
ECOLOGICAL SYSTEM: NORTHEASTERN INTERIOR DRY-MESIC OAK FOREST

Summary: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. Soils are acidic and relatively infertile but not strongly xeric. Oak species characteristic of dry-mesic conditions (e.g., *Quercus rubra* (northern red oak), *Quercus alba* (white oak), *Quercus velutina* (black oak), and *Quercus coccinea* (scarlet oak)) and *Carya* (hickory) spp. are dominant in mature stands. *Quercus prinus* (chestnut oak) may be present but is generally less important than the other oak species. *Castanea dentata* (American chestnut) was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum* (red maple), *Betula lenta* (sweet birch), and *Betula alleghaniensis* (yellow birch) may be common associates. With a long history of human habitation, many of the forests are early- to mid-successional, where *Pinus strobus* (eastern white pine), *Pinus virginiana* (Virginia pine), or *Liriodendron tulipifera* (tuliptree) may be dominant or codominant. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands, including non-forested seeps or forested wetlands with *Acer rubrum* (red maple), *Quercus bicolor* (swamp white oak), or *Nyssa sylvatica* (blackgum) characteristic.

High-ranked Species: *Callophrys irus* (G3, frosted elfin), *Canis rufus* (G1Q, red wolf), *Carex communis* var. *amplisquama* (G5T3, fort mountain sedge), *Carex polymorpha* (G3, variable sedge), *Coreopsis delphiniifolia* (G3?Q, larkspur tickseed), *Fothergilla major* (G3, mountain witch-alder), *Gaylussacia brachycera* (G3, box huckleberry), *Taenidia montana* (G3, mountain-pimpernel), *Thermopsis fraxinifolia* (G3?, ash-leaved bush-pea), *Thermopsis mollis* (G3G4, Allegheny mountain golden-banner), *Virginia valeriae pulchra* (G5T3T4, mountain earth snake)

Range: This system is found from central New England west through Ohio and Pennsylvania and south to Virginia. It does not extend to the southernmost part of Virginia, except in the Ridge and Valley. United States: CT, MA, MD, ME, NH, NJ, NY, OH, PA, RI, VA, VT, WV

Delaware Estuary Associations:

- Central Appalachian Forested Acid Seep
- Northeastern Dry Oak-Hickory Forest
- Northeastern Modified Successional Forest
- Red Maple - Blackgum Basin Swamp
- Red Maple - Tussock Sedge Wooded Marsh
- Red Maple Upland Forest
- Successional Aspen - Gray Birch Forest
- Tuliptree - Beech - Maple Forest
- Virginia Pine Successional Forest
- White Pine - Oak Forest

CLASSIFIERS FOR NORTHEASTERN INTERIOR DRY-MESIC OAK FOREST

Primary Division: 202

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Acidic Soil; Quercus - Carya

Non-diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Ustic; F-Patch/Medium Intensity; Broad-Leaved Deciduous Tree

CENTRAL APPALACHIAN FORESTED ACID SEEP

Acer rubrum - *Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest

Range: This acidic deciduous swamp occurs in the central Appalachian Mountains north of the Cumberland drainage in the Central Appalachians and High Allegheny ecoregions, as well as the adjacent Cumberlands and Western Allegheny Plateau. This seep community occurs in the Pennsylvania portion of the Delaware Estuary.

Environmental Description: This community occurs on substrates which are saturated for extended periods during the growing season but which rarely have standing water, including forested seeps, hillsides, streamheads, floodplain edges, and poorly drained depressions. Occurrences tend to be small.

Vegetation Description: Characteristic trees are *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum), with other associates including *Tsuga canadensis* (eastern hemlock) and *Betula alleghaniensis* (yellow birch). The shrub stratum includes *Alnus serrulata* (smooth alder), *Photinia pyrifolia* (red chokeberry), *Ilex verticillata* (common winterberry), *Vaccinium corymbosum* (highbush blueberry), *Rhododendron maximum* (great laurel), and *Rubus hispidus* (bristly dewberry). Characteristic herbs include *Osmunda cinnamomea* (cinnamon fern), *Osmunda regalis* (royal fern), *Carex folliculata* (northern long sedge), *Carex trisperma* (three-seed sedge), *Carex intumescens* (greater bladder sedge), *Carex stricta* (tussock sedge), and *Poa trivialis* (rough bluegrass). *Sphagnum* (peatmoss) spp. are typical.

Characteristic Species: *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), *Osmunda cinnamomea* (cinnamon fern)

Reference Sites: none identified

Global and State Conservation Ranks and Reasons: GNR (1-Dec-1997). PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.689039

References: Anderson et al. 1998, CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Fike 1999, Harrison 2004

MOST ABUNDANT SPECIES

STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tree canopy	Broad-leaved deciduous tree	<i>Nyssa sylvatica</i> (blackgum)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Alnus serrulata</i> (smooth alder)

NORTHEASTERN DRY OAK-HICKORY FOREST

Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium Forest

Range: This association occurs from Maine to Virginia. This forest type is very common on mid- to upper slopes and dry mesic sites in Pennsylvania. It occurs in all three states of the Delaware Estuary.

Environmental Description: This forest type occurs on well-drained loamy sand of midslopes. The sites may be gently to steeply sloping and may contain scattered boulders or large rocks.

Vegetation Description: *Quercus rubra* (northern red oak), *Quercus alba* (white oak), and *Quercus*



Photo by Pennsylvania Natural Heritage Program

velutina (black oak) are prominent in the canopy. Typical hickory species include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya alba* (mockernut hickory), and *Carya ovalis* (red hickory). Other canopy associates may include *Acer rubrum* (red maple), *Sassafras albidum* (sassafras), and *Amelanchier arborea* (common serviceberry). At the northern range limit of this type, *Pinus strobus* (eastern white pine) and *Betula lenta* (sweet birch) also occur as minor associates. *Cornus florida* (flowering dogwood) is a characteristic understory tree in portions of the range. The shrub layer is characterized by *Viburnum acerifolium* (mapleleaf viburnum), with other frequent associates including *Hamamelis virginiana* (American witch-hazel), *Vaccinium corymbosum* (highbush blueberry), *Corylus cornuta* (beaked hazelnut), and *Corylus americana* (American hazelnut). A dwarf-shrub layer may be common, but generally not abundant, and characterized by *Vaccinium pallidum* (hillside blueberry) and *Gaylussacia baccata* (black huckleberry), with *Vaccinium angustifolium* (northern lowbush blueberry) occurring more frequently to the north. The herbaceous layer is characterized by *Carex pensylvanica* (Pennsylvania sedge), *Maianthemum racemosum* (feathery false lily-of-the-valley), *Aralia nudicaulis* (wild sarsaparilla), *Hieracium venosum* (rattlesnake-weed), *Solidago bicolor* (white goldenrod), *Desmodium glutinosum* (large tick-trefoil), *Desmodium paniculatum* (narrowleaf tick-trefoil), *Melampyrum lineare* (narrowleaf cow-wheat), *Chimaphila maculata* (striped pipsissewa), *Eurybia divaricata* (white wood-aster), *Danthonia spicata* (poverty oatgrass), *Aureolaria* (yellow false foxglove) spp., and *Helianthemum canadense* (long-branch frostweed).

Characteristic Species: *Carex pensylvanica* (Pennsylvania sedge), *Cornus florida* (flowering dogwood), *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (hillside blueberry), *Viburnum acerifolium* (mapleleaf viburnum)

Dynamics/Successional Trajectory: This vegetation is ecologically transitional between dry-rich oak-hickory forests of relatively high diversity and dry, acidic oak-species-poor forests.

Management Concerns: Mature stands are uncommon, and most stands are subject to logging disturbances or even complete destruction if located in rapidly developing suburban areas.

Reference Sites: East Blackbird Drainage, DE; Rancocas State Park, NJ; Hopewell Furnace National Historic Site, Berks County, PA

Global and State Conservation Ranks and Reasons: G4G5 (24-Jan-2005). DE: S3?, NJ: S4S5, PA: SNR. This type is not naturally rare and has a wide geographic distribution.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.685156

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

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Carya glabra</i> (pignut hickory)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus rubra</i> (northern red oak)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus velutina</i> (black oak)
Shrub/sapling (tall & short)	Broad-leaved deciduous tree	<i>Cornus florida</i> (flowering dogwood)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Viburnum acerifolium</i> (mapleleaf viburnum)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Gaylussacia baccata</i> (black huckleberry)
Herb (field)	Graminoid	<i>Carex pensylvanica</i> (Pennsylvania sedge)

NORTHEASTERN MODIFIED SUCCESSIONAL FOREST

Prunus serotina - *Liriodendron tulipifera* - *Acer rubrum* - *Fraxinus americana* Forest

Range: This vegetation is currently described from Pennsylvania but is of broader distribution in the northeastern U.S.

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. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples.



Photo by Pennsylvania Natural Heritage Program

Vegetation Description: Tree species may include *Prunus serotina* (black cherry), *Liriodendron tulipifera* (tuliptree), *Fraxinus americana* (white ash), and *Acer rubrum* (red maple). Other associates can include *Juglans nigra* (black walnut), *Sassafras albidum* (sassafras), *Betula populifolia* (gray birch), *Juniperus virginiana* (eastern red-cedar), *Acer negundo* (box-elder), *Acer saccharinum* (silver maple), *Ailanthus altissima* (tree-of-heaven), *Ulmus americana* (American elm), *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Amelanchier* (serviceberry) spp., and *Robinia pseudoacacia* (black locust). Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* (northern spicebush) and *Carpinus caroliniana* (American hornbeam). The low-shrub layer, if present, is usually characterized by the presence of *Rubus* (blackberry) spp. such as *Rubus flagellaris* (northern dewberry), *Rubus allegheniensis* (Allegheny blackberry), *Rubus phoenicolasius* (wine raspberry), or *Rubus hispidus* (bristly dewberry). This layer is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin.

Characteristic Species: *Acer rubrum* (red maple), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* (black cherry), *Robinia pseudoacacia* (black locust)

Dynamics/Successional Trajectory: 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. This community is associated with disturbed sites and is characterized by early-successional vegetation, often with a high cover of non-native invasive species in one or more strata. The successional trajectory is typically unclear given the often weedy nature of most stands. When occurring in a matrix of relatively intact mature forest, the adjacent forest type may provide a reasonable guide for the long-term successional trajectory of the stand.

Management Concerns: This community represents early-successional, degraded forest stands and is not a management or restoration target. The shrub layer of this community is often dominated by exotic species such as *Lonicera tatarica* (Tatarian honeysuckle), *Lonicera japonica* (Japanese honeysuckle), *Rhamnus cathartica* (common buckthorn), *Crataegus* (hawthorn) spp., *Rosa multiflora* (multiflora rose), and *Berberis thunbergii* (Japanese barberry). The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin.

Reference Sites: No reference sites were identified because this is not a desired target community for restoration.

Global and State Conservation Ranks and Reasons: GNA (ruderal) (29-Nov-2004). NJ: SNA, PA: SNA. This vegetation is modified by human activity and not of conservation concern.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.754608

References: Eastern Ecology Working Group n.d., Fike 1999, Perles et al. 2005c, Podniesinski et al. 2006

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tree canopy	Broad-leaved deciduous tree	<i>Fraxinus americana</i> (white ash)
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)
Tree canopy	Broad-leaved deciduous tree	<i>Prunus serotina</i> (black cherry)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Carpinus caroliniana</i> (American hornbeam)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Lindera benzoin</i> (northern spicebush)

RED MAPLE - BLACKGUM BASIN SWAMP

Acer rubrum - *Nyssa sylvatica* - *Betula alleghaniensis* / *Sphagnum* spp. Forest

Range: This community occurs in Pennsylvania in the Delaware Estuary.

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* (blackgum). 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.



Photo by Pennsylvania Natural Heritage Program

Vegetation Description: The canopy is dominated by *Acer rubrum* (red maple) and *Nyssa sylvatica* (blackgum); however, even where red maple is more abundant, the longevity and stature of the blackgum trees give them a strong impact. *Betula alleghaniensis* (yellow birch), *Tsuga canadensis* (eastern hemlock), *Pinus strobus* (eastern white pine), and in the north *Picea rubens* (red spruce) may be minor canopy associates. The most abundant shrubs are *Ilex verticillata* (common winterberry) and *Vaccinium corymbosum* (highbush blueberry); associated shrub species include *Viburnum nudum* var. *cassinoides* (northern wild raisin), *Nemopanthus mucronatus* (catberry), *Kalmia angustifolia* (sheep laurel), *Lyonia ligustrina* (maleberry), and *Cephalanthus occidentalis* (common buttonbush). *Osmunda cinnamomea* (cinnamon fern) is the characteristic dominant in the herb layer, with associates including *Osmunda regalis* (royal fern), *Thelypteris palustris* (eastern marsh fern), *Woodwardia virginica* (Virginia chainfern), *Glyceria canadensis* (rattlesnake mannagrass), *Coptis trifolia* (threeleaf goldthread), *Carex trisperma* (three-seed sedge), *Carex intumescens* (greater bladder sedge), *Triadenum virginicum* (Virginia marsh St. John's-wort), and *Symplocarpus foetidus* (skunk-cabbage). Mosses are primarily *Sphagnum* (peatmoss) spp., including *Sphagnum palustre* (prairie peatmoss) and *Sphagnum magellanicum* (Magellan's peatmoss). These swamps are distinguished from other basin swamps in the Northern Appalachians by the presence of *Nyssa sylvatica* (blackgum). They are distinguished from blackgum swamps further south by the absence of more central-Appalachian species such as *Liquidambar*

styraciflua (sweetgum), *Rhododendron maximum* (great laurel), *Rhododendron viscosum* (swamp azalea), and *Magnolia virginiana* (sweetbay).

Characteristic Species: *Acer rubrum* (red maple), *Ilex verticillata* (common winterberry), *Nyssa sylvatica* (blackgum), *Osmunda cinnamomea* (cinnamon fern), *Vaccinium corymbosum* (highbush blueberry)

Dynamics/Successional Trajectory: 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 topography is often pronounced, with bryophytes common on the hummocks and in those hollows where water does not stand for long periods.

Reference Sites: near Portland Pumphouse #2, Delaware Water Gap, PA

Global and State Conservation Ranks and Reasons: GNR (1-Dec-1997). NJ: SNR, PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.688103

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 1995c, Zebryk 1990

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tree canopy	Broad-leaved deciduous tree	<i>Nyssa sylvatica</i> (blackgum)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Ilex verticillata</i> (common winterberry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Vaccinium corymbosum</i> (highbush blueberry)

RED MAPLE - TUSsock SEDGE WOODED MARSH

Acer rubrum / *Carex stricta* - *Onoclea sensibilis* Woodland

Range: This wetland is found in central and northern New England, south to Pennsylvania and New Jersey. It occurs in Pennsylvania in the Delaware Estuary.

Environmental Description: This association is a partly wooded, deciduous-canopy wetland of central and northern New England. It occurs on muck soils or mineral soils with a surface organic layer, in poorly drained depressions influenced by groundwater. It is also common in those streamside and lakeside settings where the hydrology is that of a basin setting rather than a floodplain. The community is typically flooded in spring, with pools and small streams persisting throughout much of the growing season; soils may remain saturated, or may become dry on the surface over the course of the growing season. Hummock-and-hollow topography may be pronounced. In Pennsylvania this type is often associated with areas of past beaver impoundments.

Vegetation Description: The canopy consists of scattered trees, with as little as 25% overall cover. The shrub layer is patchy and may be extensive in places. The herb layer is typically well-developed, with ferns and graminoids dominant. The bryophyte cover is variable. *Acer rubrum* (red maple) is dominant in the canopy, often with many standing dead trees. Associated trees include *Fraxinus nigra* (black ash), *Nyssa sylvatica* (blackgum), *Quercus bicolor* (swamp white oak), *Quercus palustris* (pin oak), *Ulmus americana* (American elm), and occasional *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), or *Picea rubens* (red spruce). The shrub layer is characterized by *Vaccinium corymbosum* (highbush blueberry) and *Ilex verticillata* (common winterberry). Other shrubs may be locally common, including *Nemopanthus mucronatus* (catberry), *Viburnum nudum* var. *cassinoides* (northern

wild raisin), *Viburnum recognitum* (northern arrow-wood), *Lyonia ligustrina* (maleberry), *Alnus incana* (speckled alder), *Ilex laevigata* (smooth winterberry holly), *Spiraea alba* (white meadowsweet), *Spiraea tomentosa* (steeplebush), and the creeping *Rubus hispidus* (bristly dewberry). The herbaceous layer is typically dominated by the graminoids *Carex stricta* (tussock sedge), *Carex lacustris* (lake sedge), or *Calamagrostis canadensis* (bluejoint), or the ferns *Onoclea sensibilis* (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), or *Osmunda claytoniana* (interrupted fern). Less abundant herbs include *Carex intumescens* (greater bladder sedge), *Carex folliculata* (northern long sedge), *Carex canescens* (silvery sedge), *Carex trisperma* (three-seed sedge), *Glyceria striata* (fowl mannagrass), *Osmunda regalis* (royal fern), *Dryopteris cristata* (crested woodfern), *Thelypteris palustris* (eastern marsh fern), *Lycopus uniflorus* (northern bugleweed), *Caltha palustris* (yellow marsh-marigold), and *Impatiens capensis* (orange jewelweed). *Sphagnum* (peatmoss) spp. are the characteristic bryophytes, with non-sphagnous mosses as associates.

Characteristic Species: *Acer rubrum* (red maple), *Ilex verticillata* (common winterberry), *Onoclea sensibilis* (sensitive fern), *Spiraea alba* var. *latifolia* (broadleaf meadowsweet), *Vaccinium corymbosum* (highbush blueberry)

Dynamics/Successional Trajectory: This plant community type is sensitive to changes in hydrology and represents a transition from a wetter, open tussock sedge marsh with low forest cover to a red maple palustrine forest with high canopy cover (and much reduced *Carex stricta* (tussock sedge) cover). Changes in hydrology will tend to shift community composition between the two types, with persistent deeper water levels favoring *Carex stricta* (tussock sedge) and drying conditions favoring *Acer rubrum* (red maple).

Reference Sites: Lake Towhee Park, Bucks County, PA (needs to be field checked); Great Swamp National Wildlife Refuge, Morris County, NJ

Global and State Conservation Ranks and Reasons: G3G5 (1-Dec-1997). NJ: SNR, PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.684410

References: Barrett and Enser 1997, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Edinger et al. 2002, Eyre 1980, Fike 1999, Gawler 2002, Golet et al. 1993, Hunt 1999, Metzler and Barrett 2001, Moore and Taylor 1927, Rawinski 1984, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2001, Thompson and Sorenson 2000

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Ilex verticillata</i> (common winterberry)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Vaccinium corymbosum</i> (highbush blueberry)
Short shrub/sapling meadowsweet)	Broad-leaved deciduous shrub	<i>Spiraea alba</i> var. <i>latifolia</i> (broadleaf meadowsweet)
Herb (field)	Graminoid	<i>Calamagrostis canadensis</i> (bluejoint)
Herb (field)	Graminoid	<i>Carex lacustris</i> (lake sedge)
Herb (field)	Graminoid	<i>Carex stricta</i> (tussock sedge)
Herb (field)	Fern or fern ally	<i>Osmunda cinnamomea</i> (cinnamon fern)
Herb (field)	Fern or fern ally	<i>Osmunda claytoniana</i> (interrupted fern)

RED MAPLE UPLAND FOREST

Acer rubrum / *Dennstaedtia punctilobula* Forest

Range: This red maple upland forest occurs in the Pennsylvania portion of the Delaware Estuary.

Environmental Description: This community occurs in upland settings and tends to persist when embedded in an oak forest matrix but is ephemeral as part of a "northern hardwoods" matrix.

Vegetation Description: This is a successional to persistent closed-canopy forest dominated by *Acer rubrum* (red maple). Canopy associates include *Quercus* (oak) spp., *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Prunus serotina* (black cherry),



Photo by Pennsylvania Natural Heritage Program

Fraxinus americana (white ash), and *Carya* (hickory) spp. Typical shrubs include *Viburnum acerifolium* (mapleleaf viburnum), *Lindera benzoin* (northern spicebush), *Hamamelis virginiana* (American witch-hazel), *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), and *Cornus florida* (flowering dogwood). The understory is variable and dominated by *Dennstaedtia punctilobula* (eastern hay-scented fern) and *Thelypteris noveboracensis* (New York fern).

Characteristic Species: *Acer rubrum* (red maple), *Dennstaedtia punctilobula* (eastern hay-scented fern)

Dynamics/Successional Trajectory: This is a successional forest type and is becoming more common where heavy deer browse pressure following canopy disturbance favors red maple regeneration over oaks and other hardwoods. In northern hardwood forests, this type may be considered early- to mid-successional and may be expected to add typical northern hardwood canopy dominants over time (e.g., sugar maple, beech, and hemlock).

Management Concerns: None, not a conservation target. This community is heavily deer browsed.

Reference Sites: No need for reference sites as this community is not a desired target for restoration.

Global and State Conservation Ranks and Reasons: GNR (8-Jul-1999). PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.685013

References: Eastern Ecology Working Group n.d., Fike 1999

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tree canopy	Broad-leaved deciduous tree	<i>Betula lenta</i> (sweet birch)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Viburnum acerifolium</i> (mapleleaf viburnum)

SUCCESSIONAL ASPEN - GRAY BIRCH FOREST

Populus tremuloides - *Betula populifolia* Forest

Range: This community occurs in Pennsylvania in the Delaware Estuary.

Environmental Description: This is an early-successional forest type, commonly found on former agricultural land, in areas of ice-scour along streambanks, and where there has been major disturbance resulting in areas of exposed mineral soil. This type may also result from forestry practices that maintain an early-successional stage.



Photo by Pennsylvania Natural Heritage Program

Vegetation Description: This type is frequently mixed, but sometimes occurs in nearly pure stands of one of the named species. The birch may be *Betula papyrifera* (paper birch) on more northern sites, or *Betula populifolia* (gray birch) and occasionally *Betula lenta* (sweet birch). The aspen may be *Populus grandidentata* (bigtooth aspen) or *Populus tremuloides* (quaking aspen). Associates include *Sassafras albidum* (sassafras), *Acer* (maple) spp., and *Prunus* (plum, cherry) spp.

Characteristic Species: *Betula populifolia* (gray birch), *Populus tremuloides* (quaking aspen)

Dynamics/Successional Trajectory: Successional trajectory is uncertain and may be controlled by availability of propagules from adjacent forest stands.

Management Concerns: Not a conservation target, early-successional community typical of disturbed land.

Reference Sites: Fort Indiantown Gap National Guard Training Center, Lebanon County, PA; Delaware Water Gap National Recreation Area; Valley Forge National Historical Park

Global and State Conservation Ranks and Reasons: GNR (8-Jul-1999). PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.688070

References: Eastern Ecology Working Group n.d., Fike 1999

MOST ABUNDANT SPECIES

STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Populus tremuloides</i> (quaking aspen)

TULIPTREE - BEECH - MAPLE FOREST

Fagus grandifolia - *Betula lenta* - *Liriodendron tulipifera* - *Acer saccharum* Forest

Range: This vegetation is currently described primarily from Pennsylvania and is also documented in New Jersey. It may occur in Maryland. This is a very common forest type in the Pennsylvania portion of the Delaware Estuary study area.

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* (tuliptree), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *Betula lenta*



Photo by Pennsylvania Natural Heritage Program

(sweet birch), and other associated species, including *Acer rubrum* (red maple), *Nyssa sylvatica* (blackgum), and *Carya alba* (mockernut hickory). The subcanopy is characterized by *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Ostrya virginiana* (eastern hop-hornbeam). Common species of the shrub layer include *Hamamelis virginiana* (American witch-hazel) and *Lindera benzoin* (northern spicebush), which can be abundant. The herbaceous layer is characterized by *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot), *Botrychium virginianum* (rattlesnake fern), *Dicentra cucullaria* (Dutchman's breeches), *Dicentra canadensis* (squirrel-corn), *Allium tricoccum* (ramps), and *Claytonia virginica* (Virginia springbeauty).

Characteristic Species: *Acer saccharum* (sugar maple), *Allium tricoccum* (ramps), *Betula lenta* (sweet birch), *Botrychium virginianum* (rattlesnake fern), *Carpinus caroliniana* (American hornbeam), *Claytonia virginica* (Virginia springbeauty), *Cornus florida* (flowering dogwood), *Dicentra cucullaria* (Dutchman's breeches), *Fagus grandifolia* (American beech), *Liriodendron tulipifera* (tuliptree), *Ostrya virginiana* (eastern hop-hornbeam), *Podophyllum peltatum* (mayapple), *Sanguinaria canadensis* (bloodroot)

Dynamics/Successional Trajectory: In successional stands of this type, *Liriodendron tulipifera* (tuliptree) may be a strong canopy dominant as a result of its early colonization after disturbance.

Management Concerns: This forest type often persists on the landscape in a degenerate form - a monotypic canopy of pure *Liriodendron tulipifera* (tuliptree), with limited subcanopy and shrub layers, and dominated by invasive exotic plants in the ground story. *Microstegium vimineum* (Japanese stiltgrass), *Berberis thunbergii* (Japanese barberry), *Rosa multiflora* (multiflora rose), and *Lonicera* (honeysuckle) spp. can be abundant in degraded examples of this type. Restoration of this type should promote diverse species composition in the canopy, subcanopy, and herbaceous layers. Management of invasive plant species should be a priority.

Reference Sites: Identifying a high-quality reference site for this type in the Pennsylvania portion of the Delaware Estuary is challenging due to land-use history, development, disturbance, and deer browse. Degraded examples of this type are abundant.

Global and State Conservation Ranks and Reasons: GNR (6-Dec-2004). NJ: SNR, PA: SNR. More information is required to determine the range and rank of this vegetation type.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.755371

References: Eastern Ecology Working Group n.d., Fike 1999, Podnieszinski et al. 2006

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Broad-leaved deciduous tree	<i>Acer saccharum</i> (sugar maple)
Tree canopy	Broad-leaved deciduous tree	<i>Betula lenta</i> (sweet birch)
Tree canopy	Broad-leaved deciduous tree	<i>Fagus grandifolia</i> (American beech)
Tree canopy	Broad-leaved deciduous tree	<i>Liriodendron tulipifera</i> (tuliptree)
Tree subcanopy	Broad-leaved deciduous tree	<i>Carpinus caroliniana</i> (American hornbeam)
Tree subcanopy	Broad-leaved deciduous tree	<i>Cornus florida</i> (flowering dogwood)
Tree subcanopy	Broad-leaved deciduous tree	<i>Ostrya virginiana</i> (eastern hop-hornbeam)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Hamamelis virginiana</i> (American witch-hazel)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Lindera benzoin</i> (northern spicebush)
Herb (field)	Fern or fern ally	<i>Botrychium virginianum</i> (rattlesnake fern)

VIRGINIA PINE SUCCESSIONAL FOREST

Pinus virginiana Successional Forest

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

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



Photo by Pennsylvania Natural Heritage Program

Vegetation Description: This forest typically has a very dense canopy of *Pinus virginiana* (Virginia pine) and little understory vegetation. *Pinus echinata* (shortleaf pine) and *Pinus rigida* (pitch pine) may co-occur with *Pinus virginiana* (Virginia pine) in the canopy. The canopy can also have significant admixtures of early-successional deciduous trees (e.g., *Acer rubrum* (red maple), *Liquidambar styraciflua* (sweetgum), *Liriodendron tulipifera* (tuliptree)). Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species. Shrub and herb strata are absent to sparse in coverage. The subcanopy may contain *Acer saccharum* (sugar maple) and *Cornus florida* (flowering dogwood); other associated species may include *Cercis canadensis* (eastern redbud), *Parthenocissus quinquefolia* (Virginia creeper), *Lonicera japonica* (Japanese honeysuckle), and *Microstegium vimineum* (Japanese stiltgrass) (Andreu and Tukman 1995). The dense ericaceous shrub stratum contains *Vaccinium* (blueberry) spp., *Gaylussacia* (huckleberry) spp., *Kalmia latifolia* (mountain laurel), and *Rhododendron* (azalea, rhododendron) spp.

Characteristic Species: *Pinus virginiana* (Virginia pine)

Dynamics/Successional Trajectory: This is an early-successional forest type. Damage from ice storms can be a main disturbance observed in these stands. In addition, fire and insect infestation are likely damaging agents.

Management Concerns: These stands can be managed for pulpwood production. They have a low aesthetic value so would not provide suitable recreational opportunities. Since this association is an early-successional forest type, it typically should not be considered as a restoration target.

Reference Sites: (Note: more inventory needs to be done to confirm that this type is in the Delaware Estuary.

Global and State Conservation Ranks and Reasons: GNA (ruderal) (13-Jun-2000). NJ: SNA, PA: SNA. This forest represents early-successional vegetation and is thus not of conservation concern.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.688932

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

MOST ABUNDANT SPECIES		
STRATUM	LIFEFORM	SPECIES
Tree canopy	Needle-leaved tree	<i>Pinus virginiana</i> (Virginia pine)
Tree subcanopy	Needle-leaved tree	<i>Juniperus virginiana</i> (eastern red-cedar)
Tree subcanopy	Broad-leaved deciduous tree	<i>Acer rubrum</i> (red maple)
Tree subcanopy	Broad-leaved deciduous tree	<i>Cornus florida</i> (flowering dogwood)
Tree subcanopy	Broad-leaved deciduous tree	<i>Nyssa sylvatica</i> (blackgum)
Tree subcanopy	Broad-leaved deciduous tree	<i>Oxydendrum arboreum</i> (sourwood)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Cornus florida</i> (flowering dogwood)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Nyssa sylvatica</i> (blackgum)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Oxydendrum arboreum</i> (sourwood)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Vaccinium arboreum</i> (farkleberry)
Tall shrub/sapling	Broad-leaved deciduous shrub	<i>Vaccinium stamineum</i> (deerberry)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Cercis canadensis</i> (eastern redbud)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Cornus florida</i> (flowering dogwood)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Oxydendrum arboreum</i> (sourwood)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Quercus alba</i> (white oak)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Sassafras albidum</i> (sassafras)
Herb (field)	Vine/Liana	<i>Lonicera japonica</i> (Japanese honeysuckle)
Herb (field)	Vine/Liana	<i>Smilax glauca</i> (whiteleaf greenbrier)
Herb (field)	Vine/Liana	<i>Toxicodendron radicans</i> (eastern poison-ivy)

WHITE PINE - OAK FOREST

Pinus strobus - *Quercus* (*rubra*, *velutina*) - *Fagus grandifolia* Forest

Range: This association occurs in New England south and west to Pennsylvania, West Virginia and possibly New Jersey.

Environmental Description: This mixed white pine - oak forest is a ridge and valley community that 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. It occurs at elevations below 915 m (3000 feet) throughout the range.



Photo by Pennsylvania Natural Heritage Program

Vegetation Description: The tree canopy is dominated by *Pinus strobus* (eastern white pine) with a mixture of oaks, including *Quercus velutina* (black oak), *Quercus rubra* (northern red oak), *Quercus alba*

(white oak), *Quercus prinus* (chestnut oak), and in the southern portions of the range *Quercus coccinea* (scarlet oak). Oak species drop out at the northern extreme of the type's range, leaving only *Quercus rubra* (northern red oak). *Fagus grandifolia* (American beech) is characteristic but not always present. Other less frequent canopy associates may include *Acer rubrum* (red maple), *Carya alba* (mockernut hickory), *Populus tremuloides* (quaking aspen), *Tsuga canadensis* (eastern hemlock), and *Populus grandidentata* (bigtooth aspen). The variable subcanopy may include *Hamamelis virginiana* (American witch-hazel); other species, such as *Carpinus caroliniana* (American hornbeam), *Cornus florida* (flowering dogwood), and *Nyssa sylvatica* (blackgum), may be present in the central and southern portions of the range. The stand can contain a moderately dense to dense tall-shrub layer of *Pinus strobus* (eastern white pine) saplings. The sparse to well-developed, generally ericaceous short-shrub layer includes *Gaylussacia* (huckleberry) spp., *Kalmia latifolia* (mountain laurel), *Vaccinium* (blueberry) spp., as well as *Rubus* (blackberry) spp., *Corylus americana* (American hazelnut), *Gaultheria procumbens* (wintergreen), *Sassafras albidum* (sassafras), and *Viburnum prunifolium* (smooth blackhaw). The herb layer ranges from sparse to moderately dense cover, with species including *Aralia nudicaulis* (wild sarsaparilla), *Ageratina altissima* (white snakeroot), *Amphicarpaea bracteata* (American hog-peanut), *Brachyelytrum erectum* (bearded shorthusk), *Carex communis* (fibrous-root sedge), *Carex pensylvanica* (Pennsylvania sedge), *Carex lucorum* (Blue Ridge sedge), *Melampyrum lineare* (narrowleaf cow-wheat), *Pteridium aquilinum* (bracken fern), *Trientalis borealis* (starflower), *Chimaphila maculata* (striped pipsissewa), *Desmodium nudiflorum* (naked-flower tick-trefoil), *Goodyera pubescens* (downy rattlesnake-plantain), *Hieracium venosum* (rattlesnake-weed), *Maianthemum racemosum* (feathery false lily-of-the-valley), *Maianthemum canadense* (Canada mayflower), *Medeola virginiana* (Indian cucumber-root), *Mitchella repens* (partridgeberry), *Monotropa uniflora* (Indian-pipe), *Poa cuspidata* (early bluegrass), *Polygonatum biflorum* (smooth Solomon's-seal), *Polystichum acrostichoides* (Christmas fern), and/or *Viola hastata* (halberd-leaf yellow violet). The bryophyte layer is not well-documented but supports *Leucobryum* (leucobryum moss) sp. and *Polytrichum* (haircap moss) sp.

Characteristic Species: *Fagus grandifolia* (American beech), *Gaylussacia baccata* (black huckleberry), *Pinus strobus* (eastern white pine), *Quercus rubra* (northern red oak), *Vaccinium angustifolium* (northern lowbush blueberry), *Vaccinium pallidum* (hillside blueberry)

Reference Sites: near Adams Creek and much of the escarpment on the Pennsylvania side of the Delaware Water Gap National Recreation Area

Global and State Conservation Ranks and Reasons: G5 (1-Dec-1997). NJ?:SNA, PA: SNR.

VegBank Link for Plot Data: http://vegbank.org/natureserve/element_global.2.688827

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

MOST ABUNDANT SPECIES

STRATUM	LIFEFORM	SPECIES
Tree canopy	Needle-leaved tree	<i>Pinus strobus</i> (eastern white pine)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus alba</i> (white oak)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus prinus</i> (chestnut oak)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus rubra</i> (northern red oak)
Tree canopy	Broad-leaved deciduous tree	<i>Quercus velutina</i> (black oak)
Tree subcanopy	Broad-leaved deciduous tree	<i>Prunus serotina</i> (black cherry)
Shrub/sapling (tall & short)	Needle-leaved shrub	<i>Pinus strobus</i> (eastern white pine)
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	<i>Hamamelis virginiana</i> (American witch-hazel)
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Gaylussacia baccata</i> (black huckleberry)
Short shrub/sapling blueberry)	Broad-leaved deciduous shrub	<i>Vaccinium angustifolium</i> (northern lowbush
Short shrub/sapling	Broad-leaved deciduous shrub	<i>Vaccinium pallidum</i> (hillside blueberry)
Short shrub/sapling	Broad-leaved evergreen shrub	<i>Kalmia latifolia</i> (mountain laurel)
Herb (field)	Forb	<i>Aralia nudicaulis</i> (wild sarsaparilla)
Herb (field)	Forb	<i>Maianthemum canadense</i> (Canada mayflower)
Herb (field)	Forb	<i>Trientalis borealis</i> (starflower)
Herb (field)	Graminoid	<i>Carex pensylvanica</i> (Pennsylvania sedge)