cordifolia*, *Dryopteris marginalis*, *Menziesia pilosa*, *Parthenocissus quinquefolia*, *Polypodium appalachianum*, *Quercus prinus*, *Ribes rotundifolium*, *Scutellaria saxatilis*, *Vaccinium angustifolium*

Other Noteworthy Species: *Gymnocarpium appalachianum*, *Heuchera americana* var. *hispida*

USFWS Wetland System:

DISTRIBUTION

Range: This community occurs locally throughout the Blue Ridge and Ridge and Valley sections of Pennsylvania, Virginia, West Virginia, and Maryland. In Virginia, it reaches optimal development on sideslopes of linear sandstone and quartzite strike ridges in the Ridge and Valley, and on the western, metasedimentary flank of the northern Blue Ridge. Landsliding and debris avalanches, which generate and regenerate boulderfield environments, are dominant erosional processes in these landscapes (Hack and Goodlett 1960).

States/Provinces: MD, PA, VA:S3S4, WV

Federal Lands: NPS (Blue Ridge Parkway, Catoctin Mountain, Harpers Ferry, Shenandoah, Valley Forge); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G3G4 (9-Aug-2004)

Reasons: Although this community type occurs in small patches over a limited geographic range, there are probably >200 sites (if not many hundreds of sites) in Virginia and West Virginia alone. Moreover, stands occupy rugged habitats that are not prone to anthropogenic disturbances.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This vegetation type is poorly represented by plot data and additional sampling is needed, particularly of lower elevation and south-slope stands. Even with limited data, potential variants of the type in Virginia were proposed by Fleming and Moorhead (2000). A variant of sheltered north slopes in which *Tsuga canadensis* is co-dominant with *Betula lenta* and/or *Quercus* spp. has been reported from Virginia by Hupp (1983) and from Pennsylvania by Fike (1999). Many Virginia populations of the state-rare, northern tree *Betula papyrifera var. cordifolia* are associated with this community type.

This boulderfield woodland represents a long-term sere in the geomorphic and vegetational progression from exposed, lichen-dominated block fields to fully forested mountain slopes with well-developed mineral soils. In addition to edaphic stresses, trees of

these habitats are subject to frequent damage from wind and ice storms. Boundaries between the boulderfield woodlands and adjacent forests are often obscure, with composition gradually changing along with substrate conditions and soil depth. This type frequently intergrades with several communities of the Mixed Oak / Heath Forests group, especially *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) of somewhat sheltered, often very rocky slopes.

Similar Associations:

- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320)--is known from ME, NH, VT, NY, PA and perhaps NJ, is similar but more northern in character; it lacks *Betula lenta, Nyssa sylvatica*, and *Kalmia latifolia*.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)--of somewhat sheltered, often very rocky slopes.

Related Concepts:

- *Betula lenta / Parthenocissus quinquefolia* Association (Rawinski et al. 1996) ?
- *Betula lenta / Ribes rotundifolium - Menziesia pilosa / Parthenocissus quinquefolia - Polypodium appalachianum* Woodland (Fleming and Coulling 2001) ?
- *Quercus rubra - Quercus montana - Betula lenta / Ilex montana / Menziesia pilosa* Forest (Fleming and Moorhead 2000) ?
- *Quercus rubra - Quercus montana - Betula lenta / Parthenocissus quinquefolia* Forest (Fleming and Moorhead 2000) ?

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Anderson et al. 1998, Eastern Ecology Working Group n.d., Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Hack and Goodlett 1960, Hupp 1983, Lea 2003, Rawinski et al. 1996, Russell and Schuyler 1988, VDNH 2003

Common Name (Park-specific): Central Appalachian Basic Boulderfield Forest (Montane Basswood - White Ash Type)

SYNONYMS:

NVC English Name: American Basswood - White Ash / Striped Maple - Eastern Hop-hornbeam / Virginia Creeper - Yellow Jewelweed Woodland

NVC Scientific Name: *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia* - *Impatiens pallida* Woodland

NVC Identifier: CEGL008528

LOCAL DESCRIPTION

Environmental Description: See Global Environment. All known occurrences of this type in the park are on metabasalt and granitic boulderfields.

Vegetation Description: Composition of Shenandoah National Park stands is very similar to that described under Global Vegetation. *Acer saccharum* is present in only 21% of documented park stands. Additional species that are locally common in the type include *Hamamelis virginiana, Prunus virginiana, Hydrangea arborescens, Corylus cornuta var. cornuta, Acer spicatum*, and *Toxicodendron radicans*.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum, Ageratina altissima, Fraxinus americana, Hamamelis virginiana, Impatiens pallida, Laportea canadensis, Ostrya virginiana, Parthenocissus quinquefolia, Polymnia canadensis, Quercus rubra, Sambucus racemosa, Tilia americana*

Other Noteworthy Species: *Information not available.*

Local Range: This type is widespread on bouldery sites underlain by Catoctin metabasalt and apparently more local on granitic substrates. It is most characteristic of middle-elevation sites but has been documented in suitable habitats as low as 520 m (1700 feet).

Classification Comments: Although it is sometimes found at low elevations, this type is most abundant in the elevational zone (>760 m [2500 feet]), where *Liriodendron tulipifera* drops out as a dominant tree of coves and mesic slopes. The type can intergrade with bouldery variants of *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest (CEGL006237), which typically has a major overstory component of *Acer saccharum* and a much lusher herb layer.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP004, SHNP027, SHNP040, SHNP041, SHNP042, SHNP044, SHNP045, SHNP050, SHNP051, SHNP054, SHNP514, SHNP534, SHNP577, SHNP654.

Shenandoah National Park Inventory Notes: Represented by 14 plots from the park.

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	Cold-deciduous woodland (II.B.2.N.a.)
Alliance	*Tilia americana - Fraxinus americana - (Acer saccharum)* Woodland Alliance (A.628)
Alliance (English name)	American Basswood - White Ash - (Sugar Maple) Woodland Alliance
Association	*Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland
Association (English name)	American Basswood - White Ash / Striped Maple - Eastern Hop-hornbeam / Virginia Creeper - Yellow Jewelweed Woodland
Ecological System(s):	Central and Southern Appalachian Montane Oak Forest (CES202.596) North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)

GLOBAL DESCRIPTION

Concept Summary: This community type occurs throughout the northern Blue Ridge in Virginia, Maryland, and West Virginia, and more locally in the western Virginia Ridge and Valley region. Sites include steep, boulder and stone slides below cliffs; boulder-filled slope concavities and hollow-heads; and other very rocky, submesic to mesic habitats at middle elevations between 760 and 1030 m (2500-3400 feet). This is an open to closed, mixed hardwood forest, with tall, well-formed trees. Because of somewhat unstable substrates and occasional exposure to severe wind and ice storms, downfalls and crown damage may be frequent in some stands. *Tilia americana* (including both *var. americana* and *var. heterophylla*), *Fraxinus americana*, and *Quercus rubra* are the most abundant, variably dominant or co-dominant canopy trees. *Carya cordiformis, Robinia pseudoacacia*, and *Carya ovata* are minor but constant canopy associates. Understory layers tend to be open, with *Acer pensylvanicum, Ostrya virginiana, Sambucus racemosa (= Sambucus pubens),* and *Ribes rotundifolium* the most characteristic species. The usually patchy herb layer varies greatly in richness and density with substrate conditions.

Environmental Description: Sites include steep, boulder and stone slides below cliffs; boulder-filled slope concavities and hollow-heads; and other very rocky, submesic to mesic habitats at middle elevations. Most plot-sampled stands are situated between 760 and 1030 m (2500-3400 feet) elevation, but stands occasionally occur as low as 520 m (1700 feet). The community is most frequent and characteristic of sites underlain by Catoctin metabasalt (greenstone) but also occurs locally on base-rich granitic rocks of the Blue Ridge basement complex, e.g., layered pyroxene granulite, charnockite, and porphyritic leucocharnockite. Scattered boulderfield habitats for this community in the Ridge and Valley province are derived from calcareous shales and siltstones. Stands occur at lower, middle, and upper slope topographic positions. Mean slope in plots is 23 degrees. Rock cover (bedrock, boulders, and/or stones) is essentially continuous, but surficial exposure of rocks averages 50%, with leaf litter (47%) and decaying wood (3%) comprising the remainder of the substrate. Soils are mostly interstitial, have high organic content (mean = 23%), and are generally difficult to extract. Samples collected from plots are very strongly acidic (mean pH = 4.7) but have moderately high calcium, magnesium, and manganese levels (up to 4628 ppm, 372 ppm, and 269 ppm, respectively).

Vegetation Description: Stand physiognomy is an open to closed, mixed hardwood forest, with tall, well-formed trees. Because of somewhat unstable substrates and occasional exposure to severe wind and ice storms, downfalls and crown damage may be frequent in some stands. *Tilia americana* (including both *var. americana* and *var. heterophylla*), *Fraxinus americana*, and *Quercus rubra* are the most abundant, variably dominant or co-dominant canopy trees. More locally, *Betula lenta* and *Acer saccharum* are co-dominants in the mixtures, although the latter is absent from the majority of plot-sampled stands. *Carya cordiformis, Robinia pseudoacacia*, and *Carya ovata* are minor but constant canopy associates. Understory layers tend to be open, with *Acer pensylvanicum, Ostrya virginiana, Sambucus racemosa (= Sambucus pubens),* and *Ribes rotundifolium* the most characteristic species. The usually patchy herb layer varies greatly in richness and density with substrate conditions. Scrambling vines of *Parthenocissus quinquefolia*, along with the forbs *Impatiens pallida, Laportea canadensis*, and *Ageratina altissima*, constitute much of the herb-layer cover. Additional more-or-less constant herbs include *Actaea racemosa (= Cimicifuga racemosa), Arisaema triphyllum, Asarum canadense, Dryopteris marginalis, Eurybia divaricata (= Aster divaricatus), Galium triflorum, Hydrophyllum virginianum, Osmorhiza claytonii*, and *Polymnia canadensis*, all of which are well-adapted to the interstices and moss mats of very bouldery/rocky habitats. On sites with slightly better development of mineral soils, a larger variety of nutrient-demanding herbs (e.g., *Caulophyllum thalictroides, Trillium grandiflorum, Viola canadensis*) may be present. Species richness of plot-sampled stands ranges from 14 to 59 taxa per 400 square meters (mean = 40).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Acer pensylvanicum*, *Ageratina altissima*, *Fraxinus americana*, *Impatiens pallida*, *Laportea canadensis*, *Ostrya virginiana*, *Polymnia canadensis*, *Prunus virginiana*, *Quercus rubra*, *Ribes rotundifolium*, *Sambucus racemosa*, *Tilia americana*

Other Noteworthy Species: *Gymnocarpium appalachianum*

USFWS Wetland System:

DISTRIBUTION

Range: This community type occurs in suitable habitats throughout the northern Blue Ridge in Virginia, Maryland, and West Virginia, and more locally in the western Virginia Ridge and Valley region. Stands assigned to this type but somewhat transitional to northern hardwood forest, *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (CEGL008502), also occur on the northwest flank of Peters Mountain in Alleghany County, Virginia. Similar forests have been observed in a few other sites of the western Virginia Ridge and Valley region.
States/Provinces: MD, VA:S3?, WV
Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G3 (1-Oct-2001)
Reasons: Based on current documentation, there are probably fewer than 100 occurrences of this community rangewide. Patch sizes are not large, and the type appears to be associated with a narrow range of ecological conditions, including base-rich substrates and intermediate elevations. The Blue Ridge of Maryland and the Ridge and Valley of Virginia and West Virginia support additional occurrences, but these are unlikely to be numerous due to a general lack of suitable substrates within the critical elevation range.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 2 - Moderate
Comments: Classification of this unit is supported by 19 plots from Alleghany, Amherst, Botetourt, Greene, Madison, Page, Rappahannock, Rockbridge, and Rockingham counties, Virginia (G. Fleming pers. comm.). Boulderfield forests and woodlands have not been thoroughly inventoried in Virginia and elsewhere. The global ranges and ecological relationships of this and other units are not well known and require additional study. In particular, the distribution and status of *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland (CEGL008528) in the Ridge and Valley province needs clarification. The distribution of this community type in the northern Blue Ridge appears to be centered above 760 m (2500 feet) elevation, where *Liriodendron tulipifera* begins to reach its upper elevational limits. Similar low-elevation habitats probably support *Liriodendron tulipifera - Tilia americana - Betula lenta / Asimina triloba / Dryopteris marginalis* Forest [Provisional] (CEGL008527). Above 1000 to 1060 m (3300-3500 feet) (depending on aspect) elevation, this type is replaced by *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (CEGL008504).
Similar Associations:
Related Concepts:

- *Liriodendron tulipifera - Acer saccharum - Tilia americana / Laportea canadensis - Impatiens pallida* Association, *pro parte* (Rawinski et al. 1996) ?
- *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland (Fleming and Coulling 2001) =
- *Tilia americana - Fraxinus americana / Ostrya virginiana / Ageratina altissima* Forest (Fleming and Moorhead 2000) ?

SOURCES

Description Authors: G. Fleming and P. Coulling
References: Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Fleming et al. 2004, Rawinski et al. 1996

Common Name (Park-specific): High-Elevation Acidic Heath Barren / Pavement

SYNONYMS:

NVC English Name: Mountain Laurel - Hillside Blueberry Shrubland
NVC Scientific Name: *Kalmia latifolia - Vaccinium pallidum* Shrubland
NVC Identifier: CEGL008538

LOCAL DESCRIPTION

Environmental Description: The two known localities in the park are on sublevel to steeply sloping outcrop pavements of charnockite and Old Rag granite, respectively. Habitats are consistent with the Global Environment description.
Vegetation Description: Composition is similar to that described in Global Vegetation. *Kalmia latifolia* and *Vaccinium pallidum* co-dominate, and extremely stunted *Pinus pungens, Quercus prinus*, and *Quercus rubra* occur as scattered individuals. *Menziesia pilosa* co-dominates at one site. *Deschampsia flexuosa, Carex pensylvanica,* and *Solidago puberula var. puberula* are the most characteristic herbs.
Most Abundant Species

Stratum **Lifeform** **Species**

Characteristic Species: *Carex pensylvanica, Deschampsia flexuosa, Kalmia latifolia, Menziesia pilosa, Pinus pungens, Solidago puberula* var. *puberula, Vaccinium pallidum*

Other Noteworthy Species: *Arctostaphylos uva-ursi, Minuartia groenlandica*

Local Range: This type is known from middle- to high-elevation outcrops of granitic rocks at Old Rag and Millers Head in the central section of the park. The type is extensive on the exposed summits of Old Rag. It probably occurs on other granitic outcrops and possibly on some higher quartzite exposures in the park.

Classification Comments: *Information not available.*

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP025, SHNP035, SHNP567.

Shenandoah National Park Inventory Notes: Represented by three plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Mixed evergreen-deciduous shrubland (III.C.)
Physiognomic Group	Mixed evergreen - cold-deciduous shrubland (III.C.2.)
Physiognomic Subgroup	Natural/Semi-natural mixed evergreen - cold-deciduous shrubland (III.C.2.N.)
Formation	Mixed evergreen - cold-deciduous shrubland (III.C.2.N.a.)
Alliance	*Kalmia latifolia - Gaylussacia baccata* Shrubland Alliance (A.1050)
Alliance (English name)	Mountain Laurel - Black Huckleberry Shrubland Alliance
Association	*Kalmia latifolia - Vaccinium pallidum* Shrubland
Association (English name)	Mountain Laurel - Hillside Blueberry Shrubland

Ecological System(s):

GLOBAL DESCRIPTION

Concept Summary: This community type appears to be scattered on exposed acidic outcrops of both the northern Blue Ridge and Ridge and Valley provinces in Virginia. Similar vegetation has been observed on Ridge and Valley outcrops below 1200 m (4000 feet) elevation in Pendleton County, West Virginia. Stands occur on moderately to steeply sloping (12 to >30 degrees) outcrops, pavements, and clifftops of acidic bedrock at moderately high elevations. Four plot-sampled stands are associated with outcrops of Tuscarora quartzite, charnockite, leucocharnockite, and Old Rag granite. These sites are situated on convex upper slopes and summits with south to northwest aspects, at elevations from about 975 to 1160 m (3200-3800 feet). Surface cover of bedrock and loose boulders averages 80%, and lichen cover on rocks is generally >50%. Total vegetation cover is often <25% and consists of patchy shrub thickets and herbaceous mats among the exposed rocks. *Kalmia latifolia* and *Vaccinium pallidum* are dominant shrubs, each with mean cover of 5-10% in plot samples. Other woody plants occurring irregularly in the type include *Gaylussacia baccata, Menziesia pilosa, Parthenocissus quinquefolia,* and extremely stunted (<3 m tall) *Quercus rubra, Quercus prinus,* and *Pinus pungens*. *Deschampsia flexuosa* is the most constant herbaceous species. Other locally important herbs are *Carex pensylvanica, Schizachyrium scoparium, Paronychia argyrocoma, Danthonia spicata, Saxifraga michauxii, Lysimachia quadrifolia,* and *Campanula divaricata*.

Environmental Description: Stands occur on moderately to steeply sloping (12 to >30 degrees) outcrops, pavements, and clifftops of acidic bedrock at moderately high elevations. Four plot-sampled stands are associated with outcrops of Tuscarora quartzite, charnockite, leucocharnockite, and Old Rag granite. These sites are situated on convex upper slopes and summits with south to northwest aspects, at elevations from about 975 to 1160 m (3200-3800 feet). Surface cover of bedrock and loose boulders averages 80%, and lichen cover on rocks is generally >50%. Soil development is minimal, consisting of localized crevices and mats of disintegrated rock and organic matter. These habitats have a distinctly xeric moisture regime and are subject to year-around microclimatic extremes, including high solar exposure and temperatures in summer, high winds, periodic ice, and low winter temperatures.

Vegetation Description: Total vegetation cover is often <25% and consists of patchy shrub thickets and herbaceous mats among the exposed rocks. *Kalmia latifolia* and *Vaccinium pallidum* are dominant shrubs, each with mean cover of 5-10% in plot samples. Other woody plants occurring irregularly in the type include *Gaylussacia baccata, Menziesia pilosa, Parthenocissus quinquefolia,* and extremely stunted (<3 m tall) *Quercus rubra, Quercus prinus,* and *Pinus pungens*. *Deschampsia flexuosa* is the most constant herbaceous species. Other locally important herbs are *Carex pensylvanica, Schizachyrium scoparium, Paronychia argyrocoma, Danthonia spicata, Saxifraga michauxii, Lysimachia quadrifolia,* and *Campanula divaricata*. The occurrence of this vegetation at Miller's Head in Shenandoah National Park (Page County, Virginia) is uniquely characterized by creeping mats of the northern subshrub *Arctostaphylos uva-ursi,* occurring at its only known Virginia location. Species richness of plot-sampled stands ranges from 9 to 22 taxa per 100 square meters (mean = 17).

Most Abundant Species

Stratum **Lifeform** **Species**
Characteristic Species: *Carex pensylvanica, Deschampsia flexuosa, Gaylussacia baccata, Kalmia latifolia, Paronychia argyrocoma, Pinus pungens, Vaccinium pallidum*
Other Noteworthy Species: *Arctostaphylos uva-ursi, Minuartia groenlandica*
USFWS Wetland System:

DISTRIBUTION
Range: This community type appears to be scattered on exposed, acidic outcrops of both the northern Blue Ridge and Ridge and Valley provinces in Virginia. Similar vegetation has been observed by Virginia VANHP ecologists on Ridge and Valley outcrops below 1200 m (4000 feet) elevation in Pendleton County, West Virginia.
States/Provinces: VA, WV
Federal Lands: NPS (Shenandoah); USFS (George Washington)

CONSERVATION STATUS
Rank: G2G3 (21-Jun-2001)
Reasons: This community is probably more widespread than documentation indicates, but is a naturally restricted, small-patch vegetation type. There are few threats to this vegetation because of its remote, often inaccessible habitats.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: Additional inventory, data collection, and analysis are needed to clarify the classification and geographic distribution of this unit. Current documentation in Virginia consists of four rather floristically heterogeneous stands that are united by similar habitats and shrub species dominance. The environmental dynamics of this vegetation, particularly the influences of bedrock chemistry and elevation, are poorly known. It is possible that splitting of this unit may be warranted once adequate data are collected and analyzed.
Similar Associations:
- *Kalmia latifolia - Gaylussacia baccata - Vaccinium angustifolium - Menziesia pilosa* Shrubland (CEGL003939)--occurs higher (>1200 m; 4000 feet)and has many other characteristic species.

Related Concepts:
- *Kalmia latifolia - Vaccinium pallidum* Shrubland [Provisional] (Fleming and Coulling 2001) =

SOURCES
Description Authors: G. Fleming
References: Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004

Common Name (Park-specific): High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic Type)

SYNONYMS:
NVC English Name: Black Chokeberry - Black Huckleberry / Pennsylvania Sedge Shrubland
NVC Scientific Name: *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland
NVC Identifier: CEGL008508

LOCAL DESCRIPTION
Environmental Description: Sites in Shenandoah National Park occur on medium- to high-elevation exposed, west-facing clifftops of Catoctin metabasalt (greenstone), but could potentially occur on similar outcrops of granitic composition. Elevations range from 880 to 1070 m (2900 to 3500 feet). Habitats have very high cover of exposed bedrock and boulders, with thin veneers of moss, lichens, and extremely acidic, infertile soil.
Vegetation Description: Composition of stands in the park is similar to the Global Vegetation description, except that *Rhododendron catawbiense, Paronychia argyrocoma,* and *Heuchera villosa* are absent. Wind-dwarfed *Quercus rubra* and *Betula alleghaniensis* occur on the edges of the outcrops. *Photinia melanocarpa (= Aronia melanocarpa)* and *Gaylussacia baccata* are co-dominant shrubs at all sites; *Spiraea alba var. latifolia* co-dominates at one site. *Rubus allegheniensis, Hamamelis virginiana,* and stunted *Betula lenta* also occur. The herbaceous component is sparse, with *Hylotelephium telephioides (= Sedum telephioides), Carex pensylvanica,* and *Solidago simplex var. randii* the most frequent and abundant species. Forest herbs such as *Amianthium muscitoxicum, Aralia nudicaulis,* and *Maianthemum canadense* frequently occur in deep organic mats in the denser shrub thickets.
Most Abundant Species

Stratum **Lifeform** **Species**

Characteristic Species: *Carex pensylvanica, Gaylussacia baccata, Photinia melanocarpa, Quercus rubra, Sedum telephioides, Solidago simplex* var. *randii, Sorbus americana*

Other Noteworthy Species: *Information not available.*

Local Range: Seven locations for this vegetation type are currently known in the park: on Mount Marshall and Pass Mountain in the northern section, on Bearfence, Franklin Cliffs, and Hawksbill in the central section, and on Hightop in the southern section. Additional patches are likely on higher-elevation metabasalt and granitic outcrops.

Classification Comments: *Information not available.*

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP038, SHNP039, SHNP662.

Shenandoah National Park Inventory Notes: Represented by three plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Mixed evergreen-deciduous shrubland (III.C.)
Physiognomic Group	Mixed evergreen - cold-deciduous shrubland (III.C.2.)
Physiognomic Subgroup	Natural/Semi-natural mixed evergreen - cold-deciduous shrubland (III.C.2.N.)
Formation	Mixed evergreen - cold-deciduous shrubland (III.C.2.N.a.)
Alliance	*Kalmia latifolia - Gaylussacia baccata* Shrubland Alliance (A.1050)
Alliance (English name)	Mountain Laurel - Black Huckleberry Shrubland Alliance
Association	*Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland
Association (English name)	Black Chokeberry - Black Huckleberry / Pennsylvania Sedge Shrubland
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
	Southern Appalachian Grass and Shrub Bald (CES202.294)
	Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)

GLOBAL DESCRIPTION

Concept Summary: This community type is known from scattered localities along nearly the full length of the Blue Ridge in Virginia and could potentially occur in North Carolina, West Virginia, Maryland, and Pennsylvania. This vegetation type is associated with medium- to high-elevation exposed outcrops of igneous and metamorphic rocks, including metabasalt (greenstone), porphyritic leucocharnockite, amphibolite, and rhyolite. Elevation ranges from about 1030-1400 m (3400-4600 feet), but occurrences as low as 730 m (2400 feet) have been observed in the northern Virginia Blue Ridge. Habitats are typically on strongly convex, upper slopes and rocky summits with west to northwest or flat aspects. The community is a patchwork of shrub thickets, small herbaceous mats, and exposed, lichen-covered rock surfaces. *Photinia melanocarpa (= Aronia melanocarpa)* is the dominant shrub, or is co-dominant with *Gaylussacia baccata, Hamamelis virginiana, Smilax tamnoides*, and/or *Kalmia latifolia*. Minor woody components include *Sorbus americana, Rhododendron catawbiense*, and *Menziesia pilosa*, as well as severely stunted *Betula alleghaniensis* and *Quercus rubra*.

Environmental Description: This vegetation type is associated with medium- to high-elevation exposed outcrops of igneous and metamorphic rocks, including metabasalt (greenstone), porphyritic leucocharnockite, amphibolite, and rhyolite. The elevation range of plot-sampled stands is from about 884 to 1400 m (2900-4600 feet), but occurrences as low as 730 m (2400 feet) have been observed in the northern Virginia Blue Ridge. Habitats are typically on strongly convex, upper slopes and rocky summits with west to northwest or flat aspects. Surface cover of bedrock and loose boulders in plot-sampled stands averages 80%, with mean lichen cover of 44% on these rocks. Soil development and moisture potential at these sites are minimal, and habitats may also be subject to severe winter temperatures, high winds, and ice.

Vegetation Description: The community is a patchwork of shrub thickets, small herbaceous mats, and exposed, lichen-covered rock surfaces. *Photinia melanocarpa (= Aronia melanocarpa)* is the dominant shrub, or is co-dominant with *Gaylussacia baccata, Hamamelis virginiana, Smilax tamnoides*, and/or *Kalmia latifolia*. Minor woody components include *Sorbus americana, Rhododendron catawbiense*, and *Menziesia pilosa*, as well as severely stunted *Betula alleghaniensis* and *Quercus rubra*. The most frequent herbaceous species are *Carex pensylvanica, Saxifraga michauxii, Dennstaedtia punctilobula, Polypodium appalachianum, Agrostis perennans, Paronychia argyrocoma, Solidago simplex var. randii, Hylotelephium telephioides (= Sedum telephioides), Heuchera villosa, Campanula divaricata*, and *Danthonia spicata*. Species richness of plot-sampled stands ranges from 12 to 37 taxa per 100 square meters (mean = 22).

Most Abundant Species

Stratum **Lifeform** **Species**

Characteristic Species: *Carex pensylvanica, Gaylussacia baccata, Paronychia argyrocoma, Photinia melanocarpa, Saxifraga michauxii, Sedum telephioides, Smilax tamnoides, Solidago simplex* var. *randii*

Other Noteworthy Species: *Huperzia appalachiana, Minuartia groenlandica, Sibbaldiopsis tridentata*

USFWS Wetland System:

DISTRIBUTION
Range: This community type is known from scattered localities along nearly the full length of the Blue Ridge in Virginia. It is of potential occurrence in North Carolina, West Virginia, Maryland, and Pennsylvania.
States/Provinces: MD?, NC?, PA?, VA:S1, WV?
Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS
Rank: G1? (20-Jun-2001)
Reasons: This is a naturally rare, small-patch vegetation type limited by special habitat requirements. Currently, there are only 10 known stands of this vegetation, in aggregate covering less than 4 hectares (10 acres). Additional occurrences are likely but would not significantly increase the aggregate acreage of the type.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: Additional data collection from known stands that have not been plot-sampled would increase the robustness of this type's classification. Examples of this community should be sought outside the Virginia Blue Ridge.
Similar Associations:
Related Concepts:
- *Hamamelis virginiana - Rhododendron catawbiense - Physocarpus opulifolius* Association (Rawinski and Wieboldt 1993) ?
- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (Fleming and Coulling 2001) = *Saxifraga michauxii - Solidago randii - Sibbaldiopsis tridentata* Herbaceous Vegetation (Coulling and Rawinski 1999) ?

SOURCES
Description Authors: G. Fleming
References: Coulling and Rawinski 1999, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Rawinski and Wieboldt 1993

Common Name (Park-specific): Shenandoah Valley Sinkhole Pond (Typic Type)

SYNONYMS:
NVC English Name: Pin Oak / Redtop Panicgrass - Warty Panicgrass - Needle Spikerush Herbaceous Vegetation
NVC Scientific Name: *Quercus palustris / Panicum rigidulum* var. *rigidulum - Panicum verrucosum - Eleocharis acicularis* Herbaceous Vegetation
NVC Identifier: CEGL007858

LOCAL DESCRIPTION
Environmental Description: Same as Global Environment.
Vegetation Description: The single Shenandoah National Park occurrence has a small (about 100 square meters) herbaceous center dominated in draw-down periods by *Panicum verrucosum, Eleocharis acicularis,* and *Panicum rigidulum var. rigidulum.* A dense thicket of short *Quercus palustris, Vaccinium fuscatum,* and *Smilax rotundifolia* borders the open area.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Eleocharis acicularis*, *Panicum rigidulum* var. *rigidulum*, *Panicum verrucosum*, *Quercus palustris*, *Viola lanceolata* ssp. *lanceolata*
Other Noteworthy Species: *Information not available.*
Local Range: Many ponds supporting this community occur just outside the western Shenandoah National Park boundary in Augusta and Rockingham counties. However, only a single pond extends partly inside the park boundary east of Grottoes, Rockingham County.
Classification Comments: The single Shenandoah National Park example is small but representative of the type.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP090.
Shenandoah National Park Inventory Notes: Represented by one plot from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Rhynchospora* spp. - *Panicum (rigidulum, verrucosum)* - *Rhexia virginica* Seasonally Flooded Herbaceous Alliance (A.1384)
Alliance (English name)	Beaksedge species - (Redtop Panicgrass, Warty Panicgrass) - Virginia Meadow-beauty Seasonally Floode
Association	*Quercus palustris / Panicum rigidulum* var. *rigidulum* - *Panicum verrucosum* - *Eleocharis acicularis* Herbaceous Vegetation
Association (English name)	Pin Oak / Redtop Panicgrass - Warty Panicgrass - Needle Spikerush Herbaceous Vegetation
Ecological System(s):	Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018)

GLOBAL DESCRIPTION

Concept Summary: This community occurs in seasonally flooded depression ponds developed by solution and collapse of carbonate rocks underlying acidic colluvial materials deposited on the eastern edge of the Great Valley of Virginia, in Augusta, Rockingham, and southern Page counties, Virginia. This community has a variable physiognomy, from an open woodland with scattered individuals or groves of *Quercus palustris*, to entirely herbaceous with a marginal zone of trees. *Quercus palustris* is the most common and characteristic tree species; other trees include *Acer rubrum, Nyssa sylvatica, Pinus rigida*, and *Diospyros virginiana*. The shrub (and woody vine) stratum is usually sparse or absent; it can include *Vaccinium corymbosum, Vaccinium fuscatum, Cephalanthus occidentalis*, and *Smilax rotundifolia*. The herb stratum is well-developed. Herbaceous species with high constancy include *Panicum rigidulum var. rigidulum, Panicum verrucosum, Eleocharis acicularis, Agrostis perennans, Dichanthelium acuminatum, Hypericum boreale, Helenium virginicum* (endemic to this and related communities in Virginia), *Panicum philadelphicum, Bidens frondosa, Viola lanceolata, Erechtites hieraciifolia, Symphyotrichum dumosum (= Aster dumosus), Fimbristylis autumnalis, Rhexia mariana,* and *Rhexia virginica*.

Environmental Description: This community occurs in seasonally flooded depression ponds developed by solution and collapse of carbonate rocks underlying acidic materials eroded from the Blue Ridge and deposited along the eastern edge of the Great Valley of Virginia in massive alluvial fans. Ponds supporting this community range in size from about 0.04 hectare (0.1 acre) to over 1.0 hectare (2.4 acres). Flooding duration is controlled by groundwater fluctuations and ranges from intermittent to extended, but is often characterized by relatively short seasonal flooding. The dates during which ponds draw down vary widely with annual rainfall patterns, but these habitats are almost always exposed by the end of the growing season. Soils are predominantly clay loams with thin organic horizons of matted, partly decomposed leaf litter and *Sphagnum*. Soil samples collected from 19 sites were very strongly acidic (mean pH = 4.5), with high levels of aluminum (Al) and arsenic (As), and low levels of boron, calcium, phosphorus, magnesium, and potassium. Low pH in combination with high Al and As may impair the assimilation of macronutrients by plants. These data suggest that soil chemistry, in combination with hydrologic conditions, produce unusual edaphic stresses that strongly influence floristic composition in these ponds.

Vegetation Description: This community has a variable physiognomy, from an open woodland with scattered individuals or groves of *Quercus palustris*, to entirely herbaceous with a marginal zone of trees. *Quercus palustris* is the most common and characteristic tree species; minor trees include *Acer rubrum, Nyssa sylvatica, Pinus rigida*, and *Diospyros virginiana*. The shrub stratum is usually sparse or absent, but can include *Vaccinium corymbosum, Vaccinium fuscatum,* and *Cephalanthus occidentalis*. Thick tangles of *Smilax rotundifolia* are typical around pond borders. The herb layer is usually well-developed. *Eleocharis acicularis* often forms the first vegetation patches during late stages of flooding and early draw-down. As it matures, sprouts of *Panicum rigidulum* (including both *var. rigidulum* and *var. pubescens*), *Panicum verrucosum,* and many other species appear and constitute the late-season draw-down vegetation. Additional species with high constancy include *Agrostis perennans, Dichanthelium acuminatum, Hypericum boreale, Hypericum gymnanthum, Helenium virginicum* (nearly endemic to this and related communities in Virginia), *Juncus* spp., *Panicum philadelphicum, Bidens frondosa, Viola lanceolata, Erechtites hieraciifolia, Symphyotrichum dumosum (= Aster dumosus), Fimbristylis autumnalis, Rhexia mariana,* and *Rhexia virginica.* Intermittently flooded ponds may support dry-site plants such as *Schizachyrium scoparium, Sorghastrum nutans, Andropogon virginicus, Baptisia tinctoria, Diodia teres, Hypericum gentianoides, Polygala nuttallii,* and *Salix humilis var. tristis*.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Eleocharis acicularis, Fimbristylis autumnalis, Helenium virginicum, Hypericum boreale, Panicum rigidulum, Panicum verrucosum, Quercus palustris, Rhexia mariana, Rhexia virginica, Viola lanceolata*

Other Noteworthy Species: *Ambystoma tigrinum, Cyperus dentatus, Echinodorus tenellus, Eleocharis melanocarpa, Helenium virginicum, Lysimachia hybrida, Sabatia campanulata*

USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This community is known only from natural pond complexes along the western foot of the Blue Ridge in Augusta, Rockingham, and southern Page counties, Virginia
States/Provinces: VA:S1
Federal Lands: NPS (Shenandoah); USFS (George Washington)

CONSERVATION STATUS
Rank: G1 (7-Jan-1999)
Reasons: This community appears to be endemic to Augusta, Rockingham, and Page counties, Virginia, a region that is undergoing rapid population growth and development. Although more than 40 individual ponds supporting this association have been documented, most are located on private land and are highly threatened by hydrologic alterations, off-road vehicles, trash dumping, timber cutting, or outright destruction.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Examples occur in the Maple Flats pond complex (Augusta County, Virginia). This is the most prevalent and characteristic community of the Shenandoah Valley sinkhole ponds. No comparable or similar vegetation has been documented elsewhere in Virginia or nationally.
Similar Associations:
Related Concepts:
- *Quercus palustris / Panicum rigidulum - Panicum verrucosum - Eleocharis acicularis* Wooded Herbaceous Vegetation (Fleming and Coulling 2001) ?
- *Quercus palustris / Panicum rigidulum var. rigidulum - Panicum verrucosum - Eleocharis acicularis* community (Fleming and Van Alstine 1999) ?

SOURCES
Description Authors: G. Fleming and P. Coulling
References: Buhlmann et al. 1999, Fleming and Coulling 2001, Fleming and Van Alstine 1999, Fleming et al. 2001, Mitchell and Buhlmann 1999, Roble 1999, Simurda and Knox 2000, Southeastern Ecology Working Group n.d., VDNH 2003

Common Name (Park-specific): Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)

SYNONYMS:
NVC English Name: White Ash / Eastern Ninebark / Pennsylvania Sedge - Nodding Onion - (Small-flower Scorpionweed) Wooded Herbaceous Vegetation
NVC Scientific Name: *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation
NVC Identifier: CEGL008529

LOCAL DESCRIPTION
Environmental Description: See Global Environment. All but one documented site in the park are on metabasalt outcrops, but additional occurrences on granitic outcrops are possible in poorly inventoried areas.
Vegetation Description: Examples of this community type in the park have a composition similar to that described in Global Vegetation. However, *Schizachyrium scoparium* and *Chionanthus virginicus* are not as abundant or characteristic in the park as elsewhere. Species that are locally important on some park outcrops include *Parthenium integrifolium var. integrifolium*, *Deschampsia flexuosa*, and *Viburnum rafinesquianum*.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Agrostis perennans*, *Allium cernuum*, *Amelanchier sanguinea*, *Carex pensylvanica*, *Fraxinus americana*, *Helianthus divaricatus*, *Houstonia longifolia*, *Phacelia dubia*, *Physocarpus opulifolius*, *Rhus typhina*, *Rosa carolina*, *Sedum telephioides*, *Symphyotrichum laeve* var. *concinnum*
Other Noteworthy Species: *Information not available.*

Local Range: This outcrop barren community is scattered on metabasalt (and rarely granitic) outcrops at middle elevations (550-1030 m [1800-3400 feet]), primarily in the northern and central sections of the park.
Classification Comments: In the park, this community often occurs on massive outcrops embedded within stands of *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683), which has a definite woodland physiognomy and a comparatively larger component of low-cover, shade-tolerant xerophytic grasses and forbs. It is also similar to *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037) but occurs at generally higher elevations. This type lacks (or mostly lacks) many of the typical low-elevation plants.(e.g., *Juniperus virginiana*) and obligate calciphiles typical of CEGL006037. Nevertheless, conceptual overlap between these two barrens warrants further analysis.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP005, SHNP019, SHNP024, SHNP043, SHNP053, SHNP058, SHNP063.
Shenandoah National Park Inventory Notes: Represented by seven plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse tree layer (V.A.6.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse tree layer (V.A.6.N.)
Formation	Bedrock temperate or subpolar grassland with a sparse tree layer (V.A.6.N.q.)
Alliance	*(Fraxinus americana, Juniperus virginiana) / Carex pensylvanica - Schizachyrium scoparium* (A.3014) Wooded Herbaceous Alliance
Alliance (English name)	(White Ash, Eastern Red-cedar) / Pennsylvania Sedge - Little Bluestem Wooded Herbaceous Alliance
Association	*Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation
Association (English name)	White Ash / Eastern Ninebark / Pennsylvania Sedge - Nodding Onion - (Small-flower Scorpionweed) Wooded Herbaceous Vegetation
Ecological System(s):	Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)

GLOBAL DESCRIPTION

Concept Summary: This community is known only from the northern Virginia Blue Ridge and possibly the higher adjacent foothills, in areas underlain by Catoctin metabasalt (greenstone) and Middle Proterozoic plutonic rocks. Sites are located on steep (up to 37 degrees), xeric, middle-elevation slopes where exposed outcrops effectively limit the establishment and normal development of trees. Underlying bedrock at most sites is metabasalt (greenstone). Two documented sites are underlain by charnockite, a pyroxene-bearing granitic rock, and it is likely that additional stands occur on this and related plutonic formations. Elevation of plot-sampled stands ranges from 543-1049 m (1782-3442 feet), with a mean of 835 m (2740 feet). Middle-slope topographic positions are typical, with slopes convex in at least one direction. Aspect varies from southeast to northwest, with westerly aspects prevalent. This vegetation type is dominated by herbaceous plants with scattered shrub patches and stunted trees. The herb layer usually ranges from 25-60% total cover (occasionally higher or lower), and from scattered to locally dense where soil and organic matter have accumulated. *Carex pensylvanica* and *Schizachyrium scoparium* are consistently dominant herbs. *Phacelia dubia* is an abundant spring ephemeral in about two-thirds of the plots, and this species may have been missed in late-season sampling of other plots.
Environmental Description: Sites are located on steep (up to 37 degrees), xeric, middle-elevation slopes where exposed outcrops effectively limit the establishment and normal development of trees. Underlying bedrock at most sites is metabasalt (greenstone). Two documented sites are underlain by charnockite, a pyroxene-bearing granitic rock, and it is likely that additional stands occur on this and related plutonic formations. Elevation of plot-sampled stands ranges from 543-1049 m (1782-3442 feet), with a mean of 835 m (2740 feet). Middle-slope topographic positions are typical, with slopes convex in at least one direction. Aspect varies from southeast to northwest, with westerly aspects prevalent. Surface cover of exposed outcrops and loose rocks averages >50% and soil development is limited to depositional crevices and thin veneers on ledges. Soil samples collected from plots are very strongly acidic (mean pH = 4.5), with substantial organic matter content (mean = 26%), but have moderately high levels of calcium (mean = 1185 ppm) and magnesium (mean = 174 ppm).
Vegetation Description: This vegetation type is dominated by herbaceous plants with scattered shrub patches and stunted trees. The herb layer usually ranges from 25-60% total cover (occasionally higher or lower), and from scattered to locally dense where soil and organic matter have accumulated. *Carex pensylvanica* and *Schizachyrium scoparium* are consistently dominant herbs. *Phacelia dubia* is an abundant spring ephemeral in about two-thirds of the plots, and this species may have been missed in late-season sampling of other plots. Other relatively frequent (>50% constancy) herbs are *Agrostis perennans, Allium cernuum, Ambrosia artemisiifolia, Danthonia spicata, Dichanthelium acuminatum, Elymus hystrix, Helianthus divaricatus, Hylotelephium telephioides (= Sedum telephioides),* and *Polygonatum biflorum*. *Deschampsia flexuosa, Festuca rubra,* and *Symphyotrichum laeve var. concinnum (= Aster laevis var. concinnus)* are each common locally. Herbaceous species that are characteristic of gravelly or mossy crevices and

depressions with ephemeral spring seepage or periodic moisture accumulation include *Draba ramosissima, Muhlenbergia glomerata, Polygonum tenue, Saxifraga virginiensis, Talinum teretifolium,* and *Woodsia ilvensis*. Stunted trees (<10 m tall) of *Fraxinus americana* are consistent features of the community type. *Physocarpus opulifolius* and *Rosa carolina* are the most frequent shrubs, but *Chionanthus virginicus, Rhus typhina, Juniperus virginiana, Amelanchier sanguinea, Ptelea trifoliata,* and *Spiraea alba var. latifolia* are each important in a subset of plots. Species richness of plot-sampled stands ranges from 28 to 43 taxa per 400 square meters (mean = 36).

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Amelanchier sanguinea, Carex pensylvanica, Chionanthus virginicus, Fraxinus americana, Phacelia dubia, Physocarpus opulifolius, Rhus typhina, Rosa carolina, Sedum telephioides, Symphyotrichum laeve* var. *concinnum, Talinum teretifolium, Woodsia ilvensis*

Other Noteworthy Species: *Cuscuta coryli, Muhlenbergia glomerata, Paxistima canbyi, Potentilla arguta*

USFWS Wetland System:

DISTRIBUTION

Range: This community is known only from the northern Virginia Blue Ridge and possibly the higher adjacent foothills, in areas underlain by Catoctin metabasalt (greenstone) and Middle Proterozoic plutonic rocks.

States/Provinces: VA:S2

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

CONSERVATION STATUS

Rank: G2 (11-Oct-2001)

Reasons: This vegetation is naturally rare, being restricted to special edaphic habitats on metavolcanic and plutonic rocks of limited geographic extent. There are probably at least 30 occurrences in Virginia and globally. Patches are small (generally <0.5 ha), but there are few threats to this community since most occurrences are on steep, remote sites in federally protected areas.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: Although this community type has been referred to as a "greenstone glade" (Fleming 1993), this name is inappropriate given the occasional occurrence of the type on granitic rocks. Additional inventory and data collection are needed to determine the extent of this association on plutonic substrates.

This vegetation type often occurs adjacent to, or nested within, a larger patch of *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683). Conceptual overlap between both of these communities and *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037) needs resolution. The latter community is reported to be endemic to steep slopes underlain by calcareous shales of the Jennings and Hampshire formations in the Ridge and Valley region of Maryland. Based on descriptive material in the USNVC, it appears that this dry open woodland has characteristics of both basic woodlands and barrens, as well as of the more diverse shale barrens.

Similar Associations:

- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683)
- *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037)

Related Concepts:

- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (Fleming and Coulling 2001) ?
- Greenstone glade (Fleming 1993) ?

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Fleming 1993, Fleming and Coulling 2001, Fleming et al. 2001, Southeastern Ecology Working Group n.d., VDNH 2003

Common Name (Park-specific): Central Appalachian Circumneutral Barren

SYNONYMS:

NVC English Name: Eastern Red-cedar - White Ash / Pennsylvania Sedge - Hairy Lipfern Wooded Herbaceous Vegetation

NVC Scientific Name: *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation

Vegetation

NVC Identifier: CEGL006037

LOCAL DESCRIPTION

Environmental Description: Occurrences of this community type in Shenandoah National Park are all on low-elevation outcrops of Catoctin metabasalt (greenstone). The elevation range of eight known stands in the park is from 425 to 580 m (1400 to 1900 feet). Habitats are on steep (mean = 27 degrees), southeast- to southwest-facing, xeric slopes with > 50% cover of metabasalt outcrops and boulders. Soils are thin, but locally well developed on ledges and in crevices. Samples extracted from sampling sites were strongly acidic (mean pH = 5.2), with high calcium and very high magnesium levels.

Vegetation Description: Composition of park stands is similar to that described under Global Vegetation. *Juniperus virginiana* is present at only half of the park sites. *Rhus aromatica* forms large, low-shrub patches at some sites. The most constant and abundant herbaceous species are *Schizachyrium scoparium, Carex pensylvanica, Danthonia spicata*, and *Cheilanthes lanosa*. *Bouteloua curtipendula, Sporobolus clandestinus*, and *Sorghastrum nutans* are each abundant at a small subset of sites. Additional species not mentioned in the Global description that are characteristic of park stands include *Panicum philadelphicum, Acalypha virginica, Sporobolus vaginiflorus*, and *Hedeoma pulegioides*. Many additional species occur at low cover and constancy.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Bouteloua curtipendula, Carex pensylvanica, Cercis canadensis, Cheilanthes lanosa, Danthonia spicata, Fraxinus americana, Pycnanthemum incanum, Rhus aromatica, Schizachyrium scoparium*

Other Noteworthy Species: *Oligoneuron rigidum* var. *rigidum*

Local Range: This community type is widely scattered in small patches on low-elevation metabasalt spur ridges. The largest number of occurrences are known from Dickey Ridge at the north end of the park.

Classification Comments: In the park, this community often occurs on massive outcrops within stands of *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683), which has a definite woodland physiognomy and a comparatively larger component of low-cover, shade-tolerant xerophytic grasses and forbs. This community is also similar to *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529) but occurs at generally lower elevations. This type contains many of the typical low-elevation plants.(e.g., *Juniperus virginiana*) and obligate calciphiles that are absent (or nearly absent) in CEGL008529. Nevertheless, conceptual overlap between these two barrens warrants further analysis.

Other Comments: *Information not available.*

Local Description Authors: G. Fleming

Plots: NH Plots: SHNP009, SHNP057, SHNP060, SHNP066, SHNP069, SHNP070, SHNP072, SHNP100.

Shenandoah National Park Inventory Notes: Represented by eight plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse tree layer (V.A.6.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse tree layer (V.A.6.N.)
Formation	Bedrock temperate or subpolar grassland with a sparse tree layer (V.A.6.N.q.)
Alliance	*(Fraxinus americana, Juniperus virginiana) / Carex pensylvanica - Schizachyrium scoparium* (A.3014) Wooded Herbaceous Alliance
Alliance (English name)	(White Ash, Eastern Red-cedar) / Pennsylvania Sedge - Little Bluestem Wooded Herbaceous Alliance
Association	*Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation
Association (English name)	Eastern Red-cedar - White Ash / Pennsylvania Sedge - Hairy Lipfern Wooded Herbaceous Vegetation
Ecological System(s):	Appalachian Shale Barrens (CES202.598)

GLOBAL DESCRIPTION

Concept Summary: This barrens community occurs on steep slopes underlain by calcareous sedimentary, metasedimentary, and metamorphic rocks of the Central Appalachians. Soils are derived from calcareous shales of the Jennings and Hampshire Shale formations in the Ridge and Valley province, and from metabasalt of the Catoctin Formation on the northern Blue Ridge. Similar vegetation has also been reported from steep, rocky slopes underlain by Harpers Formation metasiltstone and phyllite on the Blue

Ridge. Habitats are on steep, southeast - to southwest-facing slopes at elevations from 170 to 580 m (550-1900 feet). On sites underlain by shale, soils are thin but generally better developed than other shale-barren associations. Metabasalt sites typically have high cover (about 50%) of exposed bedrock outcrops with some areas of shallow soil development. Soils from both substrates have high calcium levels; those weathered from metabasalt also have high magnesium and manganese levels. A patchy overstory of stunted trees may ameliorate to some degree the otherwise xeric conditions imposed by exposure and slope. Canopy closure is usually less than 30%, occasionally higher, and tends to be patchy, with herbaceous openings. Shrubs are sparse at most known locations. The herbaceous layer forms 25-90% ground cover. The canopy is co-dominated by *Juniperus virginiana* and *Fraxinus americana*, with other associates including *Carya glabra, Quercus prinus, Celtis tenuifolia, Amelanchier arborea, Quercus rubra*, and *Pinus virginiana*. *Rhus aromatica* is a characteristic shrub. The herbaceous layer is very diverse. *Carex pensylvanica* is constant and dominant. *Danthonia spicata* is frequent but sparse. Other characteristic species include *Cheilanthes lanosa, Woodsia obtusa, Phacelia dubia, Deschampsia flexuosa, Solidago arguta var. harrisii (= Solidago harrisii), Schizachyrium scoparium, Phlox subulata, Silene antirrhina, Elymus hystrix (= Hystrix patula), Tradescantia virginiana, Helianthus divaricatus, Polygonum scandens var. cristatum, Polygonatum biflorum, Triodanis perfoliata, Pycnanthemum incanum, Allium cernuum*, and *Arenaria serpyllifolia*. This association is distinguished from other shale-barren types by its open physiognomy, occurrence on circumneutral to calcareous rock at low to moderate elevations, and the frequency of several characteristic herbs including *Cheilanthes lanosa, Phacelia dubia, Tradescantia virginiana*, and *Triodanis perfoliata*. In addition, *Fraxinus americana* and *Celtis tenuifolia* occur at a higher frequency in this association than in other shale-barren types.

Environmental Description: This barrens community occurs on steep slopes underlain by calcareous sedimentary, metasedimentary, and metamorphic rocks of the Central Appalachians. Soils are derived from calcareous shales of the Jennings and Hampshire Shale formations in the Ridge and Valley province, and from metabasalt of the Catoctin Formation on the northern Blue Ridge. Similar vegetation has also been reported from steep, rocky slopes underlain by Harpers Formation metasiltstone and phyllite on the Blue Ridge. Habitats are on steep, southeast - to southwest-facing slopes at elevations from 170 to 580 m (550-1900 feet). On sites underlain by shale, soils are thin but generally better developed than other shale barren associations. Metabasalt sites typically have high cover (about 50%) of exposed bedrock outcrops with some areas of shallow soil development. Soils from both substrates have high calcium levels; those weathered from metabasalt also have high magnesium and manganese levels.

Vegetation Description: This community type is characterized by a mixed physiognomy of scattered, stunted trees and herbaceous openings. The patchy canopy may ameliorate to some degree the otherwise xeric conditions imposed by exposure and slope. Canopy closure is usually less than 30%, occasionally higher. Shrubs are sparse at most known locations. The herbaceous layer forms 25-90% ground cover, except where broken by rock outcrops. The canopy is co-dominated by *Juniperus virginiana* and *Fraxinus americana*, with other associates including *Carya glabra, Quercus prinus, Celtis tenuifolia, Amelanchier arborea, Quercus rubra*, and *Pinus virginiana*. *Rhus aromatica* is a characteristic shrub. The herbaceous layer is very diverse. *Carex pensylvanica* is constant and dominant. *Danthonia spicata* is frequent but sparse. Other characteristic species include *Cheilanthes lanosa, Woodsia obtusa, Phacelia dubia, Deschampsia flexuosa, Solidago arguta var. harrisii (= Solidago harrisii), Schizachyrium scoparium, Phlox subulata, Silene antirrhina, Elymus hystrix (= Hystrix patula), Tradescantia virginiana, Helianthus divaricatus, Polygonum scandens var. cristatum, Polygonatum biflorum, Triodanis perfoliata, Pycnanthemum incanum, Allium cernuum*, and *Arenaria serpyllifolia*.

Although they are very similar, expressions of this community type on shale and metabasalt exhibit some compositional differences. Shale occurrences contain a greater number of low-cover forbs and exclusively contain several shale endemics and other species common on shale barrens, including *Blephilia ciliata, Deschampsia flexuosa, Draba ramosissima, Melica nitens, Minuartia michauxii, Oenothera argillicola, Packera antennariifolia*, and *Trifolium virginicum*. Metabasalt occurrences tend to have stratified graminoid dominance, with *Schizachyrium scoparium* forming a taller layer over *Carex pensylvanica*. Species documented only on metabasalt, including *Cyperus lupulinus, Isanthus brachiatus, Muhlenbergia capillaris var. capillaris, Polygonum tenue, Oligoneuron rigidum var. rigidum (= Solidago rigida ssp. rigida), Sporobolus clandestinus*, and *Talinum teretifolium*, are probably associated with high-magnesium soils weathered from this substrate. However, despite these differences, stands on both substrates share almost all of the type's characteristic species as well as a remarkable number of other specialized xerophytic species, including *Asclepias verticillata, Symphyotrichum oblongifolium (= Aster oblongifolius), Bouteloua curtipendula, Lithospermum canescens, Paronychia montana, Selaginella rupestris, Taenidia montana*, and *Triosteum perfoliatum*.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*

Other Noteworthy Species: *Arabis serotina, Clematis coactilis, Clematis viticaulis, Trifolium virginicum*

USFWS Wetland System:

DISTRIBUTION

Range: This association is restricted to two subsections of four states in of the Central Appalachians.

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

Federal Lands: NPS (C&O Canal, Harpers Ferry?, Shenandoah)

CONSERVATION STATUS

Rank: G2 (23-Nov-1998)

Reasons: This small-patch community likely totals less than 1000 acres rangewide in fewer than 60 occurrences. It is restricted to two subsections in the central Appalachians. Although the community is relatively isolated by its steep slope and unstable substrate, it is threatened by invasive exotics such as *Bromus sterilis, Bromus tectorum, Bromus japonicus, Centaurea biebersteinii, Lonicera japonica, Verbascum thapsus, Alliaria petiolata,* and *Ailanthus altissima*.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 1 - Strong
Comments:
Similar Associations:

- *(Pinus virginiana, Juniperus virginiana) / Schizachyrium scoparium - Eriogonum allenii* Wooded Herbaceous Vegetation (CEGL008530)
- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529)
- *Pinus virginiana - Juniperus virginiana - Quercus rubra / Solidago arguta* var. *harrisii - Opuntia humifusa* Woodland (CEGL006288)
- *Pinus virginiana - Quercus prinus / Packera antennariifolia - Phlox subulata* Woodland (CEGL006562)

Related Concepts:

- Eastern Redcedar: 46 (Eyre 1980) B
- Red cedar-white ash alkaline shale woodland (CAP pers. comm. 1998) ?

SOURCES

Description Authors: G.P. Fleming, mod. S.C. Gawler
References: CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Eyre 1980, Fike 1999, Fleming et al. 2001, Lea 2003

Common Name (Park-specific): Northern Blue Ridge Mafic Fen

SYNONYMS:

NVC English Name: Broadleaf Meadowsweet - Gray Dogwood / Bluejoint - Canada Burnet - Pointed Broom Sedge Shrub Herbaceous

Vegetation

NVC Scientific Name: *Spiraea alba* var. *latifolia - Cornus racemosa / Calamagrostis canadensis - Sanguisorba canadensis -*

Carex scoparia **Shrub Herbaceous Vegetation**

NVC Identifier: CEGL006249

LOCAL DESCRIPTION

Environmental Description: Same as Global Environment.
Vegetation Description: Same as Global Vegetation.
Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus racemosa*, *Spiraea alba* var. *latifolia*
Herb (field)	Forb	*Menyanthes trifoliata*, *Sanguisorba canadensis*
Herb (field)	Graminoid	*Calamagrostis canadensis*, *Carex echinata* ssp. *echinata*, *Carex scoparia*

Characteristic Species: *Betula populifolia, Calamagrostis canadensis, Carex buxbaumii, Carex scoparia, Glyceria striata, Juncus effusus, Lycopus uniflorus, Solidago rugosa, Spiraea alba* var. *latifolia*
Other Noteworthy Species: *Information not available.*
Local Range: Same as Global Range.
Classification Comments: Data have been collected from four plots.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP010, SHNP017, SHNP018, SHNP117.
Shenandoah National Park Inventory Notes: Represented by four plots from the park.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse shrub layer (V.A.7.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.)
Formation	Saturated temperate or subpolar grassland with a sparse cold-deciduous shrub layer (V.A.7.N.p.)
Alliance	*Alnus serrulata - Spiraea* spp. / *Sanguisorba canadensis* Saturated Shrub Herbaceous (A.3026) Alliance
Alliance (English name)	Smooth Alder - Meadowsweet species / Canada Burnet Saturated Shrub Herbaceous Alliance
Association	*Spiraea alba* var. *latifolia - Cornus racemosa / Calamagrostis canadensis - Sanguisorba canadensis - Carex scoparia* Shrub Herbaceous Vegetation
Association (English name)	Broadleaf Meadowsweet - Gray Dogwood / Bluejoint - Canada Burnet - Pointed Broom Sedge Shrub Herbaceous Vegetation

Ecological System(s):

GLOBAL DESCRIPTION

Concept Summary: This saturated wetland occurs on soils weathered from Catoctin metabasalt (greenstone), a mafic metamorphic rock. The type is associated with sublevel headwater seepages on a broad summit of the northern Blue Ridge in Page and Madison counties, Virginia (vicinity of Big Meadows, Shenandoah National Park). Microtopography is typically irregular, and soils are strongly to slightly acidic, with high magnesium and iron levels and moderately low calcium content. The physiognomy of this vegetation type ranges from dense to open shrublands to wholly herbaceous but is usually a patch-mosaic of shrub thickets and herbaceous openings. *Spiraea alba var. latifolia* and *Cornus racemosa* are the typical woody dominants. In some areas, *Betula populifolia* forms a sparse tree layer 6-10 m tall. Other shrubs documented in the type are *Ilex verticillata, Lyonia ligustrina var. ligustrina, Photinia melanocarpa,* and sapling-sized *Acer rubrum*. *Calamagrostis canadensis, Sanguisorba canadensis,* and *Carex scoparia* are patch-dominant herbs common to all known occurrences of the type. Other characteristic herbaceous species are *Carex buxbaumii, Carex lurida, Epilobium leptophyllum, Glyceria striata, Iris versicolor, Isoetes valida, Juncus effusus var. solutus, Juncus subcaudatus var. subcaudatus, Lycopus virginicus, Oxypolis rigidior, Packera aurea (= Senecio aureus), Scirpus cyperinus, Solidago rugosa,* and *Thelypteris palustris var. pubescens*. Herbs that are inconstant but locally abundant in the type include *Caltha palustris, Carex conoidea, Carex echinata ssp. echinata, Carex gynandra,* and *Menyanthes trifoliata*. The processes that maintain this vegetation in open condition are poorly understood. All of the documented occurrences are small and have been disturbed to some degree by grazing and/or adjacent clearing. Ditching and groundwater alterations from a large well serving the Big Meadows Campground, deer grazing, non-native weeds, woody succession, and probably fire exclusion are continuing threats to this naturally rare wetland.

Environmental Description: This saturated wetland is similar to a calcareous fen but occurs on soils weathered from Catoctin metabasalt (greenstone), a mafic metamorphic rock. This small-patch vegetation type is associated with sublevel headwater seepages on a broad summit of the northern Blue Ridge in Page and Madison counties, Virginia. Microtopography is typically irregular, with hummock-and-hollow development, braided streams, areas of coarse gravel and cobble deposition, muck-filled depressions, and superficial to substantial peat accumulations. Soils, derived from underlying metabasalt, are strongly to slightly acidic, with high magnesium and iron levels and moderately low calcium content.

Vegetation Description: The physiognomy of this vegetation type ranges from dense to open shrublands to wholly herbaceous but is usually a patch-mosaic of shrub thickets and herbaceous openings. Based on observations made over a 25-year period, shrub densities have increased greatly, probably because of fire exclusion (G. Fleming pers. obs.). *Spiraea alba var. latifolia* and *Cornus racemosa* are the typical woody dominants. In some areas, *Betula populifolia* forms a sparse tree layer 6-10 m tall. Other shrubs documented in the type are *Ilex verticillata, Lyonia ligustrina var. ligustrina, Photinia melanocarpa,* and sapling *Acer rubrum*. *Calamagrostis canadensis, Sanguisorba canadensis,* and *Carex scoparia* are patch-dominant herbs common to all known patches of the type. Other characteristic herbaceous species are *Carex buxbaumii, Carex lurida, Epilobium leptophyllum, Glyceria striata, Iris versicolor, Isoetes valida, Juncus effusus var. solutus, Juncus subcaudatus var. subcaudatus, Lycopus virginicus, Oxypolis rigidior, Packera aurea (= Senecio aureus), Scirpus cyperinus, Solidago rugosa,* and *Thelypteris palustris var. pubescens*. Herbs that are inconstant but locally abundant in the type include *Caltha palustris, Carex conoidea, Carex echinata ssp. echinata, Carex gynandra,* and *Menyanthes trifoliata*. The introduced weeds *Agrostis capillaris, Holcus lanatus,* and *Poa pratensis* are well-established in this community but have not become highly invasive to date.

Most Abundant Species

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus racemosa*, *Spiraea alba* var. *latifolia*
Herb (field)	Forb	*Menyanthes trifoliata*, *Sanguisorba canadensis*
Herb (field)	Graminoid	*Calamagrostis canadensis*, *Carex echinata* ssp. *echinata*, *Carex scoparia*

Characteristic Species: *Betula populifolia, Calamagrostis canadensis, Carex buxbaumii, Carex scoparia, Glyceria striata, Juncus effusus, Lycopus uniflorus, Solidago rugosa, Spiraea alba* var. *latifolia*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System:

DISTRIBUTION
Range: This community is known only from the vicinity of Big Meadows (Shenandoah National Park) on the northern Blue Ridge, in Page and Madison counties, Virginia.
States/Provinces: VA:S1
Federal Lands: NPS (Shenandoah)

CONSERVATION STATUS
Rank: G1 (9-Aug-2004)
Reasons: This type appears to be endemic to a single portion of the northern Virginia Blue Ridge (vicinity of Big Meadows, Shenandoah National Park), where it occurs in several discrete patches totaling less than 25 acres in aggregate. Some of these occurrences have been degraded by hydrologic alterations (wells, drainage ditches), and shrubs have increased dramatically over the past 25 years, possibly because of fire exclusion.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: Data have been collected from four plots.
Similar Associations:
- *Alnus serrulata / Sanguisorba canadensis - Calamagrostis canadensis* Shrubland (CEGL004252)
- *Alnus serrulata / Sanguisorba canadensis - Parnassia grandifolia - Helenium brevifolium* Shrubland (CEGL003917)

Related Concepts:
- *Spiraea alba* var. *latifolia - Cornus racemosa* / *Calamagrostis canadensis - Sanguisorba canadensis - Carex scoparia* Shrub Herbaceous Vegetation (Fleming et al. 2004) =
- Northern Blue Ridge Mafic Fen (Fleming et al. 2004) =

SOURCES
Description Authors: G. Fleming
References: Eastern Ecology Working Group n.d., Fleming et al. 2004

Common Name (Park-specific): High-Elevation Greenstone Barren

SYNONYMS:
NVC English Name: Bush-honeysuckle - Rand's Goldenrod - Wavy Hairgrass - Appalachian Live-forever - Cliff Saxifrage Herbaceous Vegetation
NVC Scientific Name: *Diervilla lonicera - Solidago simplex* var. *randii - Deschampsia flexuosa - Hylotelephium telephioides* - *Saxifraga michauxii* Herbaceous Vegetation
NVC Identifier: CEGL008536

LOCAL DESCRIPTION
Environmental Description: Same as Global Environment.
Vegetation Description: Same as Global Vegetation.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Deschampsia flexuosa, Diervilla lonicera, Heuchera pubescens, Huperzia appalachiana, Liatris turgida, Physocarpus opulifolius, Saxifraga michauxii, Sedum telephioides, Sibbaldiopsis tridentata, Solidago simplex* var. *randii, Sorbus americana*
Other Noteworthy Species: *Information not available.*
Local Range: Same as Global Range.
Classification Comments: See Global Classification Comments.
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: NH Plots: SHNP003, SHNP007, SHNP008, SHNP013, SHNP015, SHNP021, SHNP023, SHNP075, SHNP112.
Shenandoah National Park Inventory Notes: Represented by nine plots from the park.

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	Low temperate or subpolar perennial forb vegetation (V.B.2.N.b.)
Alliance	*Saxifraga michauxii* Herbaceous Alliance (A.1621)
Alliance (English name)	Cliff Saxifrage Herbaceous Alliance
Association	*Diervilla lonicera - Solidago simplex* var. *randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation
Association (English name)	Bush-honeysuckle - Rand's Goldenrod - Wavy Hairgrass - Appalachian Live-forever - Cliff Saxifrage Herbaceous Vegetation
Ecological System(s):	Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)

GLOBAL DESCRIPTION

Concept Summary: This association is known only from a few high-elevation mafic rock outcrops in the northern Virginia Blue Ridge. All known sites are located in Shenandoah National Park. This community type is associated with exposed rocky summits and upper slope outcrops of Catoctin Formation metabasalt (greenstone) at elevations from 900-1200 m (3000-4000 feet). Slope shape is typically convex in at least one direction, and aspect varies from west to north. The vegetation is characterized by a patchwork of shrub thickets (typically <25% cover), herbaceous mats (typically <40% cover), and crustose lichen colonies on exposed rock surfaces. The most frequent woody species include extremely stunted, wind-blasted specimens of the trees *Betula alleghaniensis* and *Sorbus americana*; characteristic shrubs and woody vines are *Diervilla lonicera*, *Physocarpus opulifolius, Prunus pensylvanica, Prunus virginiana, Kalmia latifolia*, and *Smilax tamnoides*. *Deschampsia flexuosa* and *Solidago simplex var. randii* are usually the dominant herbaceous species.

Environmental Description: This community type is associated with exposed rocky summits and upper slope outcrops of Catoctin Formation metabasalt (greenstone) at elevations from 900-1200 m (3000-4000 feet). Mean elevation of nine plot-sampled stands is 1068 m (3506 feet); an exceptional occurrence on the north slope of Mount Marshall is situated at an unusually low elevation of 870 m (2860 feet). Slope shape is typically convex in at least one direction, and aspect varies from west to north. Mean surface cover of bedrock and loose rocks at sample sites is 69%, while mean lichen / moss cover on these rocks is 42%. The moisture regime of these sites is xeric, and soil development is limited to shallow accumulations of disintegrated rock and humus on shelves and in crevices. However, an ephemeral spring seep with seasonally wet moss mats is present at one site (Stony Man Mountain). These habitats are periodically exposed to extreme winter temperatures, high winds, and ice. Soil samples extracted from plot locations are extremely acidic (mean pH = 4.0) but often have moderately high levels of calcium, magnesium, and manganese and high levels of aluminum (mean = 1577 ppm).

Vegetation Description: The vegetation is characterized by a patchwork of shrub thickets (typically <25% cover), herbaceous mats (typically <40% cover), and crustose lichen colonies on exposed rock surfaces. The most frequent woody species include extremely stunted, wind-blasted specimens of the trees *Betula alleghaniensis* and *Sorbus americana*; characteristic shrubs and woody vines are *Diervilla lonicera, Physocarpus opulifolius, Prunus pensylvanica, Prunus virginiana, Kalmia latifolia*, and *Smilax tamnoides*. *Deschampsia flexuosa* and *Solidago simplex var. randii* are usually the dominant herbaceous species, with mean cover in plot samples of 10-25% and 5-10%, respectively. *Sibbaldiopsis tridentata* is abundant (up to 25% cover) in a subset of sites but is absent from the majority of sites. Other relatively constant and characteristic herbaceous species are *Campanula divaricata, Carex pensylvanica, Heuchera pubescens, Hylotelephium telephioides (= Sedum telephioides), Phlox subulata, Poa compressa, Polypodium appalachianum,* and *Saxifraga michauxii*. Inconstant but locally prominent herbaceous species include *Allium cernuum, Angelica triquinata, Arabis lyrata, Houstonia longifolia, Danthonia spicata, Liatris turgida*, and *Saxifraga virginiensis*. The grass *Calamagrostis canadensis* is abundant in the local seepage area on Stony Man Mountain, Virginia. Mean species richness of plot-sampled stands is 29 taxa per 100 square meters.

Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Deschampsia flexuosa, Diervilla lonicera, Heuchera pubescens, Huperzia appalachiana, Liatris turgida, Physocarpus opulifolius, Saxifraga michauxii, Sedum telephioides, Sibbaldiopsis tridentata, Solidago simplex* var. *randii, Sorbus americana*

Other Noteworthy Species: *Abies balsamea, Clematis occidentalis, Conioselinum chinense, Falco peregrinus, Gymnocarpium appalachianum, Juncus trifidus, Liatris turgida, Rubus idaeus* ssp. *strigosus, Trisetum spicatum*

USFWS Wetland System:

DISTRIBUTION

Range: This association is known only from a few high-elevation mafic rock outcrops in the northern Virginia Blue Ridge. All known sites are located in Shenandoah National Park. Most occurrences are in the higher, central section of the park, from the Big Meadows Area on the south to Stony Man Mountain on the north. A somewhat disjunct stand occurs on Mount Marshall in the northern section of the park.

States/Provinces: TN?, VA:S1
Federal Lands: NPS (Shenandoah)

CONSERVATION STATUS
Rank: G1 (3-Oct-2001)
Reasons: This is a naturally rare, small-patch community type limited by special habitat requirements. Currently, habitats supporting this unit are known from less than 15 discrete outcrops which together form five complexes or occurrences (Franklin Cliffs, Hawksbill, Crescent Rocks, Stony Man Mountain, Mount Marshall). Total coverage of all known occurrences is probably <12 hectares (30 acres). It is unlikely that any additional occurrences will be found, and these would not significantly increase the aggregate acreage of the type.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This type (CEGL008536) was formerly represented, in part, by the now-obsolete *Saxifraga michauxii - Solidago simplex var. randii - Sibbaldiopsis tridentata* Herbaceous Vegetation (CEGL004941). Recent multivariate analyses of a 956-plot dataset by the Virginia Dept. of Conservation / Division of Natural Heritage strongly supports the segregation of this type from vegetation documented south of Shenandoah National Park on the granitic summit of Spy Rock (Nelson County) and the amphibolite summit of Buffalo Mountain (Floyd County). The barrens of these two sites have been classified as *Minuartia groenlandica - Paronychia argyrocoma - Saxifraga michauxii* Herbaceous Vegetation (CEGL008509). Several additional high-elevation greenstone outcrops in the park (e.g., Pass Mountain, Mount Marshall, Hightop) and elsewhere (e.g., Humpback Rocks, Nelson County) support *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (CEGL008508). Vegetation of CEGL008508 is characterized by rhizomatous colonies of the low shrubs *Photinia melanocarpa* and *Gaylussacia baccata* and has a lower herb diversity and overall species richness than CEGL008536. Vegetation of the Stony Man seepage area was formerly recognized as a distinct type, *Physocarpus opulifolius / Calamagrostis canadensis* Shrub Herbaceous Vegetation (CEGL004253) but is now regarded as a variant of CEGL008536.

Among the ten state-rare plant species associated with these barrens are several long-range boreal disjuncts that are likely Pleistocene relicts. The only known Virginia populations of *Juncus trifidus* and *Conioselinum chinense* occur on the Stony Man barrens, while the sole population of *Trisetum spicatum* occupies steep, turfy barrens on the Hawksbill north slope.

Because this association is endemic to Shenandoah National Park, stewardship of the existing occurrences is critical to ensure long-term viability. Although some habitats are remote and rarely visited, others (e.g., Crescent Rocks, Franklin Cliffs, and the Hawksbill, Stony Man, and Little Stony Man summits) are popular overlooks along trails and the Skyline Drive. In the latter localities, years of heavy visitation have essentially destroyed the fragile mats of herbaceous vegetation. More recently, rock climbing at Little Stony Man has added a new threat to those plants occupying the more protected, vertical crevices and cliff-face shelves. *Poa compressa* and *Rumex acetosella* are the only frequent exotic plants found on high-elevation greenstone barrens, and both may occasionally exhibit invasive tendencies, especially in heavily trampled areas.
Similar Associations:
- *Minuartia groenlandica - Paronychia argyrocoma - Saxifraga michauxii* Herbaceous Vegetation (CEGL008509)

Related Concepts:
- *Diervilla lonicera - Solidago simplex var. randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation (Fleming and Coulling 2001) ?

SOURCES
Description Authors: G. Fleming
References: Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, TDNH unpubl. data

Common Name (Park-specific): Central Appalachian Woodland Seep

SYNONYMS:
NVC English Name: Yellow Marsh-marigold - Orange Jewelweed - Marsh Blue Violet Herbaceous Vegetation
NVC Scientific Name: *Caltha palustris - Impatiens capensis - Viola cucullata* Herbaceous Vegetation [Provisional]
NVC Identifier: CEGL006258

LOCAL DESCRIPTION

Environmental Description: Two plot-sampled occurrences in Shenandoah National Park occupy gently sloping (4- to 7-degree slope) spring seeps over metabasalt and charnockite, respectively. Additional, somewhat steeper occurrences have also been observed in areas underlain by these substrates. Most occurrences appear to represent natural, small-patch inclusions embedded in second-growth upland forest types. However, the larger of the two documented occurrences in the park is located near an old home site and appears to have resulted from clearing of a large forested wetland. In the two plot samples, mean cover of boulders and cobbles is 18% and shallow water covers 8% of the surface substrates. Soil samples collected from these sites consisted of heterogeneous sandy and silty alluvium and muck of intermediate fertility.
Vegetation Description: See Global Vegetation description. *Caltha palustris, Impatiens capensis*, and *Viola cucullata* are dominant species at both plot-sampled sites. However, other species may dominate sites that have not been formally inventoried.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Caltha palustris, Carex gynandra, Impatiens capensis, Viola cucullata*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: G. Fleming
Plots: *Information not available.*
Shenandoah National Park Inventory Notes: Represented by two plots from the park.

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	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
Alliance	*Symplocarpus foetidus - Caltha palustris* Saturated Herbaceous Alliance (A.1694)
Alliance (English name)	Skunk-cabbage - Yellow Marsh-marigold Saturated Herbaceous Alliance
Association	*Caltha palustris - Impatiens capensis - Viola cucullata* Herbaceous Vegetation [Provisional]
Association (English name)	Yellow Marsh-marigold - Orange Jewelweed - Marsh Blue Violet Herbaceous Vegetation

Ecological System(s):

GLOBAL DESCRIPTION

Concept Summary: This community is a saturated, herbaceous, small-patch wetland occurring on relatively steep, usually gravelly or bouldery slopes at sites of groundwater discharge. The type is probably scattered in the northern Blue Ridge and parts of the Ridge and Valley province, in areas underlain by base-rich metamorphic, igneous, or sedimentary rocks. Occurrences are more common at, but not restricted to, elevations above 760 m (2500 feet) elevation. Habitats are typically narrow and partially or wholly shaded by tree species rooted in adjacent upland forests. A few occurrences encompass larger spring seeps that may have resulted from the clearing of forested seepage swamps. Vegetation is similar to the herbaceous component of forested seepage swamps but is usually more forb-rich. Characteristic species include *Caltha palustris, Impatiens capensis, Viola cucullata, Chelone glabra, Pilea pumila, Chrysosplenium americanum, Lycopus virginicus, Lycopus uniflorus, Packera aurea (= Senecio aureus), Veratrum viride, Laportea canadensis*, and *Carex gynandra*.
Environmental Description: This community occupies narrow, relatively steep, usually gravelly or bouldery spring seeps. Underlying bedrock includes base-rich metamorphic and igneous rocks such as Catoctin metabasalt (greenstone) and pyroxene-bearing granites, or calcareous sedimentary rocks. Occurrences are more common at, but not restricted to, elevations above 760 m (2500 feet) elevation. Habitats are typically narrow and partially or wholly shaded by tree species rooted in adjacent upland forests. A few occurrences encompass larger spring seeps that may have resulted from the clearing of forested seepage swamps.
Vegetation Description: Vegetation is similar to the herbaceous component of forested seepage swamps but is usually more forb-rich. Characteristic species include *Caltha palustris, Impatiens capensis, Viola cucullata, Chelone glabra, Pilea pumila, Chrysosplenium americanum, Lycopus virginicus, Lycopus uniflorus, Packera aurea (= Senecio aureus), Veratrum viride, Laportea canadensis*, and *Carex gynandra*.
Most Abundant Species

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System:

DISTRIBUTION

Range: This community type is probably scattered in the northern Blue Ridge and parts of the Ridge and Valley province, in areas underlain by base-rich metamorphic, igneous, or sedimentary rocks.
States/Provinces: VA
Federal Lands: NPS (Shenandoah)

CONSERVATION STATUS
Rank: GNR (7-Oct-2004)
Reasons: Insufficient data are currently available to rank this community.

CLASSIFICATION INFORMATION
Status: Provisional
Confidence: 3 - Weak
Comments: This association is highly provisional, and much additional inventory and quantitative data collection are needed before a robust classification can be produced. Some occurrences of this vegetation are natural, while others appear to have resulted from disturbance. Montane seeps are poorly understood and problematic in that most patches fall well below minimum map unit size for vegetation mapping projects. Because of their extremely small, narrow, and linear configuration, they are also difficult to plot-sample without including extraneous vegetation.
Similar Associations:
- *Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis* Herbaceous Vegetation (CEGL004296)--a similar southern Appalachian type.
- *Impatiens (capensis, pallida) - Monarda didyma - Rudbeckia laciniata* var. *humilis* Herbaceous Vegetation (CEGL004293)--a similar southern Appalachian type.

Related Concepts:

SOURCES
Description Authors: G. Fleming
References: Eastern Ecology Working Group n.d.

Bibliography for Shenandoah National Park

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.

Allard, H. A., and E. C. Leonard. 1943. The vegetation and floristics of Bull Run Mountain, Virginia. Castanea 8:1-64.

Ambrose, J. 1990a. Georgia's natural communities--A preliminary list. Unpublished document. Georgia Natural Heritage Inventory. 5 pp.

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

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.

Arends, E. 1981. Vegetation patterns a half century following the chestnut blight in the Great Smoky Mountains National Park. M.S. thesis, University of Tennessee, Knoxville. 79 pp.

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

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

Barden, L. S. 1977. Self-maintaining populations of *Pinus pungens* Lam. in the southern Appalachian Mountains. Castanea 42:316-323.

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

Bernard, J. M., and F. A. Bernard. 1971. Mature upland forests of Cape May County, New Jersey. Bulletin of the Torrey Botanical Club 98:167-171.

Boufford, D. E., and E. W. Wood. 1977. An unusual plant community in South Carolina. Castanea 42:116-119.

Bowman, P. 2000. Draft classification for Delaware. Unpublished draft. Delaware Natural Heritage Program.

Braun, E. L. 1928. The vegetation of the Mineral Springs region of Adams County, Ohio. The Ohio State University Bulletin, Volume 32, No. 30. Ohio Biological Survey, Bulletin 15. 3(5):383-517.

Braun, E. L. 1950. Deciduous forests of eastern North America. Hafner Press, New York. 596 pp.

Breden, T. F. 1989. A preliminary natural community classification for New Jersey. Pages 157-191 in: E. F. Karlin, editor. New Jersey's rare and endangered plants and animals. Institute for Environmental Studies, Ramapo College, Mahwah, NJ. 280 pp.

Breden, T. F., Y. R. Alger, K. S. Walz, and A. G. Windisch. 2001. Classification of vegetation communities of New Jersey: Second iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, New Jersey Department of Environmental Protection, Trenton.

Brodowicz, W. W. 1989. Report on the Coastal Plain flora of the Great Lakes region. Prepared for the Michigan Natural Features Inventory.

Brush, G. S., C. Lenk, and J. Smith. 1980. The natural forests of Maryland: An explanation of the vegetation map of Maryland. Ecological Monographs 50:77-92.

Buhlmann, K. A., J. C. Mitchell, and L. R. Smith. 1999. Descriptive ecology of the Shenandoah Valley sinkhole pond system in Virginia. Banisteria 13:23-51.

Burns, R. M., and B. H. Honkala, technical coordinators. 1990a. Silvics of North America: Volume 1. Conifers. USDA Forest Service. Agriculture Handbook 654. Washington, DC. 675 pp.

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.

Callaway, R. M., E. E. C. Clebsch, and P. S. White. 1987. A multivariate analysis of forest communities in the western Great Smoky Mountains National Park. The American Midland Naturalist 118:107-120.

Campbell, J. 2001. Native vegetation types of Appalachian Kentucky. Unpublished report. The Nature Conservancy, Lexington, KY. 210 pp.

Campbell, J. J. N. 1989b. Historical evidence of forest composition in the Bluegrass Region of Kentucky. Pages 231-246 in: Proceedings of the Seventh Central Hardwood Forest Conference, Southern Illinois University, Carbondale.

Carr, L. G. 1939. Some notes on the ecology of plants of Magnolia Swamp, August County, Virginia. Claytonia 5:37-47.

Chapman, J. A. 1957. The natural vegetation of English Mountain, Tennessee. Ph.D. dissertation, University of Tennessee, Knoxville. 102 pp.

Chester, E. W., and A. F. Scott. 1980. *Pinus strobus* in Middle Tennessee: Fifty-four years after discovery. Journal of the Tennessee Academy of Science 55:85-86.

Clancy, K. 1993b. A preliminary classification of the natural communities of Delaware. Unpublished draft, Delaware Natural Heritage Inventory, Division of Parks and Recreation, Dover. 30 pp.

Clancy, K. 1996. Natural communities of Delaware. Unpublished review draft. Delaware Natural Heritage Program, Division of Fish and Wildlife, Delaware Division of Natural Resources and Environmental Control, Smyrna, DE. 52 pp.

Cleland, D. T., J. B. Hart, G. E. Host, K. S. Pregitzer, and C. W. Ramm. 1994. Field guide to the ecological classification and inventory system of the Huron-Manistee National Forest. USDA Forest Service, North Central Forest Experiment Station.

Coffman, M. S., and G. L. Willis. 1977. The use of indicator species to classify climax sugar maple and eastern hemlock forests in upper Michigan. Forestry and Ecology Management 1:149-168.

Cooper, A. W. 1963. A survey of the vegetation of the Toxaway River Gorge with some remarks about early botanical explorations and an annotated list of the vascular plants of the gorge area. Journal of the Elisha Mitchell Scientific Society 79:1-22.

Cooper, A. W., and J. W. Hardin. 1970. Floristics and vegetation of the gorges on the southern Blue Ridge escarpment. Pages 291-330 in: P. C. Holt, editor. The distributional history of the biota of the southern Appalachians, Part II: Flora. Virginia Polytechnical Institute and State University, Research Division Monograph No. 2.

Coulling, P. P., and T. J. Rawinski. 1999. Classification of vegetation and ecological land units of the Piney River and Mt. Pleasant area, Pedlar Ranger District, George Washington and Jefferson National Forests, Virginia. Natural Heritage Technical Report 99-03, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond.

Crites, G. D., and E. E. C. Clebsch. 1986. Woody vegetation in the inner Nashville Basin: An example from the Cheek Bend area of the central Duck River valley. ASB Bulletin 33:167-177.

Crow, T. R. 1988. Reproductive mode and mechanisms for self-replacement of northern red oak (*Quercus rubra*)--a review. Forest Science 34:19-40.

Curtis, J. T. 1959. The vegetation of Wisconsin: An ordination of plant communities. University of Wisconsin Press, Madison. 657 pp. [reprinted in 1987]

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

Davis, A. F., et al. 1992. A natural areas inventory of Delaware County, Pennsylvania. Pennsylvania Science Office of The Nature Conservancy. Middletown, PA. 110 pp.

DeLapp, J. A. 1978. Gradient analysis and classification of the high elevation red oak community of the southern Appalachians. M.S. thesis, North Carolina State University, Raleigh. 483 pp.

Dellinger, B. 1992. Natural areas survey, Nantahala National Forest, Highlands Ranger District: Site survey reports. Unpublished data. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh.

DuMond, D. M. 1970. Floristic and vegetational survey of the Chattooga River Gorge. Castanea 35:201-244.

Eastern Ecology Working Group of NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation. NatureServe, Boston, MA.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero, editors. 2002. Ecological communities of New York state. Second edition. A revised and expanded edition of Carol Reschke's ecological communities of New York state. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

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

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

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.

Faber-Langendoen, D., and Midwest State Natural Heritage Program Ecologists. 1996. Terrestrial vegetation of the midwest United States. International classification of ecological communities: Terrestrial vegetation of the United States. The Nature Conservancy, Arlington, VA.

Feldcamp, S. M. 1984. Revegetation of upper elevation debris slide scars on Mt. LeConte in the Great Smoky Mountains National Park. M.S. thesis, University of Tennessee, Knoxville. 106 pp.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Recreation. Bureau of Forestry. Harrisburg, PA. 86 pp.

Flaccus, E., and L. F. Ohmann. 1964. Old-growth northern hardwood forests in northeastern Minnesota. Ecology 45:448-459.

Fleming, G. P. 1993. Floristics and preliminary classification of greenstone glade vegetation in Virginia. Virginia Journal of Science 44:119 (Abstract).

Fleming, G. P. 1998. Virginia natural community framework, version January 30, 1998. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 6 pp.

Fleming, G. P. 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. 2001. Community types of Coastal Plain calcareous ravines in Virginia. Preliminary analysis and classification. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 4 pp.

Fleming, G. P. 2002a. Ecological communities of the Bull Run Mountains, Virginia: Baseline vegetation and floristic data for conservation planning and natural area stewardship. Natural Heritage Technical Report 02-12, Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report prepared for Virginia Outdoors Foundation. 274 pp. plus appendices.

Fleming, G. P., P. P. Coulling, D. P. Walton, K. M. McCoy, and M. R. Parrish. 2001. The natural communities of Virginia: Classification of ecological community groups. First approximation. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

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

Fleming, G. P., and P. P. Coulling. 2001. Ecological communities of the George Washington and Jefferson national forests, Virginia. Preliminary classification and description of vegetation types. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 317 pp.

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

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

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

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., 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.

Fountain, M. S., and J. M. Sweeney. 1985. Ecological assessment of the Roaring Branch Research Natural Area. USDA Forest Service, Southern Forest Experiment Station. Research Paper SO-213. New Orleans, LA. 15 pp.

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.

Fralish, J. S., and F. B. Crooks. 1989. Forest composition, environment and dynamics at Land Between the Lakes in northwest Middle Tennessee. Journal of the Tennessee Academy of Science 64:107-112.

Franklin, S. B., P. A. Robertson, J. S. Fralish, and S. M. Kettler. 1993. Overstory vegetation and successional trends of Land Between the Lakes, USA. Journal of Vegetation Science 4:509-520.

Frothingham, E. H., J. S. Holmes, W. J. Damtoft, E. F. McCarthy, and C. F. Korstian. 1926. A forest type classification for the southern Appalachian Mountains and adjacent plateau and coastal region. Journal of Forestry 24:673-684.

Funk, V. A. 1975. A floristic and geologic survey of selected seeps in Calloway County, Kentucky. M.S. thesis, Murray State University, Murray, KY. 84 pp.

Funk, V. A., and M. J. Fuller. 1978. A floristic survey of the seeps of Calloway County, Kentucky. Castanea 43:162-172.

Gaertner, F. 1955. Honeylocust (*Gleditsia triacanthos* L.) in field shelterbelts of western Oklahoma. Unpublished M.S. thesis, Oklahoma State University, Stillwater.

Gallyoun, M., G. Meyer, A. Andreu, and W. Slocumb. 1996. Mapping vegetation communities with The Nature Conservancy's vegetation classification system on five small national parks in the southeastern USA. Unpublished report. The Nature Conservancy, Southeast Regional Office, Conservation Science Department, Chapel Hill, NC.

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

Gettman, R. W. 1974. A floristic survey of Sumter National Forest--The Andrew Pickens Division. M.S. thesis, Clemson University, Clemson, SC. 131 pp.

Gibbon, E. L. 1966. The vegetation of three monadnocks in the eastern Piedmont of North Carolina. M.S. thesis, North Carolina State University, Raleigh. 98 pp.

Glitzenstein, J. S., and D. R. Streng. 2004. Evaluating the NatureServe preliminary plant community classification for Francis Marion National Forest. Tall Timbers Research Station, Tallahassee, FL. Plus appendices and data.

Golden, M. S. 1974. Forest vegetation and site relationships in the central portion of the Great Smoky Mountains National Park. Ph.D. dissertation, University of Tennessee, Knoxville. 275 pp.

Golden, M. S. 1979. Forest vegetation of the lower Alabama Piedmont. Ecology 60:770-782.

Golden, M. S. 1981. An integrated multivariate analysis of forest communities of the central Great Smoky Mountains. The American Midland Naturalist 106:37-53.

Golet, F. C., A. J. K. Calhoun, W. R. DeRagon, D. J. Lowry, and A. J. Gold. 1993. Ecology of red maple swamps in the glaciated Northeast: A community profile. USDI Fish & Wildlife Service, Washington, DC. 151 pp.

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

Govus, T. E. 1982. Vegetative profiles of the major forest types in the Pisgah and Nantahala national forests. USDA Forest Service. Contract No. 00-4550-1-1399. 71 pp.

Greenlee, K. W. 1974. A vegetation analysis of a pristine and a selectively cut cove forest of the Unicoi Mountains, western North Carolina. M.S. thesis, Western Carolina University, Cullowhee, NC. 36 pp.

Hack, J. T., and J. C. Goodlett. 1960. Geomorphology and forest ecology of a mountain region in the central Appalachians. USDI Geologic Survey. Professional Paper 347.

Hansen, H. L., L. W. Krefting, and V. Kurmis. 1973. The forest of Isle Royale in relation to fire history and wildlife. University of Minnesota, Agricultural Experiment Station, Technical Bulletin 294, Forestry Series 13.

Harbor, D. J. 1996. Classification and mapping of geomorphology in the Peters Mountain, Laurel Fork, and Upper Piney River areas, George Washington National Forest. Unpublished report to the USDA Forest Service. Washington and Lee University, Lexington, VA. 25 pp.

Harvill, A. M., Jr. 1967. The vegetation of Assateague Island, Virginia. Castanea 32:105-108.

Heckscher, S. 1994. The vegetation of the Glades Region, Cumberland County, New Jersey. Bartonia 58:101-113.

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

Hoagland, B. W. 1997. Preliminary plant community classification for Oklahoma. Unpublished draft document, version 35629. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman. 47 pp.

Hoagland, B. W. 1998a. Classification of Oklahoma vegetation types. Working draft. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman. 43 pp.

Horn, J. C. 1980. Short-term changes in vegetation after clearcutting in the southern Appalachians. Castanea 45:88-96.

Host, G. E., and K. S. Pregitzer. 1991. Ecological species groups for upland forest ecosystems of northwestern Lower Michigan. Forest Ecology and Management 43:87-102.

Hupp, C. R. 1983. Vegetation pattern on channel features in the Passage Creek Gorge, Virginia. Castanea 48:62-72.

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

Johnson, G. G., and S. Ware. 1982. Post-chestnut forests in the central Blue Ridge of Virginia. Castanea 47:329-343.

Jones, S. M. 1988a. Old-growth forests within the Piedmont of South Carolina. Natural Areas Journal 8:31-37.

Jones, S. M. 1988b. Old-growth, steady state forests within the Piedmont of South Carolina. Ph.D. dissertation, Clemson University, Clemson, SC. 94 pp.

Keddy, C. J., and M. J. Sharp. 1989. Atlantic coastal plain flora conservation in Ontario. Prepared for the Natural Heritage League and World Wildlife Fund.

Kotar, J., J. A. Kovach, and C. T. Locey. 1988. Field guide to forest habitat types of northern Wisconsin. Department of Forestry, University of Wisconsin and Department of Natural Resources.

Kotar, J., and T. L. Burger. 1989. Forest habitat type classification for the Menominee Indian Reservation. Department of Forestry, University of Wisconsin, Madison. 90 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.

Lincoln, A., Jr. 1961. A notable assemblage of plants in New Hampshire. Rhodora 63:294-295.

Livingston, D., and C. Mitchell. 1976. Site classification and mapping in the Mt. LeConte growth district, Great Smoky Mountains National Park. Unpublished report. Great Smoky Mountains National Park Library.

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

Lundgren, J. 2000. Lower New England - Northern Piedmont Ecoregion Forest Classification. The Nature Conservancy, Conservation Science, Boston, MA. 72 pp.

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

Major, C. S., C. Bailey, J. Donaldson, R. McCoy, C. Nordman, M. Williams, and D. Withers. 1999. An ecological inventory of selected sites in the Cherokee National Forest. Tennessee Department of Environment and Conservation, Tennessee Division of Natural Heritage. Cost Share Agreement #99-CCS-0804-001. Nashville, TN.

Malter, J. L. 1977. The flora of Citico Creek Wilderness Study Area, Cherokee National Forest, Monroe County, Tennessee. M.S. thesis, University of Tennessee, Knoxville. 116 pp.

Martin, D. L., and L. M. Smith. 1991. A survey and description of the natural plant communities of the Kisatchie National Forest, Winn and Kisatchie districts. Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA. 372 pp.

Martin, W. H. 1971. Forest communities of the Great Valley of East Tennessee and their relationship to soil and topographic properties. Ph.D. dissertation, University of Tennessee, Knoxville. 366 pp.

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.

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

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

McGee, C. E., and R. M. Hooper. 1970. Regeneration after clearcutting in the southern Appalachians. USDA Forest Service. Research Paper SE-70. 12 pp.

McLeod, D. E. 1988. Vegetation patterns, floristics, and environmental relationships in the Black and Craggy mountains of North Carolina. Ph.D. dissertation, University of North Carolina, Chapel Hill. 222 pp.

McNab, W. H., and S. A. Browning. 1993. Preliminary ecological classification of arborescent communities on the Wine Spring Creek watershed, Nantahala National Forest. Pages 213-221 in: J. C. Brissette, editor. Proceedings of the Seventh Biennial Southern Silvicultural Research Conference. USDA Forest Service, Southern Forest Experiment Station. General Technical Report SO-93. New Orleans, LA.

Metzler, K. J., and J. P. Barrett. 2001. Vegetation classification for Connecticut. Draft 5/21/2001. Connecticut Department of Environmental Protection, Natural Resources Center, Natural Diversity Database, Hartford.

Mitchell, J. C., and K. A. Buhlmann. 1999. Amphibians and reptiles of the Shenandoah Valley sinkhole pond system and vicinity, Augusta County, Virginia. Banisteria 13:129-142.

Monk, C. D., D. W. Imm, and R. L. Potter. 1990. Oak forests of eastern North America. Castanea 55(2):77-96.

Mowbray, T. B. 1966. Vegetational gradients in the Bearwallow Gorge of the Blue Ridge escarpment. Journal of the Elisha Mitchell Scientific Society 82:138-149.

NAP [Northern Appalachian-Boreal Forest Working Group]. 1998. Northern Appalachian-Boreal Working group discussions. The Nature Conservancy, Boston, MA.

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. 1997. Local and regional variation in the vegetation of the southern Appalachian Mountains. Ph.D. dissertation, University of North Carolina, Chapel Hill. 1008 pp.

Newell, C. L., R. K. Peet, and J. C. Harrod. 1997. Vegetation of Joyce Kilmer-Slickrock Wilderness, North Carolina. Unpublished report to USDA Forest Service. University of North Carolina, Curriculum in Ecology & Department of Biology, Chapel Hill, NC. 282 pp. plus maps.

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.

Newell, C. L., and R. K. Peet. 1996a. Vegetation of Shining Rock Wilderness, North Carolina. Unpublished report to USDA Forest Service. University of North Carolina, Department of Biological Science, Chapel Hill, NC. 253 pp. plus map.

Newell, C. L., and R. K. Peet. 1996b. Plant species richness of southern Appalachian forests. Bulletin of the Ecological Society of America 77 (suppl.):324 (Abstract).

Nowacki, G. J., M. D. Abrams, and C. G. Lorimer. 1990. Composition, structure, and historical development of northern red oak stands along an edaphic gradient in north-central Wisconsin. Forest Science 36(2):276-292.

Nowacki, G. J., and M. D. Abrams. 1992. Community, edaphic, and historical analysis of mixed oak forests of the Ridge and Valley Province in central Pennsylvania. Canadian Journal of Forest Research 22:790-800.

Oakley, S. C., H. E. LeGrand, Jr., and M. P. Schafale. 1995. An inventory of mafic natural areas in the North Carolina Piedmont. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh. 252 pp.

Oosting, H. J. 1942. An ecological analysis of the plant communities of Piedmont, North Carolina. The American Midland Naturalist 28:1-127.

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

Peet, R. K., T. R. Wentworth, M. P. Schafale, and A.S. Weakley. 2002. Unpublished data of the North Carolina Vegetation Survey. University of North Carolina, Chapel Hill.

Peet, R. K., and N. L. Christensen. 1980. Hardwood forest vegetation of the North Carolina Piedmont. Veroffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rubel, in Zurich 68:14-39.

Phillips, D. L., and D. J. Shure. 1990. Patch-size effects on early succession in southern Appalachian forests. Ecology 71:204-212.

Pregitzer, K. S., and B. V. Barnes. 1984. Classification and comparison of upland hardwood and conifer ecosystems of the Cyrus H. McCormick Experimental Forest, upper Michigan. Canadian Journal of Forest Research 14:362-375.

Pyne, M. 1994. Tennessee natural communities. Unpublished document. Tennessee Department of Conservation, Ecology Service Division, Nashville. 7 pp.

Racine, C. H. 1966. Pine communities and their site characteristics in the Blue Ridge escarpment. Journal of the Elisha Mitchell Scientific Society 82:172-181.

Rawinski, T. 1984. Natural community description abstract - southern New England calcareous seepage swamp. Unpublished report. The Nature Conservancy, Boston, MA. 6 pp.

Rawinski, T. J. 1992. A classification of Virginia's indigenous biotic communities: Vegetated terrestrial, palustrine, and estuarine community classes. Unpublished document. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report No. 92-21. Richmond, VA. 25 pp.

Rawinski, T. J., G. P. Fleming, and F. V. Judge. 1994. Forest vegetation of the Ramsey's Draft and Little Laurel Run Research Natural Areas, Virginia: Baseline ecological monitoring and classification. Natural Heritage Technical Report 94-14. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. 45 pp. plus appendices.

Rawinski, T. J., K. N. Hickman, J. Waller-Eling, G. P. Fleming, C. S. Austin, S. D. Helmick, C. Huber, G. Kappesser, F. C. Huber, Jr., T. Bailey, and T. K. Collins. 1996. Plant communities and ecological land units of the Glenwood Ranger District, George Washington and Jefferson national forests, Virginia. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Natural Heritage Technical Report 96-20. Richmond. 65 pp. plus appendices.

Rawinski, T. J., and T. F. Wieboldt. 1993. Classification and ecological interpretation of mafic glade vegetation on Buffalo Mountain, Floyd County, Virginia. Banisteria 2:3-10.

Rheinhardt, R. D. 1981. The vegetation of the Balsam Mountains of Southwest Virginia: A phytosociological study. M.A. thesis. College of William and Mary, Williamsburg, VA. 146 pp.

Robertson, P. A., M. D. MacKenzie, and L. F. Elliott. 1984. Gradient analysis and classification of the woody vegetation for four sites in southern Illinois and adjacent Missouri. Vegetatio 58:87-104.

Robichaud, B., and M. F. Buell. 1973. Vegetation of New Jersey. Rutgers University Press, New Brunswick, NJ. 340 pp.

Roble, S. M. 1999. Dragonflies and damselflies (Odonata) of the Shenandoah Valley sinkhole pond system and vicinity, Augusta County, Virginia. Banisteria 13:101-127.

Rodgers, C. L., and R. E. Shake. 1965. Survey of vascular plants in Bearcamp Creek watershed. Castanea 30:149-166.

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

Russo, M. J. 1997. Arnold Engineering Development Center preliminary community classification. Appendix to draft report to The Nature Conservancy, Tennessee Field Office, Nashville. 23 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.

Schafale, Mike P. Personal communication. Ecologist, North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program, Raleigh.

Schmalzer, P. A. 1978. Classification and analysis of forest communities in several coves of the Cumberland Plateau in Tennessee. M.S. thesis, University of Tennessee, Knoxville. 24 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.

Simurda, M. C., and J. S. Knox. 2000. ITS sequence evidence for the disjunct distribution between Virginia and Missouri of the narrow endemic *Helenium virginicum* (Asteraceae). Journal of the Torrey Botanical Society 127:316-323.

Small, C. J. 1996. Characterization of montane cedar-hardwood woodlands in the Southern Blue Ridge Province. M.S. thesis, North Carolina State University, Raleigh. 79 pp.

Smith, T. L. 1983. Natural ecological communities of Pennsylvania. Draft, revised 1991. Pennsylvania Natural Diversity Inventory, Middletown, PA.

Smith, T. L. 1991. Natural ecological communities of Pennsylvania. First revision. Unpublished report. Pennsylvania Science Office of The Nature Conservancy, Middletown, PA. 111 pp.

Sneddon, L., M. Anderson, and K. Metzler. 1996. Community alliances and elements of the Eastern Region. Unpublished report. The Nature Conservancy, Eastern Heritage Task Force, Boston, MA. 235 pp.

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

Sperduto, D. D. 2000a. Natural communities of New Hampshire: A guide and classification. Near final unformatted draft without pictures and illustrations; includes upland classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord, NH. 127 pp.

Stephenson, S. L., and H. S. Adams. 1989. The high-elevation red oak (*Quercus rubra*) community type in western Virginia. Castanea 54:217-229.

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

Steyermark, J. A. 1940. Studies of the vegetation of Missouri. I. Natural plant associations and succession in the Ozarks of Missouri. Field Museum of Natural History Botany Series 9:349-475.

Sutherland, E. K., H. Grissino-Mayer, C. A. Woodhouse, W. W. Covington, S. Horn, L. Huckaby, R. Kerr, J. Kush, M. Moore, and T. Plumb. 1993. Two centuries of fire in a southwestern Virginia *Pinus pungens* community. Paper presented at IUFRO conference on inventory and management in the context of catastrophic events. University Park, PA.

Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA.

TDNH [Tennessee Division of Natural Heritage] Unpublished data. Tennessee Division of Natural Heritage, 14th Floor, L&C Tower, 401 Church Street, Nashville, TN 37243-0447. 615-532-0431

Thomas, R. D. 1966. The vegetation and flora of Chilhowee Mountain. Ph.D. dissertation, University of Tennessee, Knoxville. 355 pp.

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

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

Tobe, J. D., J. E. Fairey, III, and L. L. Gaddy. 1992. Vascular flora of the Chauga River Gorge, Oconee County, South Carolina. Castanea 57:77-109.

Tucker, L. W. 1973. Vegetational analysis of Joyce Kilmer Memorial Forest. M.A. thesis, Western Carolina University, Cullowhee, NC. 79 pp.

Turrill, N. L., and E. R. Buckner. 1995. The loss of southern Appalachian *Pinus pungens* Lam. due to fire suppression. ASB Bulletin 42:109.

USFS [U.S. Forest Service]. 1990. Establishment record for Dismal Hollow Research Natural Area within Ozark National Forest, Newton County, Arkansas. Unpublished document. USDA Forest Service, Ozark National Forest, Russellville, AR. 20 pp. plus map.

USFS [U.S. Forest Service]. 1994. Field guide to the ecological classification and inventory system of the Huron-Manistee national forests. USDA Forest Service.

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.

Vankat, J. L. 1990. A classification of the forest types of North America. Vegetatio 88:53-66.

Weakley, A. S. 1980. Natural areas inventory and management recommendations for Big Yellow Mountain, Avery County, North Carolina. Unpublished document. The Nature Conservancy, North Carolina Field Office. Carrboro, NC. 100 pp.

Weakley, A. S., L. A. Mehrhoff, III, and L. Mansberg. 1979. Natural area inventory--Master plan for Bluff Mountain, Ashe County, North Carolina. Unpublished report. The Nature Conservancy, North Carolina Field Office, Carrboro. 225 pp.

Weakley, A. S., and M. P. Schafale. 1994. Non-alluvial wetlands of the Southern Blue Ridge: Diversity in a threatened ecosystem. Water, Air, and Soil Pollution 77:359-383.

Wells, E. F. 1970c. A vascular flora of the Uwharrie Wildlife Management Area, Montgomery County, North Carolina. M.S. thesis, University of North Carolina, Chapel Hill. 85 pp.

Wells, E. F. 1974. A vascular flora of the Uwharrie Wildlife Management Area, Montgomery County, North Carolina. Castanea 39:39-57.

Wharton, C. H. 1978. The natural environments of Georgia. Georgia Department of Natural Resources, Atlanta. 227 pp.

Wheat, R. M. 1986. Classification of forest plant communities and their relationships to landtypes on the highly dissected plateau of the western Highland Rim in middle Tennessee. M.S. thesis, University of Tennessee, Knoxville. 146 pp.

Whigham, D. F. 1969. Vegetation patterns on the north slopes of Bluff Mountain, Ashe County, North Carolina. Journal of the Elisha Mitchell Scientific Society 85:1-15.

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.

Whittaker, R. H. 1956. Vegetation of the Great Smoky Mountains. Ecological Monographs 26:1-80.

Wieland, R. G. 1994b. Mississippi Natural Heritage Program: Ecological communities. Unpublished document. Mississippi Department of Wildlife, Fisheries, and Parks, Museum of Natural Science, Natural Heritage Program, Jackson, MS. 7 pp.

Williams, C. E. 1991. Maintenance of the disturbance-dependent Appalachian endemic, *Pinus pungens*, under low disturbance regimes. Natural Areas Journal 11:169-170.

Williams, C. E., M. V. Lipscomb, W. C. Johnson, and E. T. Nilsen. 1990a. Influence of leaf litter and soil moisture on early establishment of *Pinus pungens*. The American Midland Naturalist 124:142-152.

Williams, C. E., and W. C. Johnson. 1990. Age structure and the maintenance of *Pinus pungens* in pine-oak forests of southwestern Virginia. The American Midland Naturalist 124:130-141.

Williams, C. E., and W. C. Johnson. 1992. Factors affecting recruitment of *Pinus pungens* in the southern Appalachian Mountains. Canadian Journal of Forest Research 22:878-887.

Wiser, S. K. 1993. Vegetation of high-elevation rock outcrops of the southern Appalachians: Composition, environmental relationships, and biogeography of communities and rare species. Ph.D. dissertation, University of North Carolina, Chapel Hill. 271 pp.

Wiser, S. K., R. K. Peet, and P. S. White. 1996. High-elevation rock outcrop vegetation of the southern Appalachian Mountains. Journal of Vegetation Science 7:703-722.

Zobel, D. B. 1969. Factors affecting the distribution of *Pinus pungens*, an Appalachian endemic. Ecological Monographs 39:303-333.