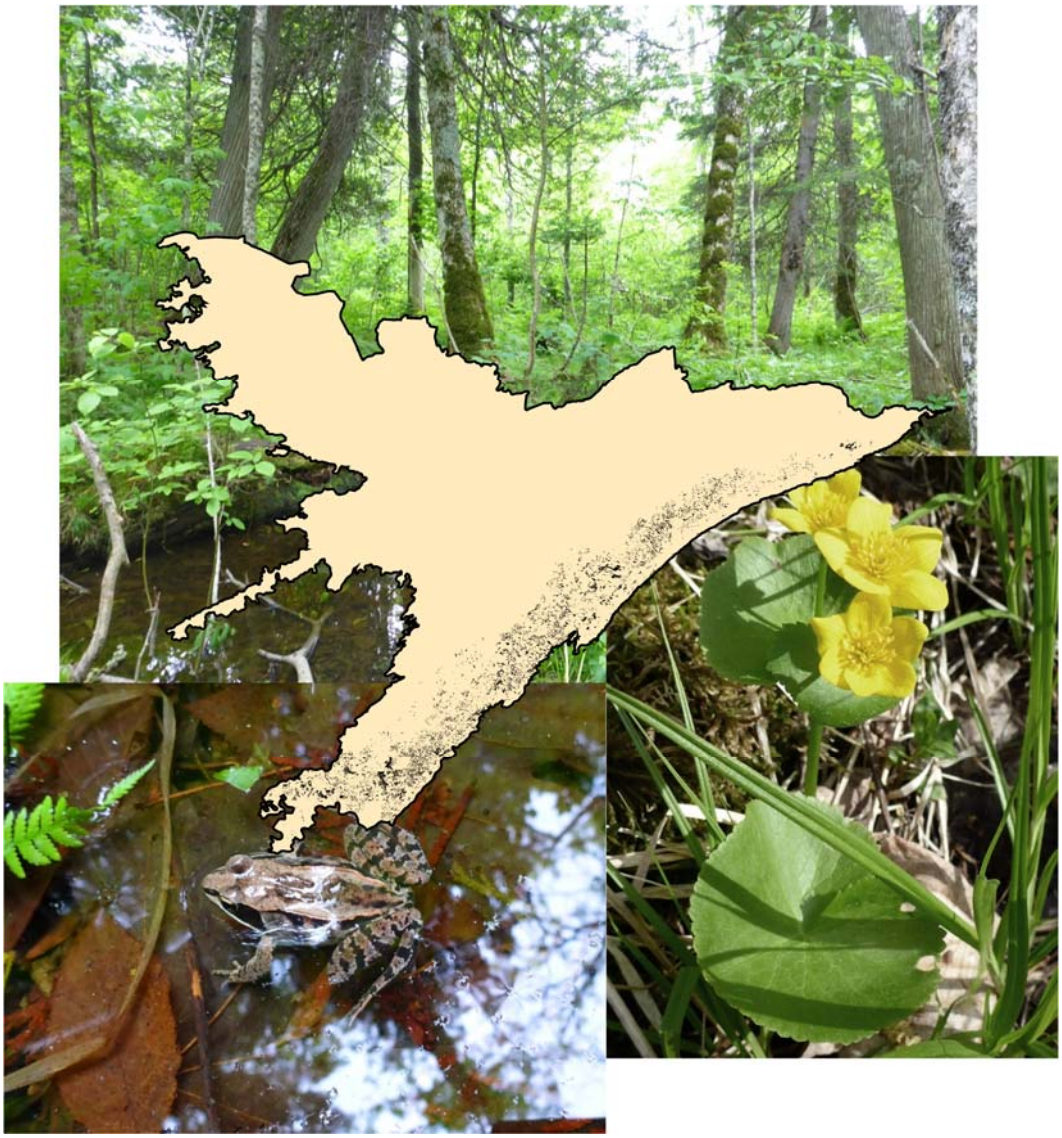
United States Department of Agriculture

Ecological Site Description

Major Land Resource Area 93A

Superior Stony and Rocky Loamy Plains and Hills, Western Part



Depressional Wet Hardwood Forests

Black Ash – Northern White Cedar / Speckled Alder – Mountain Maple / Fowl Mannagrass – Yellow Marsh Marigold

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Front cover: Top photo is of an old growth forest community of Depressional Wet Hardwood Forests. Bottom left photo is of a wood frog (*Rana sylvatica*) at the same site, which is reliant on this ecological site for breeding habitat. Both photos were taken on the Superior National Forest in Cook County, Minnesota (by Kyle Steele, USDA-NRCS). Bottom right photo is of a yellow marsh marigold (*Caltha palustris*) plant in full bloom, taken at Magney-Snively Natural Area, St. Louis County, Minnesota (by Kyle Steele, USDA-NRCS).

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General Information

Ecological Site Name:

Abiotic: Depressional Wet Hardwood Forests

Biotic: Black Ash – Northern White Cedar / Speckled Alder – Mountain Maple / Fowl Mannagrass – Yellow Marsh Marigold

Fraxinus nigra – Thuja occidentalis / Alnus incana ssp. rugosa – Acer spicatum / Glyceria striata – Caltha palustris

Ecological Site ID: 093AY003

Hierarchical Framework Relationships

Major Land Resource Area (MLRA): Superior Stony and Rocky Loamy Plains and Hills, Western Part (93A)

USFS Subregions: Northern Superior Uplands Section (212L); North Shore Highlands Subsection (212Lb)

MLRA Notes

The Superior Stony and Rocky Loamy Plains and Hills, Western Part is located and completely contained in northeastern Minnesota (Figure 1). This area has both the highest and lowest elevations in the state, as well as some of the state's most rugged topography (Ojakangas and Matsch, 1982). The MLRA was glaciated by numerous advances of the Superior, Rainy, and Des Moines glacial lobes during the Wisconsin glaciation as well as pre-Wisconsin glacial periods. The geomorphic surfaces in this MLRA are geologically very young (i.e., 10,000 to 20,000 years) and dominated by drumlin fields, moraines, small lake plains, outwash plains, and bedrock-controlled uplands (USDA-NRCS, 2006). There are thousands of lakes

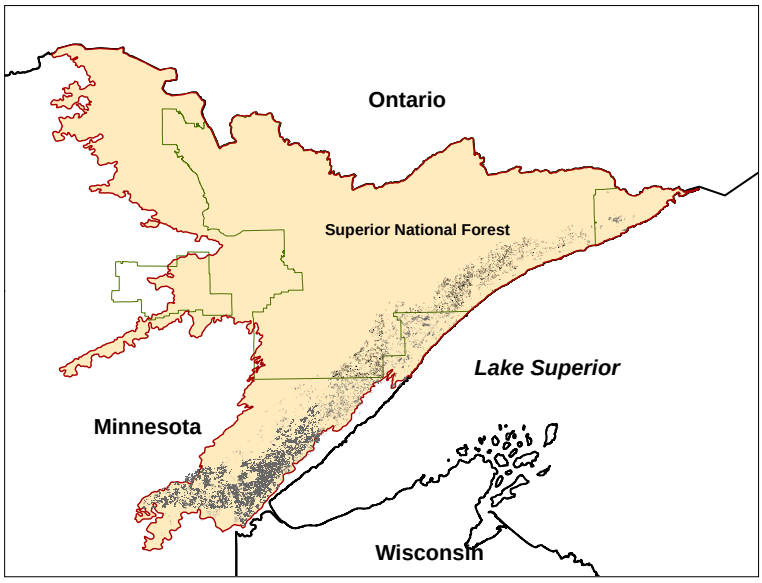


Figure 1. Potential distribution of Depressional Wet Hardwood Forests within MLRA 93A. Light colored polygons show USDA-NRCS Soil Survey mapping and dark colored polygons show Superior National Forest Landtype Phase mapping.

scattered throughout the region that were created by these glacial events. Most of these lakes are bedrock-controlled in comparison to adjacent glaciated regions where glacial drift deposits are much thicker and the lakes occur in depressions atop the glacial drift (Ojakangas and Matsch, 1982). In contrast to adjacent MLRAs, the depth to the predominantly crystalline or sandstone bedrock in MLRA 93A is relatively shallow because the most recent glacial events were more erosional than depositional (Ojakangas and Matsch, 1982).

Ecological Site Concept

Depressional Wet Hardwood Forests are common throughout the distribution of the Superior Lobe glacial advance within MLRA 93A. These sites are developed primarily from low lying mineral soils, but can have up to sixteen inches of organic surface. Underlying parent materials include both till and outwash. They occur on small to moderate-sized closed depressions and shallow, low gradient drainage networks, surrounded by an upland forest matrix. Ponding occurs throughout the spring and much of the early growing season. Later in the growing season ponding recedes, but occurs again during heavy rainfall events. Fallen trees create pit and mound micro-topography, with micro-depressions that may hold water all year and adjacent root wads that shed water. Soil textures are often stratified and are of limited importance since these sites are saturated nearly all year.

Plant communities include an array of species that are adapted to periods of seasonal ponding and soil saturation. Black ash (*Fraxinus nigra*) is the dominant tree species, along with northern white cedar (*Thuja occidentalis*). Yellow birch (*Betula alleghaniensis*) is often an important component in the subcanopy. Both northern white cedar and yellow birch find rooting medium in the small hummocks and so-called nurse logs created by fallen trees. White spruce (*Picea glauca*) and balsam fir (*Abies balsamea*) become important in older forests.

Relative to other forested wetland communities in this MLRA, Depressional Wet Hardwood Forests are comparatively richer in both plant species diversity and biomass production. Wetland species like yellow marsh marigold (*Caltha palustris*), fowl mannagrass (*Glyceria striata*), and bluejoint (*Calamagrostis canadensis*), and a variety of sedges (*Carex* spp.) are almost always present. Interestingly, the drier conditions on hummocks allow a number of common upland species to persist, such as wild sarsaparilla (*Aralia nudicaulis*), starflower (*Trientalis borealis*), and Canada mayflower (*Maianthemum canadense*). In contrast, the adjacent wet micro-depressions often host obligate wetland species that are characteristic of more permanent wetlands, such as northern blueflag (*Iris versicolor*).

Physiographic Features

Wet Depressional Hardwood Forests are located on end moraines, ground moraines, outwash plains and inter-drumlins associated with the Automba and Nickerson phases of the Superior Lobe glacial advance, which deposited coarse-loamy and fine-loamy till, respectively (Table 1). The most common landforms are ponded depressions and subtle, concave areas. They can also occur in shallow, low gradient drainageways that may receive concentrated flow (e.g., incipient drainage ways). Slope shape can be either linear or concave up slope, and is always concave across slope. Individual sites can be quite small in size, ranging from less than one acre to ten acres. These sites are ponded throughout the spring and early summer months, and generally dry out by August, but are subject to ponding again following moderate to heavy rain events. During dry times the water table is generally within 10 inches of the soil surface, but can be as low as 24 inches below the surface. These sites receive runoff and lateral subsurface flow from adjacent, upslope ecological sites. They also produce runoff and lateral subsurface flow downslope, to streams, rivers, and large peatland basins. Elevation is mainly between 1,000 and 1,600 feet above sea level.

Table 1. Physiographic features.
(Data and information presented here were obtained from the National Soil Information System (NASIS) and USDA-NRCS integrated plot data.)

	Minimum	Maximum
Elevation (ft.)	1,000	1,600
Slope (percent)	0	1
Water Table Depth (in.)	0	24
Flooding	none	none
Ponding Depth (in.)	0	6
Ponding Frequency	occasional	frequent
Ponding Duration	brief	very long
Landforms: depressions, shallow drainageways		
Slope Shape: concave (up slope), concave (across slope)		

Climatic Features

The average freeze-free period of this ecological site is about 140 days, and ranges from 131 to 149 days (Table 2). Average annual precipitation is 32 inches, which includes rainfall plus the water equivalent from snowfall. About 65 percent of the precipitation falls as rain during the growing season (from May through September), and about 21 percent falls as snow (Table 3). Most of the spring snowmelt runs off the steeply sloping or high relief surfaces into high gradient drainageways and then into wetlands, streams or lakes. Most of the rainfall during the growing season is transpired by plants, which leaves a small proportion of the total precipitation for deep aquifer recharge. Much of the distribution of this ecological site is located in the highlands above Lake Superior which receive the most snowfall in Minnesota, averaging over 70 inches annually (Flaccus and Ohmann, 1964; MN DNR, 2013a). This lake effect snow is the result of warm, moist air rising and moving inland from the lake, ultimately cooling to produce localized snowfall (Anderson and Fischer, 2015; MN DNR, 2013a). The average annual low and high temperatures are 28 and 48 degrees Fahrenheit, respectively. Frost pockets and of cold air drainage from above and the fact that wet soils are generally colder than dry soils make this ecological site colder than adjacent ecological sites (SNF, unpublished report a, b). As a result, snow and frost remain longer in the spring, thus resulting in shorter growing seasons than the adjacent uplands. Climate data and analyses are derived from 30-year averages gathered from four National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site, but were not necessarily located on correlated map units (Table 4).

Table 2. Frost-free and freeze-free days.
(Data were obtained from NOAA weather stations within the range of this ecological site, using 30-year averages.)

	Minimum days	Maximum days
Frost-free period (32.5°F or greater, 90% probability)	97	124
Freeze-free period (Less than 28.5 °F, 90% probability)	131	149

Table 3. Monthly and annual precipitation and temperature.
(Data were obtained from NOAA weather stations within the range of this ecological site, using 30-year averages.)

Monthly Moisture (Inches) and Temperature (°F) Distribution			
		----------Temperature----------	
	Average Precipitation	**Average Low**	**Average High**
January	1.21	-0.3	19.0
February	0.86	3.5	24.3
March	1.59	14.8	34.5
April	2.63	28.2	48.6
May	3.25	39.0	61.4
June	4.03	48.6	70.2
July	3.64	53.9	75.6
August	3.70	53.1	73.5
September	3.78	44.7	64.0
October	3.35	33.2	50.8
November	2.50	20.7	35.2
December	1.56	6.1	22.6
Annual	32.10	28.8	48.3

Table 4. NOAA climate stations used for data analysis, located within the range of this ecological site.

Station ID	Location	From	To
MN4918	LUTSEN 3NNE	1981	2010
MN8421	TWO HARBORS 7NW	1981	2010
MN9134	WOLF RIDGE ELC	1981	2010
MN4913	DULUTH INTL AP	1981	2010

Influencing Water Features

These sites can be incipient drainage networks, feeding small perennial streams, or they can be in closed, isolated depressions. Seasonal ponding is most prominent during March through June (following snowmelt) and October through November. Water tables and water table recharge primarily come from precipitation and surface runoff and closely mimics annual rainfall graphs (Slesak et al., 2014). They are either at or above the surface much of the year, but may drop to a low of 24 inches during the driest months. In addition to precipitation and surface inputs, these sites likely receive some subsurface water from surrounding sites.

They also discharge water to lower elevation ecological sites, and ultimately to rivers, lakes, or large peatland basins. In these relatively young, morainic landscapes, clear dendritic drainage networks have not yet been developed. Instead, these sites exhibit water flow though after significant rainfall events. Landforms behave like closed depressions until an overflow threshold is achieved, then they begin to behave like drainageways. It is a complex interaction that is dependent upon factors like relative elevation and degree of incision. Stream orders associated with these sites are first, second, third, and fourth (SNF, unpublished report b). These sites may also provide some deep percolation for local aquifer recharge.

Depressional Wet Hardwood Forests are classified in the Palustrine System, Forested Wetland Class, and depending on the State of vegetation, either a Broadleaf Deciduous or Dead Subclass, as described by Cowardin et al. (1979).

Representative Soil Features

The parent material for these soils includes coarse-loamy and fine-loamy till, as well as outwash, from the Superior lobe glacial advance (Table 5). Although these are primarily mineral soils, up to 16 inches of organic parent material may be on the surface. On a typical site, organic deposits (if existing) will be thickest near the center of the landform. In some cases there may be deeper organic surfaces that classify as Histosols (17 or more inches of organic soil material), but this is not the typical condition on these landforms. These soils are ponded for nearly four months of the year and saturated with 2 feet of the soil surface, hence they are classified as very poorly drained. However, wetness varies both seasonally and sporadically on these soils, which is a primary site factor defining this ecological site. Due to concave landforms and very poorly drained and ponded soils, soil textural classes have reduced significance as a determining factor for vegetation. Surface texture is loam or sandy loam, and subsurface textures range from loam to very gravelly coarse sand. Soil water chemistry contributes to the rich nature of these plant communities; pH ranges from 5.5 (moderately acid) to 6.5 (slightly acid), which is relatively high when compared to other wetland ecological sites in the MLRA. Soil orders are Inceptisols, and taxonomic classes are either Typic or Histic Humaquepts. Giese, Twig, Wahbegon, and Hulligan are all representative soil series for this ecological site.

Table 5. Representative soil features.
(Data and information presented here were obtained from the National Soil Information System (NASIS) and USDA-NRCS integrated plot data.)

	Minimum	Maximum
Surface Fragments less than 3" (percent cover)	0	1
Surface Fragments greater than 3" (percent cover)	0	1
Subsurface Fragments less than 3" (percent volume)	8	65
Subsurface Fragments greater than 3" (percent volume)	0	12
Soil Depth (in.)	80	80+
Permeability Class	slow	rapid
Soil Reaction/pH (1:1 water)	5.5	6.5

Drainage Class: very poorly drained
Parent Material – Kind: ablation till, outwash, lodgment till
Parent Material – Origin: various igneous and sedimentary bedrock
Surface Texture: loam, sandy loam, mucky peat
Surface Texture Modifier: gravelly or none
Subsurface Group: coarse-loamy, fine-loamy
Soil Series: Giese, Twig, Wahbegon, Hulligan
Taxonomic Class: Typic and Histic Humaqepts

States and Community Phases

Ecological Dynamics

Seasonal variation in water table is the most important site factor defining Depressional Wet Hardwood Forests. Water tables limit the amount of oxygen available to plant roots. Oxygen levels determine the extent to which root respiration can take place, the level of organic litter decomposition, and the release of important nutrients for uptake by plants (MN DNR, 2011). Species characteristic of this ecological site are adapted to this variation in water saturation, in comparison to species which dominate the drier uplands and wetter, less hydrologically variable peatland ecosystems. Similar black ash-dominated vernal wetlands are widely distributed throughout the upper Midwestern and Northeastern U.S. and into adjacent Canadian Provinces (NatureServe, 2013a, 2013b; Landfire, 2007). In MLRA 93A, they are on the Boreal fringe, and are often mixed with coniferous species and sub-boreal ground flora (Table 6). Northern white cedar is the most common coniferous species, along with white spruce and balsam fir. Tamarack (*Larix laricina*) may have historically been a component, but it has been on a considerable and continuing decline region-wide in all forest types (MN Div. of Forestry, 2013). To what degree this species was important to these sites historically is not known, and may never be known. Yellow birch and red maple are often important subcanopy species. The most common shrubs are speckled alder, mountain maple, American red raspberry, redosier dogwood, and beaked hazelnut. Ground flora diversity is very high in these forests. At a given location, as many as 60 or more plant species can be found on these sites. A number of site variables contribute to high diversity, such as: seasonal variation in water levels and soil saturation, dry and wet microsites created by fallen trees, and downed woody debris creating potential rooting medium. Yellow marsh marigold, northern bugleweed (*Lycopus uniflorus*), blue skullcap (*Scuttelaria lateriflora*), sensitive fern (*Onoclea sensibilis*), fowl mannagrass, bluejoint, and a variety of sedges (*Carex* spp.) are all indicative of the ground flora.

Historically, fire was not an important disturbance factor on this ecological site, primarily because of lush vegetation with high water content. Average fire return intervals for stand replacing events have been estimated to be in excess of 1,000 years (MN DNR, 2014). In general, fire in wet forest communities was related to the surrounding matrix forest types (Landfire, 2007; Gucker, 2005). In the case of this ecological site, it is mostly surrounded by mesic hardwood forests, where fire was also uncommon. Thus, it can be inferred that fire was not a significant disturbance factor in

Table 6. Reference State Community Phase 1.1 composition.
(Adapted from MN DNR, 2005 and USDA USDA-NRCS integrated plot data. Not all species are assumed to be present in one location.)

Layer	Common Name	Scientific Name	USDA Symbol	Type	Cover (%)	Height (ft)
Canopy	BLACK ASH	*Fraxinus nigra*	FRNI	tree	50-75	50-80
	NORTHERN WHITE CEDAR	*Thuja occidentalis*	THOC2	tree	5-25	40-50
Sub Canopy	BLACK ASH	*Fraxinus nigra*	FRNI	tree	25-50	16-40
	NORTHERN WHITE CEDAR	*Thuja occidentalis*	THOC2	tree	5-25	16-40
	YELLOW BIRCH	*Betula alleghaniensis*	BEAL2	tree	5-25	16-40
	MOUNTAIN MAPLE	*Acer spicatum*	ACSP2	tree	5-15	16-40
	WHITE SPRUCE	*Picea glauca*	PIGL	tree	1-10	16-40
	BALSAM FIR	*Abies balsamea*	ABBA	tree	1-5	16-40
	RED MAPLE	*Acer rubrum*	ACRU	tree	1-5	16-40
Shrub/ Seedling	SPECKLED ALDER	*Alnus incana* ssp. *rugosa*	ALINR	shrub	25-75	1-16
	MOUNTAIN MAPLE	*Acer spicatum*	ACSP2	tree	5-25	1-16
	REDOSIER DOGWOOD	*Cornus sericea*	COSE16	shrub	1-15	1-10
	AMERICAN RED RASPBERRY	*Rubus idaeus*	RUID	shrub	1-15	1-10
	BEAKED HAZELNUT	*Corylus cornuta*	COCO6	shrub	1-15	1-10
	BLACK ASH	*Fraxinus nigra*	FRNI	tree	1-15	1-10
	CHOKECHERRY	*Prunus virginiana*	PRVI	tree	1-5	1-10
	AMERICAN FLY HONEYSUCKLE	*Lonicera canadensis*	LOCA7	shrub	1-5	1-5
	AMERICAN CRANBERRYBUSH	*Viburnum opulus* var. *americanum*	VIOPA2	shrub	1-5	1-5
	RED CURRANT	*Ribes triste*	RITR	shrub	1-5	1-5
Herbaceous	BLUEJOINT	*Calamagrostis canadensis*	CACA4	graminoid	10-50	0.1-3
	YELLOW MARSH MARIGOLD	*Caltha palustris*	CAPA5	forb	10-50	0.1-1
	FOWL MANNAGRASS	*Glyceria striata*	GLST	graminoid	5-25	0.1-3
	NORTHERN BUGLEWEED	*Lycopus uniflorus*	LYUN	forb	5-25	0.1-1
	COMMON LADYFERN	*Athyrium filix-femina*	ATFI	forb	5-25	0.1-2
	DWARF RED BLACKBERRY	*Rubus pubescens*	RUPU	forb	5-15	0.1-1
	SENSITIVE FERN	*Onoclea sensibilis*	ONSE	fern	5-15	0.1-2
	BLUE SKULLCAP	*Scutellaria lateriflora*	SCLA2	forb	1-5	0.1-1
	TOUCH-ME-NOT	*Impatiens* spp.	IMPAT	forb	5-15	0.1-3
	INTERMEDIATE WOODFERN	*Dryopteris intermedia*	DRIN5	fern	5-15	0.1-1
	PURPLESTEM ASTER	*Symphyotrichum puniceum* var. *puniceum*	SYPUP	forb	5-15	0.1-3
	BRISTLYSTALKED SEDGE	*Carex leptalea*	CALE10	graminoid	5-15	0.1-2
	GREATER BLADDER SEDGE	*Carex intumescens*	CAIN12	graminoid	1-10	0.1-2
	AWLFRUIT SEDGE	*Carex stipata*	CAST5	graminoid	1-10	0.1-1
	GRACEFUL SEDGE	*Carex gracillima*	CAGR2	graminoid	1-10	0.1-1
	SOFTLEAF SEDGE	*Carex disperma*	CADI6	graminoid	1-10	0.1-1

Species list continued

Layer	Common Name	*Scientific Name*	USDA Symbol	Type		
	FLAT-TOP ASTER	*Doellingeria umbellata* var. *umbellata*	DOUMU	forb	1-10	0.1-3
	WILD SARSASPARILLA	*Aralia nudicaulis*	ARNU2	forb	1-5	0.1-2
	STARFLOWER	*Trientalis borealis*	TRBO2	forb	1-5	0.1-1
	WOOD ANEMONE	*Anemone quinquefolia*	ANQU	forb	1-5	0.1-1
	CANADA MAYFLOWER	*Maianthemum canadense*	MACA4	forb	1-5	0.1-1
	BUNCHBERRY DOGWOOD	*Cornus canadensis*	COCA13	forb	1-5	0.1-1
	LONG BEECHFERN	*Phegopteris connectilis*	PHCO24	fern	1-5	0.1-1
	NAKED MITERWORT	*Mitella nuda*	MINU3	forb	1-5	0.1-1
	WESTERN OAKFERN	*Gymnocarpium dryopteris*	GYDR	fern	1-5	0.1-1
	WOODLAND HORSETAIL	*Equisetum sylvaticum*	EQSY	forb	1-5	0.1-1
	THREELEAF GOLDTHREAD	*Coptis trifolia*	COTR2	forb	1-5	0.1-1
	JACK IN THE PULPIT	*Arisaema triphyllum*	ARTR	forb	1-5	0.1-2
	SMALL ENCHANTER'S NIGHTSHADE	*Circaea alpina*	CIAL	forb	1-5	0.1-1
	GIANT GOLDENROD	*Solidago gigantea*	SOGI	forb	1-5	0.1-3
	EASTERN SWAMP SAXIFRAGE	*Saxifraga pensylvanica*	SAPE8	forb	1-5	0.1-2
	NORTHERN BLUEFLAG	*Iris versicolor*	IRVE2	forb	1-5	0.1-2
	TALL BLUEBELLS	*Mertensia paniculata*	MEPA	forb	1-5	0.1-1
	PURPLE MEADOW-RUE	*Thalictrum dasycarpum*	THDA	forb	1-5	0.1-3
	ARCTIC SWEET COLTSFOOT	*Petasites frigidus*	PEFR5	forb	1-5	0.1-1
	SPOTTED JOE PYE WEED	*Eupatorium maculatum*	EUMA9	forb	1-5	0.1-3
	OSTRICH FERN	*Matteuccia struthiopteris*	MAST	fern	1-5	0.1-3
	FRINGED BROME	*Bromus ciliatus*	BRCI2	graminoid	1-5	0.1-2

Depressional Wet Hardwood Forests in MLRA 93A for both intrinsic and extrinsic reasons. Instead, historic variability in vegetation structure was primarily related to small and moderate sized canopy openings produced from either dead/dying trees or mature and over-mature windthrown trees (MN DNR, 2014; Landfire, 2007; Gucker, 2005). Tree species common to this ecological site have shallow and spreading root systems, which is further exacerbated by a limited rooting zone resulting from frequent high water tables. As canopy trees reached the dominant canopy class they became more susceptible to relatively frequent small-scale (microburst) wind events. Black ash are especially susceptible to this this type of windthrow (MN DNR, 2011; Wright and Rauscher, 1990). Climatic variation, both in terms of drought as well as excess precipitation, interacted with wind

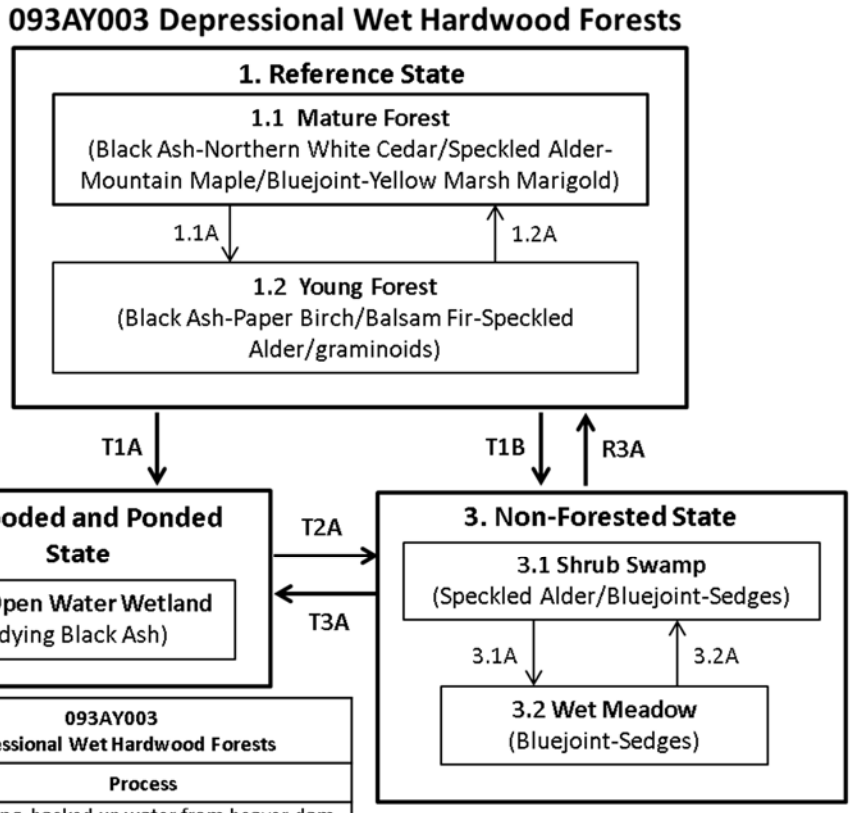
events to create these canopy openings. Also drought and extended ponding can stress trees to the point of being more susceptible to disease and overall decline, and thus further weakening their ability to withstand strong winds. These fine- to moderate-scale windthrow events occurred on nearly every site in an estimated 110 year rotation, and possibly as frequent as 40 years (MN DNR, 2014; Landfire, 2007).

Today the dynamics of plant communities in this ecological site are similar to what they were historically. Although these sites are broadly distributed, they are generally small in size, and are part of a broader matrix of various upland forest types. As a result, they weren't affected as much as some forest types during the logging era following European settlement. Early settlers used black ash as firewood, but it was probably used on a small scale and local basis (MN DNR, 2011). In some regions, northern white cedar and other softwoods were selectively logged, leaving monotypic black ash stands. While black ash has always been co-dominant on these sites, it is possible that their abundance has increased during the last century. Overall, these sites were largely left undeveloped, and a majority of Depressional Wet Forest ecological sites closely resemble communities described in the Reference State (Figure 2).

Alteration of natural hydrology is the most important driver of state change in this ecological site. Potentially, in the future, insect infestations such as emerald ash borer (*Agrilus planipennis*) or climate change will cause state change. Damming nearby water courses can produce near permanent ponding on these sites, transitioning them to open water wetlands. This can happen as a result of beaver (*Castor canadensis*) activity or as a result of human development (primarily road building). In some cases, road building activities can also block the flow of water to these sites, drying them out. This condition has not been documented within the MLRA, but it is surmised that such a condition would result in novel plant communities. Another way hydrology can be altered is by the complete loss of the forested canopy, which can significantly reduce the transpiration of water from the site, resulting in consistently higher water tables, and ultimately preclude forest regeneration (Mitsch and Gosselink, 2007; Palik et al., 2012; Erdmann et al., 1987). This process converts the site to non-forested shrub swamps or wet meadows. This can result from poor silvicultural practices, extreme wind events, or significant insect or disease outbreaks.

Average site index at base age 50 for black ash averaged 46 feet, and ranged between 42 and 54. Site index curves were developed by Carmean (1978). This is relatively low for black ash in comparison to where it occurs in some upland forests, which can be as high as 80 (Carmean,

1989). There may be some differences in productivity, species composition, or response to disturbance on small, isolated depressions within these sites compared to shallow drainage networks. It has been noted that a higher abundance of bluejoint, less structural development of the overstory, and less black ash regeneration occur in these situations (Chel Anderson, MN DNR Ecologist, personal communication). These small contrasting sites within the larger site are most likely caused by the perching of water by a dense till substratum and concave slope shape and may be related to dense till which perches water. More research is needed to determine if there are significant differences.



093AY003 Depressional Wet Hardwood Forests	
Code	**Process**
T1A, T3A	Flooding, backed up water from beaver dam or road bed.
T1B	Removal of tree canopy resulting in loss of transpiration and elevated water levels.
T2A	Drainage of open water.
1.1A	Stand-levelling disturbance or small areas of partial canopy openings from wind or dead trees.
1.2A	Succession (75+ years without disturbance)
3.1A	Increased ponding, soil saturation.
3.2A	Decreased ponding, soil saturation.
R3A	Long term forest succession.

Figure 2. State-and-transition diagram for Depressional Wet Hardwood Forest ecological site.

Figure 3. Photo of a yellow birch with aerial roots, rooted on a northern white cedar tree tip mound; Twig soils. Photo by Kyle Steele, Superior National Forest, Cook County, Minnesota, in June of 2014.

STATE 1 – REFERENCE STATE

Community phases within the Reference State are related to scattered small and moderate sized canopy openings from dead and/or windthrown trees. Windthrown trees were primarily dominant, above the canopy, and more exposed to wind events. These trees, with shallow root systems, were likely previously weakened by either excessive drought or ponding, leaving them open to attack by forest pests (MN DNR, 2014). Standing dead trees from excessive ponding or drought may also provide these canopy openings. An estimated rotation of such events is 110 years (MN DNR, 2014; MN DNR, 2005). This produced a patchwork of young and mature forests, all dominated by black ash. Black ash is fairly shade tolerant as a seedling, and is often the only advanced regeneration present in the understory, and thus it tends to replace itself in many

situations (Gucker, 2005; Erdmann et al., 1987). Black ash is also a long-lived species and can live to over 250 years old (Gucker, 2005). Without larger openings, structure and composition of mature stands can be nearly perpetual, and gradually regenerate new trees within small, one to many tree sized openings (Table 7). As a result of rather frequent creation of small scale openings, stands do not often become old growth (i.e., greater than 135 years; MN DNR, 2014). But on sites where old-growth does exist, canopy structure is complex, and generally includes a component of long-lived and more shade tolerant white spruce and balsam fir.

Table 7. Reference State Community Phase 1.1 ground surface cover, downed wood, and tree snags.
(Data presented are based on ground cover transects at three USDA-NRCS type locations.)

	Type	Cover (%)
Ground Surface Cover	Grass/Grasslike	9-15
	Forb	20-40
	Shrub/Vine	4-13
	Tree	1-10
	Non-Vascular Plants	5-20
	Biological Crust	0
	Litter	10-20
	Surface Fragments (.25-3”)	0-1
	Surface Fragments (>3”)	0-1
	Bedrock	0
	Water	1-3
	Bare Ground	6-8
Downed Wood	Fine/Small (1-hour)	1-10
	Fine/Medium (10-hour)	1-8
	Fine/Large (100-hour)	1-5
	Coarse/Small (1,000-hour)	0-2
	Coarse/Large (10,000-hour)	1-4
Tree Snags (No./acre)	Hard Snags	20-80
	Soft Snags	10-30

Northern white cedar and yellow birch often find their primary rooting substrate on downed woody debris associated with these openings. Both species regenerate well on mossy, rotting wood (i.e., nurse logs) that have consistent moisture (Smith, 2008 Erdmann, 1990; Johnston, 1990).

Eventually, initial rooting media from downed woody debris can leave roots exposed to air and result in poorly formed trees (Figure 3). Northern white cedar can also regenerate by vegetation reproduction. These stems usually are developed from fallen trees and root from branches that come in contact with moist rooting media and are extremely shade tolerant (Erdmann, 1990). Hummocks and micro depressions resulting from windthrown trees are an important component of the Reference State. This variability in microsites provides opportunity for obligate wetland species in ponded micro depressions and facultative or even some upland species on the drier hummocks. Today, most of the distribution of this ecological site is in community phases very similar those in the Reference State.

Community Phase 1.1 Mature Forest By stand age 75, a more characteristic, closed canopy and multi-tiered forest structure begins to develop (Table 8; Figure 4). Stands are initially dominated by black ash, but regeneration opportunities for northern white cedar, yellow birch, and white spruce begin to increase as the forest ages (Table 9). Closed canopy conditions result in a transition from obligate wetland graminoids to higher densities of facultative and facultative upland forbs (Palik et al., 2007). Also during this time down woody debris accumulates and the characteristic pit and mound micro-topography increases in areal extent; these ecological phenomena provide more sites for a greater diversity of ground flora species. Many sites will be essentially self-sustaining at this point, with periodic canopy openings keeping stands from attaining old growth status.

Pathway 1.1A - Stand-levelling disturbance or small areas of partial canopy openings from wind or dead trees.

Table 8. Reference State Community Phase 1.1 canopy cover by height class.
(Data presented are based on relevè data from three USDA-NRCS type locations.)

	Percent Cover			
Height Above Ground (ft.)	Grass/ Grasslike	Forb	Shrub/ Vine	Tree
0.5	1-5	1-5	0-1	0-1
0.5-1	5-25	5-25	1-5	1-5
1-2	25-50	25-50	5-10	5-10
2-4.5	5-15	5-15	10-50	5-40
4.5-13	-	-	25-50	10-40
13-40	-	-	1-10	25-50
40-80	-	-	-	35-65
80-120	-	-	-	-

Figure 4. Reference State (Community Phase 1.1 Mature Forest) for Depressional Wet Hardwood Forest ecological site; Twig soils. Photo by Kyle Steele, Superior National Forest, Cook County, Minnesota, in June of 2014.

Table 9. Reference State Community Phase 1.1 overstory.
(Data presented are adapted from USDA-NRCS plot data.)

Species	USDA Symbol	DBH (in)	Basal Area (ft^2/ac)	Trees Per Acre
BLACK ASH (*Fraxinus nigra*)	FRNI	8-15	40-80	90-120
NORTHERN WHITE CEDAR (*Thuja occidentalis*)	THOC2	12-20	20-40	20-40
YELLOW BIRCH (*Betula alleghaniensis*)	BEAL2	5-10	5-15	10-30
BALSAM FIR (*Abies balsamea*)	ABBA	3-8	1-5	5-10
WHITE SPRUCE (*Picea glauca*)	PIGL	3-8	0-3	0-5
STAND TOTAL	-	-	70-140	120-200

Community Phase 1.2 Young Forest The initiation of stand development follows partial canopy loss by windthrow or canopy openings developed from pockets of dead trees (Figure 5). Black ash advanced regeneration is the dominant regenerating tree, but is accompanied by other hardwoods, such as paper birch, balsam poplar (*Populus balsamea*), or quaking aspen (*Populus tremuloides*). Increased light also favors some wetland shrubs and ground flora, particularly speckled alder and bluejoint. Co-dominant canopy trees generally reach a diameter of around eight inches before transitioning to a mature forest (MN DNR, 2014).

Pathway 1.2A - Succession (75+ years without disturbance).

Transition 1A - Flooding, backed up water from beaver dam or road bed.

Transition 1B - Removal of tree canopy resulting in loss of transpiration and elevated water levels.

Figure 5. Reference State (Community Phase 1.2 Young Forest) for Depressional Wet Hardwood Forest ecological site; Giese soils. Photo by Kyle Steele, Magney-Snively Natural Area, St. Louis County, Minnesota, in May of 2014.

STATE 2 – FLOODED AND PONDED STATE

The Flooded and Ponded State develops as a result of dammed or blocked waterways. Flooding and more permanent forms of inundation (i.e., ponding) are caused by either beaver activity or development associated with road building. Only drainageway landforms are affected, and isolated depressions do not go through this state. Sites that have blocked water drainage from roads may become perpetual open water wetlands. In natural settings, the Flooded and Ponded State can last for many years, but it ultimately depends on maintenance of high quality habitat conditions for beaver to proliferate. Once a site is abandoned, dams will gradually decline and ultimately drain, thereby beginning the transition to the Non-Forested State.

Beaver populations in North America were drastically reduced by broad scale fur trapping during the Colonial time period, into the 1800s (Mitsch and Gosselink, 2007). As a result, natural conversion of these sites to the Flooded and Ponded State may be less common today than it was prior to European settlement.

Community Phase 2.1 Open Water Wetland The only community phase in this state is characterized as having dead or dying overstory trees, and being flooded and subsequently ponded by up to several feet of essentially permanent water (Figure 6). Depending on depth of water, there will be areas with emergent and submergent aquatic vegetation, as well as scattered remnants of the former vegetation.

Transition 2A - Drainage of open water.

Figure 6. Flooded and Ponded State similar to Community Phase 2.1 Open Water Wetland for Depressional Wet Hardwood Forest ecological site. Photo by Ethan Perry, Itasca County, Minnesota, in 2006.

STATE 3 – NON-FORESTED STATE

Sites can transition to this state by relatively sudden and complete loss of the tree canopy, thereby losing the transpiration of water from trees that would normally occur later in the growing season to keep water tables at bay (i.e., drawdown; Slesak et al., 2014). This can happen as a result of intensive logging, forest pests, or general forest decline. Since water tables on these sites mimic annual rainfall graphs, the primary change in hydrology occurs later in the growing season, when overstory tree species would normally be causing drawdown in the Reference State. This state will likely become very common in this MLRA if the invasion of the exotic and completely destructive emerald ash borer beetle is not halted (Slesak et al., 2014; Palik et al., 2012). Plant community species composition will shift from primarily facultative wetland species to primarily obligate wetland species, such as lake sedge (Slesak et al., 2014).

Sites can also transition to this state from the Flooded and Ponded State following drainage of backed up water from beaver activity or road building. Initially, sites are wet meadows dominated by graminoids (i.e. grasses, sedges, and rushes), eventually becoming invaded by wetland shrubs depending on level of ponding and soil saturation. These sites may have different soil characteristics depending on the extent and depth of sedimentation, which is largely dependent on how long the site was dammed (Naiman et al., 2005) and is also related to nearby land use and landscape-level soil geomorphology. More research is needed on how soil properties change following long term flooding from blocked hydrology and the potential for invasive species to establish in the Non-Forested State.

Other than a few scattered trees, these sites do not seem to regenerate forests well. The probability of transitioning to the Reference State is largely unknown; it will probably require many decades to produce a closed canopy forest again. There is limited evidence that these communities succeed to a forested structure within a reasonable time frame (SNF, unpublished report b), but non-forested wetland conditions may persist for decades, and even centuries (Naiman et al., 2005; Terwilliger and Pastor, 1999). Viability of black ash seeds is only 8 years (Wright and Rauscher, 1990), so that initial seedbank is extirpated from the site. And since most sites are small and isolated, there may not be a reliable seed source nearby. The loss of important mycorrhizal relationships is also likely to impede succession to forest trees. It has been shown that long-term flooding kills symbiotic mycorrhizae; these fungi form essential relationships with tree species on most ecological sites, forested wetlands included, and recolonization following draining

may be inhibited (Anderson and Fischer, 2015; Terwilliger and Pastor, 1999), which is likely the case on this ecological site as well. All of the aforementioned factors, in combination with extreme competition for light, nutrients, and growing space with fibrous rooted resident vegetation, make succession to a forested state very difficult.

Figure 7. Non-Forested State similar to Community Phase 3.1 Shrub Swamp of Depressional Wet Hardwood Forest ecological site; Rifle soils. Photo by Kyle Steele, Cloquet Valley State Forest, St. Louis County, Minnesota, in August of 2011.

Community Phase 3.1 Shrub Swamp In this phase, shrubs are greater than 25% cover (Figure 7; MN DNR, 2005). Dominant species are speckled alder, redosier dogwood, and willows (*Salix* spp.). Bluejoint and a variety of sedges are also dominant, along with a myriad of sun-loving wetland forb species. There may be scattered trees as well, but they comprise low cover and are not significant to the overall structure of the plant community. But even scattered trees have ecological value as nest trees and perches for birds or den trees for small mammals. With a continued lowering of the water table, it is possible for this phase to succeed to the Reference State if black ash and other trees can successfully establish.

Pathway 3.1A - Increased ponding, soil saturation.

Figure 8. Non-Forested State similar to community Phase 3.2 Wet Meadow of Depressional Wet Hardwood Forest ecological site. Photo by Kyle Steele, Superior National Forest, St. Louis County, Minnesota, in July of 2013.

Community Phase 3.2 Wet Meadow In this phase, shrubs are less than 25% cover (Figure 8; MN DNR, 2005). Bluejoint, sedges, and a variety of sun-loving wetland forbs dominate this phase. Lake sedge (*Carex lacustris*), the small hummock-forming tussock sedge (*C. stricta*), and beaked sedge (*C. utriculata*) are the most common sedges, and can be dominant (MN DNR, 2005). The most common shrubs are speckled alder, redosier dogwood, and willows. There may be some scattered live trees but standing dead trees are much more common. They add some structure to the site for use by wildlife.

Pathway 3.2A - Decreased ponding, soil saturation.

Transition 3A - Flooding, backed up water from beaver dam or road bed.

Restoration Pathway 3A - Long term forest succession.

Supporting Information

Relationship to Other Established Classifications

Superior National Forest Terrestrial Ecological Unit Inventory (SNF unpublished report a, b); mapping concepts are most similar to:

Landtype: 2 Lowland Loamy Wet

Landtype Phase: 71 Unnamed (Superior moraines, wet depressions and drainageways, loamy)

MN DNR Native Plant Community Classification (MN DNR, 2005); the reference community of this ecological site is most similar to:

Primary: WFn64a Northern Very Wet Ash Swamp

Secondary: WFn55a Northern Wet Ash Swamp; WMn82a, b Northern Wet Meadow/Carr

Vegetation Associations (National Vegetation Classification System, NatureServe, 2013a); the reference community of this ecological site is most similar to:

Black Ash - Mixed Hardwood Swamp;

White-cedar - Black Ash Swamp

Ecological Systems (National Vegetation Classification System, NatureServe, 2013b); the reference community of this ecological site is most similar to:

Laurentian-Acadian Alkaline Conifer-Hardwood Swamp

Associated Ecological Sites

This ecological site is surrounded by upland soils and landforms. There are often rims of somewhat poorly and poorly drained soils of the same parent material adjacent to this site and they form a transitional area to the uplands. The transitional areas occur on adjacent footslopes and toeslopes. To date, the only ESD developed for associated sites is Till Upland Mesic Hardwood Forests (093AY001) is the only other ecological site description developed as yet. In some cases, this ecological site is isolated and completely surrounded by a Till Upland Mesic Hardwood Forest matrix. In other cases, shallow drainageways meander and connect many adjacent ecological sites.

Similar Ecological Sites

Currently, there are no published ecological site descriptions within the MLRA that are similar to Depressional Wet Hardwood Forests. However, there is another wet forest type that is dominated by black ash. These sites tend to occur on poorly drained soils that pond for shorter periods and somewhat poorly soils that do not pond. These forests are more productive and have a strong component of upland mesic hardwoods. Development of this ecological site is in progress. There may be soils and landforms with similar properties that produce the same, or very similar ecological sites within the distribution of the nearby Rainy lobe glaciation as opposed to the Superior lobe soil parent materials on this site. More investigation is needed on this topic.

Inventory Data References

A total of 12 integrated plots, ranging from Tier 2 to Tier 3 intensity, were used as a basis for this ecological site. Three of these were Type Locations representing the data-supported Community Phase 1.1 in the state-and-transition model (Figure 2), and included all necessary data elements for a Tier 3 dataset (Table 10). No other community phases were supported with quantitative data analysis. All 12 plots had soil pedon and site data collected by a NRCS soil scientist using a form equivalent to SF-232. Pits were hand-dug using spade shovels, sharpshooters, and/or bucket augers. Of the 12 plots, two were located at established MN DNR relevé points, obtained and used with permission from the MN DNR County Biological Survey. List of MN DNR relevé plots used with verified soils data: 3475 and 8301.

Table 10. Location of Tier 3 data used for Type Locations.

State	County	Ownership	Legal Description	Easting	Northing
Minnesota	St. Louis	Magney-Snively Natural Area, City of Duluth	T49 R15 S22	558350	5174212
Minnesota	Lake	Lake County Forest	T55 R10 S34	606564	5228760
Minnesota	Lake	Superior National Forest	T61 R2 S26	683546	5289881

Other References

Anderson, C.E. and Adelheid Fischer 2015. North Shore: A Natural History of Minnesota's Superior Coast. University of Minnesota Press. Minneapolis, MN.

Carmean, W.H. 1978. Site Index Curves for Northern Hardwoods in Northern Wisconsin and Upper Michigan. USDA For. Serv. Research Paper NC-160. St. Paul, MN.

Carmean, W.H., J.T. Hahn, and R.D. Jacobs. 1989. Site Index Curves for Forest Tree Species in the Eastern United States. USDA For. Serv. Gen. Tech. Rep. NC-128. St. Paul, MN.

Cowardin, L. M., V. Carter, F. C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31, U.S. Department of Interior-Fish and Wildlife Service, Washington, D.C.

Erdmann, G.G. 1990. Yellow Birch. In: Silvics of North America, Vol. 2, Burns, R.M., and B.H. Honkala (tech cords). USDA For. Serv. Handb. 654, Washington, DC.

Erdmann, G.G., T.R. Crow, R.M. Peterson, Jr., and C.D. Wilson. 1987. Managing Black Ash in the Lake States. USDA For. Serv. Gen. Tech. Rep., NC-115.

Flaccus, E. and L.F. Ohmann. 1964. Old-growth Northern Hardwood Forests in Northeastern Minnesota. Ecology 45:3, 448-459.

Gucker, C.L. 2005. Fraxinus nigra. In: Fire Effects Information System, [Online]. USDA For. Serv. Rocky Mountain Research Station, Fire Sciences Laboratory. Available online at http://www.fs.fed.us/database/feis/; last accessed January 3, 2014.

Johnston, W.F. 1990. Northern White Cedar. In: Silvics of North America, Vol. 2, Burns, R.M., and B.H. Honkala (tech cords). USDA For. Serv. Handb. 654, Washington, DC.

Landfire. 2007. Biophysical Setting 4114810 Laurentian-Acadian Alkaline Conifer-Hardwood Swamp. In: Landfire National Vegetation Dynamics Models. USDA For. Serv. and U.S. Department of Interior. Washington, DC.

Minnesota Department of Natural Resources. 2014. WFn64 – Northern Very Wet Ash Swamp: Natural Disturbance Regime, Stand Dynamics, and Tree Behavior. Available online at http://files.dnr.state.mn.us/forestry/ecssilviculture/plantcommunities/WFn64.pdf; last accessed November 11, 2014.

Minnesota Department of Natural Resources. 2013a. Climate – Frequently Asked Questions. Available online at http://www.dnr.state.mn.us/climate/faqs.html; last accessed December 11, 2013.

Minnesota Department of Natural Resources. 2011. Ash Management Guidelines for Private Forest Landowners. University of Minnesota Extension. St. Paul, MN.

Minnesota Department of Natural Resources. 2005. Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. St. Paul, Minnesota.

Minnesota Division of Forestry. 2013. Minnesota Department of Natural Resources Tamarack Assessment Project. Available online at http://files.dnr.state.mn.us/forestry/ecssilviculture/policies/tamarackAssessmentProject2013.pdf; last accessed November 11, 2014.

Mitsch, W.J. and J.G. Gosselink. 2007. Wetlands, fourth ed. John Wiley & Sons, Inc. New York, NY.

Naiman, R.J., H. Dècamps, and M.E. McClain. 2005. Riparia: Ecology, Conservation, and Management of Streamside Communities. Elsevier Academic Press. San Diego, CA.

NatureServe. 2013a. Associations and Alliances of USFS Section 212L in Minnesota. NatureServe, St. Paul, Minnesota.

NatureServe. 2013b. Ecological Systems of USFS Section 212L in Minnesota. NatureServe, St. Paul, Minnesota.

Ojakangas, R.W. and C.L. Matsch. 1982. Minnesota's Geology. University of Minnesota Press. Minneapolis, MN.

Palik, B.J., M.E. Ostry, R.C. Venette, and E. Abdela. 2012. Tree Regeneration in Black Ash (*Fraxinus nigra*) Stands Exhibiting Crown Dieback in Minnesota. Forest Ecol. Mgmt. 269: 26-30.

Palik, B., D. Streblow, L. Egeland, and R. Buech. 2007. Landscape Variation of Seasonal Pool Plant Communities in Forests of Northern Minnesota, USA. Wetlands 27: 1, 12-23.

Slesak, R.A., C.F. Lenhart, K.N. Brooks, D.W. D'Amato, and B.J. Palik. 2014. Water Table Response to Harvesting and Simulated Emerald Ash Borer Mortality in Black Ash Wetlands in Minnesota, USA. Can. J. Forest Res. 44:961-968.

Smith, W.R. 2008. Trees and Shrubs of Minnesota. University of Minnesota Press. Minneapolis, MN.

Superior National Forest. Unpublished report (a). Superior National Forest Ecological Landtype Descriptions. USDA For. Serv. Duluth, Minnesota.

Superior National Forest. Unpublished report (b). Superior National Forest Ecological Landtype Phase Descriptions. USDA For. Serv. Duluth, Minnesota.

Terwilliger, J. and J. Pastor. 1999. Small Mammals, Ectomycorrhizae, and Conifer Succession in Beaver Meadows. Oikos 85: 83–94.

United States Department of Agriculture (USDA), Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. USDA Handbook 296. Washington, DC.

Wright, J.W. and H.M. Rauscher. 1990. Black Ash. In: Silvics of North America, Vol. 2, Burns, R.M., and B.H. Honkala (tech cords). USDA For. Serv. Handb. 654, Washington, DC.

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