National Park Service
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Northeast Region
Philadelphia, Pennsylvania

Classification and Mapping of Vegetation and Fire Fuel Models at Delaware Water Gap National Recreation Area: Volume 2 of 2 – Appendix G

Technical Report NPS/NER/NRTR—2007/076

ON THE COVER
Hickory - Eastern Red-cedar Rocky Woodland, near Milford, Pennsylvania, in the Delaware Water Gap National Recreation Area.
Photograph by: Gregory Podniesinski.

Classification and Mapping of Vegetation and Fire Fuel Models at Delaware Water Gap National Recreation Area: Volume 1 of 2

Technical Report NPS/NER/NRTR—2007/076

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March 2007

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This report was accomplished under Cooperative Agreements 4560A0019 and H4506060766, with assistance from the NPS. The statements, findings, conclusions, recommendations, and data in this report are solely those of the author(s), and do not necessarily reflect the views of the U.S. Department of the Interior, National Park Service.

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Please cite this publication as:

Perles, S. J., G. S. Podniesinski, E. Eastman, L. A. Sneddon, and S. C. Gawler. 2007. Classification and Mapping of Vegetation and Fire Fuel Models at Delaware Water Gap National Recreation Area: Volume 1 of 2. Technical Report NPS/NER/NRTR—2007/076. National Park Service. Philadelphia, PA.

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KEY TO VEGETATION ASSOCIATIONS IN DELAWARE WATER GAP NATIONAL RECREATION AREA

1. Area is predominantly bare rock outcrops, boulders, talus, scree, cobbles, gravel, sand, or bare leaf litter with scattered vegetation covering less than 25% of total area. These areas are often on extremely steep slopes, cliffs, ridgetops, or along the Delaware River shoreline.
SPARSE VEGETATION GROUP

1. Area is not predominantly bare rock outcrops, boulders, talus or scree. Vegetation covers 25% or more of the area.

    2. Association is dominated by herbaceous or graminoid species. Woody species cover less than 25% of the area. (Small patch herbaceous seeps or vernal pools that may occur under closed or partially closed forest canopy are included here).
HERBACEOUS GROUP

    2. Woody species (shrubs or trees) cover at least 25% of the area.

        3. Shrubs (woody species 5 meters tall or less) cover at least 25% of the area. Trees (woody species greater than 5 meters tall) cover less than 25% of the area.
SHRUB GROUP

        3. Trees (woody species greater than 5 meters tall) cover at least 25% of the area.

            4. Trees (woody species greater than 5 meters tall) cover 25–60% of the area.
WOODLAND GROUP

            4. Trees (woody species greater than 5 meters tall) greater than 60% of the area.
FOREST GROUP

SPARSE VEGETATION GROUP

1. Sparse vegetation occurs on cobble, gravel, or sand bars adjacent to the Delaware River.
Riverine Scour Vegetation

1. Sparse vegetation does not occur on cobble, gravel, or sand bars adjacent to the Delaware River.

    2. Ground is concave, a shallow basin or depression that holds standing water for at least part of the year. The bottom of the shallow basin may be lined with leaf litter or large boulders.

        3. The bottom of the depression is lined with leaf litter.
Eastern Woodland Vernal Pool Sparse Vegetation

        3. The bottom of the depression is lined with large boulders. These depression occur on the top of Kittantinny Ridge.
Boulder Vernal Pool Sparse Vegetation

    2. Either, the ground is convex and occurs on ridgetop or the crests of steep slopes with a substrate of large rock outcrops; OR the ground is steeply sloping with a substrate of loose weathered shale scree, rock cliffs, or large talus boulders. The area does NOT hold standing water for part of the year.

        4. Area is steeply sloping, at upper, middle or lower slope topographic positions. Substrate is composed of loose weathered shale scree, rock cliffs, or large talus boulders.

            5. Sparse variable vegetation established in crevices of steep, often southeast-facing sandstone or shale cliffs. Substrate not talus boulders, shale scree, or ridgetop rock outcrops.
Sparsely Vegetated Cliff

            5. Substrate is talus boulders or shale scree.

                6. Sparse variable vegetation established in crevices between large boulders that cover the ground (i.e., boulderfields). Occurs on very steep, typically southeast-facing lower slopes of the Kittatiny Ridge.
Sandstone Talus

                6. Association occurs on very steep, southeast-facing lower slopes covered in gravelly shale scree along the eastern edge of the plateau in Pennsylvania. Vegetation is variable and can be absent or sparse.
Shale Scree Slope

4. Area occurs on ridgetop or the crests of steep slopes. Substrate is large rock outcrops. Substrate is not loose weathered shale scree, rock cliffs, or large talus boulders.

    7. Trees and shrubs cover less than 10% of the area. Prominent vegetation includes herbaceous and graminoid species growing in crevices and in thin soil over bedrock. Characteristic species include wavy hairgrass (*Deschampsia flexuosa*), common sheep sorrel (*Rumex acetosella*), eastern hayscented fern (*Dennstaedtia punctilobula*), poverty oatgrass (*Danthonia spicata*), little bluestem (*Schizachyrium scoparium*), and tapered rosette grass (*Dichanthelium acuminatum* var. *acuminatum*).

        Wavy Hairgrass - Common Sheep Sorrel Rock Outcrop

    7. Trees and shrubs cover 10–25% of the area.

        8. Association occurs on rocky summits and ridgetops, often with northern or western aspect. Slope generally less than 25 %.

            Pitch Pine - Mixed Hardwood Rocky Summit

        8. Association occurs among rock outcrops on upper slopes, on the tops of cliffs along Kittatinny Ridge, or along narrow shelves on very steep southeast-facing cliffs in Pennsylvania. Aspect is generally to south to southeast with a slope greater than 25% (often greater than 50%).

            Hickory - Eastern Red-cedar Rocky Woodland

HERBACEOUS GROUP

1. Riparian vegetation that occurs in the floodplain of the Delaware River on islands, shorelines, gravel/cobble bars, or riverbeds. Vegetation structure and composition are influenced by river flooding and scour.

    2. Association is dominated (relative cover >50%) by either American water-willow (*Justicia americana*) or Japanese knotweed (*Polygonum cuspidatum*).

        3. Association is dominated by American water-willow (*Justicia americana*), forming emergent beds at the heads of islands or adjacent to bars and shorelines.
        Water-willow Emergent Bed

        3. Association is dominated by Japanese knotweed (*Polygonum cuspidatum*), establishing on islands and shorelines.
        Japanese Knotweed Herbaceous Vegetation

    2. Association is not dominated (relative cover <50%) of American water-willow (*Justicia americana*) or Japanese knotweed (*Polygonum cuspidatum*).

        4. Vegetation established on limestone outcrops or large fractured limestone cobbles along the New Jersey shoreline of the Delaware River.

            5. Association is characterized by open, sparsely vegetated sections of smooth Onondaga limestone outcrops with north-northwest exposure. Typical vegetation is a mixture of riparian species, xeric-loving crevice plants, and rare calciphiles.
            Calcareous Riverside Outcrop

            5. Association occurs on alluvial deposits combined with fractured limestone substrate. Seeps occur where groundwater flows out and over the cobbled substrate. Vegetation can be dense, robust, and diverse, supporting many grasses, sedges and rare calciphiles.
            Calcareous Riverside Seep

        4. Vegetation not associated with limestone outcrops or large fractured limestone cobbles along the New Jersey shoreline of the Delaware River.

            6. Vegetation dominated by reed canarygrass (*Phalaris arundinacea*) or hairyfruit sedge (*Carex trichocarpa*).

                7. Vegetation dominated by reed canarygrass (*Phalaris arundinacea*) that has greater than 50% cover.
                Reed Canarygrass Riverine Grassland

                7. Vegetation dominated by hairyfruit sedge (*Carex trichocarpa*) that has greater than 50% cover.
                Hairyfruit Sedge Wetland

6. Reed canarygrass (*Phalaris arundinacea*) and hairyfruit sedge (*Carex trichocarpa*) are absent or constitute less than 50% relative cover.

    8. Vegetation resembles tall prairie-like grassland (in summer and early fall) dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*) and little bluestem (*Schizachyrium scoparium*). Association occurs on sand/gravel deposits along shorelines and on islands.

        Big Bluestem - Indiangrass Riverine Grassland

    8. Variable vegetation in and directly adjacent to the active channel that is underwater for a significant portion of the year and is exposed during periods of low water (typically mid summer to early fall except during flood events). Frequent scour causes variation in species composition that is characteristic of this community. Cobbles and sand on island heads, bars, spits, low terraces, and shorelines support this vegetation type.

        Riverine Scour Vegetation

1. Palustrine or terrestrial vegetation that is not directly associated with the Delaware River. Palustrine vegetation associated with creeks and tributaries to the Delaware River is included here.

    9. Palustrine vegetation with standing water, saturated soil, or groundwater seepage for at least a portion of the growing season.

        10. Association occurs as a small patch community directly associated with groundwater seepage, often over calcareous bedrock.

            11. Wetland occurs over calcareous bedrock and may contain calciphilic plant species.

                12. Typical species include New York ironweed (*Vernonia noveboracensis*), eastern marsh fern (*Thelypteris palustris*), violets (*Viola* spp.), golden ragwort (*Packera aurea*), skunk-cabbage (*Symplocarpus foetidus*), Jack in the pulpit (*Arisaema triphyllum*), American marshpennywort (*Hydrocotyle americana*), thoroughwort (*Eupatorium* spp.), touch-me-not (*Impatiens* spp.), whorled mountainmint (*Pycnanthemum verticillatum*), American hogpeanut (*Amphicarpaea bracteata*), twoleaf miterwort (*Mitella diphylla*), white turtlehead (*Chelone glabra*), white edge sedge (*Carex debilis*), Japanese stiltgrass (*Microstegium vimineum*), and rice cutgrass (*Leersia oryzoides*). Does not contain the characteristic fen indicators listed below for Calcareous Fen.

                Calcareous Seep

12. Wetland contains some of the following characteristic fen indicator species: fen grass-of-Parnassus (*Parnassia glauca*), Ontario lobelia (*Lobelia kalmii*), downy willowherb (*Epilobium strictum*), rigid sedge (*Carex tetanica*), smallhead rush (*Juncus brachycephalus*), and purple avens (*Geum rivale*). Common species include golden ragwort (*Packera aurea*), eastern marsh fern (*Thelypteris palustris*), narrowleaf mountainmint (*Pycnanthemum tenuifolium*), sensitive fern (*Onoclea sensibilis*), woodland rush (*Juncus subcaudatus*), wrinkleleaf goldenrod, (*Solidago rugosa*), tussock sedge (*Carex stricta*), crested woodfern (*Dryopteris cristata*), and Dudley's rush (*Juncus dudleyi*).

Calcareous Fen

11. Wetland occurs on acidic sandstone, siltstone, shale or slate bedrock. Characteristic vegetation includes tufted hairgrass (*Deschampsia cespitosa*), downy goldenrod (*Solidago puberula*), Boreal chickweed (*Cerastium biebersteinii*), and Hammond's claytonia (*Claytonia virginica* var. *hammondiae*).

Acidic Seep

10. Association not limited to areas with groundwater seepage. Vegetation is typically flooded at least in the early portion of the growing season.

13. Vegetation occurs adjacent to creeks and tributaries. Vegetation dominated by reed canarygrass (*Phalaris arundinacea*) or hairyfruit sedge (*Carex trichocarpa*).

14. Vegetation dominated by reed canary grass (*Phalaris arundinacea*) that has greater than 50% cover.

Reed Canarygrass Riverine Grassland

14. Vegetation dominated by hairyfruit sedge (*Carex trichocarpa*) that has greater than 50% cover.

Hairyfruit Sedge Wetland

13. Vegetation is not associated with creeks and tributaries. Reed canarygrass (*Phalaris arundinacea*) and hairyfruit sedge (*Carex trichocarpa*) are absent or constitute less than 50% relative cover.

15. Wetland contains standing water for most or all of the year and is often associated with impounded drainages, ponded areas near streams, or saturated areas surrounding drainages.

16. Dominant species is tussock sedge (*Carex stricta*) covering 30-75% of the area.

Tussock Sedge Marsh

16. Tussock sedge (*Carex stricta*) covers less than 30% of the wetland. Vegetation is dominated species that are tolerant of standing water, although species composition is variable.

    17. Cattails (*Typha* spp.) are the clear dominant in the wetland, covering greater than 50% relative cover.

        Cattail Marsh

    17. Cattails (*Typha* spp.) are not the clear dominant. Species composition can be variable. Common species include: needle spikerush (*Eleocharis acicularis*), swamp verbena (*Verbena hastata*), nodding beggartick (*Bidens cernua*), rice cutgrass (*Leersia oryzoides*), marshpepper knotweed (*Polygonum hydropiper*), arrowleaf tearthumb (*Polygonum sagittatum*), field horsetail (*Equisetum arvense*), New England aster (*Aster novae-angliae*), owlfruit sedge (*Carex stipata*), and/or marsh seedbox (*Ludwigia palustris*).

        Mixed Forb Marsh

15. Wetland is typically flooded in early growing season and is dry or saturated the rest of the year.

    18. Vegetation is typically thick (>75% absolute cover). Typical species include a diverse mix of hydrophilic graminoids such as sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), rushes (*Juncus* spp.), rice cutgrass (*Leersia oryzoides*), and rough bentgrass (*Agrostis scabra*). Associated herbs include arrowleaf tearthumb (*Polygonum sagittatum*), eastern marsh fern (*Thelypteris palustris*), and giant goldenrod (*Solidago gigantea*).

        Wet Meadow

    18. Vegetation is typically sparse (0–50% absolute cover) and occurs in a small depression that is seasonally flooded and lined with leaf litter.

        Eastern Woodland Vernal Pool Sparse Vegetation

9. Terrestrial vegetation with no standing water, saturated soils, or groundwater seepage.

    19. Vegetation occurs on bedrock outcrops or thin soils and covers less than 50% of the area. Wavy hairgrass (*Deschampsia flexuosa*), common sheep sorrel (*Rumex acetosella*), and poverty oatgrass (*Danthonia spicata*) are characteristic species.

        Wavy Hairgrass - Common Sheep Sorrel Rock Outcrop

    19. Vegetation is dense (>80% cover), not dominated by wavy hairgrass (*Deschampsia flexuosa*), and is not associated with bedrock outcrops.

        20. Little bluestem (*Schizachyrium scoparium*) covers greater than 50% of the area.

            Little Bluestem Grassland

20. Little bluestem (*Schizachyrium scoparium*) covers less than 50% of the area. Characteristically dominant species are wrinkleleaf goldenrod (*Solidago rugosa*) and sweet vernalgrass (*Anthoxanthm odoratum*) with numerous other graminoid and herbaceous associates.

Old Field

SHRUB GROUP

1. Riparian vegetation that occurs in the floodplain of the Delaware River on islands, shorelines, gravel/cobble bars, or riverbeds. Vegetation structure and composition are influenced by river flooding and scour.

    2. Vegetation is characterized by a moderately dense to dense short shrub layer less than 2 m in height. Characteristic species include willows (*Salix nigra, Salix eriocephala, Salix sericea*) and sycamore (*Platanus occidentalis*). Tall shrubs (2-5 m in height) cover less than 25% of the area.

        Sycamore (Willow) - Mixed Hardwood Riverine Dwarf Shrubland

    2. Vegetation is characterized by a moderately dense to dense tall shrub layer of shrubs 2–5 m in height that cover greater than 25% of the area. Dominant species is typically sycamore (*Platanus occidentalis*), with associates river birch (*Betula nigra*), black willow (*Salix nigra*), and silver maple (*Acer saccharinum*).

        Sycamore - Mixed Hardwood Riverine Shrubland

1. Palustrine or terrestrial vegetation that is not directly associated with the Delaware River. Palustrine vegetation associated with creeks and tributaries to the Delaware River is included here.

    3. Palustrine vegetation with standing water, saturated soil or groundwater seepage for at least a portion of the growing season.

        4. Association is dominated or co-dominated by thick layer of leatherleaf (*Chamaedaphne calyculata*) that covers 50% or more of the wetland.

            5. Cover of highbush blueberry (*Vaccinium corymbosum*) and other tall shrubs is <50% of the wetland. A stunted dense layer of leatherleaf (*Chamaedaphne calyculata*) is prominent. Common “bog” plants such as purple pitcherplant (*Sarracenia purpurea*), roundleaf sundew (*Drosera rotundifolia*), swamp loosestrife (*Decodon verticillatus*), and white beaksedge (*Rhynchospora alba*) are typically growing on a thick sphagnum moss (*Sphagnum* sp.) mat.

                Leatherleaf Peatland

            5. Highbush blueberry (*Vaccinium corymbosum*) and other tall shrubs cover 50% or more of the wetland. A stunted dense layer of leatherleaf (*Chamaedaphne calyculata*) is prominent under the tall shrubs. The “bog” plants listed above are not common.

                Highbush Blueberry - Leatherleaf Wetland

        4. Leatherleaf (*Chamaedaphne calyculata*) is absent or a minor component of the wetland (cover < 50%).

6. Association occurs as a small patch community that contains calciphilic plants and is directly associated with groundwater seepage from calcareous bedrock. Shrubby cinquefoil (*Dasiphora floribunda*) and poison sumac (*Toxicodendron vernix*) are often present and may be abundant.

    7. Wetland contains active precipitation of marl deposits and the alga Chara (*Chara* spp.).

    Marl Fen

    7. Wetland does not contain active precipitation of marl deposits or the alga Chara (*Chara* spp.).

    Calcareous Fen

6. Association not limited to areas with groundwater seepage and does not contain calciphilic plants. Shrubby cinquefoil (*Dasiphora floribunda*) and poison sumac (*Toxicodendron vernix*) are absent. Area contains standing water in at least the early portion of the growing season or is associated with floodplains of creeks and drainages.

    8. Wetland is dominated by common buttonbush (*Cephalanthus occidentalis*) or alders (*Alnus* spp.).

        9. Vegetation is dominated by common buttonbush (*Cephalanthus occidentalis*). Wetland experiences prolonged or semi-permanent flooding and contains sparse herbaceous vegetation.

        Buttonbush Wetland

        9. Vegetation is dominated by smooth alder (*Alnus serrulata*) or mountain alder (*Alnus incana*). Tussock sedge (*Carex stricta*) is typically dominant (>50% cover) in the herbaceous layer.

        Alder Wetland

    8. Wetland is dominated by silky dogwood (*Cornus amomum*), multiflora rose (*Rosa multiflora*), highbush blueberry (*Vaccinium corymbosum*), and/or steeplebush (*Spiraea tomentosa*).

        10. Vegetation is dominated by silky dogwood (*Cornus amomum*), crack willow (*Salix fragilis*), Morrow's honeysuckle (*Lonicera morrowii*), and/or multiflora rose (*Rosa multiflora*) within a matrix of graminoids similar to those in a Wet Meadow or Reed Canarygrass Riverine Grassland. Wetland typically occurs on the floodplain of a creek or near a drainageway.

        Silky Dogwood Successional Palustrine Shrubland

10. Vegetation is dominated by highbush blueberry (*Vaccinium corymbosum*) and/or steeplebush (*Spiraea tomentosa*). Wetland occurs in a small upland depression or a basin surrounding a small streams.

Highbush Blueberry - Steeplebush Wetland

3. Terrestrial vegetation with no standing water, saturated soils, or groundwater seepage.

11. Shrubland typically occurs at mid to low elevations on former agricultural land. Characteristic shrubs are autumn-olive (*Elaeagnus umbellata*), gray dogwood (*Cornus racemosa*), multiflora rose (*Rosa multiflora*), eastern red cedar (*Juniperus virginiana*), eastern white pine (*Pinus strobus*), flowering dogwood (*Cornus florida*), Morrow's honeysuckle (*Lonicera morrowii*), smooth sumac (*Rhus glabra*), blackhaw (*Viburnum prunifolium*), and raspberries (*Rubus allegheniensis, Rubus phoenicolasius, Rubus occidentalis*). Herbaceous vegetation is typical of Old Field Vegetation.

Successional Shrubland

11. Shrubland is restricted to rocky soil at high elevations of the Kittatinny Ridge or the plateau in Pennsylvania. Associations typically occur above 200 meters elevation in New Jersey and above 150 meters in elevation in Pennsylvania. In general, the influential factors in vegetation structure and composition are harsh edaphic conditions and fire regimes. Characteristic shrubs include bear oak (*Quercus ilicifolia*), lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), black huckleberry (*Gaylussacia baccata*), sheep laurel (*Kalmia angustifolium*), mountain laurel (*Kalmia latifolia*) and eastern red cedar (*Juniperus virginiana*).

12. Shrubland occurs on cliffs, the crests of cliffs, bouldery outcrops, or steeply sloping bedrock outcrops. Bare rock can cover a significant portion of the area. Scattered stunted trees of eastern red-cedar (*Juniperus virginiana*), pignut hickory (*Carya glabra*), or pitch pine (*Pinus rigida*) are present.

13. Vegetation occurs on cliffs, the crests of cliffs, or steeply sloping bedrock outcrops. Aspect is generally to south to southeast with a slope greater than 25% (often greater than 50%). The sparse stunted shrubland is characterized by eastern red-cedar (*Juniperus virginiana*), pignut hickory (*Carya glabra*), and chestnut oak (*Quercus prinus*).

Hickory - Eastern Red-cedar Rocky Woodland

13. Vegetation occurs on bouldery ridgetop outcrops or steeply sloping bedrock outcrops. Aspect is variable. The sparse stunted trees are typically pitch pine (*Pinus rigida*) with occasional hardwood associates.

Pitch Pine - Mixed Hardwood Rocky Summit

12. Shrubland occurs at high elevations, but not on cliffs, bouldery outcrops or steep rocky slopes. Bare rock outcrops may be scattered, but do not cover a significant portion of the area. Trees are rare or absent.

    14. In general, ericaceous shrub layer covers 80-100% of the area, while grasses and forbs cover <5% of the area. Huckleberry (*Gaylussacia baccata*) and blueberries (*Vaccinium* spp.) are typically the dominant heath species, with bear oak (*Quercus ilicifolia*) as a common tall shrub associate. Association is created and maintained by fire.

        Successional Bear Oak - Heath Shrubland

    14. In general, ericaceous shrubs and bear oak (*Quercus ilicifolia*) cover 25-75% of the area, interspersed with graminoids that cover 40-70% of the area. Bear oak (*Quercus ilicifolia*) is often the dominant shrub species, with heath species such as black huckleberry (*Gaylussacia baccata*) and blueberries (*Vaccinium* spp.) as associates. Common graminoids include wavy hairgrass (*Deschampsia flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), and little bluestem (*Schizachyrium scoparium*). Association is influenced by thin soils over acidic bedrock, with fire as a secondary influence.

        Bear Oak - Wavy Hairgrass Shrubland

WOODLAND GROUP

1. Riparian or palustrine vegetation that contains saturated soil for at least part of the growing season or that occurs in the floodplain of the Delaware River, its major tributaries, or smaller drainages.

    2. Canopy is dominated by silver maple (*Acer saccharinum*) or black walnut (*Juglans nigra*).

        3. Canopy is dominated by silver maple (*Acer saccharinum*), often with a dense layer of reed canarygrass (*Phalaris arundinacea*) beneath.

            Silver Maple Floodplain Forest

        3. Canopy is dominated by black walnut (*Juglans nigra*), often with a dense layer of Japanese stilt grass (*Microstegium vimineum*) beneath.

            Black Walnut Bottomland Forest

    2. Canopy is dominated by red maple (*Acer rubrum*).

        4. Palustrine woodland that occurs above 150 meters elevation in New Jersey (currently only known from NJ). Open canopy is dominated by red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*), over a thick tall shub layer of highbush blueberry (*Vaccinium corymbosum*) or great laurel (*Rhododendron maximum*). Associates distinctive to this association include yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*), pitch pine (*Prinus rigida*), and black spruce (*Picea mariana*) in the canopy; and catberry (*Nemopanthus murcronatus*), and leatherleaf (*Chamaedaphne calyculata*) in the shrub layer. Common groundstory species include prickly bog sedge (*Carex atlantica* ssp. *capillacea*), northern long sedge (*Carex folliculata*), roundleaf sundew (*Drosera rotundifolia*), water arum (*Calla palustre*), threeleaf goldthread (*Coptis trifolia*).

            Red Maple - Black Spruce - Highbush Blueberry Palustrine Woodland

        4. Palustrine woodland does not contain the distinctive associates listed above.

            5. Woodland contains highbush blueberry (*Vaccinium corymbosum*) in the tall shrub layer (15-50% absolute cover). This association is often semi-permenantly or permenantly flooded.

                Red Maple - Highbush Blueberry Palustrine Forest

            5. Highbush blueberry (*Vaccinium corymbosum*) is sparse or absent (<15% absolute cover). Red maple (*Acer rubrum*) is the canopy dominant (25-95% relative cover) with a variety of associates. This association can be temporarily to permenantly flooded.

                Red Maple Palustrine Forest

1. Terrestrial forests that do not regularly experience saturated soils during the growing season or occur on the floodplain of river, creeks, or drainages.

    6. Vegetation is restricted to rocky and thin soils, often above 200 meters elevation in New Jersey and above 150 meters in elevation in Pennsylvania. Also includes rocky summits, rock outcrops, scree slopes, and talus slopes. In general, the influential factors in vegetation structure and composition are harsh edaphic conditions and fire regimes.

        7. Woodland occurs on very steep, often southeast-facing cliffs or scree, on gently to steeply sloping large bedrock outcrops, or on rocky summits.

            8. Woodland occurs on steep shale scree, typically at mid- to lower slopes in Pennsylvania. Typical trees include eastern white pine (*Pinus strobus*), gray birch (*Betula populifolia*), and tree of heaven (*Ailanthus altissima*).

                Shale Scree Slope

            8. Woodland occurs on cliffs, gently to steeply sloping large bedrock outcrops, or rocky summits in Pennsylvania or New Jersey.

                9. Woodland occurs among rock outcrops on upper slopes or on the crests of cliffs along Kittatinny Ridge. Aspect is generally to south to southeast with a slope greater than 25% (often greater than 50%). Characteristic trees include pignut hickory (*Carya glabra*), eastern red-cedar (*Juniperus virginiana*), pitch pine (*Pinus rigida*), and chestnut oak (*Quercus prinus*).

                    Hickory - Eastern Red-cedar Rocky Woodland

                9. Woodland occurs on gently to moderately steep sloping (slope <25%) rock outcrops and rocky summits. Characteristic trees include pitch pine (*Pinus rigida*), pignut hickory (*Carya glabra*), chestnut oak (*Quercus prinus*), and sweet birch (*Betula lenta*).

                    Pitch Pine - Mixed Hardwood Rocky Summit

        7. Woodland does not occur on very steep, often southeast-facing cliffs or scree, on gently to steeply sloping large bedrock outcrops, or on rocky summits.

            10. Woodland contains a thick layer of shrubs (often ericaceous) that cover greater than 40% of the area. Typical shrub species include lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), black huckleberry (*Gaylussacia baccata*), sheep laurel (*Kalmia angustifolium*), mountain laurel (*Kalmia latifolia*), and bear oak (*Quercus ilicifolia*).

11. Open canopy consists of scattered established trees with diameters at breast height typically >20 cm. Tyipcal tree species are: oaks (*Quercus prinus, Quercus coccinea, Quercus rubra, Quercus alba, Quercus velutina*), blackgum (*Nyssa sylvatica*), eastern white pine (*Pinus strobus*), sweet birch (*Betula lenta*), pignut hickory (*Carya glabra*) and/or pitch pine (*Pinus rigida*).
Dry Oak - Heath Forest

11. Open canopy consists of newly established trees with diameters at breast height typically <20 cm. Common species include quaking aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*), gray birch (*Betula populifolia*), sweet birch (*Betula lenta*), and black cherry (*Prunus serotina*).
Successional Heath Shrubland

10. Woodland does not contain a thick layer of typically ericaceous shrubs that cover greater than 40% of the area.

12. Ridgetop woodland is dominated or co-dominated by hickories (*Carya* spp.) that cover >25% of the canopy. Frequent on upper slopes of the southeast face of Kittatiny Ridge. Occasional as small patch in other sections of the Ridge.
Dry Hickory Ridgetop Forest

12. Woodland dominated by oaks (*Quercus* spp.) and/or pines (*Pinus* spp.)

13. Eastern white pine (*Pinus strobus*) and/or pitch pine (*Pinus rigida*) constitute greater than 25% relative cover in the canopy and subcanopy combined. Dry oaks (*Quercus prinus*, *Quercus rubra*, *Quercus velutina*, *Quercus alba*, *Quercus coccinea*) are the canopy associates. The stands often contain a thick layer of regenerating pine in the tall shrub layer.
Dry Eastern White Pine - Oak Forest

13. Eastern white pine (*Pinus strobus*) and/or pitch pine (*Pinus rigida*) constitute less than 25% relative cover in the canopy and subcanopy combined.

14. Woodland occurs on coarse, bouldery sandstone talus, either on the rocky steep southeast-facing slope of the Kittatiny Ridge or on occasional boulderfields in other sections of the park. Chestnut oak (*Quercus prinus*) and sweet birch (*Betula lenta*) are common canopy components.
Oak Talus Forest

14. Woodland occurs on coarse, bouldery sandstone talus. Canopy is dominated by dry oaks (*Quercus prinus, Quercus alba, Quercus coccinea, Quercus velutina*) with hickories (*Carya* spp.) and sweet birch (*Betula lenta*) as associates. The herbaceous layer is often dominated by graminoids.

Dry Oak - Mixed Hardwood Forest

6. Vegetation is not restricted to rocky sites with thin soils. In general, current vegetation structure and composition are most influenced by past land management and land use history (for former shale quarry sites, see rocky couplet above).

15. Woodland dominated by conifers such as eastern red-cedar (*Juniperus virginiana*), pine (*Pinus* spp.) or spruce (*Picea* spp.).

16. Open woodland dominated by young eastern red-cedar (*Juniperus virginiana*) with diameters at breast height typically <20 cm. Groundstory vegetation is typically dense and characteristic of Old Field Vegetation and.shrubs are often characterisitic of Successional Shrublands.

Eastern Red-cedar Forest

16. Woodland dominated by pine (*Pinus* spp.) or spruce (*Picea* spp.).

17. Open woodland dominated by young eastern white pine (*Pinus strobus*) with diameters at breast height typically <20 cm. Groundstory vegetation is typically dense and characteristic of Old Field Vegetation and.shrubs are often characterisitic of Successional Shrublands.

Successional Eastern White Pine Woodland

17. Woodland is dominated by scattered established eastern eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), blue spruce (*Picea pungens*) or larch (*Larix* sp.) with diameters at breast height typically >20 cm. Conifers appear planted in a pattern (typically in rows). Adventitious hardwoods may be present. The herbaceous layer is usually sparse with low diversity.

Conifer Plantation

15. Woodland dominated by hardwoods (eastern red-cedar [*Juniperus virginiana*] may be co-dominant in some stands).

18. Groundstory vegetation is typically dense and characteristic of Old Field Vegetation and.shrubs are often characterisitic of Successional Shrublands. Woodland is composed of scattered open-grown trees, of variable species composition.

Wooded Successional Old Field

18. Groundstory vegetation is not characteristic of Old Field Vegetation and shrubs are not characterisitic of Successional Shrublands. Woodland is characterized by early successional, weedy species such as black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), eastern red-cedar (*Juniperus virginiana*), bigtooth aspen (*Populus grandidentata*), black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*) and eastern white pine (*Pinus strobus*). Invasive shrub and herb species are characteristic and abundant

    19. Black walnut (*Juglans nigra*) is the clear canopy dominant, often with a dense layer of Japanese stilt grass (*Microstegium vimineum*) beneath.
    Black Walnut Bottomland Forest

    19. Black walnut (*Juglans nigra*) is not the clear canopy dominant, although it can be an associate. White ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), eastern red-cedar (*Juniperus virginiana*), bigtooth aspen (*Populus grandidentata*), and black cherry (*Prunus serotina*) are common canopy dominants. Invasive shrub and herb species are characteristic and abundant.
    Northeastern Modified Successional Forest

FOREST GROUP

1. Riparian or palustrine vegetation that contains saturated soil for at least part of the growing season OR that occurs in the alluvial or glacial floodplain terraces of the Delaware River Valley. Please note that some terrestrial forest associations can also occur on these floodplain terraces (see couplet 12 below).

    2. Forest is dominated by silver, sugar, or red maple (*Acer* spp.) that constitute at least 25% relative cover of the canopy. Numerous species may be present as associates, but each of the following species do not constitute more than 25% relative cover of the canopy: sycamore (*Platanus occidentalis*), bitternut hickory (*Carya cordiformis*), river birch (*Betula nigra*), eastern hemlock (*Tsuga canadensis*), oaks (*Quercus palustris*, *Quercus bicolor*), ashes (*Fraxinus nigra, Fraxinus americana, Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and American hornbeam (*Carpinus caroliniana*). If maples constitute 25-50% relative cover, and one of the above species constitutes greater than 25% relative cover, see couplet 6 below.

        3. Forest is dominated by silver maple (*Acer saccharinum*) or sugar maple (*Acer saccharum*). Forest typically occurs on the floodplain of the Delaware River or its major tributaries.

            4. Silver maple (*Acer saccharinum*) constitutes at least 25% relative cover of the canopy; frequently relative cover exceeds 50%. Sugar maple (*Acer saccharum*) can be absent or co-dominant.

                Silver Maple Floodplain Forest

            4. Silver maple (*Acer saccharinum*) and sycamore (*Platanus occidentalis*) are absent or are occasional canopy associates (<25% relative cover). Sugar maple (*Acer saccharum*) constitutes at least 25% relative cover of the canopy and is prominent in the subcanopy; frequently relative cover exceeds 50%. [If sycamore canopy cover exceeds 25% relative cover, see couplet 10 below].

                Sugar Maple Floodplain Forest

        3. Forest is dominated by red maple (*Acer rubrum*) and typically occurs around smaller drainages, in depressions, and near groundwater seepage.

            5. Forest contains red maple (*Acer rubrum*) in the canopy (>50% relative cover) and highbush blueberry (*Vaccinium corymbosum*) in the tall shrub layer (15-50% absolute cover). This association is often semi-permenantly or permenantly flooded.

                Red Maple - Highbush Blueberry Palustrine Forest

5. Highbush blueberry (*Vaccinium corymbosum*) is sparse or absent (<15% absolute cover). Red maple (*Acer rubrum*) is the canopy dominant (25-95% relative cover) with a variety of associates. This association can be temporarily to permenantly flooded.

Red Maple Palustrine Forest

2. Forest is not dominated by silver, sugar, or red maple (*Acer* spp.). Canopy is dominated by one or more of the following species that can constitute more than 25% relative cover of the canopy: sycamore (*Platanus occidentalis*), bitternut hickory (*Carya cordiformis*), river birch (*Betula nigra*), eastern hemlock (*Tsuga canadensis*), oaks (*Quercus palustris, Quercus bicolor*), ashes (*Fraxinus nigra, Fraxinus americana, Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and American hornbeam (*Carpinus caroliniana*). Maples may constitute 25-50% relative cover, if one of the above species constitutes grater than 25% relative cover.

6. Eastern hemlock (*Tsuga canadensis*) composes 25% or greater in the canopy and subcanopy combined. Common canopy associates include red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and/or blackgum (*Nyssa sylvatica*). Forest occurs along small creeks and drainages.

Eastern Hemlock - Mixed Hardwood Palustrine Forest

6. Eastern hemlock (*Tsuga canadensis*) composes less than 25% in the canopy and subcanopy combined. Canopy dominants are bitternut hickory (*Carya cordiformis*), black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), oaks (*Quercus palustris, Quercus bicolor*), ashes (*Fraxinus nigra, Fraxinus americana, Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and/or American hornbeam (*Carpinus caroliniana*).

7. Canopy dominants are bitternut hickory (*Carya cordiformis*) or black walnut (*Juglans nigra*).

8. Bitternut hickory (*Carya cordiformis*) constitutes at least 25% relative cover of the canopy; frequently relative cover exceeds 50%. Forest occurs on the floodplain of the Delaware River or its major tributaries.

Bitternut Hickory Lowland Forest

8. Black walnut (*Juglans nigra*) is the clear canopy dominant; frequently relative cover exceeds 50%. Forest can occur on the floodplain of the Delaware River, its major tributaries, or in smaller drainages and swales

Black Walnut Bottomland Forest

7. Canopy dominants are sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), oaks (*Quercus palustris, Quercus bicolor*), ashes (*Fraxinus nigra, Fraxinus americana, Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and/or American hornbeam (*Carpinus caroliniana*).

9. Forest is dominated by pin oak (*Quercus palustris*) and/or swamp white oak (*Quercus bicolor*) with 25–75% relative cover in the canopy. Common canopy associates include red maple (*Acer rubrum*), American hornbeam (*Carpinus caroliniana*), ashes (*Fraxinus americana, Fraxinus nigra, Fraxinus pennsylvanica*), and American elm (*Ulmus americana*).

Bottomland Oak Palustrine Forest

9. Mesic oaks (*Quercus palustris, Quercus bicolor*) have relative cover less than 25% in the canopy. Canopy dominants are sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), ashes (*Fraxinus nigra, Fraxinus americana, Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and/or American hornbeam (*Carpinus caroliniana*).

10. Sycamore (*Platanus occidentalis*) constitutes at least 25% relative cover in the canopy.

11. Sycamore (*Platanus occidentalis*) constitutes 50% or greater relative cover of the canopy, usually with ash (*Fraxinus* spp.) as an associate.

Sycamore Floodplain Forest

11. Sycamore (*Platanus occidentalis*) constitutes less than 50% relative cover of the canopy, and co-occurs with sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), white ash (*Fraxinus americana*) and/or river birch (*Betula nigra*).

Sycamore - Mixed Hardwood Floodplain Forest

10. Forest is typically weedy. None of the following species show clear dominance (>25% relative canopy cover): sycamore (*Platanus occidentalis*), eastern hemlock (*Tsuga canadensis*), mesic oaks (*Quercus palustris, Quercus bicolor*), red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), or bitternut hickory (*Carya cordiformis*), though these species may be present as associates. Canopy can be dominated by one or more of the following: black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvanica*), American hornbeam (*Carpinus caroliniana*), and/or river birch (*Betula nigra*).

Bottomland Mixed Hardwood Palustrine Forest

1. Terrestrial forests that do not regularly experience saturated soils during the growing season.

12. Within the canopy and subcanopy combined, conifers have relative cover of 75% or greater.

CONIFEROUS TERRESTRIAL FOREST SUBGROUP

12. Within the canopy and subcanopy combined, conifers have relative cover less than 75%.

13. Within the canopy and subcanopy combined, conifers have relative cover between 25–75%.

MIXED TERRESTRIAL FOREST SUBGROUP

13. Within the canopy and subcanopy combined, conifers have relative cover less than 25%.

DECIDUOUS TERRESTRIAL FOREST SUBGROUP

CONIFEROUS TERRESTRIAL FOREST SUBGROUP

[Note: Due to hemlock decline, observed foliar cover in hemlocks may be lower than the percentages listed in the key.]

1. Successional forest dominated by eastern red-cedar (*Juniperus virginiana*), with some of the following associates: white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), bigtooth aspen (*Populus grandidentata*), black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*) and eastern white pine (*Pinus strobus*).

Eastern Red-cedar Forest

1. Forest not dominated by eastern red-cedar (*Juniperus virginiana*) with early successional and weedy associates.

    2. Relative cover of pines (*Pinus* spp.) or spruces (*Picea* spp.) in the canopy and subcanopy combined is greater than the relative cover of eastern hemlock (*Tsuga canadensis*) in the canopy and subcanopy combined. Eastern red-cedar (*Juniperus virginiana*) may be common in the subcanopy.

        3. Forest is dominated by eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), blue spruce (*Picea pungens*) or larch (*Larix* sp.). Adventitious hardwoods may be present as associates. Common species include: white ash (*Fraxinus americana*), flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), American hornbeam (*Carpinus caroliniana*), sweet birch (*Betula lenta*), oaks (*Quercus* spp.) and hickories (*Carya* spp.). Eastern red-cedar (*Juniperus virginiana*) may be common in the subcanopy. Canopy conifer trees are even-aged and often regularly spaced.

Conifer Plantation

        3. Forest is dominated by eastern white pine (*Pinus strobus*), with associates pitch pine (*Pinus rigida*), eastern hemlock (*Tsuga canadensis*), sweet birch (*Betula lenta*), mockernut hickory (*Carya alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), sugar maple (*Acer saccharum*), and red maple (*Acer rubrum*). Canopy trees are not even-aged or regularly spaced.

Eastern White Pine Forest

    2. Relative cover of eastern hemlock (*Tsuga canadensis*) in the canopy and subcanopy combined is greater than the relative cover of pines (*Pinus* spp.) or spruces (*Picea* spp.) in the canopy and subcanopy combined.

Eastern Hemlock Forest

MIXED TERRESTRIAL FOREST SUBGROUP

[Note: Due to hemlock decline, observed foliar cover in hemlocks may be lower than the percentages listed in the key.]

1. Successional forest dominated by eastern red-cedar (*Juniperus virginiana*) or eastern white pine (*Pinus strobus*), with early successional, weedy associates such as white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), bigtooth aspen (*Populus grandidentata*), black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), and red maple (*Acer rubrum*). Abundant invasive herb, shrub and vine species are characteristic.

Northeastern Modified Successional Forest

1. Forest is not as described above.

    2. Relative cover of pines (*Pinus* spp.) or spruces (*Picea* spp.) in the canopy and subcanopy combined is greater than the relative cover of eastern hemlock (*Tsuga canadensis*) in the canopy and subcanopy combined. Eastern red-cedar (*Juniperus virginiana*) may be common in the subcanopy.

        3. Forest is dominated by eastern white pine (*Pinus strobus*), red pine (*Pinus resinosa*), Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), blue spruce (*Picea pungens*) or larch (*Larix* sp.). Adventitious hardwoods are present as associates in the canopy or subcanopy. Common species include: white ash (*Fraxinus americana*), flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), American hornbeam (*Carpinus caroliniana*), sweet birch (*Betula lenta*), oaks (*Quercus* spp.) and hickories (*Carya* spp.). Eastern red-cedar (*Juniperus virginiana*) may be common in the subcanopy. Canopy trees are even-aged and often regularly spaced.

Conifer Plantation

        3. Forest is dominated by eastern white pine (*Pinus strobus*), with hardwood associates typical of dry oak forests or northern hardwood forests. Canopy trees are not even-aged or regularly spaced.

            4. Forest occurs on dry sites. Canopy is composed of eastern white pine (*Pinus strobus*), pitch pine (*Pinus rigida*), dry oaks (*Quercus prinus, Quercus rubra, Quercus velutina, Quercus alba, Quercus coccinea*), eastern hemlock (*Tsuga canadensis*) and eastern red-cedar (*Juniperus virginiana*) as associates. Common shrubs include bear oak (*Quercus ilcifolia*), mountain laurel (*Kalmia latifolia*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), and eastern teaberry (*Gaultheria procumbens*). Dense eastern white pine regeneration may be present in shrub layer. The herbaceous layer is typically very sparse (<5% cover).

Dry Eastern White Pine - Oak Forest

4. Forest occurs on dry-mesic to mesic sites. Canopy is composed of eastern white pine (*Pinus strobus*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), and mesic oaks (*Quercus rubra, Quercus palustris*), with associates eastern-red cedar (*Juniperus virginiana*), eastern hemlock (*Tsuga canadensis*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), bigtooth aspen (*Populus grandidentata*), sugar maple (*Acer saccharum*), bitternut hickory (*Carya cordiformis*) and yellow birch (*Betula alleghaniensis*). Common shrubs include northern spicebush (*Lindera benzoin*), common winterberry (*Ilex verticillata*), blackhaw (*Viburnum prunifolium*), southern arrowwood (*Viburnum dentatum*), Japanese barberry (*Berberis thunbergii*), mapleleaf viburnum (*Viburnum acerifolium*), and raspberries (*Rubus* spp.). Ericaceous shrubs (*Kalmia* spp., *Gaylussacia* spp., *Vaccinium* spp.) may be occasional in this type. The herbaceous layer is usually sparse to moderately dense.

Eastern White Pine - Successional Hardwood Forest

2. Relative cover of eastern hemlock (*Tsuga canadensis*) in the canopy and subcanopy combined is greater than the relative cover of pines (*Pinus* spp.) or spruces (*Picea* spp.) in the canopy and subcanopy combined.

5. Canopy is composed of eastern hemlock (*Tsuga canadensis*), dry oaks (*Quercus prinus, Quercus rubra, Quercus velutina, Quercus alba*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), hickories (*Carya glabra*, *Carya alba*), blackgum (*Nyssa sylvatica*), and common serviceberry (*Amelanchier arborea*). Common shrubs include: great laurel (*Rhododendron maximum*), mountain laurel (*Kalmia latifolia*), American witch-hazel (*Hamamelis virginiana*), Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*). The herb layer is also characteristically sparse (0-10% cover).

Dry Eastern Hemlock - Oak Forest

5. Canopy is composed of eastern hemlock (*Tsuga canadensis*) with mesic associates such as sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), yellow birch (*Betula alleghaniensis*), tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). Oaks (*Quercus rubra*, Q*uercus alba, Quercus prinus*) may be present but are not co-dominant as in the Dry Eastern Hemlock - Oak Forest.

Eastern Hemlock - Northern Hardwood Forest

DECIDUOUS TERRESTRIAL FOREST SUBGROUP

1. In general, forests occur on dry sites, mid- to upper slopes, and ridgetops. In general, forests are dominated by dry oaks (*Quercus prinus, Quercus alba, Quercus coccinea, Quercus velutina, Quercus rubra*) and/or hickories (*Carya glabra, Carya alba, Carya ovalis*). Common associates include red maple (*Acer rubrum*), sweet birch (*Betula lenta*), blackgym (*Nyssa sylvatica*), eastern white pine (*Pinus strobus*), pitch pine (*Pinus rigida*), and eastern hemlock (*Tsuga canadensis*). Characteristic shrubs are ericaceous species (*Gaylussacia baccata, Vaccinium* spp.*, Kalmia* spp.*).*

    2. Forests contains dense tall and/or short shrub layer (40-95% absolute cover) dominated by ericaceous species (*Gaylussacia baccata, Vaccinium* spp., *Kalmia* spp.).

        3. Canopy is composed of young quaking aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*), gray birch (*Betula populifolia*) and sweet birch (*Betula lenta*). Scattered individuals of pitch pine (*Pinus rigida*), scarlet oak (*Quercus coccinea*) and chestnut oak (*Quercus prinus*) may be also present.

            Successional Heath Shrubland

        3. Canopy is composed of established chestnut oak (*Quercus prinus*), northern red oak (*Quercus rubra*) and/or white oak (*Quercus alba*). Other common canopy associates include scarlet oak (*Quercus coccinea*), sweet birch (*Betula lenta*), red maple (*Acer rubrum*), pignut hickoty (*Carya glabra*), black oak (*Quercus velutina*), pitch pine (*Pinus rigida*), blackgum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), eastern white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*).

            Dry Oak - Heath Forest

    2. Ericaceous shrubs (*Gaylussacia baccata, Vaccinium* spp., *Kalmia* spp.) cover less than 40% of the forest floor.

        4. The relative cover of hickories (*Carya* spp.) in the canopy and subcanopy combined exceeds the relative cover of oaks (*Quercus* spp.).

            Dry Hickory Ridgetop Forest

        4. The relative cover of oaks (*Quercus* spp.) in the canopy and subcanopy combined exceeds the relative cover of hickories (*Carya* spp.).

            5. Forest occurs on the rocky steep sandstone talus boulderfields. The open forest canopy is dominated by chestnut oak (*Quercus prinus*) and/or sweet birch (*Betula lenta*), with associates pignut hickory (*Carya glabra*), mockernut hickory (*Carya alba*), blackgum (*Nyssa sylvatica*), black oak (*Quercus velutina*), white oak (*Quercus alba*), red maple (*Acer ruburm*), eastern white pine (*Pinus strobus*) and pitch pine (*Pinus rigida*).

                Oak - Birch Talus Forest

            5. Forest does not occur on the rocky steep sandstone talus boulderfields.

6. Chestnut oak (*Quercus prinus*) and/or white oak (*Quercus alba*) are dominant with associates other oaks (*Quercus velutina, Quercus coccinea, Quercus rubra*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), hickories (*Carya glabra, Carya alba, Carya ovalis*), eastern hemlock (*Tsuga canadensis*), blackgum (*Nyssa sylvatica*), eastern white pine (*Pinus strobus*), pitch pine (*Pinus rigidia*), and rarely sugar maple (*Acer saccharum*). Patches of ericaceous shrubs species (*Kalmia* spp., *Gaylussacia baccata, Vaccinium* spp.) are typical. Common groundstory species are wavy hairgrass (*Deschampsia flexuosa*), Swan's sedge (*Carex swanii*), partridgeberry (*Mitchella repens*), striped prince's pine (*Chimaphila maculata*), Pennsylvania sedge (*Carex pensylvanica*), marginal woodfern (*Dryopteris marginalis*), wild sarsaparilla (*Aralia nudicaulis*), and starflower (*Trientalis borealis*).

Dry Oak - Mixed Hardwood Forest

6. Northern red oak (*Quercus rubra*) is often the most prominent oak species with associates of other oak species (*Quercus velutina, Quercus alba, Quercus coccinea, Quercus prinus*), hickories (*Carya glabra, Carya cordiformis, Carya ovata*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), sugar maple (*Acer saccharum*), tuliptree (*Liriodendron tulipifera*) and white ash (*Fraxinus amercana*). Common shrubs include American hornbeam (*Carpinus caroliniana*), northern spicebush (*Lindera benzoin*), and Japanese barberry (*Berberis thunbergii*). Characteristic herbs include Christmas fern (*Polystichum acrostichoides*), garlic mustard (*Alliaria petiolata*), and mayapple (*Podophyllum peltatum*).

Northern Red Oak - Mixed Hardwood Forest

1. In general, forests occur on dry-mesic to mesic sites, mid- to lower slopes, and low elevations. In general, forests are dominated by maples (*Acer* spp.), birches (*Betula* spp.), tuliptree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), bitternut hickory (*Carya cordiformis*), and/or American basswood (*Tilia americana*). Also included here are young hardwood forests in which diameter at breast height of canopy trees does not exceed 25 cm for most trees, and forests dominated by early successional or weedy trees with abundant invasive species. Characteristic shrubs are northern spicebush (*Lindera benzoin*), American witch-hazel (*Hamamelis virginiana*), American hornbeam (*Carpinus caroliniana*), common winterberry (*Ilex verticillata*) and raspberries (*Rubus* spp.).

7. Successional forest dominated by early successional, weedy species such as white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), bigtooth aspen (*Populus grandidentata*), black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), eastern red-cedar (*Juniperus virginiana*) and eastern white pine (*Pinus strobus*). Abundant invasive herb, shrub and vine species are characteristic.

Northeastern Modified Successional Forest

7. Forest is not dominated by early successional, weedy tree species, invasive herb, shrub and vine species.

8. Oaks species (most commonly *Quercus rubra*, also *Quercus velutina* and *Quercus alba*) constitute at least 25% relative cover in the canopy. Common associates include red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*), and hickories (*Carya glabra*, *Carya cordiformis*).

Northern Red Oak - Mixed Hardwood Forest

8. Oaks species (*Quercus* spp.) constitute less than 25% relative cover in the canopy.

    9. Tuliptree (*Liriodendron tulipifera*) constitutes at least 25% relative cover in the canopy. Common associates include red maple (*Acer rubrum*), white ash (*Fraxinus americana*), sweet birch (*Betula lenta*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*).

Tuliptree - Beech - Maple Forest

    9. Tuliptree (*Liriodendron tulipifera*) constitutes less than 25% relative cover in the canopy.

        10. Sweet birch (*Betula lenta*) and/or red maple (*Acer rubrum*) constitute at least 50% relative cover in the canopy and subcanopy. Sugar maple (*Acer saccharum*) is not a significant component of the canopy or subcanopy. In general, forest is not restricted to calcareous bedrock. Current species composition and forest structure is generally influenced significantly by previous silvicultural or agricultural activities.

Red Maple - Sweet Birch Hardwood Forest

        10. Sweet birch (*Betula lenta*) and/or red maple (*Acer rubrum*) constitute less than 50% relative cover in the canopy. Sugar maple (*Acer saccharum*) is a significant component of the canopy or subcanopy. In general, forest tends to occur over calcareous bedrock and is less disturbed than Red Maple - Sweet Birch Hardwood Forest.

            11. American basswood (*Tilia americana*) constitutes at least 25% relative cover in the canopy, with associates sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*), yellow birch (*Betula alleghaniensis*), oaks (*Quercus* spp.), eastern hemlock (*Tsuga canadensis*), and white ash (*Fraxinus americana*). Forest often on steep slopes with diverse, rich herbaceous layer containing bloodroot (*Sanguinaria canadensis*), blue cohosh (*Caulophyllum thalictroides*), dogtooth violet (*Erythronium americanum*), Virginia springbeauty (*Claytonia virginica*), northern maidenhair fern (*Adiantum pedatum*) and Canadian wild ginger (*Asarum canadense*).

Sugar Maple - American Basswood Forest

11. American basswood (*Tilia americana*) constitutes less than 25% relative cover in the canopy. Canopy dominants include sugar maple (*Acer saccharum*) and sweet birch (*Betula lenta*), with associates northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), pignut hickory (*Carya glabra*), red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), and white ash (*Fraxinus americana*).

Sugar Maple - American Beech - Sweet Birch Forest

Appendix G

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

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

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

COMMON NAME (PARK-SPECIFIC): CONIFER PLANTATION

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

LOCAL INFORMATION

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

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

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

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

Other Comments: None.

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

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

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	*Pinus strobus* Planted Forest Alliance (A.98)

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

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

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

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

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: This type is intended for plantations of mixed pines or pine mixed with other non-native planted conifers.
Similar Associations:
- *Pinus strobus* Planted Forest (CEGL007178)--monotypic white pine.

Related Concepts: Information not available.

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

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

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

COMMON NAME (PARK-SPECIFIC): EASTERN HEMLOCK FOREST

SYNONYMS

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

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

NVC Identifier: **CEGL006328**

LOCAL INFORMATION

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

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

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

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

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

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

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

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

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

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

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

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

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

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

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

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

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

SYNONYMS

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

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

NVC Identifier: **CEGL006328**

LOCAL INFORMATION

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

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

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

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

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

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

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

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

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

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

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

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

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

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

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

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

LOCAL INFORMATION

Environmental Description: Successional Eastern White Pine Woodland occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed. This association develops with white pine colonizing open fields, typically from the outer edges of the field into the center or as scattered clumps throughout the field. Over time, these sites will succeed into Eastern White Pine Forest or Northeastern Modified Successional Forest if left unmanaged. Some of these fields are mowed or brushcut only in strips or paths that crisscross the field. These sites contain moderately well-drained to well-drained soils, typical of the following series: Wallpack, Lordstown, Nassau, Manlius, Hoosic, Otisville, and Hazen. The woodlands are flat to gently sloping, often bounded by stonewalls or fencerows.

Vegetation Description: The vegetation structure of Successional Eastern White Pine Woodland contains scattered trees covering 25-60% of the field. Eastern white pine (*Pinus strobus*) is the characteristic tree, which typically extends from 5-10 m in height. Occasionally, Norway spruce (*Picea abies*) or white spruce (*Picea glauca*) may occur with or in place of the eastern white pine trees. Eastern red-cedar (*Juniperus virginiana*) is often present but is not dominant or codominant. Tall and short shrubs can be scattered throughout the field. Characteristic tall shrubs include autumn-olive (*Elaeagnus umbellata*), gray dogwood (*Cornus racemosa*), multiflora rose (*Rosa multiflora*), eastern red-cedar, flowering dogwood (*Cornus florida*), Morrow's honeysuckle (*Lonicera morrowii*), smooth sumac (*Rhus glabra*), blackhaw (*Viburnum prunifolium*), Japanese barberry (*Berberis thunbergii*), Allegheny blackberry (*Rubus allegheniensis*), wine raspberry (*Rubus phoenicolasius*), and black raspberry (*Rubus occidentalis*). The herbaceous layer is variable depending on the density of tree and shrub cover. Typical species are those associated with old fields, little bluestem grasslands, and agricultural sites. Common species include wrinkleleaf goldenrod (*Solidago rugosa*), wild bergamot (*Monarda fistulosa*), sweet vernalgrass (*Anthoxanthum odoratum*), eastern poison ivy (*Toxicodendron radicans*), Kentucky bluegrass (*Poa pratensis*), common yellow oxalis (*Oxalis stricta*), flat-top goldentop (*Euthamia graminifolia*), giant goldenrod (*Solidago gigantea*), red fescue (*Festuca rubra*), little bluestem (*Schizachyrium scoparium*), Virginia mountainmint (*Pycnanthemum virginianum*), false baby's breath (*Galium mollugo*), common dandelion (*Taraxacum officinale*), common cinquefoil (*Potentilla simplex*), common yarrow (*Achillea millefolium*), Queen Anne's lace (*Daucus carota*), white clover (*Trifolium repens*), smooth brome (*Bromus inermis*), redtop (*Agrostis gigantea*), and quackgrass (*Elymus repens*), among many others.

Most Abundant Species:

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

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

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

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

GLOBAL INFORMATION

NVC CLASSIFICATION

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

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

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

DISTRIBUTION
Range: This weedy type may be expected to occur throughout the range of the alliance (i.e., from Michigan, northern Wisconsin, northern and eastern Minnesota, extreme northeastern Iowa, from Maine and New Hampshire south to Georgia and Tennessee, as well as in Ontario, Canada). It has only been documented in areas where project-specific needs have required it.
States/Provinces: CT, GA, KY, MA, MD?, ME, MI, MN, NC, NH, NJ, NY, PA, RI, SC, TN, VA, VT, WI, WV.
Federal Lands: NPS (Big South Fork, Blue Ridge Parkway, Carl Sandburg Home, Delaware Water Gap, Gettysburg, Great Smoky Mountains, Marsh-Billings-Rockefeller, New River Gorge, Obed, Saint-Gaudens); USFS (Cherokee?, Daniel Boone, George Washington, Jefferson); USFWS (Great Meadows, Moosehorn).

CONSERVATION STATUS
Rank: GNA (ruderal) (11-Feb-2001).
Reasons: This forest represents early successional vegetation and is thus not of conservation concern and does not receive a conservation status rank.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This weedy type may be expected to occur throughout the range of the alliance but has only been attributed in areas where The Nature Conservancy ecoregional planning or other project-specific needs have documented its occurrence. Rangewide review should greatly expand its geographic scope.
Similar Associations:
- *Pinus strobus* Planted Forest (CEGL007178).

Related Concepts: Information not available.

SOURCES
Description Authors: K. D. Patterson, mod. L. A. Sneddon and S. C. Gawler.
References: Fleming and Coulling 2001, NatureServe Ecology - Southeastern U.S. unpubl. data, Southeastern Ecology Working Group n.d., TDNH unpubl. data.

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

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

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

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

LOCAL INFORMATION

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Old-field Eastern Red-cedar Forest	Walz et al 2006
PA	SNA	1	no crosswalk	Fike 1999

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

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

Other Comments: None.

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

Plots and Data Sources: DEWA.81.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)

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

GLOBAL DESCRIPTION

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

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

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

Most Abundant Species:

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

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

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

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

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

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

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

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

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

LOCAL INFORMATION

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

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

Most Abundant Species:

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

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

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

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

Local Range: This forest type occurs occasionally throughout the park in a variety of palustrine settings.
Classification Comments: Hemlock - Mixed Hardwood Palustrine Forest can be distinguished from other palustrine forests by the codominance of *Tsuga canadensis* in the canopy, often with *Acer rubrum, Betula alleghaniensis*, and/or *Nyssa sylvatica*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.74, DEWA.95, DEWA.168; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar needle-leaved evergreen forest (I.A.8.N.)
Formation	Saturated temperate or subpolar needle-leaved evergreen forest (I.A.8.N.g.)
Alliance	*Tsuga canadensis* Saturated Forest Alliance (A.201)
Alliance (English name)	Eastern Hemlock Saturated Forest Alliance
Association	*Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest
Association (English name)	Eastern Hemlock / Great Laurel / Peatmoss species Forest
Ecological System(s):	North-Central Appalachian Acidic Swamp (CES202.604)

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

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

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

Federal Lands: NPS (Delaware Water Gap).

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

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

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

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

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

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

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

SYNONYMS

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

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

NVC Identifier: **CEGL006252**

LOCAL INFORMATION

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

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

Most Abundant Species:

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

Characteristic Species: *Acer saccharum, Betula lenta, Carpinus caroliniana, Fagus grandifolia, Lindera benzoin, Mitchella repens, Ostrya virginiana, Polystichum acrostichoides*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

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

Local Range: This association likely occurs throughout the park on gentle to steep midslopes with a northerly or, less commonly, eastern aspect. This association is usually found over calcareous bedrock.
Classification Comments: The association differs from other hardwood types by the strong dominance of one or two of the following species: *Acer saccharum, Betula lenta,* and *Fagus grandifolia*. It lacks a significant oak component typical of the oak-dominated hardwood forests such as Northern Red Oak - Mixed Hardwood Forest. This type is distinguished from Sugar Maple - American Basswood Forest by having relatively low cover or absence of *Tilia americana*. It is distinguished from Sugar Maple Floodplain Forest in that it does not occur on the floodplain of the Delaware River or its tributaries. This type differs from Red Maple - Sweet Birch Hardwood Forest as the latter is typically dominated by *Acer rubrum* (occasionally *Betula lenta*), does not contain significant cover of *Acer saccharum*, and is generally influenced significantly by previous silvicultural or agricultural activities.
Other Comments: None.
Local Description Authors: G. S. Podniesinski and S. J. Perles (PNHP).
Plots and Data Sources: DEWA.33, DEWA.43, DEWA.45, DEWA.156, DEWA.169, DEWA.174, DEWA.203, DEWA.240; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

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

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

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

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

Most Abundant Species:

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

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

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

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

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

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations:
- *Acer saccharum - (Fraxinus americana) / Arisaema triphyllum* Forest (CEGL006211).
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004).
- *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008).
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005).
- *Picea rubens - Betula alleghaniensis / Dryopteris campyloptera* Forest (CEGL006267).
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173).
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129).

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

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

SOURCES

Description Authors: S. C. Gawler.

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

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

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

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

SYNONYMS

NVC English Name: **Sugar Maple - White Ash - Butternut / American Bladdernut Forest**

NVC Scientific Name: ***Acer saccharum - Fraxinus americana - Juglans cinerea / Staphylea trifolia* Forest**

NVC Identifier: **CEGL006020**

LOCAL INFORMATION

Environmental Description: This association occurs on moderately steep to steep (30% to greater than 60%) slopes over calcareous bedrock, typically limestone. Aspect is variable. Typical soils include channery silt loams and loams of the Benson, Farmington and Galway soil series. These soils are usually circumneutral to alkaline with abundant calcium.

Vegetation Description: The canopy height varies from 20 to 30 m with total cover usually 85% or more. The dominant canopy tree is sugar maple (*Acer saccharum*) often with American basswood (*Tilia americana*) as a codominant. Other minor canopy associates may include sweet birch (*Betula lenta*), yellow birch (*Betula alleghaniensis*), oaks (*Quercus* spp.), eastern hemlock (*Tsuga canadensis*), and white ash (*Fraxinus americana*). The subcanopy is 5 to 15 m in height with total cover between 10 and 40%. Sugar maple is usually codominant to near monotypic in the subcanopy, with other associate species including sweet birch, eastern hop-hornbeam (*Ostrya virginiana*), American basswood, and eastern hemlock. The tall-shrub layer is 2-5 m in height and varies from sparse up to 30% total cover. The most characteristic tall shrub is American bladdernut (*Staphylea trifolia*). Other common tall-shrub/sapling species include eastern hop-hornbeam, sugar maple, American witch-hazel (*Hamamelis virginiana*), common serviceberry (*Amelanchier arborea*). The short-shrub layer, less than 2 m in height, is typically sparse (under 10% total cover). Common short-shrub/sapling species include American bladdernut, northern spicebush (*Lindera benzoin*), eastern hop-hornbeam, Japanese barberry (*Berberis thunbergii*), sugar maple, and American witch-hazel. The herbaceous layer typically has 50% cover or less and is under 1 m in height. The herbaceous layer is often diverse and may include Christmas fern (*Polystichum acrostichoides*), garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), Jack in the pulpit (*Arisaema triphyllum*), bloodroot (*Sanguinaria canadensis*), blue cohosh (*Caulophyllum thalictroides*), dogtooth violet (*Erythronium americanum*), Virginia springbeauty (*Claytonia virginica*), northern maidenhair (*Adiantum pedatum*), and Canadian wild ginger (*Asarum canadense*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum, Tilia americana, Betula lenta*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum, Tilia americana, Ostrya virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Staphylea trifolia, Hamamelis virginiana, Ostrya virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Lindera benzoin, Staphylea trifolia*

Herb (field)	Forb	*Alliaria petiolata, Arisaema triphyllum, Sanguinaria canadensis*
Herb (field)	Graminoid	*Microstegium vimineum*
Herb (field)	Fern or fern ally	*Polystichum acrostichoides*

Characteristic Species: *Acer saccharum, Betula lenta, Tilia americana, Lindera benzoin, Ostrya virginiana, Staphylea trifolia, Adiantum pedatum, Arisaema triphyllum, Asarum canadense, Caulophyllum thalictroides, Polystichum acrostichoides.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2	1	Calcareous Slope Forest	Walz et al 2006
PA	S4	1	Sugar maple - basswood forest	Fike 1999

Local Range: This association appears to be restricted to moderately steep to steep slopes over calcareous bedrock (typically limestone or dolomite). The greatest concentration of calcareous bedrock (and this association) appears to be a southwest/northeast-trending series of calcareous limestone, shale and siltstone bedrock formations slightly north of Kittatinny Ridge (Buttermilk Falls, Decker, Kalkberg, Minisink and Roundout formations and others).

Classification Comments: This association is characterized by the dominance of *Acer saccharum* with an abundance (and occasional codominance) of *Tilia americana* and a rich diverse herb layer. It differs from Sugar Maple - American Beech - Sweet Birch Forest as the latter does not contain an abundance or even codominance of *Tilia americana* or the rich diverse herb layer. This type differs from Sugar Maple Floodplain Forest by not occurring on the Delaware River floodplain while the Sugar Maple Floodplain Forest lacks *Tilia americana* or the rich diverse herb layer.

Other Comments: None.

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

Plots and Data Sources: DEWA.37, DEWA.85; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Acer saccharum - Fraxinus americana - Tilia americana* Forest Alliance (A.217)
Alliance (English name)	Sugar Maple - White Ash - American Basswood Forest Alliance
Association	*Acer saccharum - Fraxinus americana - Juglans cinerea / Staphylea trifolia* Forest
Association (English name)	Sugar Maple - White Ash - Butternut / American Bladdernut Forest

Ecological System(s): Laurentian-Acadian Northern Hardwoods Forest (CES201.564)
North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)
South-Central Interior Mesophytic Forest (CES202.887)
Southern and Central Appalachian Cove Forest (CES202.373)

GLOBAL DESCRIPTION

Concept Summary: This semi-rich to rich forest of southern New England to Virginia occurs on talus slopes or shallow rocky soils overlying calcareous or circumneutral bedrock. Canopy dominants are *Acer saccharum* with *Fraxinus americana*. Canopy associates are *Juglans cinerea, Quercus rubra, Tilia americana, Carya cordiformis, Ostrya virginiana,* and *Carpinus caroliniana*. *Betula alleghaniensis, Fagus grandifolia, Quercus muehlenbergii,* and *Ulmus* spp. may also occur. The shrub layer is fairly open, characterized by *Staphylea trifolia, Corylus* spp., and *Hamamelis virginiana* along with *Parthenocissus quinquefolia, Toxicodendron radicans,* and *Vitis* spp. This community is characterized by a fairly diverse herbaceous flora. Typical herbs include *Actaea pachypoda, Adiantum pedatum, Allium tricoccum, Anemone quinquefolia, Aralia nudicaulis, Aralia racemosa, Arisaema triphyllum, Asplenium platyneuron, Asarum canadense, Eurybia divaricata (= Aster divaricatus), Circaea lutetiana* ssp. *canadensis, Claytonia virginica, Cystopteris fragilis, Cystopteris bulbifera, Dryopteris* spp., *Polystichum acrostichoides, Sanguinaria canadensis, Solidago flexicaulis, Trillium erectum, Woodsia obtusa,* and others. Characteristic graminoids include *Carex laxiflora, Carex sprengelii, Carex virescens, Elymus hystrix (= Hystrix patula),* and *Piptatherum racemosum (= Oryzopsis racemosa).* This association grades into open woodland [see related woodland types *Tilia americana - Fraxinus americana / Acer spicatum / Cystopteris fragilis* Woodland (CEGL006204) and *Acer saccharum - Tilia americana - Fraxinus americana / Ostrya virginiana / Geranium robertianum* Woodland (CEGL005058)] and bedrock upslope.

Environmental Description: Sites include talus slopes or shallow rocky soils weathered from calcareous or circumneutral bedrock. In Virginia and West Virginia, sites are restricted to mesic or submesic, weathered limestone and dolomitic boulderfields and bouldery to gravelly colluvium from these rocks. Habitats are situated on lower to middle slopes subtending streams in low-elevation montane valleys and gorges. Slopes are steep, usually with north to east aspects. Bedrock outcrops are frequent. Exposed rock (boulder + outcrop) cover can be up to 50%, which reduces both species richness and herbaceous cover. However, due to the relatively rapid weathering of carbonate materials and extremely fertile soils, these habitats are typically well vegetated with herbaceous plants. High cover of mosses provides a foothold for many species, while organic mats and soil pockets are also numerous.

Vegetation Description: In the northern part of this type's range, canopy dominants are *Acer saccharum* and *Fraxinus americana*, with typical associates of *Juglans cinerea, Quercus rubra, Tilia americana, Carya cordiformis,* and *Quercus muehlenbergii*. *Betula alleghaniensis, Betula lenta, Fagus grandifolia,* and *Ulmus* spp. may also occur locally. *Ostrya virginiana* and *Carpinus caroliniana* are typical small trees. The shrub layer is open and characterized by *Staphylea trifolia, Corylus* spp., *Hamamelis virginiana, Rubus odoratus, Parthenocissus quinquefolia, Toxicodendron radicans,* and *Vitis* spp. In the more southerly portions of the range, *Lindera benzoin* and *Asimina triloba* may also be present. Typical species of the fairly diverse herb layer include *Actaea pachypoda, Adiantum pedatum, Allium tricoccum, Anemone quinquefolia, Aralia nudicaulis, Aralia racemosa, Arisaema triphyllum, Asplenium platyneuron, Asarum canadense, Eurybia divaricata (= Aster divaricatus), Circaea lutetiana* ssp. *canadensis,*

Claytonia virginica, Cystopteris fragilis, Cystopteris bulbifera, Dryopteris spp., *Polystichum acrostichoides, Sanguinaria canadensis, Solidago flexicaulis, Trillium erectum, Woodsia obtusa*, and others. Characteristic graminoids include *Carex laxiflora, Carex sprengelii, Carex virescens, Elymus hystrix (= Hystrix patula),* and *Piptatherum racemosum (= Oryzopsis racemosa).* Virginia stands, representing the more southern expression of this type, often include *Asplenium rhizophyllum, Cimicifuga racemosa, Hepatica nobilis* var. *acuta (= Hepatica acutiloba), Impatiens pallida, Mitella diphylla, Osmorhiza claytonii, Polymnia canadensis, Sedum ternatum,* and *Thalictrum dioicum*. *Phacelia bipinnatifida* and *Meehania cordata* are locally abundant herbs at some southwestern Virginia sites. Virginia stands also have a variable overstory composition, with *Tilia americana* (including both var. *americana* and var. *heterophylla*) consistently important, along with *Acer saccharum* and/or *Acer nigrum*. *Fraxinus americana* and *Ulmus rubra* are minor but constant canopy associates. South of the James River, *Aesculus flava* becomes important or sometimes solely dominant in the overstory mixtures. In areas with a history of disturbance, exotic shrubs and herbs including *Berberis thunbergii, Alliaria petiolata,* and *Microstegium vimineum* may be common. Species richness of plot-sampled stands in Virginia ranges from 21 to 97 taxa per 400 m2 (mean = 57).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum*

Characteristic Species: *Acer saccharum, Asarum canadense, Cystopteris bulbifera, Hepatica nobilis* var. *acuta, Ostrya virginiana, Sanguinaria canadensis, Solidago flexicaulis, Staphylea trifolia, Thalictrum dioicum, Tilia americana.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community is known to occur in the northern and central Appalachian regions, from Vermont and New Hampshire south to Virginia and West Virginia. In Virginia, the type is locally scattered in carbonate rock districts throughout the Ridge and Valley and Cumberland Mountains.

States/Provinces: CT, MA, MD, NH, NJ:S2, NY, PA:S2?, VA:S3?, VT.

Federal Lands: NPS (Delaware Water Gap); USFS (George Washington, Jefferson).

CONSERVATION STATUS

Rank: G4? (1-Oct-2001).

Reasons: Although occurring mostly in small, local patches, this community type has a wide geographic range and occupies rugged habitats that are not prone to many anthropogenic disturbances. There are likely >50 occurrences in Virginia, and many in West Virginia (D. Walton pers. comm.).

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Prominent distinguishing features of this community are its extremely steep, bouldery/gravelly mesic habitats, the infrequency of *Quercus* spp., the general abundance of *Staphylea trifolia* and *Cystopteris bulbifera,* and, in Virginia, the prevalence of other more or less lithophytic or rock-loving species e.g., *Hydrangea arborescens, Asplenium rhizophyllum, Sedum* spp., *Mitella diphylla, Solidago flexicaulis,* etc. Conspicuously absent, or less important,

are species such as *Caulophyllum thalictroides, Trillium* spp., and *Diplazium pycnocarpon*, which thrive in deep mineral soils. It intergrades with both dry, open forests and other mesophytic forests along environmental continua defined by slope position and interrelated degrees of rock substrate and mineral soil development. As a result, transitional or intermediate stands that are difficult to classify may be encountered.

Similar Associations:

- *Acer saccharum - Liriodendron tulipifera - Fraxinus americana / Staphylea trifolia* Forest (CEGL006201).
- *Acer saccharum - Quercus muehlenbergii / Carex platyphylla* Forest (CEGL006162).
- *Acer saccharum - Tilia americana - Fraxinus americana / Ostrya virginiana / Geranium robertianum* Woodland (CEGL005058).

Related Concepts:

- *Acer (nigrum, saccharum) - Tilia americana - (Aesculus flava) / Staphylea trifolia / Cystopteris bulbifera* Forest (Fleming and Coulling 2001) ?
- *Acer saccharum / Asarum canadense* community (Metzler and Barrett 1996) ?
- *Tilia americana / Staphylea trifolia / Cystopteris bulbifera* Forest (type 1.2) (Fleming 1999) ?
- SNE Calcareous Talus Forest/Woodland (Rawinski 1984) ?
- SNE rich mesic forest (circumneutral to basic) (Rawinski 1984) ?
- Sugar Maple - Basswood: 26 (Eyre 1980) B
- Sugar maple-white ash-basswood cove forest (CAP pers. comm. 1998) ?
- Talus Slope Community (Breden 1989) B
- Transition Hardwood Talus Woodland (Thompson 1996) ?

SOURCES

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

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Eyre 1980, Fike 1999, Fleming 1999, Fleming and Coulling 2001, Fleming et al. 2001, Harrison 2004, Lundgren 2000, Metzler and Barrett 1996, Metzler and Barrett 2001, Rawinski 1984, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003, Walton pers. comm.

Figure 14. Sugar Maple - American Basswood Forest in Delaware Water Gap National Recreation Area (plot DEWA.37). June 2003.

Figure 15. Sugar Maple - American Basswood Forest in Delaware Water Gap National Recreation Area (plot DEWA.85). August 2003.

COMMON NAME (PARK-SPECIFIC): DRY HICKORY RIDGETOP FOREST

SYNONYMS

NVC English Name:	**Northern Red Oak - (Pignut Hickory, Shagbark Hickory) / Eastern Hop-hornbeam / Blue Ridge Sedge Forest**
NVC Scientific Name:	***Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest**
NVC Identifier:	**CEGL006301**

LOCAL INFORMATION

Environmental Description: This forest association occurs on ridgetops and the upper portions of high slopes, usually with a southeast aspect. This forest type is common on the upper slopes of the southeast face of Kittatinny Ridge or in patches within a matrix of Dry Oak - Mixed Hardwood Forest. This association occurs on rapidly or well-drained, extremely rocky soils such as found in the Benson, Manlius, Arnot, Oquaga, and Lackawanna series. This forest type is restricted to xeric, acidic sites, often on shallow soils that occur in complexes with rock outcrops. Boulders and large rocks are frequent on the forest floor.

Vegetation Description: This ridgetop forest is dominated or codominated by hickories (*Carya* spp.), such that hickories compose greater relative cover in the canopy and subcanopy than oaks (*Quercus* spp.). The canopy is often open (40-75% cover) and is dominated by one or more of the following species: pignut hickory (*Carya glabra*), red hickory (*Carya ovalis*), mockernut hickory (*Carya alba*), chestnut oak (*Quercus prinus*), and/or black oak (*Quercus velutina*). Other occasional canopy associates include white ash (*Fraxinus americana*), eastern white pine (*Pinus strobus*), scarlet oak (*Quercus coccinea*), and red maple (*Acer rubrum*). Canopy trees range in height from 10-25 m, while the subcanopy trees extend 1-15 m in height. The subcanopy can be absent or moderately dense (0-50% cover) and contains pignut hickory, chestnut oak, mockernut hickory, red hickory, common serviceberry (*Amelanchier arborea*), striped maple (*Acer pensylvanicum*), and eastern red-cedar (*Juniperus virginiana*). The sparse tall-shrub layer (0-30% cover) consists of common serviceberry and saplings of the canopy trees. The sparse short-shrub layer (0-30% cover) contains scattered ericads such as deerberry (*Vaccinium stamineum*), Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), and black huckleberry (*Gaylussacia baccata*), as well as Allegheny blackberry (*Rubus allegheniensis*), northern dewberry (*Rubus flagellaris*), blackhaw (*Viburnum prunifolium*), and mapleleaf viburnum (*Viburnum acerifolium*). The herbaceous layer is typically moderately dense to dense (50-95% cover) and can be fairly diverse compared to other xeric forest types. The herbaceous layer is dominated by xerophilic graminoids such as wavy hairgrass (*Deschampsia flexuosa*), poverty oatgrass (*Danthonia spicata*), and Pennsylvania sedge (*Carex pensylvanica*). Other associates include early saxifrage (*Saxifraga virginiensis*), dwarf cinquefoil (*Potentilla canadensis*), white snakeroot (*Ageratina altissima* var. *altissima*), Bosc's panicgrass (*Dichanthelium boscii*), upland bentgrass (*Agrostis perennans*), sweet vernalgrass (*Anthoxanthum odoratum*), common gypsyweed (*Veronica officinalis*), tapered rosette grass (*Dichanthelium acuminatum* var. *acuminatum*), Swan's sedge (*Carex swanii*), smooth forked nailwort (*Paronychia canadensis*), running clubmoss (*Lycopodium clavatum*), Atlantic goldenrod (*Solidago arguta*), and early goldenrod (*Solidago juncea*), among others. The invasive species Japanese stiltgrass (*Microstegium vimineum*) can be common in this forest. The vine Virginia creeper (*Parthenocissus quinquefolia*) is occasional in this forest.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Carya glabra, Quercus prinus*
Herb (field)	Forb	*Ageratina altissima* var. *altissima, Potentilla canadensis*
Herb (field)	Graminoid	*Carex pensylvanica, Danthonia spicata, Deschampsia flexuosa*

Characteristic Species: *Carya alba, Carya glabra, Carya ovalis, Quercus prinus, Quercus velutina, Amelanchier arborea, Carex pensylvanica, Danthonia spicata, Deschampsia flexuosa*.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2S3	1	Oak - Hickory / Hop-hornbeam / Sedge Lawn Forest	Walz et al 2006
PA	S4	2	no crosswalk	Fike 1999

Local Range: This forest occurs on ridgetops and the upper portions of high slopes throughout the park and may occur as small or large patches.
Classification Comments: This type seems distinct from Dry Oak - Mixed Hardwood Forest and can be distinguished from the latter by the codominance or dominance of *Carya* spp., often *Carya glabra*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.78, DEWA.122, DEWA.179, DEWA.201, DEWA.216.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Carya (glabra, ovata) - Fraxinus americana - Quercus (alba, rubra)* Forest Alliance (A.258)
Alliance (English name)	(Pignut Hickory, Shagbark Hickory) - White Ash - (White Oak, Northern Red Oak) Forest Alliance
Association	*Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest
Association (English name)	Northern Red Oak - (Pignut Hickory, Shagbark Hickory) / Eastern Hop-hornbeam / Blue Ridge Sedge Forest

Ecological System(s): Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475)
Central Appalachian Alkaline Glade and Woodland (CES202.602)

GLOBAL DESCRIPTION

Concept Summary: This association is a dry rich hickory forest of the northeastern United States that extends discontinuously south to Virginia's southern Appalachian Mountains. It is dominated by a mixture of hickories and oaks over a hop-hornbeam subcanopy and a park-like sedge lawn. The vegetation occurs on low-elevation ridgetops, upper slopes, south- or west-facing sideslopes, and is supported by well-drained loams or sandy loams, often derived from alkaline bedrock. The tree canopy, which ranges from nearly closed forest to partially open woodland, is dominated by a mixture of *Carya glabra, Carya ovata, Carya ovalis, Quercus rubra, Quercus alba, Quercus velutina*, with occasional *Ostrya virginiana* and *Acer rubrum*. Minor associates include *Acer saccharum, Pinus strobus,* and *Fraxinus americana*. A subcanopy of *Ostrya virginiana* is conspicuous in most areas. Additional species in the subcanopy or tall-shrub layer that occur in lower abundance can include *Hamamelis virginiana, Cornus florida, Amelanchier arborea, Acer pensylvanicum,* and *Viburnum acerifolium*. Low shrubs can include *Vaccinium angustifolium, Vaccinium pallidum, Rubus idaeus,* or *Viburnum rafinesquianum*. The herb layer is primarily a sedge lawn of *Carex lucorum* with some *Carex pensylvanica, Carex woodii, Carex appalachica,* or *Carex rosea*, but is also quite diverse with scattered *Elymus hystrix, Bromus pubescens, Ageratina altissima, Festuca subverticillata, Uvularia perfoliata, Aralia nudicaulis, Maianthemum racemosum (= Smilacina racemosa), Desmodium glutinosum, Desmodium paniculatum, Prenanthes alba, Solidago bicolor, Hepatica nobilis* var. *obtusa (= Hepatica americana), Carex* (Laxiflorae group), *Deschampsia flexuosa, Packera paupercula (= Senecio pauperculus), Packera obovata (= Senecio obovatus), Symphyotrichum undulatum (= Aster undulatus), Symphyotrichum patens (= Aster patens), Polystichum acrostichoides*, and *Dichanthelium* spp. Spring ephemerals such as *Erythronium americanum* and *Claytonia virginica* also occur in some portions of the range and *Solidago caesia* var. *curtisii* occurs in the south.

Environmental Description: This community occupies upper slopes and sideslopes at low elevations, generally with southeastern to western exposures. The low relief of southern New England limits this vegetation to small occurrences, most of which are <4 ha (10 acres). Soils are well-drained loams or sandy loams and often circumneutral. Soils are often stony, but exposed bedrock, boulders, cobbles, and mineral soil are sparse.

Vegetation Description: This forest has a closed to open canopy dominated by a mixture of *Carya glabra, Carya ovata, Carya ovalis, Quercus rubra, Quercus alba, Quercus velutina*, with occasional *Ostrya virginiana, Quercus prinus, Carya alba,* and *Acer rubrum*. Minor associates include *Acer saccharum, Pinus strobus,* and *Fraxinus americana*. A subcanopy of *Ostrya virginiana* is conspicuous in most areas. Additional species in the subcanopy or tall-shrub layers that occur in lower abundance include *Hamamelis virginiana, Cornus florida, Amelanchier arborea, Acer pensylvanicum,* and *Viburnum acerifolium*. Low shrubs can include *Vaccinium angustifolium, Vaccinium pallidum, Gaylussacia baccata, Rubus allegheniensis, Rubus idaeus, Viburnum dentatum,* or *Viburnum rafinesquianum*. *Vaccinium stamineum* may be present in the most southerly (NJ/PA) occurrences of this association. The herb layer is primarily a sedge lawn of *Carex lucorum*, with some *Carex pensylvanica, Carex woodii, Carex appalachica,* or *Carex rosea*, but is also quite diverse with scattered *Elymus hystrix, Bromus pubescens, Danthonia*

spicata, Anthoxanthum odoratum, Ageratina altissima, Festuca subverticillata, Uvularia perfoliata, Aralia nudicaulis, Maianthemum racemosum (= Smilacina racemosa), Desmodium glutinosum, Desmodium paniculatum, Prenanthes alba, Solidago bicolor, Solidago juncea, Hepatica nobilis var. *obtusa (= Hepatica americana), Carex* spp. (Laxiflorae group), *Deschampsia flexuosa, Packera paupercula (= Senecio pauperculus), Packera obovata (= Senecio obovatus), Symphyotrichum undulatum (= Aster undulatus), Symphyotrichum patens (= Aster patens), Veronica officinalis, Polystichum acrostichoides,* and *Dichanthelium* spp. Spring ephemerals such as *Erythronium americanum* and *Claytonia virginica* also occur in some portions, and *Solidago arguta* and *Solidago caesia* var. *curtisii* occur in the south. Also in the southern portion of the range, the invasive grass *Microstegium vimineum* can be common.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Carya glabra, Quercus rubra*
Tree canopy	Broad-leaved deciduous tree	*Quercus alba*
Herb (field)	Forb	*Ageratina altissima* var. *altissima*
Herb (field)	Graminoid	*Deschampsia flexuosa*

Characteristic Species: *Amelanchier arborea, Carex lucorum, Carex pensylvanica, Carex rosea, Carya glabra, Carya ovalis, Carya ovata, Deschampsia flexuosa, Elymus hystrix, Maianthemum racemosum, Potentilla canadensis, Potentilla simplex, Quercus alba, Quercus prinus, Quercus rubra, Quercus velutina, Solidago bicolor, Solidago juncea, Uvularia perfoliata.*

Other Noteworthy Species: *Crataegus spathulata.*

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: The principal distribution of this community type is centered in lower New England, ranging from southern New Hampshire to New Jersey and northern Pennsylvania. Several outlying occurrences have been documented from isolated ridges and peaks scattered over nearly 180 km (110 miles) in western and southwestern Virginia, chiefly in the Ridge and Valley. Additional occurrences are likely in West Virginia.

States/Provinces: CT, MA, ME, NH, NJ:S2S3, NY, PA, RI, VA:S3?, VT.

Federal Lands: NPS (Delaware Water Gap); USFS (George Washington, Jefferson).

CONSERVATION STATUS

Rank: G4? (1-Oct-2001).

Reasons: This association appears to be widely but somewhat locally distributed in the northeastern United States. The state rank reflects the locally restricted extent of a few widely scattered known occurrences. Additional examples can be expected on isolated ridge crests in the Ridge and Valley; other occurrences should be sought in the Northern Blue Ridge. The particular structure and composition of this type may be a function of a particular combination of specific site conditions and disturbance history.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Information not available.

Similar Associations:

- *Carya (glabra, ovata) - Fraxinus americana - Quercus* spp. Forest (CEGL006236).
- *Quercus alba - Quercus prinus - Carya glabra / Cornus florida / Vaccinium pallidum / Carex pensylvanica* Forest (CEGL008515)--occurs in similar settings in VA, WV, and MD but much more oak than hickory.
- *Quercus rubra - Quercus alba / Ilex montana / Dennstaedtia punctilobula - Carex pensylvanica - Deschampsia flexuosa* Forest (CEGL008506).

Related Concepts:

- *Acer saccharum - Carya glabra - Ostrya virginiana* Alliance: *Quercus alba - Carya ovata / Carex pensylvanica - Carex woodii* Association (Rawinski et al. 1996) ?
- *Quercus alba - Quercus rubra - Carya ovalis / Elymus hystrix* Forest (Fleming and Moorhead 2000) ?
- *Quercus rubra - Quercus alba - Carya (ovata, ovalis) / Ostrya virginiana / Carex pensylvanica* Forest (Fleming and Coulling 2001) ?
- Dry Oak-Hickory-Hophornbeam Forest (Thompson 1996) B
- Dry-Mesic Inland Mixed Oak Forest (Breden 1989) B
- SNE dry rich forest - Hickory - hop hornbeam forest variant (Rawinski 1984) ?
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) B

SOURCES

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

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Gawler 2002, Lundgren 2001, Metzler and Barrett 2001, Metzler and Barrett 2004, Rawinski 1984, Rawinski et al. 1996, Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, VDNH 2003.

Figure 16. Dry Hickory Ridgetop Forest in Delaware Water Gap National Recreation Area (plot DEWA.78). August 2003.

Figure 17. Dry Hickory Ridgetop Forest in Delaware Water Gap National Recreation Area (plot DEWA.122). September 2003.

COMMON NAME (PARK-SPECIFIC): TULIPTREE - BEECH - MAPLE FOREST

SYNONYMS
NVC English Name: **American Beech - Sweet Birch - Tuliptree - Sugar Maple Forest**
NVC Scientific Name: ***Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest**
NVC Identifier: **CEGL006296**

LOCAL INFORMATION

Environmental Description: This association occurs on gentle to slightly steep low and midslopes throughout the park, often on toeslopes, in coves, or along small drainages. Soils vary from sandy loam on higher floodplain terraces to gravelly and channery loams and silt loams at higher elevations (midslopes of ridges). Typical bedrock types include shale and siltstone of the Bloomsburg Formation and graywacke and shale of the Martinsburg Formation. This vegetation type often occurs on disturbed land where evidence of past agriculture (e.g., stonewalls, drainage ditches) or silviculture is visible.

Vegetation Description: This association is dominated by tuliptree (*Liriodendron tulipifera*), often with red maple (*Acer rubrum*), white ash (*Fraxinus americana*), sweet birch (*Betula lenta*), and yellow birch (*Betula alleghaniensis*) as associates. Early successional tree species, such as quaking aspen (*Populus tremuloides*) and black locust (*Robinia pseudoacacia*), may also be present, especially in stands with a more recent history of disturbance. Oaks (*Quercus* spp.) may be present but are a minor component. American beech (*Fagus grandifolia*) is inconstant and often restricted to the tall-shrub layer in the park. American beech may occur in the canopy of this forest type elsewhere in Pennsylvania (Fike 1999) but was only observed in the tall-shrub layer at the park. The canopy is usually 25 to 35 m in height with greater than 70 % canopy closure. The subcanopy is typically 15 to 20 m in height with total cover of 10 to 30%. Typical subcanopy trees are sugar maple (*Acer saccharum*), red maple, sweet birch, and white ash. The tall-shrub layer is 2-5 m in height with cover varying from 15 to 60%. Common tall shrubs/saplings include northern spicebush (*Lindera benzoin*), American witch-hazel (*Hamamelis virginiana*), and American beech. Invasive shrubs are occasional and may include multiflora rose (*Rosa multiflora*) and autumn-olive (*Elaeagnus umbellata*). The short-shrub layer is less than 2 m in height and may vary from sparse (10% cover) to dense (80% cover). This layer usually contains sparse to dense stands of Japanese barberry (*Berberis thunbergii*), with varying amounts of northern spicebush, multiflora rose, witch-hazel, and mapleleaf viburnum (*Viburnum acerifolium*). The herbaceous layer is typically less than 1 m in height with 30 to 50% total cover. Typical herbaceous species include eastern hayscented fern (*Dennstaedtia punctilobula*), Christmas fern (*Polystichum acrostichoides*), garlic mustard (*Alliaria petiolata*), dwarf cinquefoil (*Potentilla canadensis*), white snakeroot (*Ageratina altissima* var. *altissima*), Jack-in-the-pulpit (*Arisaema triphyllum*), and Canada mayflower (*Maianthemum canadense*). Vines may be present, usually as creeping plants in the herb or short-shrub layer, but may occasionally reach the lower portion of the canopy (usually summer grape, *Vitis aestivalis*). Typical vines include Virginia creeper (*Parthenocissus quinquefolia*), roundleaf greenbrier (*Smilax rotundifolia*), and summer grape. The invasive vine Japanese honeysuckle (*Lonicera japonica*) may also be present at low cover.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera, Acer rubrum, Betula lenta, Fraxinus americana*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum, Acer rubrum, Betula lenta, Fraxinus americana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Fagus grandifolia, Hamamelis virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rosa multiflora, Lindera benzoin*
Herb (field)	Forb	*Alliaria petiolata*
Herb (field)	Graminoid	*Microstegium vimineum*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides*

Characteristic Species: *Liriodendron tulipifera, Acer rubrum, Acer saccharum, Betula lenta, Fraxinus americana, Hamamelis virginiana, Lindera benzoin, Berberis thunbergii, Dennstaedtia punctilobula, Polystichum acrostichoides.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Tuliptree - Beech - Maple Forest	Walz et al 2006
PA	S4	1	Tuliptree - beech - maple forest	Fike 1999

Local Range: This association occurs throughout the park on mesic toeslopes (often at the base of the Kittatinny Ridge) and coves, possibly where near surface groundwater creates mesic conditions, or where past disturbance has opened up the forest canopy (e.g., logging, abandoned farmland).

Classification Comments: This vegetation type differs from Northeastern Modified Successional Forest on the basis of *Liriodendron tulipifera* as the clear canopy dominant. Where disturbance is more recent and *Liriodendron tulipifera* is codominant with early-successional trees such as *Populus grandidentata* and *Robinia pseudoacacia*, distinction between the two types may be difficult.

Other Comments: None.

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

Plots and Data Sources: DEWA.118, DEWA.189, DEWA.192, DEWA.202; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)

Alliance	*Fagus grandifolia - Acer saccharum - (Liriodendron tulipifera)* Forest Alliance (A.227)
Alliance (English name)	American Beech - Sugar Maple - (Tuliptree) Forest Alliance
Association	*Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest
Association (English name)	American Beech - Sweet Birch - Tuliptree - Sugar Maple Forest
Ecological System(s):	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This mid- to lower slope deciduous forest of the mid-Atlantic region occurs on deep soils that are not strongly acidic. The tree canopy is characterized by a mixture of *Liriodendron tulipifera, Fagus grandifolia, Acer saccharum, Fraxinus americana, Betula lenta*, and other associated species, including *Acer rubrum, Betula alleghaniensis, Nyssa sylvatica*, and *Carya alba (= Carya tomentosa)*. The subcanopy, where present, is characterized by *Carpinus caroliniana, Cornus florida*, and *Ostrya virginiana*. Common species of the shrub layer include *Hamamelis virginiana* and *Lindera benzoin*. The herbaceous layer is characterized by *Podophyllum peltatum, Sanguinaria canadensis, Botrychium virginianum, Dicentra cucullaria, Dicentra canadensis, Allium tricoccum*, and *Claytonia virginica*. Associated herbs may include *Polystichum acrostichoides, Ageratina altissima* var. *altissima*, and *Arisaema triphyllum*. Invasive species such as *Berberis thunbergii, Elaeagnus umbellata, Rosa multiflora,* and *Alliaria petiolata* may be present and locally abundant in the shrub and herb layers. This vegetation type often occurs on land where evidence of past agriculture or silviculture is visible.

Environmental Description: This vegetation occurs on middle to lower slopes on moderately deep soils that are not extremely acidic.

Vegetation Description: The tree canopy is characterized by a mixture of *Liriodendron tulipifera, Fagus grandifolia, Acer saccharum, Fraxinus americana, Betula lenta*, and other associated species, including *Acer rubrum, Betula alleghaniensis, Nyssa sylvatica*, and *Carya alba (= Carya tomentosa)*. The subcanopy, where present, is characterized by *Carpinus caroliniana, Cornus florida*, and *Ostrya virginiana*. Common species of the shrub layer include *Hamamelis virginiana* and *Lindera benzoin*. The herbaceous layer is characterized by *Podophyllum peltatum, Sanguinaria canadensis, Botrychium virginianum, Dicentra cucullaria, Dicentra canadensis, Allium tricoccum*, and *Claytonia virginica*. Associated herbs may include *Polystichum acrostichoides, Ageratina altissima* var. *altissima*, and *Arisaema triphyllum*. Invasive species such as *Berberis thunbergii, Elaeagnus umbellata, Rosa multiflora,* and *Alliaria petiolata* may be present and locally abundant in the shrub and herb layers.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum*, *Liriodendron tulipifera*
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana*, *Cornus florida*, *Ostrya virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*, *Lindera benzoin*
Herb (field)	Forb	*Podophyllum peltatum*
Herb (field)	Fern or fern ally	*Botrychium virginianum*

Characteristic Species: *Acer saccharum, Allium tricoccum, Betula lenta, Botrychium virginianum, Carpinus caroliniana, Claytonia virginica, Cornus florida, Dicentra cucullaria, Fagus grandifolia, Liriodendron tulipifera, Ostrya virginiana, Podophyllum peltatum, Sanguinaria canadensis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This vegetation is currently described primarily from Pennsylvania and is also documented in New Jersey. It may occur in Maryland.
States/Provinces: MD?, NJ, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Friendship Hill, Morristown).

CONSERVATION STATUS
Rank: GNR (6-Dec-2004).
Reasons: More information is required to determine the range and rank of this vegetation type.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: his description is based on the tuliptree - beech - maple forest of Fike (1999) as well as samples from NPS mapping projects in Pennsylvania and New Jersey. More information is required to determine the range of this type.
Similar Associations:
- *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera* Unglaciated Forest (CEGL002411)--also contains *Liquidambar styraciflua, Asimina triloba, Carya cordiformis,* and *Betula lenta* is absent.
- *Fagus grandifolia - Acer saccharum* Glaciated Midwest Forest (CEGL005013)--has a shrub layer characterized by *Diervilla lonicera, Euonymus obovatus, Lonicera canadensis,* and *Betula lenta* is absent.
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921)--lacks *Acer saccharum,* and *Quercus* spp. are more important.

Related Concepts: Information not available.

SOURCES
Description Authors: J. Fike and L. A. Sneddon, mod. E. Largay and S. C. Gawler.
References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999.

Figure 18. Tuliptree - Beech - Maple Forest in Delaware Water Gap National Recreation Area (plot DEWA.189). May 2004.

Figure 19. Tuliptree - Beech - Maple Forest in Delaware Water Gap National Recreation Area (plot DEWA.202). June 2004.

COMMON NAME (PARK-SPECIFIC): BLACK WALNUT BOTTOMLAND FOREST

SYNONYMS
NVC English Name: **Black Walnut - White Ash / Northern Spicebush Forest**
NVC Scientific Name: ***Juglans nigra - Fraxinus americana / Lindera benzoin* Forest [Provisional]**
NVC Identifier: **CEGL006449**

LOCAL INFORMATION

Environmental Description: This association typically occurs along drainage swales and the floodplain of smaller streams in the Delaware River valley. The substrate varies from silt loam to gravelly sandy loams, with Venango silt loam, Hoosic-Otisville complex, and Delaware fine sandy loam being typical soil series. This association may also occur on mid to high floodplain terraces of the Delaware River (e.g., Poxono Island).
Vegetation Description: The canopy of this riparian forest is strongly dominated by black walnut (*Juglans nigra*), typically with greater than 50% relative canopy cover. Canopy associates may include white ash (*Fraxinus americana*), American elm (*Ulmus americana*), and sugar maple (*Acer saccharum*). Canopy height is usually 20 to 30 m. The subcanopy is usually open, 10 to 15 m in height and may include scattered individuals of American elm, black walnut, common hackberry (*Celtis occidentalis*), American hornbeam (*Carpinus caroliniana*), and bitternut hickory (*Carya cordiformis*). The tall-shrub layer is 2-5 m in height and often sparse. Typical tall shrubs may include blackhaw (*Viburnum prunifolium*), northern spicebush (*Lindera benzoin*), and white ash saplings. The short-shrub layer (under 2 m in height) cover is variable from sparse to dense (rarely). Common short shrubs include northern spicebush, multiflora rose (*Rosa multiflora*), and black haw. The herb layer is also variable, often with one or a few species providing most of the cover. Characteristic herbs include mayapple (*Podophyllum peltatum*), jewelweed (*Impatiens capensis*), broadleaf enchanter's nightshade (*Circaea lutetiana* ssp. *canadensis*), and white snakeroot (*Ageratina altissima* var. *altissima*). One stand of this association was observed on Poxono Island with a near monotypic herb layer of hairyfruit sedge (*Carex trichocarpa*) (not sampled). Invasive exotic species are usually present and may be locally abundant, including Japanese stiltgrass (*Microstegium vimineum*), garlic mustard (*Alliaria petiolata*), and oriental ladysthumb (*Polygonum caespitosum*). Vines are occasional but rarely abundant; Virginia creeper (*Parthenocissus quinquefolia*) is a typical vine species.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Juglans nigra, Ulmus americana Fraxinus americana*
Tree subcanopy	Broad-leaved deciduous tree	*Juglans nigra, Ulmus americana Carpinus caroliniana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Fraxinus americana, Lindera benzoin, Viburnum prunifolium*

Short shrub/sapling	Broad-leaved deciduous shrub	*Rosa multiflora, Lindera benzoin, Viburnum prunifolium*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Ageratina altissima* var. *altissima, Alliaria petiolata, Impatiens capensis, Podophyllum peltatum*

Characteristic Species: *Juglans nigra, Lindera benzoin, Carpinus caroliniana, Fraxinus americana, Ulmus americana, Viburnum prunifolium, Impatiens capensis, Alliaria petiolata, Podophyllum peltatum.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Black Walnut Bottomland Forest	Walz et al 2006
PA	SNA	2	not crosswalk	Fike 1999

Local Range: This association typically occurs along drainage swales and the floodplain of smaller streams in the Delaware River valley. This association may also occur on mid to high floodplain terraces of the Delaware River (e.g., Poxono Island).
Classification Comments: This association differs from Northeastern Modified Successional Forest in having black walnut as the clear canopy dominant and being restricted to wet-mesic sites along floodplains of small drainages, swales, and occasionally Delaware River floodplain terraces. Where black walnut occurs in Northeastern Modified Successional Forest (typically on drier upland soils), it is usually accompanied by other early-successional tree species, such as bigtooth aspen (*Populus grandidentata*), black locust (*Robinia pseudoacacia*), and black cherry (*Prunus serotina*), with a higher cover of invasive shrub and vine species.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.8, DEWA.12, DEWA.134.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Juglans nigra* Forest Alliance (A.1932)
Alliance (English name)	Black Walnut Forest Alliance
Association	*Juglans nigra - Fraxinus americana / Lindera benzoin* Forest [Provisional]
Association (English name)	Black Walnut - White Ash / Northern Spicebush Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association typically occurs along drainage swales and the floodplain of smaller streams of some mid-Atlantic rivers (e.g., in the Delaware River valley). It may also occur on mid to high floodplain terraces. The substrate varies from silt loam to gravelly sandy loams. The canopy of this riparian forest is strongly dominated by *Juglans nigra*, typically with greater than 50% relative canopy cover. Canopy associates may include *Fraxinus americana, Ulmus americana*, and *Acer saccharum*. Canopy height is usually 20 to 30 m. The subcanopy is usually open, 10 to 15 m in height and may include scattered individuals of the canopy species as well as *Celtis occidentalis, Carpinus caroliniana*, and *Carya cordiformis*. The shrub layer is usually sparse. Typical shrubs include *Viburnum prunifolium* and *Lindera benzoin*, along with the exotic *Rosa multiflora*. The herb layer is variable, often with one or a few species providing most of the cover. Characteristic herbs include *Podophyllum peltatum, Impatiens capensis, Circaea lutetiana* ssp. *canadensis*, and *Ageratina altissima* var. *altissima*. Invasive exotic herbs are usually present and may be locally abundant, including *Microstegium vimineum, Alliaria petiolata*, and *Polygonum caespitosum*. Vines are occasional but rarely abundant; *Parthenocissus quinquefolia* is a typical vine species.

Environmental Description: This association typically occurs along drainage swales and the floodplain of smaller streams of some mid-Atlantic rivers (e.g., in the Delaware River valley). It may also occur on mid to high floodplain terraces. The substrate varies from silt loam to gravelly sandy loams.

Vegetation Description: The canopy of this riparian forest is strongly dominated by *Juglans nigra*, typically with greater than 50% relative canopy cover. Canopy associates may include *Fraxinus americana, Ulmus americana*, and *Acer saccharum*. Canopy height is usually 20 to 30 m. The subcanopy is usually open, 10 to 15 m in height and may include scattered individuals of the canopy species as well as *Celtis occidentalis, Carpinus caroliniana*, and *Carya cordiformis*. The shrub layer is usually sparse. Typical shrubs include *Viburnum prunifolium* and *Lindera benzoin*, along with the exotic *Rosa multiflora*. The herb layer is variable, often with one or a few species providing most of the cover. Characteristic herbs include *Podophyllum peltatum, Impatiens capensis, Circaea lutetiana* ssp. *canadensis*, and *Ageratina altissima* var. *altissima*. Invasive exotic herbs are usually present and may be locally abundant, including *Microstegium vimineum, Alliaria petiolata*, and *Polygonum caespitosum*. Vines are occasional but rarely abundant; *Parthenocissus quinquefolia* is a typical vine species.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Juglans nigra, Ulmus americana*
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana*
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Viburnum prunifolium*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Fraxinus americana*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Ageratina altissima* var. *altissima, Impatiens capensis, Podophyllum peltatum*

Characteristic Species: *Carpinus caroliniana, Fraxinus americana, Impatiens capensis, Juglans nigra, Lindera benzoin, Podophyllum peltatum, Ulmus americana, Viburnum prunifolium.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is currently documented from northern New Jersey and Pennsylvania but probably ranges further in the northeastern U.S.
States/Provinces: NJ, NY?, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (7-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Provisional.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d.

Figure 20. Black Walnut Bottomland Forest in Delaware Water Gap National Recreation Area (plot DEWA.8). May 2003.

Figure 21. Black Walnut Bottomland Forest in Delaware Water Gap National Recreation Area (plot DEWA.12). May 2003.

COMMON NAME (PARK-SPECIFIC): RED MAPLE - SWEET BIRCH HARDWOOD FOREST

SYNONYMS

NVC English Name: **Sweet Birch - Red Maple / Stiff Clubmoss - Hay-scented Fern Forest**

NVC Scientific Name: ***Betula lenta - Acer rubrum / Lycopodium annotinum - Dennstaedtia punctilobula*** **Forest**

NVC Identifier: **CEGL008503**

LOCAL INFORMATION

Environmental Description: This association does not appear to have any particular fidelity to site conditions other than it does not occur on dry ridgetops, wet bottomlands or on active floodplains. The majority of stands appear to be forests established on former agricultural land or stands from which the oaks (*Quercus* spp.) were previously high-graded. These sites are often bounded by relict stonewalls. Slope and aspect are variable and not diagnostic. Soils and underlying bedrock are also variable and not diagnostic. Contrary to Sugar Maple - American Beech-Sweet Birch Forest, this association does not necessarily show the fidelity to limestone and calcareous sandstones, siltstones and shale.

Vegetation Description: This association is characterized by closed canopies (total cover 70 to 90%) with canopy height ranging from 20 to 30 m. Red maple (*Acer rubrum*) and/or sweet birch (*Betula lenta*) are usually the canopy dominants, often with high relative cover (>50%). Numerous associate species can be present, depending on site conditions and land-use history. Common associates include white ash (*Fraxinus americana*), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), black oak (*Quercus velutina*), sugar maple (*Acer saccharum*), quaking aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), eastern hemlock (*Tsuga canadensis*), sassafras (*Sassafras albidum*), American beech (*Fagus grandifolia*), and hickories (*Carya alba, Carya glabra, Carya ovata*). The subcanopy is typically dominated by red maple and/or sweet birch with black cherry, sugar maple, flowering dogwood (*Cornus florida*), American hornbeam (*Carpinus caroliniana*), and oaks as common associates. The subcanopy layer varies in height from 10 to 20 m (20 m in stands with a higher canopy) with total cover ranging from 20 to 40%. The tall-shrub layer is usually 2-5 m in height and varies from absent to moderately dense (30% total cover). Northern spicebush (*Lindera benzoin*) is the most common and locally abundant species in the tall-shrub/sapling layer. Several other species may be occasional to locally abundant, including red maple, sweet birch, American beech, blackhaw (*Viburnum prunifolium*), common serviceberry (*Amelanchier arborea*), and pink azalea (*Rhododendron periclymenoides*). The short-shrub layer is less than 2 m in height with total cover usually 20% or less. Occasionally the short-shrub layer maybe relatively dense and reach 50% or more total cover (usually when high cover of invasive shrubs are present). Typical short-shrub/sapling species include northern spicebush, Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), northern dewberry (*Rubus flagellaris*), and seedlings of the canopy and subcanopy trees. The herb layer is usually less than 1 m in height but varies greatly in total cover (10 to 70%). Eastern hayscented fern (*Dennstaedtia punctilobula*) is a typical dominant (often with 25-50% cover), with associates Christmas fern (*Polystichum acrostichoides*), Swan's sedge (*Carex swanii*), garlic mustard (*Alliaria petiolata*), New York fern

(*Thelypteris noveboracensis*), Jack in the pulpit (*Arisaema triphyllum*), groundcedar (*Lycopodium complanatum*), cinnamon fern (*Osmunda cinnamomea*), common cinquefoil (*Potentilla simplex*), white snakeroot (*Ageratina altissima* var. *altissima*), licorice bedstraw (*Galium circaezans*), and Canada mayflower (*Maianthemum canadense*). Vines are usually present at low cover but may reach the lower portions of the forest canopy. The most common vines include Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*), and grapes (*Vitis* spp.).

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum, Betula lenta*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer rubrum, Betula lenta, Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Lindera benzoin*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Alliaria petiolata*
Herb (field)	Graminoid	*Carex swanii*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides, Thelypteris noveboracensis*

Characteristic Species: *Acer rubrum, Betula lenta, Quercus rubra, Lindera benzoin.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Red Maple - Sweet Birch Hardwood Forest	Walz et al 2006
PA	S5	1	Red maple (terrestrial) forest	Fike 1999

Local Range: This association occurs throughout the park and is most prevalent on former agricultural land and in forest stands from which the oaks have been high-graded.
Classification Comments: This association is closely related to Dry Oak - Mixed Hardwood Forest and Northern Red Oak - Mixed Hardwood Forest in which oaks have greater than 25% relative canopy cover. Sugar Maple - American Beech - Sweet Birch Forest is also closely related; however, *Acer saccharum* (occasionally *Betula lenta*) is typically dominant in the Sugar Maple - American Beech - Sweet Birch Forest, which is often restricted to limestone or calcareous bedrock and tends to be less disturbed.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.2, DEWA.10, DEWA.27, DEWA.29, DEWA.70, DEWA.79, DEWA.98, DEWA.187, DEWA.191, DEWA.244, DEWA.245; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)

Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis – Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Betula lenta - Acer rubrum / Lycopodium annotinum – Dennstaedtia punctilobula* Forest
Association (English name)	Sweet Birch - Red Maple / Stiff Clubmoss - Hay-scented Fern Forest
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This vegetation type is associated with mesic, generally infertile sites that have been altered by logging and fires. Its distribution is centered in the Central Appalachians. Stands are floristically depauperate and characterized by even-aged, nearly pure *Betula lenta, Acer rubrum,* or mixtures of the two. Associated species, minor in importance, vary somewhat with geography and include *Betula alleghaniensis, Fraxinus americana, Fagus grandifolia, Prunus serotina, Quercus rubra, Quercus alba, Quercus velutina, Liriodendron tulipifera, Populus tremuloides, Populus grandidentata,* and/or *Robinia pseudoacacia*. *Magnolia acuminata* and *Magnolia fraseri* are sometimes associates in the southern portion of the range. The subcanopy, when developed, consists mainly of *Fagus grandifolia*. *Tsuga canadensis* forms a scattered canopy or understory in some stands. *Ilex montana* is a characteristic shrub in the southern portion of the type's range, and *Lindera benzoin* is typical elsewhere. Shrub associates include *Kalmia latifolia, Acer pensylvanicum, Hamamelis virginiana, Amelanchier arborea, Viburnum prunifolium, Fagus* sprouts, *Rhododendron calendulaceum, Rhododendron periclymenoides*, and *Rhododendron maximum*. Herb layers may be dominated by dense and extensive colonies of *Lycopodium annotinum*, often in association with *Lycopodium dendroideum, Lycopodium clavatum*, and/or *Lycopodium digitatum*, or by *Dennstaedtia punctilobula*. Herbaceous associates include *Thelypteris noveboracensis, Polystichum acrostichoides, Carex swanii*, and others.

Environmental Description: This vegetation type is associated with mesic, generally infertile sites that have been severely altered by logging and fires. It occupies various slope and aspect positions. The type is rarely found on bouldery or rocky sites. Soils vary but are often acidic and low in base status. Deep surficial duff, with small pieces of charred wood or thin charcoal lenses are typical of soils at Virginia sampling sites (Fleming and Moorhead 1996).

Vegetation Description: Stands are floristically depauperate and characterized by even-aged, nearly pure *Betula lenta, Acer rubrum,* or mixtures of the two. Associated species vary somewhat with geography and include *Betula alleghaniensis, Fraxinus americana, Fagus grandifolia, Prunus serotina, Quercus rubra, Quercus alba, Quercus velutina, Populus tremuloides, Populus grandidentata,* and/or *Robinia pseudoacacia*. *Magnolia acuminata* and *Magnolia fraseri* are sometimes associates in the southern portion of the range. The subcanopy, when developed, consists mainly of *Fagus grandifolia*. *Tsuga canadensis* forms a scattered canopy or understory in some stands. *Ilex montana* is a characteristic shrub in the southern portion of the type's range, and *Lindera benzoin* is typical elsewhere. Shrub associates include

Kalmia latifolia, Acer pensylvanicum, Amelanchier arborea, Viburnum prunifolium, Fagus sprouts, *Rhododendron calendulaceum, Rhododendron periclymenoides,* and *Rhododendron maximum*. Herb layers may be dominated by dense and extensive colonies of *Lycopodium annotinum,* often in association with *Lycopodium dendroideum, Lycopodium clavatum*, and/or *Lycopodium digitatum,* or by *Dennstaedtia punctilobula*. Herbaceous associates include *Thelypteris noveboracensis, Polystichum acrostichoides, Carex swanii, Dryopteris intermedia, Smilax rotundifolia, Medeola virginiana, Maianthemum canadense, Monotropa uniflora*, and *Oclemena acuminata (= Aster acuminatus)*. Mean species richness of plot-sampled stands in Virginia is 15 taxa per 400 m2.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Acer rubrum, Betula lenta, Dennstaedtia punctilobula, Lycopodium annotinum, Lycopodium clavatum, Lycopodium dendroideum.*
Other Noteworthy Species: *Carex arctata, Pyrola elliptica, Schizachne purpurascens.*
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community has been documented from the Central Appalachians in Virginia and West Virginia, north to Pennsylvania and New Jersey. Its range may extend further in the northeastern United States.
States/Provinces: MD?, NJ, PA, VA, WV.
Federal Lands: NPS (Delaware Water Gap); USFS (George Washington, Monongahela).

CONSERVATION STATUS

Rank: GNA (modified/managed) (21-Jun-2001).
Reasons: This association appears to be an early-successional but persistent vegetation type resulting from major anthropogenic disturbances. It has some significance for conservation in Virginia, however, since its successional development most likely will result in one of the state-rare community types that are confined in Virginia to Allegheny Mountain. For conservation planning in Virginia it is best considered a low-quality occurrence of Tsuga canadensis - Fagus grandifolia - Quercus rubra Forest (CEGL006088) or Picea rubens / Acer rubrum / Maianthemum canadense - (Lycopodium clavatum, Lycopodium dendroideum) Forest (CEGL008501).

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: 2 – Moderate.
Comments: Because of the consistent dominance of *Betula lenta* and/or *Acer rubrum* and locally dense *Lycopodium* or *Dennstaedtia punctilobula* ground cover, this community type is readily identifiable in the field. *Lycopodium* spp. as well as *Dennstaedtia punctilobula* are specialized colonizers of moist, sterile, exposed mineral soils, which were plentiful in these habitats after the burning off of the original forest humus. Current stand composition suggests that the likely successors to this association in Virginia are *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088) or *Picea rubens / Acer rubrum / Maianthemum canadense - (Lycopodium clavatum, Lycopodium dendroideum)* Forest (CEGL008501). However, potentially devastating impacts of beech bark disease and hemlock woolly adelgid on

Allegheny Mountain could alter some of the present successional trends (Fleming and Moorhead 1996).

Similar Associations:

- *Quercus rubra - Acer rubrum - Betula* spp. - *Pinus strobus* Forest (CEGL006506)--occupies similar mid-successional settings but is generally more northern (*Betula papyrifera* more typical than *Betula lenta*)and contains a component of white pine.

Related Concepts:

- *Betula lenta / Ilex montana / Lycopodium annotinum* Association (Fleming and Moorhead 1996) ?
- *Betula lenta / Ilex montana / Lycopodium annotinum* Forest (Fleming and Coulling 2001) =

SOURCES

Description Authors: G. Fleming, mod. S. C. Gawler.

References: Eastern Ecology Working Group n.d., Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Fleming et al. 2004.

Figure 22. Red Maple - Sweet Birch Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.29). June 2003.

Figure 23. Red Maple - Sweet Birch Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.79). August 2003.

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

SYNONYMS
NVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
NVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest**
NVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This forest type occurs on high terraces above the Delaware River, low terrace floodplains of small creeks, or any broad flat area with saturated soils or diffuse/braided drainage. The substrate is often poorly drained soil, such as Alden silt loam, Catden mucky peat, Delaware fine sandy loam, Hazen-Hoosic complex, or Fredon-Halsey complex. These areas can be seasonally flooded or saturated, often with networks of small drainages and pools throughout. Many of these areas were previously used as pasture or farm land.

Vegetation Description: This palustrine forest type has variable species composition and is often of weedy character. Past land-use history and adjacent land uses often influence the existing species composition. The canopy can be dominated by one or more of the following species: black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvanica*), American hornbeam (*Carpinus caroliniana*), and river birch (*Betula nigra*). Black cherry (*Prunus serotina*), bitternut hickory (*Carya cordiformis*), quaking aspen (*Populus tremuloides*), sweet birch (*Betula lenta*), and tuliptree (*Liriodendron tulipifera*) may be associates. Red maple, pin oak and swamp white oak each do not cover more than 25% of the canopy. Canopy trees typically extend 15-25 m in height and cover approximately 60% of the area, while subcanopy trees are 10-15 m in height and cover 10-30% of the area. The subcanopy can be composed of a mixture of the species listed above for the canopy. The tall-shrub layer (25-50% cover) is variable and contains such species as common winterberry (*Ilex verticillata*), northern spicebush (*Lindera benzoin*), blackhaw (*Viburnum prunifolium*), silky dogwood (*Cornus amomum*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), and the invasive species multiflora rose (*Rosa multiflora*), Amur honeysuckle (*Lonicera maackii*), Morrow's honeysuckle (*Lonicera morrowii*), and common buckthorn (*Rhamnus cathartica*). The short-shrub layer covers 20-50% of the area and contains the species found in the tall-shrub layer, seedlings of the canopy trees and the invasive Japanese barberry (*Berberis thunbergii*). The herbaceous layer varies depending on past and adjacent land uses, local hydrology and available seed sources. Common species include ground ivy (*Glechoma hederacea*), blunt broom sedge (*Carex tribuloides*), bladder sedge (*Carex intumescens*), eastern hayscented fern (*Dennstaedtia punctilobula*), intermediate woodfern (*Dryopteris intermedia*), spotted ladysthumb (*Polygonum persicaria*), sensitive fern (*Onoclea sensibilis*), Christmas fern (*Polystichum acrostichoides*), cleavers (*Galium aparine*), white avens (*Geum canadense*), mayapple (*Podophyllum peltatum*), American golden saxifrage (*Chrysosplenium americanum*), jewelweed (*Impatiens capensis*), reed canarygrass (*Phalaris arundinacea*), false baby's breath (*Galium mollugo*), spotted geranium (*Geranium maculatum*), and Jack in the pulpit (*Arisaema triphyllum*). The invasive species creeping Jenny (*Lysimachia*

nummularia) and garlic mustard (*Alliaria petiolata*) can be abundant in this forest type. The vines fox grape (*Vitis labrusca*) and Virginia creeper (*Parthenocissus quinquefolia*) can also be abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	highly variable, see description
Tree subcanopy	Broad-leaved deciduous tree	highly variable, see description
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Rosa multiflora, Lonicera* spp.
Herb (field)	Forb and Graminoid	highly variable, see description
Herb (field)	Vine/Liana	*Vitis labrusca, Parthenocissus quinquefolia*

Characteristic Species: *Acer rubrum, Acer saccharum, Betula nigra, Carpinus caroliniana, Carya cordiformis, Fraxinus americana, Fraxinus nigra, Fraxinus pennsylvanica, Quercus bicolor, Quercus palustris, Ulmus americana.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	3	no crosswalk	Walz et al 2006
PA	SNA	3	no crosswalk	Fike 1999

Local Range: This broadly defined forest type occurs in a variety of palustrine settings throughout the park.

Classification Comments: This type is broadly inclusive of hardwood-dominated forests in palustrine settings, often weedy due to previous or existing adjacent agricultural land uses. Bottomland Mixed Hardwood Palustrine Forest can be distinguished from other palustrine forests by the dominance of one or more of the following species: *Fraxinus nigra, Acer rubrum, Carya cordiformis, Ulmus americana, Quercus palustris, Quercus bicolor, Acer saccharum, Fraxinus americana, Fraxinus pennsylvanica, Carpinus caroliniana,* and/or *Betula nigra*. *Acer rubrum, Quercus palustris,* and *Quercus bicolor* each do not cover more than 25% of the canopy.

Other Comments: None.

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

Plots and Data Sources: DEWA.3, DEWA.13, DEWA.49, DEWA.53.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis – Quercus* spp. Forest Alliance (A.237)

Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum – Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that have generally been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species may include *Prunus serotina, Liriodendron tulipifera, Fraxinus americana,* and *Acer rubrum*. Other associates can include *Juglans nigra, Sassafras albidum, Betula populifolia, Juniperus virginiana, Acer negundo, Acer saccharinum, Ailanthus altissima, Ulmus americana, Quercus* spp., *Betula lenta, Amelanchier* spp., and *Robinia pseudoacacia*. Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* and *Carpinus caroliniana*. The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. such as *Rubus flagellaris, Rubus allegheniensis, Rubus phoenicolasius,* or *Rubus hispidus*. This layer is often dominated by exotic species such as *Lonicera tatarica, Lonicera japonica, Rhamnus cathartica, Crataegus* spp., *Rosa multiflora,* and *Berberis thunbergii*. The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin.
Environmental Description: Information not available.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: Information not available.
States/Provinces: Information not available.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Friendship Hill).

CONSERVATION STATUS

Rank: GNA (ruderal) (29-Nov-2004).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Nonstandard.
Confidence: 3 – Weak.
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Fike 1999, Perles et al. 2006c.

Figure 24. Bottomland Mixed Hardwood Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.3). May 2003.

Figure 25. Bottomland Mixed Hardwood Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.53). July 2003.

COMMON NAME (PARK-SPECIFIC): NORTHEASTERN MODIFIED SUCCESSIONAL FOREST

SYNONYMS
NVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
NVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest**
NVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This forest type occurs on former agricultural lands and other disturbed or degraded environmental settlings. These sites are often mesic and occur at mid to low elevations. These disturbed forests are usually located on moderately well-drained to well-drained soils such as Wallpack fine sandy loam, Delaware fine sandy loam, Chenango gravelly fine sandy loam, Rexford gravelly silt loam, Galway loam, and/or Hoosic-Otisville complex. These forests nearly always contain or are bounded by stonewalls, evidence of past agricultural land use. Large old wolf trees may be present along the stonewalls. These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species give these forest stands a weedy character. The successional trajectory of these stands is uncertain.

Vegetation Description: The species composition and vegetation structure of this forest type are extremely variable among and within sites. The type is characterized by early-successional or weedy tree species and an abundance of invasive species and vines. Forests are typically young, with canopy trees extending from 10-30 m in height and covering 40-90% of the stand. The canopy can be dominated by one or more of the following species: white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), eastern red-cedar (*Juniperus virginiana*), bigtooth aspen (*Populus grandidentata*), black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), and eastern white pine (*Pinus strobus*). Other canopy associates include sweet birch (*Betula lenta*), sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), tuliptree (*Liriodendron tulipifera*), oaks (*Quercus* spp.), and hickories (*Carya* spp.). Subcanopy trees range from 6-15 m in height and cover 5-40% of the stand. Dead or declining eastern red-cedars are characteristic subcanopy trees. Other common subcanopy trees include American elm (*Ulmus americana*), flowering dogwood (*Cornus florida*), and species from the canopy. The invasive species tree of heaven (*Ailanthus altissima*) may be present in the canopy or subcanopy. The variable tall-shrub layer (5-60% cover) can contain northern spicebush (*Lindera benzoin*), blackhaw (*Viburnum prunifolium*), common winterberry (*Ilex verticillata*), and mapleleaf viburnum (*Viburnum acerifolium*). The invasive shrubs multiflora rose (*Rosa multiflora*), autumn-olive (*Elaeagnus umbellata*), Tatarian honeysuckle (*Lonicera tatarica*), and Morrow's honeysuckle (*Lonicera morrowii*) can also be abundant in the tall- or short-shrub layers. The short-shrub layer is also variable (5-50% cover) and contains canopy, subcanopy and tall-shrub species, as well as black raspberry (*Rubus occidentalis*), northern dewberry (*Rubus flagellaris*), and the invasive species Japanese barberry (*Berberis thunbergii*) and wine raspberry (*Rubus phoenicolasius*). The herbaceous layer may be sparse or dense (20-95% cover) and has variable species composition influenced by local hydrology, land-use history, and available seed sources. Common species include white snakeroot (*Ageratina altissima* var. *altissima*), spotted ladysthumb (*Polygonum*

persicaria), touch-me-not (*Impatiens* spp.), broadleaf enchanter's nightshade (*Circaea lutetiana* ssp. *canadensis*), mayapple (*Podophyllum peltatum*), ground ivy (*Glechoma hederacea*), Christmas fern (*Polystichum acrostichoides*), hedge false bindweed (*Calystegia sepium* ssp. *sepium*), cleavers (*Galium aparine*), common yellow oxalis (*Oxalis stricta*), jumpseed (*Polygonum virginianum*), eastern hayscented fern (*Dennstaedtia punctilobula*), Jack in the pulpit (*Arisaema triphyllum*), wild garlic (*Allium vineale*), and common gypsyweed (*Veronica officinalis*), among many others. The invasive species garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*) and oriental lady'sthumb (*Polygonum caespitosum*) can be abundant in this disturbed forest type. Vines can be absent or abundant (0-60% cover). In stands with high vine cover, the vegetation structure can be degraded by the weight of the vines pulling down trees and shrubs. Common vines include Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*), fox grape (*Vitis labrusca*), and the invasive vines oriental bittersweet (*Celastrus orbiculatus*) and Japanese honeysuckle (*Lonicera japonica*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana, Juglans nigra, Populus grandidentata, Robinia pseudoacacia*
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Elaeagnus umbellata, Rosa multiflora*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rosa multiflora*
Herb (field)	Vine/Liana	*Celastrus orbiculatus, Parthenocissus quinquefolia*
Herb (field)	Forb	*Ageratina altissima* var. *altissima, Alliaria petiolata, Polygonum persicaria*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Fraxinus americana, Juglans nigra, Juniperus virginiana, Acer rubrum, Populus grandidentata, Prunus serotina, Robinia pseudoacacia, Ailanthus altissima, Berberis thunbergii, Elaeagnus umbellata, Rosa multiflora, Microstegium vimineum, Polygonum persicaria, Alliaria petiolata.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Northeastern Modified Successional Forest	Walz et al 2006
PA	SNA	1	Black locust forest	Fike 1999

Local Range: This variable forest type is common in the park, particularly in mesic areas of mid to low elevations where past agricultural land use occurred. This association is rarely found on xeric ridgetops or at high elevations within the park.

Classification Comments: Modified Successional Forest is highly variable in species composition and vegetation structure; however, it is identifiable by the abundance of early-

successional or weedy tree species, invasive species, and vines. These forests will probably not succeed to a community dominated by native plants.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.23, DEWA.24, DEWA.34, DEWA.38, DEWA.80, DEWA.125, DEWA.153, DEWA.157, DEWA.159, DEWA.160, DEWA.193.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis – Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum – Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591) Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that are becoming reforested after having been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina, Liriodendron tulipifera, Fraxinus americana, Robinia pseudoacacia*, and *Acer rubrum*. Other associates can include *Juglans nigra, Sassafras albidum, Betula populifolia, Juniperus virginiana, Acer negundo, Acer saccharinum, Ailanthus altissima, Ulmus americana, Quercus* spp., *Betula lenta, Amelanchier* spp., *Pinus strobus*, and *Populus grandidentata*. Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* and *Carpinus caroliniana*. The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. such as *Rubus flagellaris, Rubus allegheniensis, Rubus phoenicolasius*, or *Rubus hispidus*. This layer is often dominated by exotic species such as *Lonicera tatarica, Lonicera morrowii, Rhamnus cathartica, Crataegus* spp., *Rosa multiflora*, and *Berberis thunbergii*. The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima* var. *altissima, Polygonum persicaria, Impatiens capensis, Glechoma hederacea, Polystichum acrostichoides, Calystegia sepium* ssp. *sepium, Galium aparine, Oxalis stricta, Polygonum virginianum, Dennstaedtia punctilobula, Arisaema triphyllum, Allium vineale,* and

Veronica officinalis, among many others. The invasive species *Alliaria petiolata, Microstegium vimineum,* and *Polygonum caespitosum* can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia, Toxicodendron radicans, Vitis labrusca,* and the invasive vines *Celastrus orbiculatus* and *Lonicera japonica*. These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species give these forest stands a weedy character. It is unlikely that these stands will succeed to a natural plant community dominated by native species.

Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples. Occasionally this type may occur in formerly agricultural bottomlands, in which case the soils may be temporarily flooded or saturated.

Vegetation Description: Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species often include some combination of *Prunus serotina, Liriodendron tulipifera, Fraxinus americana, Robinia pseudoacacia,* and *Acer rubrum*. Other associates can include *Juglans nigra, Sassafras albidum, Betula populifolia, Juniperus virginiana, Acer negundo, Acer saccharinum, Ailanthus altissima, Ulmus americana, Quercus* spp., *Betula lenta, Amelanchier* spp., *Pinus strobus,* and *Populus grandidentata*. Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* and *Carpinus caroliniana*. The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. such as *Rubus flagellaris, Rubus allegheniensis, Rubus phoenicolasius,* or *Rubus hispidus*. This layer is often dominated by exotic species such as *Lonicera tatarica, Lonicera morrowii, Rhamnus cathartica, Crataegus* spp., *Rosa multiflora,* and *Berberis thunbergii*. The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin. Common species include *Ageratina altissima* var. *altissima, Polygonum persicaria, Impatiens capensis, Glechoma hederacea, Polystichum acrostichoides, Calystegia sepium* ssp. *sepium, Galium aparine, Oxalis stricta, Polygonum virginianum, Dennstaedtia punctilobula, Arisaema triphyllum, Allium vineale,* and *Veronica officinalis,* among many others. The invasive species *Alliaria petiolata, Microstegium vimineum,* and *Polygonum caespitosum* can be abundant in this disturbed forest type. Vines can be absent or abundant. In stands with high vine cover, the vegetation structure can be altered by the weight of the vines pulling down trees and shrubs. Common vines include *Parthenocissus quinquefolia, Toxicodendron radicans, Vitis labrusca,* and the invasive vines *Celastrus orbiculatus* and *Lonicera japonica*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Fraxinus americana, Juglans nigra, Liriodendron tulipifera, Prunus serotina*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous tree	*Carpinus caroliniana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Herb (field)	Forb	*Alliaria petiolata, Polygonum persicaria*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Acer rubrum*, *Alliaria petiolata*, *Berberis thunbergii*, *Elaeagnus umbellata*, *Fraxinus americana*, *Juglans nigra*, *Liriodendron tulipifera*, *Microstegium vimineum*, *Polygonum persicaria*, *Prunus serotina*, *Robinia pseudoacacia*, *Rosa multiflora*.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This vegetation is currently described from Pennsylvania and New Jersey but is of broader distribution in the northeastern U.S.
States/Provinces: NJ, NY, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Fort Necessity, Friendship Hill, Gettysburg, Johnstown Flood, Morristown, Valley Forge); USFWS (Great Meadows?).

CONSERVATION STATUS
Rank: GNA (ruderal) (29-Nov-2004).
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations:
- *Liriodendron tulipifera* - *Quercus* spp. Forest (CEGL007221)--is more strongly dominated by *Liriodendron* and is generally in a later successional state as evidenced by taller trees and more closed canopy.
- *Robinia pseudoacacia* Forest (CEGL007279).

Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Ehrenfeld 1977, Fike 1999, Perles et al. 2006c.

Figure 26. Northeastern Modified Successional Forest in Delaware Water Gap National Recreation Area (plot DEWA.153). July 2003.

Figure 27. Northeastern Modified Successional Forest in Delaware Water Gap National Recreation Area (plot DEWA.193). May 2004.

COMMON NAME (PARK-SPECIFIC): DRY OAK - MIXED HARDWOOD FOREST

SYNONYMS

NVC English Name: **(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest**

NVC Scientific Name: ***Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest**

NVC Identifier: **CEGL006336**

LOCAL INFORMATION

Environmental Description: This forest type is common on high to midslopes, steps-in-slope, and other dry-mesic sites. This association can occur on extremely stony xeric soils such the Manlius, Arnot, Dekalb, Oquaga, Lackawanna, and Chippawa series, as well as the more mesic and less rocky Hazen, Hoosic, and Otisville series. This association occurs on sandstone, shale, and siltstone within the park. This forest type often occurs downslope of Dry Oak - Heath Forest on slightly less xeric sites, and upslope of the more mesic Northern Red Oak - Mixed Hardwood Forest. The sites may be gentle to steeply sloping and may contain scattered boulders and large rocks. Also included here are more depauperate stands occurring on scree slopes below rapidly weathering siltstone and shale outcrops. These forests have likely been harvested numerous times in the past several centuries. Small scattered seeps or drainages may occur in this forest type, influencing the herbaceous layer immediately around them.

Vegetation Description: Species composition of the forest may vary with site-specific micro-climates, surrounding vegetation types, and land-use history. The canopy (70-80% cover) is dominated by oaks (*Quercus* spp.) that cover 25-75% of the stand, with a wide variety of associates. White oak (*Quercus alba*) and chestnut oak (*Quercus prinus*) are the most common oak dominants, although black oak (*Quercus velutina*) and northern red oak (*Quercus rubra*) can also be dominant. The most common canopy associates are red maple (*Acer rubrum*) and sweet birch (*Betula lenta*). Other common canopy associates include eastern hemlock (*Tsuga canadensis*), pignut hickory (*Carya glabra*), mockernut hickory (*Carya alba*), red hickory *(Carya ovalis*), blackgum (*Nyssa sylvatica*), eastern white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*). Canopy trees extend 15-30 m in height and subcanopy trees range 5-20 m in height. The subcanopy (10-50% cover) consists of red maple, blackgum, sugar maple, common serviceberry (*Amelanchier arborea*), eastern red-cedar (*Juniperus virginiana*), and the oaks and hickories found in the canopy. Stands with a woodland physiognomy (25-60% canopy cover) with a similar species composition are included in this type. These forests may contain dense white pine regeneration, indicating that the site will succeed to Dry White Pine - Oak Forest in the future. The sparse tall-shrub layer (0-30% cover) typically contains American witch-hazel (*Hamamelis virginiana*), common serviceberry, flowering dogwood (*Cornus florida*), mountain laurel (*Kalmia latifolia*), mapleleaf viburnum (*Viburnum acerifolium*), and saplings of the canopy trees. Occasionally, on north-facing slopes, this forest may contain dense stands of great laurel (*Rhododendron maximum*). Scattered patches of low heath that cover <40% of the forest floor are characteristic of this forest type. Common ericaceous species include black huckleberry (*Gaylussacia baccata*), Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), and deerberry (*Vaccinium stamineum*). The heath patches are often interspersed with dense patches of eastern hayscented fern (*Dennstaedtia punctilobula*). The herbaceous layer is extremely variable (5-70% cover)

depending on site-specific conditions and land-use history. In stands with open woodland canopies, the herbaceous layer may be well-developed and dominated by graminoids. Some common species are Canada mayflower (*Maianthemum canadense*), marginal woodfern (*Dryopteris marginalis*), wild sarsaparilla (*Aralia nudicaulis*), white snakeroot (*Ageratina altissima* var. *altissima*), wavy hairgrass (*Deschampsia flexuosa*), Swan's sedge (*Carex swanii*), partridgeberry (*Mitchella repens*), striped prince's pine (*Chimaphila maculata*), Indian cucumber (*Medeola virginiana*), Pennsylvania sedge (*Carex pensylvanica*), smooth Solomon's seal (*Polygonatum biflorum*), sessileleaf bellwort (*Uvularia sessilifolia*), upland bentgrass (*Agrostis perennans*), tapered rosette grass (*Dichanthelium acuminatum* var. *acuminatum*), and starflower (*Trientalis borealis*). The invasive species Japanese stiltgrass (*Microstegium vimineum*) and Japanese barberry (*Berberis thunbergii*) may be present in this forest type.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba, Quercus prinus, Betula lenta, Acer rubrum*
Tree subcanopy	Broad-leaved deciduous tree	*Nyssa sylvatica, Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium* spp.
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Quercus alba, Quercus prinus, Quercus rubra, Quercus velutina, Acer rubrum, Amelanchier arborea, Betula lenta, Gaylussacia baccata, Hamamelis virginiana*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S4S5	1	Northeastern Dry Oak-Hickory Forest	Walz et al 2006
PA	S4	2	Dry oak - mixed hardwood forest	Fike 1999

Local Range: This very common forest type occurs throughout the park in moderately dry settings.

Classification Comments: Although species composition is variable, Dry Oak - Mixed Hardwood Forest can be distinguished from Northern Red Oak - Mixed Hardwood Forest (mesic oak) by the presence of drier canopy components such as *Quercus prinus, Carya glabra, Carya ovalis, Carya alba,* and *Amelanchier arborea*, as well as the presence of scattered ericads (*Gaylussacia baccata, Vaccinium* spp.). Dry Oak - Mixed Hardwood Forest is also found on higher elevation, more xeric sites than Northern Red Oak - Mixed Harwood Forest. Northern Red Oak - Mixed Hardwood Forest tends to contain more mesic associate species such as *Liriodendron tulipifera, Fagus grandifolia,* and *Lindera benzoin*. In stands of Dry Oak - Mixed Hardwood Forest from which the oaks have been high-graded, *Acer rubrum* and *Betula lenta* may be overabundant, reducing oak dominance below 25% relative cover. In these cases, Red Maple - Sweet Birch Hardwood Forest is more characteristic. If the canopy and subcanopy combined contain >25% relative cover of *Pinus strobus* or *Tsuga canadensis*, then refer to Dry Eastern White Pine - Oak Forest or Dry Eastern Hemlock - Oak Forest. Stands with a woodland physiognomy (25-60% canopy cover) with similar species composition to that described above are included here.

Other Comments: None.

Local Description Authors: S. J. Perles and G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.62, DEWA.71, DEWA.86, DEWA.93, DEWA.117, DEWA.120, DEWA.128, DEWA.133, DEWA.142, DEWA.180, DEWA.214; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus alba - (Quercus rubra, Carya* spp.) Forest Alliance (A.239)
Alliance (English name)	White Oak - (Northern Red Oak, Hickory species) Forest Alliance
Association	*Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest
Association (English name)	(White Oak, Northern Red Oak, Black Oak) / Flowering Dogwood / Mapleleaf Viburnum Forest
Ecological System(s):	Northern Atlantic Coastal Plain Dry Hardwood Forest (CES203.475) Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This northeastern oak-hickory forest occurs on well-drained loamy sand of midslopes. This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak species-poor forests. *Quercus rubra, Quercus alba,* and *Quercus velutina* are prominent in the canopy. *Quercus prinus* and *Quercus coccinea* are canopy associates in the southern portion of the range. Typical hickory species include *Carya glabra, Carya ovata, Carya alba (= Carya tomentosa),* and *Carya ovalis*. Other canopy associates may include *Acer rubrum, Sassafras albidum,* and *Amelanchier arborea*. At the northern range limit of this type, *Pinus strobus* and *Betula lenta* also occur as minor associates. *Cornus florida* is a characteristic understory tree in portions of the range. The shrub layer is characterized by *Viburnum acerifolium,* with other frequent associates including *Hamamelis virginiana, Vaccinium corymbosum, Corylus cornuta,* and *Corylus americana*. A dwarf-shrub layer may be common, but is generally not abundant, and is characterized by *Vaccinium pallidum* and *Gaylussacia baccata,* with *Vaccinium angustifolium* occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica, Carex rosea, Maianthemum racemosum (= Smilacina racemosa), Aralia nudicaulis, Hieracium venosum, Solidago bicolor, Desmodium glutinosum, Desmodium paniculatum, Melampyrum lineare, Chimaphila maculata, Eurybia divaricata (= Aster divaricatus), Danthonia spicata, Aureolaria* spp., and *Helianthemum canadense*.
Environmental Description: This forest type occurs on well-drained loamy sand of midslopes and other dry-mesic sites.

Vegetation Description: This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak-species-poor forests. *Quercus rubra, Quercus alba,* and *Quercus velutina* are prominent in the canopy. Typical hickory species include *Carya glabra, Carya ovata, Carya alba (= Carya tomentosa),* and *Carya ovalis*. Other canopy associates may include *Acer rubrum, Quercus prinus, Sassafras albidum,* and *Amelanchier arborea*. *Pinus strobus, Tsuga canadensis,* and *Betula lenta* may also occur as minor associates. *Cornus florida* is a characteristic understory tree in portions of the range. The shrub layer is typically rather sparse and characterized by *Viburnum acerifolium,* with other frequent associates including *Hamamelis virginiana, Vaccinium corymbosum, Kalmia latifolia, Corylus cornuta,* and *Corylus americana*. A dwarf-shrub layer may be common but generally not abundant, characterized by *Vaccinium pallidum* and *Gaylussacia baccata,* with *Vaccinium angustifolium* occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica, Maianthemum racemosum (= Smilacina racemosa), Dryopteris marginalis, Aralia nudicaulis, Hieracium venosum, Solidago bicolor, Desmodium glutinosum, Desmodium paniculatum, Melampyrum lineare, Chimaphila maculata, Eurybia divaricata (= Aster divaricatus), Danthonia spicata, Deschampsia flexuosa, Dennstaedtia punctilobula, Aureolaria* spp., and *Helianthemum canadense*. The invasive species *Microstegium vimineum* and *Berberis thunbergii* may also be present in this forest type.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba, Quercus prinus, Quercus rubra, Quercus velutina*
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	*Cornus florida*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata*
Herb (field)	Graminoid	*Carex pensylvanica*

Characteristic Species: *Aralia nudicaulis, Carex pensylvanica, Carya alba, Carya glabra, Carya ovalis, Cornus florida, Gaylussacia baccata, Maianthemum racemosum, Quercus prinus, Vaccinium pallidum, Viburnum acerifolium.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association occurs from Maine to Virginia.
States/Provinces: CT, DE:S3?, MA, MD, ME, NH, NJ:S4S5, NY:S3, PA, RI, VA, VT.
Federal Lands: NPS (Booker T. Washington, Cape Cod, Delaware Water Gap, Fort Necessity, Fredericksburg-Spotsylvania, Gettysburg, Minute Man, Morristown, Prince William?, Weir Farm); USFWS (Assabet River, Great Meadows).

CONSERVATION STATUS
Rank: G4G5 (24-Jan-2005).
Reasons: This type is not naturally rare and has a wide geographic distribution. Mature stands, however, are uncommon and most stands are subject to logging disturbances or even complete destruction if located in rapidly developing suburban areas.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.

Comments: Information not available.

Similar Associations:

- *Acer saccharum - Betula alleghaniensis - Quercus rubra / Viburnum acerifolium* Forest (CEGL006943).
- *Carya (glabra, ovata) - Fraxinus americana - Quercus* spp. Forest (CEGL006236).
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293)--can intergrade with this type in New England but is characterized by *Fagus grandifolia* (more or less absent in CEGL006336), a greater amount of *Pinus strobus* in the canopy (usually >20%), and little or no *Carya*.
- *Quercus alba - Quercus (rubra, coccinea) - Carya (alba, glabra) / Vaccinium pallidum* Piedmont Dry-Mesic Forest (CEGL008475)--is more diverse and occupies soils with slightly higher base status. *Quercus velutina* is not as characteristic of this type. A number of southern herbs such as *Aristolochia serpentaria* are not found in CEGL006375.
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acid Forest (CEGL002067)--also contains *Cimifuga racemosa* and can occur on cherty limestone, and *Quercus velutina* is not characteristic.
- *Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum* Forest (CEGL006375)--lacks *Viburnum acerifolium* and *Cornus florida* and in general is less diverse and occurring on relatively more nutrient-poor soils.
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest (CEGL006282).
- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076)--also contains *Quercus ellipsoidalis* or *Quercus macrocarpa* and is of shorter stature and more open canopy.
- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078)--is drier and more infertile, and lacks *Viburnum acerifolium, Hamamelis virginiana* and other shrubs.

Related Concepts:

- *Quercus (alba, rubra, velutina) / Cornus florida - Viburnum acerifolium* Forest (Bartgis 1986) =
- *Quercus montana - Quercus rubra - Carya (ovalis, glabra) / Viburnum acerifolium* Forest (Fleming pers. comm.) ?
- Mesic Coastal Plain mixed oak forest (Breden 1989) ?
- Northeastern Acidic Oak-Hickory Forest (Fleming et al. 2004) ?
- SNE mesic central hardwood forest on acidic till (Rawinski 1984) ?

SOURCES

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

References: Bartgis 1986, Berdine 1998, Breden 1989, Breden et al. 2001, Clancy 1996, Damman 1977, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Fleming et al. 2001, Fleming et al. 2004, Fleming pers. comm., Gawler 2002, Harrison 2004, Hunt 1997a, MENHP 1991, McCoy and Fleming 2000, Metzler and Barrett 2001, Patterson pers. comm., Rawinski 1984, Sperduto 1997b, Sperduto and Nichols 2004, Swain and Kearsley 2001, VDNH 2003.

Figure 28. Dry Oak - Mixed Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.62). July 2003.

Figure 29. Dry Oak - Mixed Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.128). May 2003.

COMMON NAME (PARK-SPECIFIC): DRY OAK - HEATH FOREST

SYNONYMS

NVC English Name:	**Chestnut Oak - (Northern Red Oak, Black Oak) / Northern Lowbush Blueberry Forest**
NVC Scientific Name:	***Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest**
NVC Identifier:	**CEGL006282**

LOCAL INFORMATION

Environmental Description: This common forest association occurs in most high-elevation portions of the park, on ridgetops, high slopes, and high plateaus on both sides of the river. It is the prominent matrix forest community for upper elevations of the Kittatinny Ridge and the Glaciated Low Plateau in Pennsylvania. In areas that have experienced significant tree mortality from fire, storms, or insects, this association may resemble a woodland. This forest occurs on acidic, rapidly or well-drained, extremely rocky or thin soils such as found in the Manlius, Mardin, Arnot, Oquaga, Lackawanna, Lordstown, Hazelton, and Dekalb series. Rock outcrops, boulders and large rocks are frequent on the forest floor. This association occurs on shale, siltstone and sandstone within the park.

Vegetation Description: This forest type is characterized by the presence of ericaceous species that form substantial heath layers under a closed canopy or occasionally an open canopy in disturbed stands. Ericaceous species cover 40-95% of the forest, forming dense tall- and/or short-shrub layers. Mountain laurel (*Kalmia latifolia*) is often the dominant tall shrub, with American witch-hazel (*Hamamelis virginiana*), striped maple (*Acer pensylvanicum*), bear oak (*Quercus ilicifolia*), and sprouts of American chestnut (*Castanea dentata*) as associates. The short ericad layer is dominated by black huckleberry (*Gaylussacia baccata*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), and/or lowbush blueberry (*Vaccinium angustifolium*). The diverse short-shrub layer also includes blue huckleberry (*Gaylussacia frondosa*), eastern teaberry (*Gaultheria procumbens*), sheep laurel (*Kalmia angustifolia*), trailing arbutus (*Epigaea repens*), mountain laurel, and seedlings of the canopy and subcanopy trees. The canopy covers 30 to 90% of the area and is typically dominated or codominated by chestnut oak (*Quercus prinus*). Northern red oak (*Quercus rubra*) and white oak (*Quercus alba*) may also be codominant or dominant. Other common canopy associates include scarlet oak (*Quercus coccinea*), sweet birch (*Betula lenta*), red maple (*Acer rubrum*), pignut hickory (*Carya glabra*), black oak (*Quercus velutina*), pitch pine (*Pinus rigida*), blackgum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), eastern white pine (*Pinus strobus*), and eastern hemlock (*Tsuga canadensis*). Canopy trees range in height from 15-30 m, while subcanopy trees extend 5-20 m in height. The subcanopy (10-60% cover) is typically dominated by red maple, with sweet birch, pignut hickory, chestnut oak, common serviceberry (*Amelanchier arborea*), black chokeberry (*Photinia melanocarpa*), eastern hemlock, blackgum, white oak, black oak, and scarlet oak. The herbaceous layer is typically extremely sparse, with scattered graminoid or herbaceous species persisting underneath the dense shrubs. The herbaceous layer is denser in open patches in between the dense clumps of ericads. Wavy hairgrass (*Deschampsia flexuosa*) and eastern hayscented fern (*Dennstaedtia punctilobula*) are the most common species, with Pennsylvania sedge (*Carex pensylvanica*), western bracken fern (*Pteridium aquilinum*), Swan's sedge (*Carex swanii*), poverty oatgrass (*Danthonia spicata*), narrowleaf cowwheat (*Melampyrum lineare*),

Indian cucumber (*Medeola virginiana*), running clubmoss (*Lycopodium clavatum*), smooth Solomon's seal (*Polygonatum biflorum*), starflower (*Trientalis borealis*), marginal woodfern (*Dryopteris marginalis*), white snakeroot (*Ageratina altissima* var. *altissima*), and wild sarsaparilla (*Aralia nudicaulis*). Vines are typically sparse or absent and may include Virginia creeper (*Parthenocissus quinquefolia*) and roundleaf greenbrier (*Smilax rotundifolia*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus alba, Quercus prinus, Quercus rubra*
Tree canopy	Needle-leaved tree	*Pinus rigida*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum, Betula lenta, Carya glabra*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum*
Herb (field)	Graminoid	*Deschampsia flexuosa*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Quercus alba, Quercus prinus, Gaylussacia baccata, Kalmia latifolia, Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3S4	1	Lower New England Slope Chestnut Oak Forest	Walz et al 2006
PA	S5	1	Dry oak - heath forest	Fike 1999
PA	S3	1	Dry oak - heath woodland	Fike 1999

Local Range: This common forest type occurs in most high-elevation portions of the park.

Classification Comments: This forest is identified by the dense tall- and/or short-shrub layers (40-95% cover) dominated by ericaceous species (*Gaylussacia* spp., *Vaccinium* spp., *Kalmia* spp.). The canopy usually covers 60% of the stand and is often dominated by *Quercus prinus*, although *Quercus alba* and/or *Quercus rubra* can also be dominant or codominant. Stands with a woodland physiognomy (25-60% canopy cover) with similar species composition are included here.

Other Comments: None.

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

Plots and Data Sources: DEWA.61, DEWA.64, DEWA.69, DEWA.72, DEWA.75, DEWA.88, DEWA.92, DEWA.97, DEWA.127, DEWA.136, DEWA.144, DEWA.147, DEWA.148, DEWA.195, DEWA.198, DEWA.200, DEWA.207; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus prinus - (Quercus coccinea, Quercus velutina)* Forest Alliance (A.248)
Alliance (English name)	Chestnut Oak - (Scarlet Oak, Black Oak) Forest Alliance
Association	*Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest
Association (English name)	Chestnut Oak - (Northern Red Oak, Black Oak) / Northern Lowbush Blueberry Forest
Ecological System(s):	Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This dry to xeric oak-heath forest of central and southern New England ranges south to the northern Piedmont and central Appalachian Mountains. It occurs on upper slopes and ridgetops with thin, nutrient-poor, acidic soils. Windthrow, fire and ice damage are common natural disturbances. The canopy is closed to partially open and is dominated by *Quercus prinus*, which can be codominant with *Quercus rubra*. *Quercus alba, Quercus velutina,* and *Acer rubrum* are common associates, with other less frequent trees including *Betula lenta, Quercus coccinea, Amelanchier arborea, Pinus rigida,* and *Pinus strobus*. *Sassafras albidum, Cornus florida,* and *Nyssa sylvatica* can be minor associates at the southern and western portions of the range. The low-shrub layer is well-developed and comprised chiefly of ericaceous species, including *Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum, Gaylussacia baccata,* or *Kalmia angustifolia*. A tall-shrub layer is often lacking but when present may include *Castanea dentata, Kalmia latifolia, Viburnum acerifolium, Hamamelis virginiana, Quercus ilicifolia,* and *Viburnum prunifolium*. *Ilex montana, Rhododendron prinophyllum,* and *Menziesia pilosa* are minor shrub associates at the southern end of the range. The herbaceous layer is of sparse to moderate cover, depending on shrub cover, and may include *Carex pensylvanica, Deschampsia flexuosa, Danthonia spicata, Ageratina altissima* var. *altissima, Antennaria plantaginifolia, Aralia nudicaulis, Aureolaria laevigata, Gaultheria procumbens, Chimaphila maculata, Carex rosea, Carex swanii, Carex pensylvanica, Corydalis sempervirens, Comandra umbellata, Cypripedium acaule, Dryopteris marginalis, Epigaea repens, Goodyera pubescens, Hieracium venosum, Lycopodium clavatum, Medeola virginiana, Melampyrum lineare, Monotropa uniflora, Potentilla canadensis, Pteridium aquilinum,* and *Uvularia sessilifolia*.

Environmental Description: This forest generally occurs on xeric upper slopes and ridgetops and steep sideslopes with shallow, acidic, rocky, infertile soils. Windthrow, fire, and ice storms are common natural disturbances in these habitats.

Vegetation Description: The canopy is closed to partially open and dominated by *Quercus prinus,* which can be codominant with *Quercus rubra*. *Quercus alba, Quercus velutina,* and *Acer rubrum* are common associates, with other less frequent trees including *Betula lenta, Quercus coccinea, Amelanchier arborea, Pinus rigida,* and *Pinus strobus*. *Sassafras albidum, Cornus florida,* and *Nyssa sylvatica* can be minor associates at the southern and western portions of the

range. The low-shrub layer is well-developed and comprised chiefly of ericaceous species, including *Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum, Gaylussacia baccata,* or *Kalmia angustifolia*. A tall-shrub layer is often lacking but when present may include *Castanea dentata, Kalmia latifolia, Viburnum acerifolium, Hamamelis virginiana, Quercus ilicifolia,* and *Viburnum prunifolium*. *Ilex montana, Rhododendron prinophyllum,* and *Menziesia pilosa* are minor shrub associates at the southern end of the range. The herbaceous layer is of sparse to moderate cover, depending on shrub cover, and may include *Carex pensylvanica, Deschampsia flexuosa, Danthonia spicata, Ageratina altissima* var. *altissima, Antennaria plantaginifolia, Aralia nudicaulis, Aureolaria laevigata, Gaultheria procumbens, Chimaphila maculata, Carex rosea, Carex swanii, Carex pensylvanica, Corydalis sempervirens, Comandra umbellata, Cypripedium acaule, Dryopteris marginalis, Epigaea repens, Goodyera pubescens, Hieracium venosum, Lycopodium clavatum, Medeola virginiana, Melampyrum lineare, Monotropa uniflora, Potentilla canadensis, Pteridium aquilinum,* and *Uvularia sessilifolia*.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus, Quercus rubra*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Vaccinium angustifolium, Vaccinium pallidum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium stamineum*
Herb (field)	Forb	*Aralia nudicaulis*
Herb (field)	Graminoid	*Carex pensylvanica*
Herb (field)	Fern or fern ally	*Pteridium aquilinum*

Characteristic Species: *Acer rubrum, Amelanchier arborea, Aralia nudicaulis, Carex pensylvanica, Castanea dentata, Danthonia spicata, Deschampsia flexuosa, Gaultheria procumbens, Gaylussacia baccata, Kalmia latifolia, Nyssa sylvatica, Pteridium aquilinum, Quercus coccinea, Quercus prinus, Quercus rubra, Quercus velutina, Sassafras albidum, Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This community ranges from southern Maine through the Central Appalachians to higher elevations in Virginia and West Virginia, and north more locally in the Piedmont.
States/Provinces: CT, DE, MA, MD, ME, NH, NJ:S3S4, NY, PA, RI, VA, VT, WV.
Federal Lands: NPS (Delaware Water Gap, Harpers Ferry, Rock Creek, Valley Forge, Weir Farm); USFS (George Washington, Jefferson).

CONSERVATION STATUS
Rank: G5 (1-Oct-2001).
Reasons: This is a very widely distributed oak / ericad forest that covers large areas.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This community type is closely related to other oak / heath. It is distinguished by the presence of northern species, such as *Pinus strobus* and *Vaccinium angustifolium,* and its

general lack of southern Appalachian species, such as *Gaylussacia ursina, Leucothoe recurva,* and *Galax urceolata*. In comparison to *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023), it lacks *Oxydendrum arboreum, Pinus echinata,* and *Pinus virginiana*. It occupies poorer sites and has a more abundant ericaceous shrub component than *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) and *Quercus prinus - Quercus velutina / Oxydendrum arboreum - Cornus florida* Forest (CEGL008522). The Chestnut Oak / Low-Elevation Subtype of Virginia intergrades with the more southern *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271) throughout west-central Virginia. A well-developed Piedmont example of the Chestnut Oak / Low-Elevation Subtype is described by Allard and Leonard (1943). The Chestnut Oak - Northern Red Oak / High-Elevation Subtype of Virginia is similar to *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523) of high-elevation granitic terrain on the northern Blue Ridge, but lacks *Quercus velutina, Rhododendron periclymenoides*, and the suite of low-cover herbaceous species characteristic of mineral soil microhabitats in that unit. The recognition of global subtypes equivalent to two distinct state community types is well supported by quantitative analysis of compositional and environmental data. Further study may support the elevation of these subtypes to full association-level status in the USNVC.

Similar Associations:

- *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336)--is similar to the more mesic end of the range of variation found in this type at Valley Forge National Historical Park.
- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271)--of Southern Appalachians.
- *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299).
- *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023)--of Western Alleghenies, Interior Low Plateau, etc.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057).
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700).
- *Quercus prinus - Quercus velutina / Oxydendrum arboreum - Cornus florida* Forest (CEGL008522).
- *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523).

Related Concepts:

- *Quercus (prinus, rubra) / Calamagrostis porteri* Ridgetop Forest (Walton et al. 1997) ?
- *Quercus prinus - Quercus rubra / Acer pensylvanicum* Association: *Betula lenta / Ilex montana* Subassociation (Fleming and Moorhead 1996) ?
- *Quercus prinus - Quercus rubra / Kalmia latifolia / Vaccinium angustifolium - Gaultheria procumbens* Forest (Fleming and Coulling 2001) F
- *Quercus velutina - (Quercus prinus)* Forest (Metzler and Barrett 1996) ?
- CNE dry hardwood forest on acidic bedrock or till (Rawinski 1984) ?
- Chestnut Oak Forest (Breden 1989) =

- Chestnut Oak: 44 (Eyre 1980) B
- Dry Oak Woodland (Thompson 1996) B
- SNE dry oak/pine forests on acidic bedrock or till (Rawinski 1984) B
- SNE mesic oak/pine forest on acidic bedrock or till (Rawinski 1984) ?

SOURCES

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

References: Allard and Leonard 1943, Breden 1989, Breden et al. 2001, Clancy 1996, Collins and Anderson 1994, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming and Moorhead 2000, Fleming et al. 2001, Gawler 2002, Harrison 2004, Harshberger 1919, Hunt 1997, Kasmer et al. 1984, Keever 1973, Metzler and Barrett 1996, Metzler and Barrett 2001, Nerurkar 1974, Overlease 1978, Overlease 1987, Pearson 1963, Pearson 1974, Pearson 1979, Rawinski 1984, Rawinski et al. 1994, Rawinski et al. 1996, Russell and Schuyler 1988, Shreve et al. 1910, Sperduto 1997a, Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2000, Thompson 1996, Thompson and Sorenson 2000, Vanderhorst 2000b, Walton et al. 1997.

Figure 30. Dry Oak - Heath Forest in Delaware Water Gap National Recreation Area (plot DEWA.61). July 2003.

Figure 31. Dry Oak - Heath Forest in Delaware Water Gap National Recreation Area (plot DEWA.97). August 2003.

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

SYNONYMS
NVC English Name: **Northern Red Oak - Sugar Maple - Tuliptree Forest**
NVC Scientific Name: ***Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest**
NVC Identifier: **CEGL006125**

LOCAL INFORMATION

Environmental Description: This association occurs on gentle to moderate slopes with variable aspect. Bedrock tends to be siltstone, sandstone and conglomerate of the Silurian Bloomsburg Formation and limestones and limy shales of the Buttermilk Falls Limestone, Esopus, and Marcellus Shale formations. Soils vary from loamy sand and fine sandy loam to extremely stony silt loams. Soil pH varies from medium acidic (pH = 5.6) to slightly alkaline (pH = 7.3) in most stands, with some stands being much more acidic (pH <5.5). Soils are typically well-drained but not droughty.

Vegetation Description: This association is broadly defined to capture dry-mesic forests that are common throughout the park. The tree canopy is typically closed or nearly so (canopy cover generally 80% or more) and usually more than 25 m in height (occasionally greater than 30 m). Northern red oak (*Quercus rubra*) may be dominant or more often codominant with red maple (*Acer rubrum*), black oak (*Quercus velutina*), hickories (*Carya glabra, Carya cordiformis*), and sweet birch (*Betula lenta*). Other occasional associates include white oak (*Quercus alba*), sugar maple (*Acer saccharum*), tuliptree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), and scarlet oak (*Quercus coccinea*). A subcanopy is usually discernible with 20 to 40% total cover and ranging from 5 to 20 m in height, depending on the stand. The dominant subcanopy tree is American hornbeam (*Carpinus caroliniana*), often with sweet birch, red maple, and flowering dogwood (*Cornus florida*) as associates or codominants. The tall-shrub layer varies from sparse to moderately abundant (5-30% total cover) and is variable in composition. Height of the tall-shrub layer is usually 2-5 m. The tall-shrub layer often contains one or more of the following as a dominant or codominant: northern spicebush (*Lindera benzoin*), American witch-hazel (*Hamamelis virginiana*), eastern hop-hornbeam (*Ostrya virginiana*), and eastern hemlock (*Tsuga canadensis*). The short-shrub layer varies in total cover from 10 to 30% and is less than 2 m in height. Composition is variable with one or more of the following typically present and/or abundant: Japanese barberry (*Berberis thunbergii*), northern spicebush, Blue Ridge blueberry (*Vaccinium pallidum*), mapleleaf viburnum (*Viburnum acerifolium*), sugar maple, sweet birch, hickory (*Carya* spp.), and multiflora rose (*Rosa multiflora*). The herbaceous layer is highly variable, usually less than 1 m in height and varies from 10 to 50 % total cover. Characteristic herbs include Christmas fern (*Polystichum acrostichoides*), eastern hayscented fern (*Dennstaedtia punctilobula*), garlic mustard (*Alliaria petiolata*), Canada mayflower (*Maianthemum canadense*), clubmosses (*Lycopodium* spp.), and mayapple (*Podophyllum peltatum*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus rubra, Quercus velutina, Acer rubrum, Carya glabra*
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana, Lindera benzoin, Ostrya virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Vaccinium pallidum, Viburnum acerifolium*
Herb (field)	Forb	*Alliaria petiolata, Podophyllum peltatum*
Herb (field)	Graminoid	*Carex pensylvanica, Carex swanii*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula, Polystichum acrostichoides*

Characteristic Species: *Quercus rubra*, *Quercus velutina, Acer rubrum, Carpinus caroliniana, Carya glabra, Hamamelis virginiana*, *Lindera benzoin*, *Ostrya virginiana, Dennstaedtia punctilobula, Polystichum acrostichoides.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	High Allegheny Rich Red Oak - Sugar Maple Forest	Walz et al 2006
PA	S4	2	Red oak - mixed hardwood forest	Fike 1999

Local Range: This common association occurs throughout the park at mid- to lower slope positions and occasionally on the higher terraces of the Delaware River floodplain.

Classification Comments: This vegetation type is highly variable and is somewhat defined by what it is not. It differs from the drier oak forests in lacking *Quercus prinus*, and while hickories may be present, they are one of several codominants. The herb layer reflects more mesic conditions than occur in drier forests, with *Deschampsia flexuosa*, a typical grass of dry oak and hickory forests, relatively rare or absent. In stands of this association where the oaks (*Quercus* spp.) have been high-graded, the current composition may be more similar to Red Maple - Sweet Birch Hardwood Forest, due to the low cover of oaks (<25% relative cover) and the prominence of *Acer rubrum* and/or *Betula lenta*. The relatively low abundance or absence of *Fagus grandifolia, Acer saccharum, Tilia americana*, and *Liriodendron tulipifera* also differentiate this type from several of other mesic forest types in the park. In general, this forest type represents a transition between Dry Oak - Mixed Hardwood Forest of mid- to upper slopes and the more mesic forests found in the park on low slopes, ravines, and river floodplain terraces. This transitional position is reflected in the variable species composition in this association.

Other Comments: None.

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

Plots and Data Sources: DEWA.6, DEWA.17, DEWA.22, DEWA.55, DEWA.84, DEWA.175, DEWA.182, DEWA.190; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus rubra - (Acer saccharum)* Forest Alliance (A.251)
Alliance (English name)	Northern Red Oak - (Sugar Maple) Forest Alliance
Association	*Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest
Association (English name)	Northern Red Oak - Sugar Maple - Tuliptree Forest
Ecological System(s):	Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563 Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)

GLOBAL DESCRIPTION

Concept Summary: This red oak - sugar maple community is found primarily in the Allegheny Plateau and Appalachian Mountains of the United States, as well as on the northern Piedmont north to the Hudson Valley, with possible extensions east and west of those areas. It is typically found in coves, on moist north- and east-facing slopes and on well-drained flats. Soils are slightly acidic and of intermediate fertility. The closed-canopy tree layer is dominated by a mixture of oaks, primarily *Quercus alba* and *Quercus rubra*, with other hardwoods including *Acer saccharum, Acer rubrum*, and *Liriodendron tulipifera*. *Carya ovata, Carya alba (= Carya tomentosa), Nyssa sylvatica*, and *Quercus velutina* are possible associates. *Carya* spp. may share dominance in some stands. Dominance by *Acer rubrum* or *Liriodendron* may indicate a past disturbance history. A wide variety of more mesic associates, such as *Betula alleghaniensis, Betula lenta, Fagus grandifolia*, and *Fraxinus americana*, could occur but are negligible in dominance. In addition to *Acer saccharum* reproduction, some understory species may include *Carpinus caroliniana, Cercis canadensis, Cornus florida*, and *Ostrya virginiana*. Shrub and vine species include *Amelanchier laevis, Amelanchier arborea, Cornus* spp., *Hamamelis virginiana, Lindera benzoin, Viburnum acerifolium, Viburnum dentatum* var. *lucidum*, and *Vitis riparia*. Ericaceous shrubs, such as *Kalmia latifolia, Vaccinium angustifolium* and *Vaccinium pallidum*, may also be present but are not abundant. The ground layer species are highly variable but include *Caulophyllum thalictroides, Ageratina altissima, Dennstaedtia punctilobula, Podophyllum peltatum, Maianthemum racemosum (= Smilacina racemosa), Medeola virginiana, Thelypteris noveboracensis, Dryopteris marginalis, Actaea* spp., and *Uvularia sessilifolia*. Exotic species, including *Rosa multiflora* and *Alliaria petiolata*, may be present in the shrub and herb layers of disturbed stands.

Environmental Description: Stands are typically found in coves, on moist north- and east-facing slopes, and on well-drained flats. Soils are slightly acid and of intermediate fertility (Anderson 1982, Reschke 1990, Fike 1999).

Vegetation Description: Stands of this red oak - sugar maple forest feature a closed-canopy tree layer dominated by a mixture of oaks, primarily *Quercus alba* and *Quercus rubra*, with

other hardwoods including *Acer saccharum, Acer rubrum,* and *Liriodendron tulipifera. Carya ovata, Carya alba (= Carya tomentosa), Nyssa sylvatica,* and *Quercus velutina* are possible associates. *Carya* spp. may share dominance in some stands. Dominance by *Acer rubrum* or *Liriodendron* may indicate a past disturbance history. A wide variety of more mesic associates, such as *Betula alleghaniensis, Betula lenta, Fagus grandifolia,* and *Fraxinus americana,* could occur but are negligible in dominance. In addition to *Acer saccharum* reproduction, some understory species may include *Carpinus caroliniana, Cercis canadensis, Cornus florida*, and *Ostrya virginiana*. Shrub and vine species include *Amelanchier laevis, Amelanchier arborea, Cornus* spp., *Hamamelis virginiana, Lindera benzoin, Viburnum acerifolium, Viburnum dentatum* var. *lucidum*, and *Vitis riparia*. Ericaceous shrubs, such as *Kalmia latifolia, Vaccinium angustifolium* and *Vaccinium pallidum*, may also be present but are not abundant. The ground layer species are highly variable but include *Caulophyllum thalictroides, Ageratina altissima, Dennstaedtia punctilobula, Podophyllum peltatum, Maianthemum racemosum (= Smilacina racemosa), Medeola virginiana, Thelypteris noveboracensis, Dryopteris marginalis, Actaea* spp., and *Uvularia sessilifolia*. Exotic species, including *Rosa multiflora* and *Alliaria petiolata,* may be present in the shrub and herb layers of disturbed stands.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum, Acer saccharum*
Tree canopy	Broad-leaved deciduous tree	*Quercus alba, Quercus rubra*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Viburnum acerifolium*
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium pallidum*
Herb (field)	Forb	*Podophyllum peltatum*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Acer saccharum, Carex pensylvanica, Carpinus caroliniana, Caulophyllum thalictroides, Liriodendron tulipifera, Vaccinium angustifolium, Vaccinium pallidum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This red oak - sugar maple community is found primarily in the Allegheny Plateau and Appalachian Mountains of the United States, with possible extensions east and west of those areas, ranging from New Jersey and southeastern New York west to Pennsylvania, West Virginia, and southeastern Ohio.
States/Provinces: CT, NJ, NY, OH, PA, WV?
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Fort Necessity, Friendship Hill).

CONSERVATION STATUS
Rank: GNR (31-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.

Comments: According to Anderson (1982) in Ohio, where this community is found in the southeastern unglaciated plateau region, it is differentiated from the oak-maple type, *Quercus alba - Quercus rubra - Quercus prinus - Acer saccharum / Lindera benzoin* Forest (CEGL002059), and the Appalachian oak forest type, *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023), by the substantial presence (over 20% canopy or basal area) of *Liriodendron tulipifera* and insignificant amounts of *Fagus grandifolia* or other mesic tree species. This type concept may overlap considerably with that of the oak-maple type, *Quercus alba - Quercus rubra - Quercus prinus - Acer saccharum / Lindera benzoin* Forest (CEGL002059). Braun (1950, e.g., p. 140) reports stands similar to this type in the Shawnee Hills and Mammoth Cave area of Kentucky, as well as other Interior Low Plateau sites. In New York, this type is reported primarily from the southeastern part of the State (Reschke 1990). In the mid-Atlantic states, this type is differentiated from *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336) by somewhat more mesic conditions, a higher non-oak canopy component, and the absence of *Quercus prinus*.

Similar Associations:

- *Acer saccharum - Quercus rubra - Carya (glabra, ovata) / Ageratina altissima - Bromus pubescens* Forest (CEGL008517)--for similar vegetation in Virginia.
- *Fagus grandifolia - Quercus alba - Quercus rubra* Forest (CEGL006377).
- *Quercus alba - (Quercus rubra, Acer saccharum, Fagus grandifolia) / Aesculus flava* Forest (CEGL007233)--is a related type to the south and west.
- *Quercus alba - Quercus rubra - Quercus prinus - Acer saccharum / Lindera benzoin* Forest (CEGL002059).
- *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023).
- *Quercus rubra - Acer saccharum - Tilia americana* var. *heterophylla - Aesculus flava – (Cladrastis kentukea)* Forest (CEGL007698).
- *Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest (CEGL006566).

Related Concepts:

- Dry-Mesic Inland Mixed Oak Forest, mixed oak-hardwood type (Breden 1989) ?

SOURCES

Description Authors: D. Faber-Langendoen, mod. E. Largay and S. C. Gawler.

References: Anderson 1982, Braun 1950, Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Fike 1999, Fleming 1999, Lundgren 2001, Metzler and Barrett 2001, Reschke 1990.

Figure 32. Northern Red Oak - Mixed Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.6). May 2003.

Figure 33. Northern Red Oak - Mixed Hardwood Forest in Delaware Water Gap National Recreation Area (plot DEWA.84). August 2003.

COMMON NAME (PARK-SPECIFIC): SILVER MAPLE FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **Silver Maple - American Elm Forest**
NVC Scientific Name: ***Acer saccharinum* - *Ulmus americana* Forest**
NVC Identifier: **CEGL002586**

LOCAL INFORMATION

Environmental Description: This floodplain forest occurs on the downstream ends of islands and on high terraces along the shoreline of the Delaware River. The substrate is typically silt loam or sandy loam, as in Delaware fine sandy loam or Pope fine sandy loam. The forest floor frequently has numerous parallel swales created by flood scour. These forests are inundated only during larger flood events.

Vegetation Description: This floodplain forest is dominated by silver maple (*Acer saccharinum*), covering 40-75% of the canopy. Sugar maple (*Acer saccharum*) can be a canopy codominant, with sycamore (*Platanus occidentalis*) and river birch (*Betula nigra*) as occasional associates. The canopy trees typically extend 20-30 m in height, while subcanopy trees range in height from 5-10 m. The sparse subcanopy can contain sugar maple, bitternut hickory (*Carya cordiformis*), silver maple, boxelder (*Acer negundo*), white ash (*Fraxinus americana*), eastern hop-hornbeam (*Ostrya virginiana*), black cherry (*Prunus serotina*), and black walnut (*Juglans nigra*). The sparse short-shrub layer includes black raspberry (*Rubus occidentalis*) and is often dominated by the invasive species Japanese barberry (*Berberis thunbergii*) and multiflora rose (*Rosa multiflora*). The dense herbaceous layer contains reed canarygrass (*Phalaris arundinacea*), ground ivy (*Glechoma hederacea*), whitegrass (*Leersia virginica*), ostrich fern (*Matteuccia struthiopteris*), hedge false bindweed (*Calystegia sepium* ssp. *sepium*), dogtooth violet (*Erythronium americanum*), Jack in the pulpit (*Arisaema triphyllum*), spotted ladysthumb (*Polygonum persicaria*), giant goldenrod (*Solidago gigantea*), sensitive fern (*Onoclea sensibilis*), and sweet woodreed (*Cinna arundinacea*). The invasive species Japanese knotweed (*Polygonum cuspidatum*) can form dense thickets on the forest floor. Garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) are other common herbaceous invasive species in this forest. Vines such as eastern poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*) can also be common.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharinum*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia, Toxicodendron radicans*
Herb (field)	Forb	*Calystegia sepium* ssp. *sepium, Glechoma hederacea, Polygonum cuspidatum*
Herb (field)	Graminoid	*Leersia virginica, Phalaris arundinacea*
Herb (field)	Fern or fern ally	*Matteuccia struthiopteris*

Characteristic Species: *Acer saccharinum, Acer saccharum, Matteuccia struthiopteris*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Silver Maple - American Elm Floodplain Forest	Walz et al 2006
PA	S5	1	Silver maple floodplain forest	Fike 1999

Local Range: This forest occurs on island and terrace shorelines associated with the Delaware River in the park.
Classification Comments: Silver Maple Floodplain Forest can be distinguished from other floodplain forests by the dominance of *Acer saccharinum* (40-75% cover), often with *Acer saccharum* as codominant in the canopy or subcanopy.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.108, DEWA.112, DEWA.124; Fike 1999, Podniesinski and Wagner 2002.
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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer saccharinum* Temporarily Flooded Forest Alliance (A.279)
Alliance (English name)	Silver Maple Temporarily Flooded Forest Alliance
Association	*Acer saccharinum - Ulmus americana* Forest
Association (English name)	Silver Maple - American Elm Forest
Ecological System(s):	Laurentian-Acadian Floodplain Forest (CES201.587) Central Appalachian Floodplain (CES202.608) Mississippi River Riparian Forest (CES203.190) North-Central Interior Floodplain (CES202.694) South-Central Interior Large Floodplain (CES202.705)

GLOBAL DESCRIPTION

Concept Summary: This silver maple - elm - cottonwood forest community is found throughout the midwestern United States and parts of the eastern United States. Stands occur on large, regularly flooded floodplains. The canopy cover is more-or-less closed and dominated by *Acer saccharinum*. Codominants may include *Platanus occidentalis, Betula nigra,* and rarely *Acer saccharum*. Associated species may include *Ulmus americana, Ulmus rubra, Acer negundo, Salix nigra, Celtis occidentalis, Carya cordiformis, Juglans nigra*, and *Fraxinus pennsylvanica*. The shrub and sapling layer is often open (<25% cover). Species that may be present include *Sambucus nigra* spp. *canadensis, Rubus occidentalis,* or *Lindera benzoin.* Woody and herbaceous vines can be prominent, including among the woody vines *Parthenocissus quinquefolia, Toxicodendron radicans,* and *Vitis riparia*. Herbaceous vine

species include *Apios americana, Amphicarpaea bracteata,* and *Echinocystis lobata*. Herbaceous grasses, forbs, and ferns dominate the ground layer, including *Symphyotrichum lateriflorum (= Aster lateriflorus), Boehmeria cylindrica, Erythronium americanum, Solidago gigantea, Cinna arundinacea, Leersia virginica, Elymus virginicus, Impatiens pallida, Laportea canadensis, Matteuccia struthiopteris, Onoclea sensibilis, Pilea pumila, Urtica dioica,* and others. A variety of exotics may be present, including *Lysimachia* spp., *Microstegium vimineum, Polygonum cuspidatum, Rosa multiflora,* and *Lonicera japonica*.

Environmental Description: This community occurs on temporarily flooded soils along major rivers and smaller perennial streams. Soils may be well-drained and sandy, more loamy on infrequently flooded bottomlands and levees, or deep silts on stabilized sites along larger rivers. The structure and composition of the type is influenced by the flooding regime. Floods leave river-deposited debris on the forest floor, ice scars on trees, and abandoned channels that retain water at or above the level of the main river channel.

Vegetation Description: The canopy cover is more-or-less closed and dominated by *Acer saccharinum*. Codominants may include *Platanus occidentalis, Betula nigra,* and rarely *Acer saccharum*. Associated species may include *Ulmus americana, Ulmus rubra, Acer negundo, Salix nigra, Celtis occidentalis, Carya cordiformis, Juglans nigra,* and *Fraxinus pennsylvanica*. The shrub and sapling layer is often open (<25% cover). Species that may be present include *Sambucus nigra* spp. *canadensis, Rubus occidentalis,* or *Lindera benzoin*. Woody and herbaceous vines can be prominent, including among the woody vines *Parthenocissus quinquefolia, Toxicodendron radicans,* and *Vitis riparia*. Herbaceous vine species include *Apios americana, Amphicarpaea bracteata,* and *Echinocystis lobata*. Herbaceous grasses, forbs, and ferns dominate the ground layer, including *Symphyotrichum lateriflorum (= Aster lateriflorus), Boehmeria cylindrica, Erythronium americanum, Solidago gigantea, Cinna arundinacea, Leersia virginica, Elymus virginicus, Impatiens pallida, Laportea canadensis, Matteuccia struthiopteris, Onoclea sensibilis, Pilea pumila, Urtica dioica,* and others. A variety of exotics may be present, including *Lysimachia* spp., *Microstegium vimineum, Polygonum cuspidatum, Rosa multiflora,* and *Lonicera japonica* (MNNHP 1993, Anderson 1996, Central Appalachian Ecoregional Team pers. comm. 1998).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharinum*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia, Toxicodendron radicans*
Herb (field)	Graminoid	*Leersia virginica*

Characteristic Species: *Acer negundo, Acer saccharinum, Alliaria petiolata, Conium maculatum, Elymus virginicus, Glechoma hederacea, Humulus japonicus, Populus deltoides, Urtica dioica* ssp. *Gracilis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is found throughout the midwestern United States and in the mid-Atlantic region of the eastern United States, ranging from Delaware, New Jersey, and Pennsylvania west to Minnesota, and south to Arkansas.

States/Provinces: AR, DE, IA:SU, IL, IN, KY, MI, MN, MO, NJ, OH, ON, PA, TN, WI:S3.

Federal Lands: NPS (Delaware Water Gap, Effigy Mounds, New River Gorge); USFS (Ozark?).

CONSERVATION STATUS
Rank: G4? (3-Oct-1996).
Reasons: There has been significant conversion of stands to agriculture, hydrologic modifications due to river dams, etc., and siltation caused by modified flooding regimes.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This type includes stands where *Acer saccharinum* represents the majority of trees (>50% cover or basal area?). This type is most clearly expressed on larger rivers. To some degree this type is more northern, separable from the more southern type *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431), but this distinction is not yet well resolved. In the southern parts of its range, this type may overlap with *Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334), but that type is generally a higher terrace, small stream type. Compare this type with SAF cover type 62 (Eyre 1980). In Minnesota stands with less than either 50% cottonwood or silver maple and not in northwestern Minnesota tend to occur here (i.e., a mixed floodplain forest), as do silver maple stands with a supercanopy of cottonwoods. In southwestern Minnesota, stands with only some swamp white oak go here. If swamp white oak is dominant the stands probably belong with either an association in the *Quercus palustris - (Quercus bicolor)* Seasonally Flooded Forest Alliance (A.329), or *Quercus macrocarpa - Quercus bicolor - Carya laciniosa / Leersia* spp. - *Cinna* spp. Forest (CEGL002098), at least in the Midwest. *Fraxinus pennsylvanica* is a typical codominant in this type. In Wisconsin, this type may better be named *Acer saccharinum - Fraxinus pennsylvanica - Betula nigra* Forest (E. Epstein pers. comm. 1999).
Similar Associations:

- *Acer (rubrum, saccharinum) - Fraxinus* spp. - *Ulmus americana* Forest (CEGL005038)—grades into this community in backwater swamps.
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147)--is somewhat more northern, lacking *Platanus* and *Betula nigra*.
- *Acer saccharinum - Acer negundo / Ageratina altissima - Laportea canadensis - (Elymus virginicus)* Forest (CEGL006217).
- *Acer saccharinum - Betula nigra / Cephalanthus occidentalis* Forest (CEGL007810).
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431)--is more southern.
- *Acer saccharinum* Temporarily Flooded Forest [Placeholder] (CEGL007304)
- *Fagus grandifolia - Quercus* spp. - *Acer rubrum - Juglans nigra* Forest (CEGL005014)--in the eastern part of its range on the mesic side.
- *Fraxinus pennsylvanica - Ulmus americana - (Acer negundo, Tilia americana)* Northern Forest (CEGL002089)--in the western part of its range on the mesic side.
- *Fraxinus pennsylvanica - Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014).
- *Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334)--may overlap in southern parts of the range of CEGL002586.
- *Populus deltoides - Salix nigra* Forest (CEGL002018)--grades into this community on the wetter side.

- *Quercus macrocarpa - Quercus bicolor - Carya laciniosa / Leersia* spp. - *Cinna* spp. Forest (CEGL002098).

Related Concepts:

- Silver Maple - American Elm: 62 (Eyre 1980) B
- Silver maple-American elm-cottonwood floodplain forest (CAP pers. comm. 1998) ?

SOURCES

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

References: Anderson 1996, CAP pers. comm. 1998, Eyre 1980, Fike 1999, INAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Podniesinski and Wagner 2002, TDNH unpubl. data, WINHIP unpubl. data.

Figure 34. Silver Maple Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.112). August 2003.

Figure 35. Silver Maple Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.124). May 2003.

COMMON NAME (PARK-SPECIFIC): SUGAR MAPLE FLOODPLAIN FOREST

SYNONYMS

NVC English Name: **Sugar Maple - White Ash / American Hornbeam / Mayapple Forest**

NVC Scientific Name: ***Acer saccharum - Fraxinus americana / Carpinus caroliniana / Podophyllum peltatum* Forest**

NVC Identifier: **CEGL006459**

LOCAL INFORMATION

Environmental Description: This association occurs on low to mid terraces of the Delaware River and its tributaries. The soils appear to be alluvial in origin for the most part and include Barbour fine sandy loam, Galway loam, Pope silt loam and undifferentiated alluvium. These soils tend to be slightly acidic to alkaline. Stands on lower terraces may flood occasionally, but the period of inundation is short. The underlying bedrock is a variety of calcareous shale and siltstone, limestone and dolomite.

Vegetation Description: The canopy height varies from 20 to 35 m with total cover 70 to 90%. The dominant canopy tree is sugar maple (*Acer saccharum*). White ash (*Fraxinus americana*) is a common associate and may be codominant in some stands. Other minor associate species include American beech (*Fagus grandifolia*), pignut hickory (*Carya glabra*), black cherry (*Prunus serotina*), black oak (*Quercus velutina*), and American elm (*Ulmus americana*). The subcanopy can vary from 5 to 25 m in height with total cover ranging from sparse (5%) up to 30%. Sugar maple is often the only species in the subcanopy, or sometimes with American hornbeam (*Carpinus caroliniana*) as a minor associate. The tall-shrub layer is 2-5 m in height and is usually sparse (<10% cover) or absent. The most characteristic tall shrubs/saplings are northern spicebush (*Lindera benzoin*) and sugar maple. The short-shrub layer, less than 2 m in height, may also be sparse (under 5% total cover) or have up to 30% cover. Common short-shrub/sapling species include Japanese barberry (*Berberis thunbergii*), northern spicebush, and sugar maple. The herbaceous layer can be quite variable with respect to cover, ranging from as little as 20% to over 80%. The herbaceous layer is usually under 1 m in height. The herbaceous layer is often diverse but is often dominated by invasive herbs, especially garlic mustard (*Alliaria petiolata*), ground ivy (*Glechoma hederacea*), Japanese stiltgrass (*Microstegium vimineum*), and oriental ladysthumb (*Polygonum caespitosum*). Common native herbs include silver false spleenwort (*Deparia acrostichoides*), Christmas fern (*Polystichum acrostichoides*), cleavers (*Galium aparine*), sensitive fern (*Onoclea sensibilis*), whitegrass (*Leersia virginica*), and mayapple (*Podophyllum peltatum*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharum, Fraxinus americana*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum, Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Lindera benzoin*

Herb (field)	Forb	*Alliaria petiolata, Galium aparine, Glechoma hederacea, Polygonum caespitosum*
Herb (field)	Graminoid	*Leersia virginica, Microstegium vimineum*
Herb (field)	Fern or fern ally	*Deparia acrostichoides, Polystichum acrostichoides*

Characteristic Species: *Acer saccharum, Fraxinus americana, Lindera benzoin, Caulophyllum thalictroides, Deparia acrostichoides, Galium aparine, Onoclea sensibilis, Podophyllum peltatum, Polystichum acrostichoides.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	3	Rich Sugar Maple - Hardwood Floodplain Terrace Forest	Walz et al 2006
PA	S4	1	no crosswalk	Fike 1999

Local Range: This association appears to be restricted primarily to floodplain terraces of the Delaware River and its tributaries and may also occur on low steps-in-slope over calcareous bedrock.
Classification Comments: This association is characterized by the dominance of *Acer saccharum* in nearly all strata. It differs from Sugar Maple - American Beech - Sweet Birch Forest in that the latter does not occur on floodplain terraces. It differs from Sugar Maple - American Basswood Forest in that *Tilia americana* is usually absent and it rarely occurs on steep slopes. It differs from other floodplain forest communities in that *Platanus occidentalis, Betula nigra,* and *Acer saccharinum* are rare or absent.
Other Comments: The correct crosswalk to the NVCS and the New Jersey state classification for this association is questionable. This association is also similar to NVCS CEGL006114 [*Acer saccharum - Fraxinus* spp. - *Tilia americana* / *Matteuccia struthiopteris - Ageratina altissima* Forest] and to CEGL006914 [*Acer saccharinum* - (*Acer saccharum, Juglans cinerea, Juglans nigra, Ulmus rubra, Ulmus americana, Prunus serotina, Celtis occidentalis*) Forest].
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.28, DEWA.158, DEWA.173, DEWA.249.
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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer saccharum - Carya cordiformis* Temporarily Flooded Forest Alliance (A.302)
Alliance (English name)	Sugar Maple - Bitternut Hickory Temporarily Flooded Forest Alliance

Association	*Acer saccharum - Fraxinus americana / Carpinus caroliniana / Podophyllum peltatum* Forest
Association (English name)	Sugar Maple - White Ash / American Hornbeam / Mayapple Forest
Ecological System(s):	Central Appalachian Floodplain (CES202.608)

GLOBAL DESCRIPTION

Concept Summary: These rich floodplain forests are found on slightly elevated alluvial terraces and active floodplains of larger rivers in the mid-Atlantic states, interior to the Coastal Plain. The setting is a raised river terrace; however, this forest may occur very close to the riverbank if the water channel is well-entrenched. The alluvial soils are slightly acidic to alkaline and less regularly inundated than the soils supporting floodplain forests dominated by silver maple or sycamore. Stands on lower terraces may flood occasionally, but the period of inundation is short. The canopy is closed to somewhat open, and a subcanopy is often present. Shrubs are typically sparse but may range up to about 30% cover. The herb layer is well-developed, fairly diverse, and seasonally variable, with spring ephemerals giving way to taller ferns, graminoids and forbs. Bryoids are very minor. The canopy dominants are usually some combination of *Acer saccharum, Fraxinus americana*, and sometimes *Carya cordiformis*. Canopy associates include *Quercus rubra, Juglans nigra, Prunus serotina, Fraxinus nigra, Liriodendron tulipifera, Ulmus americana, Tilia americana,* and *Fagus grandifolia*. *Carpinus caroliniana* is often present as a small tree, along with *Acer saccharum*. *Lindera benzoin* is the most common shrub; *Asimina triloba* is characteristic in the southern portion of this type's range. Vines such as *Toxicodendron radicans* and *Parthenocissus quinquefolia* are frequent but usually at low cover. The herb layer usually features spring ephemerals, including *Claytonia virginica, Dicentra canadensis,* and *Erythronium americanum,* followed by a mixture of ferns, forbs and graminoids. Characteristic species include *Arisaema triphyllum, Caulophyllum thalictroides, Carex laxiculmis, Deparia acrostichoides, Elymus virginicus, Elymus riparius, Galium aparine, Onoclea sensibilis,* and *Podophyllum peltatum*. Exotic species, such as *Microstegium vimineum, Glechoma hederacea,* and *Alliaria petiolata,* may be abundant, especially in disturbed areas. These terrace forests are related to lower floodplain forests, e.g. *Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica* Forest (CEGL004073), but distinguished by the reduced importance of *Acer saccharinum* and *Platanus occidentalis*; they differ from enriched upland hardwood forests, e.g., *Acer (nigrum, saccharum) - Tilia americana / Asimina triloba / Jeffersonia diphylla - Hydrophyllum canadense* Forest (CEGL008412), in their alluvial soils and flooding regime.

Environmental Description: These rich floodplain forests are found on slightly elevated alluvial terraces of mid-sized to larger rivers. The setting is a raised river terrace; however, this forest may occur very close to the riverbank if the water channel is well-entrenched. The alluvial soils are slightly acidic to alkaline. Stands on lower terraces may flood occasionally, but the period of inundation is short.

Vegetation Description: The canopy is closed to somewhat open, and a subcanopy is often present. Shrubs are typically sparse but may range up to about 30% cover. The herb layer is well-developed, fairly diverse, and seasonally variable, with spring ephemerals giving way to taller ferns, graminoids and forbs. Bryoids are very minor. The canopy dominants are usually some combination of *Acer saccharum, Fraxinus americana*, and sometimes *Carya cordiformis*. Canopy associates include *Quercus rubra,, Juglans nigra, Prunus serotina, Fraxinus nigra, Liriodendron tulipifera, Ulmus americana, Tilia americana,* and *Fagus grandifolia*. *Carpinus*

caroliniana is often present as a small tree, along with *Acer saccharum*. *Lindera benzoin* is the most common shrub; *Asimina triloba* is characteristic in the southern portion of this type's range. Vines such as *Toxicodendron radicans* and *Parthenocissus quinquefolia* are frequent but usually at low cover. The herb layer usually features spring ephemerals, including *Claytonia virginica, Dicentra canadensis,* and *Erythronium americanum,* followed by a mixture of ferns, forbs and graminoids. Characteristic species include *Arisaema triphyllum, Caulophyllum thalictroides, Carex laxiculmis, Deparia acrostichoides, Elymus virginicus, Elymus riparius, Galium aparine, Onoclea sensibilis,* and *Podophyllum peltatum*. Exotic species, such as *Microstegium vimineum, Glechoma hederacea,* and *Alliaria petiolata,* may be abundant, especially in disturbed areas.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer saccharum*
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer saccharum*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Acer saccharum, Arisaema triphyllum, Fraxinus americana, Lindera benzoin, Onoclea sensibilis, Podophyllum peltatum.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is known from the mid-Atlantic states from Pennsylvania and New Jersey to Virginia.

States/Provinces: MD, NJ:S2S3, PA, VA.

Federal Lands: NPS (C&O Canal, Delaware Water Gap).

CONSERVATION STATUS

Rank: G3G4? (20-Jun-2006).

Reasons: Type is fairly widely distributed but occurs in settings typically cleared for agriculture, and intact examples are not well-documented.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: This community has been drastically reduced from its original extent, as it makes excellent fertile farmland. Originally it was probably a large-patch type.

Similar Associations:

- *Acer saccharum - Fraxinus* spp. - *Tilia americana / Matteuccia struthiopteris - Ageratina altissima* Forest (CEGL006114).
- *Acer saccharum - Juglans cinerea / Carpinus caroliniana / Matteuccia struthiopteris* Forest (CEGL006430).
- *Liriodendron tulipifera - Fraxinus* spp. / *Lindera benzoin - Viburnum prunifolium / Podophyllum peltatum* Forest (CEGL006314).
- *Tilia americana - Acer saccharum - Acer nigrum / Laportea canadensis* Forest (CEGL006405).

Related Concepts:

- Palustrine Broad-leaved Deciduous Forested Wetland, Seasonally Flooded (PFO1C) (Cowardin et al. 1979) ?
- Sugar Maple - Basswood: 26 (Eyre 1980) B

SOURCES

Description Authors: S. C. Gawler.

References: Cowardin et al. 1979, Eastern Ecology Working Group n.d., Eyre 1980, Harrison 2004, Harrison and Stango 2003, Lea 2000, Thomson et al. 1999.

Figure 36. Sugar Maple Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.28). June 2003.

Figure 37. Sugar Maple Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.158). July 2003.

COMMON NAME (PARK-SPECIFIC): BITTERNUT HICKORY LOWLAND FOREST

SYNONYMS
NVC English Name: **Bitternut Hickory - Black Cherry / White Snakeroot Forest**
NVC Scientific Name: ***Carya cordiformis - Prunus serotina / Ageratina altissima* Forest**
NVC Identifier: **CEGL006445**

LOCAL INFORMATION

Environmental Description: This association typically occurs on mid to high floodplain terraces of the Delaware River within the park and has been observed on the upper Delaware River (Butternut Island near Callicoon, New York) in a similar setting. Flood frequency is unknown, but it is likely flooded less often than sycamore- (*Platanus occidentalis*) and silver maple- (*Acer saccharinum*) dominated forests found on lower floodplain terraces. Soils are derived from alluvial deposits and consist of fine sandy loams and loamy fine sand.
Vegetation Description: This association is characterized by the dominance or codominance of bitternut hickory (*Carya cordiformis*). Other potential codominant or associate canopy species include northern red oak (*Quercus rubra*), butternut (*Juglans cinerea*), black cherry (*Prunus serotina*), American elm (*Ulmus americana*), white ash (*Fraxinus americana*), and silver maple (*Acer saccharinum*). The canopy is usually somewhat open to closed (total cover 70 to 90%) and 20 to 25 m in height. The subcanopy height ranges from 5 to 18 m with total cover of about 20 to 30%. Composition of the subcanopy is similar to the canopy layer and may also include red maple (*Acer rubrum*) and sugar maple (*Acer saccharum*). The tall-shrub and short-shrub layers are usually sparse and may include occasional saplings of canopy and subcanopy species as well as scattered individuals of multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), Japanese barberry (*Berberis thunbergii*), black raspberry (*Rubus occidentalis*), and northern dewberry (*Rubus flagellaris*). The herbaceous layer is weedy with invasive exotic species common or dominant, including Japanese stiltgrass (*Microstegium vimineum*), garlic mustard (*Alliaria petiolata*), and ground ivy (*Glechoma hederacea*). Common native species include white snakeroot (*Ageratina altissima* var. *altissima*), Shawnee salad (*Hydrophyllum virginianum*), and sedges (*Carex* spp.).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Carya cordiformis*, *Prunus serotina*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum*, *Ulmus americana*, *Carya cordiformis*, *Prunus serotina*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Carya cordiformis*, *Lonicera morrowii*, *Prunus serotina*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii*, *Rosa multiflora*
Herb (field)	Forb	*Ageratina altissima* var. *altissima*, *Alliaria petiolata*, *Glechoma hederacea*, *Hydrophyllum virginianum*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Carya cordiformis*, *Prunus serotina*, *Ulmus americana, Ageratina altissima* var. *altissima.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Bitternut Hickory Floodplain Terrace Forest	Walz et al 2006
PA	S3?	2	no crosswalk	Fike 1999

Local Range: This association likely occurs throughout the park on mid to high floodplain terraces of the Delaware River. It appears to be restricted to small patches of well-drained loamy fine sand to fine sandy loam.
Classification Comments: This association differs from other mesic forest types in the dominance of *Carya cordiformis* in the canopy.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.79, DEWA.126, DEWA.243.
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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer saccharum - Carya cordiformis* Temporarily Flooded Forest Alliance (A.302)
Alliance (English name)	Sugar Maple - Bitternut Hickory Temporarily Flooded Forest Alliance
Association	*Carya cordiformis - Prunus serotina / Ageratina altissima* Forest
Association (English name)	Bitternut Hickory - Black Cherry / White Snakeroot Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association is characterized by the dominance or codominance of *Carya cordiformis* on mid to high floodplain terraces. Soils are derived from alluvial deposits and consist of fine sandy loams and loamy fine sand. Codominant or associate canopy species include *Quercus rubra, Juglans cinerea, Prunus serotina, Ulmus americana, Fraxinus americana,* and *Acer saccharinum*. The canopy is usually somewhat open, occasionally closed, and about 20 m in height. The subcanopy cover is usually 20 to 30%. Composition of the subcanopy is similar to the canopy layer and may also include *Acer rubrum* and *Acer saccharum*. The tall-shrub and short-shrub layers are usually sparse and include occasional saplings of canopy and subcanopy species, as well as scattered individuals of *Rosa multiflora, Lonicera morrowii, Berberis thunbergii, Rubus occidentalis*, and *Rubus flagellaris*. The herbaceous layer is weedy, with invasive exotic species common or dominant, including *Microstegium vimineum,*

Alliaria petiolata, and *Glechoma hederacea*. Common native species include *Ageratina altissima* var. *altissima*, *Hydrophyllum virginianum*, and *Carex* spp.

Environmental Description: This association occurs on mid to high floodplain terraces of the Delaware and Upper Delaware rivers and probably other rivers within the region. Flood frequency is unknown, but it is likely flooded less often than Platanus occidentalis and Acer saccharinum forests found on lower floodplain terraces. Soils are derived from alluvial deposits and consist of fine sandy loams and loamy fine sand.

Vegetation Description: This association is characterized by the dominance or codominance of *Carya cordiformis*. Codominant or associate canopy species include *Quercus rubra, Juglans cinerea, Prunus serotina, Ulmus americana, Fraxinus americana,* and *Acer saccharinum*. The canopy is usually somewhat open, occasionally closed, and about 20 m in height. The subcanopy cover is usually 20 to 30%. Composition of the subcanopy is similar to the canopy layer and may also include *Acer rubrum* and *Acer saccharum*. The tall-shrub and short-shrub layers are usually sparse and include occasional saplings of canopy and subcanopy species, as well as scattered individuals of *Rosa multiflora, Lonicera morrowii, Berberis thunbergii, Rubus occidentalis*, and *Rubus flagellaris*. The herbaceous layer is weedy, with invasive exotic species common or dominant, including *Microstegium vimineum, Alliaria petiolata*, and *Glechoma hederacea*. Common native species include *Ageratina altissima* var. *altissima, Hydrophyllum virginianum*, and *Carex* spp.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Carya cordiformis, Prunus serotina*
Tree subcanopy	Broad-leaved deciduous tree	*Acer saccharum, Ulmus americana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Carya cordiformis, Lonicera morrowii, Prunus serotina*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rosa multiflora*
Herb (field)	Forb	*Ageratina altissima* var. *altissima, Alliaria petiolata, Glechoma hederacea, Hydrophyllum virginianum*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Acer saccharum, Ageratina altissima* var. *altissima, Carya cordiformis, Hydrophyllum virginianum, Prunus serotina, Ulmus americana.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This type is currently documented from northern New Jersey and Pennsylvania.

States/Provinces: NJ, NY?, PA.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

Rank: GNR (7-Feb-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d.

Figure 38. Bitternut Hickory Lowland Forest in Delaware Water Gap National Recreation Area (plot DEWA.76). August 2003.

Figure 39. Bitternut Hickory Lowland Forest in Delaware Water Gap National Recreation Area (plot DEWA.243). May 2004.

COMMON NAME (PARK-SPECIFIC): SYCAMORE FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **Sycamore - Green Ash Forest**
NVC Scientific Name: ***Platanus occidentalis - Fraxinus pennsylvanica* Forest**
NVC Identifier: **CEGL006036**

LOCAL INFORMATION

Environmental Description: This association typically occurs on low terrace floodplains of major tributaries to the Delaware River, such as Bushkill Creek and Flat Brook. It also can occur on islands, bars, and low terrace shorelines of the Delaware River. The low terraces are usually immediately adjacent to the river channel and subject to frequent flooding. The substrate is typically somewhat poorly drained sand, silt and/or loam.
Vegetation Description: The characteristic vegetation for this floodplain forest is a canopy clearly dominated by sycamore (*Platanus occidentalis*). Sycamore composes 50-90% of the canopy, with occasional associates of green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), common hackberry (*Celtis occidentalis*), eastern cottonwood (*Populus deltoides*), and American elm (*Ulmus americana*). The canopy trees typically extend 20-25 m in height, while subcanopy trees range in height from 8-12 m. The sparse to moderately dense subcanopy contains red maple (*Acer rubrum*), white ash, green ash, American elm, and river birch (*Betula nigra*). The tall- and short-shrub layers often contain northern spicebush (*Lindera benzoin*); however, they are highly susceptible to invasion by the exotic species multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), and Japanese barberry (*Berberis thunbergii*). The herbaceous layer is typically moderately dense; common species include smallspike false nettle (*Boehmeria cylindrica*), arrowleaf tearthumb (*Polygonum sagittatum*), Virginia wildrye (*Elymus virginicus*), ostrich fern (*Matteuccia struthiopteris*), wild garlic (*Allium vineale*), Shawnee salad (*Hydrophyllum virginianum*), Jack in the pulpit (*Arisaema triphyllum*), white snakeroot (*Ageratina altissima* var. *altissima*), spotted ladysthumb (*Polygonum persicaria*), broadleaf enchanter's nightshade (*Circaea lutetiana* ssp. *canadensis*), bromelike sedge (*Carex bromoides*), and sensitive fern (*Onoclea sensibilis*). The herbaceous layer can be dominated by the invasive species garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*). Vines such as eastern poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*) are also common.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum*, *Fraxinus pennsylvanica*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Alliaria petiolata*, *Boehmeria cylindrica*, *Polygonum sagittatum*
Herb (field)	Graminoid	*Elymus virginicus*, *Microstegium vimineum*
Herb (field)	Fern or fern ally	*Onoclea sensibilis*

Characteristic Species: *Platanus occidentalis, Fraxinus pennsylvanica, Acer rubrum, Circaea lutetiana* ssp. *canadensis, Onoclea sensibilis.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Riverine Floodplain Forest (Early-Successional Type)	Walz et al 2006
PA	S4	1	Sycamore (river birch) - box-elder floodplain forest	Fike 1999

Local Range: This forest type is found in the floodplain of Bushkill Creek, Flat Brook, other major tributaries and the Delaware River.
Classification Comments: Sycamore Floodplain Forest is distinguished from Sycamore - Mixed Hardwood Floodplain Forest by the clear dominance of *Platanus occidentalis* covering 50-90% of the canopy in the former. In Sycamore - Mixed Hardwood Floodplain Forest, *Platanus occidentalis* is only codominant, sharing the canopy with a mix of other species. Also, Sycamore Floodplain Forest occurs on lower elevation terraces, typically immediately adjacent to the water's channel, with somewhat poorly drained finer textured substrate and a higher flood frequency. Sycamore - Mixed Hardwood Floodplain Forest occurs on slightly higher elevation mid terraces, with moderately well-drained coarser substrates and less frequent flood events.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.237, DEWA.242; Fike 1999, Podniesinski and Wagner 2002.
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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Platanus occidentalis - (Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum)* Temporarily Flooded Forest Alliance (A.288)
Alliance (English name)	Sycamore - (Green Ash, Sugarberry, Silver Maple) Temporarily Flooded Forest Alliance
Association	*Platanus occidentalis - Fraxinus pennsylvanica* Forest
Association (English name)	Sycamore - Green Ash Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This floodplain forest of the northeastern United States, primarily in the northern Piedmont, is a broadly defined successional or young version of medium-gradient river floodplain forest occurring on coarse alluvial substrates. The canopy is closed to somewhat open and usually dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum*, and *Ulmus americana* are usually present but not common; occasional associates include *Acer*

negundo, Fraxinus pennsylvanica, Juglans cinerea, Carya cordiformis, Celtis occidentalis, and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Betula nigra, Carpinus caroliniana, Salix nigra, Lindera benzoin,* or *Alnus serrulata,* plus exotic invasives such as *Rosa multiflora, Berberis thunbergii,* and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Hydrophyllum virginianum, Carex bromoides, Ageratina altissima (= Eupatorium rugosum),* plus vine species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Microstegium vimineum, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum,* and *Alliaria petiolata*.
Environmental Description: Early- to-mid successional forest occurs on cobble or sand substrates of floodplain islands or cobble shores of moderate- to high-energy rivers.
Vegetation Description: The canopy is closed to somewhat open and usually dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum,* and *Ulmus americana* are usually present but not common; occasional associates include *Acer negundo, Fraxinus pennsylvanica, Juglans cinerea, Carya cordiformis, Celtis occidentalis,* and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Betula nigra, Carpinus caroliniana, Salix nigra, Lindera benzoin,* or *Alnus serrulata,* plus exotic invasives such as *Rosa multiflora, Berberis thunbergii,* and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Hydrophyllum virginianum, Carex bromoides, Ageratina altissima (= Eupatorium rugosum),* plus vine species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Microstegium vimineum, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum,* and *Alliaria petiolata.*
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Herb (field)	Forb	*Boehmeria cylindrica*
Herb (field)	Fern or fern ally	*Onoclea sensibilis, Osmunda cinnamomea*

Characteristic Species: *Acer saccharinum, Circaea lutetiana* ssp. *canadensis, Elymus virginicus, Onoclea sensibilis, Osmunda cinnamomea, Parthenocissus quinquefolia, Platanus occidentalis, Polygonum sagittatum, Populus deltoides, Ulmus americana.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association ranges from New England south to Pennsylvania.
States/Provinces: CT, DC, DE:S3S4, MA, NH, NJ, NY, PA, RI, VA?, VT.
Federal Lands: NPS (Delaware Water Gap, Rock Creek, Valley Forge).

CONSERVATION STATUS
Rank: G4? (20-Jun-2006).

Reasons: Total acreage (rangewide) is limited. Good-quality examples are uncommon. Threats include development and filling, alteration in flooding regimes, excessive beaver activity, and encroachment by aggressive non-native plant species. Further data are needed to define the rank.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This type is not tracked as a separate floodplain element in Vermont.
Similar Associations:

- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147)--is characterized by a stronger dominance of both *Acer saccharinum* and *Matteuccia struthiopteris* and has fewer early-successional species.
- *Betula nigra - Platanus occidentalis / Impatiens capensis* Forest (CEGL006184)--southern species present, plus canopy with *Betula nigra*.

Related Concepts: Information not available.

SOURCES
Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Frye and Quinn 1979, Kearsley 1999b, Metzler and Barrett 2001, Newbold 1994, Newbold et al. 1988, Nichols et al. 2001, Overlease 1978, Overlease 1987, Podniesinski and Wagner 2002, Russell and Schuyler 1988, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Thompson and Sorenson 2000, Wistendahl 1958.

Figure 40. Sycamore Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.242). May 2004.

COMMON NAME (PARK-SPECIFIC): SYCAMORE - MIXED HARDWOOD FLOODPLAIN FOREST

SYNONYMS
NVC English Name: **Sycamore - Green Ash Forest**
NVC Scientific Name: ***Platanus occidentalis - Fraxinus pennsylvanica* Forest**
NVC Identifier: **CEGL006036**

LOCAL INFORMATION

Environmental Description: This association typically occurs on floodplain mid terraces of major tributaries to the Delaware River, such as Bushkill Creek and Flat Brook. It also occurs on islands, bars, and mid terrace shorelines of the Delaware River. These mid terraces are often slightly elevated above the water's channel and consequently flood less frequently than Sycamore Floodplain Forest. The substrate is typically moderately well-drained sandy loam.
Vegetation Description: The canopy of this floodplain forest contains a mixture of species, including sycamore (*Platanus occidentalis*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), white ash (*Fraxinus americana*), and river birch (*Betula nigra*). Sycamore covers only 25-50% of the canopy and shares dominance with the other species. Black locust (*Robinia pseudoacacia*) and tuliptree (*Liriodendron tulipifera*) may also be scattered in the canopy. The canopy trees typically extend 20-25 m in height, while subcanopy trees range in height from 6-15 m. The subcanopy can be sparse to moderately dense and contains American hornbeam (*Carpinus caroliniana*), sugar maple, bitternut hickory (*Carya cordiformis*), red maple, and silver maple. The sparse tall- and short-shrub layers can include species from the canopy and subcanopy, as well as silky dogwood (*Cornus amomum*), northern spicebush (*Lindera benzoin*), common winterberry (*Ilex verticillata*), and smooth alder (*Alnus serrulata*). Invasive shrubs may be prominent in the tall- and short-shrub layers, including multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), Japanese barberry (*Berberis thunbergii*), and winged burning bush (*Euonymus alata*). The herbaceous layer is typically moderately dense to dense; common species include ostrich fern (*Matteuccia struthiopteris*), mayapple (*Podophyllum peltatum*), cleavers (*Galium aparine*), white snakeroot (*Ageratina altissima* var. *altissima*), skunk-cabbage (*Symplocarpus foetidus*), king of the meadow (*Thalictrum pubescens*), broadleaf enchanter's nightshade (*Circaea lutetiana* ssp. *canadensis*), water knotweed (*Polygonum amphibium*), Canada goldenrod (*Solidago canadensis*), common ladyfern (*Athyrium filix-femina*), Shawnee salad (*Hydrophyllum virginianum*), sensitive fern (*Onoclea sensibilis*), and touch-me-nots (*Impatiens* spp.). The herbaceous layer can be dominated by the invasive species garlic mustard (*Alliaria petiolata*), oriental bittersweet (*Celastrus orbiculatus*), and Japanese stiltgrass (*Microstegium vimineum*). Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*) and grapes (*Vitis* spp.) are also common.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis, Acer saccharum, Acer rubrum, Acer saccharinum, Betula nigra, Fraxinus americana*

Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana, Platanus occidentalis*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus amomum, Lonicera morrowii*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin, Lonicera morrowii, Rosa multiflora*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia, Toxicodendron radicans*
Herb (field)	Forb	*Ageratina altissima var. altissima, Alliaria petiolata, Galium aparine, Podophyllum peltatum*
Herb (field)	Fern or fern ally	*Matteuccia struthiopteris*

Characteristic Species: *Platanus occidentalis, Acer rubrum, Acer saccharinum, Acer saccharum, Betula nigra, Carpinus caroliniana, Fraxinus americana, Matteuccia struthiopteris, Polygonum amphibium, Symplocarpus foetidus.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Mixed Hardwood Floodplain Terrace Forest	Walz et al 2006
PA	S4	1	Sycamore (river birch) - box-elder floodplain forest	Fike 1999

Local Range: This forest type is found in the floodplain of Bushkill Creek, Flat Brook, other major tributaries, and the Delaware River.

Classification Comments: Sycamore - Mixed Hardwood Floodplain Forest is distinguished from Sycamore Floodplain Forest by the codominance of *Platanus occidentalis* (25-50% cover) with *Acer saccharum, Acer rubrum, Acer saccharinum, Fraxinus americana,* and/or *Betula nigra*. In Sycamore Floodplain Forest, *Platanus occidentalis* is clearly dominant, covering 50-90% of the canopy. Also, Sycamore Floodplain Forest occurs on lower elevation terraces, typically immediately adjacent to the water's channel, with somewhat poorly drained finer textured substrate and a higher flood frequency. Sycamore - Mixed Hardwood Floodplain Forest occurs on slightly higher elevation mid terraces, with moderately well-drained coarser substrates and less frequent flood events.

Other Comments: The crosswalks to the NVCS and the New Jersey state classification system are uncertain. Other possible crosswalks may include NVCS CEGL006914 [*Acer saccharinum* - (*Acer saccharum, Juglans cinerea, Juglans nigra, Ulmus rubra, Ulmus americana, Prunus serotina, Celtis occidentalis*) Forest], CEGL006917 [*Acer rubrum - Platanus occidentalis - Ulmus americana* / *Lindera benzoin* Forest] or CEGL006944 [*Acer saccharinum - Liriodendron tulipifera - Platanus occidentalis* / *Lindera benzoin - Acer negundo* Forest].

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

Plots and Data Sources: DEWA.54, DEWA.241, DEWA.251; Fike 1999, Podniesinski and Wagner 2002.

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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Platanus occidentalis - (Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum)* Temporarily Flooded Forest Alliance (A.288)
Alliance (English name)	Sycamore - (Green Ash, Sugarberry, Silver Maple) Temporarily Flooded Forest Alliance
Association	*Platanus occidentalis - Fraxinus pennsylvanica* Forest
Association (English name)	Sycamore - Green Ash Forest
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This floodplain forest of the northeastern United States, primarily in the northern Piedmont, is a broadly defined successional or young version of medium-gradient river floodplain forest occurring on coarse alluvial substrates. The canopy is closed to somewhat open and usually dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum*, and *Ulmus americana* are usually present but not common; occasional associates include *Acer negundo, Fraxinus pennsylvanica, Juglans cinerea, Carya cordiformis, Celtis occidentalis*, and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Betula nigra, Carpinus caroliniana, Salix nigra, Lindera benzoin*, or *Alnus serrulata*, plus exotic invasives such as *Rosa multiflora, Berberis thunbergii*, and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Hydrophyllum virginianum, Carex bromoides, Ageratina altissima (= Eupatorium rugosum)*, plus vine species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Microstegium vimineum, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum*, and *Alliaria petiolata*.
Environmental Description: Early- to-mid successional forest occurs on cobble or sand substrates of floodplain islands or cobble shores of moderate- to high-energy rivers.
Vegetation Description: The canopy is closed to somewhat open and usually dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum*, and *Ulmus americana* are usually present but not common; occasional associates include *Acer negundo, Fraxinus pennsylvanica, Juglans cinerea, Carya cordiformis, Celtis occidentalis*, and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Betula nigra, Carpinus caroliniana, Salix nigra, Lindera benzoin*, or *Alnus serrulata*, plus exotic invasives such as *Rosa multiflora, Berberis thunbergii*, and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Hydrophyllum virginianum, Carex bromoides, Ageratina altissima (= Eupatorium rugosum)*, plus vine species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a

very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Microstegium vimineum, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum,* and *Alliaria petiolata.*

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Platanus occidentalis*
Short shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Herb (field)	Forb	*Boehmeria cylindrica*
Herb (field)	Fern or fern ally	*Onoclea sensibilis, Osmunda cinnamomea*

Characteristic Species: *Acer saccharinum, Circaea lutetiana* ssp. *canadensis, Elymus virginicus, Onoclea sensibilis, Osmunda cinnamomea, Parthenocissus quinquefolia, Platanus occidentalis, Polygonum sagittatum, Populus deltoides, Ulmus americana.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association ranges from New England south to Pennsylvania.
States/Provinces: CT, DC, DE:S3S4, MA, NH, NJ, NY, PA, RI, VA?, VT.
Federal Lands: NPS (Delaware Water Gap, Rock Creek, Valley Forge).

CONSERVATION STATUS
Rank: G4? (20-Jun-2006).
Reasons: Total acreage (rangewide) is limited. Good-quality examples are uncommon. Threats include development and filling, alteration in flooding regimes, excessive beaver activity, and encroachment by aggressive non-native plant species. Further data are needed to define the rank.

CLASSIFICATION INFORMATION
Status: Nonstandard.
Confidence: 2 – Moderate.
Comments: This type is not tracked as a separate floodplain element in Vermont.
Similar Associations:
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147)--is characterized by a stronger dominance of both *Acer saccharinum* and *Matteuccia struthiopteris* and has fewer early-successional species.
- *Betula nigra - Platanus occidentalis / Impatiens capensis* Forest (CEGL006184)—southern species present, plus canopy with *Betula nigra*.

Related Concepts: Information not available.

SOURCES
Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Frye and Quinn 1979, Kearsley 1999b, Metzler and Barrett 2001, NatureServe n.d., Newbold 1994, Newbold et al. 1988, Nichols et al. 2001, Overlease 1978, Overlease 1987, Podniesinski and Wagner 2002, Russell and Schuyler 1988, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Thompson and Sorenson 2000, Wistendahl 1958.

Figure 41. Sycamore - Mixed Hardwood Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.54). July 2003.

Figure 42. Sycamore - Mixed Hardwood Floodplain Forest in Delaware Water Gap National Recreation Area (plot DEWA.241). May 2004.

COMMON NAME (PARK-SPECIFIC): BOTTOMLAND OAK PALUSTRINE FOREST

SYNONYMS

NVC English Name:	**Pin Oak - Red Maple / Gray's Sedge - White Avens Forest**
NVC Scientific Name:	***Quercus palustris - Acer rubrum / Carex grayi - Geum canadense* Forest**
NVC Identifier:	**CEGL006185**

LOCAL INFORMATION

Environmental Description: This forest type occurs on high terraces above the Delaware River, low terrace floodplains of small creeks, or any broad flat area with diffuse or braided drainage. The substrate is variable, ranging from moderately well-drained Delaware fine sandy loam to poorly drained soils of the Fredon-Halsey complex. These areas can be seasonally, temporarily, or intermittently flooded, often with networks of small drainages and pools throughout. Many of these areas were previously used as pasture.

Vegetation Description: The canopy of this palustrine forest is dominated by pin oak (*Quercus palustris*) and/or swamp white oak (*Quercus bicolor*) that cover 25-50% of the canopy. Numerous canopy associates may be present, including red maple (*Acer rubrum*), American hornbeam (*Carpinus caroliniana*), white ash (*Fraxinus americana*), black ash (*Fraxinus nigra*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*). Other occasional canopy associates are eastern white pine (*Pinus strobus*), yellow birch (*Betula alleghaniensis*), tuliptree (*Liriodendron tulipifera*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), bitternut hickory (*Carya cordiformis*), and blackgum (*Nyssa sylvatica*). Canopy trees are typically 20-35 m in height, while subcanopy trees are 10-20 m in height. The subcanopy (20-50% cover) contains a variety of canopy tree species listed above. The tall-shrub layer is variable (15-60% cover) and can include northern spicebush (*Lindera benzoin*), American hornbeam, common winterberry (*Ilex verticillata*), southern arrowwood (*Viburnum dentatum* var. *lucidum*), common serviceberry (*Amelanchier arborea*), American witch-hazel (*Hamamelis virginiana*), highbush blueberry (*Vaccinium corymbosum*), and blackhaw (*Viburnum prunifolium*). The short-shrub layer (25-50% cover) contains northern spicebush, black raspberry (*Rubus occidentalis*), northern dewberry (*Rubus flagellaris*), Allegheny blackberry (*Rubus allegheniensis*), lowbush blueberry (*Vaccinium angustifolium*), and species from the canopy, subcanopy and tall-shrub layers. The variable herbaceous layer is typically dense and can contain a diverse flora. Common species are Canada mayflower (*Maianthemum canadense*), wrinkleleaf goldenrod (*Solidago rugosa*), sensitive fern (*Onoclea sensibilis*), common cinquefoil (*Potentilla simplex*), rosy sedge (*Carex rosea*), touch-me-not (*Impatiens* spp.), ostrich fern (*Matteuccia struthiopteris*), marsh blue violet (*Viola cucullata*), Jack in the pulpit (*Arisaema triphyllum*), greater bladder sedge (*Carex intumescens*), drooping sedge (*Carex prasina*), eastern hayscented fern (*Dennstaedtia punctilobula*), Indian strawberry (*Duchesnea indica*), bog willowherb (*Epilobium leptophyllum*), rough bedstraw (*Galium asprellum*), whitegrass (*Leersia virginica*), partridgeberry (*Mitchella repens*), cinnamon fern (*Osmunda cinnamomea*), dwarf ginseng (*Panax trifolius*), spotted ladysthumb (*Polygonum persicaria*), and skunk-cabbage (*Symplocarpus foetidus*). Numerous other species may be present. This forest is susceptible to invasion by the exotic species Japanese stiltgrass (*Microstegium vimineum*) and Japanese barberry (*Berberis thunbergii*). Vines such as Virginia creeper (*Parthenocissus quinquefolia*) and eastern poison ivy (*Toxicodendron radicans*)

can be abundant, while roundleaf greenbrier (*Smilax rotundifolia*) is typically sparsely distributed.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus palustris, Quercus bicolor, Acer rubrum*
Tree subcanopy	Broad-leaved deciduous tree	*Carpinus caroliniana, Quercus palustris*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Lindera benzoin*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb and Graminoid	highly variable

Characteristic Species: *Quercus bicolor, Quercus palustris, Acer rubrum, Carpinus caroliniana, Arisaema triphyllum, Carex rosea, Onoclea sensibilis, Potentilla simplex, Solidago rugosa, Viola cucullata.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Pin Oak Small River Floodplain Forest	Walz et al 2006
PA	S3	2	Bottomland oak - hardwood palustrine forest	Fike 1999

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

Classification Comments: Bottomland Oak Palustrine Forest can be distinguished from other palustrine forests by the dominance of *Quercus palustris* and/or *Quercus bicolor* that cover >25% of the canopy.

Other Comments: None.

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

Plots and Data Sources: DEWA.185, DEWA.238; and 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	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Quercus palustris - Acer rubrum* Temporarily Flooded Forest Alliance (A.301)
Alliance (English name)	Pin Oak - Red Maple Temporarily Flooded Forest Alliance
Association	*Quercus palustris - Acer rubrum / Carex grayi - Geum canadense* Forest
Association (English name)	Pin Oak - Red Maple / Gray's Sedge - White Avens Forest
Ecological System(s):	Central Appalachian Floodplain (CES202.608)

GLOBAL DESCRIPTION

Concept Summary: This freely drained floodplain forest occurs along smaller rivers in southern New England and the northern Piedmont. The setting can range from high terraces to any broad flat area with diffuse or braided drainage. The canopy is comprised of *Quercus palustris, Fraxinus pennsylvanica, Acer rubrum, Ulmus americana*, and occasionally *Quercus bicolor, Fraxinus americana, Fraxinus nigra, Carya cordiformis, Nyssa sylvatica*, and/or *Platanus occidentalis*. More typically upland trees sometimes found on these terraces include *Quercus alba, Liriodendron tulipifera, Betula alleghaniensis, Pinus strobus*, and *Acer saccharum*. *Carpinus caroliniana* may be present as a small tree. The shrub layer includes *Lindera benzoin, Viburnum dentatum* var. *lucidum, Cornus amomum, Cornus obliqua*, or *Sambucus nigra* spp. *canadensis*. The herbaceous layer is variable in composition and usually dense. It can have abundant sedges, including *Carex lurida, Carex crinita, Carex intumescens, Carex rosea, Carex prasina, Carex lupulina*, or *Carex grayi*, with additional species such as *Cinna arundinacea, Leersia virginica, Panax trifolius, Symplocarpus foetidus, Geum canadense, Polygonum virginianum (= Tovara virginiana), Impatiens* spp., *Onoclea sensibilis, Athyrium filix-femina, Arisaema triphyllum, Iris versicolor, Viola sororia*, and *Toxicodendron radicans*. *Berberis thunbergii* and *Microstegium vimineum* are common invasive species in these forests.

Environmental Description: This forest occurs on alluvial deposits in the floodplain of small rivers. Flooding occurs during local events, especially during winter months. These areas can be seasonally, temporarily or intermittently flooded, often with networks of small drainages and pools throughout. Many of these areas were previously used as pasture.

Vegetation Description: The canopy is comprised of *Quercus palustris, Fraxinus pennsylvanica, Acer rubrum, Ulmus americana*, and occasionally *Quercus bicolor, Fraxinus americana, Fraxinus nigra, Carya cordiformis, Nyssa sylvatica*, and/or *Platanus occidentalis*. More typically upland trees sometimes found on these terraces include *Quercus alba, Liriodendron tulipifera, Betula alleghaniensis, Pinus strobus*, and *Acer saccharum*. *Carpinus caroliniana* may be present as a small tree. The shrub layer includes *Lindera benzoin, Viburnum dentatum* var. *lucidum, Cornus amomum, Cornus obliqua*, or *Sambucus nigra* spp. *canadensis*. The herbaceous layer is variable in composition and usually dense. It can have abundant sedges, including *Carex lurida, Carex crinita, Carex intumescens, Carex rosea, Carex prasina, Carex lupulina*, or *Carex grayi*, with additional species such as *Cinna arundinacea, Leersia virginica, Panax trifolius, Symplocarpus foetidus, Geum canadense, Polygonum virginianum (= Tovara virginiana), Impatiens* spp., *Onoclea sensibilis, Athyrium filix-femina, Arisaema triphyllum, Iris versicolor, Viola sororia*, and *Toxicodendron radicans*. *Berberis thunbergii* and *Microstegium vimineum* are common invasive species in these forests.

Most Abundant Species:

Stratum	Lifeform	Species
Tree (canopy & subcanopy)	Broad-leaved deciduous tree	*Acer rubrum, Fraxinus pennsylvanica, Quercus palustris, Ulmus americana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lindera benzoin*
Herb (field)	Graminoid	*Carex crinita, Carex intumescens, Carex lurida, Cinna arundinacea*
Herb (field)	Fern or fern ally	*Onoclea sensibilis*

Characteristic Species: *Carex grayi, Fraxinus pennsylvanica, Geum canadense, Lindera benzoin, Quercus bicolor, Quercus palustris.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association is currently known from southern New England to New Jersey and Pennsylvania.
States/Provinces: CT, MA, NJ, NY, PA, RI.
Federal Lands: NPS (Delaware Water Gap, Eisenhower, Gettysburg); USFWS (Great Swamp).

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

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This type is currently described from Connecticut. Silvics manual (Burns and Honkala 1990b) notes *Quercus palustris* as reaching into the eastern United States through Pennsylvania and northern New Jersey extending northward in the Hudson and Connecticut river valleys. It also occurs along the coast in Rhode Island.
Similar Associations:
- *Quercus palustris - (Quercus bicolor) - Acer rubrum / Osmunda cinnamomea* Forest (CEGL006240)--basin swamp with *Quercus palustris* and *Acer rubrum*.

Related Concepts:
- Southern New England floodplain forest (Rawinski 1984) ?

SOURCES
Description Authors: S. L. Neid, mod. L. A. Sneddon and S. C. Gawler.
References: Barrett and Enser 1997, Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Metzler and Barrett 2001, Rawinski 1984, Swain and Kearsley 2001.

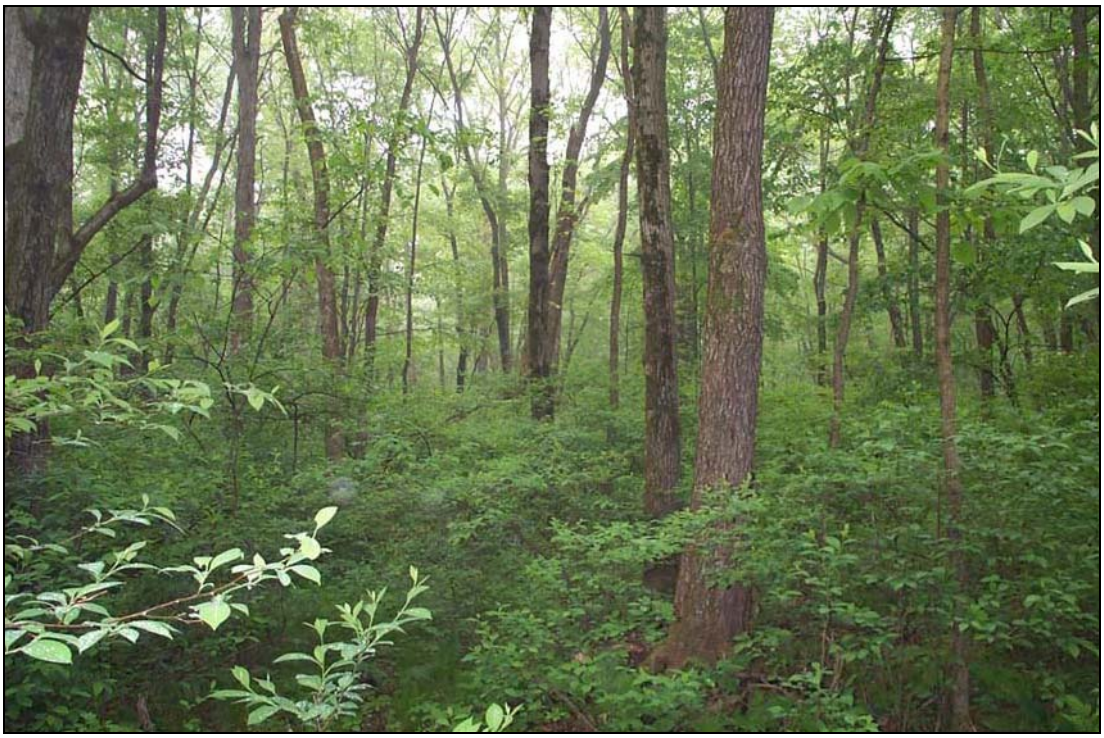

Figure 43. Bottomland Oak Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.185). May 2004.

Figure 44. Bottomland Oak Palustrine Forest in Delaware Water Gap National Recreation Area (plot DEWA.238). September 2004.

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)

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 & subcanopy)	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	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	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	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	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.

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

SYNONYMS

NVC English Name: **Eastern Red-cedar - White Ash / Poverty Oatgrass / Canada Bluegrass Woodland**

NVC Scientific Name: ***Juniperus virginiana - Fraxinus americana / Danthonia spicata - Poa compressa* Woodland**

NVC Identifier: **CEGL006002**

LOCAL INFORMATION

Environmental Description: This association occurs on very steep, typically south- to southeast-facing slopes of Kittatinny Ridge and at the top of shale and siltstone bedrock outcrops and along narrow shelves on cliffs along the east side of the Glaciated Low Plateau. This vegetation type often occurs immediately downslope of Dry Hickory Ridgetop Forest, Dry Oak - Heath Forest or Dry Oak - Mixed Hardwood Forest that has somewhat deeper soils. This community often occurs as a mosaic with Sparsely Vegetated Cliffs (sandstone, shale or siltstone) or Shale Scree Slopes. On Kittatinny Ridge, the substrate is coarse sandstone boulders and bedrock outcrops of the Silurian Shawangunk Formation. Soils are Laidig extremely stony silt loam with slopes of 25-65 %. Along the edge of the Glaciated Low Plateau, outcrops of Devonian shales and siltstones of the Mahantango Formation occur as very steep southeast-facing slopes and shale cliffs. Soils are typically very thin, acidic and rocky, when present (e.g., Arnot very channery loam). Soils are excessively well-drained and subject to drought during the growing season. Although excessively well-drained and droughty, this association may not burn often due to a low fuel load and abundance of bare rocky substrate.

Vegetation Description: This association is open woodland on a steep rocky slope. The tree canopy is often sparse, 5 to 10 m in height, and is dominated by stunted pignut hickory (*Carya glabra*) and eastern red-cedar (*Juniperus virginiana*). Other tree species include stunted white ash (*Fraxinus americana*), pignut hickory (*Carya glabra*), pitch pine (*Pinus rigida*), and chestnut oak (*Quercus prinus*). Due to the short height of the sparse canopy, there is no subcanopy. The tall-shrub layer is 2 to 5 m in height with up to 40 % total cover. Characteristic tall shrubs include tree saplings, bear oak (*Quercus ilicifolia*), and blackhaw (*Viburnum prunifolium*). The short-shrub layer (<2 m in height) is dominated by bear oak, Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*), northern dewberry (*Rubus flagellaris*), and tree seedlings. Downy arrowwood (*Viburnum rafinesquianum*) may also be locally abundant in the short-shrub layer. Dwarf sumac (*Rhus copallina*) and Carolina rose (*Rosa carolina*) are often present as short shrubs but at low total cover. The herbaceous layer is <1 m in height with total cover generally 40% or less. Wavy hairgrass (*Deschampsia flexuosa*) is the most abundant herbaceous species. Other typical species include little bluestem (*Schizachyrium scoparium*), red columbine (*Aquilegia canadensis*), garlic mustard (*Alliaria petiolata*), big bluestem (*Andropogon gerardii*), common sheep sorrel (*Rumex acetosella*), rock harlequin (*Corydalis sempervirens*), climbing false buckwheat (*Polygonum scandens*), orangegrass (*Hypericum gentianoides*), and dwarf cinquefoil (*Potentilla canadensis*). Sweet vernalgrass (*Anthoxanthum odoratum*) may be locally abundant when present. Creeping vines, especially Virginia creeper (*Parthenocissus quinquefolia*), are often present but with low total cover (<5%).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana, Pinus rigida*
Tree canopy	Broad-leaved deciduous tree	*Carya glabra*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Viburnum prunifolium, Quercus ilicifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium pallidum, Quercus ilicifolia, Rubus flagellaris*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*
Herb (field)	Forb	*Aquilegia canadensis, Corydalis sempervirens, Hypericum gentianoides, Rumex acetosella*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Danthonia spicata, Deschampsia flexuosa, Schizachyrium scoparium*

Characteristic Species: *Carya glabra, Juniperus virginiana, Quercus ilicifolia, Aquilegia canadensis, Corydalis sempervirens, Deschampsia flexuosa, Hypericum gentianoides, Schizachyrium scoparium, Solidago bicolor.*

Other Noteworthy Species: *Opuntia humifusa, Woodsia ilvensis.*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S2	1	Red-cedar Rocky Woodland	Walz et al 2006
PA	S2	1	Red-cedar - pickly pear shale shrubland	Fike 1999

Local Range: This woodland type is common within the park in Pennsylvania and New Jersey on south- to southeast-facing steep upper slopes of Kittatinny Ridge, where the substrate is large sandstone boulders and sandstone bedrock outcrops with small pockets of thin soil. In Pennsylvania, this vegetation type is restricted to shale cliffs and outcrops along the eastern rim of the Glaciated Low Plateau.

Classification Comments: This community differs from Dry Hickory Ridgetop Forest in being more open, with thinner soils, more exposed bedrock, and a more open canopy.

Other Comments: In New Jersey, the inclusion of pitch pine (*Pinus rigida*) in this association is unique to the Kittatinny Ridge (Shawangunk sandstone bedrock). The examples of this association that occur on the Watchung Mountains (Preakness basalt bedrock) outside the park do not contain pitch pine. Also, this association can be found on southwest-facing basalt (traprock) outcrops and steep slopes in the Piedmont in New Jersey.

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

Plots and Data Sources: DEWA.60, DEWA.119**,** DEWA.121, DEWA.146, DEWA.149, DEWA.246, DEWA.248; Fike 1999, Podniesinski 1999, Podniesinski and Kunsman 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	Conical-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.b.)
Alliance	*Juniperus virginiana* Woodland Alliance (A.545)
Alliance (English name)	Eastern Red-cedar Woodland Alliance
Association	*Juniperus virginiana - Fraxinus americana / Danthonia spicata – Poa compressa* Woodland
Association (English name)	Eastern Red-cedar - White Ash / Poverty Oatgrass / Canada Bluegrass Woodland
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)

GLOBAL DESCRIPTION

Concept Summary: This traprock ridge open woodland is known from mountainous sites in New England, New Jersey, and Pennsylvania, and may occur in southeastern New York. The vegetation occurs primarily on exposed outcrops of basaltic rock in the Connecticut Valley of New England and the Piedmont physiographic province in New Jersey. Sites supporting this community are upper slopes of basalt or diorite ridges from 365-1050 m elevation, characteristically south- or west-facing and range in slope from 5-30 degrees. Most sites have minimal soil development. Tree cover is sparse, ranging from 5-30% cover (average 20%) with *Juniperus virginiana* being the most constant canopy tree. Other woody species sometimes present include *Fraxinus americana, Quercus rubra, Quercus prinus, Ostrya virginiana,* and *Carya glabra*. The actual canopy composition reflects, to some extent, the surrounding forest. The scattered shrub layer often includes *Rosa carolina, Quercus prinus, Quercus ilicifolia, Rhus hirta, Vaccinium pallidum, Vaccinium angustifolium, Viburnum rafinesquianum,* and *Prunus virginiana*. The herbaceous layer usually covers 12-50% of the ground and is dominated by *Schizachyrium scoparium, Deschampsia flexuosa,* and *Danthonia spicata*, with their relative abundance varying from site to site. Numerous other herbaceous species occur in this community type, including *Carex pensylvanica, Anthoxanthum odoratum, Hypericum gentianoides, Antennaria plantaginifolia, Corydalis sempervirens, Solidago nemoralis, Poa compressa, Maianthemum racemosum, Uvularia perfoliata, Aquilegia canadensis, Asclepias verticillata, Polygonum scandens, Krigia virginica,* and *Houstonia longifolia*. No species is restricted to this community, but the assemblage listed above is very characteristic.

Environmental Description: This sparse woodland occurs primarily on exposed outcrops of basaltic rock in the Connecticut Valley of New England and the Piedmont physiographic province in New Jersey and adjacent Pennsylvania. Sites supporting this community are upper slopes of basalt or diorite ridges from 365-1050 m elevation. The ridges are characteristically south- or west-facing and range in slope from 5-30 degrees. Most sites have minimal soil development.

Vegetation Description: This community occurs as exposed, mainly herbaceous openings on ridgetops of resistant mafic rock. Occurrences are generally less than 0.1 ha in size. Tree cover is sparse, ranging from 5-30% cover (average 20%) with *Juniperus virginiana* being the most constant canopy tree. Other woody species sometimes present include *Fraxinus americana, Quercus rubra, Quercus prinus, Ostrya virginiana*, and *Carya glabra*. The actual canopy composition reflects, to some extent, the surrounding forest. The scattered shrub layer often includes *Rosa carolina, Quercus prinus, Quercus ilicifolia, Rhus hirta, Vaccinium pallidum, Vaccinium angustifolium, Viburnum rafinesquianum*, and *Prunus virginiana*. The herbaceous layer usually covers 12-50% of the ground and is dominated by *Schizachyrium scoparium, Deschampsia flexuosa*, and *Danthonia spicata*, with their relative abundance varying from site to site. Numerous other herbaceous species occur in this community type, including *Carex pensylvanica, Anthoxanthum odoratum, Hypericum gentianoides, Antennaria plantaginifolia, Corydalis sempervirens, Solidago nemoralis, Poa compressa, Maianthemum racemosum, Uvularia perfoliata, Aquilegia canadensis, Asclepias verticillata, Polygonum scandens, Krigia virginica*, and *Houstonia longifolia*. No species is restricted to this community, but the assemblage listed above is very characteristic.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Juniperus virginiana*
Herb (field)	Graminoid	*Carex pensylvanica*, *Danthonia spicata*, *Deschampsia flexuosa*, *Schizachyrium scoparium*

Characteristic Species: *Danthonia spicata, Deschampsia flexuosa, Helianthemum bicknellii, Poa compressa, Rosa carolina, Solidago nemoralis, Isanthus brachiatus.*
Other Noteworthy Species: *Arabis missouriensis, Houstonia longifolia, Muhlenbergia capillaris, Polygonum tenue, Pycnanthemum clinopodioides, Pycnanthemum torrei, Scutellaria parvula* var. *missouriensis, Selaginella rupestris.*
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This community has been described from mountainous sites in four New England states: Fall Mountain in New Hampshire; Bare Mountain, East Mountain, Mount Tom and Mount Norwottuck in Massachusetts; and Onion Mountain, Sugarloaf, Sleeping Giant and West Mountain in Connecticut. It has also been documented at sites in the Watchung Mountains in New Jersey, Kittatinny Ridge in New Jersey and Pennsylvania, and may occur in southeastern New York.
States/Provinces: CT, MA, ME?, NH, NJ:S1S2, NY, ON, PA, VT.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G2G3 (16-Nov-1997).
Reasons: There are probably 30-60 occurrences of this community rangewide. At least 19 occurrences have been documented from Connecticut, Massachusetts, Pennsylvania, and New Jersey, with outliers in New Hampshire and southeastern New York. This community is restricted to exposed outcrops of basaltic rock in the Connecticut River valley of New England, and the High Allegheny Plateau and Piedmont physiographic provinces of New Jersey and

adjacent Pennsylvania. Most occurrences are small; total acreage is probably less than 500 acres rangewide.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: In general, this community is similar to a number of other sparse woodland ridgetop communities. New Jersey occurrences are floristically related to ridgetop sparse woodlands in Virginia (e.g., greenstone glades) but appear to share more species with the northern occurrences with which they have been grouped here. However, further research may indicate that the New Jersey occurrences represent a unique vegetation assemblage. In Massachusetts, this community typically occurs as herbaceous (and probably successional) patches within a hickory-hop hornbeam forest. New York may contain some examples of this community which they classify under the name "red cedar rocky summit community."

Similar Associations:

- *Juniperus virginiana - Ostrya virginiana / Carex eburnea* Woodland (CEGL006180).

Related Concepts:

- Eastern Redcedar: 46 (Eyre 1980) B
- Red Cedar Woodland (Thompson 1996) ?
- SNE circumneutral rocky summit/rock outcrop community (Rawinski 1984) ?

SOURCES

Description Authors: M. Anderson, mod. S. C. Gawler.

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Eyre 1980, Fike 1999, Grossman et al. 1994, Lee 1985, Livingston and Lund 1982, Metzler and Barrett 1992, Metzler and Barrett 2001, Motzkin 1993, Nichols 1914, Rawinski 1984, Roberts 1914, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000, Walz 1996.

Figure 61. Hickory - Eastern Red-cedar Rocky Woodland in Delaware Water Gap National Recreation Area (plot DEWA.121). September 2003.

Figure 62. Hickory - Eastern Red-cedar Rocky Woodland in Delaware Water Gap National Recreation Area (plot DEWA.146). July 2003.

COMMON NAME (PARK-SPECIFIC): OAK - BIRCH TALUS FOREST

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

LOCAL INFORMATION

Environmental Description: This forest association occurs on the rocky steep southeast-facing slope of the Kittatinny Ridge and on occasional boulderfields in other sections of the park. The characteristic substrate for this forest is coarse, bouldery sandstone talus. The parent material is sandstone and sandstone conglomerate of the Silurian Shawangunk Formation. There is little available soil except for small amounts that accumulate in crevices and in between rocks.
Vegetation Description: This forest type is characterized by open forest canopy (50-80% cover) dominated by chestnut oak (*Quercus prinus*) and sweet birch (*Betula lenta*). Other canopy associates include pignut hickory (*Carya glabra*), mockernut hickory (*Carya alba*), blackgum (*Nyssa sylvatica*), black oak (*Quercus velutina*), white oak (*Quercus alba*), red maple (*Acer rubrum*), eastern white pine (*Pinus strobus*), and pitch pine (*Pinus rigida*). Canopy trees range in height from 15-30 m, while subcanopy trees extend 10-15 m in height. The sparse subcanopy (10-30% cover) is typically dominated by sweet birch and blackgum, with other canopy trees as associates. The tall-shrub layer (15-40% cover) commonly includes American witch-hazel (*Hamamelis virginiana*), mountain laurel (*Kalmia latifolia*), common serviceberry (*Amelanchier arborea*), striped maple (*Acer pensylvanicum*), smooth sumac (*Rhus glabra*), and sprouts of American chestnut (*Castanea dentata*). The variable short-shrub layer (0-30%cover) can contain black huckleberry (*Gaylussacia baccata*), Blue Ridge blueberry (*Vaccinium pallidum*), lowbush blueberry (*Vaccinium angustifolium*), northern dewberry (*Rubus flagellaris*), Allegheny blackberry (*Rubus allegheniensis*), as well as seedlings of canopy trees. The herbaceous layer is typically extremely sparse, due to the bouldery substrate. Common species include wavy hairgrass (*Deschampsia flexuosa*), marginal woodfern (*Dryopteris marginalis*), white wood aster (*Eurybia divaricata*), Swan's sedge (*Carex swanii*), and poverty oatgrass (*Danthonia spicata*). Vines may be common, including eastern poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus, Betula lenta*
Tree subcanopy	Broad-leaved deciduous tree	*Nyssa sylvatica, Betula lenta*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*

Characteristic Species: *Quercus prinus, Betula lenta, Hamamelis virginiana.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3?	2	Chestnut Oak - Sweet Birch / Virginia Creeper Talus Woodland	Walz et al 2006
PA	S3	2	Birch (black-gum) rocky slope woodland	Fike 1999

Local Range: This common forest type occurs along the rocky, steep, southeast-facing slope of the Kittatinny Ridge.
Classification Comments: This forest is identified by the steep, coarse, bouldery talus and open canopy dominated by *Quercus prinus* and *Betula lenta*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.59, DEWA.181; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

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

GLOBAL DESCRIPTION

Concept Summary: This talus or rocky slope woodland community occurs in the central Appalachian Mountains and extends west to the Western Allegheny Plateau in Pennsylvania. The substrate is generally quartzite or sandstone talus and usually sloping, but the type also occurs on benches, ridges, and boulderfields. Soils, where present, are shallow, organic, acidic and infertile. The canopy is of variable cover but generally open with gnarled, widely spaced trees. Characteristic trees are birches, primarily *Betula lenta* but less frequently including *Betula papyrifera, Betula populifolia*, or *Betula alleghaniensis*, as well as *Nyssa sylvatica*. Other tree associates may include *Tsuga canadensis, Acer rubrum, Carya glabra, Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina*, or *Quercus coccinea*. Typical shrubs include *Acer spicatum, Acer pensylvanicum, Amelanchier arborea, Castanea dentata, Kalmia latifolia, Hamamelis virginiana, Menziesia pilosa, Ribes rotundifolium, Vaccinium angustifolium, Vitis* spp., *Toxicodendron radicans, Smilax rotundifolia*, and *Parthenocissus quinquefolia*. Ferns characterize the herb layer and may include *Dryopteris marginalis, Polypodium virginianum, Woodsia obtusa,* or *Asplenium platyneuron*. The forbs *Aralia nudicaulis, Heuchera* spp., and *Scutellaria saxatilis* are also well-adapted to the bouldery habitats. Lichens, especially the rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata*, characterize the nonvascular layer.
Environmental Description: Sites include the edges of very large, unvegetated (except for lichens), scarcely weathered block fields, as well as a variety of more weathered boulderfields and slopes covered by coarse to fine, bouldery colluvium. Much of the bouldery rubble is weathered from resistant quartzite or sandstone caprock. The elevation range of plot-sampled stands ranges from about 300 m in New Jersey to 1025 m in Virginia (975-3360 feet). Slope position and aspect are variable, while associated landforms include landslide scarps, slide

masses, concave hollow heads, and incised hollow bottoms. Mean cover of exposed boulders at Virginia sampling sites is 72%. In this very rocky environment, soil is limited to local, interstitial, root-rich duff deposits, or to "pads" of moss and underlying, thin, organic / sandy material that have developed on wide, flat boulder surfaces. Interstitial air spaces between boulders may be prevalent for 1.0 m or more below the surface. Soils are largely organic and usually extremely acidic and infertile. There is often some heterogeneity of boulder depth and weathering, as well as of microclimate and soil moisture, within boulderfields. In general, sites are somewhat xeric and show little evidence of subsurface drainage. However, this regime is ameliorated by higher elevations and north aspects, which probably slow evaporation and increase the moisture-holding capacity of the bouldery substrate.

Vegetation Description: Physiognomy varies from nearly closed forest to open woodland with widely spaced trees. The canopy is dominated by more-or-less gnarled specimens of *Betula lenta* and *Quercus prinus* generally <20 m tall. *Betula lenta* is usually the sole dominant of less weathered, steeper, more unstable boulderfield habitats, while a greater variety of trees is often codominant with *Betula lenta* on more weathered and stable habitats. Other overstory associates that may be important on some sites are *Quercus rubra, Quercus velutina, Quercus alba, Acer rubrum, Nyssa sylvatica, Betula populifolia, Betula papyrifera* var. *cordifolia* (high elevation sites), *Carya glabra, Carya alba, Tsuga canadensis*, and *Betula alleghaniensis*. The presence of well-preserved, fallen boles indicates that *Castanea dentata* was important on some boulderfields prior to the arrival of chestnut blight (Fleming and Moorhead 2000). The typically open shrub layer contains *Acer pensylvanicum, Acer spicatum, Amelanchier arborea, Castanea dentata* sprouts, *Hamamelis virginiana, Ilex montana, Kalmia latifolia, Rhus glabra, Menziesia pilosa* (at the southern end of the range), and *Ribes rotundifolium*. Herbs are very sparse and restricted to mossy pockets or flat boulders; typical species are *Dryopteris marginalis, Polypodium appalachianum, Deschampsia flexuosa*, and *Danthonia spicata*. In the southern portion of the range, *Heuchera* spp. and *Scutellaria saxatilis* are characteristic herbs. Vines are scattered to abundant and include *Parthenocissus quinquefolia, Vitis* spp., *Toxicodendron radicans*, and *Smilax rotundifolia*. Bryophyte cover ranges up to 65% in some microhabitats. The rocktripes *Lasallia papulosa* and *Umbilicaria mammulata* are generally the most conspicuous lichens.

Most Abundant Species: Information not available.

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

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

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community occurs locally throughout the Blue Ridge and Ridge and Valley sections of Pennsylvania, Virginia, West Virginia, and Maryland, extending northeast to the Pennsylvania-New Jersey border.

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

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

CONSERVATION STATUS
Rank: G3G4 (9-Aug-2004).
Reasons: Although this community type occurs in small patches over a limited geographic range, there are probably >200 sites (if not many hundreds of sites) in Virginia and West Virginia alone. Moreover, stands occupy rugged habitats that are not prone to anthropogenic disturbances.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This vegetation type is poorly represented by plot data and additional sampling is needed, particularly of lower elevation and south-slope stands. Even with limited data, potential variants of the type in Virginia were proposed by Fleming and Moorhead (2000). A variant of sheltered north slopes in which *Tsuga canadensis* is codominant with *Betula lenta* and/or *Quercus* spp. has been reported from Virginia by Hupp (1983) and from Pennsylvania by Fike (1999). The combination of surficial boulder cover and nutrient-poor substrate results in a notably low mean species richness (n = 22 taxa per 400 square meters) in Virginia plot samples of this type.
Similar Associations:
- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320)--is known from ME, NH, VT, NY, PA and perhaps NJ, is similar but more northern in character; it lacks *Betula lenta*, *Nyssa sylvatica*, and *Kalmia latifolia*.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)--of somewhat sheltered, often very rocky slopes.

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

SOURCES
Description Authors: G. Fleming and P. Coulling, mod. S. C. Gawler.
References: Anderson et al. 1998, Eastern Ecology Working Group n.d., Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Hack and Goodlett 1960, Harrison 2004, Hupp 1983, Lea 2003, Rawinski et al. 1996, Russell and Schuyler 1988, VDNH 2003.

Figure 63. Oak - Birch Talus Forest in Delaware Water Gap National Recreation Area (Accuracy Assessment Point DEWA.128). April 2006.

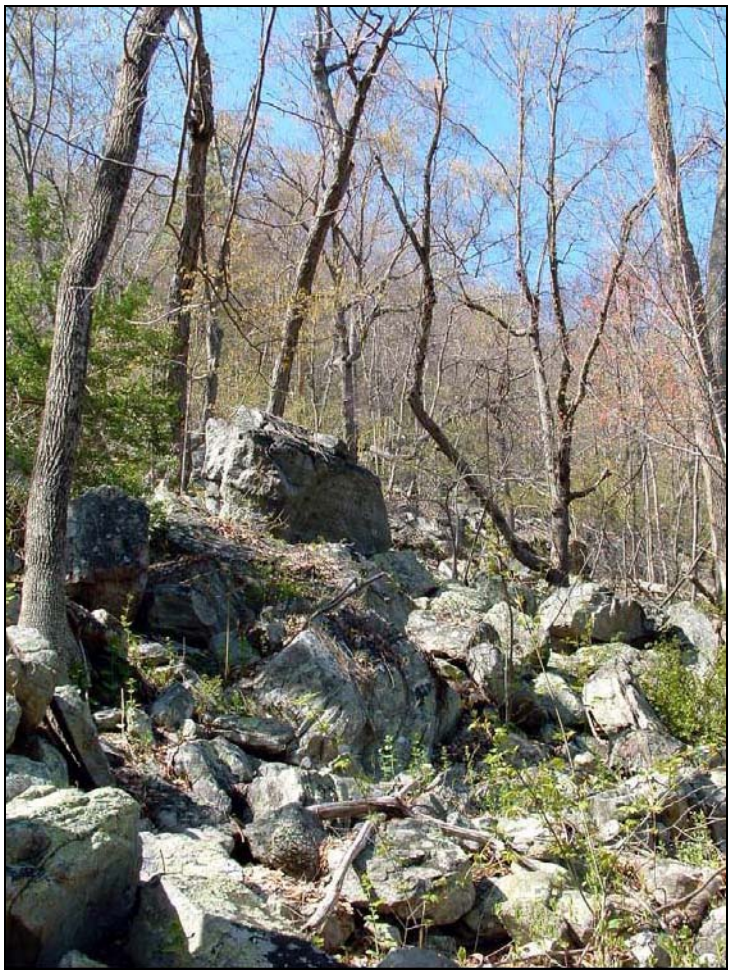

Figure 64. Oak - Birch Talus Forest in Delaware Water Gap National Recreation Area (Accuracy Assessment Point DEWA.1096). April 2006.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL SHRUBLAND

SYNONYMS

NVC English Name:	**Autumn-olive - Gray Dogwood - Multiflora Rose - Eastern Red-cedar Shrubland**
NVC Scientific Name:	***Elaeagnus umbellata - Cornus racemosa - Rosa multiflora - Juniperus virginiana* Shrubland**
NVC Identifier:	**CEGL006451**

LOCAL INFORMATION

Environmental Description: Successional Shrubland occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed. This association develops as woody species colonize the open fields, typically from the outer edges of the field into the center or as scattered clumps throughout the field. Over time, these sites will likely succeed to Northeastern Modified Successional Forest if left unmanaged. Some of these fields are mowed or brushcut only in strips or paths that crisscross the field. These sites contain moderately well-drained to well-drained soils, typical of the following series: Wallpack, Lordstown, Nassau, Manlius, Hoosic, Otisville, and Hazen. The shrublands are flat to gently sloping, often bounded by stonewalls or fencerows.

Vegetation Description: The vegetation structure of Successional Shrubland varies from open fields with scattered tall and short shrubs covering 25% of the field to dense "closed-canopy" tall shrublands with sparse ground layer vegetation. Another common vegetation structure for this type contains small, scattered open patches of herbaceous and graminoid old-field vegetation in a matrix of large, dense clumps of tall and short shrubs. Scattered trees may be present, covering <25% of the field. Typical species include eastern red-cedar (*Juniperus virginiana*), gray birch (*Betula populifolia*), choke cherry (*Prunus virginiana*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*) and black locust (*Robinia pseudoacacia*). Tall shrubs can be scattered or dense (25-90% cover). Characteristic tall shrubs include autumn-olive (*Elaeagnus umbellata*), gray dogwood (*Cornus racemosa*), multiflora rose (*Rosa multiflora*), eastern red-cedar, flowering dogwood (*Cornus florida*), Morrow's honeysuckle (*Lonicera morrowii*), smooth sumac (*Rhus glabra*), blackhaw (*Viburnum prunifolium*), and species listed above in the tree layer. The short-shrub layer (5-40% cover) is less dense than the tall-shrub layer and can contain the same species, as well as Japanese barberry (*Berberis thunbergii*), Allegheny blackberry (*Rubus allegheniensis*), wine raspberry (*Rubus phoenicolasius*), and black raspberry (*Rubus occidentalis*). In fields at higher elevations, ericaceous shrubs such as black huckleberry (*Gaylussacia baccata*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), and/or lowbush blueberry (*Vaccinium angustifolium*) can be a prominent part of the shrub layer. The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Common species include garlic mustard (*Alliaria petiolata*), wrinkleleaf goldenrod (*Solidago rugosa*), wild bergamot (*Monarda fistulosa*), sweet vernalgrass (*Anthoxanthum odoratum*), eastern poison ivy (*Toxicodendron radicans*), Kentucky bluegrass (*Poa pratensis*), common yellow oxalis (*Oxalis stricta*), flat-top goldentop (*Euthamia graminifolia*), giant goldenrod (*Solidago gigantea*), red fescue (*Festuca rubra*), little bluestem (*Schizachyrium scoparium*), Virginia mountainmint (*Pycnanthemum virginianum*), false baby's breath (*Galium mollugo*), common dandelion (*Taraxacum officinale*), common cinquefoil

(*Potentilla simplex*), common yarrow (*Achillea millefolium*), Queen Anne's-lace (*Daucus carota*), white clover (*Trifolium repens*), smooth brome (*Bromus inermis*), redtop (*Agrostis gigantea*), and quackgrass (*Elymus repens*), among many others. Vines can be absent or dominant (0-90% cover), often covering the tall and short shrubs. Common vines are summer grape (*Vitis aestivalis*), fox grape (*Vitis labrusca*), oriental bittersweet (*Celastrus orbiculatus*), Virginia creeper (*Parthenocissus quinquefolia*), and Japanese honeysuckle (*Lonicera japonica*).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus racemosa, Elaeagnus umbellata, Rosa multiflora*
Herb (field)	Vine/Liana	*Celastrus orbiculatus, Vitis aestivalis, Vitis labrusca*
Herb (field)	Forb	*Alliaria petiolata, Monarda fistulosa, Solidago rugosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Schizachyrium scoparium*

Characteristic Species: *Cornus racemosa, Elaeagnus umbellata, Juniperus virginiana, Alliaria petiolata, Anthoxanthum odoratum, Monarda fistulosa, Rosa multiflora, Solidago rugosa, Celastrus orbiculatus, Vitis aestivalis.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

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

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

Classification Comments: Information not available.

Other Comments: None.

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

Plots and Data Sources: DEWA.1, DEWA.4, DEWA.5, DEWA.15, DEWA.21, DEWA.31, DEWA.44, DEWA.47, DEWA.162, DEWA.194.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Cornus drummondii* Shrubland Alliance (A.3558)
Alliance (English name)	Roughleaf Dogwood Shrubland Alliance
Association	*Elaeagnus umbellata - Cornus racemosa - Rosa multiflora – Juniperus virginiana* Shrubland
Association (English name)	Autumn-olive - Gray Dogwood - Multiflora Rose - Eastern Red-cedar Shrubland

Ecological System(s): Information not available

GLOBAL DESCRIPTION

Concept Summary: This association comprises shrubby old fields dominated by thickets of *Elaeagnus angustifolia, Cornus racemosa, Viburnum prunifolium, Lonicera japonica, Lonicera morrowii, Ligustrum vulgare, Euonymus alatus, Rosa multiflora, Rhus glabra*, and *Rhus hirta*, with patches of herbaceous vegetation among the shrubs. Shorter shrubs include *Berberis thunbergii* and *Rubus* spp., and in some fields *Gaylussacia baccata, Vaccinium pallidum, Vaccinium stamineum*, and/or *Vaccinium angustifolium*. Small trees are often present but form <25% cover; they include *Juniperus virginiana, Betula populifolia, Prunus virginiana, Cornus florida, Acer rubrum, Juglans nigra, Prunus serotina, Robinia pseudoacacia*, and *Fraxinus americana*. The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Common species include *Solidago rugosa, Solidago gigantea, Solidago nemoralis, Monarda fistulosa, Anthoxanthum odoratum, Poa pratensis, Oxalis stricta, Viola sororia, Euthamia graminifolia, Festuca rubra, Schizachyrium scoparium, Pycnanthemum virginianum, Alliaria petiolata, Galium mollugo, Potentilla simplex, Achillea millefolium, Daucus carota, Trifolium repens, Bromus inermis, Agrostis gigantea*, and *Elymus repens (= Elytrigia repens)*, among many others. Vines can be absent or dominant, sometimes covering the tall and short shrubs. Common vines are *Vitis aestivalis, Vitis labrusca, Toxicodendron radicans, Celastrus orbiculatus, Parthenocissus quinquefolia*, and *Lonicera japonica*.

Environmental Description: This association occurs on former agricultural lands and old fields that are no longer intensively mowed, plowed or managed. These sites contain moderately well-drained to well-drained soils. The shrublands are flat to gently sloping, often bounded by stonewalls or fencerows.

Vegetation Description: The structure of this association varies from open fields with scattered tall and short shrubs covering 25% of the field, with herbaceous vegetation in the interstices, to dense "closed-canopy" tall shrublands with sparse ground layer vegetation. Common shrubs include *Elaeagnus angustifolia, Cornus racemosa, Viburnum prunifolium, Lonicera japonica, Lonicera morrowii, Ligustrum vulgare, Euonymus alatus, Rosa multiflora, Rhus glabra*, and *Rhus hirta*, with patches of herbaceous vegetation among the shrubs. Shorter shrubs include *Berberis thunbergii* and *Rubus* spp., and in some fields *Gaylussacia baccata, Vaccinium pallidum, Vaccinium stamineum*, and/or *Vaccinium angustifolium*. Small trees are often present but form <25% cover; they include *Juniperus virginiana, Betula populifolia, Prunus virginiana, Cornus florida, Acer rubrum, Juglans nigra, Prunus serotina, Robinia pseudoacacia*, and *Fraxinus americana*. The herbaceous layer is variable depending on the density of shrub cover. Typical species are those associated with old fields, grasslands, and agricultural sites. Common species include *Solidago rugosa, Solidago gigantea, Solidago nemoralis, Monarda fistulosa, Anthoxanthum odoratum, Poa pratensis, Oxalis stricta, Viola sororia, Euthamia graminifolia, Festuca rubra, Schizachyrium scoparium, Pycnanthemum virginianum, Alliaria petiolata, Galium mollugo, Potentilla simplex, Achillea millefolium, Daucus carota, Trifolium repens, Bromus inermis, Agrostis gigantea*, and *Elymus repens (= Elytrigia repens)*, among many others. Vines can be absent or dominant, sometimes covering the tall and short shrubs. Common vines are *Vitis aestivalis, Vitis labrusca, Toxicodendron radicans, Celastrus orbiculatus, Parthenocissus quinquefolia*, and *Lonicera japonica*.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cornus racemosa, Elaeagnus umbellata, Rhus glabra, Rosa multiflora*
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana*
Herb (field)	Vine/Liana	*Celastrus orbiculatus, Vitis aestivalis, Vitis labrusca*
Herb (field)	Forb	*Monarda fistulosa, Solidago canadensis* var. *scabra, Solidago rugosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Schizachyrium scoparium*

Characteristic Species: *Anthoxanthum odoratum, Celastrus orbiculatus, Cornus racemosa, Elaeagnus umbellata, Juniperus virginiana, Monarda fistulosa, Rhus glabra, Rhus hirta, Rosa multiflora, Solidago canadensis* var. *scabra, Solidago rugosa, Vitis aestivalis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This community is common in former agricultural areas in the northeastern U.S.
States/Provinces: CT, DE, MA, NJ, NY, PA.
Federal Lands: NPS (Delaware Water Gap, Valley Forge).

CONSERVATION STATUS
Rank: GNA (ruderal) (23-Jun-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This is a broadly defined type intended for shrubby vegetation on abandoned cropland or pasture.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d., Keever 1979, Newbold et al. 1988, Overlease 1987.

Figure 65. Successional Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.15). May 2003.

Figure 66. Successional Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.31). June 2003.

COMMON NAME (PARK-SPECIFIC): BEAR OAK - WAVY HAIRGRASS SHRUBLAND

SYNONYMS
NVC English Name: **Bear Oak - Sand Cherry Shrubland**
NVC Scientific Name: ***Quercus ilicifolia - Prunus pumila* Shrubland**
NVC Identifier: **CEGL006121**

LOCAL INFORMATION

Environmental Description: This vegetation type occurs on high-elevation ridges with excessively well-drained and shallow soils over sandstone and shale bedrock of the Silurian Shawangunk and Devonian Mahantango formations, respectively. This association is influenced by the extremely thin soils over acidic bedrock, with fire as a secondary influence.
Vegetation Description: This association is characterized a moderately dense to dense growth of bear oak (*Quercus ilicifolia*). The tree layer, when present, is limited to drought-tolerant species such as chestnut oak (*Quercus prinus*), pitch pine (*Pinus rigida*), and pignut hickory (*Carya glabra*). Trees are usually stunted and less than 10 m in height. The tall-shrub layer (2-5 m in height) is usually sparse and limited to occasional tree saplings, common serviceberry (*Amelanchier arborea*), and tall bear oak. The short-shrub layer (<2 m in height) is most diagnostic for this association with bear oak typically a dominant to codominant species (relative cover in short-shrub layer greater than 25%). Other common and occasionally codominant short-shrub species include lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), black huckleberry (*Gaylussacia baccata*), and common serviceberry. The herbaceous layer cover varies from 40 to 70% and is dominated by wavy hairgrass (*Deschampsia flexuosa*) with relative cover in the herbaceous layer well over 50%. Other typical herb species include Pennsylvania sedge (*Carex pensylvanica*), little bluestem (*Schizachyrium scoparium*), and smooth Solomon's seal (*Polygonatum biflorum*). Mosses may be present with low total cover, especially polytrichum mosses (*Polytrichum* spp.).
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia, Amelanchier arborea*
Short shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia, Vaccinium angustifolium, Vaccinium pallidum*
Herb (field)	Forb	*Polygonatum biflorum*
Herb (field)	Graminoid	*Carex pensylvanica, Deschampsia flexuosa, Schizachyrium scoparium*

Characteristic Species: *Quercus ilicifolia, Vaccinium angustifolium, Vaccinium pallidum, Deschampsia flexuosa.*
Other Noteworthy Species: *Prunus pumila* var. *susquehanae.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2?	1	Ridgetop Scrub Oak Barrens	Walz et al 2006
PA	S3	1	Scrub oak shrubland	Fike 1999

Local Range: This shrubland occurs on excessively well-drained, thin soils over shale or sandstone bedrock associated with ridgetops. It may occur anywhere on the Pennsylvania side of the park on the Glaciated Low Plateau and on the New Jersey side along the top of Kittatinny Ridge.
Classification Comments: This community is similar to Successional Bear Oak - Heath Shrubland but with much greater bear oak cover. Also, the herbaceous layer is better expressed in this type (with moderate to high wavy hairgrass cover), while the herb layer is sparse to absent in Successional Bear Oak - Heath Shrubland. In addition, for Successional Bear Oak - Heath Shrubland, fire is probably the primary factor influencing the association structure, such that these shrublands are likely to succeed to Dry Oak - Heath Forest in between fire events. By contrast, Bear Oak - Wavy Hairgrass Shrubland is primarily influenced by extremely thin soils over acidic bedrock, which limits tree growth.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.221, DEWA.222, DEWA.247; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Quercus ilicifolia* Shrubland Alliance (A.906)
Alliance (English name)	Bear Oak Shrubland Alliance
Association	*Quercus ilicifolia - Prunus pumila* Shrubland
Association (English name)	Bear Oak - Sand Cherry Shrubland
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
	Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This *Quercus ilicifolia* shrubland occurs on ridgetops, summits and rock outcrops in the northeastern United States. It occurs on extremely shallow, stable acidic soils over bedrock. Open bedrock is common. This shrubland is dominated by *Quercus ilicifolia*, which occurs with variable cover depending on site conditions. Associated shrubs include *Vaccinium angustifolium, Vaccinium pallidum, Comptonia peregrina, Kalmia angustifolia, Gaylussacia baccata, Photinia melanocarpa (= Aronia melanocarpa), Quercus prinoides*, and *Prunus pumila*. The herbaceous layer varies from sparse to well-developed depending on the density of shrub cover. Typical herbs include *Deschampsia flexuosa, Carex pensylvanica, Danthonia spicata, Schizachyrium scoparium, Pteridium aquilinum, Gaultheria procumbens, Comandra umbellata, Melampyrum lineare, Hypericum gentianoides, Corydalis sempervirens, Sibbaldiopsis tridentata (= Potentilla tridentata)*, plus *Andropogon gerardii* or *Polygonatum biflorum* at some sites. Scattered and stunted trees are common and include species from the surrounding ridgetop forests, such as *Quercus prinus, Quercus rubra, Quercus alba, Pinus rigida, Populus tremuloides, Betula populifolia*, and *Carya glabra*.

Environmental Description: This shrubland occurs on extremely shallow, stable acidic soils over bedrock, typically on ridges. Open bedrock is common. Fire is a secondary influence.
Vegetation Description: This shrubland is dominated by *Quercus ilicifolia*, which occurs with variable cover depending on site conditions. Associated shrubs include *Vaccinium angustifolium, Vaccinium pallidum, Comptonia peregrina, Kalmia angustifolia, Gaylussacia baccata, Photinia melanocarpa (= Aronia melanocarpa), Quercus prinoides,* and *Prunus pumila*. The herbaceous layer varies from sparse to well-developed depending on the density of shrub cover. Typical herbs include *Deschampsia flexuosa, Carex pensylvanica, Danthonia spicata, Schizachyrium scoparium, Pteridium aquilinum, Gaultheria procumbens, Comandra umbellata, Melampyrum lineare, Hypericum gentianoides, Corydalis sempervirens, Sibbaldiopsis tridentata (= Potentilla tridentata),* plus *Andropogon gerardii* or *Polygonatum biflorum* at some sites. Scattered and stunted trees are common and include species from the surrounding ridgetop forests, such as *Quercus prinus, Quercus rubra, Quercus alba, Pinus rigida, Populus tremuloides, Betula populifolia,* and *Carya glabra*.
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Quercus ilicifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium angustifolium, Vaccinium pallidum*
Herb (field)	Graminoid	*Carex pensylvanica, Deschampsia flexuosa, Schizachyrium scoparium*

Characteristic Species: *Amelanchier arborea, Comandra umbellata, Danthonia spicata, Deschampsia flexuosa, Melampyrum lineare, Prunus pumila, Pteridium aquilinum, Quercus ilicifolia, Quercus prinus, Vaccinium angustifolium, Vaccinium pallidum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is known from ridgelines from southern New England south to interior New Jersey and Pennsylvania.
States/Provinces: CT, MA, NJ, NY?, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (10-May-2002).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations:
- *Quercus ilicifolia - Quercus prinoides* Shrubland (CEGL006111).

Related Concepts: Information not available.

SOURCES
Description Authors: E. Largay, mod. S. C. Gawler.

References: Eastern Ecology Working Group n.d., Fike 1999, Metzler and Barrett 2001, Swain and Kearsley 2000.

Figure 67. Bear Oak - Wavy Hairgrass Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.221). June 2004.

Figure 68. Bear Oak - Wavy Hairgrass Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.247). June 2004.

COMMON NAME (PARK-SPECIFIC): SYCAMORE - MIXED HARDWOOD RIVERINE SHRUBLAND

SYNONYMS

NVC English Name: **River Birch - Sycamore - (Sandbar Willow, Carolina Willow) Shrubland**

NVC Scientific Name: ***Betula nigra - Platanus occidentalis - Salix (interior, caroliniana)* Shrubland**

NVC Identifier: **CEGL003896**

LOCAL INFORMATION

Environmental Description: This sycamore-dominated riverine shrubland typically occurs on cobble bars and sand/gravel bars that are adjacent to or contiguous with the shoreline of the Delaware River. This type can also occur on the upstream ends of islands. They are subject to frequent floods, high stream velocity and ice-scour, though these disturbances are often less intense than those experienced by Sycamore (Willow) - Mixed Hardwood Riverine Dwarf-shrubland.

Vegetation Description: This community is characterized by a substantial layer of tall shrubs (2-5 m in height) dominated by sycamore (*Platanus occidentalis*) that covers at least 25% of the area. River birch (*Betula nigra*) or silver maple (*Acer saccharinum*) can also be codominant in the tall-shrub layer. Individual sycamores may also be scattered in a sparse tree canopy that is 5-10 m in height. Black willow (*Salix nigra*), sycamore and river birch are dominant in the sparse short-shrub layer, with silver maple and black ash (*Fraxinus nigra*). The herbaceous layer ranges from sparse to moderately dense and can contain a wide variety of typical wetland and prairie species. Common species include marshpepper knotweed (*Polygonum hydropiper*), reed canarygrass (*Phalaris arundinacea*), switchgrass (*Panicum virgatum*), whitegrass (*Leersia virginica*), Pennsylvania smartweed (*Polygonum pensylvanicum*), deertongue (*Dichanthelium clandestinum*), upland bentgrass (*Agrostis perennans*), swamp milkweed (*Asclepias incarnata*), smallspike false nettle (*Boehmeria cylindrica*), sensitive fern (*Onoclea sensibilis*), Canadian clearweed (*Pilea pumila*), and swamp smartweed (*Polygonum hydropiperoides*). This association is highly susceptible to colonization by purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Polygonum cuspidatum*), multiflora rose (*Rosa multiflora*), purple crownvetch (*Coronilla varia*), and other invasive plants. Vines such as riverbank grape (*Vitis riparia*) and eastern poison ivy (*Toxicodendron radicans*) are often found throughout this tall sycamore-dominated shrubland.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Platanus occidentalis, Betula nigra*
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix nigra, Platanus occidentalis, Betula nigra*
Herb (field)	Vine/Liana	*Vitis riparia*
Herb (field)	Forb	*Lythrum salicaria, Polygonum hydropiper, Polygonum pensylvanicum*

Herb (field)	Graminoid	*Leersia virginica, Panicum virgatum, Phalaris arundinacea*

Characteristic Species: *Platanus occidentalis, Betula nigra, Salix nigra, Leersia virginica, Panicum virgatum, Phalaris arundinacea, Polygonum hydropiper.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Birch - Willow Riverbank Shrubland	Walz et al 2006
PA	S4	1	River birch - sycamore floodplain scrub	Fike 1999

Local Range: This vegetation type is common in the Delaware River within the park.
Classification Comments: This association is distinguished from other riparian types by the substantial tall-shrub layer of *Platanus occidentalis*, often with *Betula nigra*. The height of the shrubs (2-5 m) differentiates this type from Sycamore (Willow) - Mixed Hardwood Riverine Dwarf-shrubland in which shrubs are less than 2 m in height. Also, the shrubs in Sycamore (Willow) - Mixed Hardwood Riverine Dwarf-shrubland remain stunted because they typically receive more frequent or more intense scour than Sycamore - Mixed Hardwood Riverine Shrubland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.103, DEWA.106, DEWA.110; Fike 1999, Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.)
Alliance	*Betula nigra* Temporarily Flooded Shrubland Alliance (A.951)
Alliance (English name)	River Birch Temporarily Flooded Shrubland Alliance
Association	*Betula nigra - Platanus occidentalis - Salix (interior, caroliniana)* Shrubland
Association (English name)	River Birch - Sycamore - (Sandbar Willow, Carolina Willow) Shrubland
Ecological System(s):	Central Appalachian Riparian (CES202.609) South-Central Interior Small Stream and Riparian (CES202.706)

GLOBAL DESCRIPTION

Concept Summary: This early-successional shrub community of riverbank floodplains and river gravel bars and islands occurs in the High Allegheny Plateau, Central Appalachians, and Lower New England ecoregions. It is subject to relatively frequent and powerful flooding and ice-scour and occurs on sand, gravel or cobble deposits. It is dominated by stunted and often battered trees (less than 5 m tall), primarily *Platanus occidentalis, Betula nigra*, and/or *Acer*

saccharinum, but also including *Acer negundo, Fraxinus* spp., *Populus deltoides*, and *Ulmus americana*. *Betula nigra* is characteristic and often dominant. Associates include *Cornus amomum, Salix nigra, Salix interior (= Salix exigua), Salix caroliniana, Salix sericea, Alnus serrulata*, and sometimes *Cephalanthus occidentalis* or *Physocarpus opulifolius*. The herbaceous layer ranges from sparse to moderately dense and can contain a wide variety of typical wetland and prairie species. Characteristic herbs include *Apocynum cannabinum, Polygonum virginianum, Polygonum hydropiper, Polygonum pensylvanicum, Polygonum hydropiperoides, Eupatorium* spp., *Asclepias incarnata, Pilea pumila, Hypericum* spp., *Bidens* spp., *Sorghastrum nutans, Andropogon gerardii, Phalaris arundinacea, Dichanthelium clandestinum, Leersia virginica, Panicum virgatum*, and *Justicia americana*. Vines such as *Vitis riparia* and *Toxicodendron radicans* are often found throughout this association. Exotics such as *Lythrum salicaria, Polygonum cuspidatum, Coronilla varia*, and *Rosa multiflora* are a frequent problem.
Environmental Description: This early-successional community occurs on riverbank floodplains and river gravel bars and islands subject to frequent flooding and ice-scour. It occurs on sand, gravel or cobble deposits.
Vegetation Description: This shrubby floodplain community is dominated by stunted and often battered trees (less than 5 m tall), primarily *Platanus occidentalis, Betula nigra*, and/or *Acer saccharinum*, but also including *Acer negundo, Fraxinus* spp., *Populus deltoides*, and *Ulmus americana*. *Betula nigra* is characteristic and often dominant. Associates include *Cornus amomum, Salix nigra, Salix interior (= Salix exigua), Salix caroliniana, Salix sericea, Alnus serrulata*, and sometimes *Cephalanthus occidentalis* or *Physocarpus opulifolius*. The herbaceous layer ranges from sparse to moderately dense and can contain a wide variety of typical wetland and prairie species. Characteristic herbs include *Apocynum cannabinum, Polygonum virginianum, Polygonum hydropiper, Polygonum pensylvanicum, Polygonum hydropiperoides, Eupatorium* spp., *Asclepias incarnata, Pilea pumila, Hypericum* spp., *Bidens* spp., *Sorghastrum nutans, Andropogon gerardii, Phalaris arundinacea, Dichanthelium clandestinum, Leersia virginica, Panicum virgatum*, and *Justicia americana*. Vines such as *Vitis riparia* and *Toxicodendron radicans* are often found throughout this association. Exotics such as *Lythrum salicaria, Polygonum cuspidatum, Coronilla varia*, and *Rosa multiflora* are a frequent problem.
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Betula nigra, Platanus occidentalis*
Herb (field)	Vine/Liana	*Vitis riparia*
Herb (field)	Forb	*Lythrum salicaria, Polygonum hydropiper, Polygonum pensylvanicum*
Herb (field)	Graminoid	*Leersia virginica, Panicum virgatum, Phalaris arundinacea*

Characteristic Species: *Acer saccharinum, Betula nigra, Leersia virginica, Panicum virgatum, Phalaris arundinacea, Platanus occidentalis, Polygonum hydropiper, Salix nigra.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association is found in the High Allegheny Plateau and Central Appalachian ecoregions, and peripherally in the Lower New England ecoregion, from West Virginia, Maryland (and possibly Virginia) north to New York. It is also attributed to the Western Allegheny Plateau.

States/Provinces: MD, NJ, NY, PA, VA, WV.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

Rank: G4G5 (1-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: *Salix interior* is listed as "rare" in Maryland and Virginia (Kartesz 1999).

Similar Associations:

- *Betula nigra - Platanus occidentalis / Impatiens capensis* Forest (CEGL006184).
- *Platanus occidentalis - (Betula nigra, Salix* spp.) Temporarily Flooded Woodland [Provisional] (CEGL003725).

Related Concepts:

- Black willow - mixed hardwood riverine shrubland (Perles et al. 2004) ?
- Mixed hardwood riverine shrubland (Perles et al. 2004) ?
- River birch (sycamore) - mixed hardwood riverine shrubland (Perles et al. 2004) ?
- River birch-willow thickets (CAP pers. comm. 1998) ?
- Silver maple (river birch) - mixed hardwood riverine shrubland (Perles et al. 2004) ?
- Sycamore - mixed hardwood riverine shrubland (Perles et al. 2004) ?

SOURCES

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

References: CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Harrison 2004, Kartesz 1999, Perles et al. 2004.

Figure 69. Sycamore - Mixed Hardwood Riverine Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.106). August 2003.

Figure 70. Sycamore - Mixed Hardwood Riverine Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.110). August 2003.

COMMON NAME (PARK-SPECIFIC): SYCAMORE (WILLOW) - MIXED HARDWOOD RIVERINE DWARF SHRUBLAND

SYNONYMS

NVC English Name: **Black Willow / Reed Canarygrass - Indian-hemp Temporarily Flooded Shrubland**

NVC Scientific Name: ***Salix nigra / Phalaris arundinacea - Apocynum cannabinum* Temporarily Flooded Shrubland**

NVC Identifier: **CEGL006065**

LOCAL INFORMATION

Environmental Description: Most occurrences of this association are located on low terraces and bars attached to riverbanks of the Delaware River; however, the type can occur on islands as well. The substrate is predominantly cobbles along with sand and gravel. Due to flooding, high stream velocity and ice-scour to which these areas are frequently exposed, the majority of the shrubs remain short-statured (<2 m in height). This community occurs between Riverine Scour Vegetation and the floodplain forest along low terraces and toward island heads.

Vegetation Description: This association is characterized by a moderately dense to dense short-shrub layer less than 2 m in height. The species composition of the short-shrub layer is mixed and varied, with no one species consistently dominating. Stunted individuals of black willow (*Salix nigra*) may be codominant, along with one or more other species of willow (*Salix eriocephala, Salix sericea*) or sycamore (*Platanus occidentalis*). Other typical woody species are silver maple (*Acer saccharinum*), eastern cottonwood (*Populus deltoides*), river birch (*Betula nigra*), and red maple (*Acer rubrum*). Individual tall shrubs (2-5 m in height) of the same species may be scattered throughout the shrubland. The herbaceous layer can be sparse to dense and contains a wide diversity of herbaceous and graminoid species. Some common species are reed canarygrass (*Phalaris arundinacea*), Indian-hemp (*Apocynum cannabinum*), American water-willow (*Justicia americana*), deertongue (*Dichanthelium clandestinum*), marshpepper knotweed (*Polygonum hydropiper*), big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), wingstem (*Verbesina alternifolia*), upland bentgrass (*Agrostis perennans*), and Virginia wildrye (*Elymus virginicus*). This community is also frequently colonized by purple loosestrife (*Lythrum salicaria*).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix* spp., *Platanus occidentalis*
Herb (field)	Forb	*Apocynum cannabinum*, *Lythrum salicaria*, *Polygonum hydropiper*
Herb (field)	Graminoid	*Phalaris arundinacea*

Characteristic Species: *Salix* spp., *Platanus occidentalis, Phalaris arundinacea.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Willow River-Bar Shrubland	Walz et al 2006
PA	S4	1	Black willow shrub/scrub wetland	Fike 1999

Local Range: This vegetation type occurs throughout the Delaware River.
Classification Comments: This association is identified by the presence of a substantial short-shrub layer of *Salix* spp. and/or *Platanus occidentalis*. The height of the shrubs (<2 m in height) differentiates this type from Sycamore - Mixed Hardwood Riverine Shrubland in which shrubs are 2-5 m in height. Also, the shrubs in Sycamore (Willow) - Mixed Hardwood Riverine Dwarf-shrubland remain stunted because they typically receive more frequent or more intense scour than the tall-shrub community.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.105; Fike 1999, Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d.)
Alliance	*Salix nigra* Temporarily Flooded Shrubland Alliance (A.948)
Alliance (English name)	Black Willow Temporarily Flooded Shrubland Alliance
Association	*Salix nigra / Phalaris arundinacea - Apocynum cannabinum* Temporarily Flooded Shrubland
Association (English name)	Black Willow / Reed Canarygrass - Indian-hemp Temporarily Flooded Shrubland
Ecological System(s):	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582) Central Appalachian Riparian (CES202.609)

GLOBAL DESCRIPTION

Concept Summary: This community is a willow shrubland of low riverbanks along moderate- to high-energy rivers in the northeastern U.S. and High Allegheny Plateau. It occurs on cobble substrates with sand and gravel in areas that are flooded only during high-water events, but receive winter ice-scour. It occupies an intermediate position along a disturbance gradient between open, herbaceous cobble shores and higher floodplain forests. *Salix nigra* is often dominant or codominant with other willows or dogwoods forming a dense shrub layer. Less frequent shrubs and tree saplings include *Salix eriocephala, Salix lucida, Salix sericea, Alnus incana, Alnus serrulata, Cornus amomum, Cornus sericea (= Cornus stolonifera), Spiraea alba* var. *latifolia, Platanus occidentalis, Acer rubrum, Acer saccharinum,* and *Populus deltoides*. The herbaceous layer is typically sparse with variable composition, including *Carex torta, Panicum dichotomiflorum, Panicum virgatum, Dichanthelium clandestinum (= Panicum clandestinum), Echinochloa crus-galli, Elymus virginicus, Phalaris arundinacea, Calamagrostis canadensis, Apocynum cannabinum (= Apocynum sibiricum), Agrostis* spp., *Solidago gigantea, Solidago rugosa, Eupatorium maculatum, Lysimachia terrestris, Polygonum* spp., and *Bidens* spp. Invasive, exotic species can be problematic in this community, including *Polygonum cuspidatum, Lythrum salicaria, Tussilago farfara,* and *Cynanchum louiseae*.

Environmental Description: This community occurs on low riverbanks along moderate- to high-energy rivers on cobble substrates within a sand or gravel matrix.
Vegetation Description: *Salix nigra* is often dominant or codominant with other willows or dogwoods forming a dense shrub layer. Less frequent shrubs and tree saplings include *Salix eriocephala, Salix lucida, Salix sericea, Alnus incana, Alnus serrulata, Cornus amomum, Cornus sericea (= Cornus stolonifera), Spiraea alba* var. *latifolia, Platanus occidentalis, Acer rubrum, Acer saccharinum*, and *Populus deltoides*. The herbaceous layer is typically sparse with variable composition, including *Carex torta, Panicum dichotomiflorum, Panicum virgatum, Dichanthelium clandestinum (= Panicum clandestinum), Echinochloa crus-galli, Elymus virginicus, Phalaris arundinacea, Calamagrostis canadensis, Apocynum cannabinum (= Apocynum sibiricum), Agrostis* spp., *Solidago gigantea, Solidago rugosa, Eupatorium maculatum, Lysimachia terrestris, Polygonum* spp., and *Bidens* spp. Invasive, exotic species can be problematic in this community, including *Polygonum cuspidatum, Lythrum salicaria, Tussilago farfara*, and *Cynanchum louiseae*.
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix nigra*
Herb (field)	Forb	*Apocynum cannabinum*, *Polygonum hydropiper*
Herb (field)	Graminoid	*Phalaris arundinacea*

Characteristic Species: *Cornus amomum, Dichanthelium clandestinum, Phalaris arundinacea, Platanus occidentalis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association occurs in the eastern United States from New Hampshire and Vermont south to Pennsylvania and New Jersey.
States/Provinces: CT, MA, MD?, ME, NH:S3, NJ, NY?, PA, VT.
Federal Lands: NPS (Delaware Water Gap); USFWS (Great Meadows).

CONSERVATION STATUS
Rank: G4? (20-Jun-2006).
Reasons: This community is not well-documented but occurs over a large range and is a frequent component of floodplain systems.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations:
- *Salix caroliniana* Temporarily Flooded Shrubland (CEGL003899).
- *Salix interior - Salix eriocephala* Sandbar Shrubland (CEGL005078).

Related Concepts: Information not available.

SOURCES
Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Fike 1999, Gawler 2002, Metzler and Barrett 2001, Nichols et al. 2001, Perles et al 2004.

Figure 71. Sycamore (Willow) - Mixed Hardwood Riverine Dwarf Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.105). August 2003.

COMMON NAME (PARK-SPECIFIC): ALDER WETLAND

SYNONYMS
NVC English Name: **Smooth Alder Swamp Shrubland**
NVC Scientific Name: ***Alnus serrulata* Swamp Shrubland**
NVC Identifier: **CEGL005082**

LOCAL INFORMATION

Environmental Description: This shrub wetland occurs in a variety of palustrine settings, including depressions in floodplains, ponded drainages, upland edges of marshes, small upland depressions, and the base of slopes. The substrate is generally very poorly drained shallow peat or mineral soil with a thin organic layer, such as in Alden mucky silt loam or the Fredon-Halsey complex. These wetlands often contain standing water for most of the year. The pH of these wetlands is broadly circumneutral. Beaver dams or other impoundments may have influenced many of these wetlands.

Vegetation Description: This palustrine association is characterized by a substantial tall-shrub layer, dominated by smooth alder (*Alnus serrulata*) or gray alder (*Alnus incana*), covering 30-75% of the area. Other associated tall shrubs include silky dogwood (*Cornus amomum*), common buttonbush (*Cephalanthus occidentalis*), red maple (*Acer rubrum*), and willows (*Salix* spp.). These species also occur in the sparse short-shrub layer, along with white meadowsweet (*Spiraea alba* var. *latifolia*) and northern spicebush (*Lindera benzoin*). The herbaceous layer can be dense and contain a variety of species, including tussock sedge (*Carex stricta*), fowl mannagrass (*Glyceria striata*), eastern marsh fern (*Thelypteris palustris*), marshpepper knotweed (*Polygonum hydropiper*), arrowleaf tearthumb (*Polygonum sagittatum*), nodding beggartick (*Bidens cernua*), hairy sedge (*Carex lacustris*), true forget-me-not (*Myosotis scorpioides*), smallspike false nettle (*Boehmeria cylindrica*), Canadian clearweed (*Pilea pumila*), stiff marsh bedstraw (*Galium tinctorium*), woolgrass (*Scirpus cyperinus*), spotted water hemlock (*Cicuta maculata*), and jewelweed (*Impatiens capensis*).

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Alnus incana*, *Alnus serrulata*
Herb (field)	Forb	Forb *Bidens cernua*, *Polygonum* spp.
Herb (field)	Graminoid	*Carex lacustris*, *Carex stricta*, *Glyceria striata*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Alnus incana*, *Alnus serrulata*, *Carex lacustris*, *Carex stricta*, *Cicuta maculata*, *Glyceria striata*, *Polygonum* spp., *Sium suave*, *Thelypteris palustris.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Smooth Alder Swamp	Walz et al 2006
PA	S3S4	2	Alder - ninebark wetland	Fike 1999

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

Classification Comments: Alder Wetland is distinguished from other palustrine shrublands by the dominance of *Alnus* spp., covering 30-75% of the wetland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.51, DEWA.163; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Alnus serrulata* Seasonally Flooded Shrubland Alliance (A.994)
Alliance (English name)	Smooth Alder Seasonally Flooded Shrubland Alliance
Association	*Alnus serrulata* Swamp Shrubland
Association (English name)	Smooth Alder Swamp Shrubland
Ecological System(s):	Central Appalachian Floodplain (CES202.608) Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

GLOBAL DESCRIPTION

Concept Summary: This alder swamp is found widely throughout the northeastern United States south of near-boreal regions. These shrublands are found on muck overlying mineral soils (peat deposits are not typical) of upland marsh borders, at the edges of red maple swamps, or in acidic colluvium at bases of slopes. The pH of these systems is broadly circumneutral to somewhat calcareous. The vegetation is dominated by tall shrubs, characterized and usually dominated by *Alnus serrulata*, sometimes in a mixture with (or rarely replaced by) *Alnus incana*. Associate shrubs vary somewhat with geography and include *Cornus sericea, Rosa palustris, Physocarpus opulifolius, Viburnum dentatum* var. *lucidum*, and *Salix* spp. Saplings of *Acer rubrum* are typical. Short shrubs include *Spiraea alba* var. *latifolia* and *Lindera benzoin*. Less frequent shrubs include *Cephalanthus occidentalis, Decodon verticillatus, Ilex verticillata, Rhododendron viscosum*, and *Sambucus nigra* spp. *canadensis*. Herbaceous associates include *Calamagrostis canadensis, Osmunda regalis, Glyceria striata, Thelypteris palustris, Galium* spp., *Typha latifolia, Polygonum hydropiper, Bidens cernua, Galium tinctorium, Cicuta maculata, Peltandra virginica*, and *Carex stricta*.
Environmental Description: These shrublands are found on muck overlying mineral soils (peat deposits are not typical) of upland marsh borders, small upland depressions, at the edges of red maple swamps or other ponded drainages, or in colluvium at bases of slopes. The pH of these systems is broadly circumneutral to somewhat calcareous (Fike 1999).
Vegetation Description: The vegetation is dominated by tall shrubs and characterized by *Alnus serrulata, Alnus incana, Physocarpus opulifolius, Viburnum dentatum* var. *lucidum, Cornus amomum*, and *Salix* spp. Saplings of *Acer rubrum* are typical. Short shrubs include *Spiraea alba* var. *latifolia* and *Lindera benzoin*. Other shrubs present include *Cephalanthus occidentalis, Decodon verticillatus, Ilex verticillata, Rhododendron viscosum*, and *Sambucus nigra* spp. *canadensis* (Anderson 1996, Fike 1999). Herbaceous associates include *Calamagrostis*

canadensis, Osmunda regalis, Glyceria striata, Thelypteris palustris, Galium spp., *Typha latifolia, Polygonum hydropiper, Bidens cernua, Galium tinctorium, Cicuta maculata, Peltandra virginica,* and *Carex stricta*.

Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Alnus incana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Alnus serrulata, Physocarpus opulifolius, Viburnum dentatum* var. *lucidum*
Herb (field)	Forb	*Peltandra virginica*
Herb (field)	Graminoid	*Calamagrostis canadensis*
Herb (field)	Fern or fern ally	*Osmunda regalis*

Characteristic Species: *Alnus serrulata, Cornus amomum, Physocarpus opulifolius, Viburnum dentatum* var. *lucidum.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This alder swamp is found widely throughout the northeastern United States, ranging from central New England south to New Jersey, and west to Ohio and Pennsylvania.

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

Federal Lands: NPS (Delaware Water Gap, Minute Man).

CONSERVATION STATUS

Rank: G4G5 (22-Mar-1999).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 3 – Weak.

Comments: This type overlaps with *Alnus incana* Swamp Shrubland (CEGL002381) where the ranges abut in Ohio, Pennsylvania, southern New England, and southern New York. Where both alder species are present, this type is distinguished from the *Alnus incana* nominal type by the presence of species with a somewhat more Central Appalachian / Alleghenian affinity such as *Physocarpus opulifolius, Rhododendron viscosum, Peltandra virginica,* compared to CEGL002381 which is characterized by somewhat more northern species such as *Nemopanthus mucronatus* and *Myrica gale*. Where they overlap, the relative dominance of the two alder species should be expected to vary. If *Alnus serrulata* is present in more than token amounts, consider this type as opposed to CEGL002381.

Similar Associations:

- *Alnus incana* Swamp Shrubland (CEGL002381).
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474).

Related Concepts:

- Smooth alder shrub thicket (CAP pers. comm. 1998) ?

SOURCES

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

References: Anderson 1996, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Fike 1999, Swain and Kearsley 2001.

Figure 72. Alder Wetland in Delaware Water Gap National Recreation Area (plot DEWA.51). July 2003.

Figure 73. Alder Wetland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.547). June 2006.

COMMON NAME (PARK-SPECIFIC): WET MEADOW

SYNONYMS
NVC English Name: **Steeplebush - Blackberry species / Reed Canarygrass Shrubland**
NVC Scientific Name: ***Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland**
NVC Identifier: **CEGL006571**

LOCAL INFORMATION

Environmental Description: This variable wetland type occurs along streams and drainages on a variety of somewhat to very poorly drained soils. These wetlands typically flood early in the growing season and may be saturated at or near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil, often with a layer of muck at the surface. Wet Meadow is often found in former lakebeds that have been drained. Rivulets of water flow through these lakebeds, with relatively little area covered by standing water. The substrate in these lakebeds often contains cobbles, compacted soil, and occasionally bedrock. Some lakebeds contain patches of unvegetated bare soil.
Vegetation Description: The species composition of these wetlands is variable among sites. Within each wetland, species may be locally abundant and often have patchy distribution. A mixture of predominantly graminoid species, with numerous herbaceous associates, covers 70-95% of the wetland. Common dominants include woodland bulrush (*Scirpus expansus*), arrowleaf tearthumb (*Polygonum sagittatum*), common rush (*Juncus effusus*), eastern marsh fern (*Thelypteris palustris*), giant goldenrod (*Solidago gigantea*), rice cutgrass (*Leersia oryzoides*), hairyfruit sedge (*Carex trichocarpa*), broom sedge (*Carex scoparia*), Bailey's sedge (*Carex baileyi*), shallow sedge (*Carex lurida*), tussock sedge (*Carex stricta*), owlfruit sedge (*Carex stipata*), woolgrass (*Scirpus cyperinus*), and rough bentgrass (*Agrostis scabra*). Other associated species are northern bugleweed (*Lycopus uniflorus*), sensitive fern (*Onoclea sensibilis*), jewelweed (*Impatiens capensis*), smallspike false nettle (*Boehmeria cylindrica*), nodding sedge (*Carex gynandra*), hop sedge (*Carex lupulina*), stiff marsh bedstraw (*Galium tinctorium*), bluntleaf bedstraw (*Galium obtusum*), common marsh bedstraw (*Galium palustre*), dwarf St. Johnswort (*Hypericum mutilum*), Virginia marsh St. Johnswort (*Triadenum virginicum*), and woodland rush (*Juncus subcaudatus*). Reed canarygrass (*Phalaris arundinacea*) can occur in this type, but it is not a dominant species. The invasive species Japanese stiltgrass (*Microstegium vimineum*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*) can be abundant or form monocultures in these wetlands. Shrubs may cover up to 30% of the area; common species include steeplebush (*Spiraea tomentosa*), silky dogwood (*Cornus amomum*), and the invasive species multiflora rose (*Rosa multiflora*).
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cornus amomum*, *Rosa multiflora*, *Spiraea tomentosa*
Herb (field)	Forb	*Polygonum sagittatum*
Herb (field)	Graminoid	*Carex* spp., *Scirpus* spp., *Juncus* spp., *Leersia oryzoides*, *Microstegium vimineum*

Characteristic Species: *Carex* spp., *Scirpus* spp., *Juncus* spp., *Agrostis scabra*, *Leersia oryzoides, Polygonum sagittatum, Thelypteris palustris*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Steeplebush / Reed Canarygrass Successional Wet Meadow	Walz et al 2006
PA	S5	2	Wet meadow	Fike 1999

Local Range: This wetland type is found along streams and drainages throughout the park; however, this type is most common in drained lakebeds on the Kittatinny Ridge.
Classification Comments: Wet Meadow has a highly variable species composition; however, it is distinguished from other palustrine types by the diverse mix of graminoid species and its hydrology (flooded in early growing season and dry or saturated the rest of the year). Mixed Forb Marsh typically has year-round ponded water and associated hydrophilic species that are tolerant of standing water, without shrubs and other woody species. Tussock Sedge Marsh is dominated by *Carex stricta* (30-70% cover).
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.67, DEWA.96, DEWA.132, DEWA.199, DEWA.226; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Spiraea tomentosa* - *Rubus* spp. Seasonally Flooded Shrubland Alliance (A.3022)
Alliance (English name)	Steeplebush - Blackberry species Seasonally Flooded Shrubland Alliance
Association	*Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland
Association (English name)	Steeplebush - Blackberry species / Reed Canarygrass Shrubland
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands. The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa, Spiraea alba* var. *alba, Cornus amomum, Rubus allegheniensis, Rubus hispidus, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* and *Rosa multiflora* may be locally abundant. Associated herbaceous species

are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea, Solidago rugosa, Solidago gigantea, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Scirpus expansus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Carex trichocarpa, Vernonia noveboracensis, Triadenum virginicum, Lycopus uniflorus, Impatiens capensis, Eupatorium maculatum, Polygonum sagittatum, Thelypteris palustris, Onoclea sensibilis, Eleocharis* spp., and others. The invasive species *Microstegium vimineum, Lythrum salicaria,* and *Phragmites australis* can be abundant or form monocultures in these wetlands.

Environmental Description: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands. These wetlands typically flood early in the growing season and may be saturated to near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface.

Vegetation Description: The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Within each wetland, species may be locally abundant and often have patchy distribution. Shrub species usually include *Spiraea tomentosa, Spiraea alba* var. *alba, Cornus amomum, Rubus allegheniensis, Rubus hispidus, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* and *Rosa multiflora* may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea, Solidago rugosa, Solidago gigantea, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Scirpus expansus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Carex trichocarpa, Vernonia noveboracensis, Triadenum virginicum, Lycopus uniflorus, Impatiens capensis, Eupatorium maculatum, Polygonum sagittatum, Thelypteris palustris, Onoclea sensibilis, Eleocharis* spp., and others. The invasive species *Microstegium vimineum, Lythrum salicaria,* and *Phragmites australis* can be abundant or form monocultures in these wetlands.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis, Spiraea alba* var. *alba, Spiraea tomentosa*
Herb (field)	Forb	*Solidago canadensis, Solidago rugosa*
Herb (field)	Graminoid	*Leersia oryzoides, Phalaris arundinacea*

Characteristic Species: *Polygonum sagittatum, Rubus allegheniensis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: Although this vegetation is widespread, its range has not been evaluated. It is known from the Central Appalachian ecoregion and the Lower New England / Northern Piedmont ecoregions, and is likely in others.

States/Provinces: NJ, PA.

Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Johnstown Flood); USFWS (Assabet River?, Great Meadows?, Great Swamp, Parker River?).

CONSERVATION STATUS
Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. S. C. Gawler.
References: Decker 1955, Eastern Ecology Working Group n.d., Fike 1999, NatureServe and Russell 2003.

Figure 74. Wet Meadow in Delaware Water Gap National Recreation Area (plot DEWA.67). July 2003.

Figure 75. Wet Meadow in Delaware Water Gap National Recreation Area (plot DEWA.96). August 2003.

COMMON NAME (PARK-SPECIFIC): SILKY DOGWOOD SUCCESSIONAL PALUSTRINE SHRUBLAND

SYNONYMS
NVC English Name: **Steeplebush - Blackberry species / Reed Canarygrass Shrubland**
NVC Scientific Name: ***Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland**
NVC Identifier: **CEGL006571**

LOCAL INFORMATION

Environmental Description: This shrub-dominated type is associated with floodplains of small creeks, drainages, and upland edges of marshes. Many of these sites were formerly used as pasture or mowed during dry conditions. These sites are typically intermittently flooded, with portions of the shrubland saturated by groundwater seepage. Soils are typically poorly drained, such as those found in the Fredon-Halsey complex. These areas are similar to sites of Wet Meadow that have been colonized by shrubs. This association may succeed to a palustrine or floodplain forest if disturbance or management does not remove the woody species.
Vegetation Description: This association is characterized by tall and short shrubs that cover 50-90 % of the area, within a matrix of graminoids similar to those in Wet Meadow or Reed Canarygrass Riverine Grassland. The tall-shrub layer (30-60% cover) is dominated by silky dogwood (*Cornus amomum*), crack willow (*Salix fragilis*), common buttonbush (*Cephalanthus occidentalis*), and the invasive species Morrow's honeysuckle (*Lonicera morrowii*) and multiflora rose (*Rosa multiflora*). Scattered individuals of red maple (*Acer rubrum*), black ash (*Fraxinus nigra*), green ash (*Fraxinus pennsylvanica*), and American hornbeam (*Carpinus caroliniana*) may be present in a sparse tree canopy that covers <10% of the wetland. The short-shrub layer (20-50% cover) contains silky dogwood, multiflora rose, Allegheny blackberry (*Rubus allegheniensis*), and white meadowsweet (*Spiraea alba* var. *latifolia*). The herbaceous layer typically covers 40-70% of the wetland and varies depending on the hydrology of the site. Sites with less groundwater seepage and less frequent flooding may contain some species typical of terrestrial old-field vegetation. Common species include reed canarygrass (*Phalaris arundinacea*), arrowleaf tearthumb (*Polygonum sagittatum*), hairyfruit sedge (*Carex trichocarpa*), fowl bluegrass (*Poa palustris*), climbing false buckwheat (*Polygonum scandens*), sensitive fern (*Onoclea sensibilis*), tussock sedge (*Carex stricta*), eastern marsh fern (*Thelypteris palustris*), Canadian clearweed (*Pilea pumila*), wrinkleleaf goldenrod (*Solidago rugosa*), giant goldenrod (*Solidago gigantea*), smallspike false nettle (*Boehmeria cylindrica*), jewelweed (*Impatiens capensis*), and greater bladder sedge (*Carex intumescens*). Vines such as devil's darning needles (*Clematis virginiana*), eastern poison ivy (*Toxicodendron radicans*), and fox grape (*Vitis labrusca*) can be absent or abundant. These wetlands are susceptible to invasion by purple loosestrife (*Lythrum salicaria*) and Japanese stiltgrass (*Microstegium vimineum*).
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus amomum, Salix fragilis*
Short shrub/sapling	Broad-leaved deciduous shrub	*Cornus amomum, Lonicera morrowii, Rosa multiflora*

Herb (field)	Vine/Liana	*Clematis virginiana, Toxicodendron radicans, Vitis labrusca*
Herb (field)	Forb	*Polygonum sagittatum, Polygonum scandens*
Herb (field)	Graminoid	*Carex trichocarpa, Phalaris arundinacea, Poa palustris*
Herb (field)	Fern or fern ally	*Onoclea sensibilis*

Characteristic Species: *Cornus amomum, Lonicera morrowii, Salix fragilis, Carex trichocarpa, Phalaris arundinacea, Poa palustris, Polygonum sagittatum, Polygonum scandens.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	1	Successional Palustrine Shrubland	Walz et al 2006
PA	SNA	1	no crosswalk	Fike 1999

Local Range: This shrub wetland is found in a variety of palustrine settings throughout the park; however, it is most common in the broad floodplain surrounding Flat Brook.
Classification Comments: Silky Dogwood Successional Palustrine Shrubland is distinguished from other palustrine shrublands by the dominance of *Cornus amomum* with frequent *Salix fragilis, Lonicera morrowii*, and *Rosa multiflora* in the tall- and short-shrub layers that collectively cover 50-90% of the wetland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.48, DEWA.52, DEWA.58, DEWA.232.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Spiraea tomentosa* - *Rubus* spp. Seasonally Flooded Shrubland Alliance (A.3022)
Alliance (English name)	Steeplebush - Blackberry species Seasonally Flooded Shrubland Alliance
Association	*Spiraea tomentosa* - *Rubus* spp. / *Phalaris arundinacea* Shrubland
Association (English name)	Steeplebush - Blackberry species / Reed Canarygrass Shrubland
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands. The physiognomy is complex and variable, ranging from shrub thicket to herbaceous

meadow with scattered shrubs. Shrub species usually include *Spiraea tomentosa, Spiraea alba* var. *alba, Cornus amomum, Rubus allegheniensis, Rubus hispidus, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* and *Rosa multiflora* may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea, Solidago rugosa, Solidago gigantea, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Scirpus expansus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Carex trichocarpa, Vernonia noveboracensis, Triadenum virginicum, Lycopus uniflorus, Impatiens capensis, Eupatorium maculatum, Polygonum sagittatum, Thelypteris palustris, Onoclea sensibilis, Eleocharis* spp., and others. The invasive species *Microstegium vimineum, Lythrum salicaria,* and *Phragmites australis* can be abundant or form monocultures in these wetlands.

Environmental Description: This wet meadow vegetation of the northeastern states occurs in a variety of settings, most frequently in low-lying areas of old fields or pastures, or beaver-impacted wetlands. These wetlands typically flood early in the growing season and may be saturated to near the surface for some of the growing season, but they are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface.

Vegetation Description: The physiognomy is complex and variable, ranging from shrub thicket to herbaceous meadow with scattered shrubs. Within each wetland, species may be locally abundant and often have patchy distribution. Shrub species usually include *Spiraea tomentosa, Spiraea alba* var. *alba, Cornus amomum, Rubus allegheniensis, Rubus hispidus, Salix* spp., and others. *Hypericum densiflorum* often occurs in the Central Appalachians. The invasive exotic shrubs *Lonicera morrowii* and *Rosa multiflora* may be locally abundant. Associated herbaceous species are also variable in composition, depending on land-use history. Commonly seen are *Phalaris arundinacea, Solidago rugosa, Solidago gigantea, Solidago canadensis, Juncus effusus, Scirpus cyperinus, Scirpus expansus, Leersia oryzoides, Carex scoparia, Carex folliculata, Carex lurida, Carex lupulina, Carex vulpinoidea, Carex trichocarpa, Vernonia noveboracensis, Triadenum virginicum, Lycopus uniflorus, Impatiens capensis, Eupatorium maculatum, Polygonum sagittatum, Thelypteris palustris, Onoclea sensibilis, Eleocharis* spp., and others. The invasive species *Microstegium vimineum, Lythrum salicaria,* and *Phragmites australis* can be abundant or form monocultures in these wetlands.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis*, *Spiraea alba* var. *alba*, *Spiraea tomentosa*
Herb (field)	Forb	*Solidago canadensis*, *Solidago rugosa*
Herb (field)	Graminoid	*Leersia oryzoides*, *Phalaris arundinacea*

Characteristic Species: *Polygonum sagittatum, Rubus allegheniensis.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: Although this vegetation is widespread, its range has not been evaluated. It is known from the Central Appalachian ecoregion and the Lower New England / Northern Piedmont ecoregions, and is likely in others.
States/Provinces: NJ, PA.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Johnstown Flood); USFWS (Assabet River?, Great Meadows?, Great Swamp, Parker River?).

CONSERVATION STATUS
Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. S. C. Gawler.
References: Decker 1955, Eastern Ecology Working Group n.d., Fike 1999, NatureServe and Russell 2003.

Figure 76. Silky Dogwood Successional Palustrine Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.58). July 2003.

Figure 77. Silky Dogwood Successional Palustrine Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.232). August 2004.

COMMON NAME (PARK-SPECIFIC): HIGHBUSH BLUEBERRY - STEEPLEBUSH WETLAND

SYNONYMS

NVC English Name: **Highbush Blueberry - Swamp Azalea - Coastal Sweet-pepperbush Shrubland**

NVC Scientific Name: ***Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland**

NVC Identifier: **CEGL006371**

LOCAL INFORMATION

Environmental Description: This palustrine shrubland occurs in small upland depressions and basins surrounding small streams and drainages. The substrate is typically very poorly drained, however, a thick organic layer is typically absent. These wetlands are seasonally to permanently flooded, often influenced by beaver or other impoundments.

Vegetation Description: This association is characterized by a substantial layer of tall shrubs that cover 30-95% of the wetland. Highbush blueberry (*Vaccinium corymbosum*) may be dominant or codominant, with swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia ligustrina*), and/or common buttonbush (*Cephalanthus occidentalis*) as codominant or as associates. Smooth alder (*Alnus serrulata*), black chokeberry (*Photinia melanocarpa*), and common elderberry (*Sambucus nigra* ssp. *canadensis*) are additional associates in the tall-shrub layer. Scattered individuals of red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*) may occur in a sparse tree canopy, covering less than 10% of the wetland. The composition of the short-shrub layer (10-60% cover) is variable. Steeplebush (*Spiraea tomentosa*) can be prominent, along with highbush blueberry, swamp azalea, and/or bristly dewberry (*Rubus hispidus*) as associates. Other common short shrubs include sheep laurel (*Kalmia angustifolia*), red maple, black chokeberry, white meadowsweet (*Spiraea alba* var. *latifolia*), and common elderberry. The herbaceous layer can be highly variable both in percent cover (5-80%) and species composition. Common species include bur-reeds (*Sparganium* spp.), eastern marsh fern (*Thelypteris palustris*), tussock sedge (*Carex stricta*), common marsh bedstraw (*Galium palustre*), sensitive fern (*Onoclea sensibilis*), arrowleaf tearthumb (*Polygonum sagittatum*), fowl mannagrass (*Glyceria striata*), smallspike false nettle (*Boehmeria cylindrica*), prickly bog sedge (*Carex atlantica* ssp. *capillacea*), rice cutgrass (*Leersia oryzoides*), common rush (*Juncus effusus*), northern bugleweed (*Lycopus uniflorus*), earth loosestrife (*Lysimachia terrestris*), threeway sedge (*Dulichium arundinaceum*), American marshpennywort (*Hydrocotyle americana*), and Virginia marsh St. Johnswort (*Triadenum virginicum*). A layer of sphagnum (*Sphagnum* spp.) is common and varies in percent cover from 5-70%.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum, Lyonia ligustrina, Rhododendron viscosum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum, Spiraea tomentosa*
Herb (field)	Forb	*Galium palustre, Polygonum sagittatum*

Herb (field)	Graminoid	*Carex stricta, Glyceria striata, Sparganium* spp.
Herb (field)	Fern or fern ally	*Onoclea sensibilis, Thelypteris palustris*

Characteristic Species: *Vaccinium corymbosum, Lyonia ligustrina, Spiraea tomentosa, Dulichium arundinaceum, Sparganium* spp.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3?	1	Blueberry Wetland Thicket	Walz et al 2006
PA	S5	2	Highbush blueberry - meadow-sweet wetland	Fike 1999

Local Range: These wetlands are found occasionally throughout the park; however, they are most common in small upland depressions and basins surrounding small drainages on high elevations of the Kittatinny Ridge.
Classification Comments: Highbush Blueberry - Steeplebush Wetland is distinguished from other palustrine shrublands by the dominance or codominance of *Vaccinium corymbosum* or *Spiraea tomentosa*, often with *Rhododendron viscosum, Lyonia ligustrina*, and/or *Spiraea tomentosa* as codominant.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.63, DEWA.94, DEWA.137, DEWA.211, DEWA.212; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e.)
Alliance	*Vaccinium formosum - Vaccinium fuscatum - Vaccinium corymbosum* Seasonally Flooded Shrubland Alliance (A.992)
Alliance (English name)	Southern Highbush Blueberry - Black Highbush Blueberry – Highbush Blueberry Seasonally Flooded Shrubland Alliance
Association	*Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland
Association (English name)	Highbush Blueberry - Swamp Azalea - Coastal Sweet-pepperbush Shrubland
Ecological System(s):	Atlantic Coastal Plain Northern Basin Peat Swamp (CES203.522)
	Atlantic Coastal Plain Northern Pondshore (CES203.518)
	Atlantic Coastal Plain Northern Dune and Maritime Grassland (CES203.264)

GLOBAL DESCRIPTION

Concept Summary: This is a tall-shrub swamp of seasonally flooded basins in the eastern United States. It occurs in small open basins, closed sandplain basins, and seasonally flooded zones within larger wetlands. This vegetation can occur on the margins of Coastal Plain ponds. This community is influenced by a strongly fluctuating water table with flooded conditions in spring and early summer followed by a drop in the water table below soil surface usually by late summer. There is usually a shallow organic layer often over sand. Dominant shrubs include *Vaccinium corymbosum, Ilex verticillata*, and *Rhododendron viscosum*. Scattered *Acer rubrum* are not uncommon. *Lyonia ligustrina* and *Cephalanthus occidentalis* are characteristic although not necessarily dominant. Associated shrub species may include *Clethra alnifolia, Spiraea tomentosa, Chamaedaphne calyculata, Ilex glabra, Leucothoe racemosa, Decodon verticillatus, Kalmia angustifolia, Alnus serrulata, Myrica gale,* and *Photinia* spp. (= *Aronia* spp.). Herbaceous composition is variable; some of the more typical species include *Osmunda cinnamomea, Osmunda regalis, Thelypteris palustris, Onoclea sensibilis, Calla palustris, Lycopus uniflorus, Triadenum virginicum, Glyceria striata, Leersia oryzoides, Dulichium arundinaceum, Juncus effusus,* and *Woodwardia virginica*. A layer of peatmoss is common and varies in cover; species include *Sphagnum fimbriatum, Sphagnum rubellum, Sphagnum magellanicum, Sphagnum fallax*, and *Sphagnum viridum*.

Environmental Description: This community is influenced by a strongly fluctuating water table with flooded conditions in spring and early summer, often followed by a drop in the water table below soil surface usually by late summer. There is usually a shallow organic layer often over mineral soil.

Vegetation Description: This association is a tall-shrub swamp where the dominant shrubs include *Vaccinium corymbosum, Ilex verticillata*, and *Rhododendron viscosum*. Scattered *Acer rubrum* are not uncommon. *Lyonia ligustrina* and *Cephalanthus occidentalis* are characteristic although not necessarily dominant. Associated shrub species may include *Clethra alnifolia, Spiraea tomentosa, Chamaedaphne calyculata, Ilex glabra, Leucothoe racemosa, Decodon verticillatus, Kalmia angustifolia, Alnus serrulata, Myrica gale,* and *Photinia* spp. (= *Aronia* spp.). Herbaceous composition is variable; some of the more typical species include *Osmunda cinnamomea, Osmunda regalis, Thelypteris palustris, Onoclea sensibilis, Calla palustris, Lycopus uniflorus, Triadenum virginicum, Glyceria striata, Leersia oryzoides, Dulichium arundinaceum, Juncus effusus,* and *Woodwardia virginica*. A layer of peatmoss is common and varies in cover; species include *Sphagnum fimbriatum, Sphagnum rubellum, Sphagnum magellanicum, Sphagnum fallax*, and *Sphagnum viridum*.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata, Rhododendron viscosum, Vaccinium corymbosum*
Herb (field)	Forb	*Lycopus uniflorus*
Herb (field)	Graminoid	*Glyceria striata*
Herb (field)	Fern or fern ally	*Osmunda cinnamomea, Osmunda regalis, Woodwardia virginica*

Characteristic Species: *Calla palustris*, *Lyonia ligustrina*, *Rhododendron viscosum*, *Sphagnum fallax*, *Sphagnum fimbriatum*, *Sphagnum magellanicum*, *Sphagnum rubellum*, *Sphagnum viridum*, *Thelypteris palustris*, *Vaccinium corymbosum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This type occurs from New Hampshire south to New Jersey and possibly Delaware.
States/Provinces: CT, DE, MA, ME, NH:S4, NJ:S1S3, NY, PA, RI.
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Fire Island, Weir Farm); USFWS (Assabet River, Great Meadows, Great Swamp, Oxbow, Parker River).

CONSERVATION STATUS
Rank: GNR (14-Apr-1998).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: More inland examples of this association may lack some characteristically Coastal Plain species such as *Clethra alnifolia* and *Ilex glabra*.
Similar Associations:
- *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190).

Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon and S. L. Neid, mod. S. C. Gawler.
References: Breden et al. 2001, Conard 1935, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Golet 1973, Johnson 1981, Lynn and Karlin 1985, Metzler and Barrett 2001, Niering and Egler 1966, Reschke 1990, Schall and Murley 1984, Sperduto 2000a, Sperduto and Nichols 2004.

Figure 78. Highbush Blueberry - Steeplebush Wetland in Delaware Water Gap National Recreation Area (plot DEWA.63). July 2003.

Figure 79. Highbush Blueberry - Steeplebush Wetland in Delaware Water Gap National Recreation Area (plot DEWA.212). June 2004.

COMMON NAME (PARK-SPECIFIC): BUTTONBUSH WETLAND

SYNONYMS
NVC English Name: **Common Buttonbush - Swamp-loosestrife Shrubland**
NVC Scientific Name: ***Cephalanthus occidentalis - Decodon verticillatus* Shrubland**
NVC Identifier: **CEGL006069**

LOCAL INFORMATION

Environmental Description: This palustrine shrubland occurs in a variety of settings that experience prolonged or semipermanent flooding. The substrate may be organic or mineral soil. This wetland type is found in shallow water along lake- or pondshores, in river or stream oxbows, in wet swales, on floodplains, or in upland depressions.
Vegetation Description: Common buttonbush (*Cephalanthus occidentalis*) is dominant in these wetlands, covering >50% of the area as a tall or short shrub. Other common shrubs may include highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), silky dogwood (*Cornus amomum*), silky willow (*Salix sericea*), or common elderberry (*Sambucus nigra* ssp. *canadensis*). Scattered red maple (*Acer rubrum*) trees may be present in the wetland. The herbaceous layer is typically sparse to moderately dense and contains purplestem beggarticks (*Bidens connata*), threeway sedge (*Dulichium arundinaceum*), threepetal bedstraw (*Galium trifidum*), hemlock waterparsnip (*Sium suave*), smallspike false nettle (*Boehmeria cylindrica*), longhair sedge (*Carex comosa*), royal fern (*Osmunda regalis*), blue skullcap (*Scutellaria lateriflora*), and American bur-reed (*Sparganium americanum*).
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Cephalanthus occidentalis*
Herb (field)	Forb	*Bidens connata, Galium trifidum, Sium suave*
Herb (field)	Graminoid	*Dulichium arundinaceum*

Characteristic Species: *Cephalanthus occidentalis, Bidens connata, Carex comosa, Dulichium arundinaceum, Galium trifidum, Osmunda regalis, Scutellaria lateriflora, Sparganium americanum.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Northeastern Buttonbush Shrub Swamp	Walz et al 2006
PA	S4	1	Buttonbush wetland	Fike 1999

Local Range: This shrubland type occurs occasionally throughout the park in a variety of palustrine settings.
Classification Comments: Buttonbush Wetland is distinguished from other palustrine shrublands by the dominance of *Cephalanthus occidentalis*, covering >50% of the wetland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.228; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Semipermanently flooded cold-deciduous shrubland (III.B.2.N.f.)
Alliance	*Cephalanthus occidentalis* Semipermanently Flooded Shrubland Alliance (A.1011)
Alliance (English name)	Common Buttonbush Semipermanently Flooded Shrubland Alliance
Association	*Cephalanthus occidentalis - Decodon verticillatus* Shrubland
Association (English name)	Common Buttonbush - Swamp-loosestrife Shrubland
Ecological System(s):	Laurentian-Acadian Floodplain Forest (CES201.587) Central Appalachian Floodplain (CES202.608)

GLOBAL DESCRIPTION

Concept Summary: This buttonbush swamp occurs in the northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season, with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings, including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. The substrate is typically loose muck. *Cephalanthus occidentalis* is dominant and often monotypic. Occasional associates depend on the environmental setting and most often occur in drier areas. They include *Vaccinium corymbosum, Rhododendron viscosum, Acer rubrum, Cornus* spp. closer to upland borders, or *Acer saccharinum, Fraxinus pennsylvanica*, and *Viburnum dentatum* where adjacent to floodplains, or *Decodon verticillatus, Chamaedaphne calyculata,* and *Spiraea alba* var. *latifolia* in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis, Dulichium arundinaceum, Carex stricta, Scirpus cyperinus, Thelypteris palustris, Leersia oryzoides, Acorus calamus, Alisma plantago-aquatica, Polygonum* spp., *Sparganium* spp., and floating or submerged aquatic species such as *Lemna minor, Potamogeton natans,* and *Nuphar lutea* ssp. *variegata (= Nuphar variegata)*. Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans (= Drepanocladus fluitans), Drepanocladus aduncus,* or *Sphagnum fallax*. In disturbed areas, these wetland may be invaded by *Lythrum salicaria*.
Environmental Description: This association includes buttonbush swamps that experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small, isolated depressions where water levels recede very slowly, such as those with perched water tables. Soils are often organic mucks or silt loams.
Vegetation Description: This association includes buttonbush swamps of the eastern and northeastern United States. These swamps experience prolonged or semipermanent flooding for much of the growing season with water tables receding below the soil surface only during drought or very late in the growing season. They occur in a variety of environmental settings

including backwater sloughs or oxbow ponds, wet swales in floodplains, pond and lake borders, and small isolated depressions where water levels recede very slowly, such as those with perched water tables. *Cephalanthus occidentalis* is dominant and often monotypic. Scattered *Acer rubrum* trees may be present in the wetland. Occasional associates depend on the environmental setting, and some only occur in drier areas. They include *Vaccinium corymbosum, Rhododendron viscosum, Acer rubrum, Salix* spp., *Cornus amomum* or *Cornus sericea* closer to upland borders, or *Acer saccharinum, Fraxinus pennsylvanica,* or *Viburnum dentatum* where adjacent to floodplains, or *Decodon verticillatus, Chamaedaphne calyculata,* and *Spiraea alba* var. *latifolia* in more stagnant basins. Herbaceous species tend to be sparse but can include *Glyceria canadensis, Dulichium arundinaceum, Carex stricta, Scirpus cyperinus, Osmunda regalis, Thelypteris palustris, Bidens* spp., *Sium suave, Scutellaria lateriflora, Alisma plantago-aquatica, Polygonum* spp., *Sparganium* spp., and floating or submerged aquatic species such as *Lemna minor, Potamogeton natans,* and *Nuphar lutea* ssp. *variegata (= Nuphar variegata).* Bryophytes, if present, cling to shrub bases and include *Warnstorfia fluitans (= Drepanocladus fluitans), Drepanocladus aduncus,* or *Sphagnum fallax*.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis*
Herb (field)	Graminoid	*Dulichium arundinaceum*

Characteristic Species: *Cephalanthus occidentalis, Dulichium arundinaceum, Osmunda regalis, Sparganium americanum, Vaccinium corymbosum.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association is found throughout the northeastern United States.
States/Provinces: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV?
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Minute Man, Weir Farm); USFWS (Assabet River?, Chesapeake Marshlands, Great Meadows, Great Swamp, Oxbow).

CONSERVATION STATUS
Rank: G4G5 (8-Dec-2005).
Reasons: This association is widely distributed in the northeastern U.S. and relatively common in its small-patch setting.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This type may be synonymous with *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190), although it also ranges south of the glaciation boundary in the east. CEGL002190 is distributed from the Western Allegheny Plateau (TNC Ecoregion 49) and Great Lakes (TNC Ecoregion 48) west to the Central Tallgrass Prairie (TNC Ecoregion 36), while this type occurs from the Central Appalachian Forest (TNC Ecoregion 59) and High Allegheny Plateau (TNC Ecoregion 60) east.
Similar Associations:

- *Cephalanthus occidentalis - (Leucothoe racemosa) / Carex joorii* Shrubland (CEGL004075).
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191).
- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190).

Related Concepts:

- Buttonbush Swamp (Kettle Basin Shrub Swamp) (Thompson 1996) ?
- Buttonbush semipermanently flooded shrub swamp (CAP pers. comm. 1998) ?
- Palustrine Broad-leaved Deciduous Scrub-Shrub Wetland, Seasonally Flooded (PSS1C) (Cowardin et al. 1979) ?

SOURCES

Description Authors: S. L. Neid, mod. E. Southgate, L. A. Sneddon, S. C. Gawler, E. Largay.
References: Bowman 2000, Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Fleming et al. 2001, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, Nichols et al. 2001, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 80. Buttonbush Wetland in Delaware Water Gap National Recreation Area (plot DEWA.228). August 2004.

COMMON NAME (PARK-SPECIFIC): HIGHBUSH BLUEBERRY - LEATHERLEAF WETLAND

SYNONYMS
NVC English Name: **Highbush Blueberry / Peatmoss species Shrubland**
NVC Scientific Name: ***Vaccinium corymbosum / Sphagnum* spp. Shrubland**
NVC Identifier: **CEGL006190**

LOCAL INFORMATION

Environmental Description: These interesting wetlands occur in glacial upland depressions on the Kittatinny Ridge. In these bog-like areas, vegetation grows on organic soil, often on a floating mat. These wetlands may be ombrotrophic (receiving nutrients from rainfall only) or influenced by groundwater.

Vegetation Description: This association is characterized by a dense tall-shrub layer (50-90% cover) of highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia ligustrina*), black spruce (*Picea mariana*), and red maple (*Acer rubrum*). Scattered trees may be present (<10% cover) such as black spruce, red maple, blackgum (*Nyssa sylvatica*), or pitch pine (*Pinus rigida*). Typical short shrubs include leatherleaf (*Chamaedaphne calyculata*), black huckleberry (*Gaylussacia baccata*), swamp azalea, highbush blueberry, sheep laurel (*Kalmia angustifolia*), and cranberry (*Vaccinium macrocarpon*). Sphagnum (*Sphagnum* spp.) blankets well-developed hummocks and hollows. The herbaceous and graminoid species are scattered sparsely over the peatmoss. Common ferns include cinnamon fern (*Osmunda cinnamomea*), eastern marsh fern (*Thelypteris palustris*), and Virginia chainfern (*Woodwardia virginica*).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Vaccinium corymbosum, Lyonia ligustrina, Rhododendron viscosum*
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata*

Characteristic Species: *Vaccinium corymbosum*, *Chamaedaphne calyculata*, *Lyonia ligustrina*, *Rhododendron viscosum*, *Woodwardia virginica*, *Sphagnum* spp.

Other Noteworthy Species: *Cornus canadensis*, *Picea rubens*, *Vaccinium oxycoccos.*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S3	1	Highbush Blueberry Bog Thicket	Walz et al 2006
PA	S4	1	Highbush blueberry – sphagnum wetland	Fike 1999

Local Range: These rare wetlands occur only on the Kittatinny Ridge in New Jersey within the park.

Classification Comments: Highbush Blueberry - Leatherleaf Wetland is distinguished from Leatherleaf Peatland by the thick tall-shrub layer (>50% cover) of typically *Vaccinium corymbosum*, with *Rhododendron viscosum* and *Lyonia ligustrina*.

Other Comments: None.

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

Plots and Data Sources: DEWA.210; Accuracy Assessment Observation Point DEWA.998; Fike 1999, Breden et al 2001, Radis 1986.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Saturated cold-deciduous shrubland (III.B.2.N.g.)
Alliance	*Vaccinium corymbosum* Saturated Shrubland Alliance (A.1018)
Alliance (English name)	Highbush Blueberry Saturated Shrubland Alliance
Association	*Vaccinium corymbosum / Sphagnum* spp. Shrubland
Association (English name)	Highbush Blueberry / Peatmoss species Shrubland
Ecological System(s):	Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583)
	North-Central Interior and Appalachian Acid Peatland (CES202.606)
	Atlantic Coastal Plain Northern Pitch Pine Lowland (CES203.374)

GLOBAL DESCRIPTION

Concept Summary: Highbush blueberry peat bog of glaciated regions in the eastern and northeastern United States. This tall-shrub bog thicket occurs on oligotrophic to weakly minerotrophic peat soils, commonly as a border thicket around more open dwarf heath shrub peatlands or within small, isolated basins. Significant seasonal water level fluctuation can occur, especially in isolated basins without inlet or outlet streams. A tall-shrub layer is characterized by abundant *Vaccinium corymbosum* plus *Gaylussacia baccata, Chamaedaphne calyculata, Kalmia angustifolia, Rhododendron canadense, Lyonia ligustrina*, and *Nemopanthus mucronatus* in more northern or cooler microclimates, and *Ilex verticillata* and *Rhododendron viscosum* in the south. In locally wetter areas, *Cephalanthus occidentalis* or *Decodon verticillatus* can occur. Coastal occurrences may have additional shrub species such as *Leucothoe racemosa*, *Clethra alnifolia*, and *Gaylussacia dumosa*. Sparse, scattered trees may occur, including *Acer rubrum, Picea mariana, Larix laricina, Pinus strobus, Pinus rigida, Betula populifolia*, or *Nyssa sylvatica*, with species dependent on environmental setting. The herbaceous layer tends to be sparse, although can be locally abundant. Common herbs include *Osmunda cinnamomea, Woodwardia virginica, Carex trisperma, Sarracenia purpurea, Thelypteris palustris, Triadenum virginicum*, and *Maianthemum trifolium*. *Sphagnum* mosses blanket well-developed hummocks and hollows, including *Sphagnum magellanicum, Sphagnum centrale, Sphagnum rubellum, Sphagnum capillifolium, Sphagnum fimbriatum*, and *Sphagnum fuscum*.
Environmental Description: This tall-shrub bog thicket occurs on oligotrophic to weakly minerotrophic peat soils, commonly as a border thicket around more open dwarf heath shrub peatlands or within small, isolated basins. Significant seasonal water level fluctuation can occur, especially in isolated basins without inlet or outlet streams.
Vegetation Description: A tall-shrub layer is characterized by abundant *Vaccinium corymbosum* plus *Gaylussacia baccata, Chamaedaphne calyculata, Kalmia angustifolia,*

Rhododendron canadense, Lyonia ligustrina, and *Nemopanthus mucronatus* in more northern or cooler microclimates, and *Ilex verticillata* and *Rhododendron viscosum* in the south. In locally wetter areas, *Cephalanthus occidentalis* or *Decodon verticillatus* can occur. Sparse, scattered trees may occur, including *Acer rubrum, Picea mariana, Larix laricina, Pinus strobus, Pinus rigida, Betula populifolia,* or *Nyssa sylvatica,* with species dependent on environmental setting. The herbaceous layer tends to be sparse, although can be locally abundant. Common herbs include *Osmunda cinnamomea, Woodwardia virginica, Carex trisperma, Sarracenia purpurea, Thelypteris palustris, Triadenum virginicum,* and *Maianthemum trifolium*. *Sphagnum* mosses blanket well-developed hummocks and hollows, including *Sphagnum magellanicum, Sphagnum centrale, Sphagnum rubellum, Sphagnum capillifolium, Sphagnum fimbriatum,* and *Sphagnum fuscum*.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Lyonia ligustrina*, *Vaccinium corymbosum*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata*

Characteristic Species: *Chamaedaphne calyculata, Gaylussacia baccata, Lyonia ligustrina, Osmunda cinnamomea, Rhododendron viscosum, Vaccinium corymbosum, Woodwardia virginica.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: Occurs from Pennsylvania and New Jersey north to New Hampshire and Maine and possibly Vermont.

States/Provinces: CT, MA:S4, ME?, NH, NJ:S1S3, NY, PA, RI, VT.

Federal Lands: NPS (Cape Cod, Delaware Water Gap); USFWS (Assabet River?, Great Meadows?).

CONSERVATION STATUS

Rank: G3G5 (31-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: These tall heath shrub bog thickets tend to occur in wetter, more minerotrophic settings relative to dwarf heath shrub bogs.

Similar Associations:

- *Vaccinium corymbosum - Gaylussacia baccata - Photinia melanocarpa / Calla palustris* Shrubland (CEGL005085).
- *Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland (CEGL006371).

Related Concepts:

- *Vaccinium corymbosum-Rhododendron viscosum* tall shrub bog and bog border association [Type A] (Kearsley 1999a) ?
- Highbush blueberry shrub swamp (CAP pers. comm. 1998) ?
- New England coastal plain pondshore (Rawinski 1984) ?

- Northern New Jersey Shrub Swamp (Breden 1989) ?
- Shrub Swamp (Lundgren et al. 2000) ?

SOURCES

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

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Conard 1935, Damman and French 1987, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Johnson 1981b, Karlin and Lynn 1988, Kearsley 1999a, Lundgren et al. 2000, Lynn and Karlin 1985, Metzler and Barrett 1982, Metzler and Barrett 2001, Radis 1986, Rawinski 1984, Rozsa and Metzler n.d., Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2000, Swain and Kearsley 2001.

Figure 81. Highbush Blueberry - Leatherleaf Wetland in Delaware Water Gap National Recreation Area (plot DEWA.210). June 2004.

COMMON NAME (PARK-SPECIFIC): LEATHERLEAF PEATLAND

SYNONYMS

NVC English Name: **Leatherleaf - (Dwarf Huckleberry) - Swamp-loosestrife / Virginia Chainfern Dwarf-shrubland**

NVC Scientific Name: ***Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica*** **Dwarf-shrubland**

NVC Identifier: **CEGL006008**

LOCAL INFORMATION

Environmental Description: These interesting wetlands occur in glacial upland depressions on the Kittatinny Ridge. In these bog-like areas, vegetation grows on organic soil, often on a floating mat. These wetlands may be ombrotrophic (receiving nutrients from rainfall only) or influenced by groundwater.

Vegetation Description: This association is characterized by a thick layer of leatherleaf (*Chamaedaphne calyculata*) in the short-shrub layer, over a near continuous mat of sphagnum (*Sphagnum* spp.). Scattered trees may be present (<10% cover) such as black spruce (*Picea mariana*), red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), and pitch pine (*Pinus rigida*). The moderately dense tall-shrub layer (25-50% cover) contains highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), maleberry (*Lyonia ligustrina*), black spruce, and red maple. The characteristically dense short-shrub layer (70-80% cover) is dominated by leatherleaf, with associates black huckleberry (*Gaylussacia baccata*), swamp azalea, highbush blueberry, sheep laurel (*Kalmia angustifolia*), and cranberry (*Vaccinium macrocarpon*). The herbaceous and graminoid species are scattered sparsely over the peatmoss. Characteristic species include purple pitcherplant (*Sarracenia purpurea*), roundleaf sundew (*Drosera rotundifolia*), swamploosestrife (*Decodon verticillatus*), white beaksedge (*Rhynchospora alba*), tawny cotton-grass (*Eriophorum virginicum*), Virginia chainfern (*Woodwardia virginica*), northern long sedge (*Carex folliculata*), and prickly bog sedge (*Carex atlantica* ssp. *atlantica*). These species are more abundant in areas with less tall-shrub cover.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved evergreen shrub	*Chamaedaphne calyculata*
Herb (field)	Forb	*Decodon verticillatus*, *Drosera rotundifolia*, *Sarracenia purpurea*
Herb (field)	Graminoid	*Eriophorum virginicum*, *Rhynchospora alba*

Characteristic Species: *Chamaedaphne calyculata, Decodon verticillatus, Drosera rotundifolia, Eriophorum virginicum, Rhynchospora alba, Sarracenia purpurea*, *Vaccinium macrocarpon, Sphagnum* spp.

Other Noteworthy Species: *Cornus canadensis, Picea rubens, Vaccinium oxycoccos*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1	1	Southern New England Bog	Walz et al 2006
PA	S2	1	Leatherleaf - bog rosemary peatland	Fike 1999
PA	S2S3	1	Leatherleaf - cranberry peatland	Fike 1999

Local Range: These rare wetlands occur only on the Kittatinny Ridge in New Jersey within the park.
Classification Comments: Leatherleaf Peatland is distinguished from Highbush Blueberry - Leatherleaf Wetland by <50% cover of tall shrubs, the thick layers of *Chamaedaphne calyculata* and *Sphagnum* spp., and prominence of the characteristic "bog" plants, *Sarracenia purpurea, Drosera rotundifolia, Decodon verticillatus, Rhynchospora alba,* and *Eriophorum virginicum*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.209; Fike 1999, Breden et al 2001, Radis 1986.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Evergreen dwarf-shrubland (IV.A.)
Physiognomic Group	Needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.)
Physiognomic Subgroup	Natural/Semi-natural needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.)
Formation	Saturated needle-leaved or microphyllous evergreen dwarf-shrubland (IV.A.1.N.g.)
Alliance	*Chamaedaphne calyculata* Saturated Dwarf-shrubland Alliance (A.1092)
Alliance (English name)	Leatherleaf Saturated Dwarf-shrubland Alliance
Association	*Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica* Dwarf-shrubland
Association (English name)	Leatherleaf - (Dwarf Huckleberry) - Swamp-loosestrife / Virginia Chainfern Dwarf-shrubland
Ecological System(s):	Atlantic Coastal Plain Northern Bog (CES203.893) North-Central Interior and Appalachian Acid Peatland (CES202.606)

GLOBAL DESCRIPTION

Concept Summary: This dwarf-shrub quaking or floating bog occurs in the southern portion of the glaciated Northeast, extending west to the Western Allegheny Plateau. It occupies oligotrophic, peat-accumulating basins. *Chamaedaphne calyculata* is strongly dominant, with associate species including *Kalmia angustifolia, Kalmia polifolia, Vaccinium oxycoccos, Vaccinium macrocarpon, Gaylussacia dumosa* (on the coast), and *Gaylussacia baccata*. Associate shrubs generally occur with low cover, although they may be locally common. Scattered tall shrubs, such as *Vaccinium corymbosum, Rhododendron viscosum, Larix laricina, Picea mariana,* and *Acer rubrum,* may occur but always with low cover. Herbaceous cover is quite low but can include *Carex trisperma, Pogonia ophioglossoides, Calopogon tuberosus (= Calopogon pulchellus), Eriophorum virginicum, Drosera rotundifolia, Drosera intermedia, Sarracenia purpurea,* and *Woodwardia virginica* scattered throughout and with *Carex canescens, Carex limosa, Glyceria canadensis, Triadenum virginicum, Utricularia cornuta, Rhynchospora alba,* and sometimes *Scheuchzeria palustris* occurring in wetter fen windows.

Edges of floating mats tend to receive more nutrient enrichment and support such species as *Peltandra virginica, Decodon verticillatus,* and *Dulichium arundinaceum*. The bryophyte layer is well-developed, dominated by *Sphagnum capillifolium, Sphagnum magellanicum, Sphagnum rubellum*, and *Sphagnum fuscum* with *Sphagnum bartlettianum, Sphagnum cuspidatum, Sphagnum fallax*, and *Sphagnum recurvum* also occurring in some examples.
Environmental Description: This dwarf-shrub quaking or floating bog occupies oligotrophic, peat-accumulating basins.
Vegetation Description: *Chamaedaphne calyculata* is strongly dominant, with associate species including *Kalmia angustifolia, Kalmia polifolia, Vaccinium oxycoccos, Vaccinium macrocarpon, Gaylussacia dumosa* (near the coast), and *Gaylussacia baccata*. Associate shrubs generally occur with low cover, although they may be locally common. Scattered tall shrubs, such as *Vaccinium corymbosum, Rhododendron viscosum, Lyonia ligustrina, Larix laricina, Picea mariana*, and *Acer rubrum*, may occur but always with low cover. Herbaceous cover is quite low but can include *Carex trisperma, Pogonia ophioglossoides, Calopogon tuberosus (= Calopogon pulchellus), Eriophorum virginicum, Decodon verticillatus, Drosera rotundifolia, Drosera intermedia, Sarracenia purpurea*, and *Woodwardia virginica* scattered throughout and with *Carex canescens, Carex limosa, Carex folliculata, Carex atlantica, Glyceria canadensis, Triadenum virginicum, Utricularia cornuta, Rhynchospora alba*, and sometimes *Scheuchzeria palustris* occurring in wetter fen windows. Edges of floating mats tend to receive more nutrient enrichment and support such species as *Peltandra virginica, Decodon verticillatus*, and *Dulichium arundinaceum*. The bryophyte layer is well-developed, dominated by *Sphagnum capillifolium, Sphagnum magellanicum, Sphagnum rubellum*, and *Sphagnum fuscum* with *Sphagnum bartlettianum, Sphagnum cuspidatum, Sphagnum fallax*, and *Sphagnum recurvum* also occurring in some examples.
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Chamaedaphne calyculata*
Herb (field)	Forb	*Drosera rotundifolia*

Characteristic Species: *Chamaedaphne calyculata, Drosera rotundifolia, Eriophorum virginicum, Rhynchospora alba, Sarracenia purpurea, Vaccinium macrocarpon.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: Information not available.
States/Provinces: CT, MA, ME, NH, NJ:S1, NY, OH, ON:S3, PA, RI.
Federal Lands: NPS (Cape Cod, Delaware Water Gap?, Minute Man); USFWS (Assabet River, Nomans Land Island?).

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

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 1 – Strong.
Comments: Information not available.

Similar Associations:

- *Chamaedaphne calyculata / Eriophorum virginicum / Sphagnum rubellum* Dwarf-shrubland (CEGL006513).

Related Concepts:

- Glacial Bog (Breden 1989) ?

SOURCES

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

References: Anderson 1982, Breden 1989, Breden et al. 2001, Damman and French 1987, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Gawler 2002, Lynn and Karlin 1985, Metzler and Barrett 2001, Radis 1986, Sperduto 2000b, Sperduto and Nichols 2004, Swain and Kearsley 2000.

Figure 82. Leatherleaf Peatland in Delaware Water Gap National Recreation Area (plot DEWA.209). June 2004.

Figure 83. Leatherleaf Peatland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.999). June 2006.

COMMON NAME (PARK-SPECIFIC): SUCCESSIONAL BEAR OAK - HEATH SHRUBLAND

SYNONYMS
NVC English Name: **(Northern Lowbush Blueberry, Velvetleaf Blueberry, Hillside Blueberry) Central Appalachian Dwarf-shrubland**
NVC Scientific Name: ***Vaccinium (angustifolium, myrtilloides, pallidum)*** **Central Appalachian Dwarf-shrubland**
NVC Identifier: **CEGL003958**

LOCAL INFORMATION

Environmental Description: This association occurs on dry, high-elevation portions of Kittatinny Ridge where the fire frequency and intensity is high. This particular vegetation type is best expressed where fire has recently occurred. The soil is typically thin sandy soils over bedrock. Soils are typically acidic with low moisture content. Droughty soils conditions limit tree development, and most trees (when present) are stunted. Bedrock is primarily acidic sandstones of the Shawangunk Formation.

Vegetation Description: Due to periodic fire events on Kittatinny Ridge, this vegetation is variable in its spatial distribution and occurs in a mosaic with related dry oak and scrub oak vegetation types. This type is characterized by a dense short-shrub layer (<2 m in height) with very high cover that may exceed 90%. The short-shrub layer is very diverse and dominated by ericaceous species. Typical species include lowbush blueberry (*Vaccinium angustifolium*), Blue Ridge blueberry (*Vaccinium pallidum*), deerberry (*Vaccinium stamineum*), black huckleberry (*Gaylussacia baccata*), sheep laurel (*Kalmia angustifolia*), mountain laurel (*Kalmia latifolia*), sweet fern (*Comptonia peregrina*), and tree saplings. Bear oak (*Quercus ilicifolia*) often forms an open to occasionally dense tall-shrub overstory with low heath species below. Immediately after fire, the dense short-shrub layer regenerates. However, in the years following the fire, early-successional tall shrubs and trees establish in the low heath. Common species include quaking aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*), gray birch (*Betula populifolia*), and sweet birch (*Betula lenta*). Scattered individuals of pitch pine (*Pinus rigida*), scarlet oak (*Quercus coccinea*), and chestnut oak (*Quercus prinus*) may be also present. Tall-shrub and tree cover can vary from 0-75%, depending on the length of time since the fire. The herbaceous layer is usually sparse with low diversity (0-5% cover). Typical herb species include whorled yellow loosestrife (*Lysimachia quadrifolia*), narrowleaf cowwheat (*Melampyrum lineare*), eastern hayscented fern (*Dennstaedtia punctilobula*), white snakeroot (*Ageratina altissima* var. *altissima*), wavy hairgrass (*Deschampsia flexuosa*), poverty oatgrass (*Danthonia spicata*), hay sedge (*Carex argyrantha*), Swan's sedge (*Carex swanii*), and ribbed sedge (*Carex virescens*). Polytrichum mosses (*Polytrichum* spp.) are present and occasionally abundant below the shrub layer.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula populifolia, Populus grandidentata, Populus tremuloides, Quercus ilicifolia*

Short shrub/sapling	Broad-leaved deciduous shrub	*Comptonia peregrina, Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum*
Short shrub/sapling	Broad-leaved evergreen shrub	*Kalmia angustifolia, Kalmia latifolia*

Characteristic Species: *Gaylussacia baccata, Kalmia latifolia, Quercus ilicifolia, Vaccinium angustifolium, Vaccinium pallidum, Comptonia peregrina, Lysimachia quadrifolia, Melampyrum lineare, Dennstaedtia punctilobula, Populus grandidentata, Populus tremuloides.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2?	2	Central Appalachian Blueberry Shrubland	Walz et al 2006
PA	S2	1	Low heath shrubland	Fike 1999

Local Range: This vegetation type is known from the Sunfish Pond area of Kittatinny Ridge but may occur elsewhere where Dry Oak Heath Forests have burned with sufficient intensity to kill the oak canopy.
Classification Comments: This shrubland type appears to be successional to Dry Oak - Heath Forest and is the result of severe burns of these forest types. Successional Bear Oak - Heath Shrubland is similar to Bear Oak - Wavy Hairgrass Shrubland. However, for the Successional Bear Oak - Heath Shrubland, fire is probably the primary factor influencing the association structure, such that these shrublands are likely to succeed to Dry Oak - Heath Forest in between fire events. By contrast, Bear Oak - Wavy Hairgrass Shrubland is primarily influenced by extremely thin soils over acidic bedrock, which limits tree growth.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.205, DEWA.206, DEWA.215, DEWA.217; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Dwarf-shrubland (IV)
Physiognomic Subclass	Deciduous dwarf-shrubland (IV.B.)
Physiognomic Group	Cold-deciduous dwarf-shrubland (IV.B.2.)
Physiognomic Subgroup	Natural/Semi-natural cold-deciduous dwarf-shrubland (IV.B.2.N.)
Formation	Cespitose cold-deciduous dwarf-shrubland (IV.B.2.N.a.)
Alliance	*Vaccinium (angustifolium, myrtilloides, pallidum)* Dwarf-shrubland Alliance (A.1113)
Alliance (English name)	(Northern Lowbush Blueberry, Velvetleaf Blueberry, Hillside Blueberry) Dwarf-shrubland Alliance
Association	*Vaccinium (angustifolium, myrtilloides, pallidum)* Central Appalachian Dwarf-shrubland
Association (English name)	(Northern Lowbush Blueberry, Velvetleaf Blueberry, Hillside Blueberry) Central Appalachian Dwarf-shrubland

Ecological System(s): Central Appalachian Pine-Oak Rocky Woodland (CES202.600)

GLOBAL DESCRIPTION

Concept Summary: This association occurs on mid- to high-elevation acidic rock outcrops or summits and is characterized by abundant dwarf *Vaccinium* spp. in areas with frequent fire and/or droughty soils. This community is dominated by heaths or heath-like shrubs (typically blueberries, *Vaccinium angustifolium, Vaccinium myrtilloides, Vaccinium stamineum, Vaccinium pallidum (= Vaccinium vacillans)*) and is commonly referred to as "heath barrens." Soils are shallow accumulations of organic material on bedrock habitats, or rapidly drained and nutrient-poor sands on outwash plains. Small trees may be present but are very sparse. The herbaceous layer is usually sparse with low diversity. In addition to *Vaccinium*, the shrub layer typically contains other low shrubs such as *Gaylussacia baccata, Kalmia angustifolia,* and *Comptonia peregrina*, with *Kalmia latifolia* present in some areas. *Quercus ilicifolia* is frequently present, with variable cover, above the low heaths. Herbaceous plants scattered among the shrubs include *Deschampsia flexuosa, Schizachyrium scoparium, Carex pensylvanica, Carex argyrantha, Danthonia spicata, Piptatherum pungens (= Oryzopsis pungens), Lysimachia quadrifolia, Rubus hispidus, Melampyrum lineare, Solidago canadensis, Lycopodium dendroideum*, and *Lycopodium digitatum*. Mosses (including *Polytrichum* spp.) and lichens usually are present.

Environmental Description: These patchy communities are typically found on higher-elevation acidic rock outcrops or summits. Along with bedrock outcrops, ledges, summits of igneous or metamorphic rock, this association is sometimes found in depressions on level outwash plains or valley floor frost pockets. Soils are shallow accumulations of organic material on bedrock habitats, or rapidly drained and nutrient-poor sands on outwash plains.

Vegetation Description: This dwarf-shrubland is dominated by locally dense *Vaccinium* (*Vaccinium angustifolium, Vaccinium stamineum*, and/or *Vaccinium pallidum (= Vaccinium vacillans)*. Scattered small individuals of *Pinus strobus, Pinus rigida, Prunus serotina, Betula papyrifera*, and/or *Betula populifolia* may occur where soil has accumulated. The herbaceous layer is usually sparse with low diversity. In addition to *Vaccinium*, the shrub layer typically contains other shrubs such as *Gaylussacia baccata, Kalmia angustifolia*, and *Comptonia peregrina*, with *Kalmia latifolia* present in some areas. *Quercus ilicifolia* is frequently present, with variable cover, above the low heaths. Herbaceous plants scattered among the shrubs include *Deschampsia flexuosa, Schizachyrium scoparium, Carex pensylvanica, Carex argyrantha, Danthonia spicata, Piptatherum pungens (= Oryzopsis pungens), Lysimachia quadrifolia, Rubus hispidus, Melampyrum lineare, Solidago canadensis, Lycopodium dendroideum*, and *Lycopodium digitatum*. Mosses (including *Polytrichum* spp.) and lichens usually are present.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Quercus ilicifolia*
Short shrub/sapling	Broad-leaved deciduous shrub	*Comptonia peregrina*, *Gaylussacia baccata*, *Vaccinium angustifolium*, *Vaccinium pallidum*
Short shrub/sapling	Broad-leaved evergreen shrub	*Kalmia angustifolia*

Characteristic Species: *Comptonia peregrina*, *Deschampsia flexuosa*, *Gaylussacia baccata*, *Kalmia latifolia*, *Lysimachia quadrifolia*, *Melampyrum lineare*, *Quercus ilicifolia*, *Vaccinium angustifolium*, *Vaccinium pallidum.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is known from the mid-Atlantic states of Maryland, New Jersey, Pennsylvania and West Virginia.
States/Provinces: MD, NJ, PA, WV.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G4G5 (21-Jun-2006).
Reasons: This association is distributed over a fairly large portion of glaciated northeastern North America. In some states where it occurs, it has a state conservation rank of S4.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This type shares many species and the general environmental setting with *Vaccinium angustifolium - Sorbus americana / Sibbaldiopsis tridentata* Dwarf-shrubland (CEGL005094), but it lacks species of more northern affinity such as *Picea* spp., *Abies* spp., and *Sorbus* spp., and is not characterized by *Sibbaldiopsis tridentata*. It results from frequent fires and droughty soils, with cold climate having less effect than in CEGL005094.
Similar Associations:
- *Vaccinium angustifolium - Sorbus americana / Sibbaldiopsis tridentata* Dwarf-shrubland (CEGL005094).

Related Concepts:
- *Vaccinium myrtilloides* Dwarf-shrubland (Walton et al. 1997) ?

SOURCES
Description Authors: E. Largay, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Fike 1999, Harrison 2004, Walton et al. 1997.

Figure 84. Successional Bear Oak - Heath Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.205). June 2004.

Figure 85. Successional Bear Oak - Heath Shrubland in Delaware Water Gap National Recreation Area (plot DEWA.206). June 2004.

COMMON NAME (PARK-SPECIFIC): LITTLE BLUESTEM GRASSLAND

SYNONYMS
NVC English Name: **Little Bluestem - Goldenrod species Herbaceous Vegetation**
NVC Scientific Name: ***Schizachyrium scoparium* - *Solidago* spp. Herbaceous Vegetation**
NVC Identifier: **CEGL006333**

LOCAL INFORMATION

Environmental Description: This association occurs in various settings throughout the park, often in association with disturbed or managed openings and fields (including utility rights-of-way). Typical soils series is Wyoming, which contains excessively well-drained cobbly, gravelly or channery sandy and silt loams. These soils are often moderately to strongly acidic (pH 5.1 to 6.0).

Vegetation Description: This vegetation type is characterized by thick herbaceous and graminoid vegetation in which little bluestem (*Schizachyrium scoparium*) is at least codominant and usually dominant (absolute cover >50%). The associate species can vary but are typically restricted to drought-tolerant species or include species characteristic of Old Fields. Trees and tall shrubs are typically absent. Occasional short shrubs (<2 m in height) may include pitch pine (*Pinus rigida*), eastern red-cedar (*Juniperus virginiana*), sheep laurel (*Kalmia angustifolia*), and sweet fern (*Comptonia peregrina*). Northern dewberry (*Rubus flagellaris*) is often present as a short shrub/creeping vine. The herbaceous layer (other than little bluestem) is characterized by early goldenrod (*Solidago juncea*), common sheep sorrel (*Rumex acetosella*), wrinkleleaf goldenrod (*Solidago rugosa*), dwarf cinquefoil (*Potentilla canadensis*), and hawkweeds (*Hieracium* spp.). Drought-tolerant mosses are usually present, particularly polytrichum mosses (*Polytrichum* spp.).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Needle-leaved shrub	*Juniperus virginiana*, *Pinus rigida*
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus flagellaris*
Herb (field)	Vine/Liana	*Vitis labrusca*
Herb (field)	Forb	*Rumex acetosella*, *Solidago juncea*, *Solidago rugosa*
Herb (field)	Graminoid	*Schizachyrium scoparium*

Characteristic Species: *Schizachyrium scoparium*, *Solidago juncea*, *Rubus flagellaris*, *Rumex acetosella.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Little Bluestem Grassland	Walz et al 2006
PA	S4	2	no crosswalk	Fike 1999

Local Range: Throughout the park on well-drained to excessively drained upland soils, most examples appear to be associated with human disturbance.

Classification Comments: Key feature of this type is the relatively high cover of *Schizachyrium scoparium* (>50% cover). Other grass species, while present, are rarely abundant. *Deschampsia flexuosa* and *Danthonia* spp. are often absent.

Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.113, DEWA.114, DEWA.172.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Andropogon virginicus* Herbaceous Alliance (A.1208)
Alliance (English name)	Broomsedge Bluestem Herbaceous Alliance
Association	*Schizachyrium scoparium* - *Solidago* spp. Herbaceous Vegetation
Association (English name)	Little Bluestem - Goldenrod species Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes old fields of well-drained soils, either sandy or shallow to bedrock. They are characterized by dominance of warm-season grasses. *Schizachyrium scoparium* is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus, Eragrostis spectabilis, Festuca rubra, Deschampsia flexuosa, Danthonia spicata, Nuttallanthus canadensis (= Linaria canadensis), Rubus flagellaris, Panicum virgatum, Dichanthelium depauperatum (= Panicum depauperatum), Potentilla simplex, Dichanthelium meridionale (= Panicum meridionale), Dichanthelium dichotomum (= Panicum dichotomum), Solidago rugosa,* and *Carex pensylvanica*. Scattered shrubs are often present, including *Comptonia peregrina, Morella pensylvanica, Gaylussacia baccata*, and scattered tree saplings, such as *Prunus serotina, Sassafras albidum,* and *Juniperus virginiana*. *Polytrichum juniperinum* and other *Polytrichum* spp. are common bryophytes.
Environmental Description: This vegetation occurs on well-drained soils, either on sandy flats or on dry knolls with shallow soils. The vegetation arises spontaneously after soil disturbance.
Vegetation Description: *Schizachyrium scoparium* is characteristic and nearly always present. Species composition is variable, depending on land-use history, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states. In addition to the nominal species, other associates may include *Andropogon virginicus, Eragrostis spectabilis, Festuca rubra, Deschampsia flexuosa, Centaurea biebersteinii (= Centaurea maculosa), Danthonia spicata, Hypericum perforatum, Nuttallanthus canadensis (= Linaria canadensis), Rubus flagellaris, Panicum virgatum, Dichanthelium depauperatum (= Panicum depauperatum), Potentilla simplex, Dichanthelium meridionale (= Panicum meridionale), Dichanthelium dichotomum (= Panicum dichotomum), Solidago juncea, Solidago nemoralis, Solidago rugosa, Hieracium* spp., and *Carex pensylvanica*. Scattered shrubs are often present, including *Comptonia peregrina, Morella pensylvanica, Gaylussacia baccata*, and scattered tree saplings, such as *Prunus serotina, Sassafras albidum,* and *Juniperus virginiana*.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Dwarf-shrub	*Rubus flagellaris*
Herb (field)	Forb	*Solidago juncea, Solidago nemoralis, Solidago rugosa*
Herb (field)	Graminoid	*Schizachyrium scoparium*

Characteristic Species: *Andropogon virginicus, Schizachyrium scoparium, Solidago juncea, Solidago nemoralis, Solidago rugosa.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.
States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT.
Federal Lands: NPS (Cape Cod, Delaware Water Gap, Fire Island, Saratoga, Weir Farm); USFWS (Great Swamp).

CONSERVATION STATUS
Rank: GNA (invasive) (19-Jan-2006).
Reasons: This vegetation type includes pasture and post-agricultural fields.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: This type is distinguished, in theory, from the very similar *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation (CEGL006107) by the dominance of warm-season grasses as opposed to cool-season grasses (*Phleum, Festuca*) dominating CEGL006017. Additional data will be required to see how this distinction holds up and what geographic differences might accompany such a distinction.
Similar Associations:
- *Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation (CEGL006107).
- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048).
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018).

Related Concepts: Information not available.

SOURCES
Description Authors: L. A. Sneddon, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, House 1917, Newbold et al. 1988, Niering et al. 1970.

Figure 86. Little Bluestem Grassland in Delaware Water Gap National Recreation Area (plot DEWA.113). September 2003.

Figure 87. Little Bluestem Grassland in Delaware Water Gap National Recreation Area (plot DEWA.172). September 2003.

COMMON NAME (PARK-SPECIFIC): OLD FIELD

SYNONYMS

NVC English Name:	**Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation**
NVC Scientific Name:	***Dactylis glomerata* - *Phleum pratense* - *Festuca* spp. - *Solidago* spp. Herbaceous Vegetation**
NVC Identifier:	**CEGL006107**

LOCAL INFORMATION

Environmental Description: This association occurs in fields that are not plowed or planted in crops or hay grasses. These fields are mowed at least biannually if not more frequently. Without mowing, these sites will succeed to Successional Shrubland as woody species colonize the field. The shrublands are flat to gently sloping, often bounded by stonewalls or fencerows. Some of these sites are old homesteads from which the houses have been removed. These sites contain moderately well-drained to well-drained soils, typical of the Manlius, Chenango, Pope, and Venango series, among others. These fields may contain drainage swales in which the vegetation is similar to that of Wet Meadow.

Vegetation Description: Characteristic vegetation for this association is a diverse mixture of goldenrods, cool-season grasses, and agricultural weeds. The herbaceous layer is typically dense (80-100% cover). Species dominance in this layer shifts through the growing season, with cool-season grasses dominant early in the summer and goldenrods dominant later in the summer. Within each field, species may be locally abundant and often have patchy distribution. The two characteristically dominant species are wrinkleleaf goldenrod (*Solidago rugosa*) and sweet vernalgrass (*Anthoxanthum odoratum*). Other abundant species include flat-top goldentop (*Euthamia graminifolia*), meadow hawkweed (*Hieracium caespitosum*), red fescue (*Festuca rubra*), common cinquefoil (*Potentilla simplex*), wild bergamot (*Monarda fistulosa*), white bergamot (*Monarda clinopodia*), deertongue (*Dichanthelium clandestinum*), broomsedge bluestem (*Andropogon virginicus*), purple foxglove (*Digitalis purpurea*), lanceleaf wild licorice (*Galium lanceolatum*), Kentucky bluegrass (*Poa pratensis*), and common yarrow (*Achillea millefolium*). Other common associates are false baby's breath (*Galium mollugo*), common St. Johnswort (*Hypericum perforatum*), white clover (*Trifolium repens*), Queen Anne's lace (*Daucus carota*), common dandelion (*Taraxacum officinale*), meadow ryegrass (*Lolium pratense*), Virginia mountainmint (*Pycnanthemum virginianum*), little bluestem (*Schizachyrium scoparium*), and common gypsyweed (*Veronica officinalis*). Little bluestem can be common, however, it does not cover >50% of the field. Scattered trees, tall, or short shrubs may be present, covering <25% of the field. These typically occur near the field edges or in scattered clumps. Typical tree and tall-shrub species include eastern red-cedar (*Juniperus virginiana*), gray birch (*Betula populifolia*), choke cherry (*Prunus virginiana*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and the invasive species autumn-olive (*Elaeagnus umbellata*) and tree of heaven (*Ailanthus altissima*). Common short shrubs are gray dogwood (*Cornus racemosa*), northern dewberry (*Rubus flagellaris*), Allegheny blackberry (*Rubus allegheniensis*), wine raspberry (*Rubus phoenicolasius*), black raspberry (*Rubus occidentalis*), and the invasive species multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), and Japanese barberry (*Berberis thunbergii*).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Solidago rugosa, Euthamia graminifolia, Monarda fistulosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Festuca rubra*

Characteristic Species: *Solidago rugosa, Anthoxanthum odoratum, Monarda fistulosa, Euthamia graminifolia, Achillea millefolium, Daucus carota, Dichanthelium clandestinum, Lolium pratense, Pycnanthemum virginianum, Taraxacum officinale, Trifolium* spp.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

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

Local Range: This common vegetation type occurs throughout the park.
Classification Comments: Old Field is identified by a thick layer of herbaceous-graminoid vegetation dominated by a diverse mixture of goldenrods, cool-season grasses, and agricultural weeds. *Solidago rugosa* and *Anthoxanthum odoratum* are characteristic dominants. *Schizachyrium scoparium* covers <50% of the field. Trees and shrubs cover <25% of the field.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.26, DEWA.65, DEWA.82, DEWA.138, DEWA.151, DEWA.152, DEWA.161; Perles et al. 2006a, Perles et al. 2006b, Perles et al. 2006c.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Dactylis glomerata - Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Common Sheep Sorrel Herbaceous Alliance
Association	*Dactylis glomerata - Phleum pratense - Festuca* spp. - *Solidago* spp. Herbaceous Vegetation
Association (English name)	Orchard Grass - Timothy - Fescue species - Goldenrod species Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pastures and post-agricultural fields and is largely composed of non-native cool-season grasses and herbs (generally of European origin) in the early stages of succession. The fields are typically mowed

at least annually. Physiognomically, these grasslands are generally comprised of mid-height (1-3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and midwestern states and at higher elevations (610-1220 m [2000-4000 feet]) in the southeastern states. Dominant grasses vary from site to site but generally feature the nominal species. Other graminoid associates may include *Agrostis stolonifera, Agrostis hyemalis, Elymus repens, Bromus inermis, Bromus tectorum, Lolium perenne, Poa pratensis, Poa compressa, Schizachyrium scoparium* (not in abundance), and *Anthoxanthum odoratum*. Forbs scattered among the grasses are varied but include *Hieracium* spp., *Oxalis stricta, Achillea millefolium, Asclepias syriaca, Solidago rugosa, Solidago nemoralis, Solidago juncea, Solidago canadensis, Solidago canadensis* var. *scabra, Euthamia graminifolia, Cerastium arvense, Oenothera biennis, Potentilla simplex, Symphyotrichum lateriflorum (= Aster lateriflorus), Symphyotrichum novae-angliae (= Aster novae-angliae), Symphyotrichum lanceolatum (= Aster simplex), Daucus carota, Ambrosia artemisiifolia, Vicia cracca, Trifolium* spp., and many others.

Environmental Description: This association occurs on pastures and land that has been tilled. Generally the fields are mowed at least annually.

Vegetation Description: n addition to *Dactylis glomerata* and *Phleum pratense*, these grassy fields are characterized by graminoids including *Agrostis stolonifera, Agrostis hyemalis, Elymus repens, Bromus inermis, Bromus tectorum, Lolium perenne, Poa pratensis, Poa compressa, Schizachyrium scoparium* (not in abundance), and *Anthoxanthum odoratum*. Forbs scattered among the grasses are varied but include *Hieracium* spp., *Oxalis stricta, Achillea millefolium, Asclepias syriaca, Solidago rugosa, Solidago nemoralis, Solidago juncea, Solidago canadensis, Solidago canadensis* var. *scabra, Euthamia graminifolia, Cerastium arvense, Oenothera biennis, Potentilla simplex, Symphyotrichum lateriflorum (= Aster lateriflorus), Symphyotrichum novae-angliae (= Aster novae-angliae), Symphyotrichum lanceolatum (= Aster simplex), Daucus carota, Ambrosia artemisiifolia, Vicia cracca, Trifolium* spp., and many others.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella*
Herb (field)	Graminoid	*Dactylis glomerata, Festuca rubra, Phleum pratense*

Characteristic Species: *Achillea millefolium, Anthoxanthum odoratum, Dactylis glomerata, Euthamia graminifolia, Phleum pratense, Rumex acetosella, Solidago canadensis* var. *scabra, Solidago canadensis, Solidago rugosa.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, KY, MA, MD, ME, NH, NJ, NY, PA, RI, TN, VA, VT, WV.

Federal Lands: NPS (Allegheny Portage Railroad, Cape Cod, Delaware Water Gap, Fire Island, Fort Necessity, Friendship Hill, Gettysburg, Johnstown Flood, Marsh-Billings-Rockefeller, Minute Man, Morristown, Saint-Gaudens, Valley Forge, Weir Farm); USFWS (Aroostook, Assabet River, Carlton Pond, Great Meadows, Moosehorn, Nulhegan Basin, Oxbow, Parker River).

CONSERVATION STATUS
Rank: GNA (modified/managed) (8-Dec-2005).
Reasons: This vegetation type includes pasture and post-agricultural fields and is largely composed of non-native grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: *Schizachyrium scoparium* - *Solidago* spp. Herbaceous Vegetation (CEGL006333) is similar to this type but is dominated by warm-season grasses.
Similar Associations:
- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048).
- *Phleum pratense* - *Bromus pubescens* - *Helenium autumnale* Herbaceous Vegetation (CEGL004018).
- *Schizachyrium scoparium* - *Solidago* spp. Herbaceous Vegetation (CEGL006333).

Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Clark 1986, Dowhan and Rozsa 1989, Eastern Ecology Working Group n.d., Edinger et al. 2002, Ehrenfeld 1977, Keever 1979, Newbold et al. 1988, Perles et al. 2006a, Perles et al. 2006b, Perles et al. 2006c, Sneddon et al. 1995, TDNH unpubl. data.

Figure 88. Old Field in Delaware Water Gap National Recreation Area (plot DEWA.138). June 2003.

Figure 89. Old Field in Delaware Water Gap National Recreation Area (plot DEWA.161). August 2003.

COMMON NAME (PARK-SPECIFIC): WAVY HAIRGRASS - COMMON SHEEP SORREL ROCK OUTCROP

SYNONYMS

NVC English Name: **Little Bluestem - Poverty Oatgrass - Pennsylvania Sedge / Cup Lichen species Herbaceous Vegetation**

NVC Scientific Name: ***Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica / Cladonia* spp. Herbaceous Vegetation**

NVC Identifier: **CEGL006544**

LOCAL INFORMATION

Environmental Description: This association occurs on level to occasionally sloping ground on high elevations of the Kittatinny Ridge where the substrate is massive rock outcrops and/or thin soils over bedrock. Bedrock is composed of erosion-resistant sandstones of the Silurian Shawangunk Formation. This association commonly occurs in association with former home and cottage sites at high elevation along the ridge.

Vegetation Description: The vegetation in this type is typically sparse, with total vascular plant cover below 50%. Trees and shrubs are uncommon and often stunted (maximum height under 10 m). Typical tree species include red hickory (*Carya ovalis*), pignut hickory (*Carya glabra*), white ash (*Fraxinus americana*), and eastern red-cedar (*Juniperus virginiana*). Occasional short shrubs and saplings (<2 m in height) include sweet birch (*Betula lenta*) and black huckleberry (*Gaylussacia baccata*). The herbaceous layer (<1 m tall) is characterized by a mix of drought-tolerant species, including wavy hairgrass (*Deschampsia flexuosa*), common sheep sorrel (*Rumex acetosella*), eastern hayscented fern (*Dennstaedtia punctilobula*), poverty oatgrass (*Danthonia spicata*), little bluestem (*Schizachyrium scoparium*), and tapered rosette grass (*Dichanthelium acuminatum var. acuminatum*). The invasive species Japanese stiltgrass (*Microstegium vimineum*) is locally abundant, reflecting past disturbance. Lichens and mosses may be locally abundant on exposed rock outcrops and soils.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella*
Herb (field)	Graminoid	*Deschampsia flexuosa*

Characteristic Species: *Deschampsia flexuosa, Rumex acetosella, Fraxinus americana, Carya ovalis, Gaylussacia baccata.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S2?	1	Little Bluestem - Poverty Grass Low- to Mid-Elevation Outcrop Opening	Walz et al 2006
PA	S2	2	Little bluestem - Pennsylvania sedge opening	Fike 1999

Local Range: This vegetation type is restricted to high-elevation areas of Kittatinny Ridge in the New Jersey portion of the park.

Classification Comments: This association differs from the little bluestem grassland in that *Schizachyrium scoparium* is a minor component and usually less abundant than *Deschampsia*

flexuosa. This type often occurs within a matrix of Dry Oak - Heath Forest or Dry Oak - Mixed Hardwood Forest.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.208; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)
Alliance	*Schizachyrium scoparium - (Sporobolus cryptandrus)* Herbaceous Alliance (A.1224)
Alliance (English name)	Little Bluestem - (Sand Dropseed) Herbaceous Alliance
Association	*Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica / Cladonia* spp. Herbaceous Vegetation
Association (English name)	Little Bluestem - Poverty Oatgrass - Pennsylvania Sedge / Cup Lichen species Herbaceous Vegetation
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)

GLOBAL DESCRIPTION

Concept Summary: These grassy openings are found on rock outcrops and summits at 365-1220 m (1200-4000 feet) elevation in the Central Appalachians and adjacent regions. Settings include flat summits, outcrops, plateaus and southwest-facing upper slopes. Bare rock (acidic sandstone and conglomerates) typically makes up a large part of the cover. *Danthonia spicata, Schizachyrium scoparium,* and *Deschampsia flexuosa* are all typical. Total herbaceous cover is usually 25-50%. Other associates include *Carex pensylvanica, Piptatherum pungens (= Oryzopsis pungens), Piptatherum racemosum (= Oryzopsis racemosa), Prunus pumila, Rumex acetosella, Rubus* spp., *Sibbaldiopsis tridentata, Cladonia* sp., and *Umbilicaria* sp. There may be small patches of shrubs within the graminoid matrix, including *Vaccinium* spp., *Gaylussacia baccata,* and *Photinia melanocarpa (= Aronia melanocarpa).*
Environmental Description: This association occurs on rock outcrops and summits at 365-1220 m (1200-4000 feet) elevation in the Central Appalachians and adjacent regions. Settings include flat summits, outcrops, plateaus and southwest-facing upper slopes. Bare rock (acidic sandstone and conglomerates) typically makes up a large part of the cover.
Vegetation Description: *Danthonia spicata, Schizachyrium scoparium,* and *Deschampsia flexuosa* are all typical. Total herbaceous cover is usually 25-50%. Other associates include *Carex pensylvanica, Piptatherum pungens (= Oryzopsis pungens), Piptatherum racemosum (= Oryzopsis racemosa), Prunus pumila, Rumex acetosella, Rubus* spp., *Sibbaldiopsis tridentata, Cladonia* sp., and *Umbilicaria* sp. There may be small patches of shrubs within the graminoid matrix, including *Vaccinium* spp., *Gaylussacia baccata,* and *Photinia melanocarpa (= Aronia melanocarpa).*

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella*
Herb (field)	Graminoid	*Danthonia spicata*, *Deschampsia flexuosa*

Characteristic Species: *Carex pensylvanica*, *Danthonia spicata*, *Deschampsia flexuosa*, *Gaylussacia baccata*, *Schizachyrium scoparium.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: Information not available.
States/Provinces: CT, NJ, NY, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

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

Figure 90. Wavy Hairgrass - Common Sheep Sorrel Rock Outcrop in Delaware Water Gap National Recreation Area (plot DEWA.208). June 2004.

Figure 91. Wavy Hairgrass - Common Sheep Sorrel Rock Outcrop in Delaware Water Gap National Recreation Area (near the Appalachian Trail on the Kittatinny Ridge in New Jersey). April 2006.

COMMON NAME (PARK-SPECIFIC): BIG BLUESTEM - INDIANGRASS RIVERINE GRASSLAND

SYNONYMS

NVC English Name: **Sand Cherry / Big Bluestem - Yellow Indiangrass Herbaceous Vegetation**

NVC Scientific Name: ***Prunus pumila / Andropogon gerardii - Sorghastrum nutans* Herbaceous Vegetation**

NVC Identifier: **CEGL006518**

LOCAL INFORMATION

Environmental Description: This community type occurs on sand/gravel deposits along shorelines and on islands in the Delaware River. These sites are subject to flooding and ice-scour which removes woody vegetation and maintains a graminoid- and herbaceous-dominated vegetation.

Vegetation Description: The typical aspect is that of a tall prairie-like grassland. The dominant species are big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*). Other herbaceous species include Indian-hemp (*Apocynum cannabinum*), hairy lespedeza (*Lespedeza hirta*), reed canarygrass (*Phalaris arundinacea*), wrinkleleaf goldenrod (*Solidago rugosa*), field pennycress (*Thlaspi arvense*), prairie fleabane (*Erigeron strigosus*), and common yarrow (*Achillea millefolium*). The invasive species spotted knapweed (*Centaurea biebersteinii*) can also be present. Woody species may become established within the grassland matrix. Common species include willows (*Salix* spp.), sycamore (*Platanus occidentalis*), ashes (*Fraxinus* spp.), boxelder (*Acer negundo*), and river birch (*Betula nigra*). Vines may also be present, including Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*), fox grape (*Vitis labrusca*), and riverbank grape (*Vitis riparia*).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Apocynum cannabinum*, *Lespedeza hirta*
Herb (field)	Graminoid	*Andropogon gerardii*, *Panicum virgatum*, *Schizachyrium scoparium*, *Sorghastrum nutans*

Characteristic Species: *Andropogon gerardii, Sorghastrum nutans, Panicum virgatum, Schizachyrium scoparium, Prunus pumila* var. *depressa.*

Other Noteworthy Species: *Prunus pumila* var. *depressa.*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2?	2	Riverside Prairie Grassland	Walz et al 2006
PA	S3	1	Big bluestem - Indian grass river grassland	Fike 1999

Local Range: This vegetation is found occasionally along the Delaware River.

Classification Comments: This type can be distinguished from other riparian types by the dominance of *Andropogon gerardii, Sorghastrum nutans, Panicum virgatum*, and *Schizachyrium scoparium* that form a tall prairie-like grassland.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.107; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Temporarily flooded temperate or subpolar grassland (V.A.5.N.j.)
Alliance	*Andropogon gerardii - (Sorghastrum nutans)* Temporarily Flooded Herbaceous Alliance (A.1337)
Alliance (English name)	Big Bluestem - (Yellow Indiangrass) Temporarily Flooded Herbaceous Alliance
Association	*Prunus pumila / Andropogon gerardii - Sorghastrum nutans* Herbaceous Vegetation
Association (English name)	Sand Cherry / Big Bluestem - Yellow Indiangrass Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: These are tall alluvial grasslands in the temperate region of the northeastern United States. They are found on sandy point bars and linear deposits along semi-stable rivershores subject to periodic flooding. Ice build-up during the winter can scour the rivershore in spring, limiting woody growth. The substrate is cobble, gravel or coarse sediment with interstices of alluvial sand and silt. Bare cobble is exposed in some areas. Herbaceous plants dominate, and may form a dense cover; scattered shrubs may grow among them, but are generally kept short by the annual flooding. Bryophytes are absent or at most sparse. The dominant plants are tall grasses such as *Sorghastrum nutans, Andropogon gerardii, Schizachyrium scoparium*, and *Panicum virgatum*. Characteristic herbs include *Helianthemum canadense, Helianthus divaricatus, Asclepias tuberosa*, and *Lespedeza capitata*. *Spiraea alba, Rosa virginiana,* and *Prunus pumila* are common shrubs. Other herbaceous associates include *Anemone virginiana, Calamagrostis canadensis, Eupatorium maculatum, Lycopus uniflorus, Phalaris arundinacea, Scleria triglomerata,* and *Symphyotrichum novi-belgii*. This association differs from more northerly riverside ice meadows in being dominated by prairie grasses (*Andropogon gerardii, Sorghastrum nutans*) rather than by *Calamagrostis canadensis*.
Environmental Description: These are tall alluvial grasslands in the temperate region of the northeastern United States. They are found on sandy point bars and linear deposits along semi-stable rivershores subject to periodic flooding. Ice build-up during the winter can scour the

rivershore in spring, limiting woody growth. The substrate is cobble, gravel or coarse sediment with interstices of alluvial sand and silt. Bare cobble is exposed in some areas.
Vegetation Description: Herbaceous plants dominate and may form a dense cover; scattered shrubs may grow among them but are generally kept short by annual flooding. Bryophytes are absent or at most sparse. The dominant plants are tall grasses such as *Sorghastrum nutans, Andropogon gerardii, Schizachyrium scoparium,* and *Panicum virgatum*. Characteristic herbs include *Helianthemum canadense, Helianthus divaricatus, Apocynum cannabinum, Asclepias tuberosa, Lespedeza hirta,* and *Lespedeza capitata*. *Spiraea alba, Rosa virginiana,* and *Prunus pumila* are common shrubs. Other herbaceous associates include *Anemone virginiana, Calamagrostis canadensis, Eupatorium maculatum, Solidago rugosa, Achillea millefolium, Lycopus uniflorus, Phalaris arundinacea, Scleria triglomerata,* and *Symphyotrichum novi-belgii*.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Apocynum cannabinum, Lespedeza hirta*
Herb (field)	Graminoid	*Andropogon gerardii, Panicum virgatum, Schizachyrium scoparium, Sorghastrum nutans*

Characteristic Species: *Andropogon gerardii*, *Panicum virgatum*, *Prunus pumila* var. *depressa, Sorghastrum nutans.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

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

CONSERVATION STATUS
Rank: GNR (6-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 - Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts:
- Willow - Indian grass riverine shrubland (Perles et al. 2004) B

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Metzler and Barrett 2001, Nichols et al. 2001, Perles et al. 2004, Thompson and Sorenson 2000.

Figure 92. Big Bluestem - Indiangrass Riverine Grassland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.580). June 2006.

Figure 93. Big Bluestem - Indiangrass Riverine Grassland in Delaware Water Gap National Recreation Area (plot DEWA.107). August 2003.

COMMON NAME (PARK-SPECIFIC): HAIRYFRUIT SEDGE WETLAND

SYNONYMS

NVC English Name: **Hairy-fruit Sedge - Bulrush species - Giant Goldenrod Herbaceous Vegetation**

NVC Scientific Name: ***Carex trichocarpa* - *Scirpus* spp. - *Solidago gigantea* Herbaceous Vegetation [Provisional]**

NVC Identifier: **CEGL006447**

LOCAL INFORMATION

Environmental Description: This association is found occasionally in small patches on mainstem islands in the Delaware River, as well as on the floodplains of major tributaries where tree canopy is lacking, especially portions of Flat Brook. Typical soils include the coarse loamy to sandy Fredon-Halsey complex, which are somewhat poorly to very poorly drained glacio-fluvial deposits (characteristic along Flat Brook). This community is routinely flooded during most high-water events and commonly occurs on low flats associated with the active floodplain, either directly adjacent to the channel or in association with backwater depressions and sloughs.

Vegetation Description: Hairyfruit sedge (*Carex trichocarpa*) is the dominant species in this association. Shrubs may be present but at less than 25% cover, including multiflora rose (*Rosa multiflora*), silky dogwood (*Cornus amomum*), and Allegheny blackberry (*Rubus allegheniensis*). Other common herbaceous species include giant goldenrod (*Solidago gigantea*), smallspike false nettle (*Boehmeria cylindrica*), deertongue (*Dichanthelium clandestinum*), reed canarygrass (*Phalaris arundinacea*), stinging nettle (*Urtica dioica*), knotweeds (*Polygonum* spp.), and woolgrass (*Scirpus cyperinus*). Vines may be present at low cover including black bindweed (*Polygonum convolvulus*) and devil's darning needles (*Clematis virginiana*).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus amomum, Rosa multiflora*
Herb (field)	Forb	*Boehmeria cylindrica, Solidago gigantea*
Herb (field)	Graminoid	*Carex trichocarpa, Dichanthelium clandestinum*

Characteristic Species: *Carex trichocarpa, Boehmeria cylindrica, Solidago gigantea, Cornus amomum.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Riverside Hairy-fruit Sedge Flat	Walz et al 2006
PA	S3	1	no crosswalk	Fike 1999

Local Range: This vegetation type is occasional throughout the park on the floodplain of the Delaware River and major tributaries.

Classification Comments: This type is distinguished by the clear dominance of *Carex trichocarpa* and low shrub cover (<25%).

Other Comments: None.

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

Plots and Data Sources: DEWA.50; Accuracy Assessment Observation Points DEWA.178, DEWA.591, DEWA.551.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Temporarily flooded temperate or subpolar grassland (V.A.5.N.j.)
Alliance	*Carex torta* Temporarily Flooded Herbaceous Alliance (A.1340)
Alliance (English name)	Twisted Sedge Temporarily Flooded Herbaceous Alliance
Association	*Carex trichocarpa - Scirpus* spp. - *Solidago gigantea* Herbaceous Vegetation [Provisional]
Association (English name)	Hairy-fruit Sedge - Bulrush species - Giant Goldenrod Herbaceous Vegetation
Ecological System(s):	Central Appalachian Floodplain (CES202.608)

GLOBAL DESCRIPTION

Concept Summary: This linear association occurs in small patches on floodplain edges and islands where tree canopy is lacking, on mid-Atlantic medium- to large-sized rivers. This community is routinely flooded during most high-water events and commonly occurs on low flats associated with the active floodplain, either directly adjacent to the channel or in association with backwater depressions and sloughs. *Carex trichocarpa* is the dominant species in this association. It typically forms a band 5-10 m wide and about 50 m long. Shrubs may be present but at less than 25% cover, including *Rosa multiflora, Cornus amomum*, and *Rubus allegheniensis*. Other common herbaceous species include *Solidago gigantea, Boehmeria cylindrica, Dichanthelium clandestinum, Phalaris arundinacea, Urtica dioica, Polygonum* spp., and *Scirpus cyperinus*. Vines may be present at low cover, including *Polygonum convolvulus* and *Clematis virginiana*.
Environmental Description: This association is found occasionally in small patches on floodplain edges and islands where tree canopy is lacking. Typical soils include the coarse loamy to sandy somewhat poorly to very poorly drained glacio-fluvial deposits. This community is routinely flooded during most high-water events and commonly occurs on low flats associated with the active floodplain, either directly adjacent to the channel or in association with backwater depressions and sloughs.
Vegetation Description: *Carex trichocarpa* is the dominant species in this association. Shrubs may be present but at less than 25% cover, including *Rosa multiflora, Cornus amomum*, and *Rubus allegheniensis*. Other common herbaceous species include *Solidago gigantea, Boehmeria cylindrica, Dichanthelium clandestinum, Phalaris arundinacea, Urtica dioica, Polygonum* spp., and *Scirpus cyperinus*. Vines may be present at low cover, including *Polygonum convolvulus* and *Clematis virginiana*.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex trichocarpa*

Characteristic Species: *Boehmeria cylindrica, Carex trichocarpa, Cornus amomum, Dichanthelium clandestinum, Solidago gigantea.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This community occurs in northern New Jersey and northeastern Pennsylvania and possibly elsewhere.
States/Provinces: NJ, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (7-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Provisional.
Confidence: 2 – Moderate.
Comments: Described from Delaware Water Gap, where distinct although narrow and linear; occurrence elsewhere in the northeastern U.S. needs to be documented.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d.

Figure 94. Hairyfruit Sedge Wetland in Delaware Water Gap National Recreation Area (plot DEWA.50). July 2003.

Figure 95. Hairyfruit Sedge Wetland in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.549). June 2006.

COMMON NAME (PARK-SPECIFIC): TUSSOCK SEDGE MARSH

SYNONYMS
NVC English Name: **Tussock Sedge - Inflated Sedge Herbaceous Vegetation**
NVC Scientific Name: ***Carex stricta* - *Carex vesicaria* Herbaceous Vegetation**
NVC Identifier: **CEGL006412**

LOCAL INFORMATION

Environmental Description: These wetlands are associated with impounded drainages, ponded areas near streams, or saturated areas surrounding drainages. Tussock sedge marshes often form in areas previously influenced by beaver impoundments. The substrate may be peat, muck, Alden mucky silt loam or soils in the Fredon-Halsey complex. There is generally standing water between the tussocks for much of the year.
Vegetation Description: Tussock sedge (*Carex stricta*) dominates these wetlands, covering 30-75% of the area. Associated species are woolgrass (*Scirpus cyperinus*), swamp smartweed (*Polygonum hydropiperoides*), branched bur-reed (*Sparganium androcladum*), rice cutgrass (*Leersia oryzoides*), a variety of sedges (*Carex hystericina, Carex bebbii, Carex scoparia, Carex lurida, Carex stipata*), northern bugleweed (*Lycopus uniflorus*), arrowleaf tearthumb (*Polygonum sagittatum*), stiff marsh bedstraw (*Galium tinctorium*), eastern marsh fern (*Thelypteris palustris*), and rushes (*Juncus* spp.). The invasive species Japanese stiltgrass (*Microstegium vimineum*) and purple loosestrife (*Lythrum salicaria*) can be abundant in these wetlands. Scattered tall or short shrubs may cover up to 10% of the area; common species include white meadowsweet (*Spiraea alba*), silky dogwood (*Cornus amomum*), and gray alder (*Alnus incana*). Scattered dead or dying red maple (*Acer rubrum*) or pin oak (*Quercus palustris*) trees may also be present.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Carex stricta*

Characteristic Species: *Carex stricta, Carex* spp., *Leersia oryzoides, Polygonum hydropiperoides, Polygonum sagittatum.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Eastern Tussock Sedge Meadow	Walz et al 2006
PA	S4	1	Tussock sedge marsh	Fike 1999

Local Range: This wetland is found throughout the park associated with impounded and saturated drainages and streams.
Classification Comments: Tussock Sedge Marsh is distinguished from other palustrine types by the dominance of *Carex stricta* and often evidence of impounded hydrology.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.165, DEWA.239; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Carex stricta* Seasonally Flooded Herbaceous Alliance (A.1397)
Alliance (English name)	Tussock Sedge Seasonally Flooded Herbaceous Alliance
Association	*Carex stricta - Carex vesicaria* Herbaceous Vegetation
Association (English name)	Tussock Sedge - Inflated Sedge Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

GLOBAL DESCRIPTION

Concept Summary: These tussock sedge meadows are distributed across the northeastern United States. They occur in seasonally flooded basins or on stream or lake margins. The substrate is peat or muck of variable depth overlying mineral soil. Standing water may be present only at the beginning of, or through much of, the growing season depending on the site and the year's precipitation; even when the water drops, the soils remain saturated. Microtopography is characterized by large tussocks, particularly when the hydroperiod is extended. The physiognomy is strongly herbaceous, or in some cases herbs mixed with shrubs (up to 25% shrub cover); trees are absent. Bryophyte cover is usually sparse but may occasionally reach over 50%. *Carex stricta*, in its tussock form, is the usual dominant. *Carex vesicaria, Carex utriculata*, and *Calamagrostis canadensis* may also be locally abundant. Associated graminoids include *Carex canescens, Carex comosa, Carex scoparia, Carex stipata, Carex vulpinoidea, Glyceria canadensis, Dulichium arundinaceum, Leersia oryzoides*, and *Scirpus cyperinus*; forbs and ferns include *Asclepias incarnata, Thelypteris palustris, Eupatorium maculatum, Campanula aparinoides, Osmunda regalis, Comarum palustre (= Potentilla palustris), Lysimachia terrestris, Angelica atropurpurea, Eupatorium perfoliatum, Lycopus americanus, Polygonum hydropiperoides, Galium obtusum*, and others. *Lythrum salicaria* may be invasive in some settings. Shrub associates vary with geography. In the northern part of the range, *Alnus incana, Myrica gale, Ilex verticillata, Chamaedaphne calyculata*, and *Spiraea alba* are often present. Bryophytes, where present, include *Sphagnum magellanicum, Sphagnum girgensohnii, Sphagnum palustre, Drepanocladus aduncus*, and others. This association is differentiated from other wet meadows by the strong dominance of *Carex stricta*.

Environmental Description: These tussock sedge meadows are distributed across the northeastern United States. They occur in seasonally flooded basins or on stream or lake margins. The substrate is peat or muck of variable depth overlying mineral soil. Standing water may be present only at the beginning of, or through much of, the growing season depending on the site and the year's precipitation; even when the water drops, the soils remain saturated. Microtopography is characterized by large tussocks, particularly when the hydroperiod is extended.

Vegetation Description: The physiognomy is strongly herbaceous, or in some cases herbs mixed with shrubs (up to 25% shrub cover); trees are absent. Bryophyte cover is usually sparse but may occasionally reach over 50%. *Carex stricta*, in its tussock form, is the usual dominant. *Carex vesicaria, Carex utriculata*, and *Calamagrostis canadensis* may also be locally abundant.

Associated graminoids include *Carex canescens, Carex comosa, Carex scoparia, Carex stipata, Carex lurida, Carex vulpinoidea, Glyceria canadensis, Dulichium arundinaceum, Leersia oryzoides,* and *Scirpus cyperinus*; forbs and ferns include *Asclepias incarnata, Thelypteris palustris, Eupatorium maculatum, Campanula aparinoides, Osmunda regalis, Comarum palustre (= Potentilla palustris), Lysimachia terrestris, Angelica atropurpurea, Eupatorium perfoliatum, Lycopus americanus, Polygonum hydropiperoides, Polygonum sagittatum, Galium obtusum*, and others. *Lythrum salicaria* may be invasive in some settings. Shrub associates vary with geography. In the northern part of the range, *Alnus incana, Myrica gale, Ilex verticillata, Chamaedaphne calyculata*, and *Spiraea alba* are often present. Bryophytes, where present, include *Sphagnum magellanicum, Sphagnum girgensohnii, Sphagnum palustre, Drepanocladus aduncus*, and others.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis, Carex stricta, Carex utriculata, Carex vesicaria*

Characteristic Species: *Carex stricta, Leersia oryzoides.*
Other Noteworthy Species: *Scirpus ancistrochaetus.*
USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This tussock sedge meadow is found in northern New England, the Adirondack Mountains, and parts of the Appalachians.
States/Provinces: CT, DE, MA, MD, ME:S3, NH, NJ, NY:S4, PA, RI, VT:S4, WV.
Federal Lands: NPS (Acadia, Delaware Water Gap, Fort Necessity, Minute Man); USFWS (Aroostook?, Assabet River?, Carlton Pond?, Great Meadows?, Great Swamp, Moosehorn?, Oxbow, Parker River?).

CONSERVATION STATUS

Rank: G4G5 (12-Dec-2005).
Reasons: This association is widely distributed throughout New England and northern New York in its small-patch setting and extends sporadically southward.

CLASSIFICATION INFORMATION

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

- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519).
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258).

Related Concepts:

- *Carex stricta* wet meadow (CAP pers. comm. 1998) ?
- Coastal Plain Intermittent Pond (Breden 1989) B
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) ?
- Sedge Meadow (Thompson 1996) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

- Tussock sedge meadow (NAP pers. comm. 1998) ?

SOURCES

Description Authors: S. C. Gawler.

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Curtis 1959, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Harrison 2004, Metzler and Barrett 2001, NAP pers. comm. 1998, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto 2000b, Swain and Kearsley 2001, Thompson 1996, Thompson and Jenkins 1992, Thompson and Sorenson 2000.

Figure 96. Tussock Sedge Marsh in Delaware Water Gap National Recreation Area (plot DEWA.165). August 2003.

Figure 97. Tussock Sedge Marsh in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation point DEWA.541). April 2006.

COMMON NAME (PARK-SPECIFIC): CALCAREOUS RIVERSIDE SEEP

SYNONYMS
NVC English Name: **Tufted Hairgrass - Little Green Sedge Herbaceous Vegetation**
NVC Scientific Name: ***Deschampsia caespitosa - Carex viridula* Herbaceous Vegetation**
NVC Identifier: **CEGL006969**

LOCAL INFORMATION

Environmental Description: This vegetation type occurs along the shoreline of the Delaware River where winter ice-scouring, limestone bedrock, and natural seepage co-occur. This association occurs on alluvial deposits combined with cobble substrate in which weathered bedrock has been broken into distinct rocks of various sizes. The seeps are generated in areas where groundwater flows out and over the cobble substrate, supporting many calciphiles and rare species. Winter ice-scour that removes tall vegetation and woody plants maintains predominantly herbaceous vegetation. The early-successional floristic assemblages include species able to regenerate from buried rootstocks or from seeds dispersed along the shoreline. Seasonal and annual variation in water levels is another important process affecting the vegetation. Calcareous Riverside Seep is often found interspersed with Calcareous Riverside Outcrop along the shoreline of the Delaware River.

Vegetation Description: Vegetation can be dense, robust, and diverse. These sites are dominated by grasses, including tufted hairgrass (*Deschampsia caespitosa*), slender wedgescale (*Sphenopholis intermedia*), and big bluestem (*Andropogon gerardii*). Numerous sedges may be present, such as little green sedge (*Carex viridula*), blister sedge (*Carex vesicaria*), bottlebrush sedge (*Carex hystericina*), woolly sedge (*Carex pellita*), limestone meadow sedge (*Carex granularis*), owlfruit sedge (*Carex stipata*), broom sedge (*Carex scoparia*) and fox sedge (*Carex vulpinoidea*). Characteristic rare species include little green sedge, rough bentgrass (*Agrostis scabra*), flatstem spikerush (*Eleocharis compressa*), muskflower (*Mimulus moschatus*), panicled bulrush (*Scirpus microcarpus*), crookedstem aster (*Symphyotrichum prenanthoides*), smallhead rush (*Juncus brachycephalus*), and shining ladies'-tresses (*Spiranthes lucida*). A wide variety of associated species may be present, including annual agricultural weeds, old-field species, and plants common in Riverine Scour Vegetation. Some of the numerous common associates include spreading dogbane (*Apocynum androsaemifolium*), garden yellowrocket (*Barbarea vulgaris*), horsetails (*Equisetum* spp.), American water horehound (*Lycopus americanus*), ragged robin (*Lychnis flos-cuculi*), true forget-me-not (*Myosotis scorpioides*), sensitive fern (*Onoclea sensibilis*), fen grass of Parnassus (*Parnassia glauca*), common plantain (*Plantago major*), creeping buttercup (*Ranunculus repens*), watercress (*Rorippa nasturtium-aquaticum*), and common threesquare (*Schoenoplectus pungens*). Scattered shrubs may be present, such as smooth rose (*Rosa blanda*), sycamore (*Platanus occidentalis*), common ninebark (*Physocarpus opulifolius*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), willows (*Salix* spp.), and alders (*Alnus* spp.). These sites are susceptible to invasion by purple loosestrife (*Lythrum salicaria*) and Japanese stiltgrass (*Microstegium vimineum*).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Andropogon gerardii, Carex viridula, Deschampsia caespitosa, Sphenopholis intermedia, Carex spp.*

Characteristic Species: *Deschampsia caespitosa, Carex viridula.*
Other Noteworthy Species: *Agrostis scabra, Carex viridula, Eleocharis compressa, Juncus brachycephalus, Mimulus moschatus, Scirpus microcarpus, Spiranthes lucida, Symphyotrichum prenanthoides.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1	1	Calcareous Riverside Seep	Walz et al 2006

Local Range: There are three locations of this type of river shoreline along the New Jersey side of the Delaware River within the park.
Classification Comments: Calcareous Riverside Seep occurs interspersed with Calcareous Riverside Outcrop, however, it is restricted to areas of groundwater seepage and contains plants that are dependent on the groundwater seepage. By contrast, the Calcareous Riverside Outcrop does not contain groundwater seepage and its plants are generally xerophilic. The Calcareous Riverside Seep is distinguished from Riverine Scour Vegetation by the groundwater flowing out and over cobbled limestone substrate and the presence of numerous rare species (may be ephemeral).
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: Accuracy Assessment Observation Point DEWA.616; Shank and Shreiner 1999, Breden 1989.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Deschampsia caespitosa* Seasonally Flooded Herbaceous Alliance (A.1408)
Alliance (English name)	Tufted Hairgrass Seasonally Flooded Herbaceous Alliance
Association	*Deschampsia caespitosa - Carex viridula* Herbaceous Vegetation
Association (English name)	Tufted Hairgrass - Little Green Sedge Herbaceous Vegetation
Ecological System(s):	Central Appalachian Riparian (CES202.609)

GLOBAL DESCRIPTION

Concept Summary: This calcareous riverside seep community occurs along sections of river shoreline where winter ice-scouring, limestone outcrops, and natural seepage co-occur. The community is typically characterized by open, sparsely vegetated sections of smooth limestone

outcrops that extend for variable lengths from the woodland edge to the river edge or areas of fractured ("latticed") limestone supporting denser vegetation in the crevices. Typically, sites have a north-northwest exposure and are fully exposed to late-day sun. The slope of the outcrops ranges from a gentle incline rising from the river shoreline to a 28-degree incline at the most steeply sloped sites. Species composition is variable and diverse, but the most frequent species are *Symphyotrichum lanceolatum (= Aster lanceolatus), Deschampsia caespitosa, Carex viridula, Lythrum salicaria*, and *Phalaris arundinacea*. Other characteristic species include *Apios americana, Apocynum cannabinum (= Apocynum sibiricum), Artemisia vulgaris, Barbarea vulgaris, Doellingeria umbellata, Eleocharis* spp., *Eupatorium perfoliatum, Galium boreale, Hypericum mutilum, Juncus canadensis, Juncus dudleyi, Lobelia siphilitica, Lychnis flos-cuculi, Lycopus americanus, Lysimachia ciliata, Myosotis scorpioides, Parnassia glauca, Plantago major, Poa* spp., *Prunella vulgaris, Ranunculus repens, Rubus odoratus, Scirpus microcarpus, Spiranthes lucida, Viola* spp., and *Zizia aurea*. Several species of *Carex* are often present, including *Carex granularis, Carex hystericina, Carex pellita (= Carex lanuginosa), Carex scoparia, Carex stipata, Carex vesicaria, Carex viridula*, and *Carex vulpinoidea*. Sparse shrubs may be present, mostly at the upslope end near the forest transition; they include *Alnus incana, Platanus occidentalis, Salix* spp., *Ulmus rubra, Cornus amomum, Rosa palustris*, and *Spiraea alba*.

Environmental Description: This calcareous riverside seep community occurs along sections of river shoreline where winter ice-scouring, limestone outcrops, and natural seepage co-occur. The substrate is alluvial deposits combined with cobbled substrate in which weathered bedrock has been broken into distinct rocks of various sizes. The seeps are generated in areas where groundwater flows out and over the cobbled substrate, supporting many calciphiles and rare species. Winter ice-scour that removes tall vegetation and woody plants maintains predominantly herbaceous vegetation. The early-successional floristic assemblages include species able to regenerate from buried rootstocks or from seeds dispersed along the shoreline. Seasonal and annual variation in water levels is another important process affecting the vegetation. Typically, sites have a north-northwest exposure and are fully exposed to late-day sun. The slope of the outcrops ranges from a gentle incline rising from the river shoreline to a 28-degree incline at the most steeply sloped sites.

Vegetation Description: Species composition is variable and diverse, but the most frequent species are *Deschampsia caespitosa, Andropogon gerardii, Sphenopholis intermedia, Symphyotrichum lanceolatum (= Aster lanceolatus), Carex viridula*, and *Phalaris arundinacea*. Other characteristic species include *Agrostis scabra, Apios americana, Apocynum cannabinum (= Apocynum sibiricum), Artemisia vulgaris, Barbarea vulgaris, Doellingeria umbellata, Eleocharis compressa, Eupatorium perfoliatum, Galium boreale, Hypericum mutilum, Juncus canadensis, Juncus brachycephalus, Juncus dudleyi, Lobelia siphilitica, Lychnis flos-cuculi, Lycopus americanus, Lysimachia ciliata, Myosotis scorpioides, Parnassia glauca, Plantago major, Poa* spp., *Prunella vulgaris, Ranunculus repens, Salix interior, Scirpus microcarpus, Spiranthes lucida, Symphyotrichum prenanthoides, Viola* spp., and *Zizia aurea*. Several species of *Carex* are often present, including *Carex granularis, Carex hystericina, Carex pellita (= Carex lanuginosa), Carex scoparia, Carex stipata, Carex vesicaria, Carex viridula*, and *Carex vulpinoidea*. Scattered shrubs may be present, such as *Rosa blanda, Platanus occidentalis, Ulmus rubra, Physocarpus opulifolius, Betula nigra, Acer saccharinum, Acer rubrum, Spiraea alba, Salix* spp., and *Alnus* spp. These sites are susceptible to invasion by *Lythrum salicaria* and *Microstegium vimineum*.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Andropogon gerardii, Carex viridula, Deschampsia caespitosa, Sphenopholis intermedia*

Characteristic Species: *Carex viridula, Doellingeria umbellata, Parnassia glauca, Spiranthes lucida.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: Information not available.
States/Provinces: NJ.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (8-Nov-2000).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Community description based on report completed by Leslie Shank in 1999. All study sites were located in New Jersey along the Delaware River. This is community encompasses a wide range of species assemblages. The classification of this type is based on information from a very limited area and must be treated of low confidence pending further inventory and data collection.
Similar Associations:
- *Andropogon gerardii - Campanula rotundifolia - Solidago simplex* Sparse Vegetation (CEGL006284)--occurring on alluvial ledges rather than seeps.

Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Breden 1989, Eastern Ecology Working Group n.d., Shank and Shreiner 1999.

Figure 98. Calcareous Riverside Seep in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation point DEWA.616). June 2006.

COMMON NAME (PARK-SPECIFIC): REED CANARYGRASS RIVERINE GRASSLAND

SYNONYMS
NVC English Name: **Reed Canarygrass Eastern Herbaceous Vegetation**
NVC Scientific Name: ***Phalaris arundinacea* Eastern Herbaceous Vegetation**
NVC Identifier: **CEGL006044**

LOCAL INFORMATION

Environmental Description: This association is typically found on bars, shorelines, or islands in the Delaware River and smaller tributaries. These areas are exposed to frequent floods, high stream velocity and ice-scour. The substrate is typically coarse, composed of sand, gravel, and cobbles.

Vegetation Description: This association is characterized by thick herbaceous and graminoid vegetation dominated by reed canarygrass (*Phalaris arundinacea*). A diverse mix of other herbaceous and graminoid species also persists. Some common species are marshpepper knotweed (*Polygonum hydropiper*), stinging nettle (*Urtica dioica*), Canadian clearweed (*Pilea pumila*), watercress (*Rorippa nasturtium-aquaticum*), whitegrass (*Leersia virginica*), smallspike false nettle (*Boehmeria cylindrica*), fowl bluegrass (*Poa palustris*), wild mint (*Mentha arvensis*), and wingstem (*Verbesina alternifolia*). A few scattered willows (*Salix* spp.), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), and silky dogwood (*Cornus amomum*) may be present as short shrubs; however, their relative cover does not exceed 25%. Vines may also be present; common species include Virginia creeper (*Parthenocissus quinquefolia*), eastern poison ivy (*Toxicodendron radicans*), fox grape (*Vitis labrusca*), and riverbank grape (*Vitis riparia*).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Rubus allegheniensis, Spiraea tomentosa*
Herb (field)	Vine/Liana	*Toxicodendron radicans, Vitis riparia*
Herb (field)	Forb	*Pilea pumila, Polygonum hydropiper, Urtica dioica*
Herb (field)	Graminoid	*Phalaris arundinacea*

Characteristic Species: *Phalaris arundinacea.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Reed Canarygrass Eastern Marsh	Walz et al 2006
PA	S5	1	Bluejoint - reed canary grass marsh	Fike 1999

Local Range: This association is typically found on bars, shorelines, or islands in the Delaware River and smaller tributaries in the park.
Classification Comments: Reed Canarygrass Riverine Grassland is distinguished from other riparian types by the clear dominance of *Phalaris arundinacea*.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.109, DEWA.111; Fike 1999, Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Phalaris arundinacea* Seasonally Flooded Herbaceous Alliance (A.1381)
Alliance (English name)	Reed Canarygrass Seasonally Flooded Herbaceous Alliance
Association	*Phalaris arundinacea* Eastern Herbaceous Vegetation
Association (English name)	Reed Canarygrass Eastern Herbaceous Vegetation
Ecological System(s):	Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018) North-Central Interior Floodplain (CES202.694) Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

GLOBAL DESCRIPTION

Concept Summary: This association is found throughout the northeastern United States and Canada, but its distribution as a natural type is complicated elsewhere. It is native to the United States and Canada but is now more widely distributed and abundant because of local introductions from both local and European populations. The introduced strains may be more aggressive ecotypes than native strains. Stands are found in both minerotrophic basin wetlands as well as rivershores. *Phalaris arundinacea* has been widely used as a forage and hay crop, especially in marshes and floodplains, and it is used for wildlife food and for shoreline and ditch stabilization. Stands are dominated by *Phalaris arundinacea*, a 0.5- to 2-m tall perennial grass, which tends to occur in monocultures or associated with *Calamagrostis canadensis*. Other associates in the Northeast include *Viburnum nudum, Alnus incana* or *Alnus serrulata, Viburnum dentatum*, and *Agrostis gigantea*. Midwest associates include species characteristic of wet meadows. *Phalaris arundinacea* can displace native species over time. Further work is required to resolve the natural versus introduced nature of this type in the Southeast before a description can be completed.

Environmental Description: Stands are found in both minerotrophic basin wetlands as well as rivershores. The dominant species has been widely used as a forage and hay crop, especially in marshes and floodplains, and it is used for wildlife food and for shoreline and ditch stabilization (Barnes 1999).

Vegetation Description: Stands are dominated by *Phalaris arundinacea*, a 0.5- to 2-m tall perennial grass that is native to the United States and Canada, but which has also been introduced from European strains. The introduced strains may be more aggressive ecotypes than native strains (Barnes 1999). It tends to occur in monocultures or associated with *Calamagrostis canadensis*. Other associates in the Northeast include *Viburnum nudum, Salix* spp., *Alnus incana* or *Alnus serrulata, Viburnum dentatum, Poa palustris, Mentha arvensis, Leersia virginica*, and *Agrostis gigantea*. Midwest associates include species characteristic of wet meadows. *Phalaris arundinacea* can displace native species over time (Apfelbaum and Sams 1987, Barnes 1999, and references therein). Further work is required to resolve the natural versus introduced nature of this type in the Southeast before a description can be completed.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Phalaris arundinacea*

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

DISTRIBUTION
Range: This association is found throughout the northeastern United States and Canada, but its distribution as a natural type is complicated elsewhere. It currently ranges from Virginia north to Vermont, east to Minnesota and south to Tennessee.
States/Provinces: CT, DE, IA, MA, MD, ME, MN, NH, NJ, NY, OH, ON, PA, RI, TN, VA, VT, WV.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap, Effigy Mounds, Eisenhower, Gettysburg); USFWS (Assabet River?, Great Meadows?, Great Swamp, Oxbow, Parker River).

CONSERVATION STATUS
Rank: GNA (invasive) (1-Dec-1997).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Type has a broad distribution; in fact, it is widespread throughout temperate areas of the northern hemisphere. It is native to the United States and Canada, but is now more widely distributed and abundant because of local introductions from both local and European populations (Apfelbaum and Sams 1987). It can invade a variety of habitats, suggesting that little unites these stands apart from the dominance of *Phalaris arundinacea*. However, that may be the only reasonable way to describe this type. This vegetation is documented from Shady Valley TNC Preserve, Johnson County, Tennessee, where it occupies channelized streams, impoundments, and fen restoration sites. In these examples, characteristic associates include *Juncus effusus, Carex lurida, Carex gynandra,* and *Alnus serrulata*.
Similar Associations:
- *Calamagrostis canadensis - Phalaris arundinacea* Herbaceous Vegetation (CEGL005174).
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474).

Related Concepts:
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) ?
- Reed canary grass riverine grassland (Perles et al. 2004) ?
- SNE low-energy riverbank community (Rawinski 1984) ?
- Shallow Emergent Marsh (Thompson 1996) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES
Description Authors: D. Faber-Langendoen, mod. S. C. Gawler.
References: Apfelbaum and Sams 1987, Barnes 1999, Cowardin et al. 1979, Edinger et al. 2002, Fike 1999, Metzler and Barrett 2001, Midwestern Ecology Working Group n.d., Perles et

al. 2004, Rawinski 1984, Sperduto 2000a, Swain and Kearsley 2001, TDNH unpubl. data, Thompson 1996, Thompson and Sorenson 2000.

Figure 99. Reed Canarygrass Riverine Grassland in Delaware Water Gap National Recreation Area (plot DEWA.109). August 2003.

Figure 100. Reed Canarygrass Riverine Grassland in Delaware Water Gap National Recreation Area (plot DEWA.111). August 2003.

COMMON NAME (PARK-SPECIFIC): CATTAIL MARSH

SYNONYMS

NVC English Name: **(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation**

NVC Scientific Name: ***Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Eastern Herbaceous Vegetation**

NVC Identifier: **CEGL006153**

LOCAL INFORMATION

Environmental Description: This variable wetland type occurs in depressions and basins that contain ponded water nearly year round. In general, waterflow out of the sites is restricted, either due to naturally occurring depressions, or from beaver activity, roads, or berms. These wetlands typically occur on very poorly drained soils such as Alden mucky silt loam and shallow mucky peat.

Vegetation Description: These wetlands are strongly dominated by broadleaf cattail (*Typha latifolia*) or narrowleaf cattail (*Typha angustifolia*), that cover >50% of the area. Associated species vary widely, including tussock sedge (*Carex stricta*), bulrushes (*Scirpus* spp.), knotweeds (*Polygonum* spp.), horsetails (*Equisetum* spp.), sedges (*Carex* spp.), spikerushes (*Eleocharis* spp.), common marsh bedstraw (*Galium palustre*), sensitive fern (*Onoclea sensibilis*), and blue skullcap (*Scutellaria lateriflora*). The invasive species purple loosestrife (*Lythrum salicaria*) can form monocultures in this association.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha* spp.

Characteristic Species: *Typha angustifolia, Typha latifolia, Galium palustre, Onoclea sensibilis, Scirpus* spp.*, Polygonum* spp.*, Equisetum* spp.*, Carex* spp.*, Eleocharis* spp.

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S5	1	Eastern Cattail Marsh	Walz et al 2006
PA	S5	1	Cattail Marsh	Fike 1999

Local Range: These wetlands occur in depressions and basins that contain ponded water throughout the park.

Classification Comments: This association is identified by clear dominance (>50% cover) of *Typha* spp.

Other Comments: None.

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

Plots and Data Sources: Accuracy Assessment Observation Point DEWA.1006; Fike 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)

Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l.)
Alliance	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.*)* Semipermanently Flooded Herbaceous Alliance (A.1436)
Alliance (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance
Association	*Typha (angustifolia, latifolia)* - *(Schoenoplectus* spp.) Eastern Herbaceous Vegetation
Association (English name)	(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Eastern Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594)

GLOBAL DESCRIPTION

Concept Summary: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined to the hummocks. *Typha angustifolia, Typha latifolia*, or their hybrid *Typha X glauca* dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita (= Carex lanuginosa), Carex stricta, Scirpus cyperinus*, and bulrushes, such as *Schoenoplectus americanus (= Scirpus americanus)* and *Schoenoplectus acutus (= Scirpus acutus)*, occur along with patchy grasses, such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Onoclea sensibilis, Symplocarpus foetidus, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum*, and *Verbena hastata*. Floating aquatics, such as *Lemna minor*, may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata*, and *Spiraea alba* are common. The invasive exotic plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences. This association is distinguished from other northeastern freshwater marshes by the strong dominance of *Typha* spp.

Environmental Description: These tall emergent marshes are common throughout the northeastern United States and adjacent Canadian provinces. They occur in permanently flooded basins, often as part of a larger wetland mosaic and associated with lakes, ponds, or slow-moving streams. The substrate is muck over mineral soil. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This association is often found in impounded waters.

Vegetation Description: Tall graminoids dominate the vegetation; scattered shrubs are often present (usually totaling less than 25% cover) and are frequently shorter than the graminoids. Trees are absent. Bryophyte cover varies and is rarely extensive; bryophytes are mostly confined

to the hummocks. *Typha angustifolia, Typha latifolia,* or their hybrid *Typha X glauca* dominate, either alone or in combination with other tall emergent marsh species. Associated species vary widely; sedges, such as *Carex aquatilis, Carex lurida, Carex rostrata, Carex pellita (= Carex lanuginosa), Carex stricta, Scirpus cyperinus,* and bulrushes, such as *Schoenoplectus americanus (= Scirpus americanus)* and *Schoenoplectus acutus (= Scirpus acutus),* occur along with patchy grasses, such as *Calamagrostis canadensis*. Broad-leaved herbs include *Thelypteris palustris, Asclepias incarnata, Onoclea sensibilis, Symplocarpus foetidus, Calla palustris, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum,* and *Verbena hastata*. Floating aquatics, such as *Lemna minor,* may be common in deeper zones. Shrub species vary across the geographic range of this type; in the northern part of its range, *Myrica gale, Ilex verticillata,* and *Spiraea alba* are common. The invasive exotic plants *Lythrum salicaria* and *Phragmites australis* may be abundant in parts of some occurrences.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Typha angustifolia, Typha latifolia, Typha x glauca*

Characteristic Species: *Onoclea sensibilis, Schoenoplectus acutus, Schoenoplectus americanus, Typha angustifolia, Typha latifolia.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association occurs throughout the northeastern U.S. from Maine to North Carolina.

States/Provinces: CT, DE, MA, MD, ME:S5, NC, NH:S4?, NJ:S5, NY, PA, RI, VA, VT, WV.

Federal Lands: NPS (Acadia, Blue Ridge Parkway?, Cape Cod, Delaware Water Gap, Johnstown Flood, Minute Man, Saint-Gaudens); USFWS (Aroostook, Assabet River, Carlton Pond?, Great Meadows, Great Swamp, Moosehorn, Nomans Land Island, Nulhegan Basin, Oxbow, Pondicherry?).

CONSERVATION STATUS

Rank: G5 (1-Dec-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* often occurs in pure stands and can colonize areas recently exposed by either natural or human causes.

Similar Associations:

- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150).
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229).
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112).
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233).

Related Concepts:

- Cattail Marsh (Thompson 1996) ?
- Cattail marsh (CAP pers. comm. 1998) ?
- Palustrine Narrow-leaved Persistent Emergent Wetland, Permanently Flooded (PEM5H) (Cowardin et al. 1979) ?
- Robust Emergent Marsh (Breden 1989) ?
- Southern New England nutrient-poor streamside/lakeside marsh (Rawinski 1984) ?
- Southern New England nutrient-rich streamside/lakeside marsh (Rawinski 1984) ?

SOURCES

Description Authors: S. C. Gawler.

References: Breden 1989, Breden et al. 2001, CAP pers. comm. 1998, Clancy 1996, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Gawler 2002, Grace and Wetzel 1981, Harrison 2004, Metzler and Barrett 2001, Northern Appalachian Ecology Working Group 2000, Rawinski 1984, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

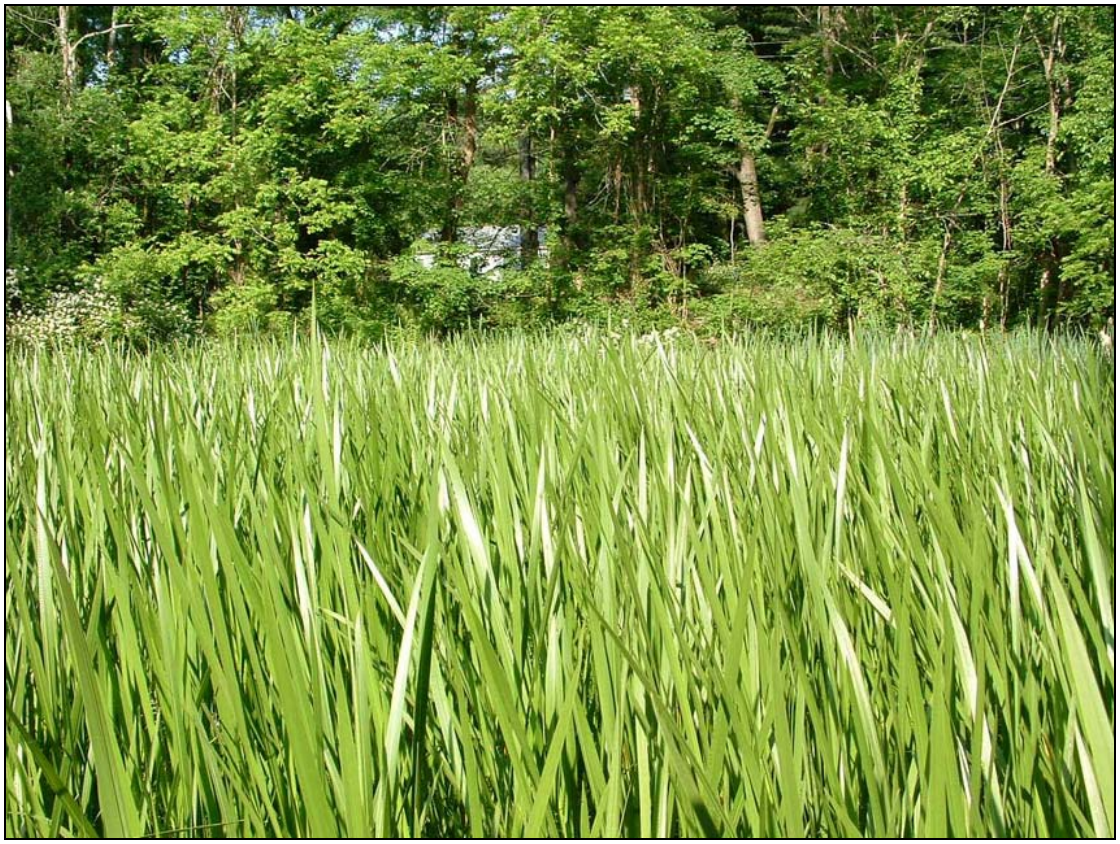

Figure 101. Cattail Marsh in Delaware Water Gap National Recreation Area (near Peters Valley in New Jersey). June 2006.

COMMON NAME (PARK-SPECIFIC): ACIDIC SEEP

SYNONYMS

NVC English Name: **Tufted Hairgrass - Hammond's Springbeauty Herbaceous Vegetation**

NVC Scientific Name: ***Deschampsia caespitosa - Claytonia virginica* var. *hammondiae* Herbaceous Vegetation**

NVC Identifier: **CEGL006101**

LOCAL INFORMATION

Environmental Description: This association is limited to a single occurrence within the park. A similar seep occurs nearby just beyond the park boundary which grades from open herbaceous seep to palustrine shrubland. The bedrock is the Ordovician Ramseyburg Member composed of acidic graywacke sandstone, siltstone, shale and slate. Soils are of the Wurtsboro-Swartswood complex, an acidic, extremely stony loam. The seeps occur near the toeslope of Kittatinny Ridge, with a southeast aspect. Groundwater seepage appears to persist for most of the growing season.

Vegetation Description: Forest and shrub strata are absent from this community. The herbaceous layer is depauperate, possibly due to the acidic nature of the groundwater seepage, but total vegetation cover is greater than 95%. The herbaceous layer is dominated by tufted hairgrass (*Deschampsia caespitosa*), with downy goldenrod (*Solidago puberula*) subdominant. Other typical species include little bluestem (*Schizachyrium scoparium*), Hammond's claytonia (*Claytonia virginica* var. *hammondiae*), bromelike sedge (*Carex bromoides*), and prickly bog sedge (*Carex atlantica* ssp. *atlantica*). Boreal chickweed (*Cerastium biebersteinii*), an exotic of European origin, is also common. A bryophyte layer dominated by *Sphagnum* species included the following species: *Sphagnum bartlettianum, Sphagnum henryense, Sphagnum palustre*, and *Sphagnum recurvum*.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Cerastium biebersteinii, Claytonia virginica* var. *hammondiae, Lobelia kalmii, Solidago puberula*
Herb (field)	Graminoid	*Deschampsia caespitosa, Schizachyrium scoparium*

Characteristic Species: *Claytonia virginica* var. *hammondiae, Deschampsia caespitosa, Lobelia kalmii, Schizachyrium scoparium, Solidago puberula.*

Other Noteworthy Species: *Claytonia virginica* var. *hammondiae.*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1	1	Kittatinny Acidic Seep	Walz et al 2006

Local Range: This association is limited to a single occurrence within the park associated with the surface discharge of acidic groundwater on the southeast toeslope of Kittatinny Ridge.

Classification Comments: This vegetation type also occurs downslope in the same drainageway. At this second location it grades from open Acidic Seep as described above to a palustrine shrubland. The palustrine shrubland contains scattered trees, including eastern white pine (*Pinus strobus*) and pitch pine (*Pinus rigida*). The tall-shrub layer is dominated by tree

saplings such as yellow birch (*Betula alleghaniensis*), eastern hemlock (*Tsuga canadensis*), and great laurel (*Rhododendron maximum*). The short-shrub layer is more variable and is characterized by sheep laurel (*Kalmia angustifolia*), black chokeberry (*Photinia melanocarpa*), northern spicebush (*Lindera benzoin*), and tree saplings. The herbaceous layer is slightly more diverse, with wavy hairgrass the dominant and boreal chickweed, Hammond's claytonia, skunk-cabbage (*Symplocarpus foetidus*), roundleaf sundew (*Drosera rotundifolia*), and rice cutgrass (*Leersia oryzoides*) as common associates.

Other Comments: None.

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

Plots and Data Sources: DEWA.233, DEWA.234; Radis 1989.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Saturated temperate or subpolar grassland (V.A.5.N.m.)
Alliance	*Deschampsia caespitosa* Saturated Herbaceous Alliance (A.1456)
Alliance (English name)	Tufted Hairgrass Saturated Herbaceous Alliance
Association	*Deschampsia caespitosa - Claytonia virginica* var. *hammondiae* Herbaceous Vegetation
Association (English name)	Tufted Hairgrass - Hammond's Springbeauty Herbaceous Vegetation
Ecological System(s):	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

GLOBAL DESCRIPTION

Concept Summary: This acidic seepage wetland community is known from a single location on the Kittatinny Mountains of northern New Jersey where seepage water is diverted to the surface by a clay fragipan. The pH ranges from 4.5-4.7. The vegetation is dominated by *Deschampsia caespitosa, Carex bromoides, Carex atlantica* ssp. *atlantica (= Carex atlantica* var. *incomperta)*, and *Claytonia virginica* var. *hammondiae*. Other less frequent associates include *Symplocarpus foetidus, Osmunda cinnamomea, Maianthemum canadense, Viola cucullata, Kalmia angustifolia, Coptis trifolia,* and *Solidago puberula*. A bryophyte layer dominated by *Sphagnum* species included the following species: *Sphagnum bartlettianum, Sphagnum henryense, Sphagnum palustre*, and *Sphagnum recurvum*. *Cerastium biebersteinii*, an exotic of European origin, also occurs in this vegetation.

Environmental Description: This acidic seepage wetland community is known from a single location on the Kittatinny Mountains of northern New Jersey where seepage water is diverted to the surface by a clay fragipan. Groundwater seepage appears to persist for most of the growing season. The bedrock is the Ordovician Ramseyburg Member composed of acidic graywacke sandstone, siltstone, shale and slate. Soils are of the Wurtsboro-Swartswood complex, an acidic,

extremely stony loam, with pH ranges from 4.5-4.7. The seeps occur near the toeslope of Kittatinny Ridge, with a southeast aspect.

Vegetation Description: The dense herbaceous vegetation is dominated by *Deschampsia caespitosa, Carex bromoides, Carex atlantica* ssp. *atlantica (= Carex atlantica* var. *incomperta),* and *Claytonia virginica* var. *hammondiae*. Other less frequent associates include *Symplocarpus foetidus, Osmunda cinnamomea, Schizachyrium scoparium, Maianthemum canadense, Viola cucullata, Kalmia angustifolia, Coptis trifolia,* and *Solidago puberula*. A bryophyte layer dominated by *Sphagnum* species included the following species: *Sphagnum bartlettianum, Sphagnum henryense, Sphagnum palustre,* and *Sphagnum recurvum*. *Cerastium biebersteinii,* an exotic of European origin, also occurs in this vegetation.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Claytonia virginica* var. *hammondiae, Lobelia kalmii, Schizachyrium scoparium, Solidago puberula*
Herb (field)	Graminoid	*Deschampsia caespitosa*

Characteristic Species: *Carex bromoides, Claytonia virginica* var. *hammondiae, Deschampsia caespitosa, Lobelia kalmii, Schizachyrium scoparium, Solidago puberula.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This community is known only from the Kittatinny Mountains of northern New Jersey. There is a slight potential that it may also occur in eastern Pennsylvania, southeastern New York, or in central Maryland.

States/Provinces: MD?, NJ:S1.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

Rank: G1 (22-Mar-1999).

Reasons: This community is known only from the Kittatinny Mountains of northern New Jersey, where it covers only a few acres. It is threatened by the expansion of an invasive plant. Although the community is somewhat similar to other acidic seepage vegetation, the dominant species and the physical setting are distinct enough to warrant the separation of this vegetation into an association.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: Information not available.

Similar Associations: Information not available.

Related Concepts:

- Inland Acidic Seep Community (Breden 1989)

SOURCES

Description Authors: Eastern Ecology Group, mod. S. C. Gawler.

References: Breden 1989, Breden et al. 2001, Eastern Ecology Working Group n.d., Radis 1986, Snyder 1992.

Figure 102. Acidic Seep in Delaware Water Gap National Recreation Area (plot DEWA.233). August 2004.

Figure 103. Acidic Seep in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.573). May 2006.

COMMON NAME (PARK-SPECIFIC): CALCAREOUS FEN

SYNONYMS

NVC English Name:	**Eastern Red-cedar / Shrubby-cinquefoil / Yellow Sedge - Rigid Sedge Shrub Herbaceous Vegetation**
NVC Scientific Name:	***Juniperus virginiana / Dasiphora fruticosa* ssp. *floribunda* / *Carex flava* - *Carex tetanica* Shrub Herbaceous Vegetation**
NVC Identifier:	**CEGL006357**

LOCAL INFORMATION

Environmental Description: These wetlands occur as small patches where calcareous groundwater discharges to the surface. They typically occur along the toeslope of ridges. Within the park, these fens have been found in association with several calcareous bedrock formations, including the Minisink limestone, Kalkberg limestone, Buttermilk Falls limestone, and the Schoharie Formation (calcareous siltstone and silty limestone). Soils vary from silt loams of the Alden series and Lordstown-Wallpack complex to shallow mucky peat. They are usually open with little or no forest canopy.

Vegetation Description: This association varies in appearance from an open shrubland to open herbaceous vegetation. The tall-shrub layer, when present, is 2-5 m in height with 20% cover or less. Typical tall shrubs include silky dogwood (*Cornus amomum*), eastern red-cedar (*Juniperus virginiana*), and poison sumac (*Toxicodendron vernix*). The short-shrub layer is less than 2 m in height with 20 % cover or less. Typical short shrubs include shrubby cinquefoil (*Dasiphora floribunda*), silky dogwood, steeplebush (*Spiraea tomentosa*), white meadowsweet (*Spiraea alba* var. *latifolia*), and maleberry (*Lyonia ligustrina*). Other characteristic, often calciphilic, shrubs include sageleaf willow (*Salix candida*) and pussy willow (*Salix discolor*). Invasive shrubs may be locally abundant in some fens, especially multiflora rose (*Rosa multiflora*) and autumn-olive (*Elaeagnus umbellata*). The herbaceous layer is up to 1 m in height with total cover greater than 75% (often near 100%). Dominant herb species include golden ragwort (*Packera aurea*), fen grass of Parnassus (*Parnassia glauca*), eastern marsh fern (*Thelypteris palustris*), narrowleaf mountainmint (*Pycnanthemum tenuifolium*), sensitive fern (*Onoclea sensibilis*), woodland rush (*Juncus subcaudatus*), wrinkleleaf goldenrod, (*Solidago rugosa*), tussock sedge (*Carex stricta*), crested woodfern (*Dryopteris cristata*), and Dudley's rush (*Juncus dudleyi*). A number of calciphilic herb species are often present, albeit at low cover values, including Ontario lobelia (*Lobelia kalmii*), downy willowherb (*Epilobium strictum*), rigid sedge (*Carex tetanica*), northeastern sedge (*Carex cryptolepis*), smallhead rush (*Juncus brachycephalus*), purple avens (*Geum rivale*), and scarlet Indian-paintbrush (*Castilleja coccinea*). Purple loosestrife (*Lythrum salicaria*) can be an abundant weed species in some fens.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Toxicodendron vernix, Cornus amomum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Dasiphora floribunda, Spiraea tomentosa, Cornus amomum*
Herb (field)	Forb	*Packera aurea, Parnassia glauca*

Herb (field)	Graminoid	*Carex stricta*, *Juncus subcaudatus*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Carex tetanica, Cornus amomum, Dasiphora floribunda, Lobelia kalmii, Packera aurea, Spiraea tomentosa, Toxicodendron vernix*
Other Noteworthy Species: *Lemna trisulca, Spiranthes lucida, Trollius laxus* ssp. *laxus, Parnassia glauca, Dasiphora floribunda, Carex tetanica, Lobelia kalmii, Carex cryptolepis, Juncus brachycephalus, Epilobium strictum, Castilleja coccinea.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S2	1	Turfy Juniper Fen	Walz et al 2006
PA	S1	1	Poison sumac - red-cedar - bayberry fen	Fike 1999

Local Range: These wetlands occur in association with calcareous groundwater seeps throughout the park wherever limestone bedrock is at or near a toeslope position.
Classification Comments: This type is closely related to Calcareous Seep and Marl Fen. It differs from Calcareous Seeps in containing more calciphilic species and presumably a greater calcareous groundwater influence (higher pH and dissolved calcium concentration). It differs from Marl Fen in lacking active marl deposition. Marl Fen also tends to have lower total herbaceous cover than Calcareous Fen.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.9, DEWA.224, DEWA.225; Fike 1999, Breden et al 2001, Radis 1989.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse shrub layer (V.A.7.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.)
Formation	Saturated temperate or subpolar grassland with a sparse cold-deciduous shrub layer (V.A.7.N.p.)
Alliance	*Carex (flava, hystericina, interior, sterilis)* Saturated Shrub Herbaceous Alliance (A.1561)
Alliance (English name)	(Yellow Sedge, Bottlebrush Sedge, Inland Sedge, Sterile Sedge) Saturated Shrub Herbaceous Alliance
Association	*Juniperus virginiana / Dasiphora fruticosa* ssp. *floribunda / Carex flava - Carex tetanica* Shrub Herbaceous Vegetation
Association (English name)	Eastern Red-cedar / Shrubby-cinquefoil / Yellow Sedge - Rigid Sedge Shrub Herbaceous Vegetation
Ecological System(s):	North-Central Appalachian Seepage Fen (CES202.607)

GLOBAL DESCRIPTION

Concept Summary: This association is a saturated wetland of turfy mineral soil occurring over calcareous bedrock, a fen supporting a number of calciphitic species. It occurs in New Jersey and Pennsylvania. It varies in appearance from an open shrubland to open herbaceous vegetation. The tall-shrub layer, when present, is 2-5 m in height with 20% cover or less. Typical tall shrubs include *Cornus amomum, Juniperus virginiana,* and *Toxicodendron vernix*. Typical short shrubs include *Dasiphora fruticosa* ssp. *floribunda, Spiraea tomentosa, Spiraea alba* var. *latifolia*, and *Lyonia ligustrina*. Other characteristic, often calciphilic, shrubs include *Salix candida* and *Salix discolor*. Invasive shrubs may be locally abundant in some fens, especially *Rosa multiflora* and *Elaeagnus umbellata*. The herbaceous layer is greater than 75% cover (often near 100%). Dominant herb species include *Packera aurea (= Senecio aureus), Parnassia glauca, Thelypteris palustris, Pycnanthemum tenuifolium, Onoclea sensibilis, Juncus subcaudatus, Solidago rugosa, Carex stricta, Dryopteris cristata,* and *Juncus dudleyi*. Other associates include *Juncus nodosus, Equisetum fluviatile, Sisyrinchium angustifolium, Solidago uliginosa, Eupatorium maculatum, Liatris spicata, Spiranthes lucida, Rudbeckia fulgida, Pedicularis canadensis,* and *Pedicularis lanceolata*. A number of calciphilic herb species are often present at low cover values, including *Lobelia kalmii, Epilobium strictum, Carex tetanica, Carex flava, Juncus brachycephalus, Bromus kalmii, Cypripedium parviflorum, Geum rivale*, and *Castilleja coccinea*. *Lythrum salicaria* can be an abundant weed species in some fens. This vegetation has been generally affected by grazing in the past, which in some cases continues to the present, and as such this vegetation is known locally as a pasture fen.

Environmental Description: These wetlands occur as small patches where calcareous groundwater discharges to the surface. They typically occur along the toeslope of ridges, in association with limestone and calcareous siltstone. Soils vary from silt loams to shallow mucky peat.

Vegetation Description: This association varies in appearance from an open shrubland to open herbaceous vegetation. The tall-shrub layer, when present, is 2-5 m in height with 20% cover or less. Typical tall shrubs include *Cornus amomum, Juniperus virginiana,* and *Toxicodendron vernix*. Typical short shrubs include *Dasiphora fruticosa* ssp. *floribunda, Spiraea tomentosa, Spiraea alba* var. *latifolia,* and *Lyonia ligustrina*. Other characteristic, often calciphilic, shrubs include *Salix candida* and *Salix discolor*. Invasive shrubs may be locally abundant in some fens, especially *Rosa multiflora* and *Elaeagnus umbellata*. The herbaceous layer is greater than 75% cover (often near 100%). Dominant herb species include *Packera aurea (= Senecio aureus), Parnassia glauca, Thelypteris palustris, Pycnanthemum tenuifolium, Onoclea sensibilis, Juncus subcaudatus, Solidago rugosa, Carex stricta, Dryopteris cristata,* and *Juncus dudleyi*. Other associates include *Juncus nodosus, Equisetum fluviatile, Sisyrinchium angustifolium, Solidago uliginosa, Eupatorium maculatum, Liatris spicata, Spiranthes lucida, Rudbeckia fulgida, Pedicularis canadensis,* and *Pedicularis lanceolata*. A number of calciphilic herb species are often present at low cover values, including *Lobelia kalmii, Epilobium strictum, Carex tetanica, Carex flava, Juncus brachycephalus, Bromus kalmii, Cypripedium parviflorum, Geum rivale,* and *Castilleja coccinea*. *Lythrum salicaria* can be an abundant weed species in some fens.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Toxicodendron vernix*

Short shrub/sapling	Broad-leaved deciduous shrub	*Dasiphora fruticosa* ssp. *floribunda*
Herb (field)	Forb	*Packera aurea, Parnassia glauca*
Herb (field)	Graminoid	*Carex stricta, Juncus subcaudatus*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Carex tetanica, Castilleja coccinea, Cornus amomum, Dasiphora fruticosa* ssp. *floribunda, Juniperus virginiana, Lobelia kalmii, Packera aurea, Spiraea tomentosa, Toxicodendron vernix.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association occurs in New Jersey, Pennsylvania, and possibly southeastern New York.
States/Provinces: NJ:S1S2, NY, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G1G2 (23-Jan-1998).
Reasons: This association is restricted to saturated wetlands of turfy mineral soil occurring over calcareous bedrock in New Jersey, Pennsylvania, and possibly New York. There are 10-20 estimated occurrences in New Jersey and possibly the same number from Pennsylvania. These fens are 0.1-1.5 acres in size, with a total of 20-40 acres known from New Jersey. The total potential acreage of this type is well below 200 acres rangewide.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: Edinger et al.'s (2002) Rich Shrub Fen has been crosswalked to this association (as well as four others), in which case the range would extend to New York.
Similar Associations:
- *Morella pensylvanica - Dasiphora fruticosa* ssp. *floribunda / Carex sterilis - Carex flava* Shrub Herbaceous Vegetation (CEGL006103)--has active marl deposition and lower herbaceous cover.
- *Vernonia noveboracensis - Thelypteris palustris - Symplocarpus foetidus* Herbaceous Vegetation (CEGL006448)--has fewer calciphilic species.

Related Concepts: Information not available

SOURCES
Description Authors: Eastern Ecology Group, mod. S. C. Gawler.
References: Breden et al. 2001, Eastern Ecology Working Group n.d., Edinger et al. 2002, Fike 1999, Radis 1986.

Figure 104. Calcareous Fen in Delaware Water Gap National Recreation Area (plot DEWA.9). May 2003.

Figure 105. Calcareous Fen in Delaware Water Gap National Recreation Area (plot DEWA.224). August 2004.

COMMON NAME (PARK-SPECIFIC): MARL FEN

SYNONYMS

NVC English Name: **Northern Bayberry - Shrubby-cinquefoil / Sterile Sedge - Yellow Sedge Shrub Herbaceous Vegetation**

NVC Scientific Name: ***Morella pensylvanica - Dasiphora fruticosa* ssp. *floribunda / Carex sterilis - Carex flava* Shrub Herbaceous Vegetation**

NVC Identifier: **CEGL006103**

LOCAL INFORMATION

Environmental Description: This association is limited to a single occurrence within the park. The bedrock is shaley to sandy siltstone of the Devonian Esopus Formation, which does include some minor calcareous siltstone beds. However, the groundwater supporting the fen likely originates in the adjacent uplands where the bedrock is calcareous siltstone and limestone of the Devonian Schoharie Formation. The soil is very stony marl deposits. Marl is actively being deposited, the result of precipitation of calcium carbonate in supersaturated groundwater seepage on the upslope edge of the fen. This fen is open with no forest canopy except where the fen borders the surrounding forest. Flowing rivulets are common throughout the fen, and the substrate is typically marl and calcium carbonate-coated stones and woody debris.

Vegetation Description: Forest canopy and tall-shrub layers are absent from this vegetation type. The short-shrub layer is low (less than 0.5 m in height) and covers about 40% of the fen. The dominant shrub is shrubby cinquefoil (*Dasiphora floribunda*). Other occasional shrub and tree sapling species include Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), and eastern hemlock (*Tsuga canadensis*). The herbaceous layer is somewhat sparse, with total cover about 40%. Herbaceous vegetation is usually less than 1 m in height. The herbaceous layer is characterized by a high relative cover of calciphilic vegetation, including fen grass of Parnassus (*Parnassia glauca*), Ontario lobelia (*Lobelia kalmii*), needle beaksedge (*Rhynchospora capillacea*), rigid sedge (*Carex tetanica*), and golden ragwort (*Packera aurea*). Other common herbaceous species included slender spikerush (*Eleocharis tenuis*), spiked muhly (*Muhlenbergia glomerata*), peppermint (*Mentha X piperita*), common selfheal (*Prunella vulgaris*), and knotted rush (*Juncus nodosus*). Some herbs invasive to fens are also present, including coltsfoot (*Tussilago farfara*) and ox-eye daisy (*Leucanthemum vulgare*). Bryophytes are common with a total cover of 20%. The alga stonewort (*Chara* sp.) is common in flowing rivulets.

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Dasiphora floribunda*
Herb (field)	Forb	*Lobelia kalmii, Packera aurea, Parnassia glauca*
Herb (field)	Graminoid	*Carex tetanica, Eleocharis tenuis, Rhynchospora capillacea*

Characteristic Species: *Carex tetanica, Dasiphora floribunda, Lobelia kalmii, Packera aurea, Parnassia glauca, Rhynchospora capillacea, Chara* spp.

Other Noteworthy Species: *Carex tetanica, Dasiphora floribunda, Lobelia kalmii, Parnassia glauca.*

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S2	1	Marl Seep Fen	Walz et al 2006

Local Range: This association is limited to a single occurrence associated with the surface discharge of groundwater supersaturated with dissolved calcium carbonate.
Classification Comments: This type is closely related to Calcareous Fen but differs in the lower total herbaceous cover and the active precipitation of marl deposits.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.227.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland with a sparse shrub layer (V.A.7.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N.)
Formation	Saturated temperate or subpolar grassland with a sparse cold-deciduous shrub layer (V.A.7.N.p.)
Alliance	*Carex (flava, hystericina, interior, sterilis)* Saturated Shrub Herbaceous Alliance (A.1561)
Alliance (English name)	(Yellow Sedge, Bottlebrush Sedge, Inland Sedge, Sterile Sedge) Saturated Shrub Herbaceous Alliance
Association	*Morella pensylvanica - Dasiphora fruticosa* ssp. *floribunda / Carex sterilis - Carex flava* Shrub Herbaceous Vegetation
Association (English name)	Northern Bayberry - Shrubby-cinquefoil / Sterile Sedge - Yellow Sedge Shrub Herbaceous Vegetation
Ecological System(s):	North-Central Appalachian Seepage Fen (CES202.607)

GLOBAL DESCRIPTION

Concept Summary: This calcareous fen association is characterized by herbaceous vegetation maintained by groundwater springs. It is restricted to New Jersey, Pennsylvania, and perhaps New York. Peat accumulation is minimal, with mineral soil or marl often evident at the surface, particularly where groundwater emerges. Although the shrubs are generally sparse (less than 25%), they are characteristic of this vegetation, with *Dasiphora fruticosa* ssp. *floribunda (= Pentaphylloides floribunda)* and *Morella pensylvanica (= Myrica pensylvanica)* common and *Toxicodendron vernix, Acer rubrum,* and *Juniperus virginiana* as frequent associates. Wettest portions of these fens lack woody vegetation. The herbaceous cover is usually about 40%. It is rich and diverse and includes the sedges *Carex sterilis, Carex flava, Carex cryptolepis, Carex tetanica, Rhynchospora capillacea, Rhynchospora alba,* as well as *Parnassia glauca, Sanguisorba canadensis, Drosera rotundifolia, Sarracenia purpurea, Packera aurea (= Senecio aureus), Lobelia kalmii, Panicum flexile, Deschampsia caespitosa, Juncus brachycephalus, Juncus nodosus, Eleocharis tenuis, Muhlenbergia glomerata, Mentha X piperita,* and *Spiranthes*

cernua. The invasive exotic shrubs *Berberis thunbergii* and *Rosa multiflora* may also be present. The diagnostic characteristic is the presence of *Morella pensylvanica* in the shrub layer.
Environmental Description: This community is a spring-fed calcareous fen generally with minimal peat accumulation over mineral soil or marl. Marl is actively deposited, the result of precipitation of calcium carbonate in supersaturated groundwater seepage upslope. Flowing rivulets are common, and the substrate is typically marl and calcium carbonate-coated stones and woody debris.
Vegetation Description: Although the shrubs are generally sparse (less than 25%), they are characteristic of this vegetation, with *Dasiphora fruticosa* ssp. *floribunda (= Pentaphylloides floribunda)* and *Morella pensylvanica (= Myrica pensylvanica)* common and *Toxicodendron vernix, Acer rubrum,* and *Juniperus virginiana* as frequent associates. Wettest portions of these fens lack woody vegetation. The herbaceous cover is usually about 40%. It is rich and diverse and includes the sedges *Carex sterilis, Carex flava, Carex cryptolepis, Carex tetanica, Rhynchospora capillacea, Rhynchospora alba,* as well as *Parnassia glauca, Sanguisorba canadensis, Drosera rotundifolia, Sarracenia purpurea, Packera aurea (= Senecio aureus), Lobelia kalmii, Panicum flexile, Deschampsia caespitosa, Juncus brachycephalus, Juncus nodosus, Eleocharis tenuis, Muhlenbergia glomerata, Mentha X piperita,* and *Spiranthes cernua*. The invasive exotic shrubs *Berberis thunbergii* and *Rosa multiflora* may also be present. The diagnostic characteristic is the presence of *Morella pensylvanica* in the shrub layer.
Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Dasiphora fruticosa* ssp. *floribunda*
Herb (field)	Forb	*Lobelia kalmii, Packera aurea, Parnassia glauca*
Herb (field)	Graminoid	*Carex tetanica, Eleocharis tenuis, Rhynchospora capillacea*

Characteristic Species: *Carex cryptolepis, Carex flava, Carex sterilis, Carex tetanica, Dasiphora fruticosa* ssp. *floribunda, Lobelia kalmii, Muhlenbergia glomerata, Packera aurea, Parnassia glauca, Rhynchospora capillacea.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association is limited to New Jersey and Pennsylvania and possibly southwestern New York.
States/Provinces: NJ:S2, NY?, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G2 (12-Jan-1998).
Reasons: This "fen" vegetation type is restricted in distribution to a few calcareous or limestone areas occurring largely in the non glaciated regions of New Jersey and Pennsylvania. There are fewer than 15 known occurrences of this vegetation, with a potential for 5-10 more. The occurrences are generally very small in size, often only an acre or two. Most occurrences are associated with areas of historic or current grazing, which apparently limits shrub establishment. In areas where grazing has been discontinued the fens are often rapidly filling with shrubs,

particularly Cornus (racemosa or sericea). In other areas, disruptions in local hydrology, caused by nearby development has had a negative effect on the condition of some occurrences. These often contain many weedy species, both native and exotic.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 1 – Strong.
Comments: Information not available.
Similar Associations:

- *Juniperus virginiana / Dasiphora fruticosa* ssp. *floribunda / Carex flava - Carex tetanica* Shrub Herbaceous Vegetation (CEGL006357)--is similar but lacks active marl deposits and *Morella pensylvanica*.

Related Concepts: Information not available

SOURCES
Description Authors: S. L. Neid, mod. S. C. Gawler.
References: Breden et al. 2001, Eastern Ecology Working Group n.d., Fike 1999.

Figure 106. Marl Fen in Delaware Water Gap National Recreation Area (plot DEWA.227). August 2004.

COMMON NAME (PARK-SPECIFIC): WATER-WILLOW EMERGENT BED

SYNONYMS
NVC English Name: **American Water-willow Herbaceous Vegetation**
NVC Scientific Name: ***Justicia americana* Herbaceous Vegetation**
NVC Identifier: **CEGL004286**

LOCAL INFORMATION

Environmental Description: This association is found at the heads of islands, along the edges of bars, banks, terraces, and spits, and in shallow sections of the river channel in the Delaware River. The lower portions of the plants' stems are under water for most of the year, with the tops of the plants emerging above the flowing water. These beds are entirely submerged by most flood events. During extreme low water periods, the soil below the beds can be exposed, showing a varied mixture of sand, gravel, and cobbles, often with deposits of silt and muck.
Vegetation Description: American water-willow (*Justicia americana*) is the dominant species in this association and is often the only species present in a colonial bed. Since American water-willow spreads by rhizomes, the species can form extensive monocultural colonies. Many other herbaceous species may be associates, including rice cutgrass (*Leersia oryzoides*), water knotweed (*Polygonum amphibium*), spikerushes (*Eleocharis* spp.), waterweed (*Elodea* sp.), common threesquare (*Schoenoplectus pungens*), and field horsetail (*Equisetum arvense*). The invasive exotic purple loosestrife (*Lythrum salicaria*) may be common in this vegetation type. Scattered shrub seedlings of black willow (*Salix nigra*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), or sycamore (*Platanus occidentalis*) may also be present.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Justicia americana*

Characteristic Species: *Justicia americana, Leersia oryzoides, Polygonum amphibium.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	1	Water-willow Rocky Bar and Shore	Walz et al 2006
PA	S5	1	Water-willow (*Justicia americana*) – smartweed riverbed	Fike 1999

Local Range: This vegetation type is common throughout the Delaware River.
Classification Comments: This type is distinguished by the clear dominance of *Justicia americana* which is partially submerged for most of the year.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.101, DEWA.104; Fike 1999, Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Temporarily flooded temperate perennial forb vegetation (V.B.2.N.d.)
Alliance	*Justicia americana* Temporarily Flooded Herbaceous Alliance (A.1657)
Alliance (English name)	American Water-willow Temporarily Flooded Herbaceous Alliance
Association	*Justicia americana* Herbaceous Vegetation
Association (English name)	American Water-willow Herbaceous Vegetation
Ecological System(s):	Central Appalachian Floodplain (CES202.608) Central Appalachian Riparian (CES202.609) South-Central Interior Small Stream and Riparian (CES202.706) Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) Ozark-Ouachita Riparian (CES202.703) Cumberland Riverscour (CES202.036) South-Central Interior Large Floodplain (CES202.705)

GLOBAL DESCRIPTION

Concept Summary: This association is found primarily in the Piedmont, Central Appalachians, Cumberland Plateau, Interior Low Plateau, Ozarks, Ouachita Mountains, and adjacent provinces. Stands occur on the shoals or bars of rocky streams and riverbeds. It provides habitat in some portions of its range for globally rare dragonflies and herbs. *Justicia americana* is the characteristic dominant. *Saururus cernuus* is often present and may be codominant. Other herbaceous species that may be present include *Leersia oryzoides, Lemna minor, Orontium aquaticum, Podostemum ceratophyllum, Scirpus* sp., *Schoenoplectus pungens, Cyperus* spp., *Eleocharis* spp., *Diodia teres, Gratiola brevifolia,* and *Xyris difformis* var. *difformis*. Exotics include *Lythrum salicaria* and *Lysimachia vulgaris*. A sparse canopy layer, which can include *Carpinus caroliniana* ssp. *caroliniana, Salix interior, Fagus grandifolia,* and *Fraxinus pennsylvanica*, among other species, may be present. Scattered shrub seedlings of *Salix nigra, Betula nigra, Acer saccharinum*, or *Platanus occidentalis* may also be present.

Environmental Description: This association occurs on the shoals or bars of rocky streams and riverbeds, or gravelly sands. The beds are entirely submerged by most flood events. During extreme low water periods, the soil below the beds can be exposed, showing a varied mixture of sand, gravel and cobbles, often with deposits of silt and muck.

Vegetation Description: *Justicia americana* is the characteristic dominant and may be the only species present in a colonial bed. *Saururus cernuus* is often present and may be codominant. Other herbaceous species that may be present include *Leersia oryzoides, Lemna minor, Orontium aquaticum, Podostemum ceratophyllum, Scirpus* sp., *Schoenoplectus pungens, Cyperus* spp., *Elodea* sp., *Eleocharis* spp., *Equisetum arvense, Diodia teres, Gratiola brevifolia,* and *Xyris*

differmis var. *differmis*. Exotics include *Lythrum salicaria* and *Lysimachia vulgaris*. In some areas, *Justicia* usually grows in nearly pure patches, so that few other species are associated with it. *Bidens* spp., *Cuscuta gronovii, Mimulus ringens, Polygonum* spp., *Rumex* spp., and *Salix interior* can occur (Anderson 1982). A sparse canopy layer may be present, which can include *Carpinus caroliniana, Fagus grandifolia,* and *Fraxinus pennsylvanica*, among others. Scattered shrub seedlings of *Salix nigra, Betula nigra, Acer saccharinum,* or *Platanus occidentalis* may also be present. In the Cumberland Plateau of Alabama, *Justicia americana* is present in dense patches with some interspersion of other species, including *Pilea pumila, Boehmeria cylindrica, Eclipta prostrata (= Eclipta alba), Juncus coriaceus, Mikania scandens, Ludwigia palustris, Leersia* sp., and *Bidens* sp. Schmalzer and DeSelm (1982) discuss *Orontium aquaticum* growing along streambanks or in shallow riffles "along or with" *Justicia americana* in the Obed River in the Cumberland Plateau of Tennessee.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Justicia americana*

Characteristic Species: *Justicia americana, Leersia oryzoides, Polygonum amphibium, Saururus cernuus, Schoenoplectus pungens.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This type is found primarily in the Piedmont, Interior Low Plateau, Cumberland Plateau, Ozarks, Ouachita Mountains, and adjacent provinces. It ranges from Alabama, Georgia and the Carolinas west to Arkansas and Oklahoma and north to Ohio, Pennsylvania, and Delaware.

States/Provinces: AL, AR, GA, KY, MD?, NC, NJ, OH:S4, OK, PA, SC?, TN, VA?, WV.

Federal Lands: NPS (Big South Fork, Delaware Water Gap, Little River Canyon?, Mammoth Cave, Natchez Trace, New River Gorge, Obed, Stones River); USFS (Bankhead, Cherokee, Daniel Boone, Oconee?, Ouachita, Ozark, Pisgah, Sumter?, Uwharrie).

CONSERVATION STATUS

Rank: G4G5 (12-Sep-1997).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Standard.

Confidence: 2 – Moderate.

Comments: This type, in Ohio, often forms pure patches, but consistent identification may require a simple cutoff rule, such as at least 50% cover of *Justicia* (Anderson 1982). However, Anderson (1996) no longer recognizes this type.

Similar Associations:

- *Hymenocallis coronaria - Justicia americana* Herbaceous Vegetation (CEGL004285).

Related Concepts:

- Aquatic Types (Schmalzer and DeSelm 1982) B
- IIE3a. Riverside Shoal and Stream Bar Complex (Allard 1990) B
- Lizard's tail emergent bed (Perles et al. 2004) ?
- Rocky Bar and Shore (Water Willow Subtype) (Schafale 1998b) ?
- Water willow emergent bed (Perles et al. 2004) ?

SOURCES

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

References: Allard 1990, Anderson 1982, Anderson 1996, Fike 1999, Fleming et al. 2001, Harrison 2004, Hoagland 1997, Hoagland 2000, Major et al. 1999, McCoy 1958, Nelson 1986, OHNHD unpubl. data, Palmer-Ball et al. 1988, Peet et al. unpubl. data 2002, Penfound 1953, Perles et al. 2004, Schafale 1998b, Schafale 2002, Schafale and Weakley 1990, Schmalzer and DeSelm 1982, Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data.

Figure 107. Water-willow Emergent Bed in Delaware Water Gap National Recreation Area (plot DEWA.101). August 2003.

Figure 108. Water-willow Emergent Bed in Delaware Water Gap National Recreation Area (plot DEWA.104). August 2003.

COMMON NAME (PARK-SPECIFIC): JAPANESE KNOTWEED HERBACEOUS VEGETATION

SYNONYMS
NVC English Name: **Japanese Knotweed Temporarily Flooded Herbaceous Vegetation**
NVC Scientific Name: ***Polygonum cuspidatum* Temporarily Flooded Herbaceous Vegetation**
NVC Identifier: **CEGL008472**

LOCAL INFORMATION

Environmental Description: This vegetation type occurs on islands and along the shoreline of the Delaware River. The substrate is typically silt loam or sandy loam, as in Delaware fine sandy loam or Pope fine sandy loam. These sites are subject to frequent floods and scour.
Vegetation Description: This vegetation type is typically a near monoculture of the invasive species Japanese knotweed (*Polygonum cuspidatum*), covering 50-100% of the area. Giant knotweed (*Polygonum sachalinense*) or a hybrid of Japanese knotweed and giant knotweed may also be present. Other typical riparian species can persist beneath and around the knotweed, including touch-me-nots (*Impatiens* spp.), garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), reed canarygrass (*Phalaris arundinacea*), whitegrass (*Leersia virginica*), marshpepper knotweed (*Polygonum hydropiper*), swamp smartweed (*Polygonum hydropiperoides*), Jack-in-the-pulpit (*Arisaema triphyllum*), spotted ladysthumb (*Polygonum persicaria*), and smallspike false nettle (*Boehmeria cylindrica*).
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum cuspidatum*

Characteristic Species: *Polygonum cuspidatum.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	2	Japanese Knotweed Rivershore	Walz et al 2006
PA	SNA	1	no crosswalk	Fike 1999

Local Range: This vegetation type occurs on islands and along the shoreline of the Delaware River.
Classification Comments: This type is distinguished by the extremely high cover of *Polygonum cuspidatum*, covering greater than 50% of the area in a non-forested riparian setting.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: Accuracy Assessment Observation Points DEWA.155, DEWA.177, DEWA.993; Podniesinski and Wagner 2002, Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Temporarily flooded temperate perennial forb vegetation (V.B.2.N.d.)
Alliance	*Polygonum cuspidatum* Temporarily Flooded Herbaceous Alliance (A.2005)
Alliance (English name)	Japanese Knotweed Temporarily Flooded Herbaceous Alliance
Association	*Polygonum cuspidatum* Temporarily Flooded Herbaceous Vegetation
Association (English name)	Japanese Knotweed Temporarily Flooded Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: Examples of this vegetation type are significant (monocultural) stands of the exotic forb *Polygonum cuspidatum,* which are found in temporarily flooded habitats such as scour bars. These disturbed habitats flood very frequently and have lots of light and rocky or sandy soil. Stands of this vegetation may be dense and shrubby, or somewhat more open. Species diversity is low, as the patches of *Polygonum* shade out other plant species. This vegetation ranges across the Southeast north at least to Pennsylvania and New Jersey. In North Carolina, this vegetation is found on scour bars and low rocky banks of the Nolichucky and French Broad rivers. In Kentucky, *Polygonum cuspidatum* is found primarily along disturbed riverbanks and bars mostly in the Cumberland Plateau and Cumberland Mountains where it can form pure, dense stands.

Environmental Description: Stands of this type are found in temporarily flooded habitats such as scour bars. These disturbed areas flood very frequently and have lots of light and rocky or sandy soil. In North Carolina, it is found on scour bars and low rocky banks of the Nolichucky and French Broad rivers (B. Brown pers. comm. 2001). In Kentucky, Polygonum cuspidatum is found primarily along disturbed riverbanks and bars mostly in the Cumberland Plateau and Cumberland Mountains where it can form pure, dense stands (M. Evans pers. comm. 2001).

Vegetation Description: These are primarily monospecific stands of *Polygonum cuspidatum* with few other plant species. Some disturbance-oriented forbs may be present, such as *Impatiens* spp., *Phalaris arundinacea, Leersia virginica, Polygonum hydropiper, Polygonum hydropiperoides, Polygonum persicaria,* and *Boehmeria cylindrica,* along with seedlings of some woody plants (e.g., *Platanus occidentalis, Salix nigra*). The invasive exotic herbs *Alliaria petiolata* and *Microstegium vimineum* may be present.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Polygonum cuspidatum*

Characteristic Species: *Polygonum cuspidatum.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This vegetation is potentially found anywhere in the southeastern and mid-Atlantic United States where the exotic rhizomatous forb Polygonum cuspidatum has formed significant (monocultural) stands. This includes at least Alabama, Georgia, Kentucky, Maryland, New Jersey, North Carolina, Pennsylvania, South Carolina, Tennessee, and Virginia.
States/Provinces: AL, GA, KY, NC, NJ, PA, SC, TN, VA.
Federal Lands: NPS (Allegheny Portage Railroad, Delaware Water Gap); USFS (Cherokee?, Daniel Boone).

CONSERVATION STATUS

Rank: GNA (invasive) (31-May-2001).
Reasons: This vegetation is composed of and dominated by a species which is not native to North America.

CLASSIFICATION INFORMATION

Status: Standard.
Confidence: Information not available.
Comments: This species has also been treated as *Reynoutria japonica*.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES

Description Authors: M. Pyne, mod. S. C. Gawler.
References: Brown pers. comm., Evans pers. comm., Schafale pers. comm., Schotz pers. comm., Southeastern Ecology Working Group n.d., TDNH unpubl. data, Perles et al. 2004, Podniesinski and Wagner 2002.

Figure 109. Japanese Knotweed Herbaceous Vegetation in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.992). June 2006.

COMMON NAME (PARK-SPECIFIC): MIXED FORB MARSH

SYNONYMS

NVC English Name:	**Nodding Beggarticks - Swamp Verbena - Smartweed species Herbaceous Vegetation**
NVC Scientific Name:	***Bidens cernua - Verbena hastata - Polygonum* spp. Herbaceous Vegetation [Provisional]**
NVC Identifier:	**CEGL006446**

LOCAL INFORMATION

Environmental Description: This variable wetland type occurs in depressions, drainages, and basins that contain ponded water year round. In general, waterflow out of the sites is restricted, either due to naturally occurring depressions, or from beaver activity, roads, or berms. The vegetation is often restricted to the edges of the depressions, with open water remaining in the center. These wetlands typically occur on very poorly drained soils such as Alden mucky silt loam and shallow mucky peat.

Vegetation Description: The species composition of these wetlands is highly variable, though always dominated by hydrophilic species tolerant of standing water. Some common dominants include needle spikerush (*Eleocharis acicularis*), swamp verbena (*Verbena hastata*), nodding beggartick (*Bidens cernua*), rice cutgrass (*Leersia oryzoides*), marshpepper knotweed (*Polygonum hydropiper*), arrowleaf tearthumb (*Polygonum sagittatum*), field horsetail (*Equisetum arvense*), New England aster (*Symphyotrichum novae-angliae*), owlfruit sedge (*Carex stipata*), and marsh seedbox (*Ludwigia palustris*). Other common associates are tussock sedge (*Carex stricta*), jewelweed (*Impatiens capensis*), northern bugleweed (*Lycopus uniflorus*), fowl mannagrass (*Glyceria striata*), purplestem beggarticks (*Bidens connata*), strawcolored flatsedge (*Cyperus strigosus*), ovate spikerush (*Eleocharis ovata*), common marsh bedstraw (*Galium palustre*), sensitive fern (*Onoclea sensibilis*), and blue skullcap (*Scutellaria lateriflora*). The invasive species purple loosestrife (*Lythrum salicaria*) can from monocultures in this association. Japanese stiltgrass (*Microstegium vimineum*) is another invasive species that can be abundant in these wetlands.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Bidens cernua, Verbena hastata*
Herb (field)	Graminoid	*Eleocharis acicularis, Leersia oryzoides*

Characteristic Species: *Bidens cernua, Carex stipata, Eleocharis acicularis, Equisetum arvense, Ludwigia palustris, Polygonum hydropiper, Polygonum sagittatum, Symphyotrichum novae-angliae, Verbena hastata.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Mixed Forb Basin Marsh	Walz et al 2006
PA	S4	3	Mixed forb marsh	Fike 1999

Local Range: These wetlands occur in depressions, drainages, and basins that contain ponded water throughout the park. They are most common in the swales that occur on the Hogback and Walpack Ridges in Pennsylvania and New Jersey, respectively.
Classification Comments: Mixed Forb Marsh has highly variable species composition; however, it is distinguished from other palustrine types by the year-round ponded water and the associated hydrophilic species that are tolerant of standing water. These wetlands are not dominated by *Typha* spp. [see Cattail Marsh]. This type lacks shrubs and other woody species. The description provided here departs from Mixed Forb Marsh described in Fike (1999) by including graminoid species and specifying ponded hydrology.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.25, DEWA.164, DEWA.170; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Semipermanently flooded temperate perennial forb vegetation (V.B.2.N.e.)
Alliance	*Pontederia cordata - Peltandra virginica* Semipermanently Flooded Herbaceous Alliance (A.1669)
Alliance (English name)	Pickerelweed - Green Arrow-arum Semipermanently Flooded Herbaceous Alliance
Association	*Bidens cernua - Verbena hastata - Polygonum* spp. Herbaceous Vegetation [Provisional]
Association (English name)	Nodding Beggarticks - Swamp Verbena - Smartweed species Herbaceous Vegetation
Ecological System(s):	Laurentian-Acadian Freshwater Marsh (CES201.594)

GLOBAL DESCRIPTION

Concept Summary: Information not available.
Environmental Description: Information not available.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This community is described from Pennsylvania and New Jersey and probably ranges northward.
States/Provinces: CT?, MA?, NJ, NY?, PA, RI?, VT?
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (7-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Provisional.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

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

Figure 110. Mixed Forb Marsh in Delaware Water Gap National Recreation Area (plot DEWA.164). August 2003.

Figure 111. Mixed Forb Marsh in Delaware Water Gap National Recreation Area (plot DEWA.170). September 2003.

COMMON NAME (PARK-SPECIFIC): CALCAREOUS SEEP

SYNONYMS

NVC English Name: **New York Ironweed - Eastern Marsh Fern - Skunk-cabbage Herbaceous Vegetation**

NVC Scientific Name: ***Vernonia noveboracensis - Thelypteris palustris - Symplocarpus foetidus* Herbaceous Vegetation**

NVC Identifier: **CEGL006448**

LOCAL INFORMATION

Environmental Description: These small wetlands typically occur in small patches (0.1 hectare) where calcareous groundwater discharge is present throughout the growing season. The substrate may vary from mineral soils to sapric peat (muck). Peat deposits, when present, are generally thin (<50 cm). Two known locations for this type are underlain by calcareous limestone (Devonian Buttermilk Falls Formation) and calcareous siltstone and shale (Devonian Oriskany group).

Vegetation Description: This association is characterized by a highly variable species composition. Tall shrubs may be present at low cover (<10%) and may include willows (*Salix* spp.), northern spicebush (*Lindera benzoin*), and poison sumac (*Toxicodendron vernix*). The short-shrub layer is also sparse (<15% total cover) and is often dominated by willows. Both the tall- and short-shrub layers may contain invasive shrubs, especially multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), and Japanese barberry (*Berberis thunbergii*). Open sites with little or no woody plant cover often are dominated by graminoids, while more shaded sites have a higher cover of forb species. Herbaceous vegetation typically exceeds 90% and may reach 2 m in height in some forb species. Typical forb species include New York ironweed (*Vernonia noveboracensis*), eastern marsh fern (*Thelypteris palustris*), violets (*Viola* spp.), golden ragwort (*Packera aurea*), skunk-cabbage (*Symplocarpus foetidus*), Jack in the pulpit (*Arisaema triphyllum*), American marshpennywort (*Hydrocotyle americana*), thoroughworts (*Eupatorium* spp.), touch-me-nots (*Impatiens* spp.), whorled mountainmint (*Pycnanthemum verticillatum*), American hogpeanut (*Amphicarpaea bracteata*), twoleaf miterwort (*Mitella diphylla*), and white turtlehead (*Chelone glabra*). Typical graminoid species include bristlystalked sedge (*Carex leptalea*), limestone meadow sedge (*Carex granularis*), prickly bog sedge (*Carex atlantica*), white edge sedge (*Carex debilis*), Japanese stiltgrass (*Microstegium vimineum*), rice cutgrass (*Leersia oryzoides*), and fowl bluegrass (*Poa palustris*). Purple loosestrife (*Lythrum salicaria*) may be present in more open seeps. Mosses are usually present but are a minor component of the vegetation (typically <5% of total vegetation cover).

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Salix* spp., *Lindera benzoin*, *Toxicodendron vernix*
Short shrub/sapling	Broad-leaved deciduous shrub	*Salix* spp.
Herb (field)	Forb	*Amphicarpaea bracteata*, *Hydrocotyle americana*, *Packera aurea*, *Symplocarpus foetidus*, *Vernonia noveboracensis*

Herb (field)	Graminoid	*Carex debilis, Leersia oryzoides*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Salix* spp., *Carex debilis, Hydrocotyle americana, Leersia oryzoides, Lindera benzoin, Packera aurea, Symplocarpus foetidus, Thelypteris palustris, Vernonia noveboracensis, Viola* spp.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1S2	2	Rich Seepage Marsh	Walz et al 2006
PA	S2	1	Golden ragwort - sedge rich seep	Fike 1999

Local Range: These wetlands are known from the New Jersey portion of the Walpack Ridge and Shoemakers Swamp in Pennsylvania, but may occur throughout the park where mineral-rich groundwater seepage occurs.
Classification Comments: This type differs from the marl and calcareous fen types in having fewer calciphilic plant species. Hydrology and groundwater pH differentiate the Calcareous Seep from the more common and generic Wet Meadow. The Calcareous Seep has base-rich groundwater discharge (alkaline to circumneutral) present throughout the growing season, whereas the hydrology in a Wet Meadow is not necessarily groundwater seepage, is typically circumneutal, and usually becomes dry later in the growing season. In addition, the Calcareous Seep typically occurs as a small patch (0.1 ha) embedded in a forested setting, while Wet Meadows are typically of larger size and not overtopped by forest canopy.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.223; Fike 1999, Wagner and Leimanis 1998.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
Alliance	*Symplocarpus foetidus - Caltha palustris* Saturated Herbaceous Alliance (A.1694)
Alliance (English name)	Skunk-cabbage - Yellow Marsh-marigold Saturated Herbaceous Alliance
Association	*Vernonia noveboracensis - Thelypteris palustris - Symplocarpus foetidus* Herbaceous Vegetation
Association (English name)	New York Ironweed - Eastern Marsh Fern - Skunk-cabbage Herbaceous Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: These small wetlands (0.1 ha) occur as patches within the forest matrix where calcareous groundwater discharge is present throughout the growing season. The substrate may vary from mineral soils to sapric peat (muck). Peat deposits, when present, are generally thin (<50 cm). This association is characterized by a highly variable species composition. Tall shrubs may be present at low cover (<10%) and include *Salix* spp., *Lindera benzoin*, and *Toxicodendron vernix*. The short-shrub layer is also sparse and often dominated by willows. The shrub layers may contain invasive shrubs, especially *Rosa multiflora, Lonicera morrowii*, and *Berberis thunbergii*. Open sites with little or no woody plant cover often are dominated by graminoids, while more shaded sites have a higher cover of forb species. Herbaceous vegetation typically exceeds 90% and may reach 2 m in height in some forb species. Typical forb species include *Vernonia noveboracensis, Thelypteris palustris, Viola* spp., *Packera aurea (= Senecio aureus), Symplocarpus foetidus, Arisaema triphyllum, Hydrocotyle americana, Eupatorium* spp., *Impatiens* spp., *Pycnanthemum verticillatum, Amphicarpaea bracteata, Mitella diphylla*, and *Chelone glabra*. Typical graminoid species include *Carex leptalea, Carex granularis, Carex atlantica, Carex debilis, Leersia oryzoides*, and *Poa palustris*. The invasive plants *Lythrum salicaria* and *Microstegium vimineum* may be present, the former particularly in more open seeps. Mosses are usually present but are typically <5% of total vegetation cover.

Environmental Description: These small wetlands (0.1 ha) occur where calcareous groundwater discharge is present throughout the growing season. The substrate may vary from mineral soils to sapric peat (muck). Peat deposits, when present, are generally thin (<50 cm).

Vegetation Description: This association is characterized by a highly variable species composition. Tall shrubs may be present at low cover (<10%) and include *Salix* spp., *Lindera benzoin*, and *Toxicodendron vernix*. The short-shrub layer is also sparse and often dominated by willows. The shrub layers may contain invasive shrubs, especially *Rosa multiflora, Lonicera morrowii*, and *Berberis thunbergii*. Open sites with little or no woody plant cover often are dominated by graminoids, while more shaded sites have a higher cover of forb species. Herbaceous vegetation typically exceeds 90% and may reach 2 m in height in some forb species. Typical forb species include *Vernonia noveboracensis, Thelypteris palustris, Viola* spp., *Packera aurea (= Senecio aureus), Symplocarpus foetidus, Arisaema triphyllum, Hydrocotyle americana, Eupatorium* spp., *Impatiens* spp., *Pycnanthemum verticillatum, Amphicarpaea bracteata, Mitella diphylla*, and *Chelone glabra*. Typical graminoid species include *Carex leptalea, Carex granularis, Carex atlantica, Carex debilis, Leersia oryzoides*, and *Poa palustris*. The invasive plants *Lythrum salicaria* and *Microstegium vimineum* may be present, the former particularly in more open seeps. Mosses are usually present but are typically <5% of total vegetation cover.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Amphicarpaea bracteata, Hydrocotyle americana, Packera aurea, Symplocarpus foetidus, Vernonia noveboracensis*
Herb (field)	Graminoid	*Leersia oryzoides*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Carex debilis, Hydrocotyle americana, Leersia oryzoides, Lindera benzoin, Packera aurea, Symplocarpus foetidus, Thelypteris palustris, Toxicodendron vernix, Vernonia noveboracensis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This community is currently known from New Jersey and Pennsylvania and is possible over a larger area.
States/Provinces: NJ, NY?, PA.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (7-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations:
- *Caltha palustris - Impatiens capensis - Viola cucullata* Herbaceous Vegetation [Provisional] (CEGL006258)--are woodland seeps that are less species-rich and with fewer calciphiles.
- *Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation [Provisional] (CEGL006567).

Related Concepts: Information not available.

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

Figure 112. Calcareous Seep in Delaware Water Gap National Recreation Area (plot DEWA.223). August 2004.

COMMON NAME (PARK-SPECIFIC): SANDSTONE TALUS

SYNONYMS

NVC English Name: **(Toadskin Lichen, Pennsylvania Toadskin Lichen) - Golden Moonglow Lichen - Culberson's Black-parmelia Nonvascular Vegetation**

NVC Scientific Name: ***Lasallia (papulosa, pensylvanica) - Dimelaena oreina - (Melanelia culbersonii)*** **Nonvascular Vegetation**

NVC Identifier: **CEGL004142**

LOCAL INFORMATION

Environmental Description: This association typically occurs on very steep, typically south- to southeast-facing slopes of Kittatinny Ridge composed of coarse, bouldery sandstone talus. The parent material is sandstone and sandstone conglomerate of the Silurian Shawangunk Formation. There is little available soil except for small amounts of accumulated organic matter in crevices. The slopes appear unstable, though the frequency of rockslides is uncertain.

Vegetation Description: The species composition of this type is dominated by drought-tolerant species. Tree and shrub species, when present, are often stunted. Canopy cover is variable from 0-50% and is often dominated by sweet birch (*Betula lenta*). Other canopy associates may include chestnut oak (*Quercus prinus*), black oak (*Quercus velutina*), scarlet oak (*Quercus coccinea*), northern red oak (*Quercus rubra*), pignut hickory (*Carya glabra*) red hickory (*Carya ovalis*), and black walnut (*Juglans nigra*). Tree canopy height ranges from 5 to 20 m. The shrub layer is very sparse and typically consists of scattered tree saplings and drought-tolerant shrubs. Typical shrub layer species include American witch-hazel (*Hamamelis virginiana*), American chestnut (*Castanea dentata*), mountain laurel (*Kalmia latifolia*), common serviceberry (*Amelanchier arborea*), and saplings of sassafras (*Sassafras albidum*), sweet birch and other canopy trees. The herbaceous layer is typically sparse to absent. Vines are often present at low cover and may include eastern poison-ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), and summer grape (*Vitis aestivalis*). Lichen cover is typically high on boulders.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta, Quercus* spp., *Carya* spp.
Shrub/sapling (tall & short)	Broad-leaved evergreen shrub	*Kalmia latifolia*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Hamamelis virginiana*
Short shrub/sapling	Broad-leaved deciduous shrub	*Betula lenta*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia, Toxicodendron radicans, Vitis aestivalis*

Characteristic Species: *Betula lenta, Quercus* spp., *Kalmia latifolia, Toxicodendron radicans, Vitis aestivalis.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3?	2	Central Appalachian Talus Slope	Walz et al 2006
PA	S3	1	no crosswalk	Fike 1999

Local Range: This type is common on the steep south- and southeast-facing slopes of Kittatinny Ridge. Excellent large examples occur near the Delaware Water Gap.
Classification Comments: This type is variable in composition but is best defined by the substrate (coarse, bouldery sandstone talus) and sparse vegetation. Areas of talus with greater than 50% canopy cover are considered Oak - Birch Talus Forest. Similar boulderfields occur elsewhere in the park, particularly on the north- and northwest-facing slopes of Kittatinny Ridge, but these boulderfields typically have a closed canopy and are considered Oak - Birch Talus Forest. Similar boulderfields also occur in depression on the top of Kittatinny Ridge, however, these hold water seasonally and are classified as Boulderfield Vernal Pool Sparse Vegetation.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.236.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Nonvascular Vegetation (VI)
Physiognomic Subclass	Lichen vegetation (VI.B.)
Physiognomic Group	Temperate or subpolar lichen vegetation (VI.B.1.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar lichen vegetation (VI.B.1.N.)
Formation	Alpine to submontane temperate or subpolar lichen vegetation (VI.B.1.N.b.)
Alliance	*Lasallia (papulosa, pensylvanica)* Nonvascular Alliance (A.1824)
Alliance (English name)	(Toadskin Lichen, Pennsylvania Toadskin Lichen) Nonvascular Alliance
Association	*Lasallia (papulosa, pensylvanica) - Dimelaena oreina – (Melanelia culbersonii)* Nonvascular Vegetation
Association (English name)	(Toadskin Lichen, Pennsylvania Toadskin Lichen) - Golden Moonglow Lichen - Culberson's Black-parmelia Nonvascular Vegetation
Ecological System(s):	North-Central Appalachian Acidic Cliff and Talus (CES202.601)

GLOBAL DESCRIPTION

Concept Summary: These small wetlands (0.1 ha) occur as patches within the forest matrix where calcareous groundwater discharge is present throughout the growing season. The substrate may vary from mineral soils to sapric peat (muck). Peat deposits, when present, are generally thin (<50 cm). This association is characterized by a highly variable species composition. Tall shrubs may be present at low cover (<10%) and include *Salix* spp., *Lindera benzoin*, and *Toxicodendron vernix*. The short-shrub layer is also sparse and often dominated by willows. The shrub layers may contain invasive shrubs, especially *Rosa multiflora, Lonicera morrowii,* and *Berberis thunbergii*. Open sites with little or no woody plant cover often are dominated by

graminoids, while more shaded sites have a higher cover of forb species. Herbaceous vegetation typically exceeds 90% and may reach 2 m in height in some forb species. Typical forb species include *Vernonia noveboracensis, Thelypteris palustris, Viola* spp., *Packera aurea (= Senecio aureus), Symplocarpus foetidus, Arisaema triphyllum, Hydrocotyle americana, Eupatorium* spp., *Impatiens* spp., *Pycnanthemum verticillatum, Amphicarpaea bracteata, Mitella diphylla,* and *Chelone glabra*. Typical graminoid species include *Carex leptalea, Carex granularis, Carex atlantica, Carex debilis, Leersia oryzoides,* and *Poa palustris*. The invasive plants *Lythrum salicaria* and *Microstegium vimineum* may be present, the former particularly in more open seeps. Mosses are usually present but are typically <5% of total vegetation cover.

Environmental Description: This association occurs primarily on fully exposed, minimally weathered quartzite and sandstone boulderfields at low and middle elevations of the northern Blue Ridge, Ridge and Valley, and adjacent foothills of the upper Piedmont. A few occurrences have also been noted on boulderfields composed of acidic granitic rocks (e.g., on Old Rag Mountain in Shenandoah National Park). The known elevation range is from about 300 to 1000 m (1000-3300 feet). Aspect is variable among sites, but slopes are typically steep to very steep (often >30 degrees). Block size is highly variable, from relatively small and loose stones (<1 m in diameter) to large, stable boulders (>1 m in diameter). Although this association is most extensive on boulder deposits, it may also occur on outcrops associated with the boulderfields, or on very large, exposed cliffs. There is little or no available soil except for occasional small deposits of organic matter in crevices.

Vegetation Description: On the largest occurrences, vascular plants are generally absent and lichens dominate. Maximum patch size is about ten acres, but most patches are considerably smaller. *Lasallia papulosa* and *Lasallia pensylvanica,* either singly or in combination, are generally abundant and conspicuous. *Dimelaena oreina* abundantly covers many dry, exposed rock surfaces that are not covered with *Lasallia* spp. and larger foliose lichens. Although of scattered occurrence, *Melanelia culbersonii* has been found across the full elevation range of the type and is a good diagnostic species, as it appears to be restricted mostly to siliciclastic rocks (and occasionally coarse-grained, quartz-rich granites that are nearly devoid of dark minerals) in this region. Other minor umbilicate and foliose species include *Hypogymnia physodes, Physcia subtilis, Umbilicaria muehlenbergii, Xanthoparmelia conspersa,* and *Xanthoparmelia plittii*. Many crustose species occur, including *Aspicilia cinerea, Fuscidea recensa, Lecanora* spp., *Lepraria* spp., *Rhizocarpon obscuratum (= Rhizocarpon reductum),* and *Sarcogyne clavus*. Flat surfaces and interstices that have thin deposits of organic matter often support a variety of fruticose lichens, including *Cladina rangiferina, Cladina uncialis, Cladonia crispata, Cladonia macilenta, Cladonia ochrochlora,* and *Cladonia squamosa*. In the upper elevation range, boreal lichens such as *Melanelia stygia* and *Arctoparmelia centrifuga* are present, but they are not abundant. Along the edges of the boulderfields, scattered individuals of *Parthenocissus quinquefolia, Vaccinium* spp., and other vascular plants may occur in transition zones with forests or woodlands. Smaller, more marginal occurrences frequently have sparse vascular plant cover, primarily stunted trees of *Betula lenta, Sassafras albidum, Quercus prinus, Quercus coccinea, Quercus velutina, Carya glabra,* and *Carya ovalis*. Widely scattered shrubs may include *Kalmia latifolia* and other ericads. Herbs are usually absent, but *Dicentra eximia* is known from some occurrences.

Most Abundant Species: Information not available.

Characteristic Species: Information not available.

Other Noteworthy Species: Information not available.

USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: This community is currently known from New Jersey and Pennsylvania and is possible over a larger area.
States/Provinces: MD, NJ, PA, VA, WV.
Federal Lands: NPS (Catoctin Mountain, Delaware Water Gap, Shenandoah); USFS (George Washington, Jefferson, Monongahela?).

CONSERVATION STATUS

Rank: G4? (28-Nov-2006).
Reasons: Although aggregate acreage is not large, there are probably several hundred occurrences of this association in Virginia alone, with many more known from or likely in adjacent states. Habitats are typically remote, extremely steep and difficult to traverse, minimizing potential human threats.

CLASSIFICATION INFORMATION

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

- *Lasallia papulosa - Lasallia pensylvanica* Nonvascular Vegetation (CEGL004385)--of quartzite cliffs in the western North Carolina Piedmont.
- *Lasallia papulosa - Stereocaulon glaucescens - Chrysothrix chlorina* Nonvascular Vegetation (CEGL004143)--occurs on mafic (metabasaltic) boulderfields of the northern Blue Ridge.
- *Umbilicaria muehlenbergii - Lasallia papulosa - (Melanelia stygia)* Nonvascular Vegetation (CEGL004389)--occurs at higher elevations in the same region and has different dominant species.

Related Concepts: Information not available.

SOURCES

Description Authors: G. P. Fleming.
References: Eastern Ecology Working Group n.d., Fleming et al. 2006, Flenniken 1999.

Figure 113. Sandstone Talus in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.187). March 2006.

Figure 114. Sandstone Talus in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.180). April 2006.

COMMON NAME (PARK-SPECIFIC): SPARSELY VEGETATED CLIFF

SYNONYMS
NVC English Name: **Eastern Red-cedar - Rock Harlequin Cliff Sparse Vegetation**
NVC Scientific Name: ***Juniperus virginiana - Corydalis sempervirens* Cliff Sparse Vegetation**
NVC Identifier: **CEGL006422**

LOCAL INFORMATION

Environmental Description: This association occurs on south- to southeast-facing acidic sandstone bedrock outcrops (Devonian Shawangunk Formation) along the Kittatinny Ridge and acidic to circumneutral shale and siltstone cliffs along the eastern edge of the Glaciated Low Plateau. The outcrops are typically vertical to near vertical. Vegetation habitat is restricted to narrow ledges and crevices in the rock face. These cliffs often occur immediately below Hickory - Eastern Red-cedar Rocky Woodlands that persist at the top of the cliff.

Vegetation Description: This vegetation type is characterized by sparse vegetation growing on narrow ledges or from bedrock crevices. The vegetation can vary greatly in composition but is generally limited to drought-tolerant species. Trees are typically absent or, when present, are usually stunted and less than 10 m in height. Occasional trees include eastern red-cedar (*Juniperus virginiana*), white ash (*Fraxinus americana*), red hickory (*Carya ovalis*), pignut hickory (*Carya glabra*), and chestnut oak (*Quercus prinus*). Tall-shrub/sapling layer (2 to 5 m in height) may include occasional bear oak (*Quercus ilicifolia*), black cherry (*Prunus serotina*), and other tree saplings. The short-shrub layer (<2 m in height), when present, is variable and may include tree saplings, sumacs (*Rhus* spp.), Allegheny blackberry (*Rubus allegheniensis*), Carolina rose (*Rosa carolina*), and Blue Ridge blueberry (*Vaccinium pallidum*). The herb layer can be very diverse, but the total cover is usually very low, ranging from <1% to as high as 40% total cover. Typical species are wavy hairgrass (*Deschampsia flexuosa*), little bluestem (*Schizachyrium scoparium*), smooth crabgrass (*Digitaria ischaemum*), poverty oatgrass (*Danthonia spicata*), and eastern hayscented fern (*Dennstaedtia punctilobula*). Occasional herbaceous species include eastern prickly-pear (*Opuntia humifusa*), rusty woodsia (*Woodsia ilvensis*), hairy lipfern (*Cheilanthes lanosa*), rock harlequin (*Corydalis sempervirens*), red columbine (*Aquilegia canadensis*), early saxifrage (*Saxifraga virginiensis*), and moss phlox (*Phlox subulata*). Vines may be present, typically summer grape (*Vitis aestivalis*) and Virginia creeper (*Parthenocissus quinquefolia*). Lichens are usually present and often abundant on bare rock.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta*, *Carya glabra*, *Carya ovalis*
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula lenta*
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer rubrum*, *Rhus copallina*, *Rubus allegheniensis*, *Vaccinium pallidum*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*, *Vitis aestivalis*

Herb (field)	Graminoid	*Danthonia spicata*, *Deschampsia flexuosa*, *Digitaria ischaemum*, *Schizachyrium scoparium*
Herb (field)	Fern or fern ally	*Dennstaedtia punctilobula*

Characteristic Species: *Betula lenta, Deschampsia flexuosa, Digitaria ischaemum, Schizachyrium scoparium, Danthonia spicata.*
Other Noteworthy Species: *Opuntia humifusa, Asplenium montanum.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S3?	1	Eastern Temperate Acidic Cliff	Walz et al 2006
PA	S3	1	no crosswalk	Fike 1999

Local Range: Restricted to sandstone cliffs on Kittatinny Ridge and shale cliffs along the eastern edge of the Glaciated Low Plateau with south and southeast aspect.
Classification Comments: Key features of this type are sparse vegetation and vertical to near-vertical sandstone outcrops and cliffs associated with Kittatinny Ridge and sparsely vegetated near-vertical shale cliffs associated with the eastern edge of the Glaciated Low Plateau. Actual species composition is variable given the limited habitat to support vegetation and the unpredictable nature of plant colonization and establishment.
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: DEWA.229, DEWA.230, DEWA235; Podniesinski 1999, Podniesinski and Kunsman 1999.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Consolidated rock sparse vegetation (VII.A.)
Physiognomic Group	Sparsely vegetated cliffs (VII.A.1.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated cliffs (VII.A.1.N.)
Formation	Cliffs with sparse vascular vegetation (VII.A.1.N.a.)
Alliance	Open Cliff Sparsely Vegetated Alliance (A.1836)
Alliance (English name)	Open Cliff Sparsely Vegetated Alliance
Association	*Juniperus virginiana - Corydalis sempervirens* Cliff Sparse Vegetation
Association (English name)	Eastern Red-cedar - Rock Harlequin Cliff Sparse Vegetation
Ecological System(s):	North-Central Appalachian Acidic Cliff and Talus (CES202.601)

GLOBAL DESCRIPTION

Concept Summary: This sparsely vegetated cliff association occurs in the oak - pine - hemlock forest region of the northeastern U.S. The setting is dry vertical exposures of resistant acidic bedrock such as granite, quartzite, sandstone, shale or schist, with little or no soil development. These cliffs are mostly dry but may contain small areas of seepy conditions, with associated floristic variation. The patchy vegetation is restricted to cracks and crevices and can vary from

well-vegetated to barren across the cliff face. In most cases, overall cover averages less than 25%. The association presents itself as a mixture of open rock, scrubby trees and shrubs, herbaceous plants, and bryoids. Typical tree species include *Juniperus virginiana, Fraxinus americana, Acer rubrum,* and *Betula papyrifera*; none usually grow very large. Individuals of additional tree species from the surrounding forest may also be present; these include *Tsuga canadensis, Quercus* spp., and *Carya* spp. *Rubus odoratus, Rubus allegheniensis*, and *Rhus copallinum* are representative shrubs. Woody vines include *Vitis aestivalis* and *Parthenocissus quinquefolia*. Herbaceous composition varies; typical species include *Deschampsia flexuosa, Danthonia spicata, Campanula rotundifolia, Aquilegia canadensis, Corydalis sempervirens, Saxifraga virginiensis*, and *Woodsia ilvensis*. *Adlumia fungosa* may be found in these habitats; *Opuntia humifusa* occurs in some of the most southerly occurrences of this association.
Environmental Description: This community is found on cliff faces developed on resistant acidic bedrock such as granite, quartzite, sandstone, shale or schist, with little or no soil development. The outcrops are typically vertical to near-vertical. Exposure varies, and moisture regime likewise varies from dry on the exposed faces to moist on more protected or seepy areas. These cliffs may contain small areas of seepage vegetation among the generally dry substrate. [For extensive seepage cliffs, see the cliff seep association Drosera rotundifolia - Viola spp. Cliff Sparse Vegetation (CEGL006429).]
Vegetation Description: The patchy vegetation is restricted to cracks and crevices and can vary from well-vegetated to barren across the cliff face. In most cases, overall cover averages less than 25%. The association presents itself as a mixture of open rock, scrubby trees and shrubs, herbaceous plants, and bryoids. Typical tree species include *Juniperus virginiana, Fraxinus americana, Acer rubrum,* and *Betula papyrifera*; none usually grow very large. Individuals of additional tree species from the surrounding forest may also be present; these include *Tsuga canadensis, Quercus* spp., and *Carya* spp. *Rubus odoratus, Rubus allegheniensis*, and *Rhus copallinum* are representative shrubs. Woody vines include *Vitis aestivalis* and *Parthenocissus quinquefolia*. Herbaceous composition varies; typical species include *Deschampsia flexuosa, Danthonia spicata, Campanula rotundifolia, Aquilegia canadensis, Corydalis sempervirens, Saxifraga virginiensis*, and *Woodsia ilvensis*. *Opuntia humifusa* occurs in some of the most southerly occurrences of this association.
Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Needle-leaved shrub	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Betula lenta*
Short shrub/sapling	Broad-leaved deciduous shrub	*Acer rubrum*, *Rubus allegheniensis*
Herb (field)	Vine/Liana	*Parthenocissus quinquefolia*

Characteristic Species: *Aquilegia canadensis*, *Campanula rotundifolia*, *Corydalis sempervirens*, *Danthonia spicata*, *Deschampsia flexuosa*, *Juniperus virginiana*, *Rhus copallinum*, *Rubus odoratus, Woodsia ilvensis.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This type is documented from Massachusetts, New Hampshire, Vermont, New Jersey, and Pennsylvania; southward and westward extent has not been determined.
States/Provinces: CT, MA, NH, NJ, NY, PA, VT:S4.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G4 (22-Jun-2006).
Reasons: This community is considered relatively common in at least two of the states where it occurs (state conservation rank of S4).

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations:

- Piedmont Acidic Cliff Sparse Vegetation (CEGL003979)--occurs primarily in the Southeast, within topographically low settings such as river bluffs that are not subject to flood scouring.
- *Polypodium (virginianum, appalachianum)* Cliff Sparse Vegetation (CEGL006528)--is similar in physiognomy and in that both occur on acidic cliffs. They are different in that this type represents a warmer climate, more typical of Lower New England than Northern Appalachians.
- Sandstone Dry Cliff Sparse Vegetation (CEGL002045)--occurs in the Midwest and the species composition is different.
- Western Allegheny Plateau Sandstone Dry Cliff Sparse Vegetation (CEGL006435)--species composition is different due to ecoregional differences.

Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler and G .S. Podniesinski.
References: Anderson 1996, Collins and Anderson 1994, Eastern Ecology Working Group n.d., Edinger et al. 2002, Metzler and Barrett 2004, Sneddon and Menard 2002, Sperduto 1992, Sperduto 2000a, Swain and Kearsley 2000, Thompson and Sorenson 2000.

Figure 115. Sparsely Vegetated Cliff in Delaware Water Gap National Recreation Area (plot DEWA.229). August 2004.

Figure 116. Sparsely Vegetated Cliff in Delaware Water Gap National Recreation Area (plot DEWA.235). September 2004.

COMMON NAME (PARK-SPECIFIC): CALCAREOUS RIVERSIDE OUTCROP

SYNONYMS

NVC English Name:	**Big Bluestem - Bluebell Bellflower - Sticky Goldenrod Sparse Vegetation**
NVC Scientific Name:	***Andropogon gerardii - Campanula rotundifolia - Solidago simplex* Sparse Vegetation**
NVC Identifier:	**CEGL006284**

LOCAL INFORMATION

Environmental Description: This vegetation type occurs along the shoreline of the Delaware River where winter ice-scouring, limestone outcrops, and natural seepage co-occur. The community is characterized by open, sparsely vegetated sections of smooth Buttermilk Falls limestone outcrops of glacial origin and Devonian age. The outcrops extend for variable lengths from the woodland edge to the river edge. Areas of fractured limestone typically support denser vegetation in the crevices. All of the outcrops have a north-northwest exposure and are fully exposed to the late day sun. The slope of the outcrops ranges from gentle incline rising from the river shoreline to a 28-degree incline at the most steeply sloped sites. Winter ice-scour that removes tall vegetation and woody plants maintains predominantly herbaceous vegetation. The early-successional floristic assemblages include species able to regenerate from buried rootstocks, rosettes protected in crevices or from seeds dispersed along the shoreline. Seasonal and annual variation in water levels is also an important process affecting the vegetation. Calcareous Riverside Seep is often found interspersed with Calcareous Riverside Outcrop along the shoreline of the Delaware River.

Vegetation Description: The limestone bedrock supports many calciphiles that thrive on the calcium-rich substrate. Vegetation is typically sparse and occurs in the cracks and crevices in the bedrock. Typical vegetation is a mixture of riparian species, xeric-loving crevice plants, and calciphiles. Characteristic rare species include tall thimbleweed (*Anemone virginiana* var. *alba*), American vetch (*Vicia americana*), meadow zizia (*Zizia aptera*), white heath aster (*Symphyotrichum ericoides* var. *ericoides*), Crawe's sedge (*Carex crawei*), Crawford's sedge (*Carex crawfordii*), great St. Johnswort (*Hypericum ascyron*), scarlet beebalm (*Monarda didyma*), tall cinquefoil (*Potentilla arguta*), strict blue-eyed grass (*Sisyrinchium montanum*), and calico aster (*Symphyotrichum lateriflorum* var. *lateriflorum*). A wide variety of associated species may be present, including annual agricultural weeds, old-field species, plants common in Riverine Scour Vegetation and calciphiles. Some of the numerous common associates include big bluestem (*Andropogon gerardii*), fowl bluegrass (*Poa palustris*), Canadian bluegrass (*Poa compressa*), northern bedstraw (*Galium boreale*), flat-top goldentop (*Euthamia graminifolia*), bluebell bellflower (*Campanula rotundifolia*), lyrate rockcress (*Arabis lyrata*), black bugbane (*Cimicifuga racemosa*), yellow pimpernel (*Taenidia integerrima*), red columbine (*Aquilegia canadensis*), maidenhair spleenwort (*Asplenium trichomanes*), limestone meadow sedge (*Carex granularis*), woolly sedge (*Carex pellita*), broom sedge (*Carex scoparia*), ox-eye daisy (*Leucanthemum vulgare*), common boneset (*Eupatorium perfoliatum*), moss phlox (*Phlox subulata*), stonecrops (*Sedum* spp.), and eastern poison ivy (*Toxicodendron radicans*). Scattered shrubs may have established in crevices or ledges of the outcrops. Common shrub species include smooth rose (*Rosa blanda*), sycamore (*Platanus occidentalis*), common ninebark (*Physocarpus opulifolius*), river birch (*Betula nigra*), silver maple (*Acer saccharinum*), red

maple (*Acer rubrum*), willows (*Salix* spp.), and alders (*Alnus* spp.). These sites are susceptible to invasion by purple loosestrife (*Lythrum salicaria*) and yellow sweetclover (*Melilotus officinalis*).
Most Abundant Species: The most abundant species varies between seasons, years, and sites.
Characteristic Species: Characteristic species include a mixture of riparian species, xeric-loving crevice species, and calciphiles. See Vegetation Description above.
Other Noteworthy Species: *Anemone virginiana* var. *alba*, *Carex crawei*, *Carex crawfordii*, *Hypericum ascyron*, *Monarda didyma*, *Potentilla arguta*, *Sisyrinchium montanum*, *Symphyotrichum ericoides* var. *ericoides*, *Symphyotrichum lateriflorum* var. *lateriflorum*, *Vicia americana*, *Zizia aptera.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	S1	2	Northern Riverside Rock Outcrop	Walz et al 2006

Local Range: There are three locations of this type of river shoreline along the Delaware River within the park.
Classification Comments: Calcareous Riverside Seep occurs interspersed with Calcareous Riverside Outcrop, however, it is restricted to areas of groundwater seepage and contains plants that are dependent on the groundwater seepage. By contrast, the Calcareous Riverside Outcrop does not contain groundwater seepage and its plants are generally xerophilic.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.219; Shank and Shreiner 1999, Breden 1989.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Consolidated rock sparse vegetation (VII.A.)
Physiognomic Group	Sparsely vegetated pavement (VII.A.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated pavement (VII.A.2.N.)
Formation	Pavement with sparse vascular vegetation (VII.A.2.N.a.)
Alliance	Open Pavement Sparsely Vegetated Alliance (A.1843)
Alliance (English name)	Open Pavement Sparsely Vegetated Alliance
Association	*Andropogon gerardii* - *Campanula rotundifolia* - *Solidago simplex* Sparse Vegetation
Association (English name)	Big Bluestem - Bluebell Bellflower - Sticky Goldenrod Sparse Vegetation
Ecological System(s):	Central Appalachian Riparian (CES202.609) Laurentian-Acadian Ice-Scour Rivershore (CES201.589)

GLOBAL DESCRIPTION

Concept Summary: This riverside rock outcrop community of the northeastern U.S. occurs on open flood-scoured bedrock exposures of major rivers, typically along river narrows. Emergent seepage is absent. Typically a gradient from dry acidic conditions higher on the bank to moist, fairly enriched conditions lower down may exist at any one site. This community is prone to flooding in the upper regions and deposition in the topographically lower areas. It is also prone to severe drought periods that may stress or kill some vegetation. Within the community, the

species are distributed patchily, probably due to microsite conditions. The variability in species composition has not been measured, but it shows substantial variation from site to site and from year to year. Vegetation is typically sparse and occurs in the cracks and crevices of the bedrock. Typical vegetation is a mixture of riparian species, xeric-loving crevice plants, and calciphiles. Characteristic species include *Andropogon gerardii, Schizachyrium scoparium, Campanula rotundifolia, Solidago simplex, Toxicodendron radicans, Ionactis linariifolius, Sisyrinchium montanum, Packera paupercula (= Senecio pauperculus)*, and *Prunus pumila*. Other associates include *Anemone virginiana* var. *alba (= Anemone virginiana* var. *riparia), Symphyotrichum lateriflorum, Carex crawei, Carex crawfordii, Potentilla arguta, Campanula rotundifolia, Arabis lyrata, Aquilegia canadensis*, and *Eupatorium perfoliatum*, among others. *Astragalus robbinsii* var. *jesupii* occurs in limited areas along the upper Connecticut River. These sites are susceptible to invasion by *Lythrum salicaria* and *Melilotus officinalis (= Melilotus alba)*. This association is more temperate than the related *Campanula rotundifolia - Packera paupercula - (Aquilegia canadensis)* Sparse Vegetation (CEGL006532), which occurs on near-boreal rivers and lacks prairie elements such as *Andropogon gerardii*.

Environmental Description: This sparse vegetation occurs on open flood-scoured bedrock exposures of major rivers, typically along river narrows. Emergent seepage is absent. Typically a gradient from dry acidic conditions higher on the bank to moist, fairly enriched conditions lower down may exist at any one site. This community is prone to flooding in the upper regions and deposition in the topographically lower areas. It is also prone to severe drought periods that may stress or kill some vegetation.

Vegetation Description: This community is essentially a rock outcrop with a bit of soil development in the lower reaches. Within the community, the species are distributed patchily, probably due to microsite conditions. The variability in species composition has not been measured but shows substantial variation both spatially and temporally. Vegetation is typically sparse and occurs in the cracks and crevices of the bedrock. Typical vegetation is a mixture of riparian species, xeric-loving crevice plants, and calciphiles. Characteristic species include *Andropogon gerardii, Schizachyrium scoparium, Campanula rotundifolia, Solidago simplex, Toxicodendron radicans, Ionactis linariifolius, Sisyrinchium montanum, Packera paupercula (= Senecio pauperculus)*, and *Prunus pumila*. Other associates include *Anemone virginiana* var. *alba (= Anemone virginiana* var. *riparia), Symphyotrichum lateriflorum, Carex crawei, Carex crawfordii, Potentilla arguta, Campanula rotundifolia, Arabis lyrata, Aquilegia canadensis*, and *Eupatorium perfoliatum*, among others. *Astragalus robbinsii* var. *jesupii* occurs in limited areas along the upper Connecticut River. These sites are susceptible to invasion by *Lythrum salicaria* and *Melilotus officinalis (= Melilotus alba)*.

Most Abundant Species: Information not available.

Characteristic Species: *Allium schoenoprasum* var. *sibiricum, Andropogon gerardii, Astragalus robbinsii* var. *jesupii, Campanula rotundifolia, Ionactis linariifolius, Packera paupercula, Prunus pumila, Schizachyrium scoparium, Solidago simplex, Toxicodendron radicans.*

Other Noteworthy Species: *Astragalus robbinsii* var. *jesupii.*

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This community is reported from Vermont, New Hampshire, Maine, Connecticut, New Jersey, and New York. It may also occur in Massachusetts.

States/Provinces: CT, MA, ME, NH, NJ, NY, VT.

Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: G2 (17-Nov-1997).
Reasons: There are probably fewer than 20 occurrences of this community rangewide. Individual occurrences tend to be small, so there are probably fewer than 500 acres rangewide. Currently five occurrences are documented in New Hampshire, with a total acreage of less than 20 acres. Similar vegetation is reported from Vermont, Maine, and New York, but these still need confirmation. This community is restricted to calcareous or basic bedrock outcrops along ice-scoured upper reaches of major rivers such as the Connecticut River in New Hampshire and Vermont, the Kennebec River in Maine, the Hudson River in New York, and the Delaware River in New Jersey.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 2 – Moderate.
Comments: This community may occur in conjunction with seep communities. However, emergent seepage is absent as are the corresponding seepage and wetland plants found in riverside seeps. Sedges are notably lacking. This community differs from rock outcrop/rocky summit communities by the paucity of lichen and woody species intolerant of flooding and the presence of flood-tolerant species on lower, somewhat enriched reaches of the community, where regular erosion and deposition of silty sediments occur.
Similar Associations:
- *Andropogon gerardii - Phlox subulata - Solidago simplex* var. *racemosa - Packera paupercula* Herbaceous Vegetation (CEGL004284).
- *Campanula rotundifolia - Packera paupercula - (Aquilegia canadensis)* Sparse Vegetation (CEGL006532).

Related Concepts:
- Riverine Lower Perennial Emergent Wetland, Seasonally Flooded (R2EMC) (Cowardin et al. 1979) ?
- Rivershore Grassland (Thompson 1996) ?
- Riverside Outcrop Community (Thompson 1996) ?
- SNE Riverside Outcrop Community (Rawinski 1984) ?

SOURCES
Description Authors: M. Anderson, mod. S. L. Neid and S. C. Gawler.
References: Breden 1989, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Gawler 2002, Grossman et al. 1994, Metzler and Barrett 2001, Rawinski 1984, Shank and Shreiner 1999, Sperduto 1992, Swain and Kearsley 2001, Thompson 1996, Thompson and Sorenson 2000.

Figure 117. Calcareous Riverside Outcrop in Delaware Water Gap National Recreation Area (plot DEWA.219). July 2004.

Figure 118. Calcareous Riverside Outcrop in Delaware Water Gap National Recreation Area (Accuracy Assessment Observation Point DEWA.616). June 2006.

COMMON NAME (PARK-SPECIFIC): SHALE SCREE SLOPE

SYNONYMS
NVC English Name: **Hairy Beardtongue Sparse Vegetation**
NVC Scientific Name: ***Penstemon hirsutus* Sparse Vegetation**
NVC Identifier: **CEGL006535**

LOCAL INFORMATION

Environmental Description: This association occurs on very steep, southeast-facing slopes composed of gravelly shale and siltstone scree along the eastern edge of the Glaciated Low Plateau in Pennsylvania. The parent material is shale and siltstone of the Devonian Mahantango Formation. The Mahantango Formation may also contain thin beds of argillaceous limestone, though expression of calcareous bedrock in this formation within the park is uncertain. The scree is very well-drained with vegetation likely experiencing droughty soil conditions for much of the growing season. Some smaller occurrences are a result of previous quarrying operations.
Vegetation Description: Vegetation on scree slopes varies from nearly absent to sparse woodland. The vegetation, when present, is typical of dry forests and grasslands. Typical tree species include chestnut oak (*Quercus prinus*), eastern white pine (*Pinus strobus*) and eastern red-cedar (*Juniperus virginiana*). Tree heights range from 5 to 20 m, with trees often appearing stunted. The shrub layer typically consists of low shrubs and tree saplings, including staghorn sumac (*Rhus hirta*), Blue Ridge blueberry (*Vaccinium pallidum*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolium*), and common serviceberry (*Amelanchier arborea*). The herbaceous layer ranges from absent to 30% cover and consists of drought-tolerant herbs and grasses. Typical herbaceous species include wavy hairgrass (*Deschampsia flexuosa*), bastard toadflax (*Comandra umbellata*), Pennsylvania sedge (*Carex pensylvanica*), Atlantic goldenrod (*Solidago arguta*), Virginia tephrosia (*Tephrosia virginiana*), and yellow wild indigo (*Baptisia tinctoria*).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus, Quercus rubra*
Tree canopy	Needle-leaved tree	*Pinus strobus*
Tree subcanopy	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Rhus* spp.
Short shrub/sapling	Broad-leaved deciduous shrub	*Gaylussacia baccata, Vaccinium angustifolium, Vaccinium pallidum*
Herb (field)	Forb	*Comandra umbellata, Solidago arguta*
Herb (field)	Graminoid	*Carex pensylvanica, Deschampsia flexuosa*

Characteristic Species: *Deschampsia flexuosa*, *Juniperus virginiana*, *Pinus strobus*, *Rhus* spp., *Quercus prinus*, *Quercus rubra*, *Vaccinium pallidum.*
Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
PA	S3	1	no crosswalk	Fike 1999

Local Range: This vegetation type is restricted to the lower slope below shale bedrock outcrops west of the Delaware River, where the Glaciated Low Plateau meets the river valley. The majority of occurrences are in the north end of the park, a few miles south of Milford.
Classification Comments: The amount of vegetation present is extremely variable and is often absent. It differs from Sandstone Talus in the source of parent material (shale vs. sandstone) and the nature of the substrate (fine to coarse shale gravel vs. massive sandstone boulders). Hickory - Eastern Red-cedar Rocky Woodland typically occurs above this type on exposed shale bedrock with some thin soil development, higher vegetation cover and general absence of oak tree species (though bear oak (*Quercus ilicifolia*) may be present).
Other Comments: None.
Local Description Authors: G. S. Podniesinski (PNHP), mod. S. C. Gawler.
Plots and Data Sources: DEWA.145.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Boulder, gravel, cobble, or talus sparse vegetation (VII.B.)
Physiognomic Group	Sparsely vegetated talus/scree slopes (VII.B.1.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated talus/scree slopes (VII.B.1.N.)
Formation	Lowland or submontane talus/scree (VII.B.1.N.a.)
Alliance	Lowland Talus Sparsely Vegetated Alliance (A.1847)
Alliance (English name)	Lowland Talus Sparsely Vegetated Alliance
Association	*Penstemon hirsutus* Sparse Vegetation
Association (English name)	Hairy Beardtongue Sparse Vegetation
Ecological System(s):	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)

GLOBAL DESCRIPTION

Concept Summary: This association consists of sparse, mostly herbaceous vegetation occurring on harsh, steep, unstable shale talus and cliffs. Heat, drought and lack of soil development prevent the establishment of many species and limit the community to crevice-rooting herbaceous plants and widely scattered small trees and shrubs. Vegetation cover is variable and patchy. Typical tree species include *Quercus prinus, Pinus strobus, Pinus pungens*, and *Juniperus virginiana*. Shrubs include scattered *Vaccinium pallidum, Rhus hirta, Gaylussacia baccata*, and *Amelanchier arborea*. The herbaceous layer ranges from absent to nearly 30% cover in patches, and consists of drought-tolerant herbs and grasses such as *Deschampsia flexuosa, Comandra umbellata, Solidago arguta, Baptisia tinctoria, Woodsia obtusa, Woodsia ilvensis, Penstemon hirsutus, Geranium robertianum, Schizachyrium scoparium, Dichanthelium linearifolium (= Panicum linearifolium),* and *Carex pensylvanica*.
Environmental Description: This association occurs on unstable shale talus with shallow, very well-drained soils. The parent material is shale and siltstone. The scree is very well-drained with vegetation likely experiencing droughty soil conditions for much of the growing season.

Vegetation Description: Vegetation cover is variable and patchy. Typical tree species include *Quercus prinus, Pinus strobus, Pinus pungens*, and *Juniperus virginiana*. Shrubs include scattered *Vaccinium pallidum, Rhus hirta, Gaylussacia baccata*, and *Amelanchier arborea*. The herbaceous layer ranges from absent to nearly 30% cover in patches, and consists of drought-tolerant herbs and grasses such as *Deschampsia flexuosa, Comandra umbellata, Solidago arguta, Baptisia tinctoria, Woodsia obtusa, Woodsia ilvensis, Penstemon hirsutus, Geranium robertianum,, Schizachyrium scoparium, Dichanthelium linearifolium (= Panicum linearifolium),* and *Carex pensylvanica*.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Comandra umbellata, Penstemon hirsutus, Solidago arguta*
Herb (field)	Graminoid	*Carex pensylvanica, Deschampsia flexuosa*

Characteristic Species: *Deschampsia flexuosa, Juniperus virginiana, Pinus strobus, Quercus prinus, Quercus rubra, Woodsia ilvensis, Woodsia obtusa.*
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION
Range: This association is known from central New England and New York state south to northern New Jersey and Pennsylvania.
States/Provinces: NJ, NY, PA, VT.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS
Rank: GNR (6-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: This community is apparently distinct, but very poorly documented.
Similar Associations:
- *Quercus rubra - Quercus prinus - Pinus strobus / Penstemon hirsutus* Woodland (CEGL006074).

Related Concepts:
- Shale Talus (Thompson 1996) ?

SOURCES
Description Authors: S. C. Gawler.
References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Thompson 1996, Thompson and Sorenson 2000.

Figure 119. Shale Scree Slope in Delaware Water Gap National Recreation Area (along Route 209, near Milford, in Pennsylvania). June 2006.

Figure 120. Shale Scree Slope in Delaware Water Gap National Recreation Area (near Accuracy Assessment Observation Point DEWA.214). April 2005.

COMMON NAME (PARK-SPECIFIC): RIVERINE SCOUR VEGETATION

SYNONYMS
NVC English Name: **Fringed Loosestrife - Indian-hemp Sparse Vegetation**
NVC Scientific Name: ***Lysimachia ciliata* - *Apocynum cannabinum* Sparse Vegetation**
NVC Identifier: **CEGL006554**

LOCAL INFORMATION

Environmental Description: This type is associated with the Delaware River in a wide variety of riverine settings. Island heads, bars, spits, low terraces, and shorelines can support this broadly defined vegetation type. The underlying substrate varies greatly, although it is often cobbles and sand, with thin deposits of silt, muck, or organic matter. Species composition also varies greatly from site to site. The unifying factor that bridges the differences in environmental factors and species composition is the frequent scour that these sites experience. This vegetation type establishes in areas of the active channel that are underwater for the majority of the year and are exposed only at low water or in drought years. Therefore, these areas are subjected to high water velocities, floods, and ice-scour more frequently than the other riparian communities (with the exception of emergent beds). The constant scour removes established vegetation and maintains or creates exposed sediments or cobbles. Water, air, and animals are constantly dispersing new seeds and plant propagules to these areas. This causes the continual flux in species composition that is characteristic of this community.

Vegetation Description: Frequent disturbance of these areas creates conditions that promote continual colonization by a wide variety of plants. After a disturbance, herbaceous and graminoid species may establish sparsely across bare substrate. As more time elapses between disturbance events, vegetation can become dense, completely covering the area. The species composition of the community varies depending upon the available seedbank, surrounding vegetation, type of substrate, ecoregion, and hydrologic conditions. Some common species include water knotweed (*Polygonum amphibium*), spikerushes (*Eleocharis* spp.), sensitive fern (*Onoclea sensibilis*), American water-willow (*Justicia americana*), Virginia marsh St. Johnswort (*Triadenum virginicum*), tussock sedge (*Carex stricta*), spotted joe-pyeweed (*Eupatorium maculatum*), eastern marsh fern (*Thelypteris palustris*), chufa flatsedge (*Cyperus esculentus*), Indian-hemp (*Apocynum cannabinum*), fringed loosestrife (*Lysimachia ciliata*), smallspike false nettle (*Boehmeria cylindrica*), common marsh bedstraw (*Galium palustre*), whitegrass (*Leersia virginica*), marshpepper knotweed (*Polygonum hydropiper*), swamp smartweed (*Polygonum hydropiperoides*), reed canarygrass (*Phalaris arundinacea*), poverty rush (*Juncus tenuis*), common threesquare (*Schoenoplectus pungens*), wild mint (*Mentha arvensis*), groundnut (*Apios americana*), flat-top goldentop (*Euthamia graminifolia*), American hogpeanut (*Amphicarpaea bracteata*), big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), and common sneezeweed (*Helenium autumnale*). Numerous other species can be present. The invasive exotic purple loosestrife (*Lythrum salicaria*) can be abundant in this community type. Scattered short and tall shrubs may be present, including river birch (*Betula nigra*), silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), willows (*Salix* spp.), and/or red maple (*Acer rubrum*).

Most Abundant Species:

Stratum	Lifeform	Species
Short shrub/sapling	Broad-leaved deciduous shrub	*Betula nigra, Platanus occidentalis*
Herb (field)	Forb	*Lythrum salicaria, Mentha arvensis, Polygonum amphibium*
Herb (field)	Graminoid	*Carex stricta, Phalaris arundinacea, Eleocharis* spp.
Herb (field)	Fern or fern ally	*Onoclea sensibilis*

Characteristic Species: This vegetation type characteristically includes wide variation in species composition between sites. See the Vegetation Description above for common species.
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	2	Loosestrife - Dogbane Scoured Rivershore	Walz et al. 2006
PA	S4	2	no crosswalk	Fike 1999

Local Range: This type is common within the Delaware River.
Classification Comments: Calcareous Riverside Outcrop and Calcareous Riverside Seep is distinguished from Riverine Scour Vegetation by the presence of exposed calcareous bedrock along the shoreline of the river that often provides habitat for rare species. Riverine Scour Vegetation occurs in a wide variety of riverine settings and on various substrates, although not bedrock.
Other Comments: None.
Local Description Authors: S. J. Perles (PNHP).
Plots and Data Sources: DEWA.99, DEWA.100, DEWA.102, DEWA.218; Perles et al 2004.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Boulder, gravel, cobble, or talus sparse vegetation (VII.B.)
Physiognomic Group	Sparsely vegetated rock flats (VII.B.2.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated rock flats (VII.B.2.N.)
Formation	Cobble/gravel beaches and shores (VII.B.2.N.b.)
Alliance	Cobble/Gravel Shore Sparsely Vegetated Alliance (A.1850)
Alliance (English name)	Cobble/Gravel Shore Sparsely Vegetated Alliance
Association	*Lysimachia ciliata - Apocynum cannabinum* Sparse Vegetation
Association (English name)	Fringed Loosestrife - Indian-hemp Sparse Vegetation
Ecological System(s):	Central Appalachian Riparian (CES202.609)

GLOBAL DESCRIPTION

Concept Summary: Island heads, bars, spits, low terraces, and riverbanks are all home to this broadly defined community. The underlying substrate also varies greatly, although it is often cobbles and sand, with thin deposits of silt, muck or organic matter. Species composition also

varies greatly from site to site. The unifying factor that bridges the differences in environmental factors and species composition is the frequent scour that these sites experience. This community establishes in areas of the active channel that are underwater for the majority of the year and are exposed only at low water or in drought years. Therefore, these areas are subjected to high water velocities, floods and ice-scour more frequently than other herbaceous communities or shrublands (with the exception of emergent beds). The constant scour removes established vegetation and maintains or creates exposed sediments, cobbles or bedrock. New seeds and plant propagules are constantly being dispersed to these areas by water, air and animals. This causes a continual flux in species composition that is characteristic of this community. Typical species are a mix of annuals and perennials, including *Lysimachia ciliata, Lysimachia vulgaris, Lysimachia nummularia, Senecio* spp., *Eupatorium* spp., other Asteraceae spp., *Convolvulus* spp., *Phyla lanceolata,, Justicia americana, Cyperus esculentus, Boehmeria cylindrica, Polygonum* spp., *Apocynum cannabinum, Betula nigra*, and *Platanus occidentalis*. This community is defined mainly by its setting and disturbance regime.

Environmental Description: sland heads, bars, spits, low terraces, and riverbanks are all home to this broadly defined community. The underlying substrate also varies greatly, although it is often cobbles and sand, with thin deposits of silt, muck or organic matter. Species composition also varies greatly from site to site. The unifying factor that bridges the differences in environmental factors and species composition is the frequent scour that these sites experience. This community establishes in areas of the active channel that are underwater for the majority of the year and are exposed only at low water or in drought years. Therefore, these areas are subjected to high water velocities, floods and ice-scour more frequently than other herbaceous communities or shrublands (with the exception of emergent beds). The constant scour removes established vegetation and maintains or creates exposed sediments, cobbles or bedrock. New seeds and plant propagules are constantly being dispersed to these areas by water, air and animals. This causes a continual flux in species composition that is characteristic of this community.

Vegetation Description: Typical species are a mix of annuals and perennials including *Lysimachia ciliata, Lysimachia vulgaris, Lysimachia nummularia, Senecio* sp., Asteraceae spp., *Eupatorium* spp., *Convolvulus* spp., *Phyla lanceolata, Justicia americana, Cyperus esculentus, Boehmeria cylindrica, Polygonum* spp., *Apocynum cannabinum, Betula nigra, Platanus occidentalis*. This community is defined mainly by its setting and disturbance regime.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Lysimachia ciliata*

Characteristic Species: *Apocynum cannabinum*, *Lysimachia ciliata*, *Polygonum amphibium.*

Other Noteworthy Species: Information not available.

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: The full distribution of this type is not well-known. It is currently documented only from Pennsylvania and New Jersey but believed to range further. Lack of samples and inherent variability are challenges.

States/Provinces: NJ, PA.

Federal Lands: NPS (Delaware Water Gap, Johnstown Flood).

CONSERVATION STATUS
Rank: GNR (8-Jul-1999).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Standard.
Confidence: 3 – Weak.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: E. Largay, mod. S. C. Gawler.
References: Eastern Ecology Working Group n.d., Fike 1999, Perles et al. 2004

Figure 121. Riverine Scour Vegetation in Delaware Water Gap National Recreation Area (plot DEWA.100). July 2004.

Figure 122. Riverine Scour Vegetation in Delaware Water Gap National Recreation Area (plot DEWA.218). August 2003.

COMMON NAME (PARK-SPECIFIC): BOULDER VERNAL POOL SPARSE VEGETATION

SYNONYMS
NVC English Name: **Boulder Vernal Pool Sparse Vegetation**
NVC Scientific Name: **Boulder Vernal Pool Sparse Vegetation**
NVC Identifier: **CEGL006453**

LOCAL INFORMATION

Environmental Description: This association occurs as boulderfields in shallow depressions atop Kittatinny Ridge. Occurrences have been noted on both the Pennsylvania and New Jersey portions of Kittatinny Ridge. The substrate is coarse boulders derived from sandstone and sandstone conglomerate of the Shawangunk Formation. Boulder vernal pools experience seasonally fluctuating water levels and may dry out completely in the summer. Hydrology is controlled by impervious bedrock below the boulderfield. Vegetation cover is typically sparse. This association typically has little or no canopy cover.
Vegetation Description: Vegetation cover is sparse, except for abundant mosses and lichens which can cover up to 90% of the boulders. Woody plant cover is sparse and usually restricted to shrubs at the margin of the pool. Typical woody shrubs include highbush blueberry (*Vaccinium corymbosum*) and steeplebush (*Spiraea tomentosa*). The herbaceous layer is usually very sparse, with scattered sedges (*Carex* spp.), Pennsylvania smartweed (*Polygonum pensylvanicum*), and swamp smartweed (*Polygonum hydropiperoides*) typical. There may also be mosses (*Sphagnum* spp.) and algae growing on or between boulders that are inundated for extended periods of time.
Most Abundant Species: The most abundant species are mosses and/or lichens. These non-vascular plants were not identified during this study, but should be identified by future studies.
Characteristic Species: *Polygonum* spp., *Spiraea tomentosa, Vaccinium corymbosum.*
Other Noteworthy Species: Information not available.
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	3	Eastern Woodland Vernal Pool Sparse Vegetation	Walz et al. 2006
PA	S1?	3	no crosswalk	Fike 1999

Local Range: This association is known from five occurrences within the park associated with the top of Kittatinny Ridge. Four examples occur in New Jersey and one example occurs near the former Mount Minsi fire tower in Pennsylvania.
Classification Comments: This vegetation type needs further investigation as it was described from field observations during accuracy assessment sampling. It differs from Eastern Woodland Vernal Pool Sparse Vegetation in having a boulderfield substrate and having a distribution limited to open ridgetops with little or no canopy cover.
Other Comments: Fairy shrimp (*Eubranchipus* sp.) were observed in the Pennsylvania occurrence in September 2003.
Local Description Authors: G. S. Podniesinski (PNHP).
Plots and Data Sources: Accuracy Assessment Observation Points DEWA.1019, DEWA.1024, DEWA.1029, DEWA.1030.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated soil flats (VII.C.4.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated soil flats (VII.C.4.N.)
Formation	Seasonally / temporarily flooded mud flats (VII.C.4.N.c.)
Alliance	Non-tidal Mud Flat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance (A.1878)
Alliance (English name)	Non-tidal Mud Flat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance
Association	Eastern Woodland Vernal Pool Sparse Vegetation [Provisional]
Association (English name)	Eastern Woodland Vernal Pool Sparse Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or impervious bedrock at or near the surface. The substrate is mineral soil with or without a layer of muck. The species composition is variable among sites, as well as annually and seasonally. Larger examples of this community type may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae.

Environmental Description: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or impervious bedrock at or near the surface. The substrate in most vernal pools is mineral soil with or without a layer of muck, but some are boulder-filled depressions. Boulder vernal pools may dry out completely in the summer, and their hydrology is controlled by impervious bedrock below the boulderfield.

Vegetation Description: The species composition is variable among sites, variable annually, and variable seasonally. Larger examples may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae. Cover may be sparse and often varies through the season. Species composition is extremely variable, and of the species listed below, only a few are likely to be found on any one site. Typical representatives include *Dulichium arundinaceum, Glyceria* sp., *Leersia oryzoides, Scirpus cyperinus, Lycopus uniflorus, Polygonum* spp., *Thelypteris palustris, Carex gynandra, Carex crinita, Carex leptonervia, Carex stipata, Carex canescens, Carex vesicaria, Juncus effusus, Bidens* spp., *Hypericum mutilum, Hypericum canadense, Osmunda cinnamomea, Osmunda regalis, Agrostis scabra, Utricularia geminiscapa, Triadenum virginicum, Sagittaria* sp., and *Eleocharis* spp. Although this community type is predominantly herbaceous, shrubs and small trees may be present. Typical woody species include *Vaccinium corymbosum, Lyonia ligustrina, Quercus palustris, Nyssa sylvatica, Acer rubrum, Salix* spp., *Cephalanthus occidentalis,* and *Ilex verticillata*.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata*, *Vaccinium corymbosum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis*
Herb (field)	Forb	*Sagittaria latifolia*
Herb (field)	Graminoid	*Juncus effusus*, *Leersia oryzoides*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Cephalanthus occidentalis*, *Leersia oryzoides*, *Sagittaria latifolia*, *Thelypteris palustris.*
Other Noteworthy Species: *Scirpus ancistrochaetus.*
USFWS Wetland System: Palustrine.

DISTRIBUTION
Range: This association occurs in the northeastern U.S., and presumably in adjacent Canada, primarily in glaciated or periglacial areas, from Quebec and New Brunswick south through New York to northern Pennsylvania and northern New Jersey.
States/Provinces: CT, MA, ME, NH, NJ, NY, PA, RI, VT.
Federal Lands: NPS (Acadia, Delaware Water Gap); USFWS (Great Swamp).

CONSERVATION STATUS
Rank: GNR (8-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION
Status: Provisional.
Confidence: 3 – Weak.
Comments: Recognition of vernal pool associations is complicated not only by the lack of good data but by the seasonal and spatial variability in composition. The largest factor, however, is that vernal pools are generally defined by their invertebrate and amphibian communities and often do not have characteristic suites of plant species. This type should be considered tentative pending more data.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Colburn 2004, Eastern Ecology Working Group n.d., Fike 1999, Thompson and Sorenson 2000.

Figure 123. Boulder Vernal Pool Sparse Vegetation in Delaware Water Gap National Recreation Area (near Mt. Minsi in Pennsylvania). April 2006.

Figure 124. Boulder Vernal Pool Sparse Vegetation in Delaware Water Gap National Recreation Area (Accuracy Assessment Obersvation Point DEWA.1024). June 2006.

COMMON NAME (PARK-SPECIFIC): EASTERN WOODLAND VERNAL POOL SPARSE VEGETATION

SYNONYMS
NVC English Name: **Eastern Woodland Vernal Pool Sparse Vegetation**
NVC Scientific Name: **Eastern Woodland Vernal Pool Sparse Vegetation [Provisional]**
NVC Identifier: **CEGL006453**

LOCAL INFORMATION

Environmental Description: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high ground water tables, seasonal flooding in nearby streams and drainages, and or impervious bedrock at or near the surface. The substrate is mineral soil with or without a layer of muck. The species composition is variable among sites, as well as annually and seasonally. Larger examples of this community type may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae.
Vegetation Description: Cover may be sparse. Species composition is extremely variable; some typical representatives include (although only a few are likely to be found on any one site) threeway sedge (*Dulichium arundinaceum*), mannagrass (*Glyceria* sp.), rice cutgrass (*Leersia oryzoides*), woolgrass (*Scirpus cyperinus*), barbed-bristle bulrush (*Scirpus ancistrochaetus*), northern bugleweed (*Lycopus uniflorus*), knotweeds (*Polygonum* spp.), eastern marsh fern (*Thelypteris palustris*), nodding sedge (*Carex gynandra*), fringed sedge (*Carex crinita*), nerveless woodland sedge (*Carex leptonervia*), owlfruit sedge (*Carex stipata*), silvery sedge (*Carex canescens*), blister sedge (*Carex vesicaria*), common rush (*Juncus effusus*), beggarticks (*Bidens* spp.), dwarf St. Johnswort (*Hypericum mutilum*), lesser Canadian St. Johnswort (*Hypericum canadense*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), rough bentgrass (*Agrostis scabra*), hidden-fruit bladderwort (*Utricularia geminiscapa*), Virginia marsh St. Johnswort (*Triadenum virginicum*), arrowhead (*Sagittaria* sp.), and spikerushes (*Eleocharis* spp.). Although this community type is predominantly herbaceous, shrubs and small trees may be present. Typical woody species include highbush blueberry (*Vaccinium corymbosum*), maleberry (*Lyonia ligustrina*), pin oak (*Quercus palustris*), blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*), willows (*Salix* spp.), common buttonbush (*Cephalanthus occidentalis*), and common winterberry (*Ilex verticillata*).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Nyssa sylvatica, Quercus palustris*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata, Vaccinium corymbosum, Salix* spp.
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis*
Herb (field)	Forb	*Sagittaria latifolia, Polygonum* spp.
Herb (field)	Graminoid	*Juncus effusus, Leersia oryzoides, Eleocharis* spp.
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Cephalanthus occidentalis, Leersia oryzoides, Sagittaria latifolia, Thelypteris palustris, Polygonum* spp.*, Bidens* spp.*, Eleocharis* spp.
Other Noteworthy Species: *Scirpus ancistrochaetus.*
Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNR	3	Eastern Woodland Vernal Pool Sparse Vegetation	Walz et al. 2006
PA	S3	1	Herbaceous vernal pond	Fike 1999

Local Range: This association is found scattered throughout the park, primarily in forested settings.
Classification Comments: This association is characterized by a seasonally flooded depression lined with leaf litter. It differs from Boulder Vernal Pool Sparse Vegetation that has a boulderfield substrate instead of leaf litter.
Other Comments: These ponds lack mature fish populations and therefore can provide critical breeding habitat for several species of amphibians. They are also an important habitat resource for many species of birds, mammals, reptiles, amphibians, and invertebrates.
Local Description Authors: G. S. Podniesinski and J. Fike (PNHP).
Plots and Data Sources: Accuracy Assessment Observation Point DEWA.109; Fike 1999.
Delaware Water Gap National Recreation Area Inventory Notes: Information not available.

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Sparse Vegetation (VII)
Physiognomic Subclass	Unconsolidated material sparse vegetation (VII.C.)
Physiognomic Group	Sparsely vegetated soil flats (VII.C.4.)
Physiognomic Subgroup	Natural/Semi-natural sparsely vegetated soil flats (VII.C.4.N.)
Formation	Seasonally / temporarily flooded mud flats (VII.C.4.N.c.)
Alliance	Non-tidal Mud Flat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance (A.1878)
Alliance (English name)	Non-tidal Mud Flat Seasonally/Temporarily Flooded Sparsely Vegetated Alliance
Association	Eastern Woodland Vernal Pool Sparse Vegetation [Provisional]
Association (English name)	Eastern Woodland Vernal Pool Sparse Vegetation
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or impervious bedrock at or near the surface. The substrate is mineral soil with or without a layer of muck. The species composition is variable among sites, as well as annually and seasonally. Larger examples of this community type may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae.
Environmental Description: This association is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. Hydrology may be affected by impermeable soils, seasonally high water tables, seasonal flooding in nearby streams and drainages, and/or

impervious bedrock at or near the surface. The substrate in most vernal pools is mineral soil with or without a layer of muck, but some are boulder-filled depressions. Boulder vernal pools may dry out completely in the summer, and their hydrology is controlled by impervious bedrock below the boulderfield.

Vegetation Description: The species composition is variable among sites, variable annually, and variable seasonally. Larger examples may exhibit strong zonation. Many smaller, shaded vernal ponds are unvegetated, their bottoms consisting of dead leaves and algae. Cover may be sparse and often varies through the season. Species composition is extremely variable, and of the species listed below, only a few are likely to be found on any one site. Typical representatives include *Dulichium arundinaceum, Glyceria* sp., *Leersia oryzoides, Scirpus cyperinus, Lycopus uniflorus, Polygonum* spp., *Thelypteris palustris, Carex gynandra, Carex crinita, Carex leptonervia, Carex stipata, Carex canescens, Carex vesicaria, Juncus effusus, Bidens* spp., *Hypericum mutilum, Hypericum canadense, Osmunda cinnamomea, Osmunda regalis, Agrostis scabra, Utricularia geminiscapa, Triadenum virginicum, Sagittaria* sp., and *Eleocharis* spp. Although this community type is predominantly herbaceous, shrubs and small trees may be present. Typical woody species include *Vaccinium corymbosum, Lyonia ligustrina, Quercus palustris, Nyssa sylvatica, Acer rubrum, Salix* spp., *Cephalanthus occidentalis,* and *Ilex verticillata*.

Most Abundant Species:

Stratum	Lifeform	Species
Tall shrub/sapling	Broad-leaved deciduous shrub	*Ilex verticillata*, *Vaccinium corymbosum*
Short shrub/sapling	Broad-leaved deciduous shrub	*Cephalanthus occidentalis*
Herb (field)	Forb	*Sagittaria latifolia*
Herb (field)	Graminoid	*Juncus effusus*, *Leersia oryzoides*
Herb (field)	Fern or fern ally	*Thelypteris palustris*

Characteristic Species: *Cephalanthus occidentalis*, *Leersia oryzoides*, *Sagittaria latifolia*, *Thelypteris palustris.*

Other Noteworthy Species: *Scirpus ancistrochaetus.*

USFWS Wetland System: Palustrine.

DISTRIBUTION

Range: This association occurs in the northeastern U.S., and presumably in adjacent Canada, primarily in glaciated or periglacial areas, from Quebec and New Brunswick south through New York to northern Pennsylvania and northern New Jersey.

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

Federal Lands: NPS (Acadia, Delaware Water Gap); USFWS (Great Swamp).

CONSERVATION STATUS

Rank: GNR (8-Feb-2006).

Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Provisional.

Confidence: 3 – Weak.

Comments: Recognition of vernal pool associations is complicated not only by the lack of good data but by the seasonal and spatial variability in composition. The largest factor, however, is

that vernal pools are generally defined by their invertebrate and amphibian communities and often do not have characteristic suites of plant species. This type should be considered tentative pending more data.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES
Description Authors: S. C. Gawler.
References: Colburn 2004, Eastern Ecology Working Group n.d., Fike 1999, Thompson and Sorenson 2000.

Figure 125. Eastern Woodland Vernal Pool Sparse Vegetation in Delaware Water Gap National Recreation Area (near Lock Lomond in Pennsylvania). July 2006.

Figure 126. Eastern Woodland Vernal Pool Sparse Vegetation in Delaware Water Gap National Recreation Area (near Hornbecks Creek in Pennsylvania). July 2006.

COMMON NAME (PARK-SPECIFIC): WOODED SUCCESSIONAL OLD FIELD

SYNONYMS

NVC English Name:	**Red Maple - Oak species / Eastern Red-cedar / Goldenrod species Woodland**
NVC Scientific Name:	***Acer rubrum* - *Quercus* spp. / *Juniperus virginiana* / *Solidago* spp. Woodland**
NVC Identifier:	**CEGL006452**

LOCAL INFORMATION

Environmental Description: This association occurs in fields that are not plowed or planted in crops or hay grasses. Although these fields may be periodically mowed, woody plants have become established and tree cover varies from 25 to 60%. Some of these sites are old homesteads from which the houses have been removed. These sites contain moderately well-drained to well-drained soils, typically of the Manlius, Chenango, Pope, and Venango series, among others. These fields may contain drainage swales in which the vegetation is similar to that of Wet Meadow.

Vegetation Description: Characteristic vegetation for this association is a diverse mixture of goldenrods, cool-season grasses, and agricultural weeds combined with an open woodland of early- and mid-successional tree species. Tree canopy cover varies from 25 to 60% and is variable in composition and may include early-successional species such as eastern red-cedar (*Juniperus virginiana*), gray birch (*Betula populifolia*), choke cherry (*Prunus virginiana*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), as well as mid- to late-successional species such as sugar maple (*Acer saccharum*), northern red oak (*Quercus rubra*), black oak (*Quercus velutina*), and hickories (*Carya* spp.). Shrubs may be present but with total cover less than 25%. Common shrubs are eastern red-cedar, gray dogwood (*Cornus racemosa*), northern dewberry (*Rubus flagellaris*), Allegheny blackberry (*Rubus allegheniensis*), wine raspberry (*Rubus phoenicolasius*), black raspberry (*Rubus occidentalis*), and the invasive species autumn-olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), and Japanese barberry (*Berberis thunbergii*). The herbaceous layer is typically dense (80-100% cover). Species dominance in this layer shifts through the growing season, with cool-season grasses dominant early in the summer and goldenrods dominant later in the summer. Within each field, species may be locally abundant and often have patchy distribution. The two characteristically dominant species are wrinkleleaf goldenrod (*Solidago rugosa*) and sweet vernalgrass (*Anthoxanthum odoratum*). Other abundant species include flat-top goldentop (*Euthamia graminifolia*), meadow hawkweed (*Hieracium caespitosum*), red fescue (*Festuca rubra*), common cinquefoil (*Potentilla simplex*), wild bergamot (*Monarda fistulosa*), white bergamot (*Monarda clinopodia*), deertongue (*Dichanthelium clandestinum*), broomsedge bluestem (*Andropogon virginicus*), purple foxglove (*Digitalis purpurea*), lanceleaf wild licorice (*Galium lanceolatum*), Kentucky bluegrass (*Poa pratensis*), and common yarrow (*Achillea millefolium*). Other common associates are false baby's breath (*Galium mollugo*), common St. Johnswort (*Hypericum perforatum*), white clover (*Trifolium repens*), Queen Anne's lace (*Daucus carota*), common dandelion (*Taraxacum officinale*), meadow ryegrass (*Lolium pratense*), Virginia

mountainmint (*Pycnanthemum virginianum*), little bluestem (*Schizachyrium scoparium*), and common gypsyweed (*Veronica officinalis*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Acer saccharum, Juglans nigra, Quercus velutina*
Tall shrub/sapling	Needle-leaved tree	*Juniperus virginiana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus racemosa, Elaeagnus umbellata, Rosa multiflora*
Short shrub/sapling	Broad-leaved deciduous shrub	*Berberis thunbergii, Rubus allegheniensis, Rubus flagellaris, Rubus occidentalis, Rubus phoenicolasius, Rosa multiflora*
Herb (field)	Forb	*Euthamia graminifolia, Solidago rugosa*
Herb (field)	Graminoid	*Anthoxanthum odoratum, Festuca rubra*

Characteristic Species: *Acer rubrum, Acer saccharum, Achillea millefolium, Anthoxanthum odoratum, Daucus carota, Dichanthelium clandestinum, Elaeagnus umbellata, Euthamia graminifolia, Juglans nigra, Juniperus virginiana, Lolium pratense, Monarda fistulosa, Pycnanthemum virginianum, Quercus velutina, Rosa multiflora, Solidago rugosa, Taraxacum officinale.*

Other Noteworthy Species: Information not available.

Subnational Distribution with Crosswalk data:

State	State Rank	Confidence	State Name	Reference
NJ	SNA	3	no crosswalk	Walz et al. 2006
PA	SNA	3	no crosswalk	Fike 1999

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

Classification Comments: Wooded Successional Old Field is identified by a thick layer of herbaceous-graminoid vegetation dominated by a diverse mixture of goldenrods, cool-season grasses, and agricultural weeds in combination with an open hardwood woodland. Tree cover varies from 25 to 60%. This type differs from Northeastern Modified Successional Forest in the lack of vine species, greater cover of mid- to late-successional tree species and lower cover of invasive shrub species. This vegetation type appears to have a clearer successional trajectory towards a native forest type than does Northeastern Modified Successional Forest.

Other Comments: None.

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

Plots and Data Sources: Accuracy Assessment Observation Points DEWA.30, DEWA.324, DEWA.412.

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

GLOBAL INFORMATION

NVC CLASSIFICATION

Physiognomic Class	Information not available.
Physiognomic Subclass	Information not available.
Physiognomic Group	Information not available.
Physiognomic Subgroup	Information not available.
Formation	Information not available.
Alliance	Information not available.
Alliance (English name)	Information not available.
Association	*Acer rubrum* - *Quercus* spp. / *Juniperus virginiana / Solidago* spp. Woodland
Association (English name)	Red Maple - Oak species / Eastern Red-cedar / Goldenrod species Woodland
Ecological System(s):	Information not available

GLOBAL DESCRIPTION

Concept Summary: Information not available.
Environmental Description: Information not available.
Vegetation Description: Information not available.
Most Abundant Species: Information not available.
Characteristic Species: Information not available.
Other Noteworthy Species: Information not available.
USFWS Wetland System: Not applicable.

DISTRIBUTION

Range: Information not available.
States/Provinces: Information not available.
Federal Lands: NPS (Delaware Water Gap).

CONSERVATION STATUS

Rank: GNR (8-Feb-2006).
Reasons: Information not available.

CLASSIFICATION INFORMATION

Status: Nonstandard.
Confidence: Information not available.
Comments: Information not available.
Similar Associations: Information not available.
Related Concepts: Information not available.

SOURCES

Description Authors: Information not available.
References: Eastern Ecology Working Group n.d.

Figure 127. Wooded Successional Old Field in Delaware Water Gap National Recreation Area (along Route 209 in Pennsylvania). June 2006.

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As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-295 March 2007

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