Boreal Forest (Global Rank G3; State Rank S2)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

Boreal Forest is a broad term that refers to the coniferous or mixed coniferous-deciduous forests that are found across much of the northern hemisphere, especially in parts of Alaska, Scandinavia, Russia, and Canada (e.g., Rowe 1972, Harris et al. 1996). Outside of Wisconsin, “boreal forest” is not commonly referred to as a single distinct plant community, but the term covers a spectrum of associations and variants sharing degrees of commonality in climate, geography, glacial geology, hydrology, vegetation structure, and species composition. “Boreal forest” is defined here as an upland forest community (Curtis 1959), though the acid conifer swamps that are prevalent across much of northern Wisconsin are also composed mostly of species with northerly origins and distributions.

In Wisconsin, Boreal Forest reaches its southernmost range extremites and is limited in abundance and distribution to areas along the Great Lakes shores and at a few scattered inland localities. The most extensive and best developed stands occupy cool, moist environments near the Great Lakes in a band parallel to the Lake Superior shore in northwestern Wisconsin (Finley 1976). Curtis (1959) estimated that the total area occupied by boreal forest prior to Euro-American settlement was around 670,000 acres. This is, for the most part, those portions of the Superior Coastal Plain Ecological Landscape that flank the Bayfield Peninsula. An even more localized variant of the boreal forest type occurs on shallow mineral soils overlying dolomite bedrock or, more rarely, on ancient gravel beach terraces, mostly on the eastern side of the northern Door Peninsula along Lake Michigan and on several of the Grand Traverse Islands in northeastern Wisconsin.

Stands of upland “spruce-fir” forest were also recorded during the federal General Land Office’s public land survey during the mid-1800s at sites away from the Grand Traverse Islands in northeastern Wisconsin. Where conifers were still available to provide a seed source, the post-disturbance stands of aspen-birch eventually succeeded in the absence of other disturbances to mixed or conifer-dominated forests.

Characteristic natural disturbances include windthrow, ice storms, fire, and periodic outbreaks of spruce budworm. Excessive white-tailed deer browse can now be a problem, especially in stands with significant amounts of northern white-cedar, eastern white pine, or even balsam fir. During the late 19th and early 20th centuries, most stands of Boreal Forest were clearcut and severely burned, often resulting in forests dominated by quaking aspen and white birch. In at least some areas, catastrophic fire may also have produced these “boreal” stands of aspen and birch, and past fires at infrequent intervals may have been a factor that led to the importance of eastern white pine in this type, especially in the Lake Superior stands (for details, see Chapter 21 in this book, “Superior Coastal Plain Ecological Landscape”). Where conifers were still available to provide a seed source, the post-disturbance stands of aspen-birch eventually succeeded in the absence of other disturbances to mixed or conifer-dominated forests.

As an item of interest from the perspective of vegetation classification and natural community restoration, eastern white pine had the highest importance value of any tree in the boreal stands of the Lake Superior region as recorded during the federal public land survey of the mid-1800s. In part, this factor underscores the potential eastern white pine has for attaining both great size and great age, and while the pines were prominent structural features of these forests, they do not really define the type. The soils of the Superior Coastal Plain Ecological Landscape are predominantly clays, though lenses of sand and gravel are present and may be locally common, and the rougher terrain of the Bayfield Peninsula and Apostle Islands is underlain by glacial tills of variable composition. In these areas, the forest cover is composed mostly of members of mesic to wet-mesic hemlock-hardwood associations. Only 318-acre Devils Island, which includes Wisconsin’s northernmost point of land, had a well-developed forest that

Locations of Boreal Forest in Wisconsin. The deeper hues shading the ecological landscape polygons indicate geographic areas of greatest abundance. An absence of color indicates that the community has not (yet) been documented in that ecological landscape. The dots indicate locations where a significant occurrence of this community is present, has been documented, and the data incorporated into the Natural Heritage Inventory database.
could be considered boreal. Smaller stands of Boreal Forest do occur on fringes of several other islands in the archipelago.

Good examples of conifer-dominated boreal forest are rare in today’s northern Wisconsin landscapes, due to the past history of severe cutting followed by intense fire, conversion of many stands near Lake Superior to aspen dominance, and direct loss as lands were cleared for agricultural use. Most inland stands have succeeded to other, more widespread forest communities.

Community Description: Composition and Structure

Mature stands of Boreal Forest are dominated by white spruce (Picea glauca) and balsam fir (Abies balsamea), often mixed with or co-dominated by other conifers and various hardwoods. Structurally, the older, well-developed stands are unique among terrestrial forest communities in Wisconsin. The dominant conifers exhibit narrow, conical crowns that taper sharply to a steeple-like spire and are also characterized by dense branches and foliage.

Common co-dominants or associates are white birch (Betula papyrifera), northern white-cedar (Thuja occidentalis), eastern white pine (Pinus strobus), balsam poplar (Populus balsamifera), and quaking aspen (Populus tremuloides). Showy mountain-ash (Sorbus decora) and sometime mountain maple (Acer spicatum) may be frequent as tall shrubs or small trees. Characteristic shrubs include thimbleberry (Rubus parviflorus), American fly honeysuckle (Lonicera canadensis), beaked hazelnut (Corylus cornuta), and dwarf red raspberry (Rubus pubescens). Thimbleberry sometimes forms luxuriant thickets in canopy gaps or along forest edges. Among the representative understory herbs are large-leaved aster (Eurybia macrophylla), red baneberry (Actaea rubra), twisted-stalk (Streptopus lanceolatus), blue-bead lily (Clintonia borealis), twinflower (Linnaea borealis), Canada mayflower (Maianthemum canadense), naked miterwort (Mitella nuda), fragrant bedstraw (Galium triflorum), one-sided shin-leaf (Orthilia secunda), gay-wings (Polygala paucifolia), wild sarsaparilla (Aralia nudicaulis), and bunchberry (Cornus canadensis). Clubmosses (Lycopodium and Huperzia spp.) are abundant.
in some stands, and red-stemmed moss (*Pleurozium schreberi*) may form extensive mats on the ground surface.

Among the rare vascular plants documented in remnant boreal stands are ram’s-head lady’s-slipper (*Cypripedium arietinum*), showy lady’s-slipper (*C. reginae*), calypso orchid (*Calypso bulbosa*), giant pinedrops (*Pterospora andromedea*) and near Lake Michigan only, the federally threatened dwarf lake iris (*Iris lacustris*). The latter is a Great Lakes endemic and occurs within canopy gaps and along edges of boreal forests near Lake Michigan.

Mosses and lichens (e.g., *Hylocomium splendens*, *Pleurozium schreberi*, *Cladonia spp.*) are important members of the boreal forest biota. For additional information on these species, the groups to which they belong, and their relevance to northern Wisconsin’s coniferous forests, peatlands, and bedrock communities, see Wetmore (1990), Glime (1993), and Crum (2004).

The animals inhabiting Boreal Forest include many birds associated with coniferous forests, such as Spruce Grouse (*Fallopippe canadensis*), Boreal Chickadee (*Poecile hudsonicus*), Olive-sided Flycatcher (*Contopus cooperi*) and many wood warblers, including Canada (*Cardellina canadensis*), Cape May (*Setophaga tigrina*), Yellow-rumped (*S. coronata*), and Blackburnian (*S. fusca*) warblers. The “northern finches,” especially those specialized to feed on conifer seeds such as the Red (*Loxia curvirostra*) and White-winged (*L. leucoptera*) Crossbills, sometimes occur in conifer-dominated stands of Boreal Forest. Of equal if not greater importance to birds is the significance that the Great Lakes shoreline stands have for migrants moving along Lake Michigan and across Lake Superior.

At this time Wisconsin’s conifer-dominated Boreal Forest remnants are too small, too altered, and the more extensive forests in which they are embedded are too fragmented by numerous scattered farms to support breeding populations of wide-ranging, area-sensitive boreal mammals such as the extirpated woodland caribou (*Rangifer tarandus*), the Canada lynx (*Lynx canadensis*), or moose (*Alces americanus*). White-tailed deer (*Odocoileus virginianus*), a common ungulate within the range of Wisconsin’s Boreal Forest, carry brain worm (*Parelaphostrongylus tenuis*), a parasitic nematode that may be fatal to moose but is better tolerated by deer. Whatever the causal relationship may be, where deer numbers are high, moose are absent or occur in very low numbers.

The reintroduced American marten (*Martes americana*) continues to hang on in a few parts of northern Wisconsin, but its range, now mostly within the North Central Forest Ecological Landscape, does overlap with that of the boreal forest community. Other mammals with ranges that include the boreal forest regions but which in Wisconsin are far more common elsewhere and in other habitats include the northern flying squirrel (*Glaucomys sabrinus*), water shrew (*Sorex palustris*), and some tree bats, such as the eastern red bat (*Lasiurus borealis*) and hoary bat (*L. cinereus*). A recent American marten sighting occurred in the Superior Coastal Plain Ecological Landscape near Red Cliff in 2010 (A. Wydeven, Wisconsin DNR, personal communication).

**Conservation and Management Issues**

Significant issues affecting the conservation of this forest community include habitat fragmentation, loss of the conifer component (white spruce, balsam fir, eastern white pine, northern white-cedar), loss of old forest and the distinctive structural features associated primarily with older forest (WDNR 2006), the continued dominance by early successional deciduous species such as quaking aspen, and shoreline development.

Because coniferous cover has declined greatly across Wisconsin since the Cutover era, one of the less direct but still important conservation values of Wisconsin’s Boreal Forest remnants is representation of a native forest community in which conifers are still important and at least potentially dominant. Retaining such forests will ensure that the animals and plants dependent on coniferous habitats will be provided for over time.
In recent decades, forest management in the Superior Coastal Plain Ecological Landscape has tended to focus on the perpetuation of quaking aspen wherever it now occurs. However, in some of these aspen or aspen-birch stands, boreal conifers, especially white spruce and balsam fir, are well represented in the understory as seedlings, saplings, and small trees. These stands offer the best opportunities for restoration of boreal conifers at local to moderate scales, especially if some of the open lands, much of which is abandoned farmland, can be reforested. Forest fragmentation is significant in this region, owing to the presence of many farms and the general absence of large, contiguous, primarily forested ownerships. Public ownership is limited within the range of Wisconsin’s Boreal Forest but does include significant properties such as the Brule River State Forest and the City of Superior’s Municipal Forest. An increase in the coniferous component on some of the county forest lands in the north could potentially complement Boreal Forest restoration efforts, afford greater watershed and soil protection, and provide a more diverse range of both habitats and forest products. In northeastern Wisconsin, the regional hemlock-hardwood forest that formerly covered much of the Door Peninsula is mostly gone, replaced by a broken mosaic of farms, residential areas, and scattered, often isolated, woodlots. Development pressures along the shorelines where the Boreal Forest community remnants are concentrated are high, but this is also where many of the public lands occur. Several NGOs, for example, the Wisconsin Chapter of The Nature Conservancy and the Door County Land Trust, have major conservation projects on the Door Peninsula. Embedding the largest and most intact boreal forest remnants in the Lake Michigan shoreline strip (which has many other natural features of high value) in better connected and more extensive areas of forest is going to be one of the major management challenges in northeastern Wisconsin. The unique properties of stands on the Door Peninsula and in the Grand Traverse Islands may lead to their eventual classification as distinct entities. In addition, both are strongly influenced by proximity to the Great Lakes, though in somewhat different ways. Inland stands away from the Great Lakes do merit protection as they contribute to local diversity and sometimes support species that are rare in the more common and widespread habitats and forest types in those regions, but all of these stands are small, opportunities to expand them are currently limited, and some sites have lost their boreal components, including the formerly dominant conifers. Still, maintaining these smaller, more isolated stands remains an important management consideration as they can increase the area occupied by otherwise diminished conifers (e.g., stands adjacent to conifer swamps or dry, pine-dominated forests) and supply structural features missing elsewhere in the local landscape. In the future, climate change seems likely to influence this community, though the proximity of the Great Lakes, with lake effect snows, frequent fogs, landforms such as steep-sided clay ravines that facilitate cold air drainage, and edaphic factors (heavy soils that are slow to warm along Lake Superior and thin but heavily shaded shallow soils over bedrock near Lake Michigan, where the boreal species are not at the competitive disadvantage they must overcome elsewhere) may help to maintain relatively cool and moist conditions. Maintenance and restoration of viable patches of Boreal Forest will require working at multiple scales to increase the abundance of diminished conifers as well as stand size, ensure the representation of all developmental stages, reduce high contrast edge by allowing for the development of larger areas of contiguous forest, and create greater connectivity between existing and future stands so that populations of sensitive species are not adversely affected by isolation or local extirpation. 

Additional Information

For additional information on similar natural communities, see the descriptions for Northern Wet-mesic Forest, Northern Dry-mesic Forest, Tamarack (Poor) Swamp, Black Spruce Swamp, and Northern Mesic Forest. The U.S. National Vegetation Classification type most closely corresponding to Wisconsin’s Boreal Forest is CEGL002475 Spruce – Fir – Aspen Forest (Faber-Langendoen 2001). Also see:
Anich et al. (2013)
Cameron and Bayne (2009)
Frelich and Reich (1995)
Hansson (1992)
Heinselman (1973)
Hunter (1993)
Kneeshaw and Gauthier (2003)
Lewis and Ferguson (1988)
Maycock (1957)
Maycock (1961)
National Council for Air and Stream Improvement (2005)
Rich et al. (2007)
Robinson (1980)
Vernier and Pearce (2005)


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

For a reference list, please see the Literature Cited.