USDA Natural Resources Conservation Service

Ecological site R105XY011WI
Mollic Loamy-Silty Upland

Last updated: 2/23/2024
Accessed: 05/04/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 105X–Upper Mississippi River Bedrock Controlled Uplands and Valleys

The Northern Mississippi Valley Loess Hills area corresponds closely to the Western Coulees and Ridges and Southwest Savanna Ecological Landscapes. Some of the following brief overview is borrowed from the Wisconsin Department of Natural Resources Ecological Landscape publication (2015).

Fifty-two percent of the Upper Mississippi River Bedrock Controlled Uplands and Valleys MLRA is in Wisconsin; Iowa, Minnesota, and Illinois contain the rest. This region is the only area in Wisconsin that has not been covered by glaciers within the past 2.4 million years. The Wisconsin portion of this MLRA is approximately 7.4 million acres (11,600 square miles). The landscape is characterized by dissected topography with deeply-incised, steep-walled valleys between bedrock controlled ridges.

Though it's called the "Driftless Region", some glacial drift is found in the major river valleys of this region in the form of outwash, deposited by proglacial streams of glacial meltwater. Wisconsin's most recent glaciations also impacted the sediment of the area through the deposition of loess. After the glacier receded and before vegetation established, the bare surfaces of the glaciated areas were highly susceptible to wind erosion. As a result, a veneer of loess (wind-blown silt) was deposited over the entire region. The thickest deposits—nearly five meters—are on ridges near the Mississippi River and gradually thin moving eastward. The loess caps in Dane and Green counties are generally 0.5-1.5 meters deep. Much of the loess has eroded downslope and collected in floodplains.

Bedrock is shallow throughout this MLRA and is a major influence on topography and hydrology. Most of the MLRA has bedrock within two meters, except in the deep river valleys that are filled with outwash and alluvium materials. Sandstone is the dominant bedrock type in MLRA 105, but the southernmost portion is dominated by dolomite. Military Ridge is an escarpment that straddles the boundary between sandstone and dolomite bedrock. The sandstone north of the ridge is weaker than the erosion-resistant dolomite south of the ridge. The sandstone is deeply cut and dissected into steep slopes and valleys. The dolomite-controlled ridges tend to be less dissected and broader with more gentle, south sloping topography. Geomorphic and fluvial processes formed these landscapes by way of sheet wash, soil creep, and flowage. These processes eroded the hillslopes, cut into bedrock, and transported the debris to streams, forming floodplains and terraces.

Underfit streams are common in MLRA 105, especially in the southern portion. These streams currently occupy large river valleys—especially those of the Black, Chippewa, Mississippi, and Wisconsin Rivers—that were carved by proglacial meltwater streams carrying much larger quantities of water than what's present today. As the climate dried, waterflow decreased and the valleys filled with alluvial sediment. Narrow meanders were formed by the shrinking streams and are often dissimilar to the meanders of the larger valleys they occupy. Fluvial landforms – including terraces, oxbow lakes, sandbars, eroding bluffs, and large floodplain complexes – are found within these large valleys and are subject to varying flooding frequencies, intensities, and durations.
Karst topography formed in this region from dissolution of carbonate bedrock by surface and groundwater. Dolomite and limestone are more easily affected by dissolution, but karst topography also formed in sandstone. Erosion by water (stream meanders, rain/runoff, and groundwater), wind, and frost weaken joints and bedding planes that can

cause collapse. In addition, sandstone materials collapse into cavities in underlying dolomite or limestone.

Historically, MLRA 105 was dominated by oak forests and oak openings making up more than 50% of the area. Prairies were significant and covered 32% of the area south of Military Ridge. Maple-basswood forests covered 19% of the are north of Military Ridge. Dominant tree species were white oak (Quercus alba), bur oak (Quercus macrocarpa), black oak (Quercus velutina), and sugar maple (*Acer saccharum*).

Classification relationships

Relationship to Established Framework and Classification Systems:

Habitat Types of S. Wisconsin (Kotar, 1996): Habitat types that likely correlate with this ES include *Acer saccharum*-Tilia/Desmodium [ATiDe], *Acer saccharum*-Tilia/Caullophyllum [ATiCa], and *Acer saccharum*/Circara-Phryma [ArCi-Ph].

Biophysical Settings (Landfire, 2014): This ES is largely mapped as North-Central Interior Maple-Basswood Forest, Eastern Cool Temperate Pasture and Hayland, Eastern Cool Temperate Row Crop, Eastern Cool Temperate Close Grown Crop, and Developed-Low Intensity

WDNR Natural Communities (WDNR, 2015): This ES is most similar to Mesic Prairie as described by the Wisconsin DNR.

Hierarchical Framework Relationships:

Major Land Resource Area (MLRA): Upper Mississippi River Bedrock Controlled Uplands and Valleys (105)

USFS Subregions: Menominee Eroded Pre-Wisconsin Till (222La), Melrose Oak Forest and Savannah (222Lb), Mississippi-Wisconsin River Ravines (222Lc), Kickapoo-Wisconsin River Ravines (222Ld), Mineral Point Prairie-Savannah (222Le)

Wisconsin DNR Ecological Landscapes: Western Coulee and Ridges, Southwest Savannah

Ecological site concept

The Mollic Loamy-Silty Upland ecological site occupies approximately 564,000 acres in MLRA 105, or about 8.2% of total land area. It is the third-most extensive site in MLRA 105. This site is found in upland positions across a variety of landforms throughout the MLRA. It is especially common to the dolomite ridge south of the Wisconsin River (Military Ridge). 75% of the acreage of this site is located south of the Wisconsin River.

These sites are characterized by moderately deep to very deep loamy soils with deep, dark surfaces (mollic epipedons) resulting from long-term additions of organic materials, especially from fine, fibrous roots of grassy vegetation. Historically, these sites were prairies, though modern fire suppression has resulted in the encroachment by woody species. Today, many sites are forested.

Associated sites

F105XY003WI	**Wet Loamy-Clayey Floodplain** These sites form in deep, loamy alluvium deposits along floodplains, especially those along smaller tributaries to the Chippewa, Black, and Wisconsin rivers. They support vegetation tolerant of seasonal flooding. They are sometimes saturated enough for hydric conditions to occur. They can be found in floodplains adjacent to Mollic Loamy-Silty Upland.
R105XY007WI	**Moist Mollic Loamy-Clayey Lowland** These sites form in loamy and clayey materials, often alluvium. They have deep, dark surfaces. They are somewhat poorly drained. They are sometimes found adjacent to Mollic Loamy-Silty Upland in lower landscape positions.

F105XY012WI	**Shallow Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They have bedrock contact within one meter of the soil surface. They are moderately well to well drained. They are often found adjacent to Mollic Loamy-Silty Upland in lower landscape positions.
F105XY013WI	**Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They are moderately well to well drained. They are often found adjacent to Mollic Loamy-Silty Upland in lower landscape positions.

Similar sites

R105XY010WI	**Shallow Mollic Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They have deep, dark surfaces and bedrock contact within one meter of the soil surface. They are well drained to somewhat excessively drained. They are similar to Mollic Loamy-Silty Upland but have bedrock contact within one meter of the soil surface.
F105XY012WI	**Shallow Loamy-Silty Upland** These sites form in loamy to silty materials, often silty loess and residuum. They have bedrock contact within one meter of the soil surface. They are moderately well to well drained. They are similar to Mollic Loamy-Silty Upland but have bedrock contact within one meter of the soil surface and have shallow surface horizons of organic-enriched soil (ochric rather than mollic epipedons).
R105XY014WI	**Mollic Clayey Upland** These sites form in clayey materials, often clayey pedisediment and residuum. They have deep, dark surfaces. They are well drained. Like Mollic Loamy-Silty Upland, they have deep, organic-enriched surface horizons (mollic epipedons) but have finer soil textures.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Sorghastrum nutans*

Physiographic features

These sites form on stream terraces, strath terraces, ridges, valley trains, valley sides, hills, and pediments. They may be found in any hillslope position. Slopes range from 0 to 90 percent. Elevation of the landform ranges from 656 to 1001 feet (200 to 305 meters) above sea level.

These sites are not subject to inundation by water. The seasonally high water table is generally found below 24 inches (61 cm) from the soil surface. Runoff potential is negligible to very high. Higher runoff potential is found on steeper slopes.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope (4) Footslope (5) Toeslope
Slope shape across	(1) Concave (2) Convex
Slope shape up-down	(1) Linear

Landforms	(1) Strath terrace (2) Stream terrace (3) Ridge (4) Valley train (5) Valley side (6) Hill (7) Pediment
Runoff class	Negligible to very high
Flooding frequency	None
Ponding frequency	None
Elevation	656–1,001 ft
Slope	0–90%
Water table depth	24–60 in
Aspect	Aspect is not a significant factor

Climatic features

The climate of the Upper Mississippi River Bedrock Controlled Uplands and Valleys MLRA is typical of southern Wisconsin, with warmer winters, warmer summers, and higher precipitation rates than MLRA in northern Wisconsin. The MRA stretches over about 2.9 degrees of latitude, or nearly 200 miles, from its northern tip in Barron county to its southern Wisconsin extent on the border of Illinois. This results in considerable variation in climate throughout the MLRA. The growing season ranges from 117 to 181 growing degree days, with longer growing seasons in the southern portion.

The average annual precipitation for this ecological site is 35 inches. The average annual snowfall is 40 inches. The annual average maximum and minimum temperatures are 56°F and 35°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	117-136 days
Freeze-free period (characteristic range)	141-164 days
Precipitation total (characteristic range)	34-37 in
Frost-free period (actual range)	107-143 days
Freeze-free period (actual range)	127-167 days
Precipitation total (actual range)	32-37 in
Frost-free period (average)	124 days
Freeze-free period (average)	151 days
Precipitation total (average)	35 in

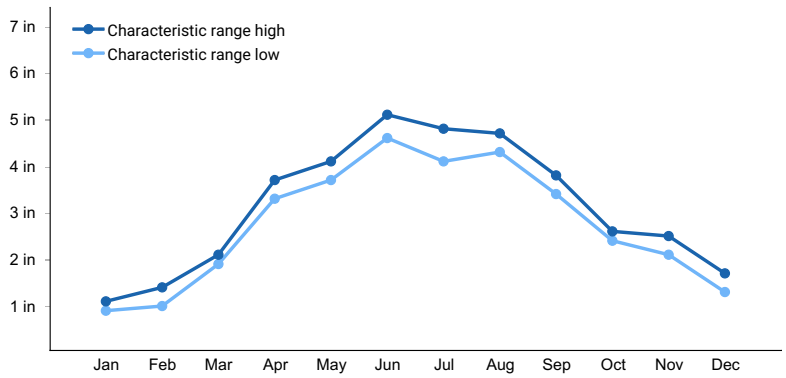


Figure 1. Monthly precipitation range

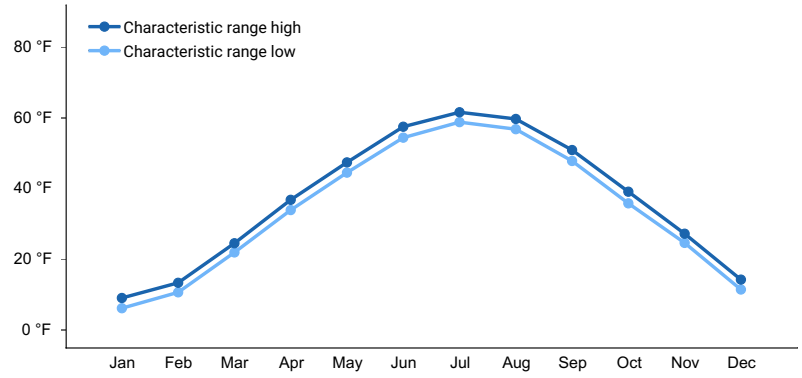


Figure 2. Monthly minimum temperature range

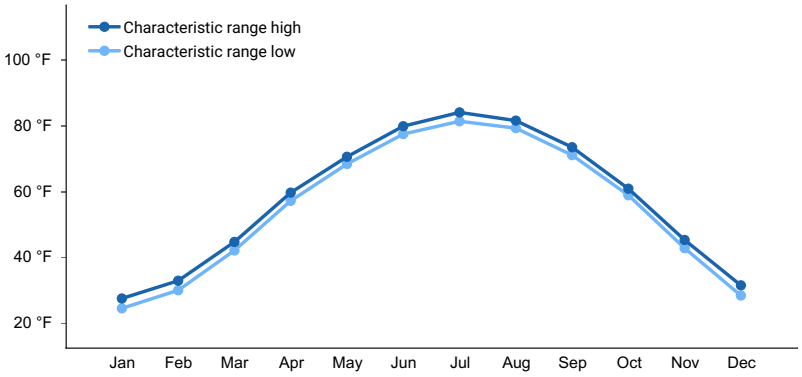


Figure 3. Monthly maximum temperature range

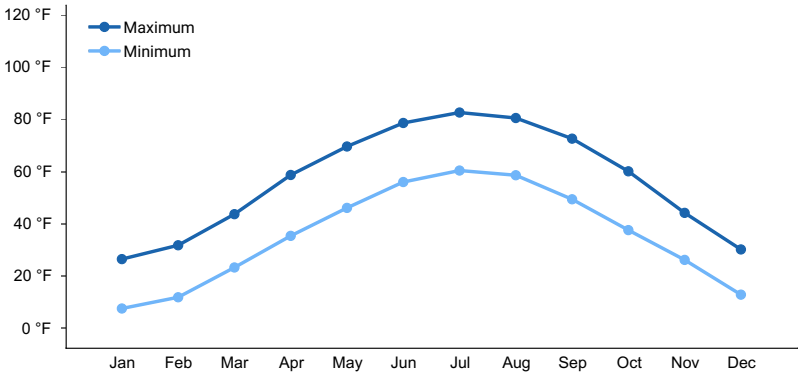


Figure 4. Monthly average minimum and maximum temperature

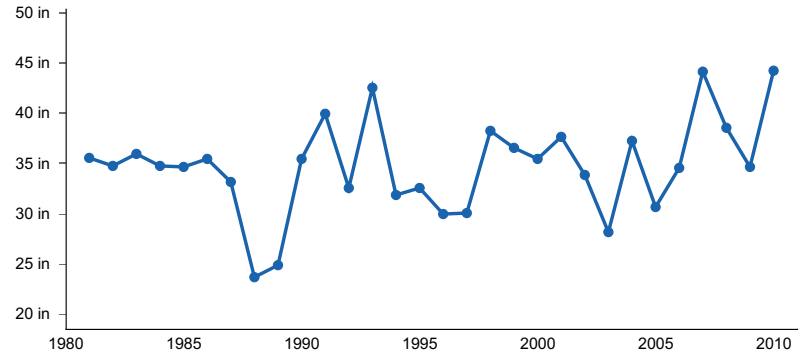


Figure 5. Annual precipitation pattern

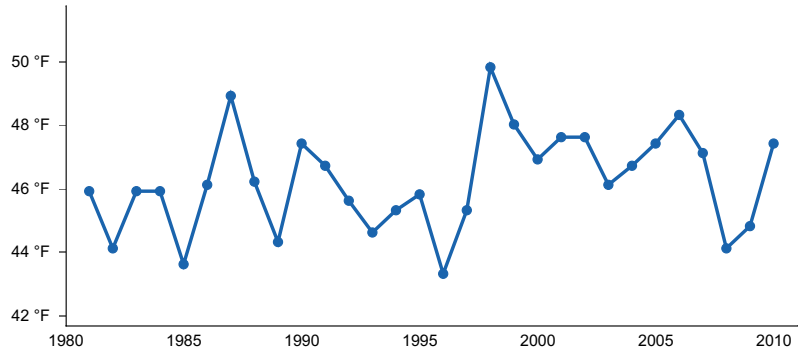


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MONDOVI [USC00475563], Mondovi, WI
- (2) PRAIRIE DU CHIEN [USC00476827], Prairie du Chien, WI
- (3) MENOMONIE [USC00475335], Menomonie, WI
- (4) LANCASTER 4 WSW [USC00474546], Bloomington, WI
- (5) PLATTEVILLE [USC00476646], Platteville, WI
- (6) LA CROSSE WFO [USC00474373], La Crosse, WI
- (7) ARGYLE [USC00470287], Argyle, WI
- (8) DARLINGTON [USC00472001], Darlington, WI
- (9) RICHLAND CTR [USC00477158], Richland Center, WI
- (10) LONE ROCK TRI CO AP [USW00014921], Spring Green, WI
- (11) PRAIRIE DU SAC 2 N [USC00476838], Prairie du Sac, WI
- (12) REEDSBURG [USC00477052], Reedsburg, WI
- (13) BLAIR [USC00470882], Blair, WI
- (14) DODGE [USC00472165], Arcadia, WI

Influencing water features

Water is received through precipitation and runoff from adjacent uplands. Water is lost from the site primarily through runoff, evapotranspiration, and groundwater recharge.
Permeability of the soils is impermeable to moderate.

The hydrologic groups for this site are A, B, C, and D.

Wetland description

Not Applicable.

Soil features

This site is represented by the Ashdale, Balmoral, Barremills, Bilson, Dakota, Dodgeville, Dubuque, Hesch, Huntsville, Judson, Keltner, Lacrescent, Lindstrom, Mickle, Nuxmaruhanixete, Pillot, Port Byron, Quarderer, Rasset, Richwood, Tama, Toddville, Trempealeau, Whitehall, and Worthen soil series. Argiudolls make up 74% of the acreage of this site. The remaining acreage is mostly Hapludolls. A small amount of Paleudolls can be found in northern Dunn county.

These soils formed in loamy and silty deposits of loess, sometimes underlain by clayey pedisediment and loamy residuum weathered from limestone or dolostone, or by sandy residuum weathered from sandstone. These soils also formed in loamy or silty alluvium, sometimes overlain by loess and underlain by sandy outwash or alluvium. Soils also form in loamy colluvium deposits. Bedrock contact may occur at depths greater than 39 inches (100 cm) from the soil surface. Subsurface fragments small than 3 inches in diameter (gravel) may occupy up to 30% volume. Larger fragments may occupy up to 35% volume. These fragments may be mixed rocks deposits by flowing water or fragments of weathered limestone, dolostone, or sandstone bedrock.

These soils have dark, rich surface horizons (mollic epipedons). Three-quarters of the sites have subsurface horizons of clay accumulations (argillic horizons). They are strongly acid to slightly alkaline. Some sites may have accumulations of secondary carbonates. These soils are moderately well to somewhat excessively drained. They do not meet hydric soil requirements.

Figure 7. Lawson(variant) soil series sampled on 07/30/2020 in Iowa County, WI.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Residuum (3) Outwash (4) Pedisediment (5) Colluvium (6) Loess
Surface texture	(1) Silt loam (2) Silty clay loam (3) Sandy loam (4) Loam
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderate
Soil depth	39–79 in
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–7%
Available water capacity (0-59.1in)	1.31–5.24 in
Calcium carbonate equivalent (0-39.4in)	0–8%
Soil reaction (1:1 water) (0-39.4in)	5.3–7.6
Subsurface fragment volume <=3" (0-39.4in)	0–30%
Subsurface fragment volume >3" (0-39.4in)	0–35%

Ecological dynamics

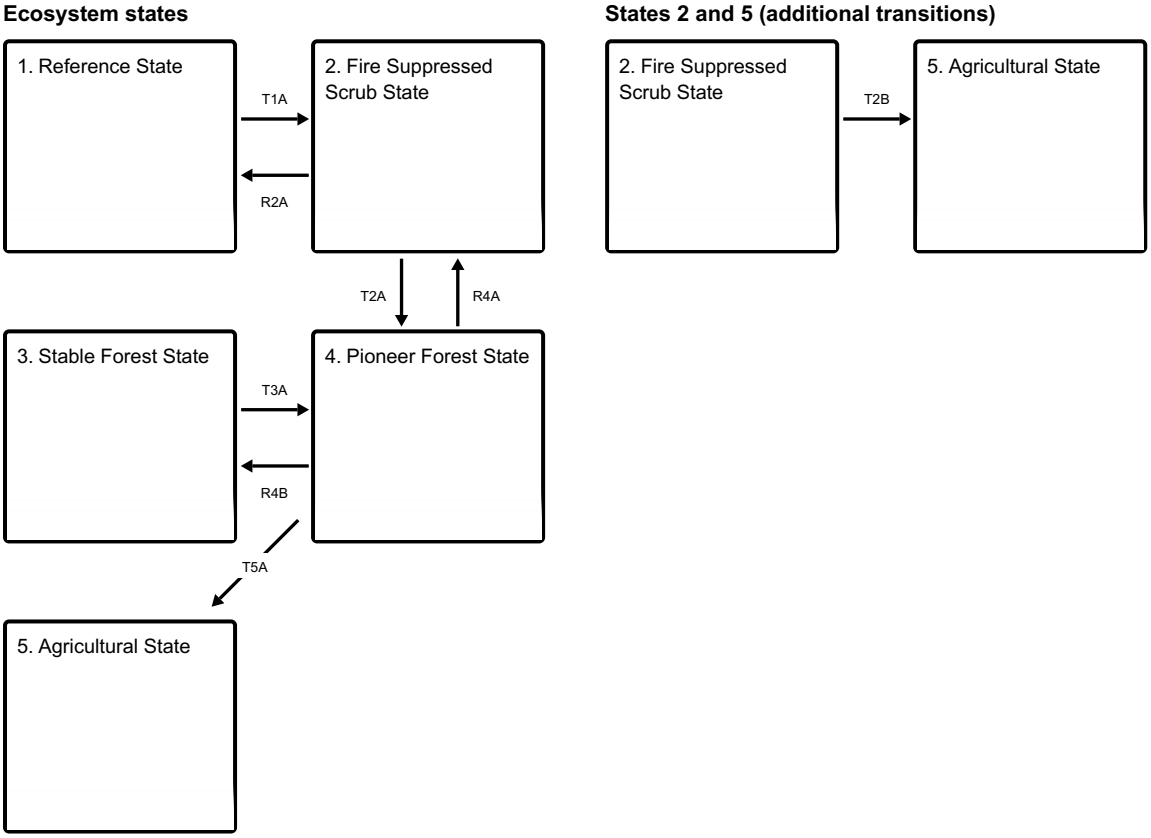
In pre-European settlement time wildfire was the main controlling factor of range and forest community dynamics. Some areas had been persistent in grasslands, but had the capacity to support both grassland and forest

depending on the frequency and intensity of fire and the presence of large grazers. Shorter fire return intervals led to grasslands, intermediate fire return intervals to scrub, and long fire return intervals to forest. Any scrub or forest community was dependent on the presence of adjacent seed source. Many of the previous grasslands have been converted to agriculture or have reverted to forest following fire suppression.

Forest communities can be described thusly, following a severe, stand-replacing fire, any of the species present on the landscape could become established, depending on seed source availability and specific conditions of post-fire seedbed. The newly established young stands of any species were easily eliminated by recurring fires, but differences in fire-resisting properties among the species began to play a role in any species' survival success. Many pine and oak species were dominant in the region because of their fire-resistant properties and successful regeneration post-fire. With clear cutting and continued fire suppression, many of these species adapted to fire and intolerant of shade are replaced by other species. Species such as white pine and red oak are still common on the landscape based on their tolerance to some shade; these species to establish under a canopy, and in time, may become a component of the canopy. Mesic hardwoods are sensitive to fire, but in its absence, the have the ability to dominate sites based on their shade tolerance and prolific seed production.

Today, these forests most commonly include stands of red oak, white oak, and other mesic hardwoods may be present as well. Some sites have a the likely reference community of sugar maple and basswood with a mixture of ashes. These sites have the conditions to support shade tolerant mesic hardwoods, but historically had significant wind throw and fire disturbance that allowed for a strong presence of oak species. As long as fire is continually suppressed, maples and other mesic hardwoods will continue to dominate the canopy.

State and transition model



T1A - Suppression of fire.

R2A - Return of fire and/or large grazers to the landscape

T2A - Continued fire suppression for over 20 years

T2B - Removal of forest/shrub cover and tilling for agricultural crop production.

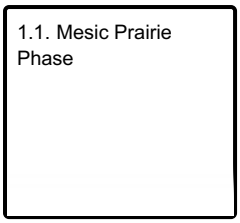
T3A - Cutting, fire, or blowdown removing existing tree canopy

R4A - Low intensity moderate return interval fire removing fire intolerant species and regeneration

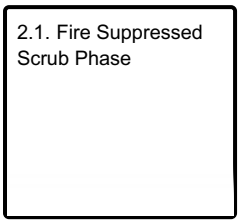
R4B - Deciduous forest community is slowly invaded by conifers.

T5A - Removal of forest/shrub cover and tilling for agricultural crop production.

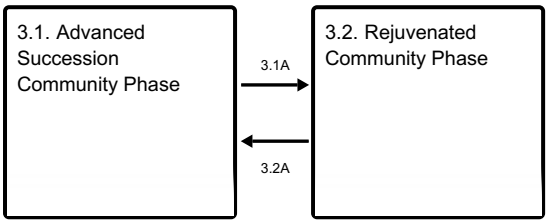
State 1 submodel, plant communities



State 2 submodel, plant communities



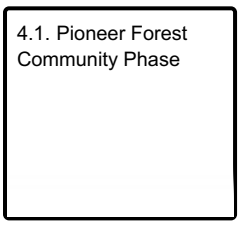
State 3 submodel, plant communities



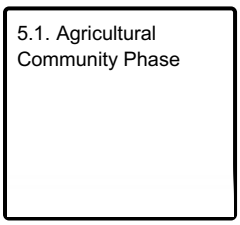
3.1A - Light to moderate intensity fires, blow-downs, ice storms.

3.2A - Disturbance-free period for 30+ years.

State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference State

The Reference State is a grassland state dominated by big bluestem, but also includes Indian grass, and little bluestem. Leadplant and sunflowers are common. The reference state for this ES is very rare today and was maintained by frequent fire removing the encroachment of tree and shrub species.

Community 1.1
Mesic Prairie Phase

The Wet-Mesic Prairie Phase is a grassland state dominated by tall grasses including big bluestem, Canada blue joint, Sedges and others with a mixture of forbs including goldenrods. This phase is very rare today.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sunflower (*Helianthus*), other herbaceous
- leadplant (*Amorpha canescens*), other herbaceous

State 2
Fire Suppressed Scrub State

A mostly open grassland with sporadic shrubs and trees. As soon as fire is suppressed tree and shrub species invade this ES and various tree and shrub species may take hold resulting in a grassland with sparse and sporadic tree and shrub cover.

Community 2.1
Fire Suppressed Scrub Phase

Fire Suppressed Scrub is a tree and shrub invaded grassland. The grassland species are similar to the reference state with the addition of various species of tree or shrub beginning to create a sparse canopy.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- oak (*Quercus*), tree
- red maple (*Acer rubrum*), tree
- pine (*Pinus*), tree
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sunflower (*Helianthus*), other herbaceous

State 3
Stable Forest State

Stable Forest state is a forest community dominated by sugar maple (*Acer saccharum*) with American basswood (*Tilia americana*), and a mixture of Ashes (Fraxinus spp.), and Oaks (Quercus spp.). Depending on history of disturbance, two community phases can be distinguished largely by differences in dominance of tree species and community age structure. In some places sugar maple seed source may be missing leading to other dominant canopy species.

Community 3.1
Advanced Succession Community Phase

In the absence of any major disturbance, specifically fire, this community is dominated by sugar maple. Common associates include American basswood, ashes, and oaks. Other species may be present in the canopy as well, including: black cherry, red maple, and shagbark hickory. The shrub layer is typically not well developed in this phase, but is likely to contain regenerating overstory species. The ground layer is often sparse but includes rich site species such as virginia creeper, enchanter's nightshade, and pointedleaf ticktrefoil.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- currant (*Ribes*), shrub
- black cherry (*Prunus serotina*), shrub
- pointedleaf ticktrefoil (*Desmodium glutinosum*), other herbaceous
- Jack in the pulpit (*Arisaema triphyllum*), other herbaceous

Community 3.2
Rejuvenated Community Phase

This community is dominated by a mixture of hardwoods including sugar maple, basswood, red oak, white oak, and ashes. Associates may include shagbark hickory, and black cherry. The shrub (often more developed in this phase) and ground layers are similar to the advanced succession phase, but may include the establishment of new seedlings to include more shade intolerant species. This community phase will quickly return to the mature or advanced succession phase with limited disturbance.

Dominant plant species

- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- ash (*Fraxinus*), tree
- currant (*Ribes*), shrub
- black cherry (*Prunus serotina*), shrub
- pointedleaf ticktrefoil (*Desmodium glutinosum*), other herbaceous
- Jack in the pulpit (*Arisaema triphyllum*), other herbaceous

Pathway 3.1A
Community 3.1 to 3.2

Light intensity fires, crown breakage from ice and snow and small scale blow-downs create canopy openings, allowing gap regeneration of less shade tolerant species such as white ash red oak and others. These species may join the canopy composition.

Pathway 3.2A
Community 3.2 to 3.1

A long period without major canopy disturbance allows gradual replacement of oldest canopy trees by younger cohorts. Lacking a major disturbance, the canopy will likely be replaced primarily with sugar maple. Small scale disturbances may still occur periodically, but once second or third canopies are established there is minimal new regeneration taking place and the forest gradually returns to mature state.

State 4
Pioneer Forest State

Community 4.1
Pioneer Forest Community Phase

These species have a very narrow window of environmental and ecological conditions for successful establishment.

Main requirements are exposed mineral soil and elimination, most effectively by fire, of on-site seed sources of potential competing vegetation. In addition, adequate soil moisture must be available for initial seedling development. Once seedlings are firmly established, height growth of both species is relatively rapid and able to outgrow most competitive species. Paper birch seedlings and saplings tolerate partial shade and often become members of mixed species communities. This is not true for aspen which requires continuous full-sun exposure for survival. Aspen stands are initially very dense due to sprouting from extensive lateral roots, but rapid natural thinning ensues as stems compete for available light.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- European white birch (*Betula pendula*), tree
- red maple (*Acer rubrum*), tree
- oak (*Quercus*), tree
- black cherry (*Prunus serotina*), shrub
- beaked hazelnut (*Corylus cornuta*), shrub
- Canada mayflower (*Maianthemum canadense*), other herbaceous

State 5
Agricultural State

Indefinite period of applying agricultural practices.

Community 5.1
Agricultural Community Phase

Indefinite period of applying agricultural practices. Crops likely include alfalfa, corn, soybeans, and hay or pasture. It is possible that some areas have been abandoned, but persist in a domesticated grassland condition having been previously pasture or hay ground.

Transition T1A
State 1 to 2

Suppression of fire leading to the encroachment of wood species. Continued suppression for 10+ years required for the establishment of woody species.

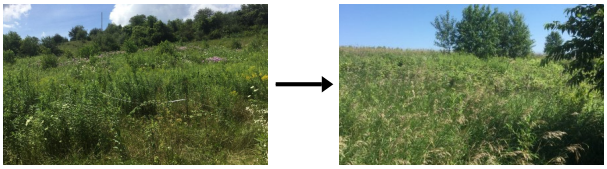
Restoration pathway R2A
State 2 to 1

Reintroduction of fire causing the mortality of encroaching trees and shrubs. This fire must then return at relatively short intervals to continue to suppress the growth of woody vegetation.

Transition T2A
State 2 to 4

Continued fire suppression for several decades will lead to a dominant woody cover on the site.

Transition T2B
State 2 to 5



Fire Suppressed Scrub State Agricultural State

Removal of forest/shrub cover and tilling for agricultural crop production.

Transition T3A
State 3 to 4

Clear cutting with initial control of competing vegetation, or stand-replacing fire, prepare the site for occupancy by shade intolerant species. This may occur through natural regeneration or by planting.

Restoration pathway R4A
State 4 to 2

Low intensity moderate return interval fire removing fire intolerant species and regeneration

Restoration pathway R4B
State 4 to 3

Deciduous forest community is slowly invaded by conifers

Transition T5A
State 4 to 5

Removal of forest/shrub cover and tilling for agricultural crop production.

Additional community tables

Inventory data references

Plot and other supporting inventory data for site identification and community phases is located on a NRCS North Central Region shared and one drive folder. University of Wisconsin-Stevens Point described soils, took photographs, and inventoried vegetation data at community phases within the reference state. The data sources include WI ESD Plot Data Collection Form - Tier 2, Releve Method, NASIS pedon description, NRCS SOI 036,

photographs, and Kotar Habitat Types.

Other references

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

County Soil Surveys from St. Croix, Polk, Barron, Rusk, Chippewa, Clark, Marathon, Taylor, Price, Sawyer, Burnett, Washburn, Douglas, Bayfield, Ashland, Lincoln, Oneida, Langlade, Shawano, Menominee, Forest, Florence, Marinette, and Pierce Counties.

Curtis, J.T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison. 657 pp.
Davis, R.B. 2016. Bogs and Fens, A Guide to the Peatland Plants of Northeastern United States and Adjacent Canada. University Press of New England, Hanover and London. 296 pp.
Finley, R. 1976. Original vegetation of Wisconsin. Map compiled from U.S. General Land Office notes. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Hvizdak, David. Personal knowledge and field experience.

Jahnke, J. and Gienccke, A. 2002. MLRA 92 Clay Till Field Investigations. Summary of field day investigations by Region 10 Soil Data Quality Specialists.
Kotar, J. 1986. Soil – Habitat Type relationships in Michigan and Wisconsin. J. For. and Water Cons. 41(5): 348-350.
Kotar, J., J.A. Kovach and G. Brand. 1999. Analysis of the 1996 Wisconsin Forest Statistics by Habitat Type. U.S.D.A. For. Serv. N.C. Res. Stn. Gen. Tech. Rept. NC-207.
Kotar, J. and T. L. Burger. 1996. A Guide to Forest Communities and Habitat Types of Central and Southern Wisconsin. University of Wisconsin-Madison, Department of Forest Ecology and Management, Madison.

Kotar, J., and T. L. Burger. 2017. Wetland Forest Habitat Type Classification System for Northern Wisconsin: A Guide for Land Managers and landowners. Wisconsin Department of Natural Resources, PUB-FR-627 2017, Madison.

Martin, L. 1965. The physical geography of Wisconsin. Third edition. The University of Wisconsin Press, Madison.

McNab, W.H. and P.W. Avers. 1994. Ecological Subregions of the United States: Section Descriptions. USDA For. Serv. Pun. WO-WSA-5, Washington, D.C.

NatureServe. 2018. International Ecological Classification Satandard: Terrestrial Ecological Classifications. NautreServe Centreal Databases. Arlington, VA. U.S.A. Data current as of 28 August 2018.

Radeloff, V.C., D.J. Mladenoff, H.S. He and M.S. Boyce. 1999. Forest landscape change in Northwestern Wisconsin Pine Barrens from pre-European settlement to the present. Can. J. For. Res. 29: 1649-1659.
Schulte, L.A., and D.J. Mladenoff. 2001. The original U.S. public land sur¬vey records: their use and limitations in reconstructing pre-European settlement vegetation. Journal of Forestry 99:5–10.

Schulte, L.A., and D.J. Mladenoff. 2005. Severe wind and fire regimes in northern forests: historical variability at the regional scale. Ecology 86(2):431–445.

Soil Survey Staff. Input based on personal experience. Tim Miland, Scott Eversoll, Ryan Bevernitz, and Jason Nemecek.
Stearns, F. W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30: 350-58.

United States Department of Agriculture, Forest Service. 1989. Proceedings – Land Classification Based on Vegetation: Applications for Management. Gen. Tech. Report INT-527.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 1, Hardwoods. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Forest Service. 1990. Silvics of North America, Vol. 2, Conifers. Agricultural Handbook 654, Washington, D.C.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource and Major Land Resource Areas of the United Sates, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. Technical Note No. 190-8-76. Washington D.C.

Wilde, S.A. 1933. The relation of soil and forest vegetation of the Lake States Region. Ecology 14: 94-105.

Wilde, S.A. 1976. Woodlands of Wisconsin. University of Wisconsin Cooperative Extension, Pub. G2780, 150 pp.

Wisconsin Department of Natural Resources. 2015. The ecological landscapes of Wisconsin: An assessment of ecological resources and a guide to planning sustainable management. Wisconsin Department of Natural Resources, PUB-SS-1131 2015, Madison.

Contributors

Jacob Prater, Associate Professor at University of Wisconsin Stevens Point
Bryant Scharenbroch, Assistant Professor at University of Wisconsin Stevens Point
John Kotar, Ecological Specialist Independent Contractor

Approval

Suzanne Mayne-Kinney, 2/23/2024

Acknowledgments

NRCS contracted UWSP to write ecological sites in MLRA 105. Completed in 2021.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/04/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or**

decadence):

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**
