COMMON NAME (PARK-SPECIFIC): RED MAPLE PALUSTRINE FOREST

SYNONYMS

NVC English Name:	**Red Maple - (Green Ash, White Ash) / Northern Spicebush / Skunk-cabbage Forest**
NVC Scientific Name:	***Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest**
NVC Identifier:	**CEGL006406**

LOCAL INFORMATION

Environmental Description: This wetland type occurs in a variety of palustrine settings, including small upland depressions, impounded drainages, poorly drained floodplains of small creeks, or as part of a larger wetland complex. This palustrine forest usually occurs on somewhat poorly to very poorly drained soil such as shallow mucky peat, Alden mucky silt loam, or the Fredon-Halsey complex. This association can be temporarily to permanently flooded and can be associated with impounded drainages.

Vegetation Description: The closed canopy (>60% cover) of this palustrine forest contains red maple (*Acer rubrum*) as dominant (25-95% cover) with a variety of associates. Canopy trees range from 20-25 m in height. Common canopy associates include American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), American hornbeam (*Carpinus caroliniana*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), shagbark hickory (*Carya ovata*), and sycamore (*Platanus occidentalis*). Pin oak (*Quercus palustris*) and swamp white oak (*Quercus bicolor*) may be present in the canopy but at low cover (less than 25%). The sparse subcanopy extends from 10-15 m in height and contains red maple and other species from the canopy. The tall-shrub layer can be sparse to dense (5-60% cover) and can contain a variety of species. Common tall shrubs are northern spicebush (*Lindera benzoin*), silky dogwood (*Cornus amomum*), common winterberry (*Ilex verticillata*), smooth alder (*Alnus serrulata*), mountain holly (*Ilex montana*), highbush blueberry (*Vaccinium corymbosum*), and southern arrowwood (*Viburnum dentatum* var. *lucidum*). Typical short shrubs (20-40% cover) include bristly dewberry (*Rubus hispidus*) and the species found in the tall-shrub layer, as well as the invasive shrubs multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and Morrow's honeysuckle (*Lonicera morrowii*). The herbaceous layer covers 30-70% of the forest and contains cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), jewelweed (*Impatiens capensis*), skunk-cabbage (*Symplocarpus foetidus*), New York fern (*Thelypteris noveboracensis*), cleavers (*Galium aparine*), Jack in the pulpit (*Arisaema triphyllum*), greater bladder sedge (*Carex intumescens*), hairy sedge (*Carex lacustris*), eastern star sedge (*Carex radiata*), American golden saxifrage (*Chrysosplenium americanum*), royal fern (*Osmunda regalis*), smallspike false nettle (*Boehmeria cylindrica*), eastern marsh fern (*Thelypteris palustris*), white avens (*Geum canadense*), and fowl mannagrass (*Glyceria striata*). The invasive species Japanese stiltgrass (*Microstegium vimineum*) and garlic mustard (*Alliaria petiolata*) can be abundant in this forest type. Vines such as fox grape (*Vitis labrusca*) can also be abundant, while Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison ivy (*Toxicodendron radicans*) are common but sparsely distributed.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Cornus amomum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Berberis thunbergii, Rosa multiflora*
Herb (field)	Vine/Liana	*Vitis labrusca*
Herb (field)	Forb	*Impatiens capensis*
Herb (field)	Graminoid	*Carex intumescens, Microstegium vimineum*
Herb (field)	Fern or fern ally	*Onoclea sensibilis, Osmunda cinnamomea*

Characteristic Species: *Acer rubrum, Cornus amomum, Lindera benzoin, Impatiens capensis, Onoclea sensibilis, Osmunda cinnamomea, Symplocarpus foetidus.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3S5	1	Southern New England Red Maple Seepage Swamp	Walz et al. 2006
PA	S3S4	2	Red maple - black gum palustrine forest	Fike 1999

Local Range: This wetland occurs throughout the park in a variety of palustrine settings.
Classification Comments: This forest has somewhat broad species composition and environmental settings. This association includes *Acer rubrum*-dominated forested swamps with standing water and circumneutral shrubs other than *Vaccinium corymbosum*. It also is the catch-all group for often weedy, lowland, wet forests dominated by *Acer rubrum* (similar to the catch-all Red Maple Terrestrial Forest). It is distinguished from other palustrine forests by the dominance of *Acer rubrum* (>25% cover) and the lack of oaks (<25% cover) and *Vaccinium corymbosum* (<25% cover). It also lacks species restricted to the higher elevations of Kittatinny Ridge, such as *Picea mariana, Chamaedaphne calyculata, Carex folliculata*, and *Drosera rotundifolia* that are characteristic of Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.42, DEWA.56, DEWA.57, DEWA.250; 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	Seasonally flooded cold-deciduous forest (I.B.2.N.e.)

Alliance	Acer rubrum - Fraxinus pennsylvanica Seasonally Flooded Forest Alliance (A.316)
Alliance (English name)	Red Maple - Green Ash Seasonally Flooded Forest Alliance
Association	*Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest
Association (English name)	Red Maple - (Green Ash, White Ash) / Northern Spicebush / Skunk-cabbage Forest
Ecological System(s):	Atlantic Coastal Plain Northern Basin Swamp and Wet Hardwood Forest (CES203.520) North-Central Appalachian Acidic Swamp (CES202.604)

GLOBAL DESCRIPTION

Concept Summary: This association is an acidic seepage swamp of southern New England and the northern Piedmont dominated by *Acer rubrum*. It generally occurs in seasonally saturated situations on slightly sloping hillsides, along small streams, or in basins that receive overland flooding in addition to groundwater influence. In general, these swamps are acidic and have some seepage indicators but are not particularly species-rich. Soils are shallow to moderately deep mucks over mineral soils. *Acer rubrum* dominates the canopy; *Fraxinus pennsylvanica* or *Fraxinus americana* are usually also found in the canopy. *Fraxinus nigra* is not generally associated with this type and, if present, occurs only as scattered individuals. Other canopy or subcanopy associates may include *Liriodendron tulipifera, Quercus bicolor, Quercus palustris, Prunus serotina, Fagus grandifolia, Ulmus americana*, and *Ulmus rubra*. Conifers such as *Tsuga canadensis* or *Pinus strobus* are generally absent or occur in very low abundance. The shrub layer may be fairly open to quite dense, depending on the amount of canopy closure. Shrub species commonly include *Ilex verticillata, Rhododendron viscosum, Clethra alnifolia, Lindera benzoin, Cornus amomum, Alnus serrulata*, and less commonly *Vaccinium corymbosum, Lyonia ligustrina, Ilex montana, Toxicodendron vernix, Viburnum dentatum*, and *Viburnum nudum* var. *cassinoides (= Viburnum cassinoides)*. The herbaceous layer is variable in cover; *Symplocarpus foetidus* and *Osmunda cinnamomea* are nearly always present. In some areas, tall ferns (*Osmunda cinnamomea, Onoclea sensibilis, Osmunda regalis, Thelypteris palustris, Thelypteris noveboracensis*) form an herbaceous canopy within which other species are scattered. These other herbaceous species include *Impatiens capensis, Galium aparine, Geum canadense, Arisaema triphyllum, Carex stricta, Carex gracillima, Carex intumescens, Carex radiata, Impatiens capensis, Veratrum viride, Pilea pumila*, and *Glyceria* spp. Microtopography is generally pronounced, resulting from tip-ups. Tree seedlings and *Sphagnum* mosses are common on hummocks but do not in general form extensive carpets. Additional nonvascular species can include *Plagiomnium cuspidatum (= Mnium cuspidatum)* and *Calliergon* spp. Invasive shrubs and herbs, including *Berberis thunbergii, Rosa multiflora, Lonicera morrowii, Alliaria petiolata*, and *Microstegium vimineum*, may be abundant.

Environmental Description: This association is an acidic seepage swamp of southern New England and adjacent areas dominated by Acer rubrum. It generally occurs in seasonally saturated situations on slightly sloping hillsides, along small streams, or in basins that receive overland flooding in addition to groundwater influence. In general, these swamps are acidic and have some seepage indicators but are not particularly species-rich. Soils are shallow to moderately deep mucks over mineral soils.

Vegetation Description: *Acer rubrum* dominates the canopy; *Fraxinus pennsylvanica* or *Fraxinus americana* are usually also found in the canopy. *Fraxinus nigra* is not generally

associated with this type and, if present, occurs only as scattered individuals. Other canopy or subcanopy associates may include *Liriodendron tulipifera, Quercus bicolor, Quercus palustris, Prunus serotina, Fagus grandifolia, Ulmus americana*, and *Ulmus rubra*. Conifers such as *Tsuga canadensis* or *Pinus strobus* are generally absent or occur in very low abundance. The shrub layer may be fairly open to quite dense, depending on the amount of canopy closure. Shrub species commonly include *Ilex verticillata, Rhododendron viscosum, Clethra alnifolia, Lindera benzoin, Cornus amomum, Alnus serrulata*, and less commonly *Vaccinium corymbosum, Lyonia ligustrina, Ilex montana, Toxicodendron vernix, Viburnum dentatum*, and *Viburnum nudum* var. *cassinoides (= Viburnum cassinoides)*. The herbaceous layer is variable in cover; *Symplocarpus foetidus* and *Osmunda cinnamomea* are nearly always present. In some areas, tall ferns (*Osmunda cinnamomea, Onoclea sensibilis, Osmunda regalis, Thelypteris palustris, Thelypteris noveboracensis*) form an herbaceous canopy within which other species are scattered. These other herbaceous species include *Impatiens capensis, Galium aparine, Geum canadense, Arisaema triphyllum, Carex stricta, Carex gracillima, Carex intumescens, Carex radiata, Impatiens capensis, Veratrum viride, Pilea pumila*, and *Glyceria* spp. Microtopography is generally pronounced, resulting from tip-ups. Tree seedlings and *Sphagnum* mosses are common on hummocks but do not in general form extensive carpets. Additional nonvascular species can include *Plagiomnium cuspidatum (= Mnium cuspidatum)* and *Calliergon* spp. Invasive shrubs and herbs, including *Berberis thunbergii, Rosa multiflora, Lonicera morrowii, Alliaria petiolata*, and *Microstegium vimineum*, may be abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Ilex verticillata, Lindera benzoin*
Herb (field)	Forb	*Symplocarpus foetidus*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea*

Characteristic Species: *Acer rubrum, Clethra alnifolia, Fraxinus americana, Fraxinus pennsylvanica, Lindera benzoin, Osmunda cinnamomea, Rhododendron viscosum, Symplocarpus foetidus.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

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

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

Federal Lands: NPS (Delaware Water Gap, Fort Necessity, Minute Man, Morristown, Weir Farm); USFWS (Great Meadows?).

CONSERVATION STATUS

Rank: G4G5 (25-Jun-1998).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 1 – Strong.

Comments: Information not available.

Similar Associations:

- *Acer rubrum - Betula alleghaniensis / Lindera benzoin* Forest (CEGL006936).
- *Acer rubrum - Fraxinus nigra - (Tsuga canadensis) / Tiarella cordifolia* Forest (CEGL006502).
- *Acer rubrum - Fraxinus pennsylvanica - Magnolia virginiana / Clethra alnifolia - Lindera benzoin* Forest (CEGL006964).
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220).
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156).

Related Concepts:

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

SOURCES

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

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

Figure 45. Red Maple Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.42). July 2003.

Figure 46. Red Maple Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.250). June 2004.

COMMON NAME (PARK-SPECIFIC): RED MAPLE - HIGHBUSH BLUEBERRY PALUSTRINE FOREST

SYNONYMS

NVC English Name: **Red Maple / Catberry - Highbush Blueberry Forest**

NVC Scientific Name: ***Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest**

NVC Identifier: **CEGL006220**

LOCAL INFORMATION

Environmental Description: This palustrine forest occurs in small upland depressions, impounded or braided drainages, or as part of a larger wetland complex. This wetland type usually occurs on very poorly drained mineral soil, often with a layer of muck, as in Alden mucky silt loam. This association is often semipermanently or permanently flooded and can be associated with past impoundments (beaver-influenced or otherwise).

Vegetation Description: This association is characterized by open woodland or closed canopy of red maple (*Acer rubrum*), over a thick tall-shrub layer of highbush blueberry (*Vaccinium corymbosum*). The canopy typically covers >60 of the wetland, though more open (cover 25-60%) examples are included here as well, and extends 10-15 m in height. A sparse subcanopy covers 10-40% of the wetland and reaches 5-10 m in height. Red maple is the dominant tree in the canopy and subcanopy. Other associated canopy and subcanopy trees include blackgum (*Nyssa sylvatica*), pin oak (*Quercus palustris*), eastern cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and black ash (*Fraxinus nigra*). Highbush blueberry dominates the tall-shrub layer that covers 15-50% of the area. Other common tall shrubs include common great laurel (*Rhododendron maximum*), common ninebark (*Physocarpus opulifolius*), common winterberry (*Ilex verticillata*), red maple, southern arrowwood (*Viburnum dentatum* var. *lucidum*), swamp azalea (*Rhododendron viscosum*), silky dogwood (*Cornus amomum*), alders (*Alnus incana, Alnus serrulata*), maleberry (*Lyonia ligustrina*), and northern spicebush (*Lindera benzoin*). The sparse short-shrub layer (20-30% cover) contains highbush blueberry, swamp rose (*Rosa palustris*), white meadowsweet (*Spiraea alba* var. *latifolia*), and the species from the tall-shrub layer. The herbaceous layer can be sparse or dense and is dominated by tussock sedge (*Carex stricta*) and a mixture of ferns, including cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), eastern marsh fern (*Thelypteris palustris*), and crested woodfern (*Dryopteris cristata*). Other common herbaceous species include skunk-cabbage (*Symplocarpus foetidus*), Jack in the pulpit (*Arisaema triphyllum*), touch-me-not (*Impatiens* spp.), common marsh bedstraw (*Galium palustre*), water-starwort (*Callitriche* spp.), American golden saxifrage (*Chrysosplenium americanum*), and marsh seedbox (*Ludwigia palustris*). Sphagnum (*Sphagnum* spp.) is common and covers approximately 10-30% of the wetland. Vines such as Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*), and roundleaf greenbrier (*Smilax rotundifolia*) are present but sparse.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium corymbosum*
Herb (field)	Graminoid	*Carex stricta*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea*

Characteristic Species: *Acer rubrum, Vaccinium corymbosum, Dryopteris cristata, Onoclea sensibilis, Osmunda cinnamomea, Osmunda regalis, Thelypteris palustris*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Northern Red Maple Swamp	Walz et al. 2006
PA	S4	1	Red maple - highbush blueberry palustrine woodland	Fike 1999

Local Range: This wetland occurs occasionally throughout the park in a variety of palustrine settings.

Classification Comments: Red Maple - Highbush Blueberry Palustrine Forest is distinguished from other palustrine forest and shrubland types by a closed canopy with *Acer rubrum* covering >50% of the area and a thick tall-shrub layer dominated by *Vaccinium corymbosum*. Woodland examples with 25 to 60% canopy cover are included here as well. This association does not include species restricted to the higher elevations of Kittatinny Ridge, such as *Picea mariana, Chamaedaphne calyculata, Carex folliculata*, and *Drosera rotundifolia*, that are characteristic of Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland.

Other Comments: None.

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

Plots and Data Sources: DEWA.7, DEWA.140, DEWA.166, DEWA,184, DEWA.186; 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	Seasonally flooded cold-deciduous forest (I.B.2.N.e.)
Alliance	Acer rubrum - Fraxinus pennsylvanica Seasonally Flooded Forest Alliance (A.316)
Alliance (English name)	Red Maple - Green Ash Seasonally Flooded Forest Alliance
Association	*Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest
Association (English name)	Red Maple / Catberry - Highbush Blueberry Forest
Ecological System(s):	Laurentian-Acadian Conifer-Hardwood Acid Swamp (CES201.574)

GLOBAL DESCRIPTION

Concept Summary: This forested red maple swamp of stream drainages and wetland borders occurs in northern to central New England and New York, extending sporadically south to New Jersey. The hydrologic regime is variable among occurrences, generally influenced by seasonal flooding and often limited groundwater seepage. This association may occur in basins with little drainage, or on stream floodplains that remain saturated throughout most of the growing season. Soils vary according to setting; generally the substrate is mineral soil, acidic to weakly minerotrophic, but in some settings organic soil may be well-developed. The deciduous canopy ranges from closed to patchy, but the overall cover is that of a closed-canopy forest. The shrub layer, particularly in openings, is generally well-developed. The herb layer is usually fairly well-developed and may be extensive. The canopy is characteristically dominated by *Acer rubrum* with associates of *Fraxinus nigra, Fraxinus pennsylvanica, Betula alleghaniensis*, and *Ulmus americana*. *Tsuga canadensis, Picea rubens*, and *Abies balsamea*, while not abundant, characterize this association as one of cooler climates. (The *Picea* and *Abies* drop out in the southernmost occurrences of this type.) Typical shrubs include *Vaccinium corymbosum* (often dominant), *Ilex verticillata, Nemopanthus mucronatus, Lindera benzoin, Rosa palustris, Alnus incana, Viburnum nudum* var. *cassinoides*, and *Viburnum dentatum* var. *lucidum*. There is north-to-south variability in the shrub component as well, with *Nemopanthus* characteristic of all but the southernmost occurrences, and *Lindera* absent from more northerly occurrences. The herbaceous layer is often dominated by ferns, including *Osmunda cinnamomea, Osmunda regalis*, and *Osmunda claytoniana*. *Onoclea sensibilis, Dryopteris cristata*, and *Thelypteris palustris* are often present, though less abundant. *Carex stricta* may be locally dominant. Other species frequent in the herbaceous layer include *Impatiens capensis, Caltha palustris, Calamagrostis canadensis, Carex intumescens, Carex trisperma*, and *Arisaema triphyllum*. The bryophyte flora is not well documented; *Sphagnum* spp. and *Mnium* spp. are frequent, although not necessarily abundant. *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406) is distinguished by its greater abundance and extent of seepage indicators and its lacks lack of northern species such as *Picea rubens, Abies balsamea*, and *Nemopanthus mucronatus*. *Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland (CEGL006119) is also similar but has a more open canopy and typically a graminoid-dominated herbaceous layer. This association is also related to *Acer rubrum - Prunus serotina / Cornus amomum* Forest (CEGL006503), which occurs along floodplains of major streams and minor rivers. While both can be dominated by red maple in the canopy, the understory vegetation differs somewhat, with species more typical of floodplains (*Carpinus caroliniana, Cornus amomum, Prunus serotina*) in that type, and species typical of more constantly saturated conditions in this type.

Environmental Description: This forested red maple swamp occupies stream drainages and wetland borders. The hydrologic regime is variable among occurrences, generally influenced both by groundwater seepage and seasonal flooding. This association may occur in basins with little drainage, or on stream floodplains that remain saturated throughout most of the growing season. Soils vary according to setting; generally the substrate is mineral soil, acidic to (less commonly) circumneutral, but in some settings organic soil may be well-developed.

Vegetation Description: The deciduous canopy ranges from closed to patchy, but the overall cover is that of a closed-canopy forest. The shrub layer, particularly in openings, is generally well-developed. The herb layer is usually fairly well-developed and may be extensive. The canopy is characteristically dominated by *Acer rubrum* with associates of *Fraxinus nigra,*

Fraxinus pennsylvanica, *Betula alleghaniensis*, and *Ulmus americana*. *Tsuga canadensis*, *Picea rubens*, and *Abies balsamea*, while not abundant, characterize this association as one of cooler climates. (The *Picea* and *Abies* drop out in the southernmost occurrences of this type.) Typical shrubs include *Vaccinium corymbosum* (often dominant), *Ilex verticillata*, *Nemopanthus mucronatus*, *Lindera benzoin*, *Rosa palustris*, *Alnus incana*, *Viburnum nudum* var. *cassinoides*, and *Viburnum dentatum* var. *lucidum*. There is north-to-south variability in the shrub component as well, with *Nemopanthus* characteristic of all but the southernmost occurrences, and *Lindera* absent from more northerly occurrences. The herbaceous layer is often dominated by ferns, including *Osmunda cinnamomea*, *Osmunda regalis*, and *Osmunda claytoniana*. *Onoclea sensibilis*, *Dryopteris cristata*, and *Thelypteris palustris* are often present, though less abundant. *Carex stricta* may be locally dominant. Other species frequent in the herbaceous layer include *Impatiens capensis*, *Caltha palustris*, *Calamagrostis canadensis*, *Carex intumescens*, *Carex trisperma*, and *Arisaema triphyllum*. The bryophyte flora is not well-documented; *Sphagnum* spp. and *Mnium* spp. are frequent, although not necessarily abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum*
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Ilex verticillata*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium corymbosum*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea*, *Osmunda claytoniana*, *Osmunda regalis*

Characteristic Species: *Acer rubrum*, *Arisaema triphyllum*, *Carex stricta*, *Dryopteris cristata*, *Ilex verticillata*, *Impatiens capensis*, *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda claytoniana*, *Osmunda regalis*, *Thelypteris palustris*, *Vaccinium corymbosum*.

Other Noteworthy Species: *Aegolius acadicus*, *Archilochus colubris*, *Buteo lineatus*, *Buteo platypterus*, *Catharus fuscescens*, *Dryocopus pileatus*, *Megascops asio*, *Melanerpes carolinus*, *Nycticorax nycticorax*, *Picoides pubescens*, *Strix varia*.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This forest of stream drainages and wetland borders occurs from northern New England south sporadically to northern New Jersey.

States/Provinces: ME, NB, NH, NJ, NY, PA, VT.

Federal Lands: NPS (Acadia, Delaware Water Gap); USFWS (Aroostook?, Assabet River?, Carlton Pond?, Great Meadows?, Moosehorn?, Nulhegan Basin, Pondicherry).

CONSERVATION STATUS

Rank: G4G5 (20-Jun-2006).

Reasons: Type is well-distributed in the glaciated Northeast.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: A continuum of northern Appalachian acidic swamps, with very similar floristics, is expressed through three associations: the coniferous *Picea rubens - Abies balsamea / Gaultheria hispidula / Osmunda cinnamomea / Sphagnum* spp. Forest (CEGL006312), the mixed

Picea rubens - Acer rubrum / Nemopanthus mucronatus Forest (CEGL006198), and the present type (deciduous), with all gradations of coniferous to deciduous evident.

Similar Associations:

- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406).
- *Acer rubrum - Fraxinus nigra - (Tsuga canadensis) / Tiarella cordifolia* Forest (CEGL006502).
- *Acer rubrum - Prunus serotina / Cornus amomum* Forest (CEGL006503).
- *Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland (CEGL006119).
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156).

Related Concepts:

- NNE Acidic Seepage Swamp (Rawinski 1984) ?
- Northern red maple swamp (NAP pers. comm. 1998) ?
- Palustrine Broad-leaved Deciduous Forested Wetlands (PFO1) (Cowardin et al. 1979) ?
- Red Maple-Black Ash Swamp (Thompson 1996) ?
- Red Maple: 108 (Eyre 1980) B
- Seasonally flooded basin swamps (Zone I) (Golet et al. 1993) ?
- Southern New England acidic seepage swamp, black ash swamp (Rawinski 1984) ?

SOURCES

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

References: Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Gawler 2002, Golet et al. 1993, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 47. Red Maple - Highbush Blueberry Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.7). May 2003.

Figure 48. Red Maple - Highbush Blueberry Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.186). May 2004.

COMMON NAME (PARK-SPECIFIC): RED MAPLE - BLACK SPRUCE - HIGHBUSH BLUEBERRY PALUSTRINE WOODLAND

SYNONYMS

NVC English Name: **Red Maple - Blackgum - Yellow Birch / Peatmoss species Forest**

NVC Scientific Name: ***Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest**

NVC Identifier: **CEGL006014**

LOCAL INFORMATION

Environmental Description: This palustrine woodland occurs as isolated pockets in small upland depressions, as part of a larger wetland complex, or in basins surrounding small headwater drainages. These wetlands are restricted to high-elevation depressions on the Kittatinny Ridge. This wetland type usually occurs on very poorly drained mineral soil, often with a layer of muck and occasionally peat. Alden mucky silt loam is a typical soil. This association is often semipermanently or permanently flooded.

Vegetation Description: This association is characterized by an open canopy of red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*), over a thick tall-shrub layer of highbush blueberry (*Vaccinium corymbosum*) or great laurel (*Rhododendron maximum*). The open canopy covers 25-60% of the wetland and extends 5-20 m in height. Red maple and blackgum are typically the dominant trees, with yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*), pitch pine (*Pinus rigida*), and black spruce (*Picea mariana*) as associates. The tall-shrub layer is characteristically dense (30-90% cover) and is dominated by highbush blueberry or great laurel. Other common tall shrubs include maleberry (*Lyonia ligustrina*), swamp azalea (*Rhododendron viscosum*), catberry (*Nemopanthus mucronatus*), common winterberry (*Ilex verticillata*), viburnums (*Viburnum* spp.), alders (*Alnus* spp.), and all of the species found in the canopy. A moderately dense short-shrub layer contains sheep laurel (*Kalmia angustifolia*), leatherleaf (*Chamaedaphne calyculata*), black huckleberry (*Gaylussacia baccata*), eastern teaberry (*Gaultheria procumbens*), white meadowsweet (*Spiraea alba* var. *latifolia*), and species typical of the tall-shrub and canopy layers. The herbaceous layer occurs primarily on hummocks surrounding the base of woody plants and in standing water. Common species include prickly bog sedge (*Carex atlantica* ssp. *capillacea*), northern long sedge (*Carex folliculata*), skunk-cabbage (*Symplocarpus foetidus*), threeway sedge (*Dulichium arundinaceum*), eastern marsh fern (*Thelypteris palustris*), woolgrass (*Scirpus cyperinus*), Canada rush (*Juncus canadensis*), spikerushes (*Eleocharis* spp.), cinnamon fern (*Osmunda cinnamomea*), roundleaf sundew (*Drosera rotundifolia*), water arum (*Calla palustris*), threeleaf goldthread (*Coptis trifolia*), and Canada mayflower (*Maianthemum canadense*). A layer of sphagnum (*Sphagnum* spp.) is common and varies in percent cover from 25-50%.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Nyssa sylvatica*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Rhododendron maximum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Kalmia angustifolia, Rhododendron viscosum, Spiraea alba* var. *latifolia*

Herb (field)	Forb	*Symplocarpus foetidus*
Herb (field)	Graminoid	*Carex atlantica* ssp. *capillacea, Carex folliculata, Dulichium arundinaceum*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea, Thelypteris palustris*

Characteristic Species: *Acer rubrum, Nyssa sylvatica, Picea mariana, Rhododendron maximum, Vaccinium corymbosum, Chamaedaphne calyculata, Carex folliculata, Drosera rotundifolia.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1?	1	Red Maple - Black Gum Basin Swamp	Walz et al. 2006
PA	S3	1	Red spruce - mixed hardwood palustrine forest	Fike 1999

Local Range: These wetlands are found occasionally in small upland depressions and basins surrounding small headwater drainages at high elevations of the Kittatinny Ridge.

Classification Comments: Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland is distinguished from other palustrine woodlands and shrublands by the open canopy (25-60% cover) of *Acer rubrum* and *Nyssa sylvatica* and the tall-shrub layer (30-90% cover) of *Vaccinium corymbosum* or *Rhododendron maximum*. *Picea mariana* and *Chamaedaphne calyculata* are diagnostic of this wetland that occurs at higher elevations within the park.

Other Comments: None.

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

Plots and Data Sources: DEWA.73, DEWA.204; 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	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 - Betula alleghaniensis / Sphagnum* spp. Forest
Association (English name)	Red Maple - Blackgum - Yellow Birch / Peatmoss species Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) North-Central Appalachian Acidic Swamp (CES202.604) Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This blackgum basin swamp of the northeastern United States is found from the Central Appalachians north to central New England, at the northern range limit for *Nyssa sylvatica*. It occupies saturated or seasonally wet basins, typically perched basins in small watersheds within upland forests. In most settings, the mineral soil is overlain with a shallow to deep peat layer. Conditions are highly acidic and nutrient-poor. The tree canopy varies from an open woodland to nearly complete. Shrubs are well-represented and may be locally dense. Herbs are likewise patchy, and the herb layer is usually dominated by only a few species. The bryoid layer varies but is often extensive. Hummock-and-hollow microtopography is often pronounced, with bryophytes common on the hummocks and in those hollows where water does not stand for long periods. The canopy is dominated by *Acer rubrum* and *Nyssa sylvatica*; however, even where red maple is more abundant, the longevity and stature of the blackgum trees give them a strong impact. *Betula alleghaniensis, Tsuga canadensis, Pinus strobus*, and occasionally *Picea rubens* or *Picea mariana* may be minor canopy associates. The most abundant shrubs are *Ilex verticillata* and *Vaccinium corymbosum*; associated shrub species include *Viburnum nudum* var. *cassinoides, Nemopanthus mucronatus, Kalmia angustifolia, Gaylussacia baccata, Chamaedaphne calyculata, Lyonia ligustrina, Spiraea alba* var. *latifolia (= Spiraea latifolia*, and *Cephalanthus occidentalis*. *Osmunda cinnamomea* is the characteristic dominant in the herb layer, with associates including *Osmunda regalis, Thelypteris palustris, Woodwardia virginica, Glyceria canadensis, Coptis trifolia, Carex atlantica, Carex trisperma, Carex folliculata, Carex intumescens, Calla palustris, Triadenum virginicum*, and *Symplocarpus foetidus*. Mosses are primarily *Sphagnum* spp., including *Sphagnum palustre* and *Sphagnum magellanicum*. These swamps are distinguished from other basin swamps in the Northern Appalachians by the presence of *Nyssa sylvatica*. They are distinguished from blackgum swamps further south by the absence of more Central Appalachian species such as *Liquidambar styraciflua, Rhododendron maximum, Rhododendron viscosum*, and *Magnolia virginiana*.

Environmental Description: This blackgum basin swamp of the northeastern United States is found from the Central Appalachians north to central New England, at the northern range limit for Nyssa sylvatica. It occupies saturated or seasonally wet basins, typically perched basins in small watersheds within upland forests. In most settings, the mineral soil is overlain with a shallow to deep peat layer. Conditions are highly acidic and nutrient-poor.

Vegetation Description: The tree canopy varies from an open woodland to nearly complete. Shrubs are well-represented and may be locally dense. Herbs are likewise patchy, and the herb layer is usually dominated by only a few species. The bryoid layer varies but is often extensive. Hummock-and-hollow microtopography is often pronounced, with bryophytes common on the hummocks and in those hollows where water does not stand for long periods. The canopy is dominated by *Acer rubrum* and *Nyssa sylvatica*; however, even where red maple is more abundant, the longevity and stature of the blackgum trees give them a strong impact. *Betula alleghaniensis, Tsuga canadensis, Pinus strobus*, and in the north *Picea rubens* may be minor canopy associates. The most abundant shrubs are *Ilex verticillata* and *Vaccinium corymbosum*; associated shrub species include *Viburnum nudum* var. *cassinoides, Nemopanthus mucronatus, Kalmia angustifolia, Gaylussacia baccata, Chamaedaphne calyculata, Lyonia ligustrina, Spiraea alba* var. *latifolia (= Spiraea latifolia)*, and *Cephalanthus occidentalis*. *Osmunda cinnamomea* is the characteristic dominant in the herb layer, with associates including *Osmunda regalis, Thelypteris palustris, Woodwardia virginica, Glyceria canadensis, Coptis trifolia, Carex atlantica, Carex trisperma, Carex folliculata, Carex intumescens, Calla palustris, Triadenum*

virginicum, and *Symplocarpus foetidus*. Mosses are primarily *Sphagnum* spp., including *Sphagnum palustre* and *Sphagnum magellanicum*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Nyssa sylvatica*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata, Vaccinium corymbosum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Kalmia angustifolia, Spiraea alba* var. *latifolia*
Herb (field)	Forb	*Symplocarpus foetidus*
Herb (field)	Graminoid	*Carex folliculata*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea, Thelypteris palustris*

Characteristic Species: *Acer rubrum, Betula alleghaniensis, Carex folliculata, Chamaedaphne calyculata, Ilex verticillata, Nyssa sylvatica, Osmunda cinnamomea, Vaccinium corymbosum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: Information not available.
States/Provinces: CT, MA:S2, MD?, ME, NH:S1S2, NJ, NY, PA, VT.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

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

CLASSIFICATION INFORMATION

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

- *Acer rubrum - Betula alleghaniensis / Lindera benzoin* Forest (CEGL006936).
- *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).
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156).
- *Acer saccharum - Betula alleghaniensis - Fraxinus pennsylvanica / Lindera benzoin* Forest (CEGL006956).
- *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226).

Related Concepts:

- Black gum-red maple swamp (NAP pers. comm. 1998) ?
- Palustrine Broad-leaved Deciduous Saturated Forested Wetland (PFO1B) (Cowardin et al. 1979) ?
- Red Maple-Black Gum Swamp (Thompson 1996) ?
- Southern New England acidic seepage swamp, black gum swamp (Rawinski 1984) ?

- Southern New England basin swamp, black gum association (Rawinski 1984) ?

SOURCES

Description Authors: S. C. Gawler.

References: Breden et al. 2001, Cain and Penfound 1938, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Golet et al. 1993, Harrison 2004, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Sperduto 2000b, Sperduto et al. 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, Vogelmann 1976, Windisch 1995, Zebryk 1990.

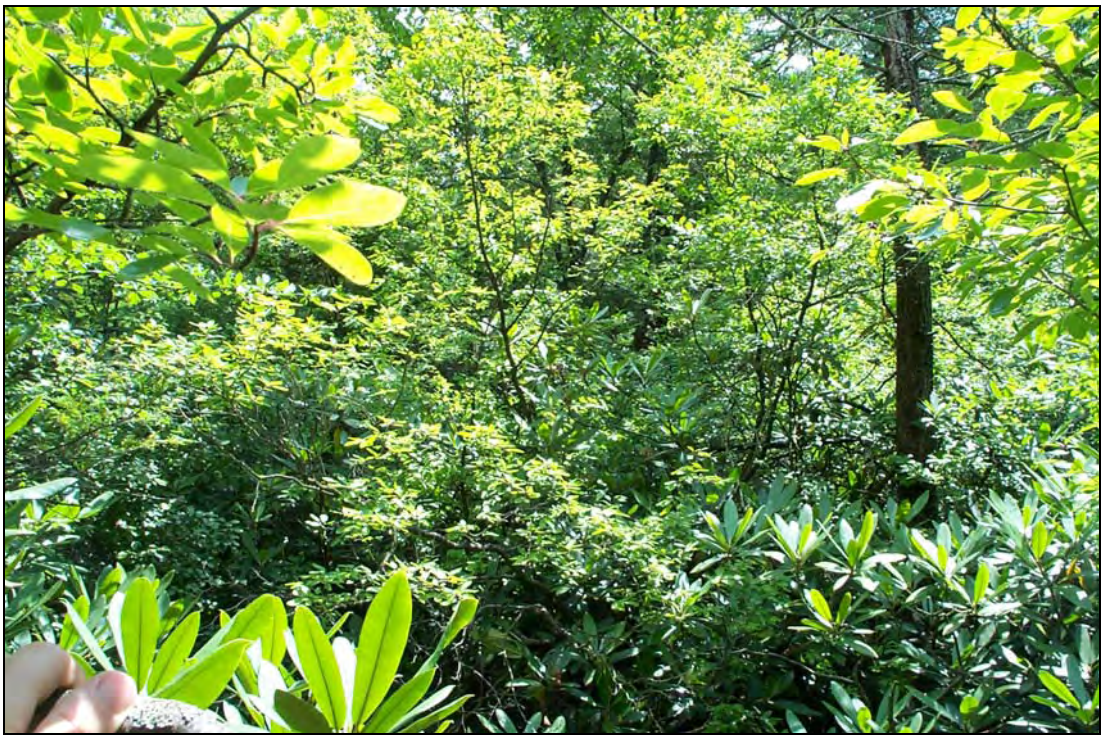

Figure 49. Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland in Delaware Water Gap National Recreation Area (plot DEWA.73). August 2003.

Figure 50. Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland in Delaware Water Gap National Recreation Area (plot DEWA.204). June 2004.

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

SYNONYMS

NVC English Name: **Eastern White Pine - (Northern Red Oak, Black Oak) - American Beech Forest**

NVC Scientific Name: ***Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest**

NVC Identifier: **CEGL006293**

LOCAL INFORMATION

Environmental Description: This forest type is common on high elevations of the Glaciated Low Plateau in Pennsylvania and portions of the Kittatinny Ridge in New Jersey. These stands are located on extremely stony xeric soils of the Arnot series, whereas low-elevation examples are located on Wyoming very cobbly sandy loam. The sites are flat to gently sloping. This association occurs over shale and siltstone bedrock and alluvial deposits within the park.

Vegetation Description: This forest association is characterized by a canopy dominated by pines (*Pinus* spp.) and oaks (*Quercus* spp.), often with a dense tall-shrub layer of regenerating eastern white pine (*Pinus strobus*). The open canopy (50-70% cover) is dominated by eastern white pine, pitch pine (*Pinus rigida*), chestnut oak (*Quercus prinus*), and northern red oak (*Quercus rubra*), with black oak (*Quercus velutina*), white oak (*Quercus alba*), scarlet oak (*Quercus coccinea*), eastern hemlock (*Tsuga canadensis*), and eastern red-cedar (*Juniperus virginiana*) as associates. Canopy trees are 20-40 m in height, and subcanopy trees are 5-20 m in height. The subcanopy (15-40% cover) consists of eastern white pine, red maple (*Acer rubrum*), eastern red-cedar, and the oaks found in the canopy. The tall-shrub layer can be sparse to dense (5-80% cover) depending on the amount of sapling eastern white pine regeneration present. Saplings of other canopy trees may also be scattered in the tall-shrub layer, along with bear oak (*Quercus ilicifolia*) and occasionally mountain laurel (*Kalmia latifolia*). The short-shrub layer (20-60% cover) typically contains scattered patches of low heath; common ericaceous species include black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), and eastern teaberry (*Gaultheria procumbens*). The herbaceous layer is typically very sparse (<5% cover) and includes Pennsylvania sedge (*Carex pensylvanica*), wavy hairgrass (*Deschampsia flexuosa*), striped prince's pine (*Chimaphila maculata*), partridgeberry (*Mitchella repens*), and starflower (*Trientalis borealis*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus, Pinus rigida*
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Quercus alba, Quercus coccinea, Quercus rubra, Quercus velutina*
Tree subcanopy	Needle-leaved tree	*Pinus strobus*
Tall shrub/sapling	Needle-leaved shrub	*Pinus strobus*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium* spp.

Characteristic Species: *Pinus strobus, Pinus rigida, Quercus alba, Quercus coccinea, Quercus rubra, Quercus velutina.*

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

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	White Pine - Oak Forest	Walz et al. 2006
PA	S4	1	Dry white pine (hemlock) - oak forest	Fike 1999

Local Range: This very common association is the matrix forest at higher elevations on the Glaciated Low Plateau in Pennsylvania and also occurs on dry sites on the Kittatinny Ridge.
Classification Comments: Dry Eastern White Pine - Oak Forest is distinguished from other forest types by the dominance of *Pinus strobus* (>25% cover), with the codominants *Pinus rigida, Quercus prinus*, and other oaks. The adventitious hardwoods such as white ash (*Fraxinus americana*), black cherry (*Prunus serotina*) and others that are characteristic of Conifer Plantation or Eastern White Pine - Successional Hardwood Forest are rare or absent from Dry Eastern White Pine - Oak Forest. Heath may or may not be present in this type.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.131, DEWA.143, DEWA.155; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	Pinus strobus - Quercus (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, velutina) - Fagus grandifolia* Forest
Association (English name)	Eastern White Pine - (Northern Red Oak, Black Oak) - American Beech Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) Northeastern Interior Dry-Mesic Oak Forest (CES202.592) Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This mixed white pine - oak forest of the northeastern U.S. occurs on dry-mesic to mesic, acidic, nutrient-poor, sandy loam to sandy soils. In the northern glaciated portion of the range, the forest occurs on outwash plains or moraines, as well as along mid- and lower slopes and within protected ravines, and on protected ridges or upper slopes of shale, sandstone or other sedimentary rock, occasionally underlain by metamorphic or igneous rock. Along the

unglaciated plateau, this community occurs on rolling topography underlain by sandstone. It occurs at elevations below 915 m (3000 feet) throughout the range. The tree canopy is dominated by a mixture of *Pinus strobus* and oaks, including *Quercus velutina, Quercus rubra, Quercus alba, Quercus prinus* (usually in minor amounts), and primarily in the southern portions of the range, *Quercus coccinea*. Oak species drop out at the northern extreme of the type's range, leaving only *Quercus rubra*. *Fagus grandifolia* is characteristic over much of the range of this type but is absent in some areas. Other less frequent canopy associates may include *Acer rubrum, Carya alba, Pinus rigida, Populus tremuloides, Fraxinus americana, Ulmus americana, Tsuga canadensis*, and at the northern range limit may include *Betula papyrifera* and *Populus grandidentata*. The variable subcanopy may include *Hamamelis virginiana* or *Prunus serotina*; other species such as *Carpinus caroliniana, Cornus florida*, and *Nyssa sylvatica* may be present in the central and southern portions of the range. It has a sparse to well-developed, generally ericaceous shrub layer. The herb layer ranges from sparse to moderately dense cover. In disturbed settings, *Rhamnus cathartica* may be an abundant shrub. The bryophyte layer is not well-documented. This association is differentiated from mixed oak-pine forests to the south by *Fagus grandifolia* and the absence of southern-ranging species *Liriodendron tulipifera, Galax urceolata, Trillium catesbaei, Halesia tetraptera*, and others. The absence of *Ilex glabra* and the unimportance of *Quercus alba* differentiate this type from a closely related association of northeastern coastal areas, *Pinus strobus - Quercus alba / Ilex glabra* Forest (CEGL006382). Earlier successional versions in New England have less pine (usually) and more *Betula* spp. and *Acer rubrum* and are separated as *Quercus rubra - Acer rubrum - Betula* spp. - *Pinus strobus* Forest (CEGL006506).

Environmental Description: This mixed white pine - oak forest occurs on dry-mesic to mesic, acidic, nutrient-poor, sandy loam to sandy soils along mid- and lower slopes, and along the unglaciated plateau on rolling topography underlain by sandstone. In the northern glaciated portion of the range, the forest occurs on outwash plains or moraines, as well as along mid- and lower slopes and within protected ravines, and on protected ridges of shale, sandstone, or other sedimentary rock, occasionally underlain by metamorphic or igneous rock. Along the unglaciated plateau, this community occurs on rolling topography underlain by sandstone. It occurs at elevations below 915 m (3000 feet) throughout the range.

Vegetation Description: The tree canopy is dominated by a mixture of *Pinus strobus* and oaks, including *Quercus velutina, Quercus rubra, Quercus alba, Quercus prinus* (usually in minor amounts), and primarily in the southern portions of the range, *Quercus coccinea*. Oak species drop out at the northern extreme of the type's range, leaving only *Quercus rubra*. *Fagus grandifolia* is characteristic but not always present. Other less frequent canopy associates may include *Acer rubrum, Carya alba, Populus tremuloides, Fraxinus americana, Ulmus americana, Tsuga canadensis*, and at the northern range limit may include *Betula papyrifera* and *Populus grandidentata*. The variable subcanopy may include *Hamamelis virginiana* or *Prunus serotina*; other species such as *Carpinus caroliniana, Cornus florida*, and *Nyssa sylvatica* may be present in the central and southern portions of the range. The sparse to well-developed, generally ericaceous shrub layer includes *Gaylussacia* spp. (usually *Gaylussacia baccata), Kalmia latifolia, Vaccinium* spp. (typically *Vaccinium pallidum* and/or *Vaccinium angustifolium),* and sometimes *Kalmia angustifolia*, as well as *Rubus* spp., *Corylus americana, Gaultheria procumbens, Sassafras albidum*, and *Viburnum prunifolium*. The herb layer ranges from sparse to moderately dense cover, with species including *Aralia nudicaulis, Ageratina altissima, Amphicarpaea bracteata, Brachyelytrum erectum, Carex communis, Carex woodii, Carex*

pensylvanica, Carex lucorum, Carex debilis, Melampyrum lineare, Pteridium aquilinum, Trientalis borealis, Gaultheria procumbens, Chimaphila maculata, Desmodium nudiflorum, Galium latifolium, Goodyera pubescens, Hieracium venosum, Houstonia purpurea, Maianthemum racemosum, Maianthemum canadense, Medeola virginiana, Mitchella repens, Monotropa uniflora, Poa cuspidata, Polygonatum biflorum, Polystichum acrostichoides, and/or *Viola hastata*. In disturbed settings, *Rhamnus cathartica* may be an abundant shrub. The bryophyte layer is not well-documented but supports *Leucobryum glaucum* and *Polytrichum commune* in occurrences in the northern portion of the range (Acadia National Park).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus*
Tree canopy	Broad-leaved deciduous tree	*Quercus alba, Quercus prinus, Quercus rubra, Quercus velutina*
Tree subcanopy	Broad-leaved deciduous tree	*Prunus serotina*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Short shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia*
Herb (field)	Forb	*Aralia nudicaulis, Maianthemum canadense, Trientalis borealis*
Herb (field)	Graminoid	*Carex pensylvanica*

Characteristic Species: *Fagus grandifolia, Pinus strobus, Quercus rubra.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: Occurs in New England south and west to Pennsylvania and West Virginia and possibly New Jersey.
States/Provinces: MA, ME, NH, NJ?, NY, PA, RI, VT:S3, WV.
Federal Lands: NPS (Acadia, Delaware Water Gap, Minute Man); USFWS (Assabet River, Great Meadows, Oxbow).

CONSERVATION STATUS

Rank: G5 (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 – Moderate.
Comments: In the northern part of this type's range, it can be similar to *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088), which is distinguished by having *Tsuga canadensis* as the principal canopy conifer. However, examples of both types may have *Pinus strobus* and *Tsuga canadensis* present. In the southern part of this type's range, drier expressions overlap conceptually with *Pinus strobus - Quercus alba - Quercus coccinea / Vaccinium stamineum* Forest (CEGL008539) to the south, and the overlap between those two needs clarification.

Similar Associations:

- *Pinus strobus - (Pinus resinosa) - Quercus rubra* Forest (CEGL002480).
- *Pinus strobus - Quercus alba - Quercus coccinea / Vaccinium stamineum* Forest (CEGL008539).
- *Pinus strobus - Quercus alba / Ilex glabra* Forest (CEGL006382).
- *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336)--has less pine, more hickory, and little or no beech, but can intergrade to this type.
- *Quercus rubra - Acer rubrum - Betula* spp. - *Pinus strobus* Forest (CEGL006506).
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088).

Related Concepts:

- Eastern White Pine: 21 (Eyre 1980) B
- Mesic Pine-Oak Forest (Thompson 1996) ?
- Pine-Oak-Heath Sandplain Forest (Thompson 1996) ?
- SNE dry central hardwood forest on acidic bedrock or till (Rawinski 1984) B
- SNE dry oak/pine forests on acidic bedrock or till (Rawinski 1984) B
- SNE mesic oak/pine forest on sandy/gravelly soil (Rawinski 1984) B
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) B
- White pine-oak-beech dry forest (large patch to matrix) (CAP pers. comm. 1998) ?

SOURCES

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

References: Breden et al. 2001, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1993, Eyre 1980, Fike 1999, Gawler 2002, Kuchler 1956, Lundgren 2001, Moore and Taylor 1927, Rawinski 1984, Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Jenkins 1992, Thompson and Sorenson 2000.

Figure 51. Dry Eastern White Pine - Oak Forest in Delaware Water Gap National Recreation Area (plot DEWA.143). June 2003.

Figure 52. Dry Eastern White Pine - Oak Forest in Delaware Water Gap National Recreation Area (plot DEWA.155). July 2003.

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

SYNONYMS

NVC English Name:	**(Northern Red Oak, Black Oak, White Oak) - Sweet Birch - (Eastern White Pine) Forest**
NVC Scientific Name:	***Quercus (rubra, velutina, alba) - Betula lenta - (Pinus strobus)* Forest**
NVC Identifier:	**CEGL006454**

LOCAL INFORMATION

Environmental Description: This association occurs on dry-mesic sites that are flat to gently rolling throughout lower elevations in the park. The bedrock varies from shale to calcareous shale and limestone. Soils are variable, from stony silt loams such as the Lordstown-Wallpack complex to the fine sandy loams of the Delaware series. Varying land-use histories are likely responsible for the species composition and structure of these stands.

Vegetation Description: Characteristic structure for this association contains large, established eastern white pine (*Pinus strobus*), over a layer of younger, smaller diameter hardwoods, such as red maple (*Acer rubrum*), sweet birch (*Betula lenta*), sugar maple (*Acer saccharum*), and mesic oaks (more commonly *Quercus rubra*, less commonly *Quercus palustris, Quercus velutina,* and *Quercus alba*). Pitch pines (*Pinus rigida*) may occur with, or rarely occur in place of, the eastern white pine. Eastern red-cedar (*Juniperus virginiana*) and eastern hemlock (*Tsuga canadensis*) may be common in the canopy or subcanopy. Other common associates include black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), bigtooth aspen (*Populus grandidentata*), sugar maple, bitternut hickory (*Carya cordiformis*), yellow birch (*Betula alleghaniensis*), and occasional dry oak species (*Quercus alba, Quercus velutina*). The canopy is typically 20 to 30 m in height with canopy cover usually greater than 70%. The subcanopy is usually 10 to 15 m in height and variable in total cover from sparse (10%) to moderately dense (40%). The subcanopy usually contains similar species as the canopy, as well as American hornbeam (*Carpinus caroliniana*) and eastern hop-hornbeam (*Ostrya virginiana*). The tall-shrub layer is typically sparse to moderately dense, consisting of northern spicebush (*Lindera benzoin*), common winterberry (*Ilex verticillata*), blackhaw (*Viburnum prunifolium*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), and saplings of canopy tree species. Characteristic short shrubs are Japanese barberry (*Berberis thunbergii*), mapleleaf viburnum (*Viburnum acerifolium*), black raspberry (*Rubus occidentalis*), northern dewberry (*Rubus flagellaris*), Allegheny blackberry (*Rubus allegheniensis*), and seedlings of canopy and subcanopy species. Ericaceous shrubs, such as mountain laurel (*Kalmia latifolia*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), and deerberry (*Vaccinium stamineum*), may be scattered in this type, however, they general do not cover greater than 25% of the forest floor. The herbaceous layer is usually sparse to moderately dense; characteristic herbs include Canada mayflower (*Maianthemum canadense*), eastern hayscented fern (*Dennstaedtia punctilobula*), fan clubmoss (*Lycopodium digitatum*), striped prince's pine (*Chimaphila maculata*), licorice bedstraw (*Galium circaezans*), false baby's breath (*Galium mollugo*), partridgeberry (*Mitchella repens*), Christmas fern (*Polystichum acrostichoides*), intermediate woodfern (*Dryopteris intermedia*), white snakeroot (*Ageratina altissima* var. *altissima*), garlic mustard (*Alliaria petiolata*), mayapple

(*Podophyllum peltatum*), and common yellow oxalis (*Oxalis stricta*). Vines are usually sparse, with Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison ivy (*Toxicodendron radicans*) typically present at low cover.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus strobus*
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Betula lenta*
Tree subcanopy	Broad-leaved deciduous tree	*Fagus grandifolia*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata, Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rubus occidentalis*
Herb (field)	Forb	*Alliaria petiolata*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides*

Characteristic Species: *Pinus strobus, Acer rubrum, Betula lenta, Fagus grandifolia, Lindera benzoin, Dennstaedtia punctilobula.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	3	Eastern White Pine - Successional Hardwood Forest	Walz et al. 2006
PA	S4	1	Hemlock (white pine) - red oak - mixed hardwood forest	Fike 1999

Local Range: Young examples of association likely occur throughout the park on dry-mesic sites with some disturbance history. Older, established examples of this type are fairly common on the ridgetop of Wallpack Ridge in New Jersey.

Classification Comments: The association is most closely related to Dry Eastern White Pine - Oak Forest. However, Dry Eastern White Pine - Oak Forest contains an abundance of dry oak species (*Quercus prinus, Quercus alba, Quercus coccinea*) and ericaceous heath species (*Kalmia* spp., *Gaylussacia* spp., *Vaccinium* spp.) whereas Eastern White Pine - Successional Hardwood Forest does not.

Other Comments: None.

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

Plots and Data Sources: DEWA.11, DEWA.16, DEWA.20, DEWA.36, DEWA.123, DEWA.231; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)

Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	Pinus strobus - Quercus (alba, rubra, velutina) Forest Alliance (A.401)
Alliance (English name)	Eastern White Pine - (White Oak, Northern Red Oak, Black Oak) Forest Alliance
Association	*Quercus (rubra, velutina, alba) - Betula lenta - (Pinus strobus)* Forest
Association (English name)	(Northern Red Oak, Black Oak, White Oak) - Sweet Birch - (Eastern White Pine) Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association covers mid-successional forests developing after heavy cutting or other disturbance in the mid-Atlantic states, where dry-mesic oak species and earlier successional trees predominate, typically with a supercanopy of *Pinus strobus*. It is usually found on dry-mesic sites that are flat to gently rolling. Characteristic structure is large *Pinus strobus* over a layer of young, small-diameter hardwoods, such as *Acer rubrum, Betula lenta*, and mesic oaks, including *Quercus rubra* and *Quercus palustris*. *Juniperus virginiana* and *Tsuga canadensis* may be common in the canopy or subcanopy. Other common associates include *Prunus serotina, Fagus grandifolia, Fraxinus americana, Populus grandidentata, Acer saccharum, Carya cordiformis, Betula alleghaniensis*, and occasional dry oak species such as *Quercus alba* or *Quercus velutina*. The subcanopy may contain *Carpinus caroliniana* and/or *Ostrya virginiana*. The tall-shrub layer is sparse to moderately dense, consisting of *Lindera benzoin, Ilex verticillata, Viburnum prunifolium, Viburnum dentatum* var. *lucidum*, and saplings of canopy tree species. Common short shrubs are *Berberis thunbergii, Viburnum acerifolium, Rubus occidentalis, Rubus flagellaris*, and *Rubus allegheniensis*. Ericaceous shrubs may be scattered in this type, however, they generally do not cover greater than 25% of the forest floor. The herbaceous layer is sparse to moderately dense; characteristic herbs include *Maianthemum canadense, Dennstaedtia punctilobula, Lycopodium digitatum, Chimaphila maculata, Galium circaezans, Galium mollugo, Mitchella repens, Polystichum acrostichoides, Dryopteris intermedia, Ageratina altissima* var. *altissima, Podophyllum peltatum*, and *Oxalis stricta*. *Alliaria petiolata* is a common invasive plant in these forests. Vines are usually sparse, with *Parthenocissus quinquefolia* and *Toxicodendron radicans* typically present at low cover.

Environmental Description: Information not available.

Vegetation Description: Characteristic structure is large *Pinus strobus* over a layer of young, small-diameter hardwoods, such as *Acer rubrum, Betula lenta*, and mesic oaks, including *Quercus rubra* and *Quercus palustris*. *Juniperus virginiana* and *Tsuga canadensis* may be common in the canopy or subcanopy. Other common associates include *Prunus serotina, Fagus grandifolia, Fraxinus americana, Populus grandidentata, Acer saccharum, Carya cordiformis, Betula alleghaniensis*, and occasional dry oak species such as *Quercus alba* or *Quercus velutina*. The canopy is typically 20 to 30 m in height with canopy cover usually greater than 70%. The subcanopy usually contains similar species as the canopy, as well as *Carpinus caroliniana* and *Ostrya virginiana*. The tall-shrub layer is sparse to moderately dense, consisting of *Lindera benzoin, Ilex verticillata, Viburnum prunifolium, Viburnum dentatum* var. *lucidum*, and saplings of canopy tree species. Common short shrubs are *Berberis thunbergii, Viburnum acerifolium, Rubus occidentalis, Rubus flagellaris*, and *Rubus allegheniensis*. Ericaceous shrubs, such as

Kalmia latifolia, Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum, and *Vaccinium stamineum*, may be scattered in this type, however, they generally do not cover greater than 25% of the forest floor. The herbaceous layer is usually sparse to moderately dense; characteristic herbs include *Maianthemum canadense, Dennstaedtia punctilobula, Lycopodium digitatum, Chimaphila maculata, Galium circaezans, Galium mollugo, Mitchella repens, Polystichum acrostichoides, Dryopteris intermedia, Ageratina altissima* var. *altissima, Podophyllum peltatum*, and *Oxalis stricta*. *Alliaria petiolata* is a common invasive plant in these forests, Vines are usually sparse, with *Parthenocissus quinquefolia* and *Toxicodendron radicans* typically present at low cover.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Pinus strobus*
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Betula lenta*
Tree subcanopy	Broad-leaved deciduous tree	*Fagus grandifolia*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata, Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus occidentalis*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Acer rubrum, Betula lenta, Dennstaedtia punctilobula, Fagus grandifolia, Lindera benzoin, Pinus strobus.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in southern New England and New York south through Maryland and possibly further.

States/Provinces: CT?, DE?, MA?, NJ, NY?, PA, VA?

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

Rank: G4G5 (23-Jun-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: Mid-successional forests like this are variable and have not been thoroughly sampled and analyzed.

Similar Associations:

- *Quercus rubra - Acer rubrum - Betula* spp. - *Pinus strobus* Forest (CEGL006506)--is somewhat more northern, with *Betula papyrifera* more typical than *Betula lenta, Quercus rubra* as the only oak species, and *Picea rubens* an occasional minor associate.

Related Concepts: Information not available.

SOURCES

Description Authors: S. C. Gawler.

References: Eastern Ecology Working Group n.d.

Figure 53. Eastern White Pine - Successional Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.11). May 2003.

Figure 54. Eastern White Pine - Successional Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.123). May 2003.

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

SYNONYMS

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

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

NVC Identifier: **CEGL006109**

LOCAL INFORMATION

Environmental Description: This association occurs in steep ravines and along north-facing lower slopes throughout the park. Slope varies from nearly level to, more typically, moderately steep (14 to 25%). The bedrock varies from shale to calcareous shale and limestone. Soils are typically channery to very stony silt loams (e.g., Lordstown-Wallpack complex, Hoosic-Otisville complex and Edgemere-Shohola complex soil series).

Vegetation Description: This association is dominated by eastern hemlock (*Tsuga canadensis*) with sweet birch (*Betula lenta*) and/or sugar maple (*Acer saccharum*) as codominants. The canopy is typically 20 to 30 m in height with canopy cover usually greater than 70%. Minor canopy associates may include oaks (*Quercus rubra, Quercus alba, Quercus prinus*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*). The subcanopy is usually 10 to 15 m in height and variable in total cover from sparse (10%) to moderately dense (50%). The subcanopy is often usually dominated by eastern hemlock and sweet birch, with sugar maple and American beech occasionally present. The tall-shrub layer is typically sparse and often absent, consisting of scattered saplings of canopy tree species. The short-shrub layer (less than 2 m in height) is also sparse, with total cover generally under 15%. Short shrubs include tree saplings and occasionally some ericad shrubs at very low cover, such as Blue Ridge blueberry (*Vaccinium pallidum*). The herbaceous layer is usually sparse (less than 10% total cover) but may reach 50% cover where the canopy is more open. Characteristic herbs include eastern hayscented fern (*Dennstaedtia punctilobula*), Canada mayflower (*Maianthemum canadense*), sessileleaf bellwort (*Uvularia sessilifolia*), Christmas fern (*Polystichum acrostichoides*), and striped prince's pine (*Chimaphila maculata*). Northern species such as starflower (*Trientalis borealis*) and threeleaf goldthread (*Coptis trifolia*) are occasional. Vines are usually absent, with Virginia creeper (*Parthenocissus quinquefolia*) sometimes present at low cover. Bryophyte cover is usually less than 5% but may be as high as 20% where the canopy is more open.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Betula lenta, Acer saccharum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula lenta, Fagus grandifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer rubrum, Acer saccharum, Fagus grandifolia*

Herb (field)	Forb	*Maianthemum canadense, Uvularia sessilifolia*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides*

Characteristic Species: *Tsuga canadensis, Acer saccharum, Betula lenta, Fagus grandifolia, Dennstaedtia punctilobula, Maianthemum canadense, Uvularia sessilifolia.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3	1	Hemlock - Northern Hardwood Forest	Walz et al. 2006
PA	S4	1	Hemlock (white pine) - northern hardwood forest	Fike 1999

Local Range: This association likely occurs throughout the park in steep ravines and on the lower portion of steep slopes with a northern aspect.
Classification Comments: This association differs from Dry Eastern Hemlock - Oak Forest in that oaks are minor stand components and are often absent.
Other Comments: The eastern hemlocks in these forests are at risk of mortality once infested with hemlock wooly adelgid.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.18, DEWA.32, DEWA.39, DEWA.77, DEWA.83, DEWA.129, DEWA.150, DEWA.213; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)
Alliance	Tsuga canadensis - 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 / Intermediate Woodfern 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 codominants 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. *Betula lenta* may replace *Betula alleghaniensis* in some areas. *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, Uvularia sessilifolia, Polystichum acrostichoides, Trientalis borealis, Huperzia lucidula (= Lycopodium lucidulum), Eurybia divaricata (= Aster divaricatus), Oclemena acuminata (= Aster acuminatus), Dennstaedtia punctilobula*, 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. Slope varies from nearly level to moderately steep. Soils can have a thick, poorly decomposed duff layer over sandy loams.

Vegetation Description: *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 codominants 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. *Betula lenta* may replace *Betula alleghaniensis* in some areas. *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, Uvularia sessilifolia, Polystichum acrostichoides, Trientalis borealis, Huperzia lucidula (= Lycopodium lucidulum), Oclemena acuminata (= Aster acuminatus), Eurybia divaricata (= Aster divaricatus), Dennstaedtia punctilobula*, 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
Tree canopy	Needle-leaved tree	*Tsuga canadensis*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Acer pensylvanicum*, *Viburnum acerifolium*
Herb (field)	Forb	*Maianthemum canadense*

Characteristic Species: *Betula alleghaniensis, Carex albicans, Dryopteris intermedia, Huperzia lucidula, Maianthemum canadense, Medeola virginiana, Mitchella repens, Oclemena acuminata, Thelypteris noveboracensis, Tsuga canadensis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community is generally distributed in large patches from New Hampshire south through 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 (Delaware Water Gap, 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, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Rawinski et al. 1994, Smith 1983, Sperduto 2000a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003.

Figure 55. Eastern Hemlock - Northern Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.32). June 2003.

Figure 56. Eastern Hemlock - Northern Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.129). May 2003.

COMMON NAME (PARK-SPECIFIC): DRY EASTERN HEMLOCK - OAK FOREST

SYNONYMS

NVC English Name:	**Eastern Hemlock - (Chestnut Oak, White Oak, Northern Red Oak, Scarlet Oak) - (Sweet Birch) / Mountain Laurel Forest**
NVC Scientific Name:	***Tsuga canadensis - Quercus (prinus, alba, rubra, coccinea) - (Betula lenta) / Kalmia latifolia* Forest**
NVC Identifier:	**CEGL006923**

LOCAL INFORMATION

Environmental Description: This forest association occurs on north- and northeast-facing slopes and shallow ravines of the Kittatinny Ridge and on the Hogback Ridge in Pennsylvania and New Jersey. It also can occur on the very steep lower slopes immediately above the Delaware River. This type is located on extremely stony soils such as those in the Oquaga, Lackawanna, Benson, and Lordstown series. This forest association occurs on shale, sandstone, siltstone, and limestone in the park. Because of the xeric setting, the hemlocks in these forests are at the greatest risk of mortality once infested with hemlock wooly adelgid. The canopy hemlocks in large areas of this forest on the north face of the Kittatinny Ridge were already dead or in severe decline in 2003. The future composition and structure of these forests are uncertain.

Vegetation Description: The characteristic canopy for this forest association is codominated by eastern hemlock (*Tsuga canadensis*), covering >25% of the stand in the canopy and subcanopy combined. The crowns of hemlocks that have experienced significant mortality may no longer cover 25% of the area. Oaks (*Quercus* spp.), predominantly chestnut oak (*Quercus prinus*), are codominant; however, other oaks include northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), and white oak (*Quercus alba*). Other canopy associates include red maple (*Acer rubrum*), sweet birch (*Betula lenta*), pignut hickory (*Carya glabra*), mockernut hickory (*Carya alba*), blackgum (*Nyssa sylvatica*), and eastern white pine (*Pinus strobus*). Canopy trees range in height from 20-35 m and typically cover 75-90% of the stand. Subcanopy trees extend 5-20 m in height and cover 10-60% of the area. Typical subcanopy species include eastern hemlock, red maple, sweet birch, common serviceberry (*Amelanchier arborea*), and oaks and hickories from the canopy. The tall-shrub layer is variable; it can be absent or dense and contain a variety of species. A dense tall-shrub layer of great laurel (*Rhododendron maximum*) can be present. Eastern hemlock saplings may also form a thick tall-shrub layer. Clumps of mountain laurel (*Kalmia latifolia*) can be common, and American witch-hazel (*Hamamelis virginiana*) is a common tall-shrub associate. The short-shrub layer is typically sparse (0-25% cover) and contains Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*), and seedlings of canopy and subcanopy trees. The herb layer is also characteristically sparse (0-10% cover). Scattered common species include Canada mayflower (*Maianthemum canadense*), eastern hayscented fern (*Dennstaedtia punctilobula*), striped prince's pine (*Chimaphila maculata*), wavy hairgrass (*Deschampsia flexuosa*), Swan's sedge (*Carex swanii*), and wild sarsaparilla (*Aralia nudicaulis*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Betula lenta*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia, Rhododendron maximum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum*

Characteristic Species: *Tsuga canadensis, Quercus prinus, Rhododendron maximum, Hamamelis virginiana, Chimaphila maculata, Maianthemum canadense.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Hemlock - Mixed Oak Ridgetop Forest	Walz et al. 2006
PA	S4	1	Dry white pine (hemlock) - oak forest	Fike 1999

Local Range: This forest association is common on north- and northeast-facing slopes and shallow ravines of the Kittatinny Ridge and on the Hogback Ridge in Pennsylvania and New Jersey.

Classification Comments: This forest association is identified by the dominance of *Tsuga canadensis* covering >25% of the stand in the canopy and subcanopy combined, often with *Quercus prinus* as a canopy codominant. This type may or may not contain a dense tall-shrub layer of *Rhododendron maximum, Kalmia latifolia,* and/or *Tsuga canadensis.*

Other Comments: Stands of Dry Eastern Hemlock - Oak Forest that are surrounded by native forest types without invasive species have high probability of shifting to Dry Oak - Mixed Hardwood Forest as the hemlocks die. However, invasive plant species and the overbrowsing of tree regeneration by white-tailed deer pose 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.66, DEWA.87, DEWA.116, DEWA.167, DEWA.178, DEWA.188, DEWA.196, DEWA.197; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Mixed evergreen-deciduous forest (I.C.)
Physiognomic Group	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.)
Physiognomic Subgroup	Natural/Semi-natural mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.)
Formation	Mixed needle-leaved evergreen - cold-deciduous forest (I.C.3.N.a.)

Alliance	Tsuga canadensis - Liriodendron tulipifera Forest Alliance (A.413)
Alliance (English name)	Eastern Hemlock - Tuliptree Forest Alliance
Association	*Tsuga canadensis - Quercus (prinus, alba, rubra, coccinea) - (Betula lenta) / Kalmia latifolia* Forest
Association (English name)	Eastern Hemlock - (Chestnut Oak, White Oak, Northern Red Oak, Scarlet Oak) - (Sweet Birch) / Mountain Laurel Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association is a hemlock - mixed oak forest which often occurs on steep northeastern to northwestern exposures. Soils are usually very stony to extremely stony sandy loam. The canopy is a mixture of *Tsuga canadensis* and oaks, typically *Quercus prinus*, but also including *Quercus velutina, Quercus coccinea*, and less commonly *Quercus alba* and/or *Quercus rubra*. Other hardwoods include *Acer rubrum, Carya glabra, Carya alba (= Carya tomentosa), Liriodendron tulipifera, Betula lenta, Sassafras albidum*, and *Fagus grandifolia*. Shrub layers can be absent or sparse due to dense shading by hemlock, with *Hamamelis virginiana, Rhododendron maximum*, and/or *Kalmia latifolia*, and virtually no ground cover. In other sites, a single dense or multiple open strata of ericaceous species can develop, including *Rhododendron maximum, Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium pallidum*. The herb layer is also characteristically sparse. Scattered common species include *Maianthemum canadense, Dennstaedtia punctilobula, Chimaphila maculata, Deschampsia flexuosa, Carex swanii*, and *Aralia nudicaulis*.

Environmental Description: This association is a hemlock - mixed oak forest which often occurs on steep northeastern to northwestern exposures. Soils are usually very stony to extremely stony sandy loam.

Vegetation Description: The canopy is a mixture of *Tsuga canadensis*- and oaks, typically *Quercus prinus*, but also including *Quercus velutina, Quercus coccinea*, and less commonly *Quercus alba* and/or *Quercus rubra*. Other hardwoods include *Acer rubrum, Carya glabra, Carya alba (= Carya tomentosa), Liriodendron tulipifera, Betula lenta, Sassafras albidum*, and *Fagus grandifolia*. Shrub layers can be absent or sparse due to dense shading by hemlock, with *Hamamelis virginiana, Rhododendron maximum*, and/or *Kalmia latifolia*, and virtually no ground cover. In other sites, a single dense or multiple open strata of ericaceous species can develop, including *Rhododendron maximum, Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium pallidum*. The herb layer is also characteristically sparse. Scattered common species include *Maianthemum canadense, Dennstaedtia punctilobula, Chimaphila maculata, Deschampsia flexuosa, Carex swanii*, and *Aralia nudicaulis*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Needle-leaved tree	*Tsuga canadensis*
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Quercus prinus*
Tree subcanopy	Broad-leaved deciduous tree	*Betula lenta*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Rhododendron maximum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium pallidum*

Characteristic Species: *Chimaphila maculata*, *Quercus prinus*, *Tsuga canadensis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is currently known from Pennsylvania and New Jersey.
States/Provinces: NJ, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap).

CONSERVATION STATUS
Rank: G3G4? (20-Jun-2006).
Reasons: The association does not appear intrinsically rare, but its future is threatened by the spread of the hemlock woolly adelgid.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Description based on A. Windisch's Picatinny Arsenal Hemlock-Mixed Oak-(Heath) Cool Sub-Mesic forest description (TcQf).
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: A. Windisch, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Fike 1999.

Figure 57. Dry Eastern Hemlock - Oak Forest in Delaware Water Gap National Recreation Area (plot DEWA.116). September 2003.

Figure 58. Dry Eastern Hemlock - Oak Forest in Delaware Water Gap National Recreation Area (plot DEWA.196). June 2004.

COMMON NAME (PARK-SPECIFIC): PITCH PINE - MIXED HARDWOOD ROCKY SUMMIT

SYNONYMS

NVC English Name:	**Pitch Pine / (Bear Oak) / Black Chokeberry / Wavy Hairgrass Woodland**
NVC Scientific Name:	***Pinus rigida / (Quercus ilicifolia) / Photinia melanocarpa / Deschampsia flexuosa* Woodland**
NVC Identifier:	**CEGL006116**

LOCAL INFORMATION

Environmental Description: This vegetation type is associated with rocky summits along the top of Kittatinny Ridge where sandstone of the Silurian Shawangunk Formation occurs as exposed outcrops and large boulders. This community occurs in small patches where exposed rocky summits occur within the Dry Oak - Heath Forest matrix. Soils, when present, are Arendtsville gravelly loam, Lordstown extremely stony silt loam and Oquaga channery loams.

Vegetation Description: The vegetation in this association is often sparse open woodland, often with significant exposures of bedrock and boulders. The canopy is stunted, usually less than 15 m in height and may be under 10 m in some stands with 10 to 40% total cover. Canopy dominants include pitch pine (*Pinus rigida*), pignut hickory (*Carya glabra*), chestnut oak (*Quercus prinus*), and sweet birch (*Betula lenta*). Given the low stature of the canopy, a recognizable subcanopy is not evident. The tall-shrub layer is 2-5 m in height and is dominated by pitch pine, bear oak (*Quercus ilicifolia*), common serviceberry (*Amelanchier arborea*), and chestnut oak. Tall-shrub cover is usually less than 20%. The short-shrub layer is under 2 m in height with a total cover of 5 to 30%. The short-shrub layer can contain lowbush blueberry (*Vaccinium angustifolium*), bear oak, black huckleberry (*Gaylussacia baccata*), Blue Ridge blueberry (*Vaccinium pallidum*), pitch pine, chestnut oak, and sweet birch. The herbaceous layer is usually under 1 m in height with total cover of 20 to 25%. Wavy hairgrass (*Deschampsia flexuosa*) is the dominant herbaceous species often with little bluestem (*Schizachyrium scoparium*) as a subdominant species. Other common herbaceous associates present at low cover include common sheep sorrel (*Rumex acetosella*), American burnweed (*Erechtites hieraciifolia*), rock harlequin (*Corydalis sempervirens*), and rock polypody (*Polypodium virginianum*). The vine layer is often absent, though Virginia creeper (*Parthenocissus quinquefolia*) is occasionally present at low cover.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida*
Tree canopy	Broad-leaved deciduous tree	*Betula lenta, Quercus prinus*
Tall shrub/sapling	Needle-leaved shrub	*Pinus rigida*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier arborea, Quercus ilicifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium angustifolium, Quercus ilicifolia*
Herb (field)	Forb	*Corydalis sempervirens, Erechtites hieraciifolia, Rumex acetosella*

Herb (field)	Graminoid	*Deschampsia flexuosa*

Characteristic Species: *Pinus rigida, Betula lenta, Quercus prinus, Quercus ilicifolia, Vaccinium angustifolium.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1	1	Pitch Pine Rocky Summit	Walz et al. 2006
PA	S2S3	2	Pitch pine - mixed hardwood woodland	Fike 1999

Local Range: This vegetation type is restricted to rocky summits along Kittatinny Ridge where the Shawangunk sandstone formation is exposed.
Classification Comments: This vegetation type differs from Hickory - Eastern Red-cedar Rocky Woodland that is restricted to shale bedrock outcrops along the east side of the Glaciated Low Plateau and to very steep, south- to southeast-facing upper slopes of Kittatinny Ridge. This type occurs on rocky summits along the top of Kittatinny Ridge where sandstone occurs as exposed outcrops.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.89, DEWA.90, DEWA.91, DEWA.115, DEWA.220; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

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 rigida Woodland Alliance (A.524)
Alliance (English name)	Pitch Pine Woodland Alliance
Association	*Pinus rigida / (Quercus ilicifolia) / Photinia melanocarpa / Deschampsia flexuosa* Woodland
Association (English name)	Pitch Pine / (Bear Oak) / Black Chokeberry / Wavy Hairgrass Woodland
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600) Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571)

GLOBAL DESCRIPTION

Concept Summary: This northeastern pitch pine community occurs on dry rocky ridges and summits of low to moderate elevations. Soils are derived from acidic bedrock and are typically shallow, well- to excessively drained, coarse sands or gravels that develop in pockets of the

exposed bedrock expanses. The canopy is open and trees are often stunted, usually less than 15 m in height and may be under 10 m. Tall shrubs are scattered and not abundant. The dwarf-shrub layer is moderately to well-developed (>20% cover, often more dense). Herbs are sparse. The bryoid layer is of variable cover, with lichens prominent. The ground cover is bare rock and deciduous and coniferous litter. The canopy is dominated by *Pinus rigida* with a variable mixture of associates, such as *Betula populifolia, Quercus rubra, Quercus prinus, Carya glabra, Pinus strobus, Pinus resinosa, Betula lenta, Acer rubrum*, and *Prunus serotina*. The tall-shrub layer is comprised of scattered *Quercus ilicifolia, Quercus prinoides*, or less commonly *Nemopanthus mucronatus*. The shrub layer is dominated by heaths, such as *Vaccinium angustifolium, Vaccinium pallidum, Vaccinium myrtilloides*, and *Gaylussacia baccata*, as well as other shrubs, such as *Comptonia peregrina* and *Photinia melanocarpa (= Aronia melanocarpa)*. The herbaceous layer typically includes *Pteridium aquilinum, Schizachyrium scoparium, Deschampsia flexuosa, Danthonia spicata, Carex pensylvanica* and/or *Carex lucorum, Maianthemum canadense, Aralia nudicaulis, Melampyrum lineare, Fragaria virginiana, Rumex acetosella, Erechtites hieraciifolia, Corydalis sempervirens, Trientalis borealis*, and *Cypripedium acaule*. In the northern Appalachian Mountains, this community generally occurs at elevations from near sea level to 520 m (1700 feet) and may include species of northern affinity, such as *Viburnum nudum, Kalmia angustifolia, Betula papyrifera, Picea rubens*, and *Rhododendron canadense*, while in the Central Appalachians, this community occurs at elevations up to 1340 m (4400 feet), with occasional associates including *Pinus pungens, Pinus virginiana*, and *Ilex montana*. Periodic fires are probably necessary for persistence of this type, except at the most extreme sites. This association is differentiated from *Pinus rigida / Corema conradii* Woodland (CEGL006154) by the absence of *Corema*, and from other *Pinus rigida*-dominated woodlands of rocky habitats by the absence or very low cover of the scrub oak *Quercus ilicifolia*.

Environmental Description: This northeastern pitch pine community occurs on dry rocky ridges and summits of low to moderate elevations. Soils are derived from acidic bedrock and are typically shallow, well- to excessively drained, coarse sands or gravels that develop in pockets of the exposed bedrock expanses. In the northern Appalachian Mountains, this community generally occurs at elevations from near sea level to 520 m (1700 feet),while in the Central Appalachians, this community occurs at elevations up to 1340 (4400 feet).

Vegetation Description: The canopy is open and trees are often stunted, usually less than 15 m in height and may be under 10 m. Tall shrubs are scattered and not abundant. The dwarf-shrub layer is moderately to well-developed (>20% cover, often more dense). Herbs are sparse. The bryoid layer is of variable cover, with lichens prominent. The ground cover is bare rock and deciduous and coniferous litter. The canopy is dominated by *Pinus rigida* with a variable mixture of associates, such as *Betula populifolia, Quercus rubra, Quercus prinus, Carya glabra, Pinus strobus, Pinus resinosa, Betula lenta, Acer rubrum*, and *Prunus serotina*. The tall-shrub layer is comprised of scattered *Quercus ilicifolia, Quercus prinoides*, or less commonly *Nemopanthus mucronatus*. The shrub layer is dominated by heaths, such as *Vaccinium angustifolium, Vaccinium pallidum, Vaccinium myrtilloides*, and *Gaylussacia baccata*, as well as other shrubs, such as *Comptonia peregrina* and *Photinia melanocarpa (= Aronia melanocarpa)*. The herbaceous layer typically includes *Pteridium aquilinum, Schizachyrium scoparium, Deschampsia flexuosa, Danthonia spicata, Carex pensylvanica* and/or *Carex lucorum, Maianthemum canadense, Aralia nudicaulis, Melampyrum lineare, Fragaria virginiana, Rumex acetosella, Erechtites hieraciifolia, Corydalis sempervirens, Trientalis borealis*, and

Cypripedium acaule. In the northern Appalachian Mountains, this community may include species of northern affinity, such as *Viburnum nudum, Kalmia angustifolia, Betula papyrifera, Picea rubens*, and *Rhododendron canadense*, while in the Central Appalachians, this community occurs with occasional associates including *Pinus pungens, Pinus virginiana*, and *Ilex montana*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus rigida*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Quercus ilicifolia*
Tall shrub/sapling	Needle-leaved shrub	*Pinus rigida*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Amelanchier arborea*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum*
Herb (field)	Forb	*Corydalis sempervirens, Erechtites hieraciifolia, Rumex acetosella*
Herb (field)	Graminoid	*Deschampsia flexuosa, Schizachyrium scoparium*

Characteristic Species: *Betula lenta, Betula populifolia, Gaylussacia baccata, Pinus rigida, Quercus ilicifolia, Quercus prinus, Vaccinium angustifolium, Vaccinium pallidum.*
Other Noteworthy Species: *Dendroica discolor.*
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This association occurs in the northeastern United States from central New England south to Maryland and possibly to Virginia.
States/Provinces: CT, MA, MD, ME, NH, NJ:S1, NY, PA, RI, VA?, VT:S1, WV.
Federal Lands: NPS (Acadia, Delaware Water Gap).

CONSERVATION STATUS

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

CLASSIFICATION INFORMATION

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

- *Pinus (pungens, rigida) / Quercus ilicifolia / Gaylussacia baccata* Woodland (CEGL004996).
- *Pinus rigida / Corema conradii* Woodland (CEGL006154).

Related Concepts:

- Pitch Pine-Oak-Heath Rocky Summit (Thompson 1996) ?
- Pitch Pine: 45 (Eyre 1980) B
- Pitch pine/black chokeberry low-mid elevation ridgetop (CAP pers. comm. 1998) ?
- Ridgetop Pitch Pine-Scrub Oak Forest (Breden 1989) B
- SNE Acidic Rocky Summit/Rock Outcrop Community (Rawinski 1984) ?

SOURCES

Description Authors: S. C. Gawler.

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fike 1999, Fleming 1985, Gawler 2002, Harrison 2004, Hunt 1999, Kuchler 1956, Lundgren 1999, Metzler and Barrett 2001, Moore and Taylor 1927, Rawinski 1984, Sperduto 1997a, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 59. Pitch Pine - Mixed Hardwood Rocky Summit in Delaware Water Gap National Recreation Area (plot DEWA.90). August 2003.

Figure 60. Pitch Pine - Mixed Hardwood Rocky Summit in Delaware Water Gap National Recreation Area (plot DEWA.220). July 2004.