Northern Wet-mesic Forest (AKA “White-cedar Swamp”)  
(Global Rank G3?; State Rank S3S4)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Northern Wet-mesic Forest is a minerotrophic coniferous wetland community that is widely distributed and common in some parts of Wisconsin north of the Tension Zone. Northern white-cedar is the dominant tree, and the type is often referred to by the vernacular name “cedar swamp.” The dominant cedars may achieve great girth and age, though they don’t become particularly tall (heights of 45 to 60 feet are typical for mature trees). Northern white-cedar may reproduce by seed or by layering and is able to continue growing following windthrow because the downed trunk is enveloped by mosses and lateral branches oriented away from the ground surface continue growing vertically. In older stands of this shallow-rooted species, short straight rows of cedar may be observed, representing a fallen canopy tree with horizontal branches that then became the next generation of upright trunks. Such behavior, along with the attributes of some of the canopy associates (deciduous trees with large spreading crowns such as yellow birch mixed with conifers having narrow, spire-shaped crowns that protrude from the canopy) lend unique structural attributes to mature cedar swamps. When present in older stands, eastern white pine and sometimes white spruce may form a supercanopy tree. Older cedar swamps are among Wisconsin’s most structurally complex forest communities.

In some upper midwestern states and the province of Ontario, the cedar-dominated northern white-cedar swamp is referred to as “Rich Forested Fen” (Harris et al. 1996, Kost et al. 2007). The roots of the northern white-cedars are in contact with nutrient-enriched, well-aerated moving groundwater, which contributes to the development and support of very different plant assemblages than those associated with the more acid, oxygen-deprived and nutrient-deficient acid peatland forests in which black spruce is typically dominant.

Soils are woody peats or mucks. In some shallow embayment basins on the Door Peninsula, the substrate is peat, muck, or mucky peat over marl (M. Grimm, The Nature Conservancy-Sturgeon Bay, personal communication). This may also be true in other parts of northeastern Wisconsin where the underlying glacial deposits are strongly calcareous.

The wet-mesic northern white-cedar swamps are major repositories of botanical diversity across their northern Wisconsin range. They possess structural attributes that are unique and support sensitive mammals, birds, and herptiles. Major threats are hydrological disruption, the spread of invasive species, and excessive browse pressure by white-tailed deer, and these must be addressed soon.

Northern white-cedar also occurs on mineral soils, either as an uncommon associate of mesic hemlock-hardwood forests or on strongly calcareous substrates such as those provided by alkaline glacial tills, outwash, or, on the Door Peninsula, bedrock. Such situations are further detailed in the descriptions of other natural communities, such as the northern fens.

Community Description: Structure and Composition

Though northern white-cedar (Thuja occidentalis) may occur in dense stands or groves with few other trees present, the potential canopy associates are a diverse and varied group and include tamarack (Larix laricina), black spruce (Picea mariana), white spruce (Picea glauca), balsam fir (Abies balsamea), yellow birch (Betula alleghaniensis), white birch (B. papyrifera), black ash (Fraxinus nigra), red maple (Acer rubrum), eastern hemlock (Tsuga canadensis), balsam poplar (Populus balsamifera), and eastern white pine (Pinus strobus).

The tall shrub layer may be prominent and varied, reaching heights of 2 to 4 meters and featuring species such as speckled alder (Alnus incana), mountain maple (Acer spicatum), common winterberry (Ilex verticillata), mountain holly (I. mucronata), showy mountain-ash (Sorbus decora),
American fly honeysuckle (Lonicera canadensis), swamp fly honeysuckle (L. oblongifolia), cranberry viburnum (Viburnum opulus), prickly currant (Ribes lacustre), swamp red currant (R. triste), and alder-leaf buckthorn (Rhamnus alnifolia). Canadian yew (Taxus candensis) was formerly an important shrub in wet-mesic conifer swamps of northern Wisconsin but has now disappeared from or been greatly diminished in most cedar swamps due to excessive browsing by whitetailed deer (Odocoileus virginianus). Low shrubs may also be a significant presence in cedar swamps, represented by species such as dwarf red raspberry (Rubus pubescens), early low blueberry (Vaccinium angustifolium), velvet-leaf blueberry (V. myrtilloides), and Labrador-tea (Ledum groenlandicum).

Other common or prevalent understory plants include herbs such as three-leaved gold-thread (Coptis trifolia), blue-bead lily (Clintonia borealis), gay-wings (Polygala paucifolia), small enchanter’s nightshade (Circaea alpina), naked miterwort (Mitella nuda), twisted-stalk (Streptopus lanceolatus), fragrant bedstraw (Galium triflorum), orange jewelweed (Impatiens capensis), water horsetail (Equisetum fluviatile), skunk-cabbage (Symplocarpus foetidus), and woody herbs (sometimes referred to as “subshrubs”) such as bunchberry (Cornus canadensis), twinflower (Linnaea borealis), and creeping-snowberry (Gaultheria hispidula). Ferns, including cinnamon fern (Osmunda cinnamomea), royal fern (O. regalis), crested shield fern (Dryopteris cristata), common oak fern (Gymnocarpium dryopteris), and northern beech fern (Phegopteris connectilis), are often common.

Characteristic graminoids, represented by sedges and grasses, may include two-seeded bog sedge (Carex disperma), swollen sedge (C. intumescens), slender sedge (C. leptalea), blue-joint grass (Calamagrostis canadensis), and fowl manna grass (Glyceria striata), along with many others.

Among the numerous rare or otherwise sensitive plants associated with cedar swamps are calypso orchid (Calypso bulbosa), ram’s-head lady’s-slipper (Cypripedium arietinum), showy lady’s-slipper (C. reginae), round-leaved orchis (Amerorchis rotundifolia), marsh valerian (Valeriana uliginosa), western Jacob’s-ladder (Polemonium occidentale ssp. lacustre), northern black currant (Ribes hudsonianum), limestone oak-fern (Gymnocarpium robertianum), northern bog sedge (Carex gynocrates), mountain cranberry (Vaccinium vitis-idaea ssp. minus), and Lapland buttercup (Ranunculus lapponicus).

The surface is often covered by a lush, continuous, sometimes hummocky, carpet of bryophytes, composed of various sphagnum mosses, brown mosses, and feather mosses. Liverworts are common in some stands. Pools of water collect in the hollows between moss hummocks, and stands receiving substantial groundwater flow are laced with seeps and spring runs. Spring ponds are sometimes present, and the associated pools, seepages, and spring runs offer microhabitats that support many additional species.

Old fallen trunks and the pit-and-mound microtopography created when large trees tip over provide important small-
scale structural features used by mammals, birds, herptiles, invertebrates, and some plants. Mammals using Northern Wet-mesic Forest include bobcat (*Lynx rufus*), northern flying squirrel (*Glaucomys sabrinus*), and water shrew (*Sorex palustris*). Among the birds, a diverse assemblage of Neotropical migrants (wood warblers, vireos, flycatchers, thrushes) find suitable breeding habitats in this forest community, especially in the older, larger, more structurally complex stands in close proximity to upland conifer forests. Boreal species such as Gray Jay (*Perisoreus canadensis*) and Black-backed Woodpecker (*Picoides arcticus*) have been documented as residents of cedar swamps. Raptors breeding in these forests include Northern Goshawk (*Accipiter gentilis*), Broad-winged Hawk (*Buteo platypterus*), Northern Saw-whet Owl (*Aegolius acadicus*), and Long-eared Owl (*Asio otus*). Stands along lakes or streams and with an eastern white or red pine super-

Both northern white-cedar and eastern hemlock are experiencing significant reproductive problems across much of their Wisconsin range. Seedlings and saplings seldom make it into the forest canopy, often due to excessive browsing by white-tailed deer. At this site, northern white-cedar, eastern hemlock, and several other browse-sensitive species are thriving. Pictured here is an unbrowsed Mike Grimm, of The Nature Conservancy’s Sturgeon Bay office. Door County, Northern Lake Michigan Coastal Ecological Landscape. Photo by Eric Epstein, Wisconsin DNR.

This moss-covered, partially decomposed “nurse” log provides suitable habitat for numerous northern white-cedar seedlings. Currently, few, if any, of these seedlings will make it to the sapling stage due to heavy browse pressure from white-tailed deer or desiccation. Chequamegon-Nicolet National Forest, Forest County. Photo by Eric Epstein, Wisconsin DNR.

Conservation and Management Considerations

Major conservation concerns include hydrologic disruption, the spread of invasive plants such as glossy buckthorn (*Rhamnus frangula*), reed canary grass (*Phalaris arundinacea*), and European swamp thistle (*Cirsium palustre*), and excessive browse damage by white-tailed deer. Logging is also a significant threat as northern white-cedar can seldom be regenerated by using silvicultural techniques alone.

Protection of site hydrology is essential if this community is to be maintained over time because the vegetation is dependent on a reliable flow of groundwater. Young cedars seldom advance beyond the seedling stage because seedlings and small saplings are frequently consumed by white-tailed deer and are now scarce or absent from many stands across the Wisconsin range of this community. Snowshoe hare (*Lepus americanus*) and deer mice (*Peromyscus sp.*) may also inhibit cedar regeneration. Reproduction of woody vegetation in “regenerating” second-growth stands is more often represented by species such as balsam fir, black ash, or tall shrubs such as speckled alder or mountain maple rather than by northern white-cedar.

The excessive browse issue must be addressed at meaningful scales soon because the structural characteristics associated with the dominant cedars are unique and very unlike the structure of lowland forests composed of other species. Isolation of stands, for example by clearcutting adjacent for-
ests, exacerbates the browse problem because deer seek out the cedar stands for food and thermal cover in winter. Isolation due to management on adjacent lands also makes stands of the shallow-rooted cedars more vulnerable to windthrow. Openings in such situations may quickly dry out or be colonized by invasive plants, creating conditions that are unsuitable for many native members of the community.

**Additional Information**

For information on similar natural communities, see descriptions for Northern Hardwood Swamp, Northern Tamarack Swamp, Black Spruce Swamp, Boreal Forest, Northern Mesic Forest, and Alder Thicket. The U.S. National Vegetation Classification (US NVC) type most closely matching Northern Wet-mesic Forest is CEGL002456 White-cedar / (Mixed Conifer)/Alder Swamp (Faber-Langendoen 2001). Note that the US NVC describes at least four additional types bearing similarities to Wisconsin’s Northern Wet-mesic Forest community.

**Also see:**
- Alverson et al. (1988)
- Christensen et al. (1959)
- Clausen (1957)
- Crum (1988)
- Harris et al. (1996)
- Pregitzer (1990)
- Rooney et al. (2002)
- Van Deelen (1999)


For a list of terms used, please visit the Glossary.

For a reference, please see the Literature Cited.