

Terrestrial & Palustrine Plant Communities Of Pennsylvania

By Jean Fike, Pennsylvania Natural Diversity Inventory

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Pennsylvania Natural Diversity Inventory

The Pennsylvania Natural Diversity Inventory is a partnership between the Pennsylvania Bureau of Forestry, The Nature Conservancy, and the Western PA Conservancy to conduct inventories and collect data to describe the Commonwealth's rarest and most significant ecological features.



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Background and Objectives

The objective of this document is to classify and describe the terrestrial and palustrine (wetland) plant communities of Pennsylvania. A plant community is an assemblage of plant populations sharing a common environment and interacting with each other, with animal populations, and with the physical environment. This classification does not include vegetation types characterized by a high degree of direct human influence (e.g. roadsides, agricultural fields, lawns, forest plantations, etc.). The term "*terrestrial and palustrine* plant communities" means that this classification is limited to terrestrial and palustrine environments. Aquatic and subterranean systems are not included.

This classification is a product of the Pennsylvania Natural Diversity Inventory (PNDI). PNDI is a partnership between the DCNR's Bureau of Forestry, the Pennsylvania Science Office of The Nature Conservancy, and the Western Pennsylvania Conservancy. PNDI's mission is to inventory and describe Pennsylvania's species of special concern, rare and exemplary natural communities, and outstanding geologic features. This information is used for conservation, research, development planning, and natural resource management. PNDI is Pennsylvania's Natural Heritage Program. The Natural Heritage Program is an international network for biological information. Data are collected and maintained using a uniform methodology. This uniform methodology and the network's integrated data management system make possible the assessment of the status of species and communities of concern across their entire range.

This classification system has been "crosswalked" or related to The Nature Conservancy's international vegetation classification system. This allows the user to compare Pennsylvania's community types to plant communities that occur throughout eastern North America. TNC's classification system is still being developed. Most crosswalks are to the 1996 draft "Community Alliances and Elements of the Eastern Region," (Sneddon, Anderson and Metzler, 1996). Contact TNC's Eastern Regional Office for the most recent version of their classification. Forested and woodland community types are also crosswalked to the Society of American Foresters' "Forest Cover types of the United States and Canada" (Eyre, 1980). A crosswalk is also provided to a draft version of "Natural Ecological Communities of Pennsylvania" (Smith 1991). The classification presented here replaces the previous draft classification developed for PNDI by Tom Smith of The Nature Conservancy.

This classification has a wide variety of potential uses. Its primary purpose is to act as a coarse filter in the

conservation of Pennsylvania's biological diversity. The Natural Heritage Program uses a coarse-filter/fine-filter approach to conservation. Protection of intact examples of all of the community types that occur in Pennsylvania acts as a coarse filter that may serve to protect the majority of the state's species diversity. Rare species, which are not effectively captured by the coarse filter, then receive individual attention. This is the "fine filter."

This document is intended to be usable by a variety of agencies and organizations. Its potential applications include mapping, environmental impact assessment, development planning, site selection for long term monitoring, preserve design and a variety of other activities related to the setting of priorities for conservation. It may also be useful in providing a common language to researchers and managers, as well as for educational purposes.

Concepts

For the purposes of this classification, a plant community is defined as an assemblage of plant populations sharing a common environment and interacting with each other, with animal populations, and with the physical environment. Most of these assemblages tend to occur repeatedly in the landscape under similar environmental conditions. No two examples of a community type are identical in their species composition or in their physical environment. The degree of similarity varies with the community type. Some community types are narrowly defined; examples of these community types will tend to be very similar to one another. Others are more broadly defined; examples of these types may vary considerably. The specificity of a community type depends on a variety of factors. In many cases, we lack sufficient information to define types more narrowly. In other cases, types are narrowly defined because of rarity, or because they occupy an unusually specific environment. Broadly defined types tend to be more common, less well studied, and tend to vary more continuously across their range of variability, making further division difficult.

The division of the natural world into discrete categories is an artificial process. The landscape displays almost infinitely complicated patterns of variation, occurring at many scales, and changing constantly over time. For practical reasons, it is useful to simplify this complexity, to assign it to "pigeonholes" that we can understand and work with. It should not surprise us that the natural world resists this reduction. Users of the classification should not expect a site to precisely resemble any of the community type descriptions given here. A community type represents a category, a range of variation, and the environmental conditions and characteristic species are



given for the most typical examples of that category. An individual example of a community type is not likely to contain all of the species listed in the description, and the description includes only a fraction of the species present in a community. Users will need to rely on their best judgment to determine which community type best describes a site. In some cases, a site may appear equally similar to two community types. In such a case, the site is best classified as intermediate between the two.

Plant communities may be described at many different scales—from the community in the fold of a leaf, to the "Northeastern Deciduous Forest Community." The scale of a classification system is driven by its intended use. The scale of this classification is intended to be appropriate for a variety of conservation activities including monitoring, management, mapping, and site conservation design.

Communities, like species, do not occur randomly scattered across the landscape, they generally form patterns of some kind; in some cases they form fairly organized groupings. These groupings are, in a sense, communities of communities. Under particular environmental conditions, certain groups of communities will tend to occur, often in a similar distribution pattern from site to site. These groups of communities are called here community complexes.

The community complex approach is reserved for cases in which patterns of community occurrence are fairly distinct and recognizable. This tends to be the case where environmental influences on plant species distribution are especially restrictive. In these areas, environmental factors so strongly shape patterns of species and community distribution that random factors become less confounding. In systems where environmental conditions are less restrictive, species and communities can more freely arrange themselves according to factors such as propagule recruitment and localized disturbance history. In these areas, repeating, environmentally driven patterns of community distribution may be difficult or impossible to recognize. For that reason, only a handful of community complexes are described. In future iterations of this classification it may be possible to describe additional complexes. In most cases, however, communities do not occur in sufficiently distinct, repeating patterns to be included in the complex section.

The community complex section of this classification therefore represents a selection of special situations rather than a parallel classification system or a level in the classification hierarchy. Just as any given community

example will not contain all the species associated with that type, and may contain some which appear incongruent or transitional, so do examples of community complexes vary in composition.

This classification effort is ongoing. Our understanding of the patterns of variation in the natural world is constantly improving; as we gather more information and come to better understand these patterns, the classification will be modified to reflect that understanding, as well as changes in Pennsylvania's ecology and vegetation over time. For the most recent classification, contact one of the PNDI partners.

Data sources

Much of the information presented here represents the collective expertise and experience of the PNDI ecology staff. The remainder has been compiled from literature review, PNDI field forms, other Heritage data, County Natural Area Inventories, limited field investigation, and consultation with relevant experts. In a few cases, types are based on quantitative analysis of inventory data. In most cases, we have not yet had the opportunity to study community types in such detail.

Organization

The community types are first divided into two major systems, palustrine (wetlands) and terrestrial (non-wetlands). These systems are then divided into physiognomic categories (e.g. forest, woodland, shrubland). A dichotomous key is provided following this introduction to assist the user in determining which system and physiognomic category best describe a given site. One additional division is made within some physiognomic categories. In categories dominated by woody plants (forests, woodlands, and shrublands), the division is based on the phenology of the dominant species (conifer, broadleaf, or combined conifer-broadleaf). In herbaceous wetlands, the division is between persistent and non-persistent vegetation. This hierarchical arrangement allows the user to classify a site at a coarser level of detail if that is more appropriate, or if a specific community type cannot be determined.

Community types are distinguished by physiognomy, hydrology, species composition, ecological processes, and distribution. Descriptions include a list of characteristic species. These species may or may not be dominant; they are either commonly associated with the community type or they serve to distinguish that type from other closely related types. Where the community type occurs under specific, known environmental conditions, those conditions are described. Environmental descriptions may include information on soils, geology,



hydrology, chemistry, hydrology, and disturbance. In many cases we do not yet have sufficient information to describe the environmental processes associated with different community types. Each community is briefly compared to other related community types with which it might be confused. The Pennsylvania range of each community type is given in terms of ecologically defined regions, these regions are shown on the map entitled "Ecological Regions of Pennsylvania." A selection of references is provided for most types. Each type is crosswalked (related) to TNC's International Vegetation Classification, and in the case of forested or woodland types, to the Society of American Foresters' Forest Cover Types.

Community type names are merely labels, and are not meant to describe community types in and of themselves. Where possible, the name usually includes one or more of the dominant species. Where species names are separated by a dash ("-") the species are commonly both present. Where species names are separated by a slash ("/") they are not typically found together. Where a species name appears in parenthesis, that species is perhaps not typical, but is dominant or sufficiently important on some sites that it effectively replaces one of the other species listed in the type name. Where the community type does not have clear dominants or where those dominants do not serve to distinguish it from other community types, other descriptors such as range and environmental information are used. Types cannot be understood from the names alone; the entire description must be read.

Descriptions of the complexes follow the community types. The complex descriptions include a list of the community types associated with that complex, an environmental description, the Pennsylvania range for that complex, and a list of selected references. A glossary of terms, a list of references, and a map of ecological regions of Pennsylvania are provided at the end of this document.

Vascular plant nomenclature follows Rhoads and Klein (1993). Bryophyte nomenclature follows Crum and Anderson (1981). Species not native to Pennsylvania are indicated by a superscript "I." The aggressive species *Phalaris arundinacea* (reed canary-grass) and *Phragmites australis* (common reed) are marked with a superscript "(I)", as their native status is unclear. Pennsylvania species of special concern are indicated by a superscript "S."

PNDI welcomes feedback from users of this classification, please send comments or data to the following address.

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Harrisburg, PA 17205-8552

Key To Sections (adapted from Unesco 1973 and Driscoll et al. 1984)

1. Vegetation non-persistent (dies back every year and is evident only during certain portions of the life cycle) **and** occurs along rivers **or** in lakes (bodies of water greater than 8 hectares in size with a depth at low water greater than 2 meters) **Aquatic vegetation - beyond the scope of this classification.**

1. Vegetation persistent **or** occurs in upland depressions less than 8 hectares in size with a depth at low water less than 2 meters.

2. Surface subject to at least periodic or seasonal flooding, or ground is saturated to within 6-18 inches of the surface during the growing season at least periodically. Vegetation at least partially hydromorphic.

3. Trees over 5m high dominate the community.

4. Canopy closed or nearly closed, majority of crowns overlapping, with between 60% and 100% tree cover..... **Palustrine Forests page 16**

4. Tree cover sparse, usually between 10% and 60% cover. Shrubs may be present, but do not dominate the community, herbs and non-vascular plant cover may be present at any cover value..... **Palustrine Woodlands page 29**

3. Trees over 5m high not present, or if present do not dominate the community, usually less than 25% total cover.

4. Shrubs and small trees dominant. Herbaceous and non-vascular plants may be present at any cover value, trees may be present but do not dominate the community, usually less than 25% cover..... **Palustrine Shrublands page 38**

4. Community dominated by herbaceous plants.

5. Vegetation robust, evident throughout the year **Persistent Emergent Wetlands page 50**

5. Vegetation dies back each year and is evident only during certain portions of the lifecycle..... **Non-Persistent Emergent Wetlands page 56**

2. Surface not subject to flooding or periods of prolonged saturation during the growing season, vegetation not predominantly hydromorphic.

3. Trees over 5m high dominate the community.

4. Canopy closed or nearly closed, majority of crowns overlapping, with between 60% and 100% tree cover..... **Terrestrial Forests page 5**

4. Tree cover sparse, usually between 10% and 60% cover. Shrubs may be present, but do not dominate the community, herbs and non-vascular plant cover may be present at any cover value..... **Terrestrial Woodlands page 22**

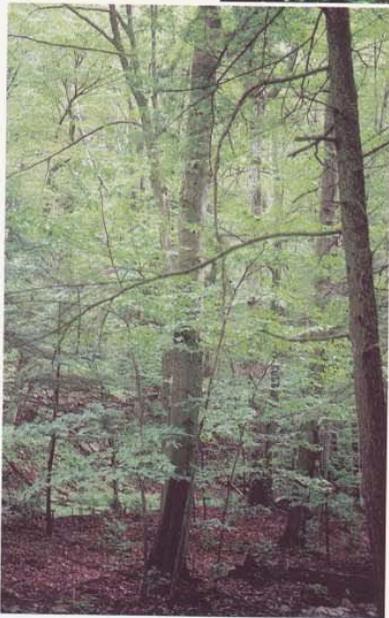
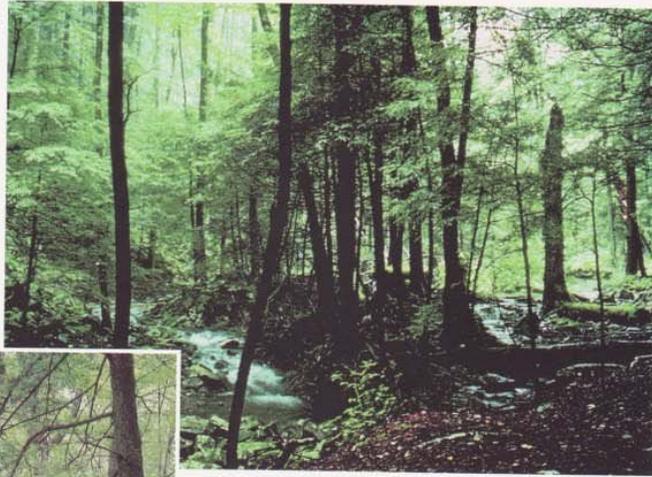
3. Trees over 5m high not present, or if present do not dominate the community, usually less than 25% total cover.

4. Shrubs and small trees dominant. Herbaceous and non-vascular plants may be present at any cover value, trees may be present but do not dominate community, usually less than 25% cover..... **Terrestrial Shrublands page 33**

4. Community dominated by herbaceous plants . **Terrestrial Herbaceous Openings page 45**



*T*errestrial Forests



The Hemlocks State Forest Natural Area, Perry County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.

Elk Run Woods, Sullivan County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.



CONIFEROUS TERRESTRIAL FORESTS

Hemlock (white pine) forest

Tsuga canadensis (eastern hemlock), *Pinus strobus* (eastern white pine), or more often a combination of the two dominates these forests. Conifer cover generally exceeds 75% of the canopy. Associate species include a variety of northern hardwoods and oaks. Typical representatives include *Betula lenta* (sweet birch), *B. alleghaniensis* (yellow birch), *Acer saccharum* (sugar maple), *A. rubrum* (red maple), *Quercus rubra* (red oak), *Q. velutina* (black oak), *Fagus grandifolia* (American beech), and *Liriodendron tulipifera* (tuliptree). Representative shrubs include *Rhododendron maximum* (rosebay), *Viburnum lantanoides* (witch-hobble), *V. acerifolium* (maple-leaved viburnum), and *Hamamelis virginiana* (witch-hazel). Typical herbs and creeping shrubs include *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridge-berry), *Lycopodium spp.* (ground pine), *Gaultheria procumbens* (teaberry), *Thelypteris noveboracensis* (New York fern), *Medeola virginiana* (Indian cucumber root), and *Polystichum acrostichoides* (Christmas fern).

Related types: If the conifer component is less than 75% relative cover, see the mixed conifer broadleaf terrestrial forest section.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: Braun 1950, Nichols 1935.

[Crosswalk: Smith's "Northern Conifer Forest," TNC's *Tsuga canadensis* - *Pinus strobus* Forest Alliance, SAF's White pine-hemlock (22) and Eastern hemlock (23).]

CONIFER – BROADLEAF TERRESTRIAL FORESTS

Serpentine pitch pine - oak forest

This community type is part of the "Serpentine barrens complex." It occurs in areas underlain by serpentine bedrock where soil development has proceeded far enough to support forest vegetation, but not so far as to override the influence of serpentine chemistry on species composition. Fire is an important factor in the establishment and persistence of pitch pine. In the absence of fire, pine is likely to decrease in favor of hardwood species. Characteristic overstory species include *Quercus stellata* (post oak), *Q. marilandica* (blackjack oak), *Pinus rigida* (pitch pine), *Sassafras albidum* (sassafras), *Juniperus virginiana* (red-cedar), *Nyssa sylvatica* (black-gum), *Populus grandidentata* (large-toothed aspen), and *Robinia pseudoacacia* (black locust)—which is generally

invasive in these systems. The shrub layer is often dominated by an impenetrable tangle of *Smilax rotundifolia* (greenbrier) and *S. glauca* (catbrier). *Q. prinoides* (chinquapin oak) occurs in the understory and in openings; *Quercus ilicifolia* (scrub oak) is also present in openings. Low shrub species include *Vaccinium pallidum* (lowbush blueberry), *V. stamineum* (deerberry), and *Gaylussacia baccata* (black huckleberry). Herbaceous species include *Pteridium aquilinum* (bracken fern), *Aralia nudicaulis* (wild sarsaparilla), and a variety of graminoids.

Related types: The "Serpentine Virginia pine - oak forest" type also occurs on serpentine-derived soils and shares many species with this type. The Virginia pine type is dominated by a mixture of *Pinus virginiana* and various oaks. *P. virginiana* produces denser shade and thicker litter than does *P. rigida*. Herbaceous and shrub growth under *P. virginiana* is generally sparse. The fire ecology of the two species is also vastly different. For a more detailed explanation of the ecology of serpentine barrens, see the description of the "Serpentine barrens complex."

Range: Piedmont.

Selected references: Latham 1992, Roger Latham-personal communication, PNFI field surveys.

[Crosswalk: Smith's "Eastern Serpentine Barren" (in part), TNC's *Quercus falcata* - *Quercus alba* Forest Alliance, SAF's Pitch pine (45).]

Serpentine Virginia pine - oak forest

This community type is part of the "Serpentine barrens complex." It occurs in areas underlain by serpentine bedrock, where soil development has proceeded far enough to support forest vegetation, but not so far as to override the influence of serpentine chemistry on species composition. Characteristic overstory species include *Quercus stellata* (post oak), *Q. marilandica* (blackjack oak), *Pinus virginiana* (Virginia pine), *Sassafras albidum* (sassafras), *Prunus serotina* (wild black cherry), *Juniperus virginiana* (red-cedar), *Nyssa sylvatica* (black-gum), *Robinia pseudoacacia* (black locust), and *Acer rubrum* (red maple). The shrub layer may be quite sparse under the dense shade and heavy litter of *Pinus virginiana* (Virginia pine). Where the canopy is more open there may be an impenetrable tangle of *Smilax rotundifolia* (greenbrier) and *S. glauca* (catbrier). Other shrub species include *Vaccinium pallidum* (lowbush blueberry), *V. stamineum* (deerberry), and *Gaylussacia baccata* (black huckleberry). *Q. prinoides* (chinquapin oak) may be present in the understory or in openings. *Q. ilicifolia* (scrub oak) may also occur in openings. Herbaceous cover is also low; species include *Pteridium aquilinum* (bracken fern) and *Aralia nudicaulis* (wild sarsaparilla).



Related types: The "Serpentine pitch pine - oak forest" type also occurs on serpentinite-derived soils and shares many species with this community. The pitch pine community is dominated by a mixture of *Pinus rigida* and various oaks. *P. virginiana* produces denser shade and thicker litter than does *P. rigida*. Herbaceous and shrub growth under *P. virginiana* is generally sparse. The fire ecology of the two species is also vastly different. For a more detailed explanation of the ecology of serpentine barrens, see the description of the "Serpentine barrens complex."

Range: Piedmont.

Selected references: Latham 1992, Roger Latham-personal communication, PNDI field surveys.

[Crosswalk: Smith's "Eastern Serpentine Barren" (in part), TNC *Pinus virginiana* - *Quercus (alba, stellata, falcata, velutina)* Forest Alliance, *Pinus (echinata, taeda, virginiana)* Forest Alliance, *Pinus virginiana* / *Quercus marilandica* Community, SAF's Virginia pine (79).]

Pitch pine - mixed oak forest

This community type generally occurs on acidic, sandy soils, often on ridgetops and dry southern exposures. Fire is an important factor in the establishment and persistence of pitch pine. In the absence of fire, pitch pine is likely to decrease in favor of hardwood species. *Pinus rigida* (pitch pine), sometimes with a mixture of other pines, e.g. *P. strobus* (eastern white pine), *P. pungens* (table-mountain pine), *P. virginiana* (Virginia pine), and less often *P. echinata* (short-leaf pine) or *P. resinosa* (red pine), contribute over 25% of the overstory. Hardwood associates may include any of the dry-site oaks including *Quercus montana* (chestnut oak), *Q. coccinea* (scarlet oak), *Q. velutina* (black oak), and *Q. alba* (white oak). Other tree species include *Nyssa sylvatica* (black-gum), *Acer rubrum* (red maple), *Betula lenta* (sweet birch), and *Carya glabra* (pignut hickory). *Quercus ilicifolia* (scrub oak) may occur in more open areas; other shrubs include *Smilax* spp. (greenbrier), *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), *Parthenocissus quinquefolia* (Virginia creeper), and *Vaccinium angustifolium (pallidum, stamineum)* (low-bush blueberries). The forest type sometimes grades into an open-canopy type, or contains gaps with an open canopy. The herbaceous layer is sparse, often with *Pteridium aquilinum* (bracken fern), *Aralia nudicaulis* (wild sarsaparilla), *Gaultheria procumbens* (teaberry), *Cypripedium acaule* (pink lady's-slipper), and various *graminoids*, including *Danthonia spicata* (poverty grass), *Deschampsia flexuosa* (common hairgrass), *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (a sedge), and *C. rosea* (a sedge).

Related types: The "Dry oak - heath forest" is distinguished from this type in that it has less than 25% relative cover by conifers. The "Pitch pine-mixed hardwood woodland" has an open canopy, the woodland type may occur up-slope adjacent to this community.

The "Serpentine pitch pine - oak forest" differs from this community in ecology and species composition. The serpentine type occurs only on serpentinite-derived soils. *Q. stellata* (post oak) and *Q. marilandica* (blackjack oak), which are not characteristic of the more common type, are found in the serpentine forest type. The understory of the serpentine type is generally dominated by *Smilax rotundifolia* (greenbrier) and/or *S. glauca* (catbrier). For a more detailed explanation of the ecology of serpentine barrens, see the description of the "Serpentine barrens complex."

Range: Glaciated NE, Piedmont, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, South Mountain.

Selected references: Hunter and Swisher 1983, Illick and Aughanbaugh 1930, Reschke 1990.

[Crosswalk: Smith's "Xeric Central Hardwood - Conifer Forest," TNC's *Pinus (rigida, echinata)* - *Quercus* Forest Alliance, SAF's Pitch pine (45).]

Virginia pine - mixed hardwood forest

This community type most often occurs as a post-agricultural forest type on sand or silt loams, in the southeastern portion of the state. It may also occur on cleared and/or burned-over areas. *Pinus virginiana* (Virginia pine), sometimes with a mixture of other pines, e.g. *P. strobus* (eastern white pine), *P. rigida* (pitch pine), *P. pungens* (Table-Mountain pine), and less often *P. echinata* (short-leaf pine) or *P. resinosa* (red pine) contribute at least 25% of the overstory. Although this is typically a mixed type, some areas may be strongly dominated by pine. Hardwood associates vary; common species include *Quercus rubra* (red oak), *Q. velutina* (black oak), *Q. coccinea* (scarlet oak), *Q. alba* (white oak), *Prunus serotina* (wild black cherry), *Acer rubrum* (red maple), *Betula lenta* (sweet birch), *Carya* spp. (hickory), *Sassafras albidum* (sassafras), and *Fraxinus americana* (white ash). Shrubs include *Smilax* spp. (greenbrier), *Juniperus virginiana* (red-cedar), *Rhus copallina* (shining sumac), *Rubus allegheniensis* (Allegheny blackberry), *Toxicodendron radicans* (poison-ivy), and *Parthenocissus quinquefolia* (Virginia creeper). Due to the thick litter, the herbaceous layer is usually sparse, often with *Chimaphila maculata* (pipsissewa), *Pteridium aquilinum* (bracken fern), *Aralia nudicaulis* (wild sarsaparilla), *Gaultheria procumbens* (teaberry), *Desmodium* spp. (tick-trefoil), *Galium* spp. (cleavers), and various *graminoids*.



Related types: The "Virginia pine - mixed hardwood shale woodland" has an open canopy and is found on dry shale slopes. If the total conifer component is below 25%, consult the "Broadleaf terrestrial forest" section.

The "Serpentine Virginia pine - oak forest" differs from this type in ecology and species composition. The serpentine type occurs only on serpentinite-derived soils. *Q. stellata* (post oak) and *Q. marilandica* (blackjack oak), which are not characteristic of the more common type, are frequently found in the serpentine forest type. For a more detailed explanation of the ecology of serpentine barrens, see the description of the "Serpentine barrens complex."

Range: Piedmont, Ridge and Valley.

Selected references: Hunter and Swisher 1983, Eyre 1980.

[Crosswalk: Smith's "Xeric Central Hardwood - Conifer Forest," TNC's *Pinus virginiana* - *Quercus* (*alba*, *stellata*, *falcata*, *prinus*, *velutina*) Forest Alliance, SAF's Virginia pine-oak (78).]

Dry white pine (hemlock) oak forest

This community type occurs on fairly dry sites, often with 25% or more of the forest floor covered by rocks, boulders and/or exposed bedrock. The canopy may be somewhat open and tree growth somewhat suppressed. The tree stratum is dominated by a mixture of *Pinus strobus* (eastern white pine), or occasionally *Tsuga canadensis* (eastern hemlock), and a mixture of dry-site hardwoods, predominantly oaks. On most sites, the conifer and the hardwood component both range between 25% and 75% of the canopy. The oak species most often associated with this type are *Quercus montana* (chestnut oak), and *Q. alba* (white oak), although *Q. velutina* (black oak), *Q. coccinea* (scarlet oak), or *Q. rubra* (northern red oak) may also occur. Other associated trees include *Nyssa sylvatica* (black-gum), *Betula lenta* (sweet birch), *Fraxinus americana* (white ash), *Prunus serotina* (wild black cherry), and *Castanea dentata* (American chestnut) sprouts. There is often a heath-dominated shrub layer with *Kalmia latifolia* (mountain laurel) being especially important; *Gaylussacia baccata* (black huckleberry), *Vaccinium* spp. (blueberries), and *Kalmia angustifolia* (sheep laurel) are also common. Other shrubs, like *Cornus florida* (flowering dogwood), *Hamamelis virginiana* (witch-hazel), *Viburnum acerifolium* (maple-leaved viburnum) may also occur on less acidic sites. There is typically a sparse herbaceous layer with a northern affinity; *Aralia nudicaulis* (wild sarsaparilla), *Pteridium aquilinum* (bracken fern), *Maianthemum canadense* (Canada mayflower), *Gaultheria procumbens* (teaberry), *Trientalis borealis*

(star-flower), and *Medeola virginiana* (Indian cucumber-root) are typical. The successional status of this type seems variable, in some cases, especially on harsher sites, it appears relatively stable, in other cases it appears to be transitional.

Related types: If the total conifer cover is less than 25% of the canopy, see the "Broadleaf terrestrial forests" section. This forest type shares several species with the "Hemlock (white pine) - red oak - mixed hardwood" forest type. The latter is more mesic; *Q. montana* (chestnut oak), *Pteridium aquilinum* (bracken fern) and *Aralia nudicaulis* (wild sarsaparilla) are more often associated with the dry type, while *Q. rubra* (red oak), *Podophyllum peltatum* (may-apple) and *Smilacina racemosa* (false Solomon's seal) are more characteristic of the mesic type.

Range: Most typical of the Ridge and Valley, also occurs on South Mountain, Glaciated NE, Glaciated NW, Pittsburgh Plateau.

Selected references: Braun 1950, Eyre 1980.

[Crosswalk: Smith's "Dry - Mesic Acidic Central Forest," TNC's *Pinus strobus* - *Quercus* (*rubra*, *alba*, *velutina*) Forest Alliance and *Tsuga canadensis* - *Pinus strobus* (dry) Forest Alliance, SAF's White pine - chestnut oak (51).]

Hemlock (white pine) - northern hardwood forest

Any of the three named components may be dominant; at least two are present in some amount. Conifers and hardwoods each contribute between 25% and 75% of the canopy. Characteristic hardwood species include *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), *A. rubrum* (red maple), *Betula lenta* (black birch), and *B. alleghaniensis* (yellow birch). The conifer component may be *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), or a combination of the two. These forests occur mostly on mesic sites, often north-facing, sometimes rocky and steep. This type is fairly widespread in northern Pennsylvania. *Rhododendron maximum* (rosebay) may be locally abundant. Other common shrubs include *Hamamelis virginiana* (witch-hazel), *Acer pensylvanicum* (moosewood), and *Viburnum* (*Viburnum* spp.). The herbaceous layer is generally sparse and reflects a northern affinity; common components include *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (star-flower), *Thelypteris noveboracensis* (New York fern), *Medeola virginiana* (Indian cucumber-root), *Lycopodium lucidulum* (shining clubmoss), *Mitchella repens* (partridge-berry), and *Clintonia borealis* (bluebead lily). There is often a rich bryophyte layer.



Related types: The "Northern hardwood forest" community type has less than 25% combined relative cover by conifers. The "Hemlock (white pine) - red oak - mixed hardwood forest" type is generally dominated by a combination of various oaks—characteristically *Quercus rubra* (red oak), *Tsuga canadensis* (eastern hemlock) and/or *Pinus strobus* (white pine). In the community described here, the same conifers usually share dominance with *Fagus grandifolia* (American beech), *Betula* spp. (birches), and *Acer saccharum* (sugar maple). The understory species associated with this community are likewise more northern in affinity.

Range: Entire state except the Coastal Plain, Piedmont, and South Mountain.

Selected references: Braun 1950, Nichols 1935, Whitney 1990a, 1990b.

[Crosswalk: Smith's "Northern Hardwood - Conifer Forest," TNC's *Tsuga canadensis* - *Pinus strobus* Forest Alliance. If split, *Tsuga canadensis* (mesic) Forest Alliance, SAF's Hemlock - yellow birch (24).]

Hemlock (white pine) - red oak - mixed hardwood forest

This type is similar to the "Red oak - mixed hardwood forest" type but with *Tsuga canadensis* (eastern hemlock) and/or *Pinus strobus* (eastern white pine) contributing more than 25% relative cover. Conifers may be scattered, locally abundant, may dominate the subcanopy, or may occur as a relict supracanopy (*Pinus strobus*), or in large former canopy gaps (*Pinus strobus*). *Quercus rubra* (northern red oak) is usually present, often dominant/codominant, most often with *Acer rubrum* (red maple), *Quercus velutina* (black oak), *Q. alba* (white oak), *Carya tomentosa* (mockernut hickory), *Betula lenta* (sweet birch), *Fraxinus americana* (white ash), *Fagus grandifolia* (American beech), and/or *Liriodendron tulipifera* (tuliptree). Shrubs include *Viburnum acerifolium* (maple-leaved viburnum), *Rhododendron periclymenoides* (pinxter-flower), *Amelanchier laevis* (smooth serviceberry), *A. arborea* (shadbush), *Carpinus caroliniana* (hornbeam), *Ostrya virginiana* (hop-hornbeam), *Hamamelis virginiana* (witch-hazel), and *Lindera benzoin* (spicebush). Herbaceous species include *Smilacina racemosa* (false Solomon's seal), *Polygonatum biflorum* (Solomon's seal), *Gaultheria procumbens* (teaberry), *Maianthemum canadense* (Canada mayflower), and *Podophyllum peltatum* (may-apple).

Related types: The "Red oak - mixed hardwood forest" type has less than 25% combined relative cover by conifers. The type described here is generally dominated by a combination of various oaks—characteristically *Quercus*

rubra (red oak), and *Tsuga canadensis* (eastern hemlock) and/or *Pinus strobus* (eastern white pine). In the "Hemlock (white pine) - northern hardwood forest," the same conifers usually share dominance with *Fagus grandifolia* (American beech), *Betula* spp. (birches), and *Acer saccharum* (sugar maple). The understory species associated with the "Hemlock (white pine) - northern hardwood forest" type are likewise more northern in affinity.

Range: Entire state except the Coastal Plain.

Selected references: Braun 1950, Eyre 1980.

[Crosswalk: Smith's "Dry - Mesic Acidic Central Forest" (in part), TNC's *Tsuga canadensis* - *Pinus strobus* Forest Alliance, SAF's White pine - northern red oak - red maple (20).]

Hemlock - tuliptree - birch forest

The presence of tuliptree and a mix of somewhat more southern species distinguish this type from the "Hemlock/white pine - northern hardwood" type. This is generally a lower slope or cove type. *Tsuga canadensis* (eastern hemlock) usually contributes at least 25% of the canopy. *Liriodendron tulipifera* (tuliptree), *Betula alleghaniensis* (yellow birch), and *B. lenta* (sweet birch) are the most characteristic hardwood species. Other tree species commonly found on these sites are *Acer rubrum* (red maple), *A. saccharum* (sugar maple), *Quercus* spp. (oaks)—usually *Q. rubra* (northern red oak), as well as *Fagus grandifolia* (American beech), *Fraxinus americana* (white ash), *Prunus serotina* (wild black cherry), *Tilia americana* (basswood), *Pinus strobus* (eastern white pine), and in western Pennsylvania, *Magnolia acuminata* (cucumber-tree). Shrubs include *Hamamelis virginiana* (witch-hazel), *Rhododendron maximum* (rosebay) and others. The herbaceous layer is highly variable; characteristic species include *Maianthemum canadense* (Canada mayflower)—especially under hemlock, *Podophyllum peltatum* (may-apple), *Dryopteris marginalis* (evergreen wood fern), *Botrychium virginianum* (rattlesnake fern), *Arisaema triphyllum* (jack-in-the-pulpit), *Aster divaricatus* (white wood aster), and *Polystichum acrostichoides* (Christmas fern).

Related types: If hemlock contributes less than 25% of the canopy cover, read the description of the "Tuliptree -(beech) - maple forest." This type is in some ways intermediate between the "Hemlock (white pine) - northern hardwoods forest," which has a more northern species composition and range, and the "Hemlock - rich mesic hardwoods forest," which has a richer, more southern species composition and a more southerly range. This type is also closely related to the "Hemlock (white pine) -red oak forest," which often occurs on dryer sites, and



generally has *Quercus rubra* (red oak) as a major canopy component.

Range: Piedmont, Pittsburgh Plateau, Ridge and Valley.

Selected references: Braun 1950, Eyre 1980.

[Crosswalk: Smith's "Dry - Mesic Acidic Central Forest," TNC's "*Tsuga canadensis* (mesic) Forest Alliance, *Tsuga canadensis* - *Fagus grandifolia* Community, SAF's Yellow poplar eastern hemlock (58).]

Rich hemlock - mesic hardwoods forest

These are species-rich, lower slope forests, reminiscent of the "Mixed mesophytic forest" type in the southwestern part of the state, but usually with a strong *Tsuga canadensis* (eastern hemlock) component. The hardwood species vary; typical representatives include *Liriodendron tulipifera* (tuliptree), *Fagus grandifolia* (American beech), *Quercus rubra* (northern red oak), *Acer rubrum* (red maple), *A. saccharum* (sugar maple), *Betula lenta* (sweet birch), *B. alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Tilia americana* (basswood) and *Carya ovata* (shagbark hickory). Hemlock cover is often patchy. Under hardwood cover, the herbaceous diversity approaches that of the richer "Mixed mesophytic" type, while under dense hemlock cover, the herbaceous stratum reflects a more northern flora. *Magnolia tripetala*^s (umbrella magnolia) is not uncommon. Other southern shrubs such as *Asimina triloba* (pawpaw) and *Staphylea trifolia* (bladdernut) may also occur, although *Rhododendron maximum* (rosebay), *Hamamelis virginiana* (witch-hazel), and *Lindera benzoin* (spicebush) are more abundant on most sites. Herbaceous species include *Adiantum pedatum* (maidenhair fern), *Erythronium americanum* (trout-lily), *Maianthemum canadense* (Canada mayflower), *Anemone quinquefolia* (wood anemone), *Dicentra canadensis* (squirrel-corn), *D. cucullaria* (dutchman's breeches), *Cimicifuga racemosa* (black snakeroot), *Geranium maculatum* (wood geranium), *Caulophyllum thalictroides* (blue cohosh), *Hepatica nobilis* (liverleaf), *Arisaema triphyllum* (jack-in-the-pulpit), *Allium tricoccum* (wild leek), *Sanguinaria canadensis* (bloodroot), *Corydalis flavula* (yellow fumewort), *Asplenium* spp. (spleenworts), *Botrychium virginianum* (rattlesnake fern), *Claytonia virginica* (spring-beauty), *Cardamine concatenata* (cut-leaved toothwort), *Mitella diphylla* (bishop's-cap), and *Asarum canadense* (wild ginger). In areas without a strong *Tsuga canadensis* (eastern hemlock) component, there may be complete annual litter turnover. This type may occur in a variety of lower slope/ravine situations.

Related types: This community type resembles a somewhat depauperate version of the "Mixed mesophytic forest"

type, with the addition of *Tsuga canadensis* (eastern hemlock) usually with at least 25% relative cover. It is much richer in species composition than the most closely related mixed conifer/broadleaf forest type, the "Hemlock - tuliptree - birch forest." Species like *Magnolia tripetala* (umbrella magnolia), *Asimina triloba* (pawpaw), *Staphylea trifolia* (bladdernut), *Corydalis flavula* (yellow fumewort), *Sanguinaria canadensis* (bloodroot), and *Dicentra* spp. (dutchman's-breeches and squirrel-corn) are more typical of this richer, more southern type.

Range: Piedmont, Pittsburgh Plateau, southeastern portion of Ridge and Valley.

Selected references: Braun 1950, PNDI field surveys.

[Crosswalk: Smith's "Mesic Central Forest" (in part), TNC's *Tsuga canadensis* (mesic) Forest Alliance, SAF's Eastern hemlock (23) and Yellow poplar - white oak - northern red oak (59).]

BROADLEAF TERRESTRIAL FORESTS

Dry oak - heath forest

This is a fairly broadly defined community type. These forests occur on xeric to moderately dry, acidic sites, often on shallow or sandy soils and/or steep slopes. The most characteristic tree species for this forest type is *Quercus montana* (chestnut oak), usually occurring with a mix of *Q. velutina* (black oak), *Q. coccinea* (scarlet oak), and/or *Q. alba* (white oak). Other tree species include *Sassafras albidum* (sassafras), *Nyssa sylvatica* (black-gum), *Betula lenta* (sweet birch), *Acer rubrum* (red maple), *Carya glabra* (pignut hickory), *Pinus rigida* (pitch pine), *P. virginiana* (Virginia pine), and *Pinus strobus* (eastern white pine). Total cover by conifers generally does not exceed 25% of the canopy. *Castanea dentata* (American chestnut) stump sprouts are not uncommon. The shrub layer is dominantly ericaceous; common species include *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (lowbush blueberry), *V. angustifolium* (low sweet blueberry), *Viburnum acerifolium* (maple-leaved viburnum), and in more open areas, *Comptonia perigrina* (sweet-fern). Owing largely to the thick, resistant oak/ericad leaf litter, the herbaceous layer is generally sparse. Common constituents include *Maianthemum canadense* (Canada mayflower), *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (a sedge), *Chimaphila maculata* (pipissewa), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (teaberry), *Aralia nudicaulis* (wild sarsaparilla), *Pteridium aquilinum* (bracken fern), and *Cypripedium acaule* (pink lady's-slipper).



Related types: The "Dry oak - mixed hardwood forest" type is similar but occurs on less acidic (and often less dry) sites and does not have an overwhelming dominance of heaths in the shrub layer. As one moves up-slope or toward a drier exposure, the evergreen component may increase and this type may grade into the "Pitch pine - mixed hardwood forest" type. Where the canopy becomes open, with trees over five meters high covering less than 60% of the site overall, this becomes the "Dry oak - heath woodland."

Range: Entire state.

Selected references: Braun 1950, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Xeric Central Hardwood Forest," TNC's *Quercus - Ericaceae* Forest Alliance and *Quercus (prinus, coccinea, velutina)* Forest Alliance, SAF: most of Chestnut oak (44), and parts of Northern red oak (55) and White oak - black oak - northern red oak (52).]

Dry oak-mixed hardwood forest

This type occurs on less acidic to somewhat calcareous, moderately dry soils. It is most often found on south and southwest-facing slopes. Common trees include *Quercus alba* (white oak), *Betula lenta* (sweet birch), *Carya cordiformis* (shellbark hickory), *Celtis occidentalis* (hackberry), *Acer rubrum* (red maple), *A. saccharum* (sugar maple), *Q. montana* (chestnut oak), *Q. velutina* (black oak), *Q. rubra* (northern red oak), *Carya glabra* (pignut hickory), *Fraxinus americana* (white ash), and *Tilia americana* (basswood). The shrub layer is perhaps more diagnostic. Characteristic shrubs include *Cornus florida* (flowering dogwood), *Carpinus caroliniana* (hornbeam), *Corylus cornuta* (beaked hazelnut), *Amelanchier arborea* (shadbush), *Cercis canadensis* (redbud), and *Ostrya virginiana* (hop-hornbeam). Ericaceous shrubs are uncommon, although *Kalmia latifolia* (mountain laurel) does occur on some sites. This type usually contains a somewhat richer herbaceous flora than the "Dry oak-heath" forest type (although restricted by moisture availability). Herbaceous species include *Smilacina racemosa* (false Solomon's-seal), *Uvularia sessilifolia* (wild-oats), *Polygonatum biflorum* (Solomon's-seal), *Asplenium platyneuron* (ebony spleenwort), *Desmodium spp.* (tick-trefoil), *Hieracium venosum* (rattlesnake weed), *Aralia nudicaulis* (wild sarsaparilla), *Carex pennsylvanica* (a sedge), *Carex communis* (a sedge), and *Lysimachia quadrifolia* (whorled loosestrife).

Related types: The "Virginia pine - mixed hardwood forest" type sometimes occurs in association with this type (especially on calcareous shales) and is distinguished by the presence of a substantial conifer component (at least

25% relative cover). The "Dry oak - heath forest" occurs on more acidic sites and is distinguished from this by a clear dominance of ericaceous shrubs in the understory. The "Yellow oak - redbud woodland" type is more strongly calciphilic, with a clear dominance of calciphiles, is much more restricted in distribution, and generally has an open canopy.

Selected references: Braun 1955, Monk, 1mm, and Potter 1990, Pearson 1974, 1979.

Range: Entire state except Coastal Plain.

[Crosswalk: Smith's "Dry-Mesic Calcareous Central Forest," "Xeric Central Hardwood Forest," TNC's *Quercus (prinus, rubra) - Carya* Forest Alliance and parts of *Carya -Fraxinus - Quercus* Forest Alliance, although the latter is generally richer and more mesic, SAF's White oak - black oak - northern red oak (52).]

Red oak - mixed hardwood forest

This broadly defined community type includes much of Pennsylvania's hardwood-dominated forests occurring on fairly mesic sites, and is therefore quite variable in composition. *Quercus rubra* (northern red oak) is usually present, often dominant/codominant, most often with *Acer rubrum* (red maple), *Quercus velutina* (black oak), *Q. alba* (white oak), *Carya tomentosa* (mockernut hickory), *C. ovata* (shagbark hickory), *Betula lenta* (sweet birch), *B. alleghaniensis* (yellow birch), *Fraxinus americana* (white ash), *Fagus grandifolia* (American beech), and/or *Liriodendron tulipifera* (tuliptree). Shrubs include *Viburnum recognitum* (northern arrowwood), *V. dentatum* (southern arrowwood), *V. acerifolium* (maple-leaved viburnum), *Amelanchier laevis* (smooth serviceberry), *A. arborea* (shadbush), *Kalmia latifolia* (mountain laurel), *Carpinus caroliniana* (hornbeam), *Ostrya virginiana* (hop-hornbeam), *Hamamelis virginiana* (witch-hazel), and *Lindera benzoin* (spicebush). The herbaceous layer is highly variable. Representative species include *Uvularia sessilifolia* (wild-oats), *Smilacina racemosa* (false Solomon's-seal), *Podophyllum peltatum* (may-apple), *Chimaphila maculata* (pipissewa), *Gaultheria procumbens* (teaberry), *Medeola virginiana* (Indian cucumber-root), *Caulophyllum thalictroides* (blue cohosh)—on richer sites, *Dryopteris spp.* (wood ferns), and *Dennstaedtia punctilobula* (hayscented fern).

Related types: The "Hemlock (white pine) - red oak - mixed hardwood forest" type is distinguished from this by the presence of at least 25% relative cover by hemlock and/or white pine. The "Northern hardwood forest" is distinguished by a greater percentage of birches, maples, and beech, and less oak.



Range: Entire state, although less common on the Unglaciaded Allegheny Plateau.

Selected references: Braun 1955, Gordon 1941, Harshberger 1904, Pearson 1974, 1979.

[Crosswalk: falls between Smith's "Dry - Mesic Acidic Central Forest" and "Mesic central forest," TNC's *Quercus rubra* - *Acer saccharum* Forest Alliance (mostly) and *Quercus (prinus, rubra)* - *Carya* Forest Alliance (to a lesser extent), SAF's Northern red oak (55).]

Northern hardwood forest

Dominant trees usually include *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *A. saccharum* (sugar maple), *Prunus serotina* (wild black cherry)—at less than 40% relative cover, *Betula lenta* (sweet birch), *B. alleghaniensis* (yellow birch), *B. papyrifera* (paper birch), *Q. rubra* (northern red oak), and *Fraxinus americana* (white ash). This type may contain scattered *Pinus strobus* (eastern white pine) and/or *Tsuga canadensis* (eastern hemlock), but combined conifer cover does not exceed 25% of the canopy. *Rhododendron maximum* (rosebay) may be locally abundant. Other common shrubs include *Hamamelis virginiana* (witch-hazel), *Acer pensylvanicum* (moose-wood), *Viburnum lantanoides* (witch-hobble), *Ilex montana* (mountain holly), *Amelanchier laevis* (smooth serviceberry), *A. arborea* (shadbush), and *Carpinus caroliniana* (hornbeam). The herbaceous layer is generally sparse and reflects a northern affinity; common components include *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Thelypteris novaboracensis* (New York fern), *Dryopteris carthusiana* (fancy fern), *Lycopodium lucidulum* (shining clubmoss), *Gaultheria procumbens* (teaberry), *Mitchella repens* (partridge-berry), *Aralia nudicaulis* (wild sarsaparilla), *Medeola virginiana* (Indian cucumber-root), and *Maianthemum canadense* (Canada mayflower).

Related types: If combined relative cover by conifers exceeds 25%, please read description for the "Hemlock (white pine) - northern hardwood forest." If cover by *Prunus serotina* (wild black cherry) exceeds 40% of canopy, please read description for the "Black cherry - northern hardwood forest" type.

Range: Glaciaded NE, Glaciaded NW, Pocono Plateau, Unglaciaded Allegheny Plateau.

Selected references: Braun 1950, Illick and Frontz 1928, Lindsey and Escobar 1976.

[Crosswalk: Smith's "Northern Hardwood (Broadleaf) Forest," TNC's *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* Forest Alliance, SAF's Sugar maple - beech - yellow birch (24).]

Black cherry - northern hardwood forest

This forest type is characterized by at least 40% relative cover by black cherry and is most characteristic of the Unglaciaded Allegheny Plateau. Common associates are *Acer rubrum* (red maple), *A. saccharum* (sugar maple), *Betula lenta* (sweet birch), *B. alleghaniensis* (yellow birch), *Fagus grandifolia* (American beech), and *Quercus* spp. (oaks), usually *Q. rubra* (northern red oak). *Pinus strobus* (eastern white pine) and/or *Tsuga canadensis* (eastern hemlock) may be present (at less than 25% relative cover). Shrubs include *Viburnum lantanoides* (witch-hobble), *Acer pensylvanicum* (moose-wood), *Rubus allegheniensis* (Allegheny blackberry), *Ilex montana* (mountain holly), *Hamamelis virginiana* (witch-hazel), and *Amelanchier arborea* (shadbush). Common herbaceous species include *Dennstaedtia punctilobula* (hayscented fern), *Thelypteris noveboracensis* (New York fern), *Dryopteris intermedia* (common wood fern), *Lycopodium* spp. (ground pine), *Aster acuminatus* (wood aster), *Viola* spp. (violets), *Medeola virginiana* (Indian cucumber-root), *Uvularia sessilifolia* (wild-oats), *Brachyelytrum erectum* (brachyelytrum), *Maianthemum canadense* (Canada mayflower), and *Oxalis acetosella* (common wood-sorrel).

Related types: The "Northern hardwood forest" may contain *Prunus serotina* (wild black cherry) as a component, but it does not generally exceed 40% relative cover. This forest type is most characteristic of the Unglaciaded Allegheny Plateau.

Range: Glaciaded NE, Glaciaded NW, Unglaciaded Allegheny Plateau.

Selected references: Hough and Forbes 1943, Marquis 1975.

[Crosswalk: Smith's "Northern Hardwood (Broadleaf) Forest," TNC's *Acer saccharum* - *Betula alleghaniensis* - *Fagus grandifolia* Forest Alliance, *Acer saccharum* - *Betula alleghaniensis* - *Prunus serotina* Community, SAF's Black cherry - maple (28).]

Tuliptree - beech - maple forest

These woods occur on fairly deep, not strongly acidic soils, at a mid-to lower-slope position. The most consistent tree species for this often very mixed type are *Acer rubrum* (red maple) and *Liriodendron tulipifera* (tuliptree). *Fagus grandifolia* (American beech) is often present and, when present, is often codominant. In successional, lower slope situations, *Liriodendron*



tulipifera (tuliptree) may occur in nearly pure stands. The long list of possible associates includes various oaks, mostly *Q. rubra* (red oak), as well as *Nyssa sylvatica* (black-gum), *Acer saccharum* (sugar maple), *Carya tomentosa* (mockernut hickory), *C. ovata* (shagbark hickory), *Betula lenta* (sweet birch), *Tsuga canadensis* (eastern hemlock)—less than 25% relative cover and in—western Pennsylvania, *Magnolia acuminata* (cucumber-tree). Common shrubs include various viburnums, *Carpinus caroliniana* (hornbeam), *Cornus Florida* (flowering dogwood), *Ostrya virginiana* (hop-hornbeam), *Hamamelis virginiana* (witch-hazel), and *Lindera benzoin* (spicebush). This type has different expressions in different parts of the state as well as according to disturbance history etc. There may be a rich herbaceous layer, especially in the vernal flora. On richer sites that are not over-browsed, this may include species like *Podophyllum peltatum* (may-apple), *Sanguinaria canadensis* (bloodroot), *Botrychium virginianum* (rattlesnake fern), *Dicentra cucullaria* (dutchman's-breeches), *D. canadensis* (squirrel corn), *Allium tricoccum* (wild leek), *Claytonia virginica* (spring-beauty) etc.

Related types: This type is closely related to the "Red oak - mixed hardwood forest" type. They share many species in common. The "Red oak - mixed hardwood forest" type is more widespread, occurs across a broader ecological range, and is usually dominated by oaks and hickories. This type is more restricted, generally occurring on toeslopes, or north-facing lower and midslopes. The dominance of beech, tulip, and maple and the near-absence of heaths, such as *Gaultheria procumbens* (teaberry) and *Kalmia latifolia* (mountain laurel), distinguish these forests from the oak-dominated type.

Range: Piedmont, Pittsburgh Plateau, Ridge and Valley.

Selected references: Pearson 1974, PNDI field surveys.

[Crosswalk: falls between Smith's "Dry-mesic acidic central forest" and "Mesic central forest", TNC's *Fagus grandifolia* - *Acer saccharum* (*Liriodendron tulipifera*) Forest Alliance, SAF's Yellow poplar (57) (in part), also some non-oak dominated portions of Yellow poplar white - oak (59).]

Sugar maple - basswood forest

In eastern Pennsylvania, this type occurs on rich rocky slopes (although it may have occurred on less steep sites previous to extensive logging that left these inaccessible remnants as our only remaining examples). In western Pennsylvania, this type occurs on a wide range of sites. Aside from *Acer saccharum* (sugar maple) and *Tilia americana* (basswood), other trees typically present include *Quercus rubra* (northern red oak) *Fraxinus*

americana (white ash), *Liriodendron tulipifera* (tuliptree), *Betula alleghaniensis* (yellow birch), and *B. lenta* (sweet birch). Shrubs include *Lindera benzoin* (spicebush), *Hamamelis virginiana* (witch-hazel), and on richer sites *Asimina triloba* (pawpaw) and *Staphylea trifolia* (bladdernut). There is generally a rich vernal flora; species include *Anemone quinquefolia* (wood anemone), *Cimicifuga racemosa* (black snakeroot), *Geranium maculatum* (wood geranium), *Caulophyllum thalictroides* (blue cohosh), *Allium tricoccum* (wild leek), *Hepatica nobilis* (liverleaf), *Sanguinaria canadensis* (bloodroot), *Erythronium americanum* (trout-lily), *Claytonia virginica* (spring-beauty), *Arisaema triphyllum* (jack-in-the-pulpit), *Mitella diphylla* (bishop's-cap), *Cardamine concatenata* (cut-leaved toothwort), and *Asarum canadense* (wild ginger). Other herbaceous species include *Smilacina racemosa* (false Solomon's-seal), *Dryopteris marginalis* (evergreen wood fern), and *Botrychium virginianum* (rattlesnake fern).

Related types: The "Red oak - mixed hardwood forest" is usually dominated by oaks and hickories, and more often has heaths like *Kalmia latifolia* (mountain laurel) and *Gaultheria procumbens* (teaberry) in the understory. The "Tuliptree - beech - maple forest" type generally lacks *Tilia americana* (basswood) and occurs on gentle toeslopes rather than rocky slopes. In western Pennsylvania, this type may resemble depauperate examples of the "Mixed mesophytic forest" type.

Range: Glaciated NE, Great Lakes Region, Piedmont, Pittsburgh Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Eyre 1980, Harker et al. 1993.

[Crosswalk: Smith's "Talus Slope Forest," TNC's *Acer saccharum* - *Fraxinus americana* - *Tilia americana* Forest Alliance and *Acer saccharum* - *Fraxinus americana* - *Ulmus americana* Forest Alliance, *Acer saccharum* - *Liriodendron tulipifera* - *Fraxinus americana* - *Staphylea trifolia* Community, SAF's Sugar maple - basswood (26).]

Mixed mesophytic forest

This is specific to the southwestern part of the state and includes several species that find their northern and eastern limits in Pennsylvania. This is an extremely rich community type that typically occurs on deep soils at a lower slope position. Dominant trees include *Liriodendron tulipifera* (tuliptree), *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), *Tilia americana* (basswood), *Quercus rubra* (northern red oak), *Magnolia acuminata* (cucumber-tree), *Prunus serotina* (wild black cherry), *Fraxinus americana* (white ash), *Juglans nigra* (black walnut), *Carya ovata* (shagbark hickory), *Aesculus*



glabra (Ohio buckeye), and *A. flava* (yellow buckeye). *Tsuga canadensis* (eastern hemlock) may occur in these forests, but is not characteristically a dominant. Shrubs include *Asimina triloba* (pawpaw), *Staphylea trifolia* (bladdernut), *Rhododendron maximum* (rosebay), *Magnolia tripetala*^s (umbrella magnolia), *Cercis canadensis* (redbud), *Lindera benzoin* (spicebush), *Hydrangea arborescens* (wild hydrangea), and *Hamamelis virginiana* (witch-hazel). The herbaceous flora is extremely rich and includes such species as *Trillium grandiflorum* (white trillium), *T. erectum* (purple trillium), *T. sessile* (toadshade), *Erythronium americanum* (trout-lily), *Phlox divaricata* (wild blue phlox), *Anemone quinquefolia* (wood anemone), *Dicentra canadensis* (squirrelcorn), *D. cucullaria* (dutchman's-breeches), *Clintonia umbellulata* (speckled wood-lily), *Cimicifuga racemosa* (black snakeroot), *Geranium maculatum* (wood geranium), *Caulophyllum thalictroides* (blue cohosh), *Tiarella cordifolia* (foamflower), *Hepatica nobilis* (liverleaf), *Allium tricoccum* (wild leek), *Sanguinaria canadensis* (bloodroot), *Corydalis flavula* (yellow fumewort), *Botrychium virginianum* (rattlesnake fern), *Claytonia virginica* (spring-beauty), *Cardamine concatenata* (cut-leaved toothwort), *Mitella diphylla* (bishop's-cap), and *Asarum canadense* (wild ginger). Most of these systems have a complete, or nearly complete, annual litter turnover.

Related types: The "Hemlock - mesic hardwood forest" type usually has 25% or more relative cover by *Tsuga canadensis* (eastern hemlock), but is otherwise similar in ecology and species composition. The "Sugar maple - basswood forest" type is less species-rich than this type, often occurs on rocky slopes, and generally lacks the complete annual litter turnover that characterizes this type. The range of this community type is restricted to the Pittsburgh Plateau. Similar sites in other parts of the state most likely belong to either the "Sugar maple - basswood forest" type or the "Tuliptree - beech - maple forest" type.

Range: Pittsburgh Plateau.

Selected references: Braun 1950, Harker et al. 1993, PNDI field surveys

[Crosswalk: Smith's "Mesic Central Forest" (in part), TNC's *Liriodendron tulipifera* - *Tilia americana* var. *heterophylla* - *Aesculus flava* - *Acer saccharum* Forest Alliance, SAF's Yellow-poplar - white oak - northern red oak (59)—richer examples.]

Sweet gum - oak coastal plain forest

This type is restricted to the level, sandy soils of the Coastal Plain the adjacent Piedmont; characteristic species include, *Liquidambar styraciflua* (sweet-

gum)—usually a dominant, *Quercus falcata*^s (southern red oak), *Q. phellos*^s (willow oak), *Q. alba* (white oak), *Fagus grandifolia* (American beech), *Acer rubrum* (red maple), *Smilax rotundifolia* (greenbrier), *Leucothoe racemosa*^s (fetter-bush), *Lyonia mariana*^s (stagger-bush), *Clethra alnifolia* (sweet pepperbush), *Kalmia latifolia* (mountain laurel), and sometimes *Ilex opaca*^s (American holly). Not much of this type remains in Pennsylvania, and what there is tends to be badly degraded.

Related types: The predominance of *Liquidambar styraciflua* (sweet gum), *Quercus phellos* (willow oak), *Lyonia mariana*^s (stagger-bush), and other coastal plain species makes this community type easily distinguishable from other terrestrial forest types in Pennsylvania. The "Red maple - magnolia Coastal Plain palustrine forest" is a palustrine forest type also characteristic of Pennsylvania's Coastal Plain. The difference in hydrology and associated species clearly differentiates the two.

Range: Coastal Plain, Piedmont.

Selected references: Heckscher 1994, Smith 1991.

[Crosswalk: Smith's "Coastal plain forest" (in part), TNC's *Quercus - Fagus grandifolia - Ilex opaca* Forest Alliance, *Quercus - Fagus grandifolia / Podophyllum peltatum* Community, SAF's White oak (53) (in part).]

Red maple (terrestrial) forest

This is generally an early-to mid-successional type that is becoming increasingly common as red maple increases in Pennsylvania's forests. This type is seldom pure, but *Acer rubrum* (red maple) dominates the tree stratum. Associate species include *Quercus* spp. (oaks), *Betula lenta* (sweet birch), *Liriodendron tulipifera* (tuliptree), *Carya* spp. (hickories), *Fraxinus americana* (white ash), *Prunus serotina* (wild black cherry), and other hardwoods. Because *Acer rubrum* (red maple) has such a wide ecological amplitude, this type may occur from the upper through the lower slope. Accordingly, the associated species vary greatly. Some shrubs commonly present include *Viburnum acerifolium* (maple-leaved viburnum), *Lindera benzoin* (spicebush), *Hamamelis virginiana* (witch-hazel), and *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), and *Cornus florida* (flowering dogwood). More information is needed regarding the ecology and species composition of this community type.

Related types: The "Northern hardwood forest" type may contain a substantial amount of *Acer rubrum* (red maple), especially in younger stands. This type is not intended to include very young successional stands of northern hardwoods.



Range: Entire state.

Selected reference: Abrams 1998.

[Crosswalk: Smith - no crosswalk, TNC - no crosswalk, SAF's Red maple (108).]

Black-gum ridgetop forest

This community type occurs on fairly dry ridgetops. The canopy may be somewhat open; tree growth is somewhat suppressed. These ridgetops may have been exposed to repeated fires. *Nyssa sylvatica* is the dominant species; *Betula lenta* (sweet birch), *Sassafras albidum* (sassafras), *Acer rubrum* (red maple), *Quercus montana* (chestnut oak), *Q. velutina* (black oak), and *Q. rubra* (red oak) are often present. The shrub layer is dominantly ericaceous; common species include *Kalmia latifolia* (mountain laurel), *Gaylussacia baccata* (black huckleberry), *Vaccinium* spp. (blueberry), and *Hamamelis virginiana* (witch-hazel). The herbaceous layer is generally sparse. Common constituents include *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (a sedge), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (teaberry), *Aralia nudicaulis* (wild sarsaparilla), and *Pteridium aquilinum* (bracken fern).

Related types: This type is fairly uniform in composition and is restricted to ridgetops and high shoulders. The "Birch (black-gum) rocky slope woodland" occurs on talus or scree slopes and boulderfields, has an open canopy, and has a wide range of possible associates depending on aspect and location.

Range: Ridge and Valley.

Selected references: Daniel Devlin—personal communication.

[Crosswalk: none.]

Aspen/gray (paper) birch forest

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 *B. populifolia* (gray birch) and occasionally *B. lenta* (sweet birch). The aspen may be *Populus grandidentata* (large-toothed aspen), or *P. tremuloides* (quaking aspen). Associates include *Sassafras albidum* (sassafras), *Acer* spp. (maples), and *Prunus* spp. (cherry). This is an early successional forest type, commonly found on former agricultural land, in areas of ice scour along stream banks, and where there has been major disturbance resulting in areas of exposed mineral soil. This

community type may also result from forestry practices that maintain an early successional stage.

Related types: The "Northern hardwood forest" type may contain a substantial birch component. Many forest types may contain patches of aspen or birch in former canopy gaps; this community type is not intended to describe such small patches.

Range: Entire state.

[Crosswalk: Smith's "Young Miscellaneous Forest," TNC's *Populus tremuloides* Forest Alliance, SAF's Aspen (16) and Gray birch - red maple (19).]

Black locust forest

This community type usually occurs on highly disturbed sites or in small woodlots in an agricultural or suburban matrix. *Robinia pseudoacacia* (black locust) is usually the dominant tree. *Betula lenta* (sweet birch) is frequently codominant. Other associates vary; typical representatives include *Acer rubrum* (red maple), the exotic *Acer platanoides*¹ (Norway maple), *Sassafras albidum* (sassafras), various oaks (*Quercus* spp.), or *Prunus serotina* (wild black cherry). There is generally a dense graminoid understory due to the light penetration through the canopy. *Toxicodendron radicans* (poison ivy) is commonly abundant. Exotic species usually predominate; common representatives include *Lonicera japonica*¹ (Japanese honeysuckle), *Ailanthus altissima*¹ (tree-of-heaven), *L. morrowii*¹ (Morrow's honeysuckle), *Berberis thunbergii*¹ (Japanese barberry), *Alliaria petiolata*¹ (garlic mustard), *Polygonum perfoliatum*¹ (mile-a-minute), *Microstegium vimineum*¹ (stilt grass), *Poa pratensis*¹ (Kentucky bluegrass), *Dactylis glomerata*¹ (orchard grass), and *Holcus lanatus*¹ (velvet grass).

Related types: Other forest types may contain *Robinia pseudoacacia* (black locust), this type refers to sites where it is clearly dominant.

Range: Piedmont, Pittsburgh Plateau, Ridge and Valley.

Selected references: Eyre 1980.

[Crosswalk: Smith's "Young Miscellaneous Forest," TNC -no crosswalk, SAF's Black locust (50).]



Palustrine Forests



*D*elhaas Woods, Bucks County.
Photograph by Roger Earl Latham.



*C*olumbus Bog, State Game Lands 197,
Warren County. Photograph by Paul Wiegman.



CONIFEROUS PALUSTRINE FORESTS

Black spruce - tamarack peatland forest

Picea mariana (black spruce) and/or *Larix laricina* (tamarack) dominate this community type. Other trees that may occur include *Betula populifolia* (gray birch), *Acer rubrum* (red maple), *Tsuga canadensis* (eastern hemlock), *Pinus strobus* (eastern white pine), and *Populus tremuloides* (quaking aspen). Shrub species include *Rhododendron viscosum* (swamp azalea), *Nemopanthus mucronatus* (mountain-holly), *Ilex verticillata* (winterberry), and *Vaccinium corymbosum* (highbush blueberry). Herbaceous species include *Carex trisperma* (a sedge), *C. disperma*^s (a sedge), *Trientalis borealis* (starflower), *Osmunda cinnamomea* (cinnamon fern), *O. regalis* (royal fern), *Viola* spp. (violets), *Gaultheria hispidula*^s (creeping snowberry) and *Coptis trifolia* (goldthread). Sphagnum occurs throughout. This community type may occur as part of the "Acidic glacial peatland complex."

Related types: Where canopy closure is less than 60%, this type becomes the "Black spruce - tamarack palustrine woodland." The open canopy of the woodland type allows for a much more extensive shrub layer—usually dominated by *Chamaedaphne calyculata* (leatherleaf), and a herbaceous layer more typical of open bogs.

Range: Glaciated NE, Glaciated NW, Pocono Plateau.

Selected references: PNDI field surveys, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Boreal Conifer Swamp," TNC's *Picea mariana* - *Larix laricina* Saturated Forest Alliance, SAF's Black spruce-sphagnum (12d).]

Red spruce palustrine forest

This community type occurs on shallow organic soils or mineral soils with a substantial accumulation of organic matter. *Picea rubens* (red spruce) is always present, usually dominant or codominant. Other tree species include *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), *Acer rubrum* (red maple), *Betula populifolia* (gray birch), *B. alleghaniensis* (yellow birch), *Nyssa sylvatica* (black-gum), and occasionally *Abies balsamea* (balsam fir). *Rhododendron maximum* (rosebay) is common and often forms a dense understory. Other shrub species that may be present include *Viburnum cassinoides* (with-rod), *Ilex verticillata* (winterberry), *Vaccinium corymbosum* (highbush blueberry), and *Nemopanthus mucronatus* (mountain-holly). There is usually a pronounced mound and pool microtopography. Characteristic herbs occurring on

mounds include *Osmunda cinnamomea* (cinnamon fern), *Viola* spp. (violets), *Mitchella repens* (partridge-berry), *Maianthemum canadense* (Canada mayflower), *Coptis trifolia* (goldthread), *Cornus canadensis* (bunchberry), *Carex trisperma*, and other sedge species. The bryophyte layer is usually well developed and dominated by sphagnum.

Related types: Where canopy closure is less than 60%, this type becomes the "Red spruce palustrine woodland," where dominance is shared with hardwoods (where total conifer cover is less than 75% of the canopy) this becomes the "Red spruce - mixed hardwood palustrine forest."

Range: Glaciated NE, Pocono Plateau.

Selected references: Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Boreal Conifer Swamp," TNC's *Picea rubens* Saturated Forest Alliance, SAF's Red spruce (32).]

Hemlock palustrine forest

These are wetland forests dominated or co-dominated by *Tsuga canadensis* (eastern hemlock). The canopy may also contain a mixture of other conifers, e.g. *Picea rubens* (red spruce), *Larix laricina* (tamarack), and *Pinus strobus* (eastern white pine). Hardwoods may contribute up to 25% of the tree stratum; common species include *Acer rubrum* (red maple), *Betula alleghaniensis* (yellow birch), and *Fraxinus nigra* (black ash). There is generally a pronounced mound and pool microtopography. This community type may occur as a zone around a wetter community type of a more northern affinity. It may also occur in basins or on slopes fed by groundwater seepage. *Rhododendron maximum* (rosebay) is often present, sometimes quite dense. *Viburnum cassinoides* (with-rod), *Rhododendron viscosum* (swamp azalea), *Ilex verticillata* (winterberry), and *Vaccinium corymbosum* (highbush blueberry) are also commonly associated with this type. Herbs include *Osmunda cinnamomea* (cinnamon fern), *Symplocarpus foetidus* (skunk-cabbage), *Onoclea sensibilis* (sensitive fern), *Mitchella repens* (partridge-berry), *Maianthemum canadense* (Canada mayflower), *Coptis trifolia* (goldthread), *Viola* spp. (violets), *Dalibarda repens* (false-violet), *Trientalis borealis* (star-flower), and various grasses and sedges. There may be a strong bryophyte component, usually dominated by sphagnum.

Related types: Where total conifer cover is less than 75% of the canopy, this type becomes the "Hemlock - mixed hardwood palustrine forest."



Range: Great Lakes Region, Glaciated NE, Glaciated NW, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: PNDI field surveys, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Northern Conifer Swamp," TNC's *Tsuga canadensis* (eastern hemlock) Wetland Forest Alliance, SAF's Eastern hemlock (23).]

CONIFER - BROADLEAF PALUSTRINE FORESTS

Hemlock - mixed hardwood palustrine forest

This describes a group of wetland forests that are dominated by a mixture of conifers and hardwood species. The substrate is usually mineral soil or muck over mineral soil. There is generally some groundwater enrichment in these systems. *Tsuga canadensis* (eastern hemlock) contributes between 25% and 75% of the canopy. Other conifer species that may occur with hemlock include *Pinus strobus* (eastern white pine), *Picea rubens* (red spruce), and *Larix laricina* (tamarack). The most common hardwood species are *Betula alleghaniensis* (yellow birch), *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), *Nyssa sylvatica* (black-gum), and *Betula populifolia* (gray birch). *Rhododendron maximum* (rosebay) often forms a dense understory; other shrubs include *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (winterberry), *Rhododendron viscosum* (swamp azalea) and *Viburnum cassinoides* (withe-rod). Herbaceous species include *Osmunda cinnamomea* (cinnamon fern), *Carex folliculata* (a sedge), *Viola* spp. (violets), *C. trisperma* (a sedge), *Symplocarpus foetidus* (skunk-cabbage), *Veratrum viride* (false hellebore), *Onoclea sensibilis* (sensitive fern), and *Aster puniceus* (purple-stemmed aster). The bryophyte layer is usually well developed and dominated by sphagnum.

Related types: Where the conifer component is less than 25% of the canopy, see the "Broadleaf palustrine forests" section, and where the conifer component is greater than 75%, see the "Hemlock palustrine forest" type under "Coniferous palustrine forests."

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau,.

Selected references: Smith 1991, Sneddon, Anderson, and Metzler 1996, Reschke 1990.

[Crosswalk: Smith's "Broadleaf - Conifer Swamp" subtype "a", TNC's *Tsuga canadensis* - *Acer rubrum* Saturated

Forest Alliance, SAF's Hemlock - yellow birch (24) and parts of Eastern hemlock (23).]

Red spruce - mixed hardwood palustrine forest

This describes a group of wetland forests that are dominated by a mixture of conifers and hardwood species. This community type is most typical of the Unglaciated Allegheny Plateau, although isolated occurrences may be found elsewhere. The substrate is usually shallow organic matter over mineral soil. There is generally some groundwater enrichment in these systems. *Picea rubens* (red spruce), sometimes in combination with other conifers, contributes between 25% and 75% of the canopy. Other conifer species that may occur include *Tsuga canadensis* (eastern hemlock) *Pinus strobus* (eastern white pine), and *Larix laricina* (tamarack). The most common hardwood species are *Betula alleghaniensis* (yellow birch), *Acer rubrum* (red maple), *Fraxinus nigra* (black ash), *Nyssa sylvatica* (black-gum), and *Betula populifolia* (gray birch). Shrubs include *Nemopanthus mucronatus* (mountain-holly), *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (winterberry), *Rhododendron viscosum* (swamp azalea) and *Viburnum cassinoides* (withe-rod). Herbaceous and creeping shrub species include *Coptis trifolia* (goldthread), *Osmunda cinnamomea* (cinnamon fern), *Onoclea sensibilis* (sensitive fern), *Carex folliculata* (a sedge), *C. trisperma* (a sedge), *Viola* spp. (violets), *Gaultheria hispidula*^s (creeping snowberry), and *C. disperma*^s (soft-leaved sedge). The bryophyte layer is usually well developed and dominated by sphagnum.

Related types: Where the conifer component is less than 25% of the canopy, see the "Broadleaf palustrine forests" section, and where the conifer component is greater than 75%, see the "Red spruce palustrine forest" type under "Coniferous palustrine forests."

Range: Glaciated NE, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Smith 1991, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Broadleaf - Conifer Swamp" - subtype "a", TNC's *Picea rubens* - *Acer rubrum* Saturated Forest Alliance, SAF's Red spruce (32).]



BROADLEAF PALUSTRINE FORESTS

Bottomland oak - hardwood palustrine forest

These are palustrine forests characterized by the dominance or near-dominance of *Quercus palustris* (pin oak) and/or *Q. bicolor* (swamp white oak), often with *Acer rubrum* (red maple), *Ulmus americana* (American elm), *Nyssa sylvatica* (black-gum), and *Fraxinus nigra* (black ash). Shrubs include *Lindera benzoin* (spicebush), *Vaccinium corymbosum* (highbush blueberry), *Dirca palustris* (leatherwood), *Viburnum recognitum* (northern arrow-wood), and *V. dentatum* (southern arrow-wood). Herbs include *Impatiens* spp. (jewelweed), *Thelypteris palustris* (marsh fern), *Polygonum sagittatum* (arrow-leaved tearthumb), *P. arifolium* (halberd-leaved tearthumb), and *Agrimonia parviflora* (southern agrimony).

Related types: This community types is distinguished from the various red maple palustrine forest types by the dominance or near-dominance of *Quercus palustris* (pin oak), and/or *Q. bicolor* (swamp white oak).

Range: Piedmont, Pittsburgh Plateau, Ridge and Valley.

Selected references: Smith 1991, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Circumneutral Broadleaf Swamp" (in part), TNC's *Quercus (palustris, bicolor)* Seasonally Flooded Forest Alliance, closest SAF's type is Pin oak -sweet gum (65).]

Red maple - black-gum palustrine forest

The canopy is dominated by *Acer rubrum* (red maple) and/or *Nyssa sylvatica* (black-gum). Other trees, e.g. *Betula alleghaniensis* (yellow birch), *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), *Quercus bicolor* (swamp white oak), *Q. palustris* (pin oak), or *Salix nigra* (black willow), may also occur. The shrub layer is variable and may include *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (winterberry), *Alnus* spp. (alder), and *Cornus* spp. (dogwoods). Herbs include *Symplocarpus foetidus* (skunk-cabbage), *Viola* spp. (violets), *Osmunda cinnamomea* (cinnamon fern), *Carex* spp. (various sedges), and *Onoclea sensibilis* (sensitive fern).

Related types: The "Red maple - black ash palustrine forest" occurs under the influence of calcareous waters, and is characterized by the presence of *Fraxinus nigra* (black ash) on most sites and herbaceous calciphiles on some sites.

Range: Entire state.

Selected references: Golet et al. 1993, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: subtypes "a" and "d" of Smith's "Acidic Broadleaf Swamp," and parts of "Circumneutral Broadleaf Swamp," TNC's *Acer rubrum - Nyssa sylvatica* Forest Alliance, SAF's Red maple (108).]

Red maple - black ash palustrine forest

These are palustrine forests enriched by base-rich groundwater. The substrate is usually mineral soil with a thin layer of organic matter. Calciphiles characterize this community type. The dominant trees are usually *Acer rubrum* (red maple) and *Fraxinus nigra* (black ash). Associates include *Quercus bicolor* (swamp white oak), *Nyssa sylvatica* (black-gum), and *Ulmus americana* (American elm). Common understory species include *Rhamnus alnifolia* (alder-leaved buckthorn), *Physocarpus opulifolius* (ninebark), *Spiraea latifolia* (meadowsweet), *Ilex verticillata* (winterberry), *Alnus serrulata* (smooth alder), *Vaccinium corymbosum* (highbush blueberry), and *Rhododendron viscosum* (swamp azalea). Common herbs include *Osmunda regalis* (royal fern), *Carex stricta* (tussock sedge), *C. lacustris* (lakebank sedge), *Symplocarpus foetidus* (skunk cabbage), *Viola* spp. (violets), and *Onoclea sensibilis* (sensitive fern). Most calciphilic species associated with this type have moderate to high light requirements, and thus are found in openings. These species include *Conioselinum chinense*^s (hemlock parsley), *Trollius laxus*^s (spreading globeflower), *Carex interior* (inland sedge), *C. flava*^s (yellow sedge), *C. leptalea* (bristly-stalked sedge), *Cypripedium calceolus* var. *parviflorum*^s (small yellow lady's-slipper), *C. reginae*^s (showy lady's-slipper), *Geum rivale* (water avens), and *Epilobium strictum*^s (downy willow-herb).

Related types: The much more common "Red maple - black-gum palustrine forest" is not generally influenced by calcareous waters, and lacks the *Fraxinus nigra* (black ash) and herbaceous calciphiles that characterize this type.

Range: Glaciated NE, Glaciated NW, Piedmont, Ridge and Valley.

Selected references: Golet et al. 1993, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Eastern calcareous seepage swamp," TNC's *Acer rubrum - Fraxinus nigra* Saturated Forest Alliance, SAF's Red maple (108).]



Red maple - magnolia Coastal Plain palustrine forest

This community type is largely restricted to low-lying areas of the Coastal Plain, with outliers occurring in the Piedmont and South Mountain sections. The dominant trees are *Acer rubrum* (red maple), *Magnolia virginiana*^s (sweet-bay magnolia), *Nyssa sylvatica*, (black-gum), *Liquidambar styraciflua* (sweet-gum), and *Quercus bicolor* (swamp white oak). Shrubs include *Clethra alnifolia* (sweet pepperbush), *Leucothoe racemosa*^s (fetter-bush), *Ilex verticillata* (winterberry), *laevigata* (smooth winterberry), *Vaccinium corymbosum* (highbush blueberry), *Rhododendron viscosum* (swamp azalea), and *Viburnum nudum* (possum-haw). The herbaceous layer is often sparse; species include *Triadenum virginicum* (marsh St.-John's-wort)—in openings, *Viola* spp. (violets), *Osmunda regalis* (royal fern), *Osmunda cinnamomea* (cinnamon fern), and other ferns, sedges, and sphagnum.

Related Types: The upland forest type often associated with this is the "Sweet gum - oak Coastal Plain forest." In Pennsylvania, both of these types are largely restricted to the Coastal Plain. The presence of *Magnolia virginiana*^s (sweet-bay magnolia), *Liquidambar styraciflua* (sweet-gum), and other coastal plain species distinguish this type from other red maple palustrine forests.

Range: Coastal Plain, Piedmont, South Mountain.

Selected references: Heckscher 1994, PNDI field surveys, Sneddon, Metzler and Anderson 1994.

[Crosswalk: Smith's "Coastal Plain Forest" (in part), TNC's *Acer rubrum* - *Liquidambar styraciflua* Seasonally Flooded/Saturated Forest Alliance, SAF's Red maple (108).]

Great Lakes Region lakeplain palustrine forest

These wetlands are specific to the Erie Lake Plain. While the usual aspect is that of a forest, on wetter and/or more recently disturbed sites, there may be a more open canopy. The topography is flat overall with a hummock-hollow microtopography, often with small vernal ponds scattered throughout. The water table is near the surface throughout most of the year. The dominant tree species are *Ulmus americana* (American elm), *Fraxinus pennsylvanica* (red ash), *Fraxinus profunda*^s (pumpkin ash), and *Acer saccharinum* (silver maple). Other trees commonly present include *Acer rubrum* (red maple), *Populus deltoides* (cottonwood), *Tilia americana* (basswood), *Betula alleghaniensis* (yellow birch), and *Nyssa sylvatica* (black-gum). The shrub layer is usually dominated by *Lindera benzoin* (spicebush)—although this is

likely a result of deer over-browsing. The herbaceous layer may be very diverse, representative species include *Carex bromoides* (a sedge), *C. intumescens* (a sedge), *C. crinita* var. *crinita*^s (short hair sedge), *Dryopteris carthusiana* (triploid wood fern), *Onoclea sensibilis* (sensitive fern), *Cardamine douglassii* (purple cress), *Osmunda cinnamomea* (cinnamon fern), and *Viola cucullata* (blue marsh violet). This community type in Pennsylvania remains on only a handful of sites.

Related types: In Pennsylvania this type is restricted to the Erie Lake Plain. It shares species with both floodplain forest types and rich upland types, but is distinguishable by its setting, by the presence of *Fraxinus profunda*^s (pumpkin ash) on most sites, and by the unusual combination of tree species.

Range: Great Lakes Region.

Selected references: PNDI field surveys.

[Crosswalk: none.]

Sycamore - (river birch) - box-elder floodplain forest

This community type occurs along the floodplains of our larger and mid-size river systems that receive periodic or seasonal flooding. Although this is typically a palustrine community type, there may be examples that are terrestrial. The most characteristic tree species of this type are *Platanus occidentalis* (sycamore) and *Acer negundo* (box-elder), often with *Acer rubrum* (red maple), *A. saccharinum* (silver maple), *Ulmus americana* (American elm), *Ulmus rubra* (red elm), *Fraxinus pennsylvanica* (red ash), and *Salix nigra* (black willow). *Betula nigra* (river birch) is a common component of these sites in eastern Pennsylvania, but rarely occurs in the Ohio River drainage. Common shrubs include *Salix sericea* (silky willow), *Cornus amomum* (red-willow), *C. racemosa* (swamp dogwood), *Vitis riparia* (frost grape), *Lindera benzoin* (spicebush), and *Toxicodendron radicans* (poison-ivy). Exotic shrubs such as *Rosa multiflora*^d (multiflora rose), *Lonicera japonica*^d (Japanese honeysuckle), and *Lonicera morrowii*^z (Morrow's honeysuckle) are common. Herbs include *Impatiens capensis* (jewelweed), *I. pallida* (pale jewelweed), *Pilea pumila* (clearweed), *Laportea canadensis* (wood-nettle), *Polygonum hydropiper*^d (common smartweed), *Urtica dioica* (great nettle), *P. virginianum* (jumpseed), *Microstegium vimineum*^d (stilt grass), *Polygonum cuspidatum*^d (Japanese knotweed), and *Alliaria petiolate*^d (garlic mustard). This community type is part of the "River bed - bank - floodplain complex."

Related types: The "Silver maple floodplain forest" occurs in a similar setting, but is distinguished by *Acer*



saccharinum (silver maple) dominance. In backwater areas with standing water through much of the year, the "Red maple - elm - willow floodplain swamp" often occurs. Where the canopy becomes open, usually on islands or gravel bars, this type may grade into the "River birch - sycamore floodplain scrub."

Range: Entire state.

Selected references: Eyre 1980, PNFI field surveys, Reschke 1990.

[Crosswalk: Smith's "Floodplain Forest" (in part), TNC's *Platanus occidentalis* - *Betula nigra* - *Acer negundo* Seasonally / Temporarily Flooded Forest Alliance, SAF's River birch - sycamore (61).]

Silver maple floodplain forest

These forests occur along larger rivers with a well-developed floodplain. Although this is typically a palustrine community type, there are examples that are terrestrial. Aside from *Acer saccharinum* (silver maple), which is usually dominant, other trees include *Acer rubrum* (red maple), *Salix nigra* (black willow), *Betula nigra* (river birch), *Acer negundo* (box-elder), *Ulmus americana* (American elm), and *U. rubra* (red elm). Shrubs include *Cornus amomum* (red-willow), *C. racemosa* (swamp dogwood), *Toxicodendron radicans* (poison-ivy), *Lindera benzoin* (spicebush), *Sambucus canadensis* (American elder) and, *Viburnum recognitum* (northern arrow-wood). Exotic shrubs, such as *Rosa multiflora*^a (multiflora rose), *Lonicera japonica*^d (Japanese honeysuckle), and *Lonicera morrowii*^e (Morrow's honeysuckle), are common. Herbs include *Impatiens capensis* (jewelweed), *I. pallida* (pale jewelweed), *Pilea pumila* (clearweed), *Polygonum hydropiper*¹ (common smart-weed), *P. virginianum* (jumpseed), *Microstegium vimineum*^d (stilt grass), *Polygonum cuspidatum*^l (Japanese knotweed), and *Alliaria petiolata*^l (garlic mustard). This community type is part of the "River bed - bank -floodplain complex."

Related types: The "Sycamore - (river birch) - box-elder floodplain forest" occurs in a similar setting, but is dominated by a mix of species, rather than by *Acer saccharinum* (silver maple). In backwater areas with standing water throughout much of the year, the "Red maple - elm - willow floodplain swamp" often occurs. Where the canopy becomes open, usually on islands or gravel bars, this type may grade into the "River birch - sycamore floodplain scrub."

Range: Entire state—major river systems, main stem.

Selected references: Eyre 1980, PNFI field surveys, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Floodplain Forest" (in part), TNC's *Acer Saccharin* Temporarily Flooded Forest Alliance, SAF's Silver maple - American elm (62).]

Red maple - elm - willow floodplain swamp

This palustrine forest type is primarily associated with major rivers, often located in old oxbows along the floodplain, or in depressions behind natural levees. These systems are subject to periodic flooding, may stay inundated for substantial periods of time, and may also receive groundwater enrichment and/or surface water from adjacent uplands. Characteristic species include *Acer rubrum* (red maple), *Fraxinus Pennsylvania* (red ash), *Ulmus americana* (American elm), *U. rubra* (red elm), *Quercus palustris* (pin oak), *Q. bicolor* (swamp white oak), *Carya cordiformis* (bitternut hickory), *Salix nigra* (black willow), *S. sericea* (silky willow), *Viburnum recognitum* (northern arrow-wood), *Cornus amomum* (red-willow), *Lindera benzoin* (spicebush), *Vitis riparia* (frost grape), *Sambucus canadensis* (American elder), *Onoclea sensibilis* (sensitive fern), *Matteuccia struthiopteris* (ostrich fern), and *Polygonum* spp. This community type is part of the "River bed - bank -floodplain complex."

Related types: The other floodplain forest types, "Sycamore - (river birch) - box-elder floodplain forest" and "Silver maple floodplain forest" generally occur in areas that respond more quickly to changes in river level, and do not hold water for substantial periods of time following flooding.

Range: Entire state.

Selected references: Sneddon, Anderson, and Metzler 1996, Reschke 1990.

[Crosswalk: Smith's "Floodplain Swamp," TNC's *Acer (rubrum, saccharinum)* - *Ulmus americana* - *Quercus (bicolor, palustris)* Temporarily Flooded Forest Alliance, SAF's Silver maple - American elm (62).]



Chapter 3



Terrestrial Woodlands



Wayne County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.



Red spruce rocky summit, State Game Lands 57, Wyoming County. Photograph by Jean Fike.



CONIFEROUS TERRESTRIAL WOODLANDS

Pitch pine - heath woodland

This is a woodland community type that occurs on rocky ridge-tops, on sandy soils, or both. A similar type occurs on serpentinite-derived soils on the Piedmont (see related types section below). Soils for this community are acidic; conditions are dry. Trees are drought-stressed and of small stature. *Pinus rigida* (pitch pine) is usually the dominant tree, although in southern Pennsylvania, *P. virginiana* (Virginia pine), and *Pinus pungens* (Table-mountain pine) may accompany or replace *P. rigida*. *Pinus resinosa* (red pine) may also occur on some sites. Hardwoods may be present but do not contribute more than 25% of the tree layer. Hardwood associates include *Nyssa sylvatica* (black-gum), *Sassafras albidum* (sassafras), *Betula lenta* (sweet birch), *Quercus montana* (chestnut oak), *Q. coccinea* (scarlet oak), *Betula populifolia* (gray birch), and *Acer rubrum* (red maple). *Pinus strobus* (eastern white pine) may also occur but is not common. Various shrubs, mostly ericads, form a low shrub layer. Characteristic species include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Aronia melanocarpa* (black chokeberry), *Comptonia peregrina* (sweet-fern), *Gaultheria procumbens* (tea-berry), and *Kalmia angustifolia* (sheep laurel). Scattered *Q. ilicifolia* (scrub oak) may be present but is not dominant. Herbaceous species include *Pteridium aquilinum* (bracken fern), *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (a sedge), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (common hair-grass), *Melampyrum lineare* (cow-wheat), *Danthonia spicata* (poverty grass), *Lespedeza* spp. (bush-clovers), and *Aralia nudicaulis* (wild sarsaparilla). *Cladonia* spp. and *Cladina* spp. (reindeer lichens) are also very common. This community may occur as part of the "Ridgetop acidic barren complex."

Related types: This type may contain scattered *Q. ilicifolia* (scrub oak), but sites where *Q. ilicifolia* becomes the dominant shrub should be classified as "Pitch pine - scrub oak woodland". If the hardwood component of the canopy exceeds 25% relative cover, see the "Pitch pine - mixed hardwood woodland" type. The pine-dominated type here often occurs adjacent to and upslope of the more mixed type. On the Piedmont, on areas of serpentine geology, a similar dry pine type occurs with many of the same dominants. For sites in this ecoregion of unknown geology, please read both descriptions.

Range: Glaciated NE, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Illick and Aughanbaugh 1930, Schweitzer and Rawinski 1987.

[Crosswalk: Smith's "Ridgetop Dwarf-tree Forest" (in part), "Appalachian Sand Barren" (in part), TNC's *Pinus rigida* / *Vaccinium* Woodland Alliance, SAF's Pitch pine (45).]

Pitch pine - scrub oak woodland

This is a woodland community type that occurs on rocky ridge-tops, on sandy soils, or both. Soils for this community are acidic; conditions are dry. Trees are drought-stressed and of small stature. *Pinus rigida* (pitch pine) is usually the dominant tree, although in southern Pennsylvania, *P. virginiana* (Virginia pine), and *P. pungens* (Table-mountain pine) may accompany or replace *P. rigida*. *P. resinosa* (red pine) may also occur on some sites. Hardwoods may be present but do not contribute more than 25% of the tree layer. Hardwood associates include *Nyssa sylvatica* (black-gum), *Sassafras albidum* (sassafras), *Betula lenta* (sweet birch), *Quercus montana* (chestnut oak), *Q. coccinea* (scarlet oak), *B. populifolia* (gray birch), and *Acer rubrum* (red maple). *Pinus strobus* (eastern white pine) may also occur but is not common. *Quercus ilicifolia* (scrub oak) forms a dense understory. Various shrubs, mostly ericads, often form a low shrub layer. Characteristic species include *Gaylussacia baccata* (black huckleberry), *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Aronia melanocarpa* (black chokeberry), *Comptonia perigrina* (sweet-fern), and *Gaultheria procumbens* (teaberry). Herbaceous species include *Pteridium aquilinum* (bracken fern), *Carex pensylvanica* (Pennsylvania sedge), *C. communis* (a sedge), *Oryzopsis* spp. (ricegrass), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (common hairgrass), *Melampyrum lineare* (cow-wheat), *Danthonia spicata* (poverty grass), *Aristida dichotoma* (three-awn), and *Aralia nudicaulis* (wild sarsaparilla). This community may occur as part of the "Ridgetop acidic barren complex."

Related types: If the hardwood component of the canopy exceeds 25% relative cover, see the "Pitch pine - mixed hardwood woodland" type. The pine-dominated type here often occurs adjacent to and upslope of the more mixed type. If the shrub layer is dominated by ericaceous shrubs rather than *Quercus ilicifolia* (scrub oak), consult the description for the "Pitch pine - heath woodland."

Range: Glaciated NE, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Illick and Aughanbaugh 1930, Schweitzer and Rawinski 1987.



[Crosswalk: Smith's "Ridgetop Dwarf-tree Forest" (in part), "Appalachian Sand Barren" (in part), TNC's *Pinus rigida* / *Quercus ilicifolia* Woodland Alliance, *Pinus rigida*/ *Quercus ilicifolia*/ *Aronia melanocarpa* Community, SAF's Pitch pine (45).]

Red spruce rocky summit

This type is known in the state from only one example, in Wyoming County, Northeastern Pennsylvania. The site is north-facing on fractured bedrock at an elevation of about 2200 ft. Woody species occur in pockets of soil that have accumulated in cracks in the bedrock. There are extensive areas of bare or lichen-encrusted rock. Aside from *Picea rubens* (red spruce), tree species include *Betula populifolia* (gray birch), *Pinus rigida* (pitch pine), *P. resinosa* (red pine), *P. strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and *Acer rubrum* (red maple). Trees are small in stature and shaped by exposure to wind and ice. Shrubs include *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (lowbush blueberry), *Aronia melanocarpa* (black chokeberry), *Sorbus americana* (American mountain-ash), *Ilex montana* (mountain holly), and *Kalmia angustifolia* (sheep laurel). Herbaceous species include *Carex pensylvanica* (Pennsylvania sedge), *Carex communis* (a sedge), *Deschampsia flexuosa* (common hairgrass), *Maianthemum canadense* (Canada mayflower), and *Melampyrum lineare* (cow-wheat). *Cladonia* spp and *Cladina* spp. (reindeer lichens), and crustose lichens are abundant. This community type is part of the "Ridgetop acidic barrens complex."

Related types: The Pennsylvania example of this community type lacks the fir component of spruce balds found both farther north in the Adirondacks (balsam fir), and farther south in the Blue Ridge (Fraser fir).

Range: Glaciated NE.

Selected references: PNDI field surveys.

[Crosswalk: TNC's *Picea rubens* Woodland Alliance, *Picea rubens* — *Vaccinium angustifolium* Community, SAF's Red spruce (32).]

Pitch pine - rhodora - scrub oak woodland

This community is part of the "Mesic till barren complex." This is a unique group of communities restricted to the southern Pocono Plateau. The barren-like vegetation does not appear to be a response to droughty or nutrient-poor soils. The same deep, fine-loamy Illinoian till on which it occurs also underlies the adjacent forests (Latham et al. 1996). The origin of the barrens, and the processes responsible for their persistence and distribution are not known, but fire appears to be a critical factor.

Please see the description of the "Mesic till barrens complex" for more information. Included here are all areas of the complex with at least 10% cover by trees, mostly *Pinus rigida* (pitch pine) and *Acer rubrum* (red maple). *Rhododendron canadense* (rhodora) and *Quercus ilicifolia* (scrub oak), with a mixture of *Vaccinium angustifolium* (low sweet blueberry) and *Kalmia angustifolia* (sheep laurel), dominate the shrub layer. The most abundant species in the herbaceous and creeping shrub layer are *Carex pensylvanica* (Pennsylvania sedge), *Oryzopsis racemosa* (ricegrass), *Rubus hispidus* (swamp dewberry), *Pteridium aquilinum* (bracken fern), and *Gaultheria procumbens* (teaberry). Other species include *Amianthium muscaetoxicum* (fly-poison), *Aster umbellatus* (flat-topped aster), *Calamagrostis cinnoides* (reedgrass), and the globally rare species *Carex polymorpha*^s (variable sedge) and *Lygodium palmatum*^s (climbing fern).

Related types: This type is superficially similar to the much more common "Pitch pine - scrub oak woodland" type. Location, mesic soil conditions, and the importance of rhodora in the shrub layer distinguish this highly restricted community type. See the description of the "Mesic till barren complex" for a more detailed ecological description.

Range: Pocono Plateau.

Selected references: Davis et al. 1991, Latham et al. 1996.

[Crosswalk: Smith's "Mesic Scrub Oak - Heath - Pitch Pine Barrens" (in part), TNC's *Pinus rigida* Seasonally Flooded (sic.) Woodland Alliance, *Pinus rigida* - *Quercus ilicifolia* - *Rhododendron canadense* Community, SAF's Pitch pine (45).]

CONIFER - BROADLEAF TERRESTRIAL WOODLANDS

Pitch pine - mixed hardwood woodland

This community type occurs on dry, sandy, acidic soils. *Pinus rigida* (pitch pine) contributes between 25% and 75% relative cover. *Pinus pungens* (Table-mountain pine) or *P. resinosa* (red pine) may also occur on some sites. Hardwood associates include *Quercus montana* (chestnut oak), *Q. coccinea* (scarlet oak), *Q. velutina* (black oak), *Nyssa sylvatica* (black-gum), *Sassafras albidum* (sassafras), *Betula lenta* (sweet birch), *B. populifolia* (gray birch), and *Acer rubrum* (red maple). The shrub layer may be entirely composed of low shrubs like *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Comptonia perigrina*



(sweet-fern), and *Gaylussacia baccata* (black huckleberry), or may have an additional layer of taller shrubs like *Kalmia latifolia* (mountain laurel), *V. corymbosum* (highbush blueberry), and *Quercus ilicifolia* (scrub oak). Herbaceous species include *Pteridium aquilinum* (bracken fern), *Deschampsia flexuosa* (common hair-grass), *Danthonia spicata* (poverty grass), *Epigaea repens* (trailing arbutus), *Gaultheria procumbens* (teaberry), *Melampyrum lineare* (cow-wheat), *Carex pensylvanica* (Pennsylvania sedge), *C. communes* (a sedge), *Oryzopsis* spp. (ricegrass), *Aralia nudicaulis* (wild sarsaparilla). Lichens such as *Cladonia* spp. and *Cladina* spp. (reindeer lichens) are abundant in some areas. This community may occur as part of the "Ridgetop acidic barren complex."

Related types: This type is similar to and may grade into the "Pitch pine - scrub oak woodland" community. This type is distinguished from the pine type by having at least 25% of the tree stratum contributed by hardwoods. Likewise, this type is distinguished from the "Dry oak -heath woodland" community by its greater pine component—at least 25% relative cover. The canopy is generally less open than in the "Pitch pine - scrub oak woodland" type, and often occurs adjacent downslope of that type on somewhat less dry or more sheltered sites. See the "Ridgetop acidic barren complex" description for more information.

Range: Glaciated NE, Glaciated NW, Piedmont, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Illick and Aughanbaugh 1930, Schweitzer and Rawinski 1987.

[Crosswalk: Smith's "Ridgetop Dwarf-Tree Forest" (in part), TNC's *Quercus (coccinea, velutina) - Pinus rigida* Woodland Alliance, *Quercus (coccinea, velutina) - Pinus rigida - Schizachyrium scoparium* Community, SAF's Pitch pine (45).]

Virginia pine - mixed hardwood shale woodland

This community type occurs on dry (typically acidic) shale slopes with a more or less southerly exposure. Although the overall character is that of a woodland, there may be herbaceous openings and sparsely vegetated areas within the woodland matrix. *Pinus virginiana* (Virginia pine), sometimes in combination with *P. strobus* (eastern white pine), *Juniperus virginiana* (red-cedar), or *P. pungens* (Table-mountain pine), contributes between 25% and 75% relative cover. Hardwood associates include *Fraxinus americana* (white ash), *Quercus montana* (chestnut oak), *Q. rubra* (red oak), *Q. velutina* (black oak), *Q. stellata* (post oak), *Carya glabra* (pignut

hickory), *C. ovalis* (sweet pignut hickory), and *C. ovata* (shagbark hickory). The shrub layer includes such species as *Amelanchier arborea* (shadbush), *Gaylussacia baccata* (black huckleberry), *Vaccinium stamineum* (deerberry), and *Quercus ilicifolia* (scrub oak). The herbaceous layer is generally sparse; species include *Schizachyrium scoparium* (little bluestem), *Panicum linearifolium* (panic-grass), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty grass), *Deschampsia flexuosa* (hairgrass), *Penstemon hirsutus* (beard-tongue), *Heuchera americana* (alum-root), *Cunila origanoides* (common dittany), *Aster cordifolius* (blue wood aster), and *Hieracium venosum* (rattlesnake-weed). Lichens such as *Cladonia* spp. and *Cladina* spp. (reindeer lichens) are abundant in some areas.

Related types: The "Red-cedar - mixed hardwood rich shale woodland" type also occurs on steep shale slopes. This type generally has a sparser herbaceous layer, and tends to be less open. More data are needed on substrate chemistry, but it appears that this type is more typically associated with acidic shales.

Range: Ridge and Valley and maybe Glaciated NE.

Selected references: Berdine 1998, PNDI field surveys.

[Crosswalk: *Pinus virginiana* Woodland Alliance, and *Quercus (rubra, prinus) - Pinus (strobus, virginiana)* Woodland Alliance, SAF's Virginia pine - oak (78).]

Red-cedar - mixed hardwood rich shale woodland

This is a woodland community type occurring on steep, south-facing slopes of thinly bedded, often calcareous, weathering shales. These sites are actively eroding, and very dry, at least at the surface. Surface temperatures are seasonally extremely high. Although the overall aspect is that of a woodland, there may be herbaceous openings and sparsely vegetated areas within the woodland matrix. Characteristic trees include *Juniperus virginiana* (red-cedar), *Fraxinus americana* (white ash), *Quercus montana* (chestnut oak), *Q. muhlenbergii* (yellow oak), *Q. stellata* (post oak), *Carya ovata* (shagbark hickory), *C. glabra* (pignut hickory), and *C. ovalis* (sweet pignut hickory). Other characteristic woody species include *Rhus aromatics* (fragrant sumac), *Amelanchier arborea* (shadbush), *Celtis tenuifolia* (dwarf hackberry), *Rosa carolina* (pasture rose), *Rhus copallina* (shining sumac), and *Parthenocissus quinquefolia* (Virginia creeper). This community type is characterized by a relatively dense, diverse herbaceous layer. Herbaceous species include *Danthonia spicata* (poverty grass), *Deschampsia flexuosa* (common hairgrass), *Panicum linearifolium* (panic grass), *Andropogon gerardii* (big bluestem), *Schizachyrium*



scoparium (little bluestem), *Helianthus divaricatus* (rough sunflower), *Carex pensylvanica* (Pennsylvania sedge), *Phlox subulata* ssp. *subulata* (moss-pink), *Antennaria virginica*^s (shale-barren pussytoes), *Solidago bicolor* (silver-rod), *Hedyotis longifolia* (bluets), *Melica nitens*^s (tall melic grass), *Cunila organoides* (common dittany), and *Viola pedata* (birdfoot violet). Endemic or near-endemic species include *Oenothera argillicola*^s (shale-barren evening-primrose), *Phacelia dubia* (scorpion-weed), *Calystegia spithamea* spp. *purshiana* (low bindweed), *Senecio antennarifolius*^s (shale-barren ragwort), and *Trifolium virginicum*^s (Kate's-mountain clover). Lichens such as *Cladonia* spp. and *Cladonia* spp. (reindeer lichens) may be abundant on more exposed portions of these sites.

Related types: The "Red-cedar - prickly pear shale shrubland" also occurs on shale slopes, but in Pennsylvania is generally restricted to slopes above the Delaware River in the Northeastern part of the state, and lacks the endemic species which characterize this community type. The "Virginia pine - mixed hardwood shale woodland" type also occurs on shales, but is not generally as rich in endemic species as is this type. More research is needed on the relationship between substrate chemistry and vegetation on Pennsylvania shale barrens, but it appears that this type occurs on more base-rich shales than do the other two shale barren community types.

Range: Ridge and Valley.

Selected references: Berdine 1998, Dix 1990, Henry 1954, Platt 1951, Keener 1983, PNDI field surveys.

[Crosswalk: Smith's "Appalachian Shale Barren - Central Appalachian subtype," TNC's *Juniperus virginiana* - (*Fraxinus americana*, *Ostrya virginiana*) Woodland Alliance, *Juniperus virginiana* - *Fraxinus americana* - *Carya glabra* / *Carex pensylvanica* - *Chelianthes lanosa* Woodland, SAF's Eastern red-cedar (46).]

BROADLEAF TERRESTRIAL WOODLANDS

Dry oak - heath woodland

This community type occurs on dry, acidic soils. Dominant trees include *Quercus montana* (chestnut oak), *Q. coccinea* (scarlet oak), *Q. velutina* (black oak), *Nyssa sylvatica* (black-gum), *Sassafras albidum* (sassafras), *Betula lenta* (sweet birch), *Betula populifolia* (gray birch), and *Acer rubrum* (red maple). *Pinus strobus* (eastern white pine) and *P. rigida* (pitch pine) or occasionally other dry-site pines may be present but contribute less than 25% of the tree stratum. The structure of the shrub layer is variable; it may be composed entirely of low shrubs like *Vaccinium angustifolium* (low sweet blue-

berry), *V. pallidum* (lowbush blueberry), *Gaylussacia baccata* (black huckleberry), and *Comptonia peregrina* (sweet-fern), or there may be an additional layer of taller shrubs like *Kalmia latifolia* (mountain laurel), *Quercus ilicifolia* (scrub oak), and *V. corymbosum* (highbush blueberry). Typical herbaceous species include *Pteridium aquilinum* (bracken fern), *Carex pensylvanica* (Pennsylvania sedge), *C. communis* (a sedge), *Oryzopsis* spp. (ricegrass), *Maianthemum canadense* (Canada mayflower), *Aralia nudicaulis* (wild sarsaparilla), *Gaultheria procumbens* (teaberry), and *Epigaea repens* (trailing arbutus). This type often occurs downslope adjacent to the "Pitch pine - mixed hardwood woodland" type, or along lower ridgetops or on other dry sites. This community may occur as part of the "Ridgetop acidic barren complex."

Related types: This type often occurs along a soil-moisture gradient between the "Pitch pine - mixed hardwood woodland" type and the "Dry oak - heath forest" type. It is distinguished from the former by a lack of substantial conifer component (less than 25% relative cover) and from the latter by having an open canopy (less than 40% cover by trees).

Range: Glaciated NE, Glaciated NW, Piedmont, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Davis et al. 1990, 1991.

[Crosswalk: Smith's "Ridgetop Dwarftree Forest" (in part), TNC's *Quercus rubra* - *Quercus prinus* Woodland Alliance, SAF's parts of Chestnut oak (44), Northern red oak (55) and White oak - black oak - northern red oak (52).]

Birch (black-gum) rocky slope woodland

This community type most often occurs on talus, scree or other rocky slopes. Although most typical of slopes, it may also occur on benches, ridgetops, or boulderfields. Birch, usually *Betula lenta* (sweet birch) or less commonly *B. papyrifera* (paper birch), *B. populifolia* (gray birch), or *B. alleghaniensis* (yellow birch), is nearly always present. Either birch or *Nyssa sylvatica* (black-gum) may be dominant. Associated tree species include *Tsuga canadensis* (eastern hemlock), *Acer rubrum* (red maple), *Carya glabra* (pignut hickory), *Quercus montana* (chestnut oak), *Q. alba* (white oak), *Q. velutina* (black oak), and *Q. coccinea* (scarlet oak). Other woody species include *Kalmia latifolia* (mountain laurel), *Viburnum acerifolium* (maple-leaved viburnum), *Hamamelis virginiana* (witch hazel), *Ribes* spp., *Vitis* spp., *Toxicodendron radicans* (poison ivy), and *Parthenocissus quinquefolia* (Virginia-creeper). The herbaceous layer is



sparse; representative species include *Dryopteris marginalis* (common wood fern), *Polypodium virginianum* (rock polypody), *Woodsia obtusa* (blunt-lobed woodsia), and *Asplenium platyneuron* (ebony spleenwort). There are often rich bryophyte and lichen assemblages associated with these communities. The composition of this type is variable and often responds to aspect. On north-facing slopes, *Tsuga canadensis* (eastern hemlock) may become dominant. More information is needed to determine if such variation warrants additional types.

Related types: The "Black-gum ridgetop forest" may have an open canopy in places, but is characteristic of ridgetops rather than scree or talus slopes. Where the canopy is becoming closed, this type may grade into a variety of forest types.

Range: Pittsburgh Plateau, Ridge and Valley.

[Crosswalk: Smith's "Talus Slope Forest" - much modified, TNC - no crosswalk, SAF - no crosswalk.]

Yellow oak - redbud woodland

This community type represents the high-pH range of the moderately dry mixed oak woodlands. This woodland type is characterized by the consistent presence of calciphilic species. *Quercus muhlenbergii* (yellow oak) is nearly always present, often dominant or codominant. Associate tree species include *Quercus montana* (chestnut oak), *Q. alba* (white oak), *Nyssa sylvatica* (black-gum), *Acer saccharum* (sugar maple), *Fraxinus americana* (white ash), *Tilia americana* (basswood), *Carya ovalis* (sweet pignut hickory), *C. glabra* (pignut hickory), and *Juniperus virginiana* (red-cedar). Aside from *Cercis canadensis* (redbud), characteristic shrubs include *Ostrya virginiana* (hop-hornbeam), *Rhus aromatica* (fragrant sumac), *Celtis occidentalis* (hackberry), *Viburnum rafinesquianum* (downy arrowwood), and *Cornus florida* (flowering dogwood). Herbs include *Aquilegia canadensis* (wild columbine), *Senecio obovatus* (groundsel), *Bouteloua curtipendula* (side-oats gramma), and *Asclepias quadrifolia* (four-leaved milkweed).

Related types: In areas where the canopy becomes more open, this type may grade into the "Red cedar - redbud shrubland." Sufficiently large herbaceous openings may support the "Side-oat gramma grassland" or "Calcareous opening/cliff" types. As soil conditions become less dry and the canopy closes, this woodland type may grade into the "Dry oak - mixed hardwood forest" type.

Range: Pittsburgh Plateau, Ridge and Valley.

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Dry-Mesic Calcareous Central Forest," TNC's *Acer saccharum* - *Quercus muhlenbergii* Forest Alliance, SAF - no crosswalk.]

Great Lakes Region scarp woodland

This community type is specific to the extremely steep, actively eroding lakeshore-bluff and creek-wall slopes along Lake Erie. The dominant aspect is that of a woodland (between 10% and 60% cover by trees over 5 meters tall), although some sites are forested and others are more open. Physiognomic differences generally reflect different seral stages in this very dynamic system. Common woody species include *Acer saccharum* (sugar maple), *Carpinus caroliniana* (hornbeam), *Ostrya virginiana* (hop-hornbeam), *Juniperus virginiana* (red-cedar), *Salix* spp. (willows), *Rhus typhina* (staghorn sumac), *Cornus rugosa* (round-leaved dogwood), and *Amelanchier arborea* (shadbush). Herbaceous species include *Aster cordifolius* (heart-leaved aster), *Thalictrum dioicum* (early meadow rue), *Dryopteris marginalis* (marginal wood fern), *Equisetum arvense* (common horsetail), and the exotic species *Tussilago farfara* (coltsfoot). This community type has a somewhat different species composition on bluffs that front Lake Erie than on creek-wall scarps (Charles Bier, personal communication). More data are needed to determine if they warrant separation. This community type is part of the "Great Lakes Region scam complex."

Related types: The lake sediment scams also contain areas where the substrate is saturated by groundwater seepage. These areas are actively "slumping" and support a combination of herbaceous and woody vegetation. These small wetlands are described in the palustrine section under "Great Lakes Region scarp seep."

Range: Great Lakes Region.

Selected references: Kline 1993, PNDI field surveys.

[Crosswalk: Smith's "Eastern Great Lakes Bluff/Cliff Community," TNC - no crosswalk, SAF - no crosswalk.]

Great Lakes Region bayberry - cottonwood community (also a shrubland type)

In Pennsylvania this community type occurs only on Presque Isle. This community type is dominated by a mixture of trees and shrubs. Characteristic species include *Myrica pensylvanica* (bayberry), *Amelanchier* spp. (shadbush), *Salix* spp. (willows), *Cornus* spp. (dogwoods), *Populus deltoides* (cottonwood), and the exotic



species *Betula pendula* (European white birch) and *Lonicera morrowii* (Morrow's honeysuckle). Herbaceous species include *Sorghastrum nutans* (Indian grass), *Rumex acetosella* (sheep sorrel), *Panicum uirgatum* (switch grass), *Schizachyrium scoparium* (little bluestem), *Carex tonsa* (a sedge), and *C. muhlenbergii* (a sedge). This type includes both shrubland and woodland physiognomy. Because of the extremely dynamic nature of this system, a variety of successional stages are maintained in a complex mosaic. This community type is part of the "Great Lakes Region beach - dune - sandplain complex."

Related types: Because of the extremely dynamic nature of this system, the hydrology, physiognomy, and species composition of these sites may shift dramatically over short periods of time. Lake level changes, storm action, and shifting sands cause this community type to intergrade in space and time with the "Great Lakes Region dry sandplain," the "Great Lakes Region palustrine sandplain," "Great Lakes Region bayberry-mixed shrub palustrine shrubland" and, to a lesser extent, "Great Lakes Region sparsely vegetated beach." For more information on the ecology these community types, see the description of the "Great Lakes Region beach - dune - sandplain complex."

Range: Great Lakes Region.

Selected references: Bissell and Bier 1987.

[Crosswalk: Smith's "Eastern Great Lakes Dune Community," TNC - no crosswalk, SAF - no crosswalk (the Cottonwood (63) type is closest).]



Palustrine Woodlands



Titus Bog, Erie County. Photograph by Staff of The Western Pennsylvania Conservancy.



Rosencrans Bog Natural Area, Clinton County. Photograph by Staff of The Western Pennsylvania Conservancy.



CONIFEROUS PALUSTRINE WOODLANDS

Pitch pine - leatherleaf palustrine woodland

These wetlands occur on shallow peat over glacial till, often in burned-over areas, and/or in small basins. Scattered *Betula populifolia* (gray birch), *Pinus strobus* (eastern white pine), and *Acer rubrum* (red maple) may also occur, although *P. rigida* (pitch pine) is usually the dominant tree. *Chamaedaphne calyculata* (leatherleaf) generally forms a dense shrub layer. Other shrubs include *Aronia melanocarpa* (black chokeberry), *Vaccinium myrtilloides* (velvet-leaf blueberry), *Kalmia angustifolia* (sheep laurel), *Ledum groenlandicum*^s (Labrador tea), *Rhododendron canadense* (rhodora), *Gaylussacia baccata* (black huckleberry), and *V. corymbosum* (highbush blueberry). There is a sphagnum layer beneath, often with *Vaccinium macrocarpon* (cranberry).

Related types: Although *Rhododendron canadense* (rhodora) often occurs in these wetlands, this community type may be distinguished from the much rarer "Pitch pine - rhodora - scrub oak woodland" by its hydrology (this type is a wetland, the mesic till types are not) as well as by species composition. See the description of the "Mesic till barren complex" for more information on the ecology of mesic till barrens.

Range: Glaciated NE, Pocono Plateau.

Selected references: Reschke 1990.

[Crosswalk: TNC's *Pinus rigida* Saturated Woodland Alliance, *Pinus rigida* / *Chamaedaphne calyculata* / *Sphagnum* spp. Community, SAF's Pitch pine (45).]

Black spruce - tamarack palustrine woodland

This is a peatland community type that occurs in both glaciated and non-glaciated areas. Tree cover totals between 10% and 60%. *Picea mariana* (black spruce) and *Larix laricina* (tamarack) are usually both present in some amount, at least one dominating or co-dominating the tree stratum. Other trees commonly include *Abies balsamea* (balsam fir), *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), and *Acer rubrum* (red maple). Shrubs include *Chamaedaphne calyculata* (leatherleaf), *Kalmia angustifolia* (sheep laurel), *Alnus incana* (speckled alder), *Aronia melanocarpa* (black chokeberry), *Vaccinium myrtilloides* (velvet-leaf berry), *V. corymbosum* (highbush blueberry), *Ledum groenlandicum*^s (Labrador tea), *Rhododendron viscosum* (swamp azalea), *Kalmia polifolia* (bog laurel), *V. macrocarpon* (cranberry), and *Nemopanthus mucronatus* (mountain holly). Herbs include *Rhynchospora alba* (white beak-rush), *Thelypteris palustris* (marsh fern),

Drosera intermedia (spatulate-leaved sundew), *D. rotundifolia* (round-leaved sundew), *Sarracenia purpurea* (pitcher-plant), *Eriophorum uirginicum* (tawny cotton-grass), *E. uaginatum* spp. *spissum* (cotton-grass), *Carex canescens* (a sedge), *C. trisperma* (a sedge), and *C. folliculata* (a sedge). The bryophyte layer is well developed and dominated by sphagnum. This community type may occur as part of the "Acidic glacial peatland complex."

Related types: This type is closely related to the "Black spruce - tamarack peatland forest" type, which may accompany it. The distinction between the two is the percent canopy cover; the forested type typically has greater than 60% cover by trees, the woodland type less.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: Crum 1992, PNDI field surveys.

[Crosswalk: Smith's "Non-Glacial Bog" (in part), "Oligotrophic Kettlehole Bog" (in part), TNC's *Picea mariana* Saturated Woodland Alliance, *Picea mariana* / *Ledum groenlandicum* / *Sphagnum* spp. Community, SAF's Black spruce - tamarack (13).]

Red spruce palustrine woodland

These wetlands tend to be small in size, or may occur as part of a structurally diverse wetland complex. The substrate is usually sphagnum peat. *Picea rubens* (red spruce) is always present in some amount and is often dominant or codominant; the most common associate trees are *Acer rubrum* (red maple) and *Betula populifolia* (gray birch). Common shrub species include *Vaccinium corymbosum* (highbush blueberry), *Nemopanthus mucronatus* (mountain holly), and *Lyonia ligustrina* (maleberry). Characteristic herbs include *Eriophorum vaginatum* ssp. *spissum* (a cotton-grass), and *E. virginicum* (tawny cotton-grass), *Carex folliculata*, *C. trisperma*, and other sedges, *Osmunda cinnamomea* (cinnamon fern), and *Smilacina trifolia* (false Solomon's seal). The bryophyte layer is usually well developed and dominated by sphagnum.

Related types: This type is closely related to the "Red spruce palustrine forest" type, which may accompany it. The distinction between the two is the percent canopy cover; the forested type typically has greater than 60% cover by trees, the woodland type less.

Range: Glaciated NE, Pocono Plateau.

Selected references: Sneddon, Anderson, and Metzler 1996.



[Crosswalk: Smith's "Boreal Conifer Swamp" (in part), TNC's (Southeast Region) *Picea rubens* Saturated Woodland Alliance, SAF's Red spruce (32).]

BROADLEAF PALUSTRINE WOODLANDS

Red maple - highbush blueberry palustrine woodland

This community type usually occurs on mineral soil often with a layer of muck (occasionally occurs on peat). These woodlands may occur as isolated pockets in small depressions or as part of larger wetland complexes, and are often associated with past impoundment (beaver or other). This type is most typical of northern portions of the state. *Acer rubrum* (red maple) *Nyssa sylvatica* (black-gum), and *Betula populifolia* (gray birch) are the most common trees, although other species may also be present, including *Pinus strobus* (eastern white pine), *P. rigida* (pitch pine), *Betula alleghaniensis* (yellow birch), *Tsuga canadensis* (eastern hemlock), *Larix laricina* (tamarack), and *Picea rubens* (red spruce). The most characteristic shrub species is *Vaccinium corymbosum* (highbush blueberry). Other shrubs that commonly occur are *Rhododendron viscosum* (swamp azalea), *Alnus incana* (speckled alder), *Gaylussacia baccata* (black huckleberry), *Lyonia ligustrina* (maleberry), *Nemopanthus mucronatus* (mountain holly), *Viburnum cassinoides* (withered), *V. recognitum* (arrow-wood), *Spiraea latifolia* (meadow-sweet), *S. tomentosa* (hardhack), *Sambucus canadensis* (American elder), and *Ilex verticillata* (winterberry). Herbaceous species include *Carex stricta* (tussock-sedge), *C. folliculata* (a sedge), *Juncus effusus* (soft rush), *Glyceria* spp. (mannagrass), *Dulichium arundinaceum* (three-way sedge), *Eleocharis palustris* (creeping spike-rush), *Triadenum virginicum* (marsh St.-John's-wort), and *Osmunda cinnamomea* (cinnamon fern).

Related types: This type lacks the thick sedge layer that typifies the "Red maple - sedge palustrine woodland" community type, and the associate species are generally more northern. The "Red maple - mixed shrub palustrine woodland" type is also similar, but occurs in less acidic situations, is more typical of non-glaciated regions, and has a generally more southern suite of shrub and herbaceous species.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Ridge and Valley.

Selected references: Golet et al. 1993, Metzler and Tiner 1991, PNDI field surveys.

[Crosswalk: Smith's "Acidic shrub swamp" (in part), "Broadleaf-conifer swamp" (in part), TNC's *Vaccinium corymbosum* Shrubland Alliance, SAF's Red maple (108).]

Red maple - sedge palustrine woodland

This type typically occurs in areas of past impoundment (often by beaver). *Acer rubrum* (red maple) is often the only tree species, although scattered *Nyssa sylvatica* (black-gum), *Pinus strobus* (eastern white pine), *Tsuga canadensis* (eastern hemlock), *Betula* spp. (birch), *Quercus bicolor* (swamp white oak), *Q. palustris* (pin oak), and others may also occur. There are frequently numerous snags and stumps of trees drowned out by fluctuating water levels. Depending on the condition of the dam and time since impoundment, the area may be very wet, with areas of open water, to nearly dry. Typically there is a thick sedge layer, with a pronounced tussock/hummock microtopography with live or dead trees on many of the larger hummocks. The shrub layer is variable; it may be dense, especially at the upland border, to nearly absent. Some of the possible shrub species are *Alnus incana* (speckled alder), *Vaccinium corymbosum* (highbush blueberry), *Ilex verticillata* (winterberry), *Chamaedaphne calyculata* (leatherleaf), *Spiraea latifolia* (meadow-sweet), *S. tomentosa* (hardhack), *Salix sericea* (silky willow), *Viburnum recognitum* (arrow-wood), *Cornus amomum* (red-willow), and *Sambucus canadensis* (American elder). The herbaceous layer is strongly dominated by sedges; the most common species is *Carex stricta* (tussock sedge), although other species (e.g. *C. lurida*, *C. intumescens*, *C. canescens*, *C. stipata*, and *C. tribuloides*) may also occur. Other herbaceous species include *Calamagrostis canadensis* (Canada bluejoint), *Agrostis scabra* (hairgrass), *Juncus* spp. (rushes), *Dulichium arundinaceum* (three-way sedge), and *Triadenum virginicum* (marsh St.-John's-wort), and in wetter areas, *Peltandra virginica* (arrow-arum), *Sagittaria latifolia* (arrowhead), and *Caltha palustris* (marsh marigold).

Related types: This type differs from the "Red maple - mixed shrub palustrine woodland" type in that it has a thick, sedge-dominated herbaceous layer and a less well-developed shrub layer.

Range: Entire state.

Selected references: Golet et al. 1993, Metzler and Tiner 1991, PNDI field surveys.

[Crosswalk: Smith's "Acidic Broadleaf Swamp" (in part), TNC's *Acer rubrum* - *Carex stricta* Saturated Woodland Alliance, SAF's Red maple (108).]

Red maple - mixed shrub palustrine woodland

This community type usually occurs on mineral soil with a thin layer of muck. The pH is somewhat acidic to circumneutral. *Acer rubrum* (red maple) dominates



the tree stratum, sometimes with a mixture of other trees such as *Nyssa sylvatica* (black-gum), *Tsuga canadensis* (eastern hemlock), *Pinus strobus* (eastern white pine), *Salix nigra* (black willow), *Quercus bicolor* (swamp white oak), *Q. palustris* (pin oak), and *Fraxinus nigra* (black ash). Shrubs include *Corpus amomum* (red-willow), *Ilex verticillata* (winterberry), *Lindera benzoin* (spicebush), *Alnus serrulata* (smooth alder), *Salix sericea* (silky willow), *Rosa palustris* (swamp rose), and *Cephalanthus occidentalis* (buttonbush). Ferns usually dominate the herbaceous layer. Characteristic species include *Thelypteris palustris* (marsh fern), *Osmunda cinnamomea* (cinnamon fern), *Onoclea sensibilis* (sensitive fern), *Dryopteris cristata* (crested shield fern), and *O. regalis* (royal fern). Other herbs include *Symplocarpus foetidus* (skunk-cabbage), *Bidens* spp. (beggar-ticks), *Impatiens* spp. (jewelweeds), and in wetter areas, *Peltandra virginica* (arrow-arum), *Sagittaria latifolia* (arrowhead), and *Caltha palustris* (marsh marigold).

Related types: This type differs from the "Red maple - sedge palustrine woodland" in that the latter type has a heavily sedge-dominated herbaceous layer. The "Red maple - highbush blueberry palustrine wetland" is also similar, but occurs in more acidic situations, is more typical of glaciated regions, and has a more northern suite of shrub and herbaceous species.

Range: Entire state, but more typical of southern Pennsylvania.

Selected references: Golet et al. 1993, Metzler and Tiner 1991.

[Crosswalk: Smith's "Circumneutral Shrub Swamp" (in part), "Circumneutral Broadleaf Swamp" (in part), TNC's *Acer rubrum* - *Fraxinus nigra* Saturated Forest Alliance, SAF's Red maple (108).]



*T*errestrial Shrublands



*B*ald Mountain, Carbon County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.



*M*oosic Mountain, Lackawanna County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy



CONIFEROUS TERRESTRIAL SHRUBLANDS

Red-cedar - prickly pear shale shrubland

This community type is restricted to steep, south-facing, eroding slopes composed of thinly bedded, fissile shales. The most representative examples occur along the Delaware River in Pike County. There may be species overlap with the "Red cedar - mixed hardwood rich shale woodland" community type that also occurs on south-facing shale slopes, but examples of this type occur on steeper slopes and lack endemic shale barren species. Typical species here include *Juniperus virginiana* (red-cedar), *Schizachyrium scoparium* (little bluestem), *Opuntia humifusa*^s (prickly pear), *Quercus ilicifolia* (scrub oak), *Q. montana* (chestnut oak), *Gaylussacia baccata* (black huckleberry), *Carya glabra* (pignut hickory), *Carex pensylvanica* (Pennsylvania sedge), *Hieracium venosum* (rattlesnake-weed), *Hypericum gentianoides* (orange-grass), *Danthonia spicata* (poverty grass), *Deschampsia flexuosa* (common hairgrass), *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Campanula rotundifolia* (harebell), *Arabis lyrata* (lyre-leaved rock-cress), *Aster patens* (clasping aster), *Corydalis semperuirens* (rock harlequin), *Solidago nemoralis* (gray goldenrod), *Polytrichum* spp. (hairy-cap moss), *Cladina* spp., and *Cladonia* spp. (reindeer lichens).

Related types: The "Red cedar - mixed hardwood rich shale woodland" type also occurs on shale slopes, but is more southerly in distribution and, unlike this type, is characterized by the presence of shale barren endemics.

Range: Ridge and Valley.

Selected references: Dix 1990, Henry 1954, Keener 1983, Platt 1951, PNDI field surveys.

[Crosswalk: "Smith's Northern Appalachian Shale Barren," TNC's *Juniperus virginiana* - *Fraxinus americana* Woodland Alliance, *Juniperus virginiana* - *Fraxinus americana* / *Senecio antennarifolius* - *Oenothera argillicola* Community.]

Red-cedar - pine serpentine shrubland

This community is part of the "Serpentine barren complex." It is restricted to areas underlain by serpentinite bedrock. It is this part of the serpentine barren complex that supports a dense, prairie-like graminoid cover with scattered trees and shrubs. Although the most typical aspect is that of a shrubland, some examples of this community type may have a woodland physiognomy. The dominant tree species, often less than 5 meters in height, are *Juniperus virginiana* (red-cedar), *Pinus rigida* (pitch pine), *Pinus virginiana* (Virginia pine), and *Robinia*

pseudoacacia (black locust). Other trees include *Quercus marilandica* (blackjack oak), *Q. stellata* (post oak), and *Sassafras albidum* (sassafras). Shrubs include *Rhus copallina* (shining sumac), *Quercus prinoides* (chinquapin oak), *R. glabra* (smooth sumac), and *Gaylussacia baccata* (black huckleberry). Characteristic herbaceous species include graminoids like *Schizachyrium scoparium* (little bluestem), *Andropogon gerardii* (big bluestem), *Sporobolus heterolepis*^s (prairie dropseed), *Panicum depauperatum*^s (poverty panic-grass), *Sporobolus vaginiflorus* (poverty grass), *Aristida longispica* (slimspike three-awn), *A. purpurascens*^s (arrow-feather), *A. dichotoma* (churchmouse three-awn), *Muhlenbergia mexicana* (satin grass), *Setaria geniculata* (knotroot fox-tail), *Eragrostis spectabilis* (purple lovegrass), *Scleria pauciflora*^s (few-flowered nut-rush), *Sorghastrum nutans* (Indian grass), and *Bouteloua curtipendula*^s (side-oats gramma), and forbs like *Aster depauperatus*^s (serpentine aster), *Potentilla canadensis* (old-field cinquefoil), *Phlox subulata* ssp. *subulata* (creeping phlox), *Cerastium arvense* var. *uillosissimum*^s (barrens chickweed), *Achillea millefolium*ⁱ (yarrow), *Eupatorium aromaticum* (small white snakeroot), *Oenothera fruticosa* (sundrops), *Senecio anonymus*^s (plain ragwort), *Solidago nemoralis* (gray goldenrod), and *Antennaria plantaginifolia* (plantain pussytoe).

Related types: This community may be said to end either where woody cover of at least 25% ends (here the "Serpentine barren grassland community" generally begins), or where trees exceed 5 meters in height and the tree canopy reaches about 60% total cover, becoming sufficiently continuous to prohibit dense graminoid cover (here the "Serpentine Virginia pine-oak" or "Serpentine pitch pine - oak forest" generally begins). This type often grades into the one of the serpentine forest types downslope on somewhat deeper soils. This community shares many dominants with both the "Pitch pine - scrub oak woodland" and "Pitch pine - mixed hardwood woodland." The distinction lies in the less common species present in the serpentine type (e.g. *Sporobolus heterolepis*, *Panicum depauperatum*, *Bouteloua curtipendula*^s) and the geology itself. This community is associated with several more distinctive community types that are found exclusively on areas of serpentine geology. For a list of those types, and a brief discussion of serpentine ecology, please see the description of the "Serpentine barren complex."

Range: Piedmont.

Selected references: Brooks 1987, Latham 1992, Miller 1977, Smith 1988.

[Crosswalk: Smith's "Eastern Serpentine Barren" (in part), TNC's *Pinus (virginiana, rigida)* / *Schizachyrium*



scoparium Herbaceous Alliance, *Pinus virginiana* - *Pinus rigida* / *Schizachyrium scoparium* - *Scleria pauciflora* Community.]

CONIFER - BROADLEAF TERRESTRIAL SHRUBLANDS

Red-cedar - redbud shrubland

This community type occurs in areas of calcareous parent material, where conditions are dry enough to prevent forest development (may also occur successional on calcareous sites that are less extreme). *Juniperus virginiana* (red-cedar) and *Cercis canadensis* (redbud) are both characteristic of these sites. Other shrubs commonly present include *Ostrya virginiana* (hop-hornbeam), *Amelanchier* spp. (shadbush), *Rhus aromatica* (fragrant sumac), and *Cornus florida* (flowering dogwood). Characteristic herbaceous species include *Bouteloua curtipendula*^s (tall gramma), *Andropogon gerardii* (big bluestem), *Panicum virgatum* (switch grass), *Sorghastrum nutans* (Indian grass), *Aster oblongifolius* (aromatic aster), *Lithospermum latifolium*^s (American gromwell), and *Aquilegia canadensis* (wild columbine).

Related types: This community type is closely related to both the "Yellow oak - redbud woodland" type and the "Side-oats gramma calcareous grassland" type. The three types are easily distinguished from each other on the basis of physiognomy. All three may occur together on some sites.

Range: Allegheny Mountain, Piedmont, Pittsburgh Plateau, Ridge and Valley.

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Northern Appalachian Calcareous Rocky Summit Community," TNC's *Juniperus virginiana* - *Fraxinus americana* Woodland Alliance, *Juniperus uirginiana* - *Ostrya virginiana* - *Bouteloua curtipendula* Community and *Quercus muhlenbergii* Woodland Alliance, *Quercus muhlenbergii* - *Cercis canadensis* / *Senecio obovatus* - *Lithospermum canadense* Community.]

BROADLEAF TERRESTRIAL SHRUBLANDS

Low heath shrubland

This community type occurs on either sandy soil or on thin soil over bedrock. Soils are acidic, moisture availability is low. This type most commonly occurs on ridgetops or in other situations where exposure to the elements; the frost-pocket phenomenon, or droughty conditions limits the establishment of trees and taller shrubs. These sites are often subject to periodic fire.

The dominant species are *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Kalmia angustifolia* (sheep laurel), *Aronia melanocarpa* (black chokeberry), and/or *Gaylussacia baccata* (huckleberry). Scattered small trees may occur in some places, for example where soil has accumulated in cracks in the bedrock. Typical species include *Pinus rigida* (pitch pine), *P. strobus* (eastern white pine), *Populus tremuloides* (quaking aspen), and *Betula populifolia* (gray birch). The herbaceous and creeping shrub layer includes such species as *Danthonia compressa* (northern oatgrass), *D. spicata* (poverty grass), *Lysimachia quadrifolia* (whorled loosestrife), *Melampyrum lineare* (cow-wheat), *Deschampsia flexuosa* (hairgrass), *Rubus hispidus* (swamp dewberry), *Mitchella repens* (partridge-berry), *Pteridium aquilinum* (bracken), *Schizachyrium scoparium* (little bluestem), *Carex pennsylvanica* (Pennsylvania sedge), *C. communis* (a sedge), and *Gaultheria procumbens* (teaberry). Moss and lichen cover on rocks may be considerable; more information is needed on non-vascular species. This community may occur as part of the "Ridgetop acidic barren complex."

Related types: The "Scrub oak shrubland" and "Pitch pine - scrub oak woodland" types frequently occur adjacent to this type, usually downslope, on slightly deeper soils, or in less exposed areas.

Range: Glaciated NE, Glaciated NW, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau, and perhaps South Mountain.

Selected references: Clark 1946, Hough 1945, Schege and Butch 1980.

[Crosswalk: Smith's "Northern Appalachian Low Elevation Acidic Rocky Summit." and "Ridgetop Dwarf-Tree Forest" (in part), TNC's *Vaccinium (myrtilloides, pallidum, angustifolium)* Dwarf-Shrubland Alliance, *Vaccinium (myrtilloides, pallidum, angustifolium)* high Alleghenies (HAL) Community.]

Low heath - mountain ash shrubland

This community type occurs at high elevations, usually on a thin soil layer over bedrock. Scattered trees may occur in pockets of deeper soil. Characteristic tree species include *Pinus strobus* (eastern white pine), *Betula populifolia* (gray birch), *Acer rubrum* (red maple), *Quercus montana* (chestnut oak), and rarely *Picea rubens* (red spruce). The most characteristic shrub species are *Vaccinium pallidum* (lowbush blueberry) and *Sorbus americana* (mountain ash), although *V. angustifolium* (low sweet blueberry), *Kalmia angustifolia* (sheep laurel), *Gaylussacia baccata* (huckleberry), *Aronia melanocarpa* (black chokeberry) also commonly occur.



Herbaceous species include *Potentilla tridentata*^S (three-toothed cinquefoil), *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* (hairgrass), *Minuartia glabra*^S (Appalachian sandwort), *Campanula rotundifolia* (harebell), and *Lilium philadelphicum* (wood lily). Moss and lichen cover on rocks may be considerable; more information is needed on non-vascular species. This community type may occur as part of the "Ridgetop acidic barrens complex."

Related types: The "Low heath shrubland" is more common than this type and typically occurs at lower elevations than this does. A species mix reflecting a more northern affinity, and specifically the presence of *Sorbus americana* (mountain ash), may be used to distinguish this type. The "Red spruce rocky summit" community type occurs in similar situations, but is much less common in Pennsylvania, with only one known example at the time of writing. Dominance or codominance by *Picea rubens* (red spruce) distinguishes the rarer type from that described here.

Range: Glaciated NE, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: PNDA field surveys, Sneddon, Anderson and Metzler 1996.

[Crosswalk: Smith's "Northern Appalachian High Elevation Acidic Rocky Summit," TNC's *Vaccinium (myrtilloides, pallidum, angustifolium)* Dwarf-Shrubland Alliance, *Vaccinium angustifolium - Sorbus americana* Community.]

Scrub oak shrubland

This community type occurs either on sandy soils or on thin soils over bedrock. Conditions are dry; soils are acidic. It most commonly occurs on rocky ridgetops. In this case, it may be part of the "Ridgetop barren complex." It also may occur on sites where frequent or recent disturbance has removed the tree layer. This type also includes most of what is referred to as "Sand barrens." Sand barrens are areas of sandy (Morrison series) infertile soils that form extensive, gently rolling expanses of mostly scrub oak with occasional patches of blueberries ("Low heath shrubland") and grassy frost pockets ("Little bluestem / Pennsylvania sedge grassy opening"). Sand barrens in Pennsylvania are found primarily in Huntingdon and Centre counties.

Quercus ilicifolia (scrub oak) is by far the dominant shrub species, although low shrubs like *Vaccinium angustifolium* (low sweet blueberry), *V. pallidum* (lowbush blueberry), *Gaultheria procumbens* (teaberry), *Kalmia angustifolia* (sheep laurel), *Gaylussacia baccata* (black huckleberry), *Salix humilis* (dwarf upland willow),

Prunus pumila var. *susquehanae*^S (Appalachian sand cherry), and *Comptonia peregrina* (sweet-fern) sometimes occur beneath the taller shrub stratum. Tree species may occur as scattered individuals or as small patches of woodland. Characteristic tree species include *Populus tremuloides* (quaking aspen), *Quercus prinoides* (chinquapin oak), and *Pinus rigida* (pitch pine). Herbs include *Danthonia compressa* (northern oatgrass), *Pteridium aquilinum* (bracken), *Melampyrum lineare* (cow-wheat), *Andropogon gerardii* (big bluestem), *Schizachyrium scoparium* (little bluestem), and *Hypericum gentianoides* (orange-grass). This community type may occur as part of the "Ridgetop acidic barrens complex."

Related types: The "Pitch pine - scrub oak woodland" type frequently occur in association with this community type; the two may be delineated at the physiognomic cutoff for woodlands: 10% cover by trees greater than five meters high.

Range: Glaciated NE, Pittsburgh Plateau, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Slack et al. 1991.

[Crosswalk: Smith's "Northern Appalachian Sand Barren" (in part), "Ridgetop Dwarf-Tree Forest" (in part), TNC's *Quercus ilicifolia* Shrubland Alliance.]

Rhodora - mixed heath - scrub oak shrubland

This is a very rare, highly restricted community type. It is known only from the southern Pocono Plateau. This barren-like vegetation does not appear to be a response to droughty or nutrient-poor soils. The same deep, fine-loamy Illinoian till on which it occurs also underlies nearby forests (Latham et al. 1997). The origin of the barrens, and the processes responsible for their persistence and distribution are not known, but fire appears to be a critical factor. Please see the description for the "Mesic till barrens complex" for more information. The shrub layer is dominated by a combination of *Quercus ilicifolia* (scrub oak), *Kalmia angustifolia* (sheep laurel), *Rhododendron canadense* (rhodora), and *Vaccinium angustifolium* (low sweet blueberry), often with just one or two of these species in much greater abundance than the others, with an admixture of *Aronia melanocarpa* (black chokeberry), *Gaylussacia baccata* (black huckleberry), *V. pallidum* (lowbush blueberry), and *Viburnum cassinoides* (withe-rod). Other shrub species commonly include *Amelanchier sanguinea*^S (round serviceberry), *A. stolonifera* (low juneberry), *Chamaedaphne calyculata* (leatherleaf), *Comptonia peregrina* (sweet-fern), *Gaylussacia frondosa* (dangleberry), *Hamamelis*



Virginiana (witch-hazel), *Lyonia ligustrina* (maleberry), *Spiraea latifolia* (meadow-sweet), *Vaccinium corymbosum* (highbush blueberry), *Viburnum myrtilloides* (sour-top blueberry), and *V. stamineum* (deerberry). Scattered trees may be present, mostly *Pinus rigida* (pitch pine) and *Acer rubrum* (red maple). The most abundant species in the herbaceous and creeping shrub layer are *Carex pensylvanica* (Pennsylvania sedge), *Pteridium aquilinum* (bracken fern), *Gaultheria procumbens* (teaberry), *Oryzopsis racemosa* (ricegrass) and *Rubus hispidus* (dewberry). This is part of the “Mesic till barren complex.”

Related types: This type usually occurs in combination with the “Pitch pine – rhodora – scrub oak woodland” type. These two types, together with small herbaceous openings or “frost pockets” constitute the “Mesic till barren complex.” For more information on the ecology of these systems, consult the description of the complex. This community type and its associated complex share many species with several community types belonging to the “Acidic ridgetop barren complex.” The predominance of *Rhododendron canadense* (rhodora), the presence of deep, mesic soils and the restricted distribution of this type easily distinguish it from its ridgetop counterpart.

Range: Pocono Plateau

Selected references: Latham et al. 1996

[**Crosswalk:** Smith’s “Mesic Scrub Oak – Heath – Pitch Pine Barrens” (in part), TNC’s *Pinus rigida* Seasonally Flooded (sic.) Woodland Alliance, *Pinus rigida* – *Quercus ilicifolia* – *Rhododendron canadense* Community.]

Great Lakes Region bayberry – cottonwood community (also a woodland type)

In Pennsylvania this community type occurs only on Presque Isle. This community type is dominated by a mixture of trees and shrubs. Characteristic species include *Myrica pensylvanica* (bayberry), *Amelanchier* spp. (shadbush), *Salix* spp. (willows), *Cornus* spp. (dogwoods), *Populus deltoids* (cottonwood), and the exotic species *Betula pendula* (European white birch) and *Lonicera morrowii* (Morrow’s honeysuckle). Herbaceous species include *Sorghastrum nutans* (Indian grass), *Rumex acetosella* (sheep sorrel), *Panicum virgatum* (switch grass), *Schizachyrium scoparium* (little bluestem), *Carex tonsa* (a sedge), and *C. muhlenbergii* (a sedge). This type includes both shrubland and woodland physiognomy. Because of the extremely dynamic nature of this system, a variety of successional stages is maintained in a complex mosaic. This community type is part of the “Great Lakes Region beach – dune – sandplain complex.”

Related types: Because of the extremely dynamic nature of this system, the hydrology, physiognomy, and species composition of these sites may shift dramatically over short periods of time. Lake level changes, storm action, and shifting sands cause this community type to intergrade in space and time with the “Great Lakes Region dry sandplain,” the “Great Lakes Region bayberry – mixed shrub palustrine shrubland,” and, to a lesser extent, “Great Lakes Region sparsely vegetated beach.” For more information on the ecology of this system, please see description for the “Great Lakes region beach – dune – sandplain complex.”

Range: Great Lakes Region.

Selected references: Bissell and Bier, 1987.

[**Crosswalk:** Smith’s “Eastern Lakes Dune Community,” TNC – no crosswalk.]



Palustrine Shrublands



*L*eatherleaf - bog rosemary peatland, Wayne County.
Photograph by Tony Davis



*P*ine Lake Natural Area, Delaware State
Forest, Pike County. Photograph by Jean Fike.



BROADLEAF PALUSTRINE SHRUBLANDS

Buttonbush wetland

These wetlands are characterized by prolonged or semipermanent flooding. The substrate may be organic or mineral soil. This community type may occur in shallow water along lake or pond shores, associated with river systems in oxbows, in wet swales or along floodplains, or in upland depressions. In some cases, this community represents a zone of vegetation between forest on the upland side and herbaceous vegetation downslope. Other shrubs, such as *Decodon verticillatus* (water-willow), *Rhododendron viscosum* (swamp azalea), *Corpus amomum* (red-willow), *C. sericea* (red-osier dogwood), *Salix sericea* (silky willow), *S. eriocephala* (heart-leaved willow), *Sambucus canadensis* (American elder), *Vaccinium corymbosum* (highbush blueberry), and *Acer rubrum* (red maple) seedlings and saplings may occur, but *Cephalanthus occidentalis* (buttonbush) is usually a clear dominant. Characteristic herbs include *Dulichium arundinaceum* (three-way sedge), *Triadenum virginicum* (marsh St.-John's-wort), *Lycopus uniflorus* (bugleweed), *Nuphar lutea* (spatterdock), *Polygonum hydropiperoides* (mild water-pepper), *P. punctatum* (dotted smartweed), *P. amphibium* (water smartweed), *Proserpinaca palustris* var. *crebra* (mermaid-weed), *Carex lurida* (a sedge), *C. uesicaria* (a sedge), *Scirpus cyperinus* (woolgrass), *Woodwardia virginica* (Virginia chain fern), and *Thelypteris palustris* (marsh fern).

Related types: The "Alder - ninebark wetland" type below may also contain *Cephalanthus*. The two communities are distinguished by a clear dominance of buttonbush in the case of the former. The "Alder - ninebark wetland" type is typically more mixed, with either *Alnus* spp. (alder) and or *Physocarpus opulifolius* (ninebark) dominant or codominant.

Range: Entire state.

Selected references: Jennings 1927, Metzler and Tiner 1992, PNDI field surveys.

[Crosswalk: Smith's "Circumneutral Shrub Swamp" (in part), TNC's *Cephalanthus occidentalis* Shrubland Alliance.]

Alder - ninebark wetland

These are shrub swamps dominated by *Alnus serrulata* (smooth alder) or *A. incana* (speckled alder) and /or *Physocarpus opulifolius* (ninebark). The pH of these systems is broadly circumneutral to somewhat calcareous, and calciphiles may be present. These communities may occur at the upland edge of marshes, at the wetter edge of red maple wetlands, in small upland depressions, or at

the base of slopes. The substrate is generally mineral soil with a thin organic layer, although it may occasionally occur on shallow peat. In Pennsylvania, many of these are beaver influenced or otherwise impounded systems. Grazing (past or present) may also be a factor. The species composition is variable, and dominance may be shared by any of the associate shrubs, which may include *Salix* spp. (willows), *Sambucus canadensis* (American elder), *Cornus amomum* (red-willow), *Rhododendron viscosum* (swamp azalea), *Decodon verticillatus* (water-willow), *Cephalanthus occidentalis* (buttonbush), *Ilex verticillata* (winterberry), and seedling/sapling size *Acer rubrum* (red maple). Herbaceous species include *Osmunda regalis* (royal fern), *Thelypteris palustris* (marsh fern), *Typha latifolia* (common cat-tail), *Peltandra virginica* (arrow-arum), *Carex stricta* (tussock sedge), and *Galium* spp.

Related types: The "Buttonbush wetland" type above may contain alder, but is dominated by *Cephalanthus occidentalis*. This type is broadly circumneutral, while the "Alder - sphagnum wetland" type is more acidic.

Range: Glaciated NW, Pittsburgh Plateau, Ridge and Valley.

Selected references: Jennings 1927, Metzler and Tiner 1992, PNDI field surveys, Sneddon, Anderson and Metzler 1996.

[Crosswalk: Smith's "Circumneutral Shrub Swamp" (in part), TNC's *Alnus (serrulata, incana)* Shrubland Alliance, *Alnus serrulata - Physocarpus* Community.]

Alder - sphagnum wetland

These are wetlands dominated by *Alnus serrulata* (smooth alder) and/or *A. incana* (speckled alder), and having a sphagnum layer. The substrate may be peat or mineral soil with a substantial accumulation of organic matter. This community type typically occurs in upland depressions, along slow-moving streams, or associated with large wetland complexes, frequently influenced by beaver action or other impoundment. Shrub associates include *Vaccinium corymbosum* (highbush blueberry), *Lyonia ligustrina* (maleberry), *Ilex verticillata* (winterberry), *Cornus racemosa* (swamp dogwood), and seedling and sapling size *Acer rubrum* (red maple). The most characteristic herbaceous species is *Osmunda cinnamomea* (cinnamon fern), although a variety of species, mostly ferns and sedges, may also occur.

Related types: This community type may be differentiated from the "Alder - ninebark" type described above, in that this type occupies the lower end of the pH spectrum for alder-dominated wetlands, while the former is



circumneutral to slightly calcareous. The associate species reflect this shift, with shrubs like *Physocarpus opulifolius* (ninebark), and *Cornus amomum* (red-willow) occurring in circumneutral situation, while acid-loving heaths like *Vaccinium corymbosum* (highbush blueberry) and *Lyonia ligustrina* (maleberry) are more typical under lower pH conditions. The presence of a substantial sphagnum layer generally distinguishes the two. This community type is also related to the "Highbush blueberry - sphagnum wetland" type. When *Vaccinium corymbosum* (highbush blueberry) and *Alnus* spp. occur together underlain by sphagnum, the types may be distinguished by dominance.

Range: Entire state except Coastal Plain.

Selected references: Sneddon, Anderson and Metzler 1996.

[Crosswalk: Smith's "Acidic Shrub Swamp" (in part), TNC's *Alnus (incana, serrulata)* Shrubland Alliance, *Alnus (incana, serrulata) - Osmunda cinnamomea - Sphagnum* spp. Community.]

Highbush blueberry - meadow-sweet wetland

Vaccinium corymbosum (highbush blueberry) and either *Spiraea latifolia* (meadow-sweet) or *S. alba* (meadow-sweet) are usually both present. Additional woody species include *Amelanchier* spp. (serviceberry), *Alnus incana* (speckled alder), *Viburnum recognitum* (arrow-wood), *S. tomentosa* (steeple-bush), *Rubus hispidus* (swamp dewberry), *Ilex verticillata* (winterberry), *Sambucus canadensis* (American elder), and seedling and sapling-size *Acer rubrum* (red maple). These wetlands generally lack a thick organic layer. In Pennsylvania, many of these systems are beaver-influenced or otherwise impounded, although some occur in upland depressions. The herbaceous layer is generally dominated by graminoids such as *Carex strictor* (tussock sedge), *Juncus* spp. (rushes), and *Eleocharis* spp. (spike-rushes), and by ferns, especially *Osmunda cinnamomea* (cinnamon fern), *O. regalis* (royal fern), *Onoclea sensibilis* (sensitive fern), and *Thelypteris palustris* (marsh fern). Forbs like *Triadenum virginicum* (marsh St.-John's -wort), *Symplocarpus foetidus* (skunk-cabbage), and *Impatiens* spp. (jewelweed) may also occur. Sphagnum either forms a continuous layer or occurs on hummocks.

Related types: The "Highbush blueberry - sphagnum" type below is found in more acidic situations, more often glacial in origin, with a stronger heath component.

Range: Entire state.

Selected references: PNDI field surveys, Metzler

and Tiner 1991.

[Crosswalk: Smith's "Acidic Shrub Swamp" (in part), TNC's *Vaccinium corymbosum* Shrubland Alliance.]

Highbush blueberry - sphagnum wetland

This community type generally occurs in shallow upland depressions or along the banks of slow moving acidic streams, or often as an intermediate zone between a low shrub type and a woodland or forest type within a structurally diverse wetland complex. It may also represent a successional phase, especially in beaver-influenced or otherwise impounded systems. These communities are heath-dominated with a sphagnum layer beneath. The substrate may be peat or mineral soil with a substantial accumulation of organic matter. Aside from *Vaccinium corymbosum* (highbush blueberry), shrubs commonly present include *Rhododendron viscosum* (swamp azalea), *Nemopanthus mucronatus* (mountain holly), *Chamaedaphne calyculata* (leatherleaf), *Viburnum cassinoides* (withe-rod), and *Lyonia ligustrina* (maleberry). Seedling or sapling-size *Acer rubrum* (red maple), *Betula populifolia* (gray birch), or other tree species may also be present. This community type may occur as part of the "Acidic glacial peatland complex."

Related types: The "Highbush blueberry - meadow-sweet wetland" type described above is typically found in less acidic to circumneutral situations. The "Highbush blueberry-sphagnum" type here is more characteristic of glaciated regions, is dominated by heaths, and is often associated with larger peatland complexes, while the winterberry type is more often found in upland depressions or areas of past impoundment.

Range: Glaciated NE, Glaciated NW, Piedmont (?), Pocono Plateau, Ridge and Valley, South Mountain.

Selected references: Crum 1988, Johnson 1985, PNDI field surveys, Sneddon, Anderson and Metzler 1996.

[Crosswalk: Smith's "Nonglacial Bog" (in part), "Acidic Shrub Swamp" (in part), TNC's *Vaccinium corymbosum* Shrubland Alliance, *Vaccinium corymbosum / Sphagnum* spp. Shrubland Community.]

Leatherleaf - sedge wetland

This community type usually occurs either in upland depressions or in areas of past (often beaver) impoundment. Substrate may be organic soil or mineral soil with a substantial accumulation of organic matter. This community may occupy an extensive area or occur as a relatively narrow band between herbaceous vegetation and



taller shrubs or trees. *Chamaedaphne calyculata* (leatherleaf) dominates, together with a mix of sedges and other herbs. There is usually at least a partial layer of sphagnum. In more nitrogen-poor situations, *Drosera rotundifolia* (round-leaved sundew) and occasionally *Sarracenia purpurea* (pitcher-plant) may occur. Sedges are common; species include *Carex canescens*, *C. trisperma*, *C. folliculata*, *C. lasiocarpa*, *C. rostrata*, *C. stricta*, *Eriophorum vaginatum* (cotton-grass), *E. virginicum* (tawny cotton-grass), and *Dulichium arundinaceum* (three-way sedge). Other herbs include *Sagittaria latifolia* (arrowhead), *Potentilla palustris* (marsh cinquefoil), *Lysimachia terrestris* (swamp-candles), *Vaccinium macrocarpon* (cranberry), and *Triadenum virginicum* (marsh St.-John's-wort).

Related types: The "Leatherleaf - cranberry" and "Leatherleaf - bog rosemary" peatland types below are generally found in glacial bogs, are more acidic, and have a deeper organic layer, sometimes occurring on a floating mat of sphagnum peat. This type is less acidic/nitrogen poor, younger, and often occurs on mineral soil (less than 16 inches organic matter). The associate species here are less strongly ericaceous and insectivorous plants are less common.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Crum 1988, Reschke 1990, PNDI field surveys, Johnson 1985.

[Crosswalk: Falls between Smith's "Nonglacial Bog" and "Acidic Shrub Swamp" types, TNC's *Chamaedaphne calyculata* - *Carex lasiocarpa* Sparse Shrubland Alliance.]

Leatherleaf - bog rosemary peatland

Chamaedaphne calyculata (leatherleaf) is the dominant shrub. Associate species include *Kalmia angustifolia* (sheep laurel), *Andromeda polifolia*^s (bog-rosemary), *Aronia arbutifolia* (red chokeberry), *Gaylussacia baccata* (black huckleberry), and *Ledum groenlandicum*^s (Labrador tea). This type often occurs between a woodland or tall-shrub type and the "Leatherleaf-cranberry peatland" type below. Herbaceous species include *Sarracenia purpurea* (pitcher-plant), *D. rotundifolia* (round-leaved sundew), *Rhynchospora alba* (white beak-rush), *Vaccinium macrocarpon* (cranberry), and *Eriophorum virginicum* (tawny cotton-grass). There is usually a continuous sphagnum layer. This type occurs on organic soil, sometimes on a floating mat. This community type may occur as part of the "Acidic glacial peatland complex."

Related types: In terms of pH and nitrogen availability, this type is probably intermediate

between the other two

leatherleaf types. This type is characterized by low mixed ericaceous shrubs and herbs over sphagnum, usually on organic soil.

Range: Glaciated NW, Glaciated NE, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: Crum 1988, Johnson 1985, PNDI field surveys, Reschke 1990.

[Crosswalk: Smith's "Oligotrophic Kettlehole Bog," and "Weakly Minerotrophic Lakeside Bog," TNC's *Chamaedaphne Calyculata* Dwarf - Shrubland Alliance.]

Leatherleaf - cranberry peatland

In glacial bogs, this community often occupies the central zone or one of the final zones of rooted vegetation surrounding an aquatic interior (also see "Water-willow (*Decadon verticillatus*) wetland" type). The dominant species are *Chamaedaphne calyculata* (leatherleaf) -stunted form, cranberry (*Vaccinium oxycoccos* and/or *macrocarpon*), and sphagnum. Associates include *Sarracenia purpurea* (pitcher-plant), *Drosera intermedia* (spatulate-leaved sundew), *Drosera rotundifolia* (round-leaved sundew), *Rhynchospora alba* (white beak-rush), *Xyris montana*^s (yellow-eyed-grass), and *Eriophorum virginicum* (tawny cotton-grass). This community type may occur as part of the "Acidic glacial peatland complex."

Related types: The "Leatherleaf - bog rosemary peatland" type may grade into this type, but the overwhelming dominance of stunted *Chamaedaphne calyculata* (leatherleaf) distinguishes this from the taller, more mixed type.

Range: Glaciated NW, Glaciated NE, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: Crum 1988, Johnson 1985, Reschke 1990.

[Crosswalk: Smith's "Oligotrophic Kettlehole Bog" and "Nonglacial Bog," TNC's *Chamaedaphne Calyculata* Dwarf - Shrubland Alliance.]

Water-willow (*Decadon verticillatus*) shrub wetland

Water-willow (*Decadon verticillatus*) has the ability to extend itself laterally over open water and thus forms a fringe along the aquatic edge of lakeside, creekside, or bog-lake-side wetlands. The associated species vary widely; some common examples are *Nuphar lutea* (spatterdock), *Peltandra virginica* (arrow-arum), *Pontederia*



cordata (pickerel-weed), *Utricularia* spp. (bladderworts), and *Cephalanthus occidentalis* (buttonbush). This community type may occur as part of the "Acidic glacial peatland complex."

Related types: *Decodon verticillatus* (water-willow) may occur in a variety of other palustrine types. This type is intended to describe areas of clear dominance by *Decodon verticillatus* (water-willow).

Range: Glaciated NE, Glaciated NW, Great Lakes Region, Pocono Plateau, Ridge and Valley.

Selected references: Crum 1988, Johnson 1985, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: TNC's *Decodon verticillatus* Shrubland Alliance.]

River birch - sycamore floodplain scrub

These are areas along the riverbank floodplain or on river gravel bars and islands. Tree species, mostly *Betula nigra* (river birch), *Platanus occidentalis* (sycamore), *Acer negundo* (box-elder), *Ulmus americana* (American elm), and *Acer saccharinum* (silver maple) dominate the community, but seldom exceed 5 meters in height. Associate shrub species include *Cornus amomum* (red-willow), *Salix exigua* (sandbar willow), *S. sericea* (silky willow), *S. erioccephala* (heart-leaved willow), *Alnus serrulata* (smooth alder), and *Physocarpus opulifolius* (ninebark). Along the riverbank, this community often occurs as a zone between the floodplain forest upslope and the low shrub and/or herbaceous communities to the river side. This is an early successional type usually maintained by flood and ice scour events that prevent further development toward a forested condition. The herbaceous layer is highly variable, and may include species like *Polygonum virginianum* (jumpseed), *Justicia americana* (water-willow), *Lobelia cardinalis* (cardinal-flower), and *Arisaema dracontium* (green-dragon). Exotic species, especially *Polygonum cuspidatum* (Japanese knotweed), are frequently a major problem in these systems. This community type is part of the "River bed - bank -floodplain complex."

Related types: The "Sycamore - (river birch) - box elder floodplain forest" and "Silver maple floodplain forest" types may grade into this type.

Range: Piedmont, Ridge and Valley, Unglaciated Allegheny Plateau.

Selected references: Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "River Gravel Community," TNC's *Betula nigra* Shrubland Alliance.]

Black willow scrub/shrub wetland

These communities are most typical of stream and riverbanks, but may also occur along the banks of lakes or ponds. *Salix nigra* (black willow) generally dominates; associates include *Alnus serrulata* (smooth elder), *A. incana* (speckled alder), *Cornus amomum* (red-willow), *C. sericea* (red-osier dogwood), and *Salix* spp. (willows). The herbaceous layer is variable, but often includes *Polygonum* spp. (smartweeds), *Bidens* spp. (beggar-ticks), *Phalaris arundinacea*⁰ (reed canary-grass), *Eleocharis erythropoda* (a spike-rush). This community type is part of the "River bed - bank - floodplain complex."

Related types: The "Sycamore - (river birch) - box-elder floodplain forest" and "Silver maple floodplain forest" types may grade into this type.

Range: Entire state.

Selected references: Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "River Gravel Community," TNC's *Salix nigra* Shrubland Alliance.]

Poison sumac - red-cedar - bayberry fen

This community type is specific to northeastern Pennsylvania and western New Jersey. These are wetlands that have developed under the influence of base-rich water, and usually have a substantial organic layer. The pH of surface water during the growing season ranges from 7.0 to 8.1. Structurally, they are dominated by a mixture of shrubs and herbaceous plants (predominantly sedges). Most sites have areas in the wettest portions that are without woody vegetation. Depth of organic matter ranges from zero in actively seeping areas to over a meter in basins. The dominant shrubs include *Juniperus virginiana* (red-cedar), *Myrica pensylvanica* (bayberry), *Toxicodendron vernix* (poison sumac), *Salix* spp. (willow), *Potentilla fruticosa*^s (shrubby cinquefoil), *Cornus racemosa* (swamp dogwood), *Rhamnus* (alder-leaved buckthorn), and *Physocarpus opulifolius* (ninebark). Herbaceous species include *Carex sterilis*^s (Atlantic sedge), *C. flava*^s (yellow sedge), *C. tetanica*^s (Wood's sedge), *C. lurida* (a sedge), *C. stricta* (tussock sedge), *Muhlenbergia glomerata* (spike muhly), *Rhynchospora capillacea*^s (capillary beak-rush), *R. alba* (white beak-rush), *Lobelia kalmii*^s (brook lobelia), *Eupatorium maculatum* (spotted joe-pye-weed), *Cirsium muticum* (swamp thistle), *Thelypteris palustris* (marsh fern), *Pycnanthemum virginianum* (mountain-mint),



Selaginella apoda (creeping spikemoss), *Lycopus uniflorus* (bugleweed), *Drosera rotundifolia* (round-leaved sundew), *Parnassia glauca*^s (grass-of-Parnassus), *Aster lateriflorus* (calico aster), and *Vernonia noveboracensis* (New York ironweed). Characteristic bryophytes include *Campylium stellatum*, *Aulacomnium palustre*, *Fissidens adiantoides*, and *Bryum pseudotriquetrum*. *Chara* spp. (stoneworts) occur in seeps and in unvegetated flats.

Related types: This type is ecologically similar to and shares many species with the "Buckthorn - sedge fen" type. The two differ in their distribution and species composition.

Range: Glaciated Northeast.

Selected references: PNDI field surveys, WPC and TNC 1995.

[Crosswalk: Smith's "Shrub Fen," "Basin Graminoid Forb Fen," TNC's *Carex (flava, hystericina, interior, sterilis)* - *Campylium stellatum* Herbaceous Alliance.]

Buckthorn - sedge (*Carex interior*) - golden ragwort fen

In Pennsylvania, this community type is most characteristic of the northwestern glaciated section, although it may occur elsewhere. These are wetlands that have developed under the influence of base-rich water, and usually have a substantial organic layer. The pH of surface water during the growing season ranges from 6.9 to 7.9. Structurally, they are dominated by a mixture of shrubs and herbaceous plants (predominantly sedges). Most sites have an area in the wettest portion that is without woody growth. Also, within the wetland complex, there are frequently areas of visible surface flow (seeps). Characteristic shrubs include *Rhamnus alnifolia* (alder-leaved buckthorn), *Salix* spp. (willows), *Vaccinium myrtilloides* (velvet-leaf berry), *Rubus pubescens* (dwarf blackberry), *V. corymbosum* (highbush blueberry), *Alnus incana* spp. *rugosa* (speckled alder), *Viburnum recognitum* (arrow-wood), and *Cornus sericea* (red-osier dogwood). The herbaceous species vary; some typical representatives are *Senecio aureus* (golden ragwort), *Geum rivale* (water avens), *Solidago patula* (spreading goldenrod), *Eupatorium perfoliatum* (boneset), *Equisetum arvense* (common horsetail), *Glyceria striata* (fowl mannagrass), *Carex interior* (a sedge), *C. Lasiocarpa*^s (many-fruited sedge), *C. hystericina* (a sedge), *Chelone glabra* (turtlehead), *Thelypteris palustris* (marsh fern), *Symplocarpus foetidus* (skunk cabbage), *C. lacustris* (a sedge), and *Typha latifolia* (common cat-tail). Some sites may contain calciphilic species such as *Carex aurea* (golden-fruited sedge), *C. flava*^s (yellow sedge),

C. prairea^s (prairie sedge), *C. sterilis*^s (Atlantic sedge), *C. tetanica*^s (Wood's sedge), *Eriophorum viridicarinaratum*^s (thin-leaved cotton-grass), *Muhlenbergia glomerata* (spike muhly), and *Parnassia glauca*^s (grass-of Parnassus). Characteristic bryophytes include *Campylium stellatum*, *Plagiomnium ellipticum*, *Sphagnum palustre*, *Bryum pseudotriquetrum*, and *Climacium americanum*. On many of these sites, microtopography and vegetation response creates a tight mosaic of locally different chemical conditions. Mounds of mosses, especially *Sphagnum* spp., form at the base of shrubs and stumps and lower the pH in their immediate surroundings. This provides a suitable habitat for acid-loving species like *Vaccinium* spp. (blueberries), *Clintonia* spp. (bluebead and speckled wood lilies), *Gaultheria procumbens* (teaberry), and *Tsuga canadensis* (eastern hemlock).

Related types: The presence of heaths in these systems may at first be confusing, but a closer look should reveal a number of calciphilic species. Calciphiles that may occur include *C. flava*^s (yellow sedge), *C. aurea* (golden-fruited sedge), *C. sterilis* (a sedge), *C. prairea*, (prairie sedge), *C. tetanica*^s, (a sedge), *Parnassia glauca*^s (grass-of Parnassus), *Muhlenbergia glomerata* (spike muhly), and *Eriophorum viridicarinaratum*^s (thin-leaved cotton-grass). This type is ecologically similar to and shares many species with the "Poison sumac - red-cedar - bayberry fen" type. The two differ in their distribution and species composition.

Range: Glaciated Northwest.

Selected references: PNDI field surveys, WPC and TNC 1995.

[Crosswalk: Smith's "Shrub Fen," "Basin Graminoid Forb Fen," TNC's *Carex (flava, hystericina, interior, sterilis)* - *Campylium stellatum* Herbaceous Alliance.]

Great Lakes Region scarp seep

This community type is specific to seepage areas of the extremely steep, actively eroding lakeshore-bluff and creek-wall slopes along Lake Erie. In the case of creek gorge seeps, groundwater seepage occurs at the interface of glacial and glacial-lacustrine deposits and the underlying eroded shales and sandstone. On the lakeshore bluffs, the seeps usually occur at the boundary of old beach deposits of sand and gravel, and an underlying layer of dense, more restrictive till. These communities are characteristically open, with a mixture of shrubs, sometimes with scattered trees. This is a very dynamic system, and the structure of the vegetation depends largely on its successional status. Recently slumped areas are first colonized by bryophytes and *Equisetum*



spp. (horsetails). As the substrate becomes more stable, and organic matter accumulates, graminoids, other herbs and shrubs colonize the seep. Eventually, perhaps due to the weight of the vegetation and organic matter, the entire community will "slump" or slide downslope, and the cycle begins again. More protected sites slump less frequently, and may develop a tree canopy. Woody species include *Salix* spp. (willows), *Cornus rugosa* (round-leaved dogwood), *C. sericea* (red-osier dogwood), *C. altemifolia* (alternate-leaved dogwood), *Alnus incana* (speckled alder), *Amelanchier arborea* (shadbush), *Tsuga canadensis* (eastern hemlock), *Acer saccharum* (sugar maple), *Lindera benzoin* (spicebush), *Populus deltoides* (cottonwood), *Ostrya virginiana* (hop-hornbeam), and *Rubus odoratus* (purple-flowering raspberry).

Herbaceous species include *Equisetum arvense* (common horsetail), *Parnassia glauca*^s (grass-of-Parnassus), *Senecio aureus* (golden ragwort), *Solidago flexicaulis* (zigzag goldenrod), *Impatiens pallida* (pale jewelweed), *Arisaema triphyllum* (jack-in-the-pulpit), *Glyceria striata* (fowl mannagrass), *Carex aureus*^s (golden-fruited sedge), a variety of other graminoids, the exotic species *Tussilago farfara*ⁱ (coltsfoot), and the invasive *Phragmites australis*^m (common reed). This community type is part of the "Great Lakes Region scarp complex."

Related types: Areas of the scarp that lack substantial groundwater discharge are described in the terrestrial section as "Great Lakes Region scarp woodland."

Range: Great Lakes Region.

Selected references: PNFI field surveys, WPC and TNC 1998.

[Crosswalk: Smith's "Eastern Great Lakes Bluff/Cliff Community."]

Great Lakes Region bayberry - mixed shrub palustrine shrubland

In Pennsylvania, this community type occurs only at Presque Isle. The substrate is sand, and the water table fluctuates seasonally; it is at or near the surface during the spring and below the surface in the fall. These are shrublands dominated by a mixture of *Myrica pensylvanica* (bayberry), *Cornus amomum* (red-willow), *Cornus sericea* (red-osier dogwood), *Lonicera morrowii*ⁱ (Morrow's honeysuckle), and *Salix* spp. (willows), with scattered *Populus deltoides* (cottonwood), and *Betula pendula*ⁱ (European white birch). Herbaceous species include *Calamagrostis canadensis* (bluejoint), *Carex scoparia* (a sedge), *C. bebbii*ⁱ (a sedge), *Scarps atrocinctus* (blackish woolgrass), *Solidago canadensis* (Canada goldenrod), *Juncus acuminatus* (sharp-fruited rush), and *Iris virginicas*^s (southern blue flag). This community type

is part of the "Great Lakes Region beach -dune - sandplain complex."

Related types: This type may closely resemble the "Great Lakes Region bayberry -cottonwood community," which is drier. Because the substrate on which both communities occur is sand, at times when the water table is below the surface, palustrine sites may appear dry. A careful survey for wetland species may be necessary to make a determination. The two types may intergrade.

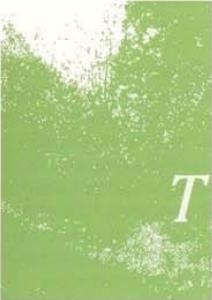
Range: Great Lakes Region.

Selected references: Bissell and Bier, 1987.

[Crosswalk: Smith's "Eastern Great Lakes Dune Community."]



Chapter 7



*T*errestrial Herbaceous Openings



*T*errestrial herbaceous opening - Unionville Serpentine Barrens, Chester County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.



*T*errestrial herbaceous opening - Side-oats gramma calcareous grassland, Westfall Ridge Prairie, Juniata County. Photograph by Julie Lundgren.



Little bluestem - Pennsylvania sedge opening

These grasslands occur on dry, acidic sites (usually over sandstone) where woody invasion is prevented or slowed by thin soil, droughty conditions, microclimate (frost pockets), frequent fire, or other disturbance regime. Some of these sites include rock outcrops and near-vertical cliffs. Species include *Schizachyrium scoparium* (little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty grass), *Deschampsia flexuosa* (common hairgrass), *C. communis* (a sedge), *Rubus flagellaris* (prickly dewberry), *Lespedeza* spp. (bush-clovers), and less commonly, *Oryzopsis pungens* (slender mountain ricegrass). Mosses and lichens, especially *Cladonia* spp. and *Cladina* spp. (reindeer lichens), and *Polytrichum* spp. (hairy-cap mosses) are abundant on some sites. This community type may occur as part of the "Ridgetop acidic barrens complex."

Related types: This community type may occur as openings in any of the dry acidic woody types (forests, woodlands, or shrublands).

Range: Entire state.

Selected references: Carke 1946, Hough 1945, Schegel and Butch 1980.

[Crosswalk: Smith's "Acidic Rocky Summit," "Ridgetop Dwarf-Tree Forest" (in part), TNC - no crosswalk.]

Side-oats gramma calcareous grassland

These grasslands occur as small (usually well under 0.5 hectares) prairie-like openings in areas of thin soils over calcareous bedrock. The dominant vegetation is graminoid, although scattered forbs and woody species are usually also present. Characteristic species include *Bouteloua curtipendula*^s (side-oats gramma), *Andropogon gerardii* (big bluestem), *Sorghastrum nutans* (Indian grass), *Panicum virgatum* (switchgrass), *Schizachyrium scoparium* (little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Lespedeza* spp. (bush clovers), *Desmodium* spp. (tick-trefoil), *Asclepias verticillata* (whorled milkweed), *A. viridiflora* (green milkweed), *Onosmodium molle* ssp. *Hispidissimum*^s (false gromwell), *Senecio obovatus* (groundsel), *Lithospermum canescens* (hoary puccoon), and *Solidago bicolor* (silver-rod). Typical woody species, which may occur scattered throughout or at margins, include *Cercis canadensis* (redbud), *Celtis tenuifolia* (dwarf hackberry), *Juniperus virginiana* (red-cedar), *Fraxinus americana* (white ash), *Quercus muhlenbergii* (yellow oak), *Ostrya virginiana* (hop-hornbeam), *Cornus florida* (flowering dogwood), *Rhus glabra* (smooth sumac), *Rhus aromatica* (fragrant sumac), and *Viburnum rafinesquianum* (downy arrow-wood).

Related types: Several woodland and shrubland types may contain openings of *Bouteloua curtipendula*^s (side-oats gramma) and other grasses. These types include the "Yellow oak - redbud woodland," and the "Red-cedar -redbud shrubland." Very small openings within a matrix of these types may be considered to be part of the woodland or shrubland types in which they occur. The "Calcareous opening/cliff" is another open calcareous community type. The cliff type tends to occur on small outcrops or on steep slopes or cliffs. There is generally some degree of shading either from the landform itself or from the surrounding vegetation. Grasses dominate the grassland type, while forbs and ferns dominate the cliff type.

Range: Ridge and Valley, Piedmont.

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Northern Appalachian Calcareous Rocky Summit" (in part), TNC's *Schizachyrium scoparium* - *Bouteloua curtipendula* Herbaceous Alliance.]

Calcareous opening/cliff

This community type occurs on calcareous cliffs, outcrops, and rocky slopes. There is generally some degree of shading from the surrounding forest or woodland community or from the land form itself. Species composition varies with the amount of moisture, shade and exposure. Herbaceous species include *Aquilegia canadensis* (wild columbine), *Dodecatheon meadia*^s (shooting star), *Aster ericoides*^s (white heath aster), *A. oblongifolius* (aromatic aster), *Cystopteris bulbifera* (bladder fern), *Bouteloua curtipendula*^s (side-oats gramma), *Pellaea atropurpurea* (purple cliff-brake), *Dryopteris marginalis* (evergreen wood fern), *Allium cernuum* (nodding onion), *Heuchera americana* (alum-root), *Carex oligocarpa* (a sedge), *Asplenium trichomanes* (maidenhair spleenwort), *Arabis hirsuta*^s (hairy rock-cress), *A. lyrata* (lyre-leaved rock-cress) and *Saxifraga virginensis* (early saxifrage). Woody species may occur scattered throughout or at the margins, these species include *Juniperus virginiana* (red-cedar), *Rhus aromatica* (fragrant sumac), *Toxicodendron radicans* (poison-ivy), *Hydrangea arborescens* (seven-bark), *Fraxinus americana* (white ash), *Parthenocissus quinquefolia* (Virginia creeper), *Cercis canadensis* (redbud), *Tilia americana* (basswood), *Carya* spp. (hickories), *Quercus muhlenbergii* (yellow oak), *Ostrya virginiana* (hop-hornbeam), and *Cornus florida* (flowering dogwood).

Related types: The "Yellow oak - redbud woodland" may contain openings that resemble this type. Small openings within a matrix of this or other types may be considered to be part of the forest, woodland, or shrubland types in which they occur. The "Side-oats gramma calcareous



grassland" is another open calcareous community type. Grasses dominate the grassland type, while forbs and ferns dominate the cliff type. This type tends to occur on small outcrops or on steep slopes or cliffs, often in a forested context, while the grassland type is generally more open, less steep, and often grades into a shrubland or woodland at the edges.

Selected references: PNDI field surveys.

Range: Ridge and Valley, Piedmont, and perhaps Allegheny Mountain and the Pittsburgh Plateau.

[Crosswalk: Smith's "Northern Appalachian Calcareous Cliff Community," TNC's *Pellaea atropurpurea* Sparsely Vegetated Calcareous Cliff Alliance.]

Serpentine grassland

This community type is part of the "Serpentine barren complex." It is restricted to areas underlain by serpentinite bedrock. The dense, prairie-like graminoid cover is usually dominated by warm-season (C₄) grasses. Warm-season grasses characteristic of this community include *Schizachyrium scoparium* (little bluestem), *Muhlenbergia mexicana* (muhly), *Eragrostis spectabilis* (purple love-grass), *Setaria geniculata* (perennial foxtail), *Andropogon gerardii* (big bluestem), *Sporobolus heterolepis*^s (prairie dropseed), *Sorghastrum nutans* (Indian grass), and *Bouteloua curtipendula*^s (side-oats gramma). Other species commonly found include *Senecio anonymus*^s (plain ragwort), *Aristida purpurascens*^s (arrow-feather), *A. dichotoma* (churchmouse three-awn), *Aster depauperatus*^s (serpentine aster), *Panicum acuminatum* (a panic-grass), *P. annulum* (annulus panic-grass), *P. dichotomum* (a panic-grass), *P. oligoanthes* (a panic-grass), *P. sphaerocarpon* (a panic-grass), *Potentilla canadensis* (old-field cinquefoil), *Rosa carolina* (prairie rose), *Setaria geniculata* (perennial foxtail), *Cerastium arvense* var. *villosissimum*^s (barrens chickweed), *Phlox subulata* ssp. *subulata* (creeping phlox), *Achillea millefolium*^s (yarrow), *Eupatorium aromaticum* (small white snakeroot), *Scleria pauciflora* (few-flowered nutrush), *Oenothera fruticosa* (sundrops), *Solidago nemoralis* (gray goldenrod), *Antennaria plantaginifolia* (plantain pussytoes), *Asclepias verticillata* (whorled milkweed), and *A. viridiflora* (green milkweed).

Related types: This community may be said to end either where graminoid dominance and continuous soil substrate ends (here the "Serpentine gravel forb community" generally begins), or where shrub cover reaches about 25% (here the "Red-cedar - pine serpentine shrubland" generally begins).

Range: Piedmont.

Selected references: Latham 1992, PNDI field surveys.

[Crosswalk: Smith's "Eastern Serpentine Barren," TNC's *Pinus (virginiana, rigida) / Schizachyrium scoparium* Herbaceous Alliance, *Pinus virginiana - Pinus rigida / Schizachyrium scoparium - Scleria pauciflora* Community.]

Serpentine gravel forb community

This community type is part of the "Serpentine barren complex." It occurs exclusively on areas of gravel or very thin soil over serpentine bedrock. These areas are not shaded; conditions are intermittently extremely dry and daytime surface temperatures are high. These factors combined with the serpentine chemistry of the substrate support a community with sparse, xeromorphic forb cover. It is in these areas that the majority of serpentine endemic plant species are found. Characteristic species include *Asclepias verticillata* (whorled milkweed), *Arabis lyrata* (lyre-leaved rock-cress), *Minuartia michauxii* (rock sandwort), *Aster depauperatus*^s (serpentine aster), *Cerastium arvense* var. *villosissimum*^s (barrens chickweed), *Fimbristylis annua*^s (annual fimbry), *Aristida dichotoma* (churchmouse three-awn), *A. longispica* (slimspike three-awn), *Chamaecrista fasciculata* (prairie senna), *Juncus secundus* (one-sided rush), *Panicum sphaerocarpon* (a panic grass), *Polygala verticillata* (whorled milkwort), *Polygonum tenue* (slender knotweed), *Sporobolus vaginiflorus* (poverty grass), *Viola sagittata* (arrow-leaved violet), *Scleria pauciflora*^s (few-flowered nut-rush), *Talinum teretifolium*^s (round-leaved fame-flower), *Phlox subulata* ssp. *subulata* (moss-pink), and stunted *Schizachyrium scoparium* (little bluestem).

Related types: This community type generally grades into the "Serpentine grassland" type. They may be delineated where sod formation and graminoid dominance begins.

Range: Piedmont.

Selected references: Latham 1992, PNDI field surveys.

[Crosswalk: Smith's "Eastern Serpentine Barren," TNC's *Cerastium arvense* Sparsely Vegetated Alliance.]

Great Lakes Region dry sandplain

These are dry grasslands occurring on sand deposits along the Lake Erie shoreline. In Pennsylvania, this community type occurs only at Presque Isle. The dominant species are *Sorghastrum nutans* (Indian grass), *Panicum virgatum* (switch grass), and *Schizachyrium scoparium* (little bluestem). Other species commonly present



include *Carex muhlenbergii* (a sedge), *C. tonsa* (a sedge), *Rumex acetosella*¹ (sheep sorrel), and *Panicum commonsianum*^s (panic grass). There may be scattered shrubs and small trees, although they usually contribute less than 25% cover overall. The most common woody species are *Populus deltoides* (cottonwood), *Betula pendula*¹ (European white birch), and *Myrica pensylvanica* (bayberry). This community type is part of the "Great Lakes Region beach - dune - sandplain complex."

Related types: This type often grades into the "Great Lakes Region bayberry - cottonwood community", which represents a somewhat later successional stage. This type may also resemble the "Great Lakes Region palustrine sandplain." Because of the sandy soils on which both types occur, the wetter type may appear dry for much of the year. It is the difference in species composition that distinguishes the two types.

Range: Great Lakes Region.

Selected references: Bissell and Bier, 1987.

[Crosswalk: Smith's "Eastern Great Lakes Sand Plain," TNC's *Panicum virgatum* - *Schizachyrium scoparium* Herbaceous Alliance.]

Great Lakes Region sparsely vegetated beach

This community occupies the sand or gravel shores from the normal water line to the upper limit of winter storms. The substrate is very unstable and subject to wave action and ice scour. The vegetation is sparse (usually less than 25% total cover). The most characteristic species are

Ammophila breviligulata^s (American beachgrass), *Cakile edentula*^s (sea-rocket), *Elymus canadensis* (Canada wild-rye), *Potentilla anserina*^s (silverweed), and *Xanthium strumarium* var. *canadense* (cocklebur). This community type is part of the "Great Lakes Region beach - dune - sandplain complex."

Related types: This type generally grades into either the "Great Lakes Region dry sandplain" or the "Great Lakes Region bayberry - cottonwood community." This community occupies the beach and foredune, generally ending just short of the dune crest.

Range: Great Lakes Region.

Selected references: Bissell and Bier, 1987.

[Crosswalk: Smith's "Eastern Great Lakes Beach Community," TNC's *Cakile edentula* Herbaceous Alliance, *Cakile edentula* - *Potentilla anserina* Community.)]



Chapter 8



*H*erbaceous Wetlands



*H*erbaceous wetland - Herbaceous vernal pond,
Pepper Run sedge pool, Clinton County.
Photograph by Jeff Wagner



PERSISTENT EMERGENT WETLANDS

Bluejoint - reed canary grass marsh

These marshes occur in a variety of landscape settings, from river backwaters to upland depressions. The most typical species are *Calamagrostis canadensis* (bluejoint) and *Phalaris arundinacea*⁽¹⁾ (reed canary grass). Associates vary widely, but commonly include *Glyceria* spp. (mannagrass), *Leersia oryzoides* (rice cutgrass), *Dulichium arundinaceum* (three-way sedge), *Eupatorium* spp. (joe-pye weed), *Typha* spp. (cat-tail), *Rubus hispidus* (swamp dewberry), *Scirpus cyperinus* (wool grass) and other *Scirpus* spp. The invasive species *Phragmites australis*⁽¹⁾ (common reed) and *Lythrum salicaria*⁽¹⁾ (purple loosestrife) are frequently a major problem in these systems.

Related types: This type may contain *Carex stricta* (tussock sedge), but it is not dominant. The "Tussock sedge marsh" type may contain *Phalaris arundinacea*⁽¹⁾ (reed canary grass) and/or *Calamagrostis canadensis* (bluejoint) but is strongly dominated by *Carex stricta*.

Range: Entire state.

Selected references: Sneddon, Anderson, and Metzler 1996, Reschke 1990, Golet and Larson 1974.

[Crosswalk: Smith's "Graminoid Marsh" (in part). TNC's *Calamagrostis canadensis* - *Phalaris arundinacea* Herbaceous Alliance.]

Cat-tail marsh

These are robust emergent marshes dominated by *Typha latifolia* (common cat-tail), or less commonly, *T. angustifolia* (narrow-leaved cat-tail). This type can occur in a variety of landscape positions including river backwaters, protected pond and lakeshores, and upland depressions. The substrate may be muck or mineral soil. The surface is usually flooded for most of the year. Associated species include *Scirpus* spp. (bulrush), *Peltandra virginica* (arrow-arum), *Sparganium americanum* (bur-reed), *Onoclea sensibilis* (sensitive fern), *Impatiens* spp. (jewelweed), *Pontederia cordata* (pickerel-weed), *Sagittaria latifolia* (arrowhead), *Bidens* spp. (beggar-ticks), *Polygonum* spp. (smartweeds), *Lemna* spp. (duckweed), and *Carex* spp. (sedges)—especially *C. stricta* (tussock sedge). The invasive species *Phragmites australis*⁽¹⁾ (common reed) and *Lythrum salicaria*⁽¹⁾ (purple loosestrife) are frequently a major problem in these systems.

Related types: Clear dominance by *Typha* spp. (cat-tail) distinguishes this type from the other marsh/palustrine herbaceous types that occur in similar settings.

Range: Entire state.

Selected references: Golet and Larson 1974, Reschke 1990, Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Robust Emergent Marsh" (in part), TNC's *Typha (angustifolia, latifolia)* - *Scirpus* spp. Semi-permanently Flooded Herbaceous Alliance.]

Tussock sedge marsh

These are *Carex stricta* (tussock sedge)-dominated marshes. The majority of these systems are influenced by past impoundment. The substrate may be peat, muck or mineral soil. There is generally standing water between the tussocks for much of the year. Associated species include other sedges (e.g. *Carex lurida*, *C. canescens*, *C. stipata*, *C. tribuloides*), rushes (*Juncus* spp.), *Calamagrostis canadensis* (bluejoint), *Thalictrum pubescens* (tall meadow-rue), *Agrostis scabra* (hairgrass), *Eupatorium* spp. (joe-pye weed), *Scirpus cyperinus* (wool grass), *Sium suave* (water parsnip), *Triadenum virginicum* (marsh St.-John's-wort), scattered *Typha latifolia* (common cat-tail) and small *Acer rubrum* (red maple). The invasive species *Phragmites australis*⁽¹⁾ (common reed) and *Lythrum salicaria*⁽¹⁾ (purple loosestrife) are frequently a major problem in these systems.

Related types: The "Bluejoint - reed canary grass marsh" may contain *Carex stricta* (tussock sedge), but it is not dominant. This type may contain *Phalaris arundinacea*⁽¹⁾ (reed canary grass) and/or *Calamagrostis canadensis* (bluejoint), but is strongly dominated by *Carex stricta*.

Range: Entire state.

Selected references: Sneddon, Anderson, and Metzler 1996, Reschke 1990, Golet and Larson 1974.

[Crosswalk: Smith's "Graminoid Marsh" (in part), TNC's *Carex stricta* Herbaceous Alliance.]

Mixed forb marsh

This is a highly variable type dominated by broad-leaved plants. This community type occurs in a variety of landscape settings, from freshwater tidal systems to inland wet meadows. Characteristic species include *Dulichium arundinaceum* (three-way sedge), *Polygonum arifolium* (halberd-leaved tearthumb), *P. sagittatum* (arrow-leaved tearthumb), *Rumex* spp., (dock), *Juncus acuminatus* (sharp-fruited rush), *Bidens* spp. (beggar-ticks), *Impatiens capensis* (jewelweed), *Onoclea sensibilis* (sensitive fern), *Sagittaria latifolia* (arrowhead), *Carex stricta* (tussock sedge), *Acorus calamus*⁽¹⁾, and *Leersia oryzoides* (rice cutgrass). The invasive species *Phragmites australis*⁽¹⁾



(common reed) and *Lythrum salicaria* (purple loose-strife) are frequently a major problem in these systems.

Related types: This type is distinguished from the various graminoid-dominated marsh types by its broad-leaf dominants. The "Herbaceous vernal pond" community is related to this, but occurs exclusively in upland depressions that dry out substantially to completely in the dry season. There is also a difference in species composition.

Range: Entire state.

Selected references: Schuyler, Anderson, and Kolaga 1993.

[Crosswalk: Smith's "Freshwater Intertidal Marsh Community" (although here not restricted to tidal areas), TNC—includes several alliances.]

Herbaceous vernal pond

This community type is characterized by seasonally fluctuating water levels; it may dry out completely in the summer. The substrate is mineral soil with or without a layer of muck. The species composition is variable between 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 covered by dead leaves and algae. 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) *Dulichium arundinaceum* (three-way sedge), *Glyceria acutiflora* (mannagrass), *Leersia oryzoides* (rice cut-grass), *Scirpus cyperinus* (wool-grass), *S. ancistrochaetus*^s (northeastern bulrush), *Lycopus uniflorus* (bugleweed), *Torreyochloa pallida* (pale meadow grass), *Polygonum* spp. (smartweeds), *Thelypteris palustris* (marsh fern), *Carex gynandra* (a sedge), *C. crinita* var. *crinita*^s (short hair sedge), *C. leptonevia* (a sedge), *C. stipata* (a sedge), *C. canescens* (a sedge), *C. vesicaria* (a sedge), *Juncus effusus* (soft rush), *Woodwardia virginica* (Virginia chain fern), *Bidens* spp. (beggar-ticks), *Hypericum mutilum* (dwarf St.-John's-wort), *Osmunda cinnamomea* (cinnamon fern), *O. regalis* (royal fern), *H. canadense* (Canadian St.-John's-wort), *Agrostis scabra* (hairgrass), *Utricularia geminiscapa* (bladderwort), *Triadenum virginicum* (marsh St.-John's-wort), *Sagittaria rigida* (arrowhead), *S. latifolia* (arrowhead), and *Eleocharis* spp (spike-rushes). Although this community type is dominantly herbaceous, shrubs and small trees may be present. Typical woody species include *Vaccinium corymbosum* (highbush blueberry), *Lyonia ligustrina* (maleberry), *Quercus palustris* (pin oak), *Nyssa sylvatica* (black-gum), *Acer rubrum* (red maple), *Salix* spp. (wil-

lows), *Cephalanthus occidentalis* (buttonbush), and *Ilex verticillata* (winterberry). 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.

Related types: This community often occurs in association with shrub and woodland community types such as the "Buttonbush wetland" or "Red maple - mixed shrub palustrine woodland" community types. On some sites, the distinction becomes a matter of scale, as small herbaceous openings often occur on shrub-dominated sites.

Range: Entire state.

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Ephemeral / Fluctuating Natural Pool," TNC—no direct crosswalk.]

Wet meadow

These are open, usually graminoid-dominated meadows. They are typically flooded early in the growing season, and may be saturated to near the surface for some of the growing season, but are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface. Although flooding may help to keep these systems open, most are also grazed or mowed.

This community type on some sites may be dominated by one or two species, but is typically mixed. Representative species include *Leersia oryzoides* (rice cut-grass), *Scirpus cyperinus* (wool-grass), *Lycopus uniflorus* (bugleweed), *Torreyochloa pallida* var. *pallida* (pale meadow grass), *Polygonum* spp. (smartweeds), *Dulichium arundinaceum* (three-way sedge), *Thelypteris palustris* (marsh fern), *C. stipata* var. *stipata* (a sedge), *C. canescens* (a sedge), *C. lurida* (a sedge), *C. cristatella* (a sedge), *C. tribuloides* (a sedge), *C. stricta* (tussock sedge), *C. vesicaria* (a sedge), *Juncus effusus* (soft rush), *Woodwardia virginica* (Virginia chain fern), *Bidens* spp. (beggar-ticks), *Hypericum mutilum* (dwarf St.-John's-wort), *Eupatorium* spp. (Joepye-weed), *E. perfoliatum* (boneset), *Osmunda cinnamomea* (cinnamon fern), *O. regalis* (royal fern), *H. canadense* (Canadian St.-John's-wort), *Calamagrostis canadensis* (bluejoint), *Vernonia noveboracensis* (New York ironweed), *Triadenum virginicum* (marsh St.-John's-wort), *Sagittaria rigida* (arrowhead), *S. latifolia* (arrowhead), *Phalaris arundinacea* (reed canary-grass), *Glyceria canadensis* (rattlesnake grass), *Scirpus atrovirens* (black bulrush), *S. pendulus* (a bulrush), and *Eleocharis* spp (spike-rushes). Scattered shrubs may be present, representative species include *S. tomentosa* (hardhack), *Cephalanthus occidentalis* (buttonbush), *Cornus amomum* (red-willow), *C. racemosa* (swamp dogwood), *C. sericea* (red-osier dogwood), and *Viburnum*



recognitum (arrow-wood). Exotic species such as *Lythrum salicaria*^d (purple loosestrife), and a variety of exotic grasses are frequently found in these meadows.

Related types: Although *Phalaris arundinacea* (reed canary-grass) *Calamagrostis canadensis* (bluejoint) may occur in this community type, they are not dominant. If one of these species or a combination of the two dominates the community, see the description of the "Bluejoint - reed canary grass marsh." If *Carex stricta* (tussock sedge) dominates the community, see the description of the "Tussock sedge marsh." If the community is a seasonally flooded basin, also read the description for "Herbaceous vernal pond."

Range: Entire state.

Selected references: Golet and Larson 1974.

[No crosswalk.]

Bulrush marsh

These are communities dominated by *Schoenoplectus tabernaemontani* (soft-stem bulrush), and/or *S. acutus* (hard-stemmed bulrush), or less commonly *S. pungens* (chairmaker's rush), *S. purshianus* (a bulrush), *S. fluviatilis*^s (river bulrush), or *S. torreyi*^s (Torrey's bulrush). This community type occurs along lake and pond margins, on mudflats, and in shallow water—both tidal and non-tidal.

Related types: This community type is easily distinguished by its clear dominance of *Schoenoplectus* spp. (bulrushes). It may occur in combination with virtually any community type that approaches a water body having the appropriate substrate.

Range: Entire state.

Selected references: Sneddon, Anderson, and Metzler 1996.

[Crosswalk: Smith's "Robust Emergent Marsh" (in part), TNC's *Scirpus* spp. Herbaceous Alliance.]

Great Lakes Region palustrine sandplain

In Pennsylvania, this community type occurs only on Presque Isle. This is a graminoid-dominated, sparsely vegetated herbaceous community that occurs on moist sandy flats. Water levels vary seasonally from standing water at times in the spring, to below the surface for drier portions of the year. Characteristic species include *Juncus articulatus* (jointed rush), *J. articus*^s (Baltic rush), *J. alpinoarticulatus* (alpine rush), *Cyperus bipartitus* (an umbrella-sedge), *C. flavescens* (an umbrella-sedge),

Agalinis paupercula^s (small-flowered false-foxglove), *Carex viridula*^s (green sedge), *C. garberi*^s (elk sedge), and *Hypericum majus*^s (Canadian St.-John's-wort). This community type is part of the "Great Lakes Region beach -dune - sandplain complex."

Related types: The "Great Lakes Region dry sandplain" is associated with this type, but is drier and less sparse, and has a different suite of species, including at times scattered trees and shrubs. Because of the sandy soils on which both types occur, the wetter type may appear dry for much of the year. It is the difference in species composition that distinguishes the two.

Range: Great Lakes Region.

Selected references: Bissell and Bier 1987.

[Crosswalk: Smith's "Eastern Great Lakes Sand Plains," TNC - no crosswalk.]

Prairie sedge - spotted joe-pye-weed marsh

This community type is dominated by graminoids with a mixture of forbs and shrubs. It occurs in areas influenced by calcareous waters. The substrate is mineral soil, often with a thin layer of muck over a restrictive layer of clay or clay-loam soils.

Characteristic species include *Carex prairea* (prairie sedge), *Eupatorium maculatum* (spotted joe-pye-weed), *C. tetanica* (wood's sedge), *C. schweinitzii* (Schweinitz's sedge), *C. interior* (a sedge), *Juncus articus* var. *littoralis* (Baltic rush), *J. nodosus* (knotted rush), *Vernonia noveboracensis* (New York ironweed), *Glyceria* spp. (mannagrass), *Galium* spp. (cleavers), and *Eleocharis intermedia*^s (matted spike-rush). The overall aspect is often that of a mosaic, with the wettest areas containing species like *Equisetum fluviatile* (water horsetail), *Potamogeton crispus*^d (curly pondweed), and *Typha latifolia* (common cat-tail). Shrubs, especially *Ribes hirtellum* (northern wild-gooseberry), may occur scattered throughout, especially in drier areas.

Related types: This type is distinguished from the other marsh types by the presence of calciphilic species.

Range: Entire state (?)

Selected references: Golet and Larson 1974, Smith 1991.

[Crosswalk: Smith's "Calcareous Marsh," TNC's (?).]

Open sedge (Carex stricta, C. prairea, C. lacustris) fen

These are open sedge-dominated wetlands, which usually occur on organic soil (sedge peat) saturated through-



out most of the year by base-rich groundwater. These sites usually lack the distinct seepage areas associated with other fen types. Surface water pH is generally between 6.9 and 7.9 during the growing season. Sedges dominate, usually by some combination of *Carex prairea*^s (prairie sedge), *C. stricta* (tussock sedge), *C. sterilise* (Atlantic sedge), *C. lacustris* (a sedge), *C. aquatilis*^s (water sedge), *C. leptalea* (a sedge), *C. lasiocarpa*^s (many-fruited sedge), and *C. tetanica*^s (Wood's sedge). Additional characteristic herbaceous species include *Pycnanthemum virginianum* (mountain-mint), *Verbena hastata* (blue vervain), *Smilacina stellata* (starflower), *Eupatorium maculatum* (spotted joe-pye-weed), *Typha latifolia* (common cat-tail), *Epilobium leptophyllum* (willow-herb), *Callum tinctorium* (cleavers), *Onoclea sensibilis* (sensitive fern), *Cirsium muticum* (swamp thistle), *Impatiens capensis* (jewelweed), *Juncus articus*' (Baltic rush), *Aster puniceus* ssp. *firmus* (purple-stemmed aster), and *Polemonium reptans* (spreading Jacob's-ladder). Typical bryophytes include *Sphagnum teres*, *Campylium stellatum*, and *Thuidium delicatulum*. These fens typically lack a substantial shrub layer. This may be due to excessive moisture, but in many cases disturbance—including cattle grazing, or more rarely, repeated fire—keeps these sites open.

Related types: Ecologically, this type resembles the herbaceous patches within the two shrub fen types: "Poison sumac - red-cedar - bayberry fen" and "Buckthorn - sedge fen." All three descriptions should be read carefully before classifying a site.

Range: Ridge and Valley, Piedmont.

Selected references: Wagner and Bier 1995.

[Crosswalk: Smith's "Hillside Graminoid-Forb Fen," TNC's (proposed) *Carex stricta*-*Carex prairea* Herbaceous Alliance.]

Golden saxifrage - sedge rich seep

These are typically small (less than 0.1 hectare) wetlands that occur where base-rich groundwater (alkaline to circumneutral) saturates the surface for most of the growing season in most years. There may be an accumulation of organic matter (peat or muck), but it is seldom more than 50 cm deep. The species composition is highly variable, and includes common species with a wide range of pH tolerance, as well as calciphilic, typically rarer species. Species composition also varies according to light availability. Sites that occur in completely open areas are usually characterized by dense graminoid cover, while those that receive some shading from surrounding vegetation typically have more forbs. The species composition is variable, but usually includes several of the following: *Carex leptalea* (a sedge), *C. granularis* (a sedge), *C. flava*^s

(yellow sedge), *C. sterilis*^s (Atlantic sedge), *C. atlantica* (a sedge), *Poa palustris* (fowl bluegrass), *Cardamine pensylvanica* (Pennsylvania bitter cress), *Senecio aureus* (golden ragwort), *Eupatorium* spp. (boneset), *Impatiens* spp. (jewelweed), *Symplocarpus foetidus* (skunk cabbage), *Chrysosplenium americanum* (golden saxifrage), *Vernonia noveboracensis* (New York ironweed), *Equisetum arvense* (common horse-tail), *E. fluviatile* (water horsetail), *Chara* spp. (stoneworts), *Rhynchospora capillacea*^s (capillary beak-rush), *R. alba* (white beak-rush), *Thelypteris palustris* (marsh fern), *Pam assia glauca*^s (grass-of-Parnassus), *Lobelia kalmii*^s (brook lobelia), *Saxifraga pensylvanica*, (swamp saxifrage), and *Chelone glabra* (turtlehead). There may be open seepage areas dominated by *Chara* spp. (stoneworts).

Related types: This community type may occur in combination with either of the fen types ("Buckthorn - sedge (*Carex interior*) - golden ragwort fen", or "Open sedge (*Carex stricta*, *C. prairea*, *C. lacustris*) fen").

Range: Glaciated NE, Glaciated NW, Pittsburgh Plateau, Ridge and Valley, Piedmont, Great Lakes Region.

Selected references: PNDI field surveys, WPC and TNC 1998.

[Crosswalk: Smith's "Northern Appalachian Calcareous Seep," TNC's *Carex* (*flava*, *hystericina*, *interior*, *sterilis*) -*Campylium stellatum* Herbaceous Alliance (?).]

Skunk cabbage - golden saxifrage forest seep

These are small communities (usually less than 0.1 hectare) that occur where groundwater comes to the surface in a diffuse flow, saturating the soil for most of the growing season. The water chemistry ranges from acidic to strongly calcareous, with only minor accompanying shifts in species composition. Where waters are moderately to strongly calcareous, any of a variety of calciphiles may be present. This case is described as the "Calcareous subtype" below. These seeps most often occur in a forested context. Canopy cover ranges widely, and may be contributed by woody plants rooted within the seep, or by overhanging foliage from those in the surrounding uplands. The species composition is highly variable. Species include *Symplocarpus foetidus* (skunk cabbage), *Chrysosplenium americanum* (golden saxifrage), *Osmunda cinnamomea* (cinnamon fern), *Carex folliculata* (a sedge), *Coptis trifolia* (goldthread), *Mitchella repens* (partridge-berry), *Impatiens capensis* (jewelweed), *Dryopteris carthusiana* (fancy fern), *Cardamine pensylvanica* (Pennsylvania bitter-cress), *Pilea pumila* (clearweed), *Galium triflorum* (sweet-scented bedstraw), *Glyceria melicaria* (slender mannagrass), *Saxifraga pensylvanica* (swamp saxifrage), *Thelypteris*



novaboracensis (New York fern), *Aster radula* (swamp aster), and *Onoclea sensibilis* (sensitive fern). Bryophytes include *Brachythecium rivulare*, *Bryhnia novae-angliae*, *Rhynchostegium serrulatum*, *Rhizomnium punctatum*, *Sphagnum* spp., and *Thuidium delicatulum*. Shrubs may be present, common representatives include *Alnus* spp. (alders), *Lindera benzoin* (spicebush), *Viburnum* spp. (viburnums), and *Cornus* spp. (dogwoods).

Calcareous subtype: These sites are influenced by moderately to strongly calcareous groundwater ([Ca²⁺] >15mg/l). They may contain any of the species above, but usually with the additional presence of one to several calciphilic species. The species of calciphile present varies; typical representatives include *Trollius laxus*^s (spreading globeflower), *Conioselinum chinense*^s (hemlock parsley), and *Parnassia glauca*^s (grass-of-Parnassus). These species also have higher light requirements, so sites or portions of sites on which they occur tend to be somewhat open.

Related types: The "Golden ragwort - sedge rich seep" receives more light than does this type. The greater light availability is reflected in the species composition. The "Water cress - golden saxifrage spring run" community is also groundwater fed, but in the case of a spring, water comes to the surface in a concentrated rather than diffuse flow.

Range: Entire state.

Selected references: PNDI field surveys, WPC and TNC 1998.

[Crosswalk: Smith's "Northern Appalachian Acidic Seep," no direct crosswalk to TNC, in part resembles openings in *Acer rubrum* - *Fraxinus nigra* Saturated Forest Alliance.]

Serpentine seepage wetland

This community type is restricted to areas underlain by serpentinite bedrock. Seeps occur on gentle slopes at the base of low hills and adjacent to streams. Groundwater saturates the surface for a substantial portion of the growing season. Graminoids dominate; *Deschampsia cespitosa* (tufted hairgrass), *Leersia oryzoides* (rice cut-grass), *Eleocharis tennis*' (slender spike-rush), and *Panicum clandestinum* (deer-tongue grass) are common. Other species that are characteristic of these seeps include *Cerastium arvense* var. *uillosum*^s (barrens chickweed), *Cyperus strigosus* (false nutsedge), *Muhlenbergia mexicana* (satin grass), *Cirsium muticum* (swamp thistle), *Polygonum* spp. (smartweeds), *Lycopus uniflorus* (bugleweed), *Philonotis capillaris* (a moss), *Sorghastrum nutans* (Indian grass), *Scleria trglomerata*

(whip-grass), *Agalinis purpurea* (false-foxglove), *Sanguisorba canadensis* (American burnet), and *Eupatorium perfoliatum* (spotted joe-pye weed). This community type is part of the "Serpentine barrens complex."

Related types: This community is distinguished from other types of seeps primarily by its landscape context. This type occurs exclusively in areas underlain by serpentinite bedrock and influenced by groundwater rich in magnesium and iron.

Range: Piedmont.

Selected references: PNDI field surveys, WPC and TNC 1998.

[Crosswalk: Smith's "Eastern Serpentine Barrens" (in part), TNC's *Deschampsia cespitosa* Herbaceous Alliance.]

Golden saxifrage - Pennsylvania bitter-cress spring run

This community type occurs in and immediately adjacent to springs. Springs are points of concentrated groundwater flow reaching the surface. Water flow is relatively constant, and temperatures at the source are generally between 9 and 15 degrees C; pH varies between 6.0 and 8.0 at the ground surface. *Chrysosplenium americanum* (golden saxifrage), *Cardamine pennsylvanica* (Pennsylvania bitter cress), and the introduced *Nasturtium officinale* (watercress) are by far the most characteristic species. Other species include *Saxifraga micranthidifolia*^s (lettuce saxifrage), *C. rotundifolia* (mountain watercress), *C. bulbosa* (bitter cress), and *Equisetum* spp. (horsetails). Bryophytes are an especially important element of this community type; more species information is needed.

Related types: A spring run is characterized by a concentrated flow of groundwater reaching the surface. Seeps are also groundwater-fed, but are characterized by diffuse flow.

Range: Entire state (?).

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Spring Community" and "Spring Run Community," TNC's *Chrysosplenium americanum* - *Nasturtium officinale* Herbaceous Alliance.]

Sphagnum - beaked rush peatland

This type occurs in the open areas of many acidic peatlands. The substrate is sphagnum peat, often a floating mat. Typical species include *Rhynchospora alba*



(white beaked-rush), *Sarracenia purpurea* (pitcher-plant), *Drosera intermedia* (spatulate-leaved sundew), *D. rotundifolia* (round-leaved sundew), *Xyris montana*^s (yellow-eyed grass), *Juncus pelocarpus* (brown-fruited rush), *Carex trisperma* (a sedge), *Platanthera blephariglottis* (white-fringed orchid), *Utricularia cornuta*^s (horned bladderwort), *Eriophorum vaginatum* (cotton-grass), and *E. virginicum* (tawny cotton-grass). *Vaccinium macrocarpon* (large cranberry), and *V. oxycoccos* (small cranberry) are abundant in some areas. Shrubs, such as *Chamaedaphne calyculata* (leatherleaf), *Kalmia polifolia* (bog laurel), and *Andromeda polifolia*^s (bog-rosemary), may also occur but do not dominate the community. This community usually occupies one of the interior zones of a larger peatland complex that may also include shrub, woodland, and forest physiognomies. In this case it may occur as part of the "Acidic glacial peatland complex."

Related types: The "Many fruited sedge - bladderwort peatland" type has a very similar structure and setting, but occurs under the influence of groundwater that raises the pH to at least 5. There is a corresponding difference in species composition. As the shrub cover increases, this type usually grades into one of the associated shrub peatland types. Pennsylvania's acidic peatlands usually represent a mosaic of floristically and physiognomically distinct patches or zones. For a description of this pattern and a list of associated community types, see the "Acidic peatland complex" description.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: Crum 1992, PNDI field surveys.

[Crosswalk: Smith's "Oligotrophic Kettlehole Bog" (in part), "Nonglacial Bog" (in part), TNC's *Chamaedaphne calyculata* - *Carex* spp. Saturated Shrub Herbaceous Alliance.]

Many fruited sedge - bladderwort peatland

These are peatland influenced by some degree of groundwater enrichment (pH 5-5.5). They are dominated by sedges, of which *Carex lasiocarpa*^s (many-fruited sedge) is the most characteristic. Bladderworts, usually *Utricularia intermedia* (flat-leaved bladderwort), are also characteristically present. Other species commonly found in these systems include *Carex lacustris* (a sedge), *Potentilla palustris* (marsh cinquefoil), *Menyanthes trifoliata* (bogbean), *Triadenum virginicum* (marsh St.-John's-wort), *C. stricta* (tussock sedge), *Spiraea latifolia* (meadow-sweet), *Typha latifolia* (common cat-tail), *Thelypteris palustris* (marsh fern), and *Vaccinium macrocarpon* (cranberry).

Related types: The "Sphagnum - beaked rush

peatland" type is structurally similar, but lacks the groundwater enrichment that characterizes this type. This type lacks the heavy sphagnum layer that characterizes the previous type. The broad-ranging associate species here are replaced by peatland specialists in the lower-pH type.

Range: Glaciated NE, Glaciated NW, Pocono Plateau, Unglaciated Allegheny Plateau.

Selected references: PNDI field surveys, Sneddon, Anderson, and Metzler 1996, Reschke 1990.

[Crosswalk: Smith's "Poor Fen," TNC's *Carex lasiocarpa* - *Myrica gale* - *Campyllum stellatum* Herbaceous Alliance.]

Water-willow (*Justicia americana*) - smart-weed riverbed community

This community type occurs on major rivers in areas of inundated alluvium, mud or on riverbed rock where soil accumulates in crevices. These areas are flooded for most of the year, but may become exposed during dry periods. The species composition varies; *Justicia americana* (water-willow) is often dominant. Other species that may occur include *Polygonum amphibium* var. *emersum* (water smartweed), *Polygonum punctatum* (dotted smartweed), *Sagittaria* spp. (arrowhead), *Rotala ramosior*^s (tooth-cup), *Schoenoplectus pungens* (chairmaker's rush), *Eleocharis compressa*^s (flat-stemmed spike-rush), *E. acicularis* (needle spike-rush), and *E. erythropoda* (a spike-rush). In more protected, backwater areas, *Saururus cernuus* (lizard's tail) is often the dominant species. This community type is part of the "River bed - bank - floodplain complex."

Related types: This community type differs from the other two herbaceous river-associated types in flooding regime and species composition. This community is flooded for most of the year, the other two types are dry for most of the year. See the description of the "River bed - bank - floodplain complex" for more information.

Range: Entire state except South Mountain.

Selected references: PNDI field surveys.

[Crosswalk: Smith - no crosswalk, TNC's *Justicia americana* Temporarily Flooded (sic.) Herbaceous Alliance.]

Riverside ice scour community

This community type occurs along the banks of major rivers where rock outcrops are subject to winter ice scour and periodic flooding. Plants grow in soil that accumulates in cracks in the rock. Several rare species are found in this habitat in different parts of the state.



These include *Marshallia grandiflora*^s (large-flowered marshallia), *Boltonia asteroides*^s (aster-like boltonia), *Trautvetteria caroliniensis*^s (Carolina tassel-rue), *Hypericum densiflorum*^s (bushy St.-John's-wort), *Prunus pumila* var. *depressa*^s (prostrate sand cherry), *Aristida purpurascens*' (arrow-feather), *Hibiscus laevis* (halberd-leaved rose-mallow), *Montia chamissoi*^s (Chamisso's miners-lettuce), and *Sida hermaphrodite*^s (Virginia mallow). More common species include *H. pyramidatum* (great St.-John's-wort), *H. ellipticum* (pale St.-John's-wort), *Amorpha fruticosa* (false-indigo), *Toxicodendron radicans* (poison ivy), *Vitis* spp. (grapes), *Osmunda regalis* (royal fern), *Rhododendron arborescens* (smooth azalea), *R. maximum* (rosebay), *Spartina pectinata* (freshwater cordgrass), *Eupatorium* spp. (joe-pye weed), *Phalaris arundinacea*⁽¹⁾ (reed canary-grass), *Senecio* spp. (groundsel), *H. mutilum* (dwarf St.-John's-wort), *Physocarpus opulifolius* (ninebark), *Hydrangea arborescens* (wild hydrangea), *Zizia aurea* (golden-Alexander), *Salix* spp. (willows), and *Betula nigra* (river birch). This community type is part of the "River bed - bank - floodplain complex."

Related types: Although *Betula nigra* (river birch) may occur in this community as scattered individuals or in small clumps, it does not dominate the community as in the "River birch sycamore floodplain scrub" type. Substrate and hydrology (temporarily flooded rock outcrops) distinguish this type from the other riverside herbaceous types.

Range: Piedmont, Pittsburgh Plateau, Glaciated Northeast, Glaciated Northwest, Ridge and Valley.

Selected references: PNDI field surveys.

[Crosswalk: Smith's "Riverside Outcrop / Cliff Community," TNC—no direct crosswalk.]

Big bluestem - Indian grass river grassland

This community type occurs on sand/gravel deposits or rock outcrops along riverbanks and on river islands. These sites are subject to flooding and ice scour. The typical aspect is that of a tall grassland. The most characteristic herbaceous species are *Andropogon gerardii* (big bluestem), *Sorghastrum nutans* (Indian grass), and *Panicum virgatum* (switch grass). Other herbaceous species include *Phalaris arundinacea*⁽¹⁾ (reed canary-grass), *Spartina pectinata* (freshwater cordgrass), *Sporobolus asper* (dropseed), *Schizachyrium scoparium* (little bluestem), *Lespedeza violacea* (bush-clover), *Apocynum cannabinum* (Indian hemp), and, in western Pennsylvania, *Baptisia australis* (blue false-indigo). In some places, woody species may become established for a time. Common species include *Salix* spp. (willows), *Platanus occidentalis* (sycamore), *Fraxinus* spp. (ash),

Acer negundo (box-elder), and, in the eastern drainages, *Betula nigra* (river birch) and *Prunus pumila* var. *depressa*^s (prostrate sand cherry). Vines may also be present; common species include *Parthenocissus quinquefolia* (Virginia creeper), *Toxicodendron radicans* (poison ivy), *Vitis labrusca* (fox grape), and *V. riparia* (frost grape). This community type is part of the "River bed - bank - floodplain complex."

Related types: This community's landscape setting and hydrology distinguishes it from related upland grassland types. Dominance by herbaceous plants (mainly grasses) distinguishes this type from the "River birch - sycamore floodplain scrub," which is dominated by stunted *Betula nigra* (river birch) and other woody species.

Range: Piedmont, Ridge and Valley, Pittsburgh Plateau, Glaciated NE.

Selected references: Jennings 1927, PNDI field surveys.

[Crosswalk: Smith's "River Gravel Community," TNC's *Andropogon gerardii* - *Sorghastrum nutans* Herbaceous Alliance.]

NON-PERSISTENT EMERGENT WETLANDS

Pickereel-weed - arrow-arum - arrowhead wetland

This community type is dominated by broad-leaved, emergent vegetation; it occurs in upland depressions and shallow ponds. The aspect of these systems changes seasonally from nearly unvegetated substrate in winter and early spring, to dense vegetation during the height of the growing season. The most characteristic species are *Pontederia cordata* (pickereel-weed), *Peltandra virginica* (arrow-arum), and *Sagittaria latifolia* (arrowhead). Other species commonly present include *Bidens laevis* (bur marigold), *Glyceria* spp. (mannagrass), *Orontium aquaticum* (golden-club), *Sparganium* spp. (bur-reed), *Sagittaria rigida* (arrowhead), *Schoenoplectus tabernaemontani* (soft-stem bulrush), *Eleocharis palustris* (creeping spike-rush), *Polygonum hydropiperoides* (water smartweed), *P. punctatum* (dotted smartweed), *Impatiens* spp. (jewelweed), and *Alisma plantagoaquatica* (water plantain). This type is restricted to small (less than 8 hectares), shallow (less than 2 meters at low water) bodies of water that usually support rooted vegetation across most of their surface. Examples of this vegetation that occur adjacent to the open water of lakes or rivers, are considered to be aquatic vegetation (Cowardin et al. 1979). Aquatic vegetation is beyond the scope of this classification.



Related types: Some examples of the "Herbaceous vernal pond" community type may resemble this floristically. The two differ in their hydrologic regime; the vernal pond type occurs in a small upland depressions that are seasonally flooded, but experience substantial or complete annual draw-down. The type described here is usually semi-permanently flooded.

Range: Glaciated NE, Glaciated NW, Ridge and Valley, Piedmont.

Selected references: Sneddon, Anderson, and Metzler 1994, Reschke 1990, Golet and Larson 1974.

[Crosswalk: Smith's "Natural Pond (in part), "Artificial Pond" (in part), "Stable Natural Pool" (in part), TNC's *Pontederia cordata* - *Peltandra virginica* Herbaceous Alliance.]

[Crosswalk: Smith's "Natural Pond (in part), "Artificial Pond" (in part), "Stable Natural Pool" (in part), TNC's *Nuphar lutea* Herbaceous Alliance, *Nymphaea odorata* - *Nymphoides cordata* Herbaceous Alliance.]

Spatterdock - water lily wetland

A combination of emergent and floating-leaved, rooted hydromorphic vegetation dominates this community type. This type occurs in upland depressions and shallow ponds. The substrate is mineral soil, muck, or peat. Water levels may fluctuate seasonally, but the substrate is seldom dry. The most typical species are *Nuphar lutea* (spatterdock) and *Nymphaea odorata* (fragrant water-lily). Other species include *Polygonum amphibium* (water smartweed), *Sparganium* spp. (bur-reed), *Sagittaria latifolia* (arrowhead), *Alisma plantago-aquatica* (water-plantain), *Schoenoplectus tabernaemontani* (soft-stem bulrush), and *Peltandra virginica* (arrow-arum). There may also be an admixture of submerged and free-floating aquatic species. This type is restricted to small (less than 8 hectares), shallow (less than 2 meters at low water) bodies of water that usually support rooted vegetation across most of their surface. Examples of this vegetation that occur adjacent to the open water of lakes or rivers, are considered to be aquatic vegetation (Cowardin et al. 1979). Aquatic vegetation is beyond the scope of this classification.

Related types: This type may occur intermingled with or surrounded by the "Pickerel-weed - arrow-arum - arrowhead wetland" type. The two types may intergrade.

Range: Entire state except Allegheny Mountain and South Mountain.

Selected references: Sneddon, Anderson, and Metzler 1994, Golet and Larson 1974, Reschke 1990.



Community Complexes

Mesic till barrens complex



Great Lakes Region scarp complex



Acidic glacial peatland complex



Communities, like species, do not occur randomly scattered across the landscape, they generally form patterns of some kind. In some cases they form fairly organized groupings. These groupings are, in a sense, communities of communities. Under particular environmental conditions, certain groups of communities will tend to occur, often in a similar distribution pattern from site to site. These groups of communities are called here community complexes.

Just as a community-based approach to conservation is becoming increasingly accepted as a highly efficient supplement to species-based efforts, the examination of relationship between community types is providing insight into ecosystem functioning and provides information vital to preserve design and other activities concerned with population viability.

The community complex approach is reserved for cases in which community distribution patterns are fairly distinct and recognizable. This tends to be the case where environmental influences on plant species distribution are especially restrictive. In these areas, environmental factors so strongly shape patterns of species and community distribution that random factors become less confounding. In systems where environmental conditions are less restrictive, species and communities can more freely arrange themselves according to factors such as propagule recruitment and localized disturbance history. In these areas, repeating, environmentally driven patterns of community distribution may be difficult or impossible to recognize. For that reason, only a handful of community complexes are described. In future iterations of this classification it may be possible to describe additional complexes. In most cases, however, communities do not display sufficiently distinct, repeating distribution patterns to be included in this section.

The community complex section of this classification represents a selection of special situations rather than a parallel classification system or a level in the classification hierarchy. It should also be remembered that just as any given community example will not contain all the species associated with that type, and may contain some which appear incongruent or transitional, so do examples of community complexes vary in composition. More information is needed to better describe the ecology and composition of the complexes given here, and to describe additional complex types.





ACIDIC GLACIAL PEATLAND COMPLEX

Community types that characterize this complex*:

Black spruce – tamarack peatland forest
Black spruce – tamarack woodland
Highbush blueberry – sphagnum wetland
Leatherleaf – bog rosemary peatland
Leatherleaf – cranberry peatland
Water-willow (*Decodon verticillatus*) shrub wetland
Sphagnum – beaked rush peatland

(*Note: several of these community types also occur in other landscape settings. Examples of this Complex need not contain all of the community types listed. Other community types may occur within examples of this complex.)

Description: This complex encompasses a group of oligotrophic peatlands occurring in glaciated areas. They form in basins with a variety of morphologies, sizes, and origins. This complex includes but is not limited to "kettlehole bogs." Kettlehole bogs are peatlands that form in kettlehole lakes. A kettlehole lake forms when an isolated block of ice is buried by stratified glacial drift that was contained in a glacier and deposited by melt water. As the ice block melts, a deep lake forms, and the outlet is dammed by glacial debris. In this case, as vegetation develops around the edges of the lake, it extends itself out from the shore as a floating mat. This mat may continue to develop until the entire lake is covered by sphagnum peat and associated vegetation, or an open water area may remain near the center. Not all of the peatlands in this complex formed in this way, and not all occur as floating mats. For more detailed information on peatland origins, structure, and development, consult Johnson



Acidic glacial peatland complex- Columbus bog, State Game Lands 197, Warren County. Photograph by Paul Wiegman.



Acidic glacial peatland complex- Little mud pond, Pike County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.

(1985), Crum (1992) and others. This complex includes a variety of peatlands that receive little or no groundwater input, and only limited input from overland flow. They are saturated to the surface throughout the year and are nutrient-poor and highly acidic, at least in the upper levels.

The vegetation of these peatlands is dominated by evergreen and semi-evergreen shrubs (*Chamaedaphne calyculata*, *Andromeda polifolia*, *Kalmia polifolia*, *Vaccinium corymbosum*, *V. oxycoccos*, *V. macrocarpon*), coniferous trees (*Picea mariana*, *Larix laricina*), and continuous layer of sphagnum mosses (*Sphagnum* spp.). Scattered hardwood trees may occur (e.g. *Betula* spp., *Acer rubrum*). Herbaceous biomass is generally low, with sedges (e.g. *Eriophorum vaginatum*, *E. virginicum*, *Rhynchospora alba*) being the most abundant group. Insectivorous plants (*Sarracenia purpurea*, *Drosera intermedia*, *D. rotundifolia*, *Utricularia* spp.) are also characteristic of this complex. In many of these peatland complexes, especially those in kettle holes, vegetation occurs in concentric rings, with forest or woodland physiognomy near the upland border giving way to tall shrubs, then stunted shrubs, and finally dwarf shrubs and herbs near the center. A continuous sphagnum layer is usually present. There may be an area of open water near the center. This may or may not have a fringe of *Decodon verticillatus* (water-willow) surrounding it.

Range: Glaciated NE, Glaciated NW, Pocono Plateau.

Crosswalk: This complex is roughly equivalent to Smith's (1991) "Oligotrophic kettlehole bog," although less restricted in landscape setting.

Selected references: Braun 1950, Crum 1992, Halma 1980, Henry 1950, Jennings 1927, Johnson 1985, PNDI Field forms, VanDersal 1936.

GREAT LAKES REGION SCARP COMPLEX

Community types that characterize this complex*:

Great Lakes Region scarp seep Great Lakes Region scarp woodland

(*Note: Examples of this complex need not contain both community types.)

General description:

This complex describes the vegetation of the extremely steep, actively eroding lakeshore-bluff and creek-wall slopes along Lake Erie. Included are one terrestrial and one palustrine community type. The dominant aspect is that of a woodland (between 10% and 60% cover by trees at least 5m tall), although some sites are forested and others are more open. Vegetation may be sparse, with some areas remaining unvegetated. Physiognomic differences generally reflect different seral stages in this very dynamic system. Common woody species include *Acer saccharum* (sugar maple), *Populus deltoides* (cottonwood), *Tsuga canadensis* (eastern hemlock), *Carpinus caroliniana* (hornbeam), *Ostrya virginiana* (hop-hornbeam), *Juniperus virginiana* (red-cedar), *Salix* spp. (willows), *Cornus rugosa* (round-leaved dogwood), *C. sericea* (red-osier dogwood), *C. alternifolia* (alternate-leaved dogwood), *Rhus typhina* (staghorn sumac), *Rubus odoratus* (purple-flowering raspberry), and *Amelanchier arborea* (shadbush). Herbaceous species include *Aster cordifolius* (heart-leaved aster), *Thalictrum dioicum* (early meadow rue), *Dryopteris marginalis* (marginal wood fern), *Solidago flexicaulis* (zigzag goldenrod), *Impatiens pallida* (pale jewelweed), *Phragmites australis*⁽¹⁾ (common reed), *Arisaema triphyllum* (jack-in-the-pulpit), *Glyceria striata* (fowl mannagrass), *Equisetum arvense* (common horsetail), and the exotic species *Tussilago farfara*¹ (coltsfoot). This complex has a somewhat different species composition on bluffs that front Lake Erie than on creek-wall scarps (Charles Bier, personal communication). More data are needed to determine if they warrant separation.



Great Lakes Region scarp complex- Erie County. Photograph by Staff of the Western Pennsylvania Conservancy.

The "Great Lakes Region

Great Lakes Region scarp complex- Erie County. Photograph by Staff of the Western Pennsylvania Conservancy.

scarp seep" community type occurs where the substrate is saturated by groundwater seepage. These areas are actively "slumping" and extremely dynamic in terms of species

composition and structure. In the case of creek gorge seeps, groundwater seepage occurs at the interface of glacial and glaciallacustrine deposits and the underlying eroded shales and sandstone. On the lakeshore bluffs, the seeps usually occur at the boundary of old beach deposits of sand and gravel, and an underlying layer of dense, more restrictive till. These communities are characteristically open. Some are completely herbaceous, but most contain shrubs, and sometimes scattered trees. This is a very dynamic system, and the structure of the vegetation depends largely on its successional status. Recently slumped areas are first colonized by bryophytes and *Equisetum* spp. (horsetails). As the substrate becomes more stable and organic matter accumulates, graminoids and other herbs and shrubs colonize the seep. Eventually, perhaps in part due to the weight of the vegetation and organic matter, the entire community will "slump" or slide downslope, and the cycle begins again. More protected sites tend to slump less frequently, and may develop a tree canopy.

The complex is united by its unique physical environment rather than a particular set of species. The species composition and physiognomy of this complex vary greatly from site to site. This variation is at least partially in response to aspect, soil characteristics, hydrology, exposure, and distance from the lake. It may be useful in the future to define variants of this complex or its communities based on such relatively stable environmental variables. However, because the vegetation on any given site is likely to change dramatically over the course of one to several decades, from a conservation perspective it may be less useful to differentiate between the various physiognomies/successional stages contained within this complex.

Range: Great Lakes Region.

Crosswalk: This complex is equivalent to Smith's (1991) "Eastern Great Lakes Bluff/Cliff Community."

Selected references: Kline 1993, WPC and TNC 1998.
ERIE LAKESHORE BEACH – DUNE –





SANDPLAIN COMPLEX

Community types that characterize this complex*:

- Great Lakes Region cottonwood - bayberry community
- Great Lakes Region dry sandplain
- Great Lakes Region palustrine sandplain
- Great Lakes Region bayberry - mixed shrub palustrine shrubland
- Great Lakes Region sparsely vegetated beach

(*Note: some of these community types also occur in other landscape settings.)

Description: This complex occurs in Pennsylvania only on Presque Isle—a sandspit peninsula that extends about seven miles into Lake Erie. The complex is best developed along the terminal one-third, from the lighthouse to the tip of the sandspit. It includes sparsely vegetated beaches, dunes of varying degrees of stability, and both dry and palustrine sand plains. *Populus deltoides* (cottonwood) dominates the discontinuous tree stratum. *Myrica pensylvanica* (bayberry) and a variety of other shrubs cover extensive areas both palustrine and terrestrial. The herbaceous stratum is extremely diverse and variable; some of the more common species include *Calamagrostis canadensis* (bluejoint), *Panicum virgatum* (switchgrass), *Schizachyrium scoparium* (little bluestem), *Andropogon gerardii* (big bluestem), and *Ammophila breviligulata* (beach grass). In addition, at least 12 plant species of special concern are found in this complex.



Great Lakes Region scarp complex- Presque Isle State Park, Erie County. Photograph by Tom Smith.



Great Lakes Region scarp complex- Presque Isle State Park, Erie County. Photographs by Paul Wiegman.

This complex occurs on a substrate of glacial sand and gravel deposits. This material is constantly being eroded and redeposited by the action of currents, waves, and storm events. The dynamic nature of the substrate maintains a variety of successional stages. Additionally, the porous nature of the substrate causes the water table to respond quickly to changes in lake level. As a result, natural communities occur as a complicated mosaic of different hydrologic conditions, seral stages, physiognomies, and floristic assemblages that shift over time.

In general, from the lake side of the sandspit, the "Great Lakes Region sparsely vegetated beach" occurs from the water's edge to the upper limit of winter storms. Moving inland, from the top of the foredune, usually one to three meters above the beach, a mosaic of the remaining four types generally occurs. Their placement and distribution depends on water levels, the stability of the substrate, and the length of time since a major storm event or other disturbance.

The dynamic nature of the system contributes greatly to its species diversity. Seedbanks associated with several of these community types may persist up to 100 years (Bier pers. communication). The persistence of the seedbank, in combination with the disturbance regime and variable hydrology, allows species or assemblages of species to persist at the complex level, even though local populations or examples of individual community types may disappear.

Range: Great Lakes Region.

Crosswalk: This complex is equivalent to a combination of Smith's (1991) "Great Lakes Region Beach Community" and "Eastern Great Lakes Sand Plains" community types.

Selected references: Bissell and Bier 1987, Kline 1993.



Mesic till barrens complex- TNC's preserve at Long Pond, Monroe County. Photograph by Roger Earl Latham.

MESIC TILL BARRENS COMPLEX

Community types:

Pitch pine - rhodora - scrub oak woodland Rhodora - mixed heath - scrub oak shrubland

Description: This complex and the community types it contains are known only from the southern Pocono Plateau of Pennsylvania. Woodlands, shrublands and forests occur in a complicated mosaic on a fairly tight spatial scale. This system is unusual among barrens in that it is not the result of droughty soil conditions (Latham et al. 1996). It occurs mainly on deep, fine-loamy Illinoian age glacial till. The vegetation is a mixture of wetland plants and plants usually associated with xeric soil conditions.

The Pocono mesic till barrens are the most plant species-rich barren type in Pennsylvania, and contains the greatest concentration of globally rare plant and animal species of any terrestrial ecosystem in Pennsylvania (Davis et al. 1991). At least 30 regionally rare and 10 globally rare species occur on the barrens (Latham et al. 1996).

The barrens are dominated by ericaceous shrubs (dominantly *Rhododendron canadense*, *Kalmia angustifolia*, *Vaccinium angustifolium*, and *Gaylussacia baccata*) and *Quercus ilicifolia* (scrub oak), with scattered individuals or clumps of *Pinus rigida* (pitch pine). The dominant herbaceous species is *Pteridium aquilinum* (bracken). Mosses include *Polytrichum commune* and *Sphagnum* spp.

The processes responsible for the origin of the barrens, their persistence, and the spatial distribution of the community types are not known. The ecosystem dynamics of this complex are the focus of ongoing research. Preliminary findings indicate that the vegetation of the barrens may represent an alternative, relatively stable community state. Maintenance of this complex may depend on feedbacks between plants and environmental factors involving fire frequency, "frost pocket" microclimates, and the nitrogen dynamics of ericaceous plants and other sclerophylls (Petraitis and Latham 1998).

There are a number of other community types that appear to be closely associated with the types given here. In future versions of this classification, this complex may be expanded to include additional community types.

Range: Pocono Plateau.

Crosswalk: This complex is equivalent to Smith's (1991) "Mesic Scrub Oak-Heath-Pitch Pine Barrens."

Selected references: Davis et al. 1991, Latham et al. 1996, Petraitis and Latham 1998.



Mesic till barrens complex- Fire at TNC's preserve at Long Pond, Photograph by Roger Earl Latham.



Serpentine Barrens Complex- Hershey Mill Barrens, Chester County. Photograph by Ann Rhoads

SERPENTINE BARRENS COMPLEX

Community types that characterize this complex*:

Serpentine pitch pine - oak forest
Serpentine Virginia pine - oak forest
Red-cedar - pine serpentine shrubland
Serpentine grassland
Serpentine gravel forb community
Serpentine seepage wetland

(*Note: Examples of this complex need not contain all of the community types listed.)

Description: This complex encompasses a distinctive pattern of vegetation occurring on predominantly Chrome-series soils overlaying serpentinite bedrock outcrops in southeastern Pennsylvania. Similar vegetation occurs on serpentinite outcrops throughout the Piedmont Upland of North America from New York to Georgia. The harsh chemistry of serpentinite soils, in combination with a history of repeated fires and in some cases grazing, maintains a unique group of plant communities with a high concentration of plant and animal species of special concern.

The vegetation of the barrens is a mosaic of different physiognomies. There are forests dominated by oaks (*Quercus stellata*, *Q. marilandica*) and pine (*Pinus rigida*, *P. virginiana*) with an understory of *Smilax* spp.

(greenbriar). There are open grasslands dominated warm-season (C₄) grasses such as *Schizachyrium scoparium* (little bluestem), *Andropogon gerardii* (big bluestem), *Sporobolus heterolepis* (prairie dropseed), and *Sorghastrum nutans* (Indian grass), with scattered trees and shrubs such as *Juniperus virginiana* (red-cedar), *Rhus copallina* (shining sumac), *R. glabra* (smooth sumac), and *Gaylussacia baccata* (black huckleberry). There are sparsely vegetated areas with little soil

development dominated by forbs such as *Arabis lyrata* (lyre-leaved rock-cress), *Asclepius verticillata* (whorled milkweed), *Aster depauperatus*^s (serpentine aster), *Cerastium arvense* var. *villosimum* (barrens chickweed), *Phlox subulata* ssp. *subulata* (moss-pink), *Talinum teretifolium*^s (round-leaved fame-flower). There may also be small, groundwater-fed wetlands.

Serpentinite-derived soils have exceptionally low levels of nitrogen, phosphorus, potassium and calcium, high levels of nickel, chromium and cobalt and—perhaps most critically for plant growth and survival—a high magnesium/calcium ratio (Kruckelberg 1954). The unique character of the vegetation, the distribution of the different community types, and the high degree of endemism associated with serpentine barrens are apparently due to a combination of soil chemistry and disturbance factors.

Only a fraction (less than 10%) of the area of Pennsylvania's serpentinite outcrops currently supports barren vegetation. Deeper soils appear to reduce the influence of serpentinite chemistry on plants to such an extent that areas with deepest soils support dry-mesic forests resembling those occurring on soils derived from non-serpentine rock types. On the barrens, community distribution is strongly correlated with soil depth (Dubinsky and Latham in prep.). The "Serpentine gravel-forb community" occurs on areas of thinnest soils and rock outcrops. It is in this community type that the majority of serpentinite endemic plant species occur. Grasslands, shrubland and woodland vegetation occur on somewhat deeper soils, while forests occur on the deepest soils. Soil-reducing or soil-removing disturbance appears to be required to maintain the distinctive character of the barrens (Latham 1992).

Historical accounts of barrens fires, charcoal fragments and observation over the past 50 years of intensive fire control confirm that the barrens as first documented by Western botanists were fire-dependent systems (Latham 1992). Aerial photo documentation and verbal/historical account show that in the absence of fire, areas of rock outcrop, gravel, and extremely thin soil have steadily decreased. Herbaceous and woody species have begun to invade open areas from the edges, creating a more temperate environment by providing shade, reducing surface temperatures, adding organic material, facilitating soil development, and increasing moisture retention.

The presence of *Pinus virginiana* instead of the fire-adapted *P. rigida* on a barren can have far-reaching implications for the site's ecology and future vegetation. *P. virginiana* appears to facilitate soil development and the invasion of barrens by mesic species (Barton and Wallenstein 1998), while *P. rigida* resists it (Latham 1993). The mechanisms



behind this dynamic are not fully known. *P. virginiana* produces dense shade; this shade appears to limit or exclude the dense layer of *Smilax* spp. that characterizes the understory of *P. rigida* forests. *Smilax* spp. in turn limits or excludes seedling establishment by mesic tree species (Latham pers. communication). The flammability of *P. rigida* and its decay-resistant litter may help the species to resist invasion by reducing nitrogen availability and increasing fire return rate (Latham pers. communication).

Researchers in Pennsylvania and elsewhere are experimenting with a range of disturbance regimes in an attempt to restore and maintain the species and communities of concern that occur on serpentine barrens. Various combinations of cutting, soil disturbance and fire of various intensities, intervals, and seasonality are being applied on experimental plots on serpentine barrens throughout the Piedmont. See the literature section

below for some sources current at the time of this writing. Consult the current literature and the Pennsylvania Field Office or the Pennsylvania Science Office of The Nature Conservancy for the latest developments in this area.

Range: In Pennsylvania, this complex is restricted to areas on and adjacent to outcrops of serpentine rock formations in the southeastern corner of Pennsylvania (Chester, Lancaster and Delaware counties) continuing into adjacent areas of Maryland and Delaware.

Crosswalk: This complex is equivalent to Smith's (1991) "Eastern Serpentine Barrens."

Selected references: Anderson 1971, Brooks 1987, Clupper 1991, Day 1953, Dorsey 1987, Dubinsky and Latham in prep., Kruckelberg 1954, Latham 1992, Miller 1977, Miller 1981, Smith 1988.



Serpentine Barrens Complex- Goat Hill Barrens, Chester County.
Photograph by Tom Smith.

RIDGETOP ACIDIC BARRENS COMPLEX

Community types that characterize this complex*:

Pitch pine - scrub oak woodland
Pitch pine - mixed hardwood woodland
Pitch pine - heath woodland
Dry oak - heath woodland
(Red spruce rocky summit-rare)
Scrub oak shrubland
Low heath shrubland
Low heath - mountain ash shrubland
Little bluestem - Pennsylvania sedge opening

(*Note: Most of these community types also occur in other landscape settings. Examples of the complex need not contain all community types listed.)

Description: The "Ridgetop acidic barren complex" represents a group of open-canopy ridgetops and summits, which occur throughout central and northeastern Pennsylvania. This complex is found on high ridgetops and summits (1200-2200 ft), where low soil moisture, shallow soils, high wind velocities, frequent fires, and usually a history of cutting limit tree growth. Similar patterns continue into New York, New Jersey, Maryland, and southward along the Appalachian highlands. More information is needed to evaluate the variation in this complex across its range.



Ridgetop Acidic Barrens Complex- Broad Mountain Barrens, Carbon County. Photograph by Staff of the Pennsylvania Science Office of The Nature Conservancy.

Structurally, these areas contain a mosaic of physiognomic types, including woodlands, shrublands, and open grassy areas. Where trees become established, they are typically stunted, and in areas exposed to high winds, flagged. The bedrock geology in these areas may be sandstone, conglomerate, acidic shale, schist, gneiss, or quartzite. Soils are usually thin, well drained to excessively well-drained, and acidic. There may be extensive areas of unvegetated or sparsely vegetated bedrock outcrops. There may also be areas of bare soil.

The vegetation is dominated by oaks (*Quercus ilicifolia*, *Q. velutina*, *Q. montana*, *Q. coccinea*) and heaths



Ridgetop Acidic Barrens Complex- State Game Lands 57, Wyoming County. Photograph by Jean Fike

(*Vaccinium angustifolium*, *V. pallidum*, *Gaylussacia baccata*, *Kalmia angustifolia*), with or without pine (*Pinus rigida*, *P. strobus*, *P. virginiana*, *P. pungens*). A variety of other hardwood species (*Ater rubrum*, *Sassafras albidum*, *Betula lenta*, *Nyssa sylvatica*, *Populus tremuloides*) and non-ericaceous shrubs (*Comptonia peregrina*, *Aronia melanocarpa*, *Sorbus americana*) may also be present. The herbaceous layer is dominated by sedges, grasses, and bracken (*Pteridium aquilinum*). There is frequently an abundance of mosses and lichens; more information is needed on nonvascular species.

The arrangement of individual community types appears to be influenced by a combination of factors including elevation, soil depth, exposure, cutting history, fire history, and microclimate (the "frost pocket" phenomenon). In general, the physiognomy becomes more open at higher elevations and on southern exposures. Where fires are frequent, *Pinus rigida* (pitch pine) will typically be present. In the absence of fire, other pines (*P. strobus*, *P. virginiana*, *P. echinata*, *P. pungens*) may accompany or replace *P. rigida*, or pine may be absent altogether. Frost pockets may play a part in maintaining open areas; this is especially true of the "Little bluestem - Pennsylvania sedge opening" type. If fire is suppressed on these sites over the long term, their distinctive vegetation may gradually give way to more mesic species typical of the surrounding forests at lower elevations.

Two of the community types associated with this complex appear to be elevation-restricted in Pennsylvania. The "Low heath -mountain ash shrubland" type generally only occurs at elevations above 1900 ft. The "Red spruce rocky summit" type is known in Pennsylvania from only one site, with an elevation of about 2200 ft.

The forest types that most typically surround this complex are the "Dry oak - heath forest" and "Pitch pine - mixed oak forest," although a variety of other types may also occur.

Range: Glaciated NE, Pocono Plateau, Ridge and Valley, South Mountain, Unglaciated Plateau.

Crosswalk: This complex is roughly equivalent to a combination of Smith's (1991) "Ridgetop Dwarf-Tree forest" and "Northern Appalachian Acidic Rocky Summit" community types.

Selected references: Dupstadt 1972, Illick and Aughanbaugh 1930, McVaugh 1957, Olsvig 1979, PNDI field forms, Reschke 1990.



River bed - bank - flood plain complex. Susquehanna River, Dauphin County. Photograph by Jean Fike.

RIVER BED – BANK – FLOODPLAIN COMPLEX

Community types that characterize this complex*:

- Sycamore - (river birch) - box elder floodplain forest**
- Silver maple floodplain forest**
- Red maple - elm - willow floodplain swamp**
- River birch - sycamore floodplain scrub**
- Black willow scrub/shrub wetland**
- Riverside ice scour community**
- Big bluestem - Indian grass river grassland**
- Water-willow - smartweed riverbed community**

(*Note: Examples of this complex will not usually contain all of the community types listed.)

Description:

This complex describes persistent emergent vegetation growing in or along rivers. It includes semi-permanently/seasonally flooded vegetation of the riverbed, banks and islands as well as temporarily flooded and saturated floodplain communities. This landscape is organized by severity and frequency of flooding, ice scour, direction of flow, and differences in substrate. Community types that are inundated for much of the growing season in most years are dominated by herbaceous vegetation (e.g. *Apocynum cannabinum*, *Justicia americana*, *Eleocharis* spp., *Cyperus* spp., *Polygonum* spp., *Bidens* spp.). Areas with less extensive periods of inundation, which are scoured by river ice in some years, are dominated by woody vegetation (e.g. *Betula nigra*, *Salix nigra*, *Platanus occidentalis*), which is maintained in an early successional stage by ice scour and flooding. Areas that are not subject to ice scour and are periodically inundated but remain dry for the majority of the year, support forest vegetation with a mixture of upland and wetland species. Floodplain sites where floodwaters are retained on site for longer periods of time or where additional hydrologic sources are present may support almost entirely wetland vegetation. Differences in disturbance regime, substrate, and hydrologic regime

produces the great structural, community, and species diversity associated with this complex.

The community type with the longest typical period of inundation is the "Water-willow - smartweed riverbed community." This community type occurs on alluvium, mud or on riverbed rock where soil accumulates in crevices. It remains inundated for most of the year, but may become exposed during dry periods. In areas subject to flooding of lesser frequency and duration but still subject to ice scour, a variety of woody and herbaceous community types occur. On sand and gravel bars, and occasionally on rock outcrops with sand and silt accumulating in cracks in the rock, a tall grassland community, with or without scattered woody plants, the "Big bluestem - Indian grass river grassland" may be found. The "Riverside ice scour community" occurs on rock outcrops, and is characterized by a mixture of herbaceous and woody plants. The frequency and severity of ice scour and flooding in these two communities maintain their open aspect.

Along the riverbanks and on larger islands, where the disturbance regime is somewhat less severe, two woody community types—the "River birch - sycamore floodplain scrub" and the "Black willow scrub/shrub wetland" frequently occur. These two communities exist on a continuum with the "Big bluestem -Indian grass river grassland." In areas where disturbance is intermediate, the vegetation may be intermediate between types. Likewise, depending on flood and scour severity in recent years, woody plants may become established on, or be removed from a given site. This is a dynamic system, driven primarily by river levels.

In areas subject to still less prolonged and less frequent flooding, and not generally subject to ice scour, floodplain forests usually occur. The "Silver maple floodplain forest" and the "Sycamore -(river birch) - box elder floodplain forest" are dry throughout most of the year, but receive at least intermittent flooding. The "Red maple - elm - willow floodplain swamp" may be flooded with a frequency similar to that of the other two floodplain forest types, but it typically occurs in depressions, old oxbows, or behind natural levees. The landscape position of this community type prevents floodwaters from draining rapidly, and water is retained on the site for prolonged periods. These wetlands may also receive groundwater enrichment and/or surface water from adjacent uplands.

More information is needed to describe in greater detail the hydrology, landscape position and successional dynamics of the community types in this complex.

Range: Entire state, associated with major river systems.

Crosswalk: This complex is equivalent to a combination of Smith's (1991) "Floodplain Swamp," "River Gravel Community," and "Riverside Outcrop / Cliff Community" types.

Selected references: Cowardin et al. 1979, PNFI Field forms, Smith 1991.



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Acidic: describes soil or water with a pH lower than 5.5.

Alluvium: unconsolidated material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

Annual: a plant that completes its entire life cycle in a single growing season.

Anthropogenic: induced or altered by the presence or activities of humans.

Aquatic bed: a wetland or deepwater habitat dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

Assemblage: a group of organisms that occur together; does not imply a particular scale.

Bar: an elongated mass of sand, gravel, or alluvium deposited on the beds of streams or lakes or at the mouth of streams.

Barrens: Woodland or shrubland communities where tree establishment or growth is suppressed by environmental conditions and/or disturbance regime. Most often associated with thin or excessively drained soils.

Bedrock: the solid rock that is exposed at the surface or underlies the soil or other unconsolidated material at the surface.

Biomass: the total dry weight of all organisms in a particular area, sample, or community.

Bog: a nutrient-poor, acidic peatland that receives water primarily from direct rainfall, with little or no input from groundwater or runoff; vegetation consists primarily of peat mosses (*Sphagnum* spp.) and ericaceous shrubs.

Bryophyte: members of division Bryophyta: the liverworts, hornworts, and mosses.

Calcareous: Describes soil, groundwater, or surface water with high calcium concentrations, often derived from limestone or calcium-rich glacial deposits.

Canopy: the branches and leaves of plants that form the uppermost layers of vegetation in a community. A canopy is said to be closed (or have 100% cover) when the ground and lower strata are completely hidden when viewed from above the canopy during the growing season.

Characteristic species: a species strongly associated with a particular community type, either as a dominant, a ubiquitous non-dominant component, or as particularly diagnostic of that community type.

Circumneutral: having a pH between 5.5 and 7.4.

Codominant: a species with relatively high abundance or percent cover; two or more species providing roughly equal cover, abundance, or influence in a community or stratum.

Community: an assemblage of plants and/or animal populations sharing a common environment and interacting with each other and with the physical environment.

Community complex: a set of community types that tend to occur together under a specific set of environmental circumstances.

Composition: all the species present in a community and their relative abundance.

Conifer: any of a large group of cone-bearing trees and shrubs, mostly evergreens such as the pine, spruce, fir, cedar, yew, etc.



Cover: the percentage of the ground surface that is covered or shaded by the leaves or stems of a plant species or a group of plant species during the growing season.

Disturbance regime: a repeating pattern of natural disturbances such as fire, flooding, ice scouring, windthrow, erosion, etc.

Dominant: a species with the greatest abundance, percent cover, or influence in a community or stratum.

Edaphic: pertaining to the soil.

Emergent: upright, rooted vegetation that may be temporarily to permanently flooded at the base, while the upper portions of the plant grow erect above the water surface; these plants do not tolerate prolonged inundation of the entire plant; e.g. cattail (*Typha* spp.).

Ericaceous: members of the heath family (*Ericaceae*).

Exotic: refers to species not native to Pennsylvania, or to the area in which they occur.

Fen: an open-canopy peatland that has developed under the influence of base-rich waters.

Floodplain: flat to nearly-flat areas along rivers and streams that are subject to at least intermittent flooding.

Forb: a broad-leaved (not grass-like) herbaceous plant; may include ferns and fern-allies.

Forest: a type of community dominated by trees greater than five meters in height, and having at least 60% canopy closure, crowns usually interlocking; may be terrestrial or palustrine.

Frost pocket: a small, low area that has poor aerial drainage and is subject to frequent frosts.

Graminoid: refers to grass-like, narrow leaved herbaceous plants; includes grasses (*Poaceae*), sedges (*Cyperaceae*), rushes (*Juncaceae*), and others.

Grass: a member of the grass (*Poaceae*) family.

Grassland: an open-canopy community dominated by graminoids; forbs may be common, but there are relatively few shrubs and very few trees.

Groundlayer: the herbs, shrubs, and woody vines beneath the trees in a forest; or the lowest layer of vegetation in an open-canopy community.

Groundwater: water found underground in openings in rock strata and soils.

Gravel: a mixture composed primarily of small rock fragments between 2mm and 7.6cm in diameter.

Hardwood: (in our region, with the exception of *Ilex opaca* — American holly) deciduous trees that are not conifers.

Heath: a member of the family *Ericaceae*.

Herb, Herbaceous: describes plants with no persistent woody stem above the ground, as distinct from trees and shrubs.

Herbaceous layer: the layer of vegetation in which herbs are common or dominant, usually the groundlayer.

Hydric: wet; describes soils that are sufficiently wet to at least periodically produce anaerobic conditions in the root zone, thereby influencing the growth of plants.



Hydrology: describes the way water is distributed in the landscape, moves over the ground surface and underground, includes precipitation, evaporation, transpiration, and flow.

Hydrophyte, Hydrophytic: describes any plant adapted to growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

Levee: a low ridge or embankment that impounds water.

Utter: fresh or partially decomposed organic debris such as leaves, twigs, fruit, etc.

Loam: soil composed of a mixture of particle sizes, specifically: 7% to 27% clay, 28% to 50% silt, and less than 52% sand.

Marsh: a wetland dominated by herbaceous (often graminoid) vegetation and usually having little or no peat accumulation.

Mesic: describes areas of intermediate soil moisture content; moist but well drained.

Microtopography: the fine scale of topography on a site.

Mineral soil: soil composed of primarily mineral rather than organic materials. For more information see Appendix D in Cowardin et al. (1979).

Minerotrophic: groundwater-fed; influenced by water that has been in contact with soil or bedrock, and is richer in mineral content than rainwater.

Mosaic: in a landscape, a complex pattern composed of different types of communities, aspects or assemblages that are intermingled.

Muck: highly decomposed organic material in which the plant parts are no longer distinguishable (sapric peat).

Native: describes species that occurred in Pennsylvania or in the area in which they are found prior to European settlement; not introduced by human activities; indigenous.

Nonpersistent emergent vegetation: emergent hydrophytes whose leaves and stem normally break down before the beginning of the next growing season. The breakdown may be the result of normal decay or the physical force of waves or ice. There is normally some portion of the year in which there are no visible traces of the plants above the surface; e.g. wild rice (*Zizania aquatica*), arrow arum (*Peltandra virginica*).

Oligotrophic: poor to extremely poor in nutrients, typically describes dilute waters with low base metal ion concentrations.

Organic matter: material derived from the decay of dead organisms.

Organic soil: soil composed of primarily organic rather than mineral materials. For more information see Appendix D in Cowardin et al. (1979).

Outcrop: the exposure of bedrock projecting through the overlying soil or other unconsolidated material at the surface.

Oxbow: an abandoned meander loop formed when a stream takes a new course. This crescent-shaped body of water becomes filled over time with fine-grained "back swamp" material.

Palustrine: describes wetlands; areas intermediate between aquatic and terrestrial habitats, supporting predominantly hydrophytic vegetation, where conditions are at least periodically wet enough during the growing season to produce anaerobic soil conditions and thereby influence plant growth.

Peat: partially decomposed remains of plant material in which at least some of the plant parts are still distinguishable (here fibric or hemic peat).



Peatland: a community or group of communities occurring over peat of at least 40 cm depth.

Perennial: a plant that persists and produces reproductive structures year after year.

Persistent emergent vegetation: emergent hydrophytes that normally remain standing at least until the beginning of the next growing season; e.g. cattails (*Typha* spp.) or bulrushes (*Scirpus* spp.).

pH: a symbol denoting the negative logarithm of hydrogen ion concentration in a solution; pH values run from 0 to 14, the lower the value, the more acidic the solution, that is, the more hydrogen ions it contains; pH 7 is neutral, less than 7 is acidic; more than 7 is alkaline.

Physiognomy: The general physical structure of vegetation (e.g. forest, woodland, shrubland etc.).

Relative cover: the aerial cover of a species or group of species expressed as a percent of the total cover of the stratum in which it occurs; the relative cover values for all species in a given stratum will always total 100%.

Rich: describes either environments where nutrients are abundant, or communities with high species diversity.

Sandspit: a small point or narrow embankment of land, consisting primarily of sand deposited by longshore drifting, and having one end attached to the mainland and the other terminating in open water.

Scarp: a line of cliffs or a wall-like steep slope formed by faulting or erosion.

Scrub: vegetation consisting primarily of stunted or dwarf trees and shrubs.

Seep: an area where groundwater discharges in a diffuse flow.

Sedge: grasslike herbaceous plant of the family *Cyperaceae*, especially members of the genus *Carex*.

Seral: of, relating to, or characteristic of an ecological sere.

Sere: a series of ecological communities that follow each other in the course of the biotic development of an area.

Serpentine: a secondary material, resulting from "hot water" alteration of magnesium silicates, such as peridotite. The name includes at least two minerals, antigorite and chrysolite.

Serpentinite: a rock consisting almost wholly of serpentine minerals derived from the alteration of olivine and pyroxene.

Shrub: a perennial, woody plant that differs from a tree in its short stature (less than five meters in height) and typically multi-stem growth form.

Shrubland: a community dominated by shrubs, with less than 25% total cover by trees.

Silt: soil composed of fine-grained mineral sediments—particles are of intermediate size between sand and clay (particle size between 0.074 and 0.002 mm)— and are carried in or deposited by moving water.

Site: a place or location.

Sphagnum: members of the moss genus *Sphagnum*.

Stratum: layer: here a layer of vegetation, e.g. tree, shrub, herbaceous.

Structure: the spatial arrangement of vegetation layers within a community.

Spring: location of concentrated groundwater discharge.



Spring run: body of running water adjacent to and originating at a spring.

Subcanopy: in a forest community, the tops and branches of the small trees and tall shrubs that form a distinct layer beneath the high tree canopy and above the shrub layer (if present).

Substrate: the foundation to which an organism is attached, or upon which a community occurs.

Succession: directional change in species composition on a site following a disturbance.

Successional: describes communities that are changing in composition relatively quickly in response to a disturbance.

Swamp: a wooded wetland, intermittently or permanently flooded.

Talus: rock fragments of any size or shape, derived from and lying at the base of a cliff or very steep rocky slope.

Terrestrial: uplands; where vegetated, supporting vegetation that is not predominantly hydrophytic.

Till: unstratified drift deposited by a glacier and composed of sand, clay, gravel, cobble and boulders in any combination and proportion.

Tree: a woody perennial plant, usually having one principle stem, that has a definite crown and characteristically reaches a mature height of at least five meters.

Ultramafic: describes soil or rock types high in magnesium and iron

Upland: sites with well-drained dry to mesic soils.

Understory: the lower layers of vegetation in a community; in a forest, all the vegetation layers beneath the canopy and subcanopy.

Vascular plants: plants with a vascular system; includes trees, shrubs, and herbs, but not bryophytes, lichens or algae.

Vernal: occurring in the spring.

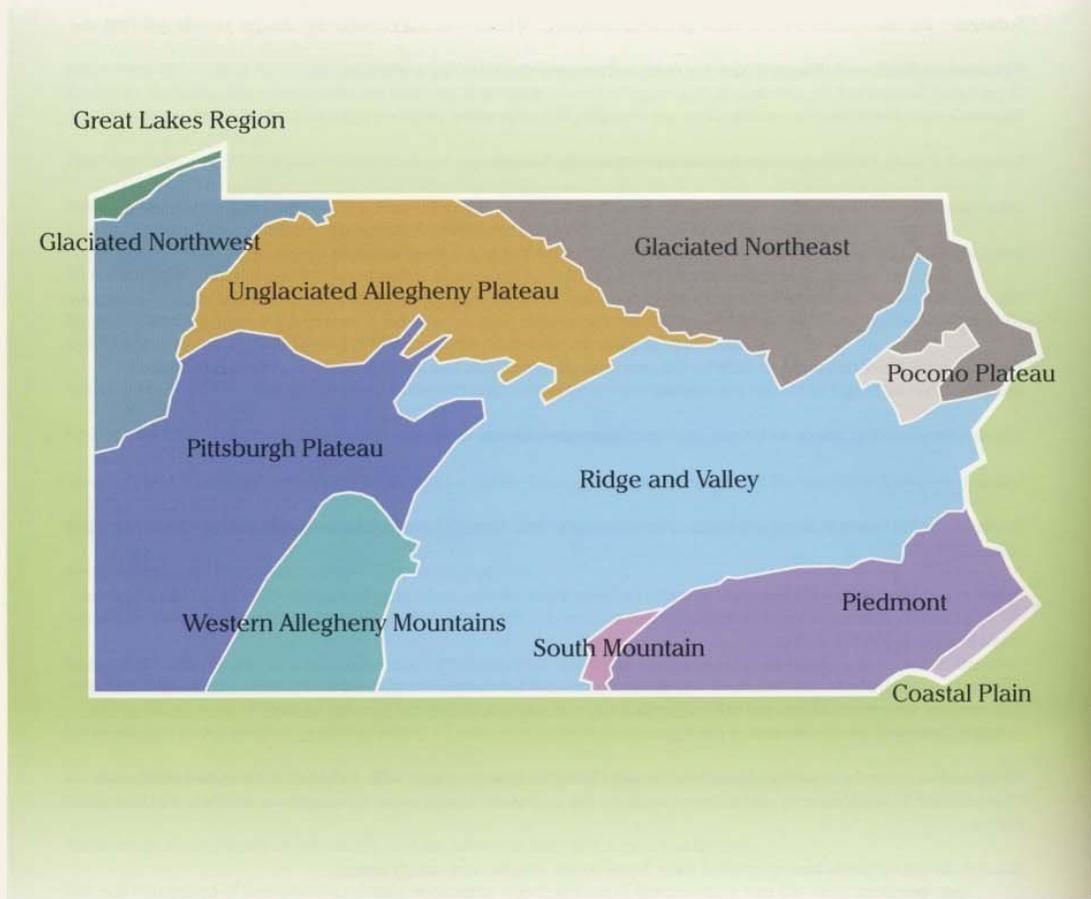
Wetlands: areas intermediate between aquatic and terrestrial habitats; characterized by a predominance of hydrophytes, where conditions are at least periodically wet enough, during the growing season, to produce anaerobic soil conditions and thereby influence plant growth.

Woodland: a community with a sparse tree canopy (10%-60% cover), usually with an herbaceous and/or shrub layer. Characteristic of environments where tree establishment or growth is suppressed by edaphic conditions or disturbance regime.

Woody: describes plants having lignified stem tissue (trees, shrubs, and woody vines).

Xeric: very dry, describes areas with dry, well drained to excessively well-drained soils.

Ecological Regions of Pennsylvania



Map based on ongoing work by
Bureau of Topologic and Geologic Survey
Pennsylvania Department of Conservation & Natural Resources