Appendix G

Detailed methodology and results of the vegetation association classification and mapping at Delaware Water Gap National Recreation Area are described in Volume 1. A map showing the locations of vegetation associations in the park was created, following the USGS/NPS Vegetation Mapping Program protocols (The Nature Conservancy and Environmental Systems Research Institute 1994a,b,c). Sixty-nine vegetation associations that occur within the park were identified and described in detail. This wide diversity of vegetation associations is a result of several factors, including differing bedrock geology, variable topographic features, and lengthy land use history.

Park-specific local descriptions for 69 vegetation associations were written based on plot data, compositional statistics, photographs of each plot, thematic accuracy assessment data, ecologists' field observations at Delaware Water Gap National Recreation Area, and other research cited in the local descriptions. Representative photographs of each vegetation type are also provided after each description.

The vegetation associations were also crosswalked to the National Vegetation Classification System (NatureServe 2006), Terrestrial and Palustrine Plant Communities of Pennsylvania (Fike 1999), and Draft New Jersey Ecological Community Crosswalk (Walz et al 2006) in order to provide a global and regional context for the park's vegetation. A global description from the National Vegetation Classification System follows each park-specific local description, and provides information on the range-wide composition and distribution of the association. One association, Wooded Successional Old Field, is a park-specific local vegetation type that is not represented in the NVCS and therefore is not attributed with a global description. The state conservation rank (S Rank), global conservation rank (G Rank), and classification confidence for state and global classifications are included in the descriptions. Definitions of the conservation ranks and classification confidence codes are shown in Appendix H in Volume 1. A dichotomous field key was also developed for these vegetation associations to assist with field recognition and classification (see page xi in this volume and Appendix D in Volume 1).

COMMON NAME (PARK-SPECIFIC): CONIFER PLANTATION

SYNONYMS
NVC English Name: **Pine species Planted Forest**
NVC Scientific Name: ***Pinus* spp. Planted Forest**
NVC Identifier: **CEGL006313**

LOCAL INFORMATION

Environmental Description: This forest type typically is located on moderately well-drained to well-drained sites that are flat or gently sloping. The plantations can occur on a variety of soils, including Chenango gravelly fine sand loam, Buchanan loam, Wallpack fine sandy loam, Lordstown-Wallpack complex, and Hoosic-Otisville complex. The age of the plantation trees and the management history have significant effects on the species composition and vegetation structure of the stand.

Vegetation Description: The conifer plantations are characterized by a closed canopy of needle-leaved evergreen trees dominated by one or more of the following species: eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), Norway spruce (*Picea abies*), Scotch pine (*Pinus sylvestris*), blue spruce (*Picea pungens*), or larch (*Larix* spp.). Canopy trees reach 20-35 m in height and cover 70-90% of the stand. Managed stands may have a sparser canopy. The subcanopy can vary widely. Trees are typically 6-20 m tall and can cover 5-80% of the stand. Eastern red-cedar (*Juniperus virginiana*) is the most common subcanopy tree. Adventitious hardwoods such as white ash (*Fraxinus americana*), flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), American hornbeam (*Carpinus caroliniana*), sweet birch (*Betula lenta*), oaks (*Quercus* spp.), and hickories (*Carya* spp.) are among the common subcanopy associates. Managed stands may contain these adventitious hardwoods in the canopy as well. The tall-shrub layer is often absent. When present, it contains northern spicebush (*Lindera benzoin*), species from the canopy and subcanopy, and the invasive shrub autumn-olive (*Elaeagnus umbellata*). The short-shrub layer is also variable and can cover 0-40% of the stand. Common short shrubs include the invasive shrubs Japanese barberry (*Berberis thunbergii*) and multiflora rose (*Rosa multiflora*), as well as seedlings of the canopy and subcanopy trees. Northern dewberry (*Rubus flagellaris*), bristly dewberry (*Rubus hispidus*), Blue Ridge blueberry (*Vaccinium pallidum*), and blackhaw (*Viburnum prunifolium*) are also common in the short-shrub layer. The herbaceous layer is typically sparse (5-30% cover), and the species composition varies with hydrology, land-use history, and available seed sources. Common species include common gypsyweed (*Veronica officinalis*), Christmas fern (*Polystichum acrostichoides*), partridgeberry (*Mitchella repens*), Canada mayflower (*Maianthemum canadense*), Jack in the pulpit (*Arisaema triphyllum*), starflower (*Trientalis borealis*), eastern hayscented fern (*Dennstaedtia punctilobula*), cleavers (*Galium aparine*), common yellow oxalis (*Oxalis stricta*), fuzzy wuzzy sedge (*Carex hirsutella*), running clubmoss (*Lycopodium clavatum*), common cinquefoil (*Potentilla simplex*), and striped prince's pine (*Chimaphila maculata*). The invasive species garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) can be abundant in this forest type. Vines can be absent or common, with such species as eastern poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), summer grape (*Vitis aestivalis*), and the invasive species oriental bittersweet (*Celastrus orbiculatus*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Picea abies, Pinus resinosa, Pinus strobus, Larix spp.*
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Fraxinus americana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Elaeagnus umbellata, Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rosa multiflora*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia, Toxicodendron radicans*
Herb (field)	Forb	*Mitchella repens, Veronica officinalis*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides*

Characteristic Species: *Picea abies*, *Pinus resinosa*, *Pinus strobus*, *Larix* spp., *Juniperus virginiana*, *Dennstaedtia punctilobula*, *Maianthemum canadense*, *Mitchella repens*, *Toxicodendron radicans*, *Trientalis borealis*, *Veronica officinalis.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Conifer Plantation	Walz et al 2006
PA	SNA	1	no crosswalk	Fike 1999

Local Range: This common forest type occurs throughout the park.

Classification Comments: Conifer Plantation is distinguished from other forest types by the dominance of *Pinus strobus*, *Pinus resinosa*, *Picea* spp., and/or *Larix* spp. in the canopy. Conceivably, one could treat several different types of conifer plantations at DEWA based on dominants (Norway spruce, red pine, white pine, etc.), but for this project all are considered within this type (CEGL006313).

Other Comments: None.

Local Description Authors: S. J. Perles (PNHP).

Plots and Data Sources: DEWA.14, DEWA.30, DEWA.40, DEWA.41, DEWA.46, DEWA.135, DEWA.154, DEWA.183.

Delaware Water Gap National Recreation Area 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	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	Pinus strobus Planted Forest Alliance (A.98)

Alliance (English name)	Eastern White Pine Planted Forest Alliance
Association	Pinus spp. Planted Forest
Association (English name)	Pine species Planted Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: These plantations consist of mature *Pinus strobus* or *Pinus sylvestris*, with other conifers sometimes present in smaller amounts, planted in post-agricultural fields and pastures. Associated canopy conifers include *Pinus resinosa, Picea abies, Picea pungens*, or *Larix decidua*. The understory varies widely in its degree of development and may be virtually absent. Northern hardwoods dominate the sapling and seedling layers in some areas; *Juniperus virginiana* is common in others. Cover is proportional to the degree of canopy break-up or opening that has occurred. Common hardwoods include *Prunus serotina, Acer rubrum*, and *Fraxinus americana*. A tall-shrub layer may be present; common species (aside from smaller individuals of the hardwood saplings) include *Crataegus* spp., *Hamamelis virginiana*, and *Lindera benzoin*. Common short shrubs include *Viburnum dentatum* var. *lucidum, Vaccinium pallidum, Rubus hispidus*, and *Rubus flagellaris*. The species composition and abundance of the herbaceous layer vary widely due to variation in canopy tree species composition, stand stocking, and soil drainage. Herbaceous species include *Ageratina altissima (= Eupatorium rugosum), Dryopteris intermedia, Dryopteris carthusiana, Oxalis stricta, Potentilla simplex, Mitchella repens, Galium aparine, Galium asprellum, Brachyelytrum erectum, Veronica officinalis, Polystichum acrostichoides, Maianthemum canadense, Trientalis borealis, Lycopodium clavatum*, and *Lycopodium digitatum (= Diphasiastrum digitatum)*. Graminoid and forb species associated with disturbed areas, such as *Agrostis stolonifera, Dichanthelium clandestinum (= Panicum clandestinum), Dennstaedtia punctilobula*, and *Hypericum perforatum*, are often dominant in these communities. Vines such as *Toxicodendron radicans, Smilax glauca, Smilax rotundifolia, Vitis* spp., and *Parthenocissus quinquefolia* may be present, but not abundant, in these plantations. Disturbance from silvicultural treatments and landscape fragmentation leaves these communities prone to invasion by exotic species, including *Lonicera tatarica, Berberis vulgaris, Rosa multiflora, Celastrus orbiculatus, Microstegium vimineum*, and *Alliaria petiolata*, which are locally abundant.

Environmental Description: These mature plantations are planted in post-agricultural fields and pastures. Soils are usually moderately well-drained to well-drained and vary from sandy to loamy.

Vegetation Description: These plantations consist of mature *Pinus strobus* or *Pinus sylvestris*, with other conifers sometimes present in smaller amounts, planted in post-agricultural fields and pastures. Associated canopy conifers include *Pinus resinosa, Picea abies, Picea pungens*, or *Larix decidua*. The understory varies widely in its degree of development and may be virtually absent. Northern hardwoods dominate the sapling and seedling layers in some areas; *Juniperus virginiana* is common in others. Cover is proportional to the degree of canopy break-up or opening that has occurred. Common hardwoods include *Prunus serotina, Acer rubrum*, and *Fraxinus americana*. A tall-shrub layer may be present; common species (aside from smaller individuals of the hardwood saplings) include *Crataegus* spp., *Hamamelis virginiana*, and *Lindera benzoin*. Common short shrubs include *Viburnum dentatum* var. *lucidum, Vaccinium pallidum, Rubus hispidus*, and *Rubus flagellaris*. The species composition and abundance of the herbaceous layer vary widely due to variation in canopy tree species composition, stand stocking, and soil drainage. Herbaceous species include *Ageratina altissima (= Eupatorium*

rugosum), Dryopteris intermedia, Dryopteris carthusiana, Oxalis stricta, Potentilla simplex, Mitchella repens, Galium aparine, Galium asprellum, Brachyelytrum erectum, Veronica officinalis, Polystichum acrostichoides, Maianthemum canadense, Trientalis borealis, Lycopodium clavatum, and *Lycopodium digitatum (= Diphasiastrum digitatum)*. Graminoid and forb species associated with disturbed areas, such as *Agrostis stolonifera, Dichanthelium clandestinum (= Panicum clandestinum), Dennstaedtia punctilobula*, and *Hypericum perforatum*, are often dominant in these communities. Vines such as *Toxicodendron radicans, Smilax glauca, Smilax rotundifolia, Vitis* spp., and *Parthenocissus quinquefolia* may be present, but not abundant, in these plantations. Disturbance from silvicultural treatments and landscape fragmentation leaves these communities prone to invasion by exotic species, including *Lonicera tatarica, Berberis vulgaris, Rosa multiflora, Celastrus orbiculatus, Microstegium vimineum*, and *Alliaria petiolata*, which are locally abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus, Pinus sylvestris*
Herb (field)	Forb	*Maianthemum canadense, Trientalis borealis, Veronica officinalis*

Characteristic Species: *Pinus strobus, Pinus sylvestris, Veronica officinalis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: Information not available.
States/Provinces: NJ, PA, VT.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Fort Necessity, Friendship Hill, Johnstown Flood, Marsh-Billings-Rockefeller).

CONSERVATION STATUS

Rank: GNA (modified/managed) (1-Dec-2004).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 3 – Weak.
Comments: This type is intended for plantations of mixed pines or pine mixed with other non-native planted conifers.
Similar Associations:

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

Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d., Perles et al. 2006a, Perles et al. 2006b.

Figure 1. Conifer Plantation in Delaware Water Gap National Recreation Area (plot DEWA.14). May 2003.

Figure 2. Conifer Plantation in Delaware Water Gap National Recreation Area (plot DEWA.183). May 2004.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK FOREST

SYNONYMS

NVC English Name:	**Eastern White Pine - Eastern Hemlock Lower New England / Northern Piedmont Forest**
NVC Scientific Name:	**Pinus strobus - *Tsuga canadensis* Lower New England / Northern Piedmont Forest**
NVC Identifier:	**CEGL006328**

LOCAL INFORMATION

Environmental Description: This forest association occurs on steep mesic slopes throughout the park. This type is common in southeast-facing ravines in Pennsylvania, north-facing steep slopes above the Delaware River, and northwest-facing slopes along drainages and ponds in New Jersey. This type is located on rocky soils such as those in the Manlius, Arnot, Mardin, Benson, Oquaga, and Lackawanna series. This forest association occurs on shale, sandstone, and limestone in the park. Because of the somewhat mesic settings, the hemlocks in these forests are at lower risk of mortality from hemlock wooly adelgid than hemlocks in Dry Eastern Hemlock - Oak Forest. However, hemlocks comprise a greater proportion of the forest canopy in this type, such that widespread hemlock mortality could remove the vast majority of the canopy trees.

Vegetation Description: The characteristic canopy for this forest association is dominated by eastern hemlock (*Tsuga canadensis*), covering 50-90% of the stand. Eastern white pine (*Pinus strobus*) may be codominant, covering up to 50% of the stand. Other scattered canopy associates include sweet birch (*Betula lenta*), yellow birch (*Betula alleghaniensis*), chestnut oak (*Quercus prinus*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), and American beech (*Fagus grandifolia*). Canopy trees range in height from 20-40 m and typically cover 80-90% of the stand. Subcanopy trees extend 5-30 m in height and cover 10-40% of the area. The prominent subcanopy species is eastern hemlock, with the same associates as the canopy. The tall- and short-shrub layers are sparse to absent (0-20% cover). Common species include great laurel (*Rhododendron maximum*), American witch-hazel (*Hamamelis virginiana*), pink azalea (*Rhododendron periclymenoides*), and seedlings of the canopy trees. The herb layer is also characteristically sparse (0-5% cover). Scattered common species include woodferns (*Dryopteris intermedia, Dryopteris marginalis, Dryopteris carthusiana*), Christmas fern (*Polystichum acrostichoides*), rock polypody (*Polypodium virginianum*), Canada mayflower (*Maianthemum canadense*), and partridgeberry (*Mitchella repens*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Rhododendron maximum*

Characteristic Species: *Tsuga canadensis, Betula lenta, Quercus prinus, Pinus strobus, Rhododendron maximum, Maianthemum canadense, Polypodium virginianum, Polystichum acrostichoides*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	White Pine-Hemlock Dry-Mesic Coniferous Forest	Walz et al 2006
PA	S4	2	Hemlock (white pine) forest	Fike 1999

Local Range: This forest association is common on steep mesic slopes and ravines throughout the park.

Classification Comments: This forest association is identified by the clear dominance of *Tsuga canadensis* covering >50% of the stand in the canopy, sometimes with *Pinus strobus* as canopy codominant. This type is characteristically found in ravines and steep mesic slopes. Where Eastern Hemlock Forest and Eastern White Pine Forest grade into one another (and when hardwood cover is insignificant), assignment to either association should be based on whichever species is dominant (i.e., greatest canopy cover).

Other Comments: Because hemlocks comprise a high proportion of the forest canopy, hemlock wooly adelgid is a serious threat to this association. In the event of widespread hemlock mortality, invasive plant species and the overbrowsing of tree regeneration by white-tailed deer would pose additional serious threats to these forests. Stands adjacent to Northeastern Modified Successional Forest, cultural vegetation or developed land are at high risk for colonization by invasive species following significant hemlock mortality.

Local Description Authors: S. J. Perles (PNHP).

Plots and Data Sources: DEWA.35, DEWA.68, DEWA.130, DEWA.139, DEWA.141, DEWA.171, DEWA.176, DEWA.177; Fike 1999.

Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.)
Alliance	Pinus strobus - Tsuga canadensis Forest Alliance (A.127)
Alliance (English name)	Eastern White Pine - Eastern Hemlock Forest Alliance
Association	Pinus strobus - Tsuga canadensis Lower New England / Northern Piedmont Forest
Association (English name)	Eastern White Pine - Eastern Hemlock Lower New England / Northern Piedmont Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This dry-mesic coniferous forest of usually sloping (moderately to steeply) sites is dominated by *Pinus strobus* and/or by *Tsuga canadensis*. It can occur in somewhat sheltered ravines where *Tsuga canadensis* is nearly monotypic in all layers. Other frequent tree species depend on geography and can include *Betula papyrifera, Acer pensylvanicum, Quercus*

rubra, and *Acer rubrum*, with *Prunus serotina, Betula lenta, Acer saccharum, Fraxinus americana, Betula alleghaniensis*, and *Betula populifolia* occurring less frequently. Although frequent, deciduous tree species generally occur with low abundance. Shrubs are absent or sparse but when present may include *Hamamelis virginiana, Kalmia latifolia, Vaccinium angustifolium*, and *Viburnum acerifolium*. The herbaceous layer is generally not well-developed nor diverse and is generally characterized by *Gaultheria procumbens, Medeola virginiana*, and *Thelypteris noveboracensis*. Other herbaceous associates often include *Aralia nudicaulis, Uvularia sessilifolia, Mitchella repens, Trientalis borealis, Monotropa uniflora, Dryopteris intermedia, Polystichum acrostichoides*, and *Maianthemum canadense*. Nonvascular plants tend to be sparse but can include *Leucobryum albidum* and *Polytrichum* and *Dicranum* species. Soils are moderately to extremely well-drained (dry-mesic to mesic) loamy sands and sandy loams, often sandy, stony or bouldery. The major natural disturbance in this forest type is generally single-tree blowdowns.

Environmental Description: This dry-mesic coniferous forest is usually found on sloping (moderately to steeply) sites or in sheltered ravines. Soils are moderately to extremely well-drained (dry-mesic to mesic), loamy sands and sandy loams, often sandy, stony, or bouldery.

Vegetation Description: This coniferous forest type is dominated by *Pinus strobus* and/or *Tsuga canadensis*. Other frequent tree species depend on geography and can include *Betula papyrifera, Quercus rubra*, and *Acer rubrum*, with *Pinus rigida, Prunus serotina, Quercus velutina, Carya alba, Betula lenta, Acer saccharum, Fraxinus americana, Betula alleghaniensis*, and *Betula populifolia* occurring less frequently. Although frequent, deciduous tree species generally occur with low abundance. Canopy cover is typically 80-90%. The subcanopy is often sparse but may extend up to 40% cover. *Acer pensylvanicum* is a common, though rarely abundant, small tree. Shrubs are absent or sparse but when present may include *Hamamelis virginiana, Kalmia latifolia, Rhododendron maximum, Vaccinium angustifolium*, and *Viburnum acerifolium*. The herbaceous layer is generally not well-developed nor diverse and is generally characterized by *Gaultheria procumbens, Medeola virginiana, Polystichum acrostichoides*, and *Thelypteris noveboracensis*. Other herbaceous associates often include *Aralia nudicaulis, Uvularia sessilifolia, Mitchella repens, Trientalis borealis, Monotropa uniflora, Dryopteris intermedia, Dryopteris marginalis, Dryopteris carthusiana, Polypodium virginianum*, and *Maianthemum canadense*. *Deschampsia flexuosa* and other grasses may be present in small openings and gaps. Nonvascular plants tend to be sparse but can include *Leucobryum albidum* and *Polytrichum* and *Dicranum* species.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus, Tsuga canadensis*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides, Thelypteris noveboracensis*

Characteristic Species: *Acer pensylvanicum, Gaultheria procumbens, Medeola virginiana, Pinus strobus, Polystichum acrostichoides, Thelypteris noveboracensis, Tsuga canadensis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in the northeastern United States and possibly adjacent Canada.
States/Provinces: CT, MA, ME, NH, NJ, NY, PA, QC?, RI, VT.
Federal Lands: NPS (Delaware Water Gap, Saint-Gaudens); USFWS (Assabet River, Great Meadows, Oxbow).

CONSERVATION STATUS

Rank: G5 (22-Mar-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 – Moderate.
Comments: This association is differentiated from *Pinus strobus* - *Tsuga canadensis* - *Picea rubens* Forest (CEGL006324) by its lack of *Picea rubens*.
Similar Associations:

- *Pinus strobus* - *Tsuga canadensis* - *Picea rubens* Forest (CEGL006324).
- *Pinus strobus* - *Tsuga canadensis / Acer pensylvanicum / Polystichum acrostichoides* Forest (CEGL006019).
- *Pinus strobus* - *Tsuga canadensis* Great Lakes Forest (CEGL002590).

Related Concepts:

- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984) ?
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B
- Eastern Hemlock: 23 (Eyre 1980) B
- Hemlock Forest (Thompson 1996) B
- White Pine - Hemlock: 22 (Eyre 1980) B

SOURCES

Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Brown et al. 1982a, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Gawler 2002, Gordon 1937a, Hough 1943, Hough and Forbes 1943, MENHP 1991, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 3. Eastern Hemlock Forest in Delaware Water Gap National Recreation Area (plot DEWA.130). May 2003.

Figure 4. Eastern Hemlock Forest in Delaware Water Gap National Recreation Area (plot DEWA.139). June 2003.

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

SYNONYMS

NVC English Name: **Eastern White Pine - Eastern Hemlock Lower New England / Northern Piedmont Forest**

NVC Scientific Name: ***Pinus strobus* - *Tsuga canadensis* Lower New England / Northern Piedmont Forest**

NVC Identifier: **CEGL006328**

LOCAL INFORMATION

Environmental Description: This forest association occurs on dry hills and slopes throughout the park often in association with Dry Eastern White Pine - Oak Forest. This type is located on rocky silt loam soils such as those in the Manlius and Arnot series. This forest association often occurs on shales in the park. These stands may be associated with former agricultural land.

Vegetation Description: The characteristic canopy for this forest association is dominated by eastern white pine (*Pinus strobus*) with cover exceeding 50%. Occasional canopy associates may include eastern hemlock (*Tsuga canadensis*), pitch pine (*Pinus rigida*), sweet birch (*Betula lenta*), mockernut hickory (*Carya alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), and red maple (*Acer rubrum*). In some deep ravines, this vegetation type may contain up to 50% eastern hemlock on south-facing slopes. Canopy trees range in height from 20-40 m and typically cover 80-90% of the stand. Subcanopy trees extend 5-30 m in height and cover 10-40% of the area. The prominent subcanopy species are eastern white pine and the same associates as the canopy. The tall- and short-shrub layers are sparse to absent (0-20% cover). Common species include mapleleaf viburnum (*Viburnum acerifolium*), American witch-hazel (*Hamamelis virginiana*), and seedlings of the canopy trees. The herb layer is also characteristically sparse (0-5% cover). Scattered common species include marginal woodfern (*Dryopteris marginalis*), spinulose woodfern (*Dryopteris carthusiana*), Christmas fern (*Polystichum acrostichoides*), rock polypody (*Polypodium virginianum*), Canada mayflower (*Maianthemum canadense*), and partridgeberry (*Mitchella repens*). Wavy hairgrass (*Deschampsia flexuosa*) and other grasses may be present in small openings and gaps.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus strobus*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Herb (field)	Graminoid	*Deschampsia flexuosa*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides*

Characteristic Species: *Pinus strobus, Polystichum acrostichoides, Deschampsia flexuosa*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	White Pine-Hemlock Dry-Mesic Coniferous Forest	Walz et al 2006
PA	S4	2	Hemlock (white pine) forest	Fike 1999

Local Range: This forest association is occasional on the Glaciated Low Plateau, usually in association with Dry Eastern White Pine - Oak Forest.

Classification Comments: This forest association is identified by the clear dominance of *Pinus strobus* typically covering >75% of the stand canopy. Other canopy associates, especially hardwoods, constitute less that 25% relative canopy cover. This type usually grades into Dry Eastern White Pine - Oak Forest or Eastern Hemlock Forest (which may have a significant *Pinus strobus* component as well, up to 50% canopy cover). Where Eastern Hemlock Forest and Eastern White Pine Forest grade into one another (and hardwood cover is insignificant), assignment to either association should be based on whichever species is dominant (i.e., greatest canopy cover).
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: Accuracy Assessment Observation Points DEWA.948, DEWA.949, DEWA.951, DEWA.952, DEWA.959, DEWA.960, DEWA.961; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.)
Alliance	Pinus strobus - Tsuga canadensis Forest Alliance (A.127)
Alliance (English name)	Eastern White Pine - Eastern Hemlock Forest Alliance
Association	*Pinus strobus* - *Tsuga canadensis* Lower New England / Northern Piedmont Forest
Association (English name)	Eastern White Pine - Eastern Hemlock Lower New England / Northern Piedmont Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)

GLOBAL DESCRIPTION

Concept Summary: This dry-mesic coniferous forest of usually sloping (moderately to steeply) sites is dominated by *Pinus strobus* and/or *Tsuga canadensis*. It can occur in somewhat sheltered ravines where *Tsuga canadensis* is nearly monotypic in all layers. Other frequent tree species depend on geography and can include *Betula papyrifera, Quercus rubra*, and *Acer rubrum*, with *Pinus rigida, Prunus serotina, Quercus velutina, Carya alba, Betula lenta, Acer saccharum, Fraxinus americana, Betula alleghaniensis*, and *Betula populifolia* occurring less frequently. Although frequent, deciduous tree species generally occur with low abundance. Canopy cover is typically 80-90%. The subcanopy is often sparse but may extend up to 40% cover. *Acer pensylvanicum* is a common, though rarely abundant, small tree. Shrubs are absent or sparse but when present may include *Hamamelis virginiana, Kalmia latifolia, Rhododendron maximum, Vaccinium angustifolium*, and *Viburnum acerifolium*. The herbaceous layer is generally not well-developed nor diverse and is generally characterized by *Gaultheria procumbens, Medeola virginiana, Polystichum acrostichoides*, and *Thelypteris noveboracensis*. Other herbaceous

associates often include *Aralia nudicaulis, Uvularia sessilifolia, Mitchella repens, Trientalis borealis, Monotropa uniflora, Dryopteris intermedia, Dryopteris marginalis, Dryopteris carthusiana, Polypodium virginianum*, and *Maianthemum canadense*. *Deschampsia flexuosa* and other grasses may be present in small openings and gaps. Nonvascular plants tend to be sparse but can include *Leucobryum albidum* and *Polytrichum* and *Dicranum* species. Soils are moderately to extremely well-drained (dry-mesic to mesic) loamy sands and sandy loams, often sandy, stony or bouldery. The major natural disturbance in this forest type is generally single-tree blowdowns.

Environmental Description: This dry-mesic coniferous forest is usually found on sloping (moderately to steeply) sites or in sheltered ravines. Soils are moderately to extremely well-drained (dry-mesic to mesic), loamy sands and sandy loams, often sandy, stony, or bouldery.

Vegetation Description: This coniferous forest type is dominated by *Pinus strobus* and/or *Tsuga canadensis*. Other frequent tree species depend on geography and can include *Betula papyrifera, Quercus rubra*, and *Acer rubrum*, with *Pinus rigida, Prunus serotina, Quercus velutina, Carya alba, Betula lenta, Acer saccharum, Fraxinus americana, Betula alleghaniensis*, and *Betula populifolia* occurring less frequently. Although frequent, deciduous tree species generally occur with low abundance. Canopy cover is typically 80-90%. The subcanopy is often sparse but may extend up to 40% cover. *Acer pensylvanicum* is a common, though rarely abundant, small tree. Shrubs are absent or sparse but when present may include *Hamamelis virginiana, Kalmia latifolia, Rhododendron maximum, Vaccinium angustifolium*, and *Viburnum acerifolium*. The herbaceous layer is generally not well-developed nor diverse and is generally characterized by *Gaultheria procumbens, Medeola virginiana, Polystichum acrostichoides*, and *Thelypteris noveboracensis*. Other herbaceous associates often include *Aralia nudicaulis, Uvularia sessilifolia, Mitchella repens, Trientalis borealis, Monotropa uniflora, Dryopteris intermedia, Dryopteris marginalis, Dryopteris carthusiana, Polypodium virginianum*, and *Maianthemum canadense*. *Deschampsia flexuosa* and other grasses may be present in small openings and gaps. Nonvascular plants tend to be sparse but can include *Leucobryum albidum* and *Polytrichum* and *Dicranum* species.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus, Tsuga canadensis*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides, Thelypteris noveboracensis*

Characteristic Species: *Acer pensylvanicum, Gaultheria procumbens, Medeola virginiana, Pinus strobus, Polystichum acrostichoides, Thelypteris noveboracensis, Tsuga canadensis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in the northeastern United States and possibly adjacent Canada.

States/Provinces: CT, MA, ME, NH, NJ, NY, PA, QC?, RI, VT.

Federal Lands: NPS (Delaware Water Gap, Saint-Gaudens); USFWS (Assabet River, Great Meadows, Oxbow).

CONSERVATION STATUS
Rank: G5 (22-Mar-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This association is differentiated from *Pinus strobus - Tsuga canadensis - Picea rubens* Forest (CEGL006324) by its lack of *Picea rubens*.
Similar Associations:
- *Pinus strobus - Tsuga canadensis - Picea rubens* Forest (CEGL006324).
- *Pinus strobus - Tsuga canadensis / Acer pensylvanicum / Polystichum acrostichoides* Forest (CEGL006019).
- *Pinus strobus - Tsuga canadensis* Great Lakes Forest (CEGL002590).

Related Concepts:
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984) ?
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B
- Eastern Hemlock: 23 (Eyre 1980) B
- Hemlock Forest (Thompson 1996) B
- White Pine - Hemlock: 22 (Eyre 1980) B

SOURCES
Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Brown et al. 1982, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Gawler 2002, Gordon 1937a, Hough 1943, Hough and Forbes 1943, MENHP 1991, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 5. Eastern White Pine Forest in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.642). April 2006.

Figure 6. Eastern White Pine Forest in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.642). April 2006.

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

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

LOCAL INFORMATION

Environmental Description: Successional Eastern White Pine Woodland occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed. This association develops with white pine colonizing open fields, typically from the outer edges of the field into the center or as scattered clumps throughout the field. Over time, these sites will succeed into Eastern White Pine Forest or Northeastern Modified Successional Forest if left unmanaged. Some of these fields are mowed or brushcut only in strips or paths that crisscross the field. These sites contain moderately well-drained to well-drained soils, typical of the following series: Wallpack, Lordstown, Nassau, Manlius, Hoosic, Otisville, and Hazen. The woodlands are flat to gently sloping, often bounded by stonewalls or fencerows.
Vegetation Description: The vegetation structure of Successional Eastern White Pine Woodland contains scattered trees covering 25-60% of the field. Eastern white pine (*Pinus strobus*) is the characteristic tree, which typically extends from 5-10 m in height. Occasionally, Norway spruce (*Picea abies*) or white spruce (*Picea glauca*) may occur with or in place of the eastern white pine trees. Eastern red-cedar (*Juniperus virginiana*) is often present but is not dominant or codominant. Tall and short shrubs can be scattered throughout the field. Characteristic tall shrubs include autumn-olive (*Elaeagnus umbellata*), gray dogwood (*Cornus racemosa*), multiflora rose (*Rosa multiflora*), eastern red-cedar, flowering dogwood (*Cornus florida*), Morrow's honeysuckle (*Lonicera morrowii*), smooth sumac (*Rhus glabra*), blackhaw (*Viburnum prunifolium*), Japanese barberry (*Berberis thunbergii*), Allegheny blackberry (*Rubus allegheniensis*), wine raspberry (*Rubus phoenicolasius*), and black raspberry (*Rubus occidentalis*). The herbaceous layer is variable depending on the density of tree and shrub cover. Typical species are those associated with old fields, little bluestem grasslands, and agricultural sites. Common species include wrinkleleaf goldenrod (*Solidago rugosa*), wild bergamot (*Monarda fistulosa*), sweet vernalgrass (*Anthoxanthum odoratum*), eastern poison ivy (*Toxicodendron radicans*), Kentucky bluegrass (*Poa pratensis*), common yellow oxalis (*Oxalis stricta*), flat-top goldentop (*Euthamia graminifolia*), giant goldenrod (*Solidago gigantea*), red fescue (*Festuca rubra*), little bluestem (*Schizachyrium scoparium*), Virginia mountainmint (*Pycnanthemum virginianum*), false baby's breath (*Galium mollugo*), common dandelion (*Taraxacum officinale*), common cinquefoil (*Potentilla simplex*), common yarrow (*Achillea millefolium*), Queen Anne's lace (*Daucus carota*), white clover (*Trifolium repens*), smooth brome (*Bromus inermis*), redtop (*Agrostis gigantea*), and quackgrass (*Elymus repens*), among many others.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus*
Tall shrub/sapling	Needle-leaved tree	*Pinus strobus*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus racemosa, Elaeagnus umbellata, Rosa multiflora*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rubus allegheniensis, Rubus occidentalis, Rubus phoenicolasius, Rosa multiflora*
Herb (field)	Forb	*Monarda fistulosa, Solidago rugosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Festuca rubra, Schizachyrium scoparium*

Characteristic Species: *Pinus strobus, Anthoxanthum odoratum, Euthamia graminifolia, Festuca rubra, Monarda fistulosa, Poa pratensis, Pycnanthemum virginianum, Solidago rugosa.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Eastern White Pine Successional Forest	Walz et al. 2006
PA	SNA	2	no crosswalk	Fike 1999

Local Range: This common successional type occurs throughout the park, particularly on the Pennsylvania side.
Classification Comments: Successional Eastern White Pine Woodland is distinguished from other types by the presence of *Pinus strobus* as scattered trees (25-60% cover, 5-10 m tall) in an old-field setting.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.19; Accuracy Assessment Observation Points DEWA.306, DEWA.314, DEWA.315, DEWA.321, DEWA.322, DEWA.323, DEWA.330.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Rounded-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.b.)
Alliance	Pinus strobus Forest Alliance (A.128)
Alliance (English name)	Eastern White Pine Forest Alliance

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

GLOBAL DESCRIPTION

Concept Summary: This forest is an early-successional forest dominated by *Pinus strobus*, typically with a very dense canopy and little understory. This successional forest is commonly associated with anthropogenic disturbance and could potentially occur anywhere within the range of the *Pinus strobus* Forest Alliance (A.128). Associated woody and herbaceous species vary with geography. In the northeastern states, the tree canopy is often monotypic and even-aged, with occasional associates including *Acer rubrum, Juniperus virginiana*, or scattered *Quercus rubra* or *Quercus velutina*. In regions where northern hardwoods are more prevalent, canopy associates include *Fraxinus americana* and *Acer saccharum*. The understory is poorly developed or characterized by scattered individuals found in the canopy. The herbaceous cover is variable depending on the density of tree and shrub cover. In more open stands, typical species are those associated with old fields: *Solidago rugosa, Solidago gigantea, Anthoxanthum odoratum, Poa pratensis, Schizachyrium scoparium, Elymus repens (= Elytrigia repens), Bromus inermis, Agrostis gigantea, Euthamia graminifolia, Achillea millefolium*, and *Daucus carota*. In stands that are more heavily forested, typical herbs include *Aralia nudicaulis, Maianthemum canadense, Trientalis borealis, Mitchella repens*, and *Lycopodium* species. The substrate is usually covered by a thick layer of pine needle duff. In the Southern Blue Ridge, where this association was originally defined, typical canopy and subcanopy associates include *Liriodendron tulipifera, Acer rubrum, Pinus rigida*, and *Liquidambar styraciflua*, with *Tsuga canadensis* often forming a dense shrub stratum. The understory is typically made up of ruderal or exotic species that favor openings or disturbance. In this ecoregion, it occurs in former old fields and on formerly cleared flats along streams. In the Daniel Boone National Forest of Kentucky, *Pinus strobus* is spreading from plantings, especially in the Red River Gorge.

Environmental Description: This wide-ranging successional forest is commonly associated with anthropogenic disturbance and could potentially occur anywhere within the range of the Pinus strobus Forest Alliance (A.128). It typically occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed, developing as Pinus strobus colonizes the open fields. Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species that favor openings or disturbance.

Vegetation Description: The tree canopy ranges from woodland to forest closure, with 25-85% cover. It is often monotypic and even-aged *Pinus strobus*, with occasional associates including *Acer rubrum, Juniperus virginiana*, or scattered *Quercus rubra* or *Quercus velutina*. In regions where northern hardwoods are more prevalent, canopy associates include *Fraxinus americana* and *Acer saccharum*. The understory is poorly developed or characterized by scattered individuals found in the canopy. Shrubs are often present in the more open stands and include native species such as *Cornus racemosa, Rhus glabra, Viburnum prunifolium*, and *Rubus* spp., as well as exotics such as *Elaeagnus umbellata, Rosa multiflora, Lonicera morrowii*, and *Berberis thunbergii*. The herbaceous cover is variable depending on the density of tree and shrub cover. In more open stands, typical species are those associated with old fields: *Solidago rugosa, Solidago gigantea, Anthoxanthum odoratum, Poa pratensis, Schizachyrium scoparium, Elymus repens (= Elytrigia repens), Bromus inermis, Agrostis gigantea, Euthamia graminifolia, Achillea*

millefolium, and *Daucus carota*. In stands that are more heavily forested, typical herbs include *Aralia nudicaulis, Maianthemum canadense, Trientalis borealis, Mitchella repens*, and *Lycopodium* species. The substrate is usually covered by a thick layer of pine needle duff. In the Southern Blue Ridge, where this association was originally defined, typical canopy and subcanopy associates include *Liriodendron tulipifera, Acer rubrum, Pinus rigida*, and *Liquidambar styraciflua*, with *Tsuga canadensis* often forming a dense shrub stratum. In the Daniel Boone National Forest of Kentucky, *Pinus strobus* is spreading from plantings, especially in the Red River Gorge.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus*

Characteristic Species: *Pinus strobus.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This weedy type may be expected to occur throughout the range of the alliance (i.e., from Michigan, northern Wisconsin, northern and eastern Minnesota, extreme northeastern Iowa, from Maine and New Hampshire south to Georgia and Tennessee, as well as in Ontario, Canada). It has only been documented in areas where project-specific needs have required it.

States/Provinces: CT, GA, KY, MA, MD?, ME, MI, MN, NC, NH, NJ, NY, PA, RI, SC, TN, VA, VT, WI, WV.

Federal Lands: NPS (Big South Fork, Blue Ridge Parkway, Carl Sandburg Home, Delaware Water Gap, Gettysburg, Great Smoky Mountains, Marsh-Billings-Rockefeller, New River Gorge, Obed, Saint-Gaudens); USFS (Cherokee?, Daniel Boone, George Washington, Jefferson); USFWS (Great Meadows, Moosehorn).

CONSERVATION STATUS

Rank: GNA (ruderal) (11-Feb-2001).

Reasons: 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: This weedy type may be expected to occur throughout the range of the alliance but has only been attributed in areas where The Nature Conservancy ecoregional planning or other project-specific needs have documented its occurrence. Rangewide review should greatly expand its geographic scope.

Similar Associations:

- *Pinus strobus* Planted Forest (CEGL007178).

Related Concepts: Information not available.

SOURCES

Description Authors: K. D. Patterson, mod. L. A. Sneddon and S. C. Gawler.

References: Fleming and Coulling 2001, NatureServe Ecology - Southeastern U.S. unpubl. data, Southeastern Ecology Working Group n.d., TDNH unpubl. data.

Figure 7. Successional Eastern White Pine Woodland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.306). June 2005.

Figure 8. Successional Eastern White Pine Woodland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.306). June 2005.

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

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

LOCAL INFORMATION

Environmental Description: This forest type occurs on former agricultural land and other disturbed or degraded environmental settlings. These sites are often mesic and occur at mid to low elevations. These disturbed forests are usually located on moderately well-drained to well-drained soils such as Wallpack fine sandy loam, Delaware fine sandy loam, Chenango gravelly fine sandy loam, Rexford gravelly silt loam, Galway loam, and/or Hoosic-Otisville complex. These forests nearly always contain or are bounded by stonewalls, fencelines or hedgerows, evidence of past agricultural land use. Large old wolf trees may be present along boundaries. These forests are often young and resulted from the colonization of old agricultural fields by eastern red-cedar. These stands may eventually succeed to other forest types as mid- and late-successional canopy species colonize and subsequently overtop the red-cedars.
Vegetation Description: The canopy of this forest type is strongly dominated by eastern red-cedar (*Juniperus virginiana*), which may occur as broadly spaced individuals with woodland physiognomy to dense closed-canopy forest. Canopy height varies with stand age and may range from 5-20 m. Canopy cover can vary from 25% to near 100%. Dense forest stands typically have very sparse herb and shrub layers. Common associates, typically occurring as scattered individuals, may include eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), oaks (*Quercus* spp.), and black cherry (*Prunus serotina*). A well-developed subcanopy layer is usually lacking. The tall-shrub layer is variable in cover and composition, from nearly absent to dense. Characteristic tall shrubs include autumn-olive (*Elaeagnus umbellata*) and Morrow's honeysuckle (*Lonicera morrowii*). The short-shrub layer, less than 2 m in height with variable cover, may include autumn-olive, Morrow's honeysuckle, multiflora rose (*Rosa multiflora*), Allegheny blackberry (*Rubus allegheniensis*), and black raspberry (*Rubus occidentalis*). Herbaceous vegetation is variable and depends, in part, on the density of the eastern red-cedar canopy. In open woodland stands, the herb layer often resembles successional old field vegetation or little bluestem grasslands, with characteristic species such as wrinkleleaf goldenrod (*Solidago rugosa*), wild bergamot (*Monarda fistulosa*), sweet vernalgrass (*Anthoxanthum odoratum*), eastern poison ivy (*Toxicodendron radicans*), Kentucky bluegrass (*Poa pratensis*), common yellow oxalis (*Oxalis stricta*), flat-top goldentop (*Euthamia graminifolia*), giant goldenrod (*Solidago gigantea*), red fescue (*Festuca rubra*), little bluestem (*Schizachyrium scoparium*), Virginia mountainmint (*Pycnanthemum virginianum*), false baby's breath (*Galium mollugo*), common dandelion (*Taraxacum officinale*), common cinquefoil (*Potentilla simplex*), common yarrow (*Achillea millefolium*), Queen Anne's lace (*Daucus carota*), white clover (*Trifolium repens*), smooth brome (*Bromus inermis*), redtop (*Agrostis gigantea*), and quackgrass (*Elymus repens*), among many others. In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as garlic mustard (*Alliaria petiolata*), wild garlic (*Allium vineale*), and eastern hayscented fern (*Dennstaedtia punctilobula*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Elaeagnus umbellata, Lonicera morrowii*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora, Rubus allegheniensis, Lonicera morrowii*
Herb (field)	Vine/Liana	*Toxicodendron radicans*
Herb (field)	Forb	*Alliaria petiolata, Euthamia graminifolia, Monarda fistulosa, Pycnanthemum virginianum, Solidago rugosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Microstegium vimineum, Schizachyrium scoparium*

Characteristic Species: *Juniperus virginiana, Elaeagnus umbellata, Lonicera morrowii, Rosa multiflora, Alliaria petiolata, Microstegium vimineum, Monarda fistulosa, Schizachyrium scoparium, Solidago rugosa.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Old-field Eastern Red-cedar Forest	Walz et al. 2006
PA	SNA	1	not crosswalk	Fike 1999

Local Range: This variable forest type is common in the park, particularly in mesic areas of mid to low elevations where past agricultural land use occurred.

Classification Comments: Eastern Red-cedar Forest typically occurs on former agricultural land, and less often on other derelict developed land within the park, and is strongly dominated by eastern red-cedar. The related Northeastern Modified Successional Forest may contain significant amounts of eastern red-cedar, but the canopy usually has one or more hardwood species as codominants. The Successional Eastern White Pine Woodland occurs in similar settings but is dominated by eastern white pine, and eastern red-cedar, when present, is a minor associate. Note that this type is meant to capture both eastern red-cedar woodlands (canopy cover 25-60%) and forests (cover >60%) on former agricultural and derelict developed land.

Other Comments: None.

Local Description Authors: G. S. Podniesinski (PNHP).

Plots and Data Sources: DEWA.81.

Delaware Water Gap National Recreation Area 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	Conical-crowned temperate or subpolar needle-leaved evergreen forest (I.A.8.N.c.)
Alliance	Juniperus virginiana Semi-natural Forest Alliance (A.137)
Alliance (English name)	Eastern Red-cedar Forest Alliance
Association	*Juniperus virginiana* Forest
Association (English name)	Eastern Red-cedar Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association is a broadly defined old-field early-successional community occurring in a variety of environmental settings. Canopy closure and height are variable, as are shrub and herbaceous associates. *Juniperus virginiana* dominates the canopy layer. Common associates, typically occurring as scattered individuals, may include *Pinus strobus, Acer rubrum, Quercus* spp., and *Prunus serotina*. Shrub cover varies, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata, Lonicera morrowii*, and *Rosa multiflora* are characteristic, along with *Rubus* spp. Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium, Festuca rubra, Anthoxanthum odoratum, Agrostis gigantea, Elymus repens (= Elytrigia repens), Solidago rugosa, Solidago gigantea, Euthamia graminifolia, Monarda fistulosa, Toxicodendron radicans, Achillea millefolium*, and *Daucus carota*. In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata* and *Allium vineale*, and *Dennstaedtia punctilobula*. These forests are often young and result from the colonization of old agricultural fields by *Juniperus virginiana* over native and exotic forbs and grasses. These stands may eventually succeed to other forest types as mid- and late-successional canopy species colonize and subsequently overtop the *Juniperus*.

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

Vegetation Description: *Juniperus virginiana* dominates the canopy layer in stands of this type, which range from broadly spaced woodlands to dense and nearly impenetrable thickets. Common associates, typically occurring as scattered individuals, may include *Pinus strobus, Acer rubrum, Quercus* spp., and *Prunus serotina*. Shrub cover varies according to canopy closure, with the most forested stands having little or no shrub cover. Exotic shrubs such as *Elaeagnus umbellata, Lonicera morrowii*, and *Rosa multiflora* are most characteristic, along with *Rubus* spp. Herbaceous cover likewise varies. Common species in the more open-canopy stands include old-field denizens such as *Schizachyrium scoparium, Festuca rubra, Anthoxanthum odoratum, Agrostis gigantea, Elymus repens (= Elytrigia repens), Solidago rugosa, Solidago gigantea, Euthamia graminifolia, Monarda fistulosa, Toxicodendron radicans, Achillea millefolium*, and *Daucus carota*. In dense forest stands, herbs may be absent or limited to scattered shade-tolerant species such as *Alliaria petiolata, Allium vineale*, and *Dennstaedtia punctilobula*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lonicera morrowii*
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Elaeagnus umbellata*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora*
Herb (field)	Forb	*Solidago rugosa*
Herb (field)	Graminoid	*Schizachyrium scoparium*

Characteristic Species: *Elaeagnus umbellata, Juniperus virginiana, Lonicera morrowii, Rosa multiflora, Schizachyrium scoparium, Solidago rugosa.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is of broad distribution, occurring widely throughout the northeastern U.S. It has been documented from only a limited range but is undoubtedly more widely distributed.
States/Provinces: MA, NJ, NY, PA.
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Fire Island).

CONSERVATION STATUS

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

CLASSIFICATION INFORMATION

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

SOURCES

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

Figure 9. Eastern Red-cedar Forest in Delaware Water Gap National Recreation Area (plot DEWA.81). August 2006.

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK - MIXED HARDWOOD PALUSTRINE FOREST

SYNONYMS
NVC English Name: **Eastern Hemlock / Great Laurel / Peatmoss species Forest**
NVC Scientific Name: ***Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest**
NVC Identifier: **CEGL006279**

LOCAL INFORMATION

Environmental Description: This forest type occurs in upland depressions and surrounds small streams and drainages. The substrate is typically somewhat poorly to very poorly drained, often on mucky peat or Alden mucky silt loam. These areas are semipermanently to permanently inundated, typically with the vegetation growing on hummocks surrounded by standing water. These wetlands are prone to flooding from beaver or man-made impoundments. Hemlocks in many stands appear to be in decline due to the hemlock wooly adelgid and/or recent flooding resulting from beaver activity.

Vegetation Description: This palustrine forest type is characterized by eastern hemlock (*Tsuga canadensis*) that is dominant or codominant in the canopy, covering at least 25% of the area (due to hemlock decline, actual foliar coverage may be <25%). Red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and/or blackgum (*Nyssa sylvatica*) are the typical canopy codominants. Canopy trees range in height from 15-20 m and cover 50-90% of the area. The subcanopy trees extend from 5-10 m in height and cover 10-30 % of the area. Eastern hemlock and red maple are typical subcanopy trees. The tall-shrub layer (30-70% cover) is often characterized by a dense thicket of great laurel (*Rhododendron maximum*), or composed of samplings of the canopy trees. Highbush blueberry (*Vaccinium corymbosum*), catberry (*Nemopanthus mucronatus*), and American witch-hazel (*Hamamelis virginiana*) are other common tall shrubs. The sparse short-shrub layer contains species from the canopy and tall-shrub layers. The herbaceous layer can be sparse or dense (5-80%), often growing on hummocks covered in sphagnum (*Sphagnum* spp.). Common species include cinnamon fern (*Osmunda cinnamomea*), purple stem beggarticks (*Bidens connata*), tussock sedge (*Carex stricta*), softleaf sedge (*Carex disperma*), northern long sedge (*Carex folliculata*), longhair sedge (*Carex comosa*), shallow sedge (*Carex lurida*), threeseeded sedge (*Carex trisperma*), fox sedge (*Carex vulpinoidea*), violets (*Viola* spp.), jewelweed (*Impatiens capensis*), rice cutgrass (*Leersia oryzoides*), smallspike false nettle (*Boehmeria cylindrica*), northern bugleweed (*Lycopus uniflorus*), royal fern (*Osmunda regalis*), and harlequin blueflag (*Iris versicolor*). The invasive species Japanese stiltgrass (*Microstegium vimineum*) can be present in this forest type.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Betula alleghaniensis, Nyssa sylvatica*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum*
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Rhododendron maximum*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium corymbosum*

Herb (field)	Graminoid	*Carex folliculata, Carex trisperma*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea*

Characteristic Species: *Tsuga canadensis, Acer rubrum, Betula alleghaniensis, Nyssa sylvatica, Rhododendron maximum, Vaccinium corymbosum, Carex folliculata, Carex trisperma*.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S2	1	Eastern Hemlock - Great Laurel Swamp	Walz et al. 2006
PA	S3S4	2	Hemlock-mixed hardwood palustrine forest	Fike 1999

Local Range: This forest type occurs occasionally throughout the park in a variety of palustrine settings.
Classification Comments: Hemlock - Mixed Hardwood Palustrine Forest can be distinguished from other palustrine forests by the codominance of *Tsuga canadensis* in the canopy, often with *Acer rubrum, Betula alleghaniensis*, and/or *Nyssa sylvatica*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.74, DEWA.95, DEWA.168; Fike 1999.
Delaware Water Gap National Recreation Area 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	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g.)
Alliance	Tsuga canadensis Saturated Forest Alliance (A.201)
Alliance (English name)	Eastern Hemlock Saturated Forest Alliance
Association	*Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest
Association (English name)	Eastern Hemlock / Great Laurel / Peatmoss species Forest
Ecological System(s):	North-Central Appalachian Acidic Swamp (CES202.604)

GLOBAL DESCRIPTION

Concept Summary: This hemlock swamp of the Central Appalachians, southeastern New York and northern New Jersey occurs on saturated acidic muck to imperfectly drained mineral soils in upland valleys, bedrock depressions, low slopes, and adjacent to streams and lakes. Mounds and depressions caused by uprooted trees are typical. The tree canopy is closed or nearly closed and is dominated by *Tsuga canadensis* with associates including *Acer rubrum, Nyssa sylvatica, Pinus strobus*, and *Betula alleghaniensis*. The well-developed shrub layer is strongly dominated by *Rhododendron maximum*. Other shrubs may include *Ilex verticillata, Rhododendron viscosum,*

Vaccinium corymbosum, and *Lindera benzoin*. The sparse herb layer includes a variety of sedges such as *Carex folliculata, Carex trisperma, Carex intumescens*, as well as ferns and forbs such as *Osmunda cinnamomea, Thelypteris palustris, Onoclea sensibilis, Maianthemum canadense, Cornus canadensis, Coptis trifolia, Symplocarpus foetidus, Trientalis borealis*, and *Calla palustris*. The bryophyte layer is well-developed and strongly dominated by *Sphagnum* mosses. Other mosses may include *Aulacomnium palustre, Hypnum imponens*, and *Leucobryum glaucum* on drier hummocks.

Environmental Description: This forest type occurs in saturated acidic muck to imperfectly drained mineral soils in upland valleys, bedrock depressions, low slopes, in small stream drainages, and adjacent to streams and lakes. The substrate is somewhat poorly to very poorly drained. Some areas are semipermanently to permanently flooded, especially where impacted by beaver or other impoundments, in which case the hemlocks may be in decline. The hemlocks may also be in decline due to hemlock woolly adelgid.

Vegetation Description: The tree canopy is closed or nearly closed (given healthy tress) and is dominated by *Tsuga canadensis* with associates including *Acer rubrum, Nyssa sylvatica, Pinus strobus*, and *Betula alleghaniensis*. (Actual foliar cover in stands where hemlocks are becoming defoliated due to hemlock woolly adelgid is much lower.) A subcanopy of *Tsuga canadensis* and *Acer rubrum* may be present. Mounds and depressions caused by uprooted trees are typical. The well-developed shrub layer is strongly dominated by *Rhododendron maximum*. Other shrubs may include *Ilex verticillata, Rhododendron viscosum, Hamamelis virginiana, Vaccinium corymbosum, Lindera benzoin*, and (in the northern part of the types range) *Nemopanthus mucronatus*. Herb cover varies from sparse to well-developed according to canopy closure and includes a variety of sedges such as *Carex folliculata, Carex trisperma, Carex disperma, Carex intumescens*, as well as ferns and forbs such as *Osmunda cinnamomea, Osmunda regalis, Thelypteris palustris, Onoclea sensibilis, Maianthemum canadense, Lycopus uniflorus, Cornus canadensis, Coptis trifolia, Symplocarpus foetidus, Trientalis borealis*, and *Calla palustris*. The bryophyte layer is well-developed and strongly dominated by *Sphagnum* mosses. Other mosses may include *Aulacomnium palustre, Hypnum imponens*, and *Leucobryum glaucum* on drier hummocks.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum*
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Rhododendron maximum*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea*

Characteristic Species: *Acer rubrum, Betula alleghaniensis, Carex folliculata, Carex trisperma, Nyssa sylvatica, Osmunda cinnamomea, Rhododendron maximum, Tsuga canadensis, Vaccinium corymbosum.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is found in the northeastern United States from New Jersey and Pennsylvania south to West Virginia and west to Ohio.

States/Provinces: MD, NJ:S1S2, NY, OH, PA, WV.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G4? (19-Jun-2006).
Reasons: This association is well-distributed through its range, but hemlock woolly adelgid may be threatening this as a type.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations:
- *Tsuga canadensis - (Pinus strobus)* Temporarily Flooded Forest (CEGL007143).
- *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226).
- *Tsuga canadensis - Betula alleghaniensis* Saturated Forest (CEGL005003).

Related Concepts:
- Hardwood-Conifer Swamp (Breden 1989) ?

SOURCES
Description Authors: S. C. Gawler.
References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Harrison 2004, Karlin 1988.

Figure 10. Eastern Hemlock - Mixed Hardwood Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.74). August 2003.

Figure 11. Eastern Hemlock - Mixed Hardwood Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.95). August 2003.

COMMON NAME (PARK-SPECIFIC): SUGAR MAPLE - AMERICAN BEECH - SWEET BIRCH FOREST

SYNONYMS

NVC English Name:	**Sugar Maple - Yellow Birch - American Beech / Hobblebush Forest**
NVC Scientific Name:	***Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest**
NVC Identifier:	**CEGL006252**

LOCAL INFORMATION

Environmental Description: This association typically occurs on the middle of gentle to moderately steep slopes (5 to 30%) with a northern, or occasionally eastern, aspect. The bedrock is typically limestone, or calcareous sandstones, siltstones and shale. Soils are usually channery silt loams to gravelly sand loams with rock outcrops common (e.g., Benson-Rock Outcrop complex soil series, Lordstown-Wallpack complex - Very Rocky). Soils are typically mildly acid to alkaline, reflecting the calcareous nature of the underlying bedrock.

Vegetation Description: This association is characterized by the dominance of sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*), and American beech (*Fagus grandifolia*). In some stands, sugar maple may be the sole dominant or strongly dominant (>75% of canopy and subcanopy). Other stands may be strongly dominated by two of the three characteristic species (sugar maple, sweet birch, and American beech). Common canopy associate species include northern red oak (*Quercus rubra*), pignut hickory (*Carya glabra*), red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), and white ash (*Fraxinus americana*). The canopy is usually closed (total cover 80 to 90%) and 20 to 35 m in height, depending on local site conditions. The subcanopy is typically dominated by sugar maple, with eastern hemlock, sweet birch, and American beech as associates. The subcanopy height is variable depending on canopy height, ranging from 5 to 25 m. Subcanopy cover ranges from sparse (5%) to moderately dense (30%). The tall-shrub layer varies from nearly absent to 30% total cover and ranges from 2-5 m in height. The tall-shrub layer is often dominated by saplings of canopy tree species, especially sugar maple, American beech and sweet birch, as well as shrub/small-tree species such as eastern hop-hornbeam (*Ostrya virginiana*) and American hornbeam (*Carpinus caroliniana*). Other common tall shrubs may include northern spicebush (*Lindera benzoin*), American witch-hazel (*Hamamelis virginiana*), great laurel (*Rhododendron maximum*), and common serviceberry (*Amelanchier arborea*). The short-shrub layer is generally under 2 m in height with sparse to moderate total cover (usually 5 to 30%, occasionally higher). Typical short shrubs include seedlings and saplings of canopy species, especially sugar maple and American beech, as well as northern spicebush, Japanese barberry (*Berberis thunbergii*), and occasionally Blue Ridge blueberry (*Vaccinium pallidum*). The herbaceous layer varies in cover from 20 to 60% total cover and is generally less than 1 m in height. The herbaceous layer often has a significant cover of ferns, especially eastern hayscented fern (*Dennstaedtia punctilobula*), Christmas fern (*Polystichum acrostichoides*), New York fern (*Thelypteris noveboracensis*), and several species of woodfern (*Dryopteris carthusiana*, *Dryopteris intermedia*, and *Dryopteris marginalis*). Other characteristic herbs include garlic mustard (*Alliaria petiolata*), Pennsylvania sedge (*Carex pensylvanica*), Japanese stiltgrass (*Microstegium vimineum*), Canada mayflower (*Maianthemum canadense*), and partridgeberry (*Mitchella repens*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum*
Tree canopy	Broad-leaved deciduous tree	*Betula lenta, Fagus grandifolia*
Tree subcanopy	Needle-leaved tree	*Tsuga canadensis*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Carpinus caroliniana, Ostrya virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum, Berberis thunbergii, Fagus grandifolia, Lindera benzoin*
Herb (field)	Forb	*Maianthemum canadense*
Herb (field)	Graminoid	*Carex pensylvanica, Microstegium vimineum*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides*

Characteristic Species: *Acer saccharum, Betula lenta, Carpinus caroliniana, Fagus grandifolia, Lindera benzoin, Mitchella repens, Ostrya virginiana, Polystichum acrostichoides*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S3	1	Northern Hardwood Forest	Walz et al. 2006
PA	S4	2	Northern hardwood forest	Fike 1999

Local Range: This association likely occurs throughout the park on gentle to steep midslopes with a northerly or, less commonly, eastern aspect. This association is usually found over calcareous bedrock.

Classification Comments: The association differs from other hardwood types by the strong dominance of one or two of the following species: *Acer saccharum, Betula lenta*, and *Fagus grandifolia*. It lacks a significant oak component typical of the oak-dominated hardwood forests such as Northern Red Oak - Mixed Hardwood Forest. This type is distinguished from Sugar Maple - American Basswood Forest by having relatively low cover or absence of *Tilia americana*. It is distinguished from Sugar Maple Floodplain Forest in that it does not occur on the floodplain of the Delaware River or its tributaries. This type differs from Red Maple - Sweet Birch Hardwood Forest as the latter is typically dominated by *Acer rubrum* (occasionally *Betula lenta*), does not contain significant cover of *Acer saccharum*, and is generally influenced significantly by previous silvicultural or agricultural activities.

Other Comments: None.

Local Description Authors: G. S. Podniesinski and S. J. Perles (PNHP).

Plots and Data Sources: DEWA.33, DEWA.43, DEWA.45, DEWA.156, DEWA.169, DEWA.174, DEWA.203, DEWA.240; Fike 1999.

Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	Acer saccharum - Betula alleghaniensis - (Fagus grandifolia) Forest Alliance (A.216)
Alliance (English name)	Sugar Maple - Yellow Birch - (American Beech) Forest Alliance
Association	*Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest
Association (English name)	Sugar Maple - Yellow Birch - American Beech / Hobblebush Forest
Ecological System(s):	Laurentian-Acadian Northern Hardwoods Forest (CES201.564) Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)

GLOBAL DESCRIPTION

Concept Summary: This association, known commonly as "northern hardwood forest," is a widespread matrix forest in central New England and at lower elevations in northern New England. This forest occurs most commonly on acidic (pH 5-6), moderate to well-drained tills at elevations generally below 762 m (2500 feet). In northern New England, they cover extensive mid-elevation ridges; elsewhere, slope settings are common. The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. On some rocky, higher-elevation sites, dense ferns and other herbs may form a lush understory (the "fern-glade variant"). The canopy is dominated by *Acer saccharum* mixed with variable amounts of *Fagus grandifolia* and/or *Betula alleghaniensis*. Associated hardwood species include *Acer rubrum*, *Betula papyrifera*, and *Fraxinus americana*. At the southern end of this type's range, especially in mid-successional stands, *Betula lenta* may be present. Conifers are usually present at low abundance. Characteristic species include *Pinus strobus*, *Tsuga canadensis*, and in the northern portion of the range, *Picea rubens*. Oaks are generally not present, although *Quercus rubra* and (southward) *Quercus alba* are sometimes present in low numbers. The shrub layer is often dominated by saplings of canopy tree species Characteristic understory shrubs or small trees include *Acer pensylvanicum, Ostrya virginiana, Viburnum lantanoides, Acer spicatum* (in the northern part of this type's range), and *Lindera benzoin* (in the southern part of this type's range. The patchy herbaceous layer is a mix of ferns, rhizomatous herbs and clubmosses. Characteristic species include *Dryopteris intermedia, Dryopteris carthusiana, Polystichum acrostichoides, Huperzia lucidula, Maianthemum canadense, Clintonia borealis, Trientalis borealis, Oclemena acuminata (= Aster acuminatus)*, and *Uvularia sessilifolia*. Occasional species include *Aralia nudicaulis, Trillium erectum, Trillium undulatum, Dryopteris campyloptera, Streptopus lanceolatus (= Streptopus roseus), Cinna latifolia, Thelypteris noveboracensis, Mitchella repens,*

Solidago macrophylla, and *Medeola virginiana*. The bryophyte layer may include *Dicranum* spp. and *Leucobryum glaucum*. Sugar maple leaf litter is high in nitrogen relative to lignin and thus decomposes rapidly, increasing the nutrient pool in the soil organic layer. Structure and composition of the forest are maintained primarily by single small tree-fall gaps. Yellow birch is maintained in the system by mineral soils on "tip-up mounds."

Environmental Description: This association, known commonly as 'northern hardwood forest,' is a widespread matrix forest in central New England, and at lower elevations in northern New England. This forest occurs most commonly on acid (pH 5-6), moderate to well-drained tills at elevations generally below 2500 feet. In northern New England, they cover extensive mid-elevation ridges; elsewhere, slope settings are common.

Vegetation Description: The closed-canopy forest has sparse to moderate shrub and herb cover and may have local carpets of tree seedlings in the ground vegetation. Bryoids are a minor component of the forest floor. On some rocky, higher-elevation sites, dense ferns and other herbs may form a lush understory (the "fern-glade variant"). The canopy is dominated by *Acer saccharum* mixed with variable amounts of *Fagus grandifolia* and/or *Betula alleghaniensis*. Associated hardwood species include *Acer rubrum, Betula papyrifera*, and *Fraxinus americana*. At the southern end of this type's range, especially in mid-successional stands, *Betula lenta* may be present. Conifers are usually present at low abundance. Characteristic species include *Pinus strobus, Tsuga canadensis*, and in the northern portion of the range, *Picea rubens*. Oaks are generally not present, although *Quercus rubra* and (southward) *Quercus alba* are sometimes present in low numbers. The shrub layer is often dominated by saplings of canopy tree species. Characteristic understory shrubs or small trees include *Acer pensylvanicum, Ostrya virginiana, Viburnum lantanoides, Acer spicatum* (in the northern part of this type's range), and *Lindera benzoin* (in the southern part of this type's range. The patchy herbaceous layer is a mix of ferns, rhizomatous herbs and clubmosses. Characteristic species include *Dryopteris intermedia, Dryopteris carthusiana, Polystichum acrostichoides, Huperzia lucidula, Maianthemum canadense, Clintonia borealis, Trientalis borealis, Oclemena acuminata (= Aster acuminatus)*, and *Uvularia sessilifolia*. Occasional species include *Aralia nudicaulis, Trillium erectum, Trillium undulatum, Dryopteris campyloptera, Streptopus lanceolatus (= Streptopus roseus), Cinna latifolia, Thelypteris noveboracensis, Mitchella repens, Solidago macrophylla*, and *Medeola virginiana*. The bryophyte layer may include *Dicranum* spp. and *Leucobryum glaucum*. At higher elevations any of the understory herbs characteristic of montane spruce-fir forests may be locally abundant. In the southern portion of the range, exotic species including *Berberis thunbergii* and *Microstegium vimineum* may be common in the shrub and herb layers.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum, Fagus grandifolia*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer pensylvanicum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ostrya virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum, Fagus grandifolia*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides*

Characteristic Species: *Acer pensylvanicum, Acer saccharum, Betula alleghaniensis, Dryopteris intermedia, Fagus grandifolia, Ostrya virginiana, Pinus strobus, Polystichum acrostichoides, Tsuga canadensis, Viburnum lantanoides.*

Other Noteworthy Species: *Accipiter striatus, Aegolius acadicus, Ambystoma maculatum, Contopus virens, Dendroica caerulescens, Dendroica virens, Desmognathus fuscus, Empidonax minimus, Empidonax virescens, Erethizon dorsatum, Eurycea bislineata, Glaucomys sabrinus, Hylocichla mustelina, Martes pennanti, Melanerpes carolinus, Meleagris gallopavo, Mniotilta varia, Napaeozapus insignis, Notophthalmus viridescens, Parula americana, Peromyscus leucopus, Peromyscus maniculatus, Picoides pubescens, Picoides villosus, Piranga olivacea, Poecile atricapillus, Rana sylvatica, Seiurus aurocapilla, Setophaga ruticilla, Sitta carolinensis, Sorex cinereus, Tamias striatus, Urocyon cinereoargenteus, Ursus americanus, Vireo olivaceus.*
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association is a widespread matrix forest from southern Quebec and the Maritime Provinces of Canada south through New England, continuing in more limited distribution to northern New Jersey and northeastern Pennsylvania.
States/Provinces: CT, MA, ME, NB, NH, NJ:S1S3, NY, PA, VT.
Federal Lands: NPS (Acadia, Delaware Water Gap, Marsh-Billings-Rockefeller); USFWS (Aroostook, Moosehorn, Nulhegan Basin, Pondicherry).

CONSERVATION STATUS

Rank: G5 (7-Dec-2005).
Reasons: This association is a widespread matrix forest in New England, upstate New York, and adjacent Canada.

CLASSIFICATION INFORMATION

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

- *Acer saccharum - (Fraxinus americana) / Arisaema triphyllum* Forest (CEGL006211).
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004).
- *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008).
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005).
- *Picea rubens - Betula alleghaniensis / Dryopteris campyloptera* Forest (CEGL006267).
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129).

Related Concepts:

- *Acer saccharum - Fagus grandifolia - Betula alleghaniensis / Viburnum alnifolium* Community (Metzler and Barrett 1996) ?
- Beech - Sugar Maple: 60 (Eyre 1980) B
- CNE dry transitional forest on sandy / gravelly soils (Rawinski 1984) ?
- CNE mesic conifer [transition] forest on acidic bedrock/till (Rawinski 1984) B
- Mesic Hemlock-Hardwood Forest (Breden 1989) B
- Mesic Northern Hardwood Forest (Beech-Birch-Maple Forest) (Thompson 1996) B

- Northern hardwood forest: boreal/montane type (NAP pers. comm. 1998) ?
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) B
- Sugar Maple: 27 (Eyre 1980) B

SOURCES

Description Authors: S. C. Gawler.

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

Figure 12. Sugar Maple - American Beech - Sweet Birch Forest in Delaware Water Gap National Recreation Area (plot DEWA.43). July 2003.

Figure 13. Sugar Maple - American Beech - Sweet Birch Forest in Delaware Water Gap National Recreation Area (plot DEWA.203). June 2004.