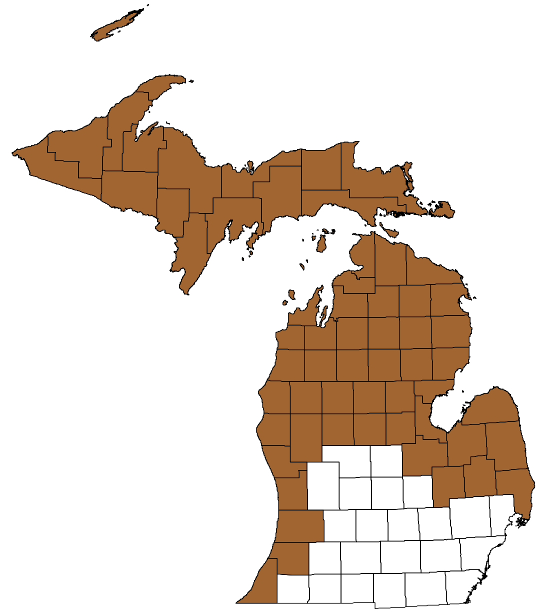
Mesic Northern Forest — Community Abstract

Photo by Jodi B. Raab

State Distribution



Global and State Rank: G4/S4

Range: The mesic northern forest community has existed as a dominant assemblage for approximately 2000 years (Davis, 1981) extending from southeastern Manitoba and northern Minnesota east across the northern U.S. and southern Canada to Maine and Nova Scotia (Barnes, 1991). Within Michigan, this forest type is predominantly found throughout the Upper Peninsula and in the northern half of the Lower Peninsula above the transition zone. This community also sporadically occurs below the transition zone along the Great Lakes shores of the Lower Peninsula.

Rank Justification: Widespread selective logging of white pine and hemlock at the end of the 19th century and the beginning of the 20th century followed by extensive slash fires greatly diminished the role of conifers as a wide-spread component of the mesic northern forest. In the Great Lakes region more than 99% of the mature hemlock-hardwood forest has been eliminated (Noss et al., 1995) and hemlock has been reduced from its former position as a regional dominant to where it now occupies only .5% of the landscape (Mladenoff and Stearns, 1993). Hemlock regeneration has diminished with this drastic reduction in seed source, the rise of winter browse pressure from the increasing deer population (Alverson et al., 1988) and the paucity of suitable establishment substrate such as decaying logs (nurse logs) and tip up mounds, features associated with old growth stands and also necessary for yellow birch establishment (Curtis, 1959). Logging, with a shift in focus from conifers to hardwoods, has continued as the primary disturbance in this forest (Frelich and Lorimer, 1991; Metzger and Schultz, 1984). Gaps generated by selective logging tend to be filled by sugar maple (Curtis, 1959), the seedlings of which often saturate the shaded understory of mesic northern forests (Barnes, 1991). Sustained and ubiquitous harvesting has reduced the structural and compositional complexity of this community. Old growth forest has dwindled from 68.0% to 5.2-8.3% of the Great Lakes landscape (Frelich, 1995). Remnants of northern hemlock-hardwood forests unscathed by logging are among the rarest vegetation types in the lake states, with just .6% remaining (Frelich and Reich, 1996). According to Noss et al. (1995), old growth eastern deciduous forest is among the 21 most endangered ecosystems in the United States.

In Michigan, 5.8% of the northern hardwood commercial forest is old growth (Frelich, 1995). In the 1800s, approximately 32.0% (over 12 million acres) of Michigan was mesic northern forest (Comer et al., 1995). Just over .4% of mesic northern forest in presettlement condition remains in Michigan. Large tracts of primary old growth forest remain in the Upper Peninsula in the Porcupine Mountains (31,000 acres), the Sylvania Wilderness (17,950 acres) and the Huron Mountains (4000 acres). Currently there are 59 documented occurrences of the mesic northern forest community. Only 8 of those occurrences, constituting just over 56,000 acres, are high quality representations of this type.

Landscape, Abiotic and Historical Context: Mesic northern forest occurs on a wide variety of soils, typically on loamy sand to sandy loam and occasionally on sand, loam and clay. Soils range widely in pH from extremely acid to moderately alkaline but are more commonly extremely acid to medium acid. According to the Köppen classification, the Northern Hardwood-Conifer region has a cool snow-forest climate with warm summers. The daily maximum temperature in July ranges from 24 to 29 °C (75 to 85 °F) and the daily minimum temperature in January ranges from –21 to –9 °C (-5 to 15 °F). The mean length of freeze-free days is between 90 to 160 days and the average number of days per year with snow cover of 2.5 cm or more is between 80 and 140 days. The normal annual total precipitation ranges from 610 to 1270 mm (Albert et al., 1986; Barnes, 1991).

A forest type of moist to dry-mesic sites lying predominantly north of the tension zone, mesic northern forest is found chiefly on coarse-textured ground and end moraines, but also occurs commonly on silty/clayey lake plains, thin glacial till over bedrock and medium-textured moraines. It also occurs locally on kettle-kame topography, moderately well-drained to well-drained sandy lake plain and sand dunes (MNFI, 1990).

Presettlement forests of eastern hemlock and yellow birch were frequent on moderate to poorly drained till plains and outwash plains, especially in the western Upper Peninsula. This assemblage was predominately found around lake and bog margins and in complex mosaics with sugar maple-hemlock forest on the surrounding better- drained soils. Beech-sugar maple-hemlock forests, which dominated nearly 17% of the state’s surface in the 1800’s, were mostly found on large expanses of rolling moraines in the northern Lower Peninsula and eastern Upper Peninsula. This species mix was also found on the clay lakeplain along Saginaw Bay. Eastern hemlock and white pine were the conifers most commonly occurring in mixed stands with hardwoods. Eastern hemlock and American beech were occasionally co-dominant, most commonly on moderately drained sand plains. Assemblages dominated by hemlock and white pine were prevalent in the 1800’s on moderately drained lake plain and outwash plain extending from Saginaw Bay through the Upper Peninsula. Large areas of hemlock–dominated forest grew on the clay plain of Huron and Sanilac counties. Extensive tracts of sugar maple and white cedar located in dunes or over calcareous bedrock were known from the surveyor’s notes and are found today locally in dunes and on the drumlin fields of Menominee County (Comer et al., 1995).

Natural Processes: The natural disturbance regime in northern mesic forests is dominated by wind (Frelich et al., 1993). The Great Lakes region is one of the most active weather zones in the northern hemisphere with polar jet streams positioned overhead much of the year. More cyclones pass over this area than any other area in the continental U.S (Frelich and Lorimer, 1991). Severe low-pressure systems are a significant source of small-scale canopy gaps, which generate diversity of age structure in these stands (Canham and Loucks, 1984). In a study in the western Upper Peninsula, Frelich and Lorimer (1991) found that 60% of the canopy trees attained their canopy ascendance as the result of periodic small-gap formation. Because of the ability of shade tolerant species to remain in a suppressed understory state for prolonged periods of time, small canopy gaps are filled by advanced regeneration (Runkle, 1982). Sugar maple seedlings often survive in the shaded understory for over 30 years (Marks and Gardescu, 1998) and suppressed hemlock seedlings can live over 100 years (Davis et al., 1996).


Photo by Gary Reese

Catastrophic windthrow is an important yet infrequent component of the disturbance regime of the northern mesic forests. Canham and Loucks (1984) estimated that the return time for large-scale windthrow (> 1.0 ha) to be 1210 years in forests of northern Wisconsin. This return time is remarkably similar to Whitney’s (1986) estimated windthrow recurrence interval of 1220 years in hemlock-white pine-northern hardwood forests of the Northern Lower. Investigating primary hemlock-hardwood forests of the Upper Peninsula, Frelich and Lorimer (1991) estimated that the rotation period of wind disturbance which leveled greater than 60% of the canopy on a given site to be more than 1500 years. The principal mechanisms for large-scale windthrow are tornadoes and downbursts from thunderstorms. Downbursts are parcels of air in down drafts that shoot out from the base of thunderstorms and splatter in all directions upon impact with the earth (Frelich and Reich, 1996). Frelich et al. (1993) proposed that unless followed by catastrophic fire, catastrophic windthrow would cause little change in species composition because of the prevalence of advanced regeneration of shade-tolerant species. Using 19th-century land-survey evidence, Whitney (1986) estimated a fire rotation of 1400 years in hemlock-hardwood forests of northern Lower Michigan. Catastrophic fire in the wake of windthrow would result in the following successional sequence: invasion by shade intolerant species such as aspen and paper birch followed by the encroachment into the disturbed stand by white pine and ending with replacement by shade tolerant species. Evidence of charcoal in the forest floor and fire scars on canopy dominants indicates that stands dominated by hemlock in the overstory are often the result of crown fires (Hix and Barnes, 1984; Simpson et al., 1990). However, the infrequency of fire historically in northern mesic forests is manifest by the paucity of successional species in land survey evidence: less than 5% of the presettlement northern hardwood forest was composed of pioneer species (Frelich and Lorimer, 1991).

Because of the long rotation period of large-scale disturbance in this community type, several generations of trees can pass between catastrophes. As a result, mesic northern forests tend to be multi-generational, with old-growth conditions lasting several centuries in the absence of anthropogenic disturbance (Frelich, 1995). In addition, the high degree of compositional stability of this forest type (Curtis, 1959) allows for ample opportunity for competitive interactions between dominant species to influence the patch structure of the landscape (Frelich et al., 1993). Studying old-growth hemlock-hardwood forest in the Sylvania Wilderness of the western Upper Peninsula, Frelich et al. (1993) concluded that hemlock and sugar maple exhibit strong positive self-association and negative reciprocal association. Each species alters their local environment, creating conditions in their immediate vicinity that favors self-recruitment and discourages establishment of seedlings of the other dominant. Sugar maple is disadvantaged by the dense shade and low nutrient conditions in the podzolized understory of hemlock-dominated stands. In sugar maple-dominated stands, hemlock seedlings are unable to penetrate the thick coarse duff and are often smothered by the ubiquitous leaf fall of sugar maple.

Vegetation Description: The mesic northern forest is a broadly defined community type with numerous regional, physiographic and edaphic variations. The following tolerant trees can dominate or co-dominate the canopy of this community: *Acer saccharum* (Sugar maple), *Tsuga canadensis* (Eastern hemlock), *Fagus grandifolia* (American Beech) and *Betula alleghaniensis* (yellow birch). Other important components of the canopy include: *Tilia americana* (American basswood), *Pinus strobus* (white pine), *Quercus rubra* (Red oak), *Thuja occidentalis* (white cedar), *Acer rubrum* (red maple), *Betula papyrifera* (paper or white birch) and *Fraxinus americana* (white ash). Tree species associated with this community but most commonly found in the sub-canopy include: *Ostrya virginiana* (ironwood or hop-hornbeam), *Ulmus americana* (american elm) and *Abies balsamea* (balsam fir).
In terms of their relative importance as arboreal components in the mesic northern forest, these trees differ greatly among themselves in different parts of the region and locally within the same region (Nichols, 1935). Significant variation in composition of communities is proportional to marked differences in local topography, soil, disturbance factors, geographic context (Barnes, 1991) and biotic factors such as competitive interactions (Frelich et al., 1993) and browsing pressure (Alverson et al., 1988).

The leading dominant of this community is sugar maple (Curtis, 1959) which thrives on moderately well drained to excessively drained deep soils (Pregitzer, 1981). Sugar maple is typically found in association with beech, basswood, yellow birch, and red oak. Basswood, characteristic on nutrient rich sites, is most prevalent in mixed-hardwood stands in the western Upper Peninsula. In a study in the McCormick Experimental Forest in the western Upper Peninsula, Pregitzer (1981) found that when ground water or bedrock influences the rooting zone, the proportion of conifers and hardwoods other than sugar maple increases. In the northern Lower Peninsula and in the eastern Upper Peninsula, sugar maple and beech occur commonly as co-dominants, frequently thriving on heavy-textured soils such as silt loam and clay loam. The absence of beech in the western Upper Peninsula is probably due to the increased dryness, shorter growing seasons and extreme minimum winter temperatures of this region (Barnes, 1991).

Conifer-dominated mesic northern forests usually have hemlock and yellow birch as the primary canopy components. Often present in these stands are white cedar and large, but widely spaced white pine, relicts of an earlier successional stage generated by forest fire and/or windthrow (Nichols, 1935). The conifer-dominated stands are generally found on moist or poorly drained sites. Mixed stands of hemlock and yellow birch or pure stands of yellow birch occur primarily in depressions or sites adjacent to swamps (Barnes, 1991).

The ground and shrub layer of mesic northern forests, like the overstory, is diverse in compositional variation. Communities of beech and sugar maple have relatively few shrubs but do support many spring ephemerals and perennial herbs. Stands composed of mixed hardwoods tend to have a well-developed shrub layer and a fairly diverse groundlayer. A plethora of spring ephemeral herbs in these assemblages can be attributed to the development of moisture holding and nutrient-rich soils. Sugar maple, yellow birch and basswood enhance the soil with their nutrient rich leaf-fall. In contrast, in hemlock-dominated stands, groundlayer diversity is low due to the nutrient-poor and acidic mor humus as well as the low understory light intensity caused by the perpetually dense hemlock canopy (Curtis, 1959).

Prevalent herbs of the mesic northern forest include: *Actaea pachypoda* (white baneberry), *Actaea rubra* (red baneberry), *Allium tricoccum* (wild leek), *Aralia nudicaulis* (wild sarsparilla), *Aralia racemosa* (spikenard), *Arisaema triphyllum* (jack-in-the-pulpit), *Carex deweyana, Carex hirtifolia, Carex leptonervia, Carex plantaginea, Carex woodii, Caulophyllum thalictroides* (blue cohosh), *Circea alpina* (enchanter's nightshade), *Circea lutetiana* (enchanter's nightshade), *Clintonia borealis* (blue-bead lily), *Cornus canadensis* (bunchberry), *Galium triflorum* (bedstraw), *Maianthemum canadense* (Canada mayflower), *Mitchella repens* (partridge berry), *Osmorhiza claytoni* (sweet cicily), *Polygonatum pubescens* (Solomon's seal), *Smilacina racemosa* (false spikenard), *Streptopus roseus* (twisted stalk), *Uvularia grandiflora* (bellwort), *Trientalis borealis* (star flower), *Trillium cernuum* (nodding trillium) and *Trillium grandiflorum* (common trillium)

Common ferns and clubmosses of this community include: *Adiantum pedatum* (maidenhair fern), *Athyrium filix-femina* (lady fern), *Athyrium thelypteroides* (silvery spleenwort), *Botrychium virginianum* (rattlesnake fern), *Dryopteris spinulosa* (spinulose woodfern), *Lycopodium annotinum* (stiff clubmoss), *Lycopodium lucidulum* (shining clubmoss) and *Lycopodium obscurum* (groundpine).

Charcteristic shrubs include: *Acer pennsylvanicum* (striped maple), *Acer spicatum* (mountain maple or moosewood), *Cornus alternifolia* (alternate-leaved dogwood), *Corylus cornuta* (beaked hazelnut), *Dirca palustris* (leatherwood), *Lonicera canadensis* (fly honeysuckle), *Ribes cynosbati* (wild gooseberry), *Sambucus pubens* (red elderberry), *Taxus canadensis* (Canada yew) and *Viburnum acerifolium* (maple-leaf viburnum). (Above species lists compiled from MNFI database and from Curtis, 1959; Gleason and Cronquist, 1964; and Nichols, 1935.)

A unique feature of this forest type is the presence of chlorophyll-free, parasitic and saprophytic seed plants such as: Indian pipes (*Monotropa*), coral root orchids (*Corallorhiza*) and beech drops (*Epifagus virginiana*) when beech is a component of the forest. These saprophytes are fed by the thick organic matter in the humus layer of the soil and are further benefited by the constant moisture supply (Curtis, 1959).

Michigan indicator species: *Aralia nudicaulis* (wild sarsparilla), *Betula alleghaniensis* (yellow birch), *Botrychium virginianum* (rattlesnake fern), *Carex hirtifolia, Caulophyllum thalictroides* (blue cohosh), *Circaea alpina* (enchanter's nightshade), *Corylus cornuta* (beaked hazelnut), *Dirca palustris* (leatherwood), *Smilacina racemosa* (false spikenard), *Taxus canadensis* (Canada yew) and *Tsuga canadensis* (hemlock).

Other noteworthy species: Rare plants associated with mesic northern forests include: *Asplenium rhizophyllum* (walking fern), *Asplenium scolopendrium* (hart's-tongue fern), *Asplenium trichomanes-ramosum* (green spleenwort), *Botrychium mormo* (goblin moonwort), *Carex assiniboinensis* (Assiniboia sedge), *Cystopteris laurentiana, Disporoum hookeri* (fairy bells), *Dryopteris filix-mas* (male fern), *Panax quinquefolius* (ginseng), *Tipularia discolor* (cranefly orchid), *Triphora trianthophora* (three-birds orchid), and *Viola novae-angliae* (New England violet).

Two rare raptor species frequently nest in mesic northern forests; *Buteo lineatus* (red-shouldered hawk) and *Accipiter gentilis* (Northern goshawk). Extensive tracts of mesic northern forest provide habitat for large mammals such as moose, wolves and martens. This community provides summer nesting habitat for many neotropical migrants, especially interior forest obligates such as, *Dendroica caerulescens* (black-throated blue warbler), *Dendoica cerulea* (cerulean warbler), *Dendroica virens* (black-throated green warbler), *Piranga olivacea* (scarlet tanager) and *Seiurus aurocappilus* (ovenbird). Rapids clubtail (*Gomphus quadricolor*, state special concern) is a rare dragonfly that utilizes quiet water pools and cool rapid streams that flow through mesic northern forests.

Conservation/management: When the primary conservation objective is to maintain biodiversity in mesic northern forests, the best management is to leave large tracts unharvested and to allow natural processes (growth, senescence, windthrow, fire, disease, insect infestation *etc*.) to operate unhindered. Lorimer and Frelich (1991) estimated the maximum size of an individual downburst in the Great Lakes region to be 3785 ha. Given the large-scale of the catastrophic disturbance to the landscape, recovery from perturbation requires protection of substantial area of forest. Johnson and Van Wagner (1985) suggest that a landscape should be at least twice the size of the largest disturbance event.

When tracts of mesic northern forest are being managed for timber harvest, care should be taken to minimize fragmentation, preserve as much area as possible in a forested matrix and maintain a range of canopy closure comparable to pre-harvest closure. Animal species associated with vernal pools and the groundlayer plant community would benefit from winter harvests. Presently, commercial timber harvest is the most common disturbance occurring in this community. Given time to recuperate, mesic northern forests have shown a high degree of resilience following logging disturbance. Metzger and Schultz (1984) and Albert and Barnes (1987) found that 50 years after logging a well-developed herb layer persisted in the understory of harvested stands.

Timber management practices that maintain or enhance characteristics of mature structure will help protect the biodiversity value of managed stands. Components of mature structure include: standing snags and dead and down woody material in various stages of decomposition and representing a diversity of species and diameter classes, a diversity of living tree species and an overstory dominated by large diameter trees but including individuals of all age classes.

Research needs: In 1931 George McIntire wrote the following: "Northern Hardwoods as a type has been considered justified because of long, wide and consistent use. This term certainly has been long and widely used but the most consistent thing about it has been the indefiniteness of its application. It is a convenient term but it means little unless accompanied by explicit description." McIntire's turn of the century criticism is still pertinent today and is applicable to the use of the phrase mesic northern forest. Misunderstanding and misuse of the term can be alleviated by the continued refinement of regional classifications that correlate species composition and landscape context.

Given the historical importance of catastrophic windthrow in this system, an important research question to be addressed is how the disturbance regime and species composition of this community will change as the Great Lakes region becomes increasingly fragmented. The prevalence of timber activity in this community demands increased post-harvest monitoring of rare species that depend on this forest and/or old growth conditions. Factors limiting hemlock and yellow birch regeneration need to be continually assessed and techniques for enhancing their regeneration need to be further explored.

Similar communities: Southern Mesic Forest, Dry-Mesic Northern Forest, Dry Northern Forest, Conifer-Hardwood Swamp

Other Classifications:

Michigan Natural Features Inventory Pre-settlement Vegetation (MNFI):
Beech-Sugar Maple-Hemlock, Hemlock-White Pine, Hemlock-Yellow Birch

Michigan Department of Natural Resources (MDNR): M-Northern Hardwoods, H-Hemlock

Michigan Resource Information Systems (MIRIS): 411 (Northern Hardwood), 41101-411109 (Undifferentiated Northern Hardwood), 41111-411119 (Sugar Maple), 41143-41149 (Beech), 41115 (Yellow Birch), 41179 (Basswood), 42 (Coniferous Forest),

The Nature Conservancy National Classification:
CODE; ALLIANCE; ASSOCIATION; COMMON NAME

I.C.3.N.a; *Tsuga Canadensis-Betula alleghaniensis* Forest Alliance; *Tsuga canadensis-Acer saccahrum-Betula alleghaniensis* Forest; North Central Hemlock-Hardwood Forest.

I.C.3.N.a; *Tsuga Canadensis-Betula alleghaniensis* Forest Alliance; *Tsuga canadensis-Fagus grandifolia-(Acer saccharum)* Great Lakes Forest; Great Lakes Hemlock-Beech-Hardwood Forest.

I.A.8.N.c; *Tsuga Canadensis* Forest Alliance; *Tsuga Canadensis-(Betula alleghaniensis*) Forest; Hemlock Mesic Forest.

I.A.8.N.b; *Pinus strobus-Tsuga canadensis* Forest Alliance; *Pinus strobus-Tsuga canadensis* Great Lakes Forest; Great Lakes White Pine-Hemlock Forest.

I.B.2.N.a; *Acer saccharum-Betula alleghaniensis-(Fagus grandifolia)* Forest Alliance; *Acer saccharum-Betula alleghaniensis-(Tilia americana)* Forest; Maple-Yellow Birch Northern Hardwoods.

I.B.2.N.a; *Acer saccharum-Betula alleghaniensis-(Fagus grandifolia)* Forest Alliance; *Acer saccharum-Fagus grandifoli-Betula spp./Maianthemum canadense* Forest, Beech-Maple-Northern Hardwood Forest.

Related Abstracts: Assiniboia sedge, cerulean warbler, fairy bells, ginseng, goblin moonwort, Northern goshawk, rapids clubtail and red-shouldered hawk.

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