USDA Natural Resources
Conservation Service

Ecological site F115XB044MO
Loamy Exposed Backslope Woodland

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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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

LRU notes

The Central Mississippi Valley Wooded Slopes, Western Part consists of deeply dissected, loess-covered hills bordering the Missouri and Mississippi Rivers as well as floodplains and terraces of these rivers. The Northern boundary runs along the South Fabius River valley separating it from the broad rounded interfluves of the northern till plain. A major physiographic feature within the LRU (Land Resource Unit) includes the Lincoln Hills region. The Lincoln Hills extend along the Mississippi River in Missouri, starting about 40 miles (64 kilometers) northwest of St. Louis and extending north to Hannibal. The Lincoln Hills partially escaped the most recent glaciation in the region during the Pleistocene. In geology and biology, they resemble the rugged and forested hills of the Ozark Highlands (MLRA 116A) more than the rolling plains of northern Missouri. The underlying limestone bedrock has formed bluffs, glades, caves, springs, and sinkholes. Elevation ranges from about 420 feet (128 meters) along the Mississippi River near Cape Girardeau, Missouri to about 830 feet (253 meters) near Clarksville along the Mississippi River upstream from St. Louis. High ridges near Hillsboro, Missouri can reach over 1,000 feet (305 meters). Underlying bedrock is mainly Ordovician-aged dolomite and sandstone, with Mississippian-aged limestone north of the Missouri River. Loess caps both stream and glacial outwash terraces along the major rivers along with Pre-Illinoisan till near the edges of the area.

Classification relationships

Major Land Resource Area (MLRA) (USDA-NRCS, 2022):
115X–Central Mississippi Valley Wooded Slopes

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Dry-Mesic Loess/Glacial Till Woodland.

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this ecological site is most similar to a Mixed Oak Woodland.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium Woodland (CEGL002150).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs primarily in Land Type Associations of the following Subsections:
Inner Ozark Border
Outer Ozark Border
Mississippi River Hills

Ecological site concept

Loamy Exposed Backslope Woodlands occupy the southerly and westerly aspects of steep, dissected slopes, and are mapped in complex with the Loamy Protected Backslope Forest ecological site. These ecological sites are in the uplands in the Missouri and Mississippi River watersheds, but are not adjacent to the river floodplains. Deep

Loess Upland and Loamy Upland ecological sites are typically upslope. Areas of Glade/Woodland ecological sites are commonly associated with these sites. Soils are very deep, and typically have coarse fragments with depth.

The reference plant community is woodland with an overstory dominated by white oak, black oak, and hickory and a ground flora of native grasses and forbs.

Associated sites

F115XB005MO	**Loamy Upland Woodland** Loamy Upland Woodland are often upslope on summits.
F115XB006MO	**Loamy Protected Backslope Forest** Loamy Protected Backslope Forests are mapped in complex with this ecological site.
F115XB048MO	**Chert Exposed Backslope Woodland** Chert Exposed Backslope Woodlands are often downslope on south and west aspects.
R115XB009MO	**Shallow Limestone/Dolomite Upland Glade/Woodland** Shallow Limestone/Dolomite Upland Glade/Woodlands commonly associated with these sites.
F115XB011MO	**Chert Protected Backslope Forest** Chert Protected Backslope Forests are often downslope on north and east aspects.

Similar sites

F115XB006MO	**Loamy Protected Backslope Forest** Loamy Protected Backslope Forests are mapped in complex with this ecological site on north and east aspects.

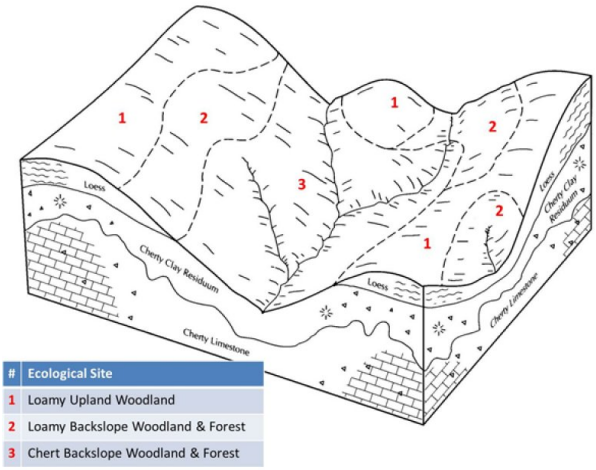
Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Carya tomentosa*
Shrub	(1) *Rhus aromatica*
Herbaceous	(1) *Carex* (2) *Schizachyrium scoparium*

Physiographic features

This site is on upland backslopes, with slopes of 15 to 50 percent. It is on exposed aspects (south, southwest, and west), which receive significantly more solar radiation than the protected aspects. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Baker, 1998) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the uplands. The site is within the area labeled “2”, on southerly and westerly exposures. Loamy Upland sites (labeled “1”) are often upslope, and Chert Backslope sites (labeled “3”) are often downslope. In other areas, Shallow Limestone/Dolomite Glade sites are associated with this site.



#	Ecological Site
1	Loamy Upland Woodland
2	Loamy Backslope Woodland & Forest
3	Chert Backslope Woodland & Forest

Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Hillslope
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	122–311 m
Slope	15–50%
Water table depth	51–152 cm
Aspect	W, SE, S, SW

Climatic features

The Central Mississippi Valley Wooded Slopes, Western Part has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes.

In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Central Mississippi Valley Wooded Slopes, Western Part experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line diagonally crossing the MLRA from northwest to southeast. Both mean annual temperature and precipitation exhibit gradients along this line.

The average annual precipitation in most of this area is 38 to 48 inches. The average annual temperature is 53 to 57 degrees F. Mean January minimum temperature follows the northwest-to-southeast gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along the same gradient as temperature. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer. Snowfall is common in winter.

During years when precipitation is normal, moisture is stored in the soil profile during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces create characteristic glade and cliff ecological sites. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

Source: University of Missouri Climate Center - http://climate.missouri.edu/climate.php; Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States

Department of Agriculture Handbook 296 - http://soils.usda.gov/survey/geography/mlra/

Table 3. Representative climatic features

Frost-free period (characteristic range)	163-166 days
Freeze-free period (characteristic range)	191-197 days
Precipitation total (characteristic range)	1,092-1,270 mm
Frost-free period (actual range)	163-167 days
Freeze-free period (actual range)	190-199 days
Precipitation total (actual range)	1,067-1,270 mm
Frost-free period (average)	165 days
Freeze-free period (average)	194 days
Precipitation total (average)	1,168 mm

Climate stations used

- (1) ANNA 2 NNE [USC00110187], Anna, IL
- (2) JACKSON [USC00234226], Jackson, MO
- (3) ST LOUIS SPRT OF S L AP [USW00003966], Chesterfield, MO
- (4) JEFFERSON CITY WTP [USC00234271], Jefferson City, MO
- (5) FESTUS [USC00232850], Crystal City, MO

Influencing water features

The water features of this upland ecological site include evapotranspiration, surface runoff, and drainage. Each water balance component fluctuates to varying extents from year-to-year. Evapotranspiration remains the most constant. Precipitation and drainage are highly variable between years. Seasonal variability differs for each water component. Precipitation generally occurs as single day events. Evapotranspiration is lowest in the winter and peaks in the summer. Water stored as ice and snow decreases drainage and surface runoff rates throughout the winter and increases these fluxes in the spring. The surface runoff pulse is greatly influenced by extreme events. Conversion to cropland or other high intensities land uses tends to increase runoff, but also decreases evapotranspiration. Depending on the situation, this might increase groundwater discharge, and decrease baseflow in receiving streams (Vano 2005).

Soil features

These soils have no major rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is loess over slope alluvium and residuum weathered from either limestone and dolomite, or from sandstone. The soils have silt loam surface horizons. Subsoils are silty clay loam in the upper part, and are very gravelly and cobbly silty clay loam, clay loam to clay in the underlying slope alluvium and residuum. Soils with sandstone residuum have more sand in the subsoil. These soils are not affected by seasonal wetness. A few soils have a bedrock contact below 40 inches. Soil series associated with this site include Bluelick, Bucklick, Crider, Holstein, Minnith, Rocheport, Useful, Weingarten, and Wrengart.

The accompanying picture of the Bluelick series shows loess over reddish brown clayey residuum, underlain by very cobbly clay. Roots can be seen in the picture throughout the soil profile. Picture from Baker (1998).

Figure 9. Bluelick series

Table 4. Representative soil features

Parent material	(1) Loess (2) Slope alluvium (3) Residuum–limestone and dolomite
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to moderately slow
Soil depth	102–183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–35%

Subsurface fragment volume >3" (Depth not specified)	0–40%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

The reference plant community is well developed woodland dominated by an overstory of white oak, black oak, and hickory. The canopy is moderately tall (60 to 85 feet) but less dense (65 to 85 percent closure) than protected slopes and the understory is poorly developed with less structural diversity. Increased light from a more open canopy causes a diversity of ground flora species to flourish. In addition, proximity to shallow soil glades provides additional opportunity for increased light and species diversity.

Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving ground flora species. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees, and tree height growth.

Fire played an important role in the maintenance of these systems. It is likely that these ecological sites burned at least once every 5 to 10 years. These periodic fires kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs. During fire free intervals, woody understory species increased and the herbaceous understory diminished. The return of fire would open the woodlands up again and stimulate the abundant ground flora.

Loamy Exposed Backslope Woodlands were also subjected to occasional disturbances from wind and ice, as well as grazing by native large herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Grazing by native large herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction.

Today, these ecological sites have been cleared and converted to pasture or have undergone repeated timber harvest and domestic grazing. Most existing forested ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices.

In the long term absence of fire, woody species, especially hickory, hophornbeam and gooseberry encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration means.

Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as coralberry, gooseberry, and Virginia creeper. Grazed sites also have a more open understory. In addition, soil compaction and soil erosion from grazing can be a problem and lower site productivity.

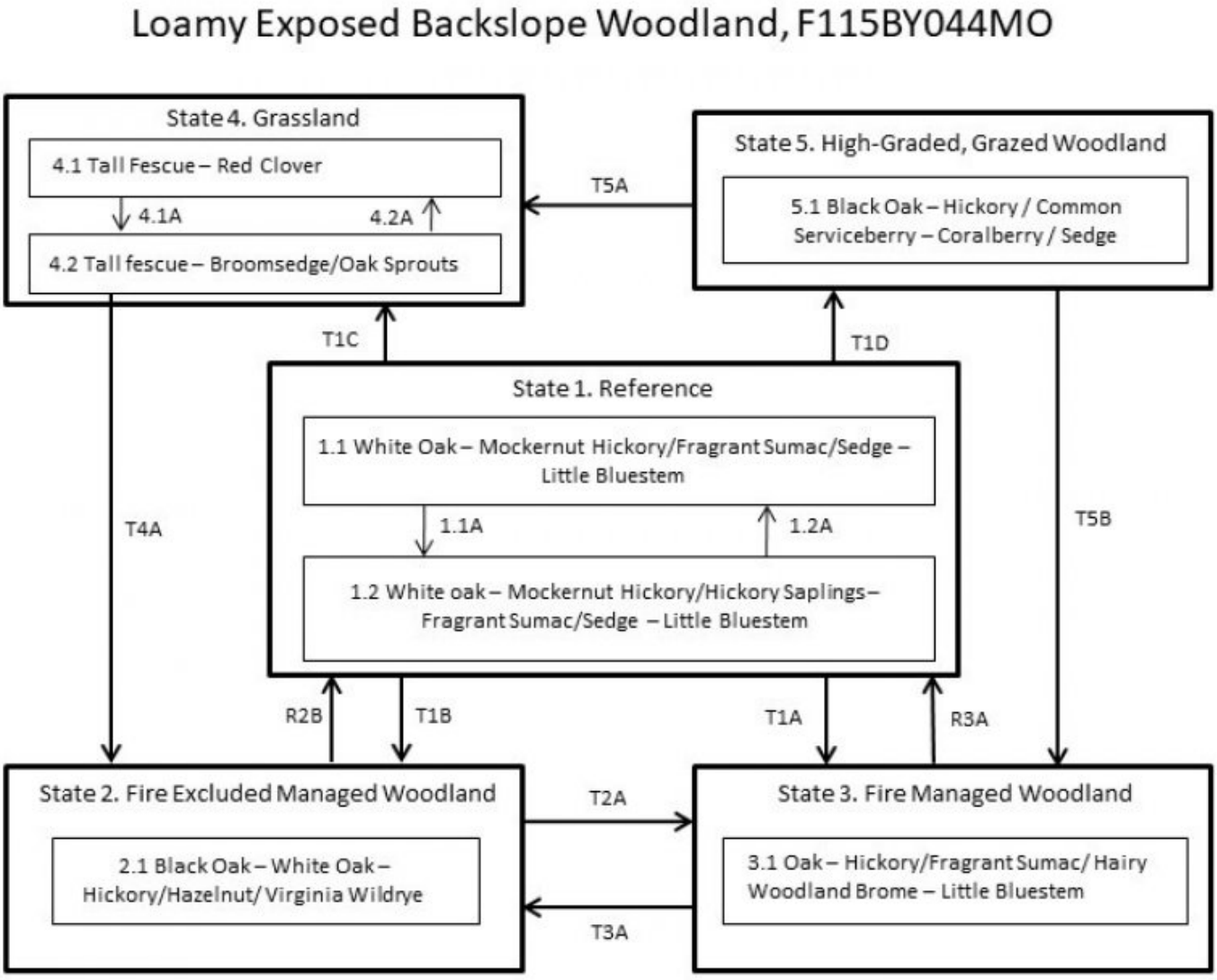
These ecological sites are moderately productive. Oak regeneration is typically problematic. Maintenance of the oak component will require disturbances such as prescribed fire and thinning that will encourage more sun adapted species and reduce shading effects.
Single tree selection timber harvests are common in this region and often results in removal of the most productive trees (high grading) in the stand leading to poorer quality timber and a shift in species composition away from more valuable oak species. Better planned single tree selection or the creation of group openings can help regenerate and maintain more desirable oak species and increase vigor on the residual trees.

Clearcutting also occurs and results in dense, even-aged stands dominated by oak. This may be most beneficial for

existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands, and periodic fires, the ground flora diversity can be shaded out and diversity of the stand may suffer.

A State and Transition Diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

State and transition model



Code	Activity/Event/Process
T1A	Even-aged management; prescribed fire
T1B	Fire suppression; uneven-age management
T1C, T5A	Clearing; grassland planting; grassland management
T1D	Poorly planned harvest; uncontrolled grazing
T2A	Prescribed fire; forest stand improvement
T3A	Even-age management; fire exclusion
T4A	Tree planting; long-term succession; no grazing
T5B	Forest management; no grazing; prescribed fire

Code	Activity/Event/Process
1.1A	No disturbances (10+ years)
1.2A	Disturbances (fire, wind, ice) < 10 years
4.1A	Over grazing; no fertilization
4.2A	Brush management; grassland seeding; grassland management

Code	Activity/Event/Process
R3A, R2B	Forest stand improvement; prescribed fire; extended rotations

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The historical reference state for this ecological site was old growth, oak woodland. The reference state was dominated by white oak, black oak, and hickory. Periodic disturbances from fire, wind or ice maintained the woodland structure and diverse ground flora species. Long disturbance-free periods allowed an increase in both the density of trees and the abundance of shade tolerant species. Two community phases are recognized in the reference state, with shifts between phases based on disturbance frequency.

Dominant plant species

- white oak (*Quercus alba*), tree
- mockernut hickory (*Carya tomentosa*), tree
- fragrant sumac (*Rhus aromatica*), shrub
- sedge (*Carex*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
White Oak – Mockernut Hickory/Fragrant Sumac/Sedge – Little Bluestem

Figure 11. Reference site in Graham Cave State Park, near Danville, Missouri

This phase has an overstory that is dominated by white oak, black oak, and hickory. This woodland community has a two-tiered structure with an open understory and a dense, diverse herbaceous ground flora. Periodic disturbances including fire, ice and wind create canopy gaps, allowing oaks to successfully reproduce and remain in the canopy. It is likely that this phase burned at least once every 5 to 10 years.

Forest overstory. The Overstory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Forest understory. The Understory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Community 1.2
White oak – Mockernut Hickory/Hickory Saplings – Fragrant Sumac/Sedge – Little Bluestem

This phase is similar to community phase 1.1 but oak and hickory understory densities are increasing due to longer periods of fire suppression. Displacement of some grasses and forbs may be occurring due to shading and competition from the increased densities of oak and hickory saplings in the understory.

Pathway P1.1A
Community 1.1 to 1.2

This pathway is a gradual transition that results from extended, disturbance-free periods for 10 or more years.

Pathway P1.2A
Community 1.2 to 1.1

This pathway is a transition that results from disturbance periods returning, such as native fires, wind, and ice storms.

State 2
Fire Excluded Managed Woodland

These stands will slowly increase in more shade tolerant species and white oak will become less dominant. These woodlands tend to be rather dense, with a sparse understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. However, in the absence of fire, the diversity and cover of the ground flora is still diminished. Without periodic disturbance, stem density and fire intolerant species, like sassafras and hickory, increase in abundance.

Dominant plant species

- black oak (*Quercus velutina*), tree
- white oak (*Quercus alba*), tree
- mockernut hickory (*Carya tomentosa*), tree
- shagbark hickory (*Carya ovata*), tree
- American hazelnut (*Corylus americana*), shrub
- Virginia wildrye (*Elymus virginicus*), grass

Community 2.1
Black Oak – White Oak – Hickory/Hazelnut/ Virginia Wildrye

This is the only phase associated with this state at this time. See the corresponding state narrative for details.

State 3
Fire Managed Woodland

Fire Managed Woodland state results from managing woodland communities with prescribed fire and canopy thinning. This state can resemble the reference state, but with younger maximum tree ages, more open canopies and lower ground flora diversity. Cessation of prescribed fire will allow transition to various managed woodland states.

Dominant plant species

- oak (*Quercus*), tree
- mockernut hickory (*Carya tomentosa*), tree
- shagbark hickory (*Carya ovata*), tree
- fragrant sumac (*Rhus aromatica*), shrub
- hairy woodland brome (*Bromus pubescens*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 3.1
Oak – Hickory/Fragrant Sumac/ Hairy Woodland Brome – Little Bluestem

This is the only phase associated with this state at this time. See the corresponding state narrative for details.

State 4
Grassland

Conversion of woodlands to planted, non-native cool season grassland species such as tall fescue is common for this region. Steep slopes, low organic matter contents and low soil infertility make grasslands harder to maintain in a healthy, productive state on this ecological site. Two community phases are recognized in the grassland state, with shifts between phases based on types of management.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- red clover (*Trifolium pratense*), other herbaceous

Community 4.1
Tall Fescue - Red Clover

This phase is well-managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring. The effects of long-term liming on soil pH, and calcium and magnesium content, is most evident in this phase. Studies show that these soils have higher pH and higher base status in soil horizons as much as two feet below the surface, relative to poorly managed grassland and to woodland communities where liming is not practiced.

Community 4.2
Tall fescue - Broomsedge/Oak Sprouts

This phase is the result of over use, poor grassland and grazing management and lack of adequate nutrient application. Oak sprouts, oak saplings, and invasive species are increasing as a result of poor management.

Pathway P1.1A
Community 4.1 to 4.2

This pathway is the result of over grazing and lack of proper grassland management.

Pathway P4.2A
Community 4.2 to 4.1

This pathway is the result of brush management, grassland reseeding and proper grassland management.

State 5
High-Graded, Grazed Woodland

States that were subjected to repeated, high-grading timber harvests and uncontrolled domestic grazing transitioned to a High-Graded, Grazed Woodland state. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as coralberry, gooseberry, poison ivy and Virginia creeper. The existing vegetation offers little nutritional value for cattle, and excessive cattle stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff.

Dominant plant species

- black oak (*Quercus velutina*), tree
- mockernut hickory (*Carya tomentosa*), tree
- shagbark hickory (*Carya ovata*), tree
- common serviceberry (*Amelanchier arborea*), shrub

- coralberry (*Symphoricarpos orbiculatus*), shrub
- sedge (*Carex*), grass

Community 5.1
Black Oak – Hickory / Common Serviceberry – Coralberry / Sedge

This is the only phase associated with this state at this time. See the corresponding state narrative for details.

Transition T1B
State 1 to 2

This transition is the result of fire suppression and uneven-age management.

Transition T1A
State 1 to 3

This transition is the result of even-aged management and prescribed fire.

Transition T1C
State 1 to 4

This transition is the result of clearing, grassland planting and grassland management.

Transition T1D
State 1 to 5

This transition is the result of poorly planned harvest and uncontrolled grazing.

Restoration pathway R2B
State 2 to 1

This restoration pathway is the result of forest stand improvement, prescribed fire and extended rotations.

Transition T2A
State 2 to 3

This transition is the result of prescribed fire and forest stand improvement.

Restoration pathway R3A
State 3 to 1

This restoration pathway is the result of forest stand improvement, prescribed fire and extended rotations.

Transition T3A
State 3 to 2

This transition is the result of even-age management and fire exclusion.

Transition T4A
State 4 to 2

This transition is the result of tree planting, long-term succession and livestock exclusion.

Transition T5A
State 5 to 4

This transition is the result of clearing, grassland planting and grassland management.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
black oak	QUVE	*Quercus velutina*	Native	–	25–50	–	–
white oak	QUAL	*Quercus alba*	Native	–	2–50	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	10–25	–	–
mockernut hickory	CATO6	*Carya tomentosa*	Native	–	10–25	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	5–10	–	–
post oak	QUST	*Quercus stellata*	Native	–	2–5	–	–
chinquapin oak	QUMU	*Quercus muehlenbergii*	Native	–	–	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	10–30
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	10–30
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	10–20
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	10–20
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	5–20
whitetinge sedge	CAAL25	*Carex albicans*	Native	–	5–10
eastern star sedge	CARA8	*Carex radiata*	Native	–	5–10
Forb/Herb					
Virginia spiderwort	TRVI	*Tradescantia virginiana*	Native	–	10–30
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	10–30
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	10–30
eastern purple coneflower	ECPU	*Echinacea purpurea*	Native	–	10–30
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	5–20
hoary puccoon	LICA12	*Lithospermum canescens*	Native	–	5–20
fourleaf milkweed	ASQU	*Asclepias quadrifolia*	Native	–	10–20
tall blazing star	LIAS	*Liatris aspera*	Native	–	5–20
American hogpeanut	AMBR2	*Amphicarpaea bracteata*	Native	–	0.1–10
bearded shorthusk	BRER2	*Brachyelytrum erectum*	Native	–	0.1–10
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	1–10
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	5–10
wild bergamot	MOFI	*Monarda fistulosa*	Native	–	1–2
manyray aster	SYAN2	*Symphyotrichum anomalum*	Native	–	1–2
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	10–30
American hazelnut	COAM3	*Corylus americana*	Native	–	10–30

Animal community

Wildlife (MDC 2006):

Oaks on this site provide abundant hard mast; scattered shrubs provide soft mast; native legumes provide high-quality wildlife food.

Sedges and native cool-season grasses provide green browse; native warm-season grasses provide cover and nesting habitat; and a diversity of forbs provides a diversity and abundance of insects.

Post-burn areas can provide temporary bare-ground and herbaceous cover habitat is important for turkey poults and quail chicks.

Birds species associated with this site are Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Summer Tanager, Eastern Wood-Pewee, Whip-poor-will, Chuck-will's widow, Red-eyed Vireo, Rose-breasted Grosbeak, Yellow-billed Cuckoo, and Broad-winged Hawk.

Reptile and amphibian species include ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, six-lined racerunner, flat-headed snake, rough earth snake, and timber rattlesnake.

Other information

Forestry (NRCS 2002, 2014):

Management: Field measured site index values for oaks average 61. Timber management opportunities are good. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality, and should be used with caution on a particular site if timber management is the primary objective.

Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On highly eroded slopes, exposed subsoils can be very gravelly and cobbly. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Potential Reference Sites: Loamy Exposed Backslope Woodland

Plot DABOCA_JK11 - Wrengart soil
Located in Daniel Boone CA, Warren County, MO
Latitude: 38.781733
Longitude: -91.391059

Plot GRCASP_KS12 – Holstein soil
Located in Graham Cave SP, Montgomery County, MO
Latitude: 38.905505
Longitude: -91.582149

Plot GRCASP_KS13 - Holstein soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.905927
Longitude: -91.579731

Plot GRCASP07 – Crider soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.905488
Longitude: -91.58221

Other references

Baker, John L. 1998. Soil Survey of Cooper County, Missouri. U.S. Dept. of Agric. Natural Resources Conservation Service.

Batek, M.J., A.J. Rebertus, W.A. Schroeder, T.L. Haithcoat, E. Compas, and R.P. Guyette. 1999. Reconstruction of early nineteenth-century vegetation and fire regimes in the Missouri Ozarks. Journal of Biogeography 26:397-412.

Frost, C., 1996. Pre-settlement Fire Frequency Regimes of the United States: A First Approximation. Pages 70-81, Proceedings of the 20nd Tall Timbers Fire Ecology Conference: Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Tall Timbers Research Station, Tallahassee, FL.

Harlan, J.D., T.A. Nigh and W.A. Schroeder. 2001. The Missouri original General Land Office survey notes project. University of Missouri, Columbia.

Ladd, D. 1991. Reexamination of the role of fire in Missouri oak woodlands. Pp. 67-80 in G.V. Brown, James K.; Smith, Jane Kapler, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

MDC, 2006. Missouri Forest and Woodland Community Profiles. Missouri Department of Conservation, Jefferson City, Missouri.

Natural Resources Conservation Service. 2002. Woodland Suitability Groups. Missouri FOTG, Section II, Soil Interpretations and Reports. 30 pgs.

Natural Resources Conservation Service. Site Index Reports. Accessed May 2014. https://esi.sc.egov.usda.gov/ESI_Forestland/pgFSWelcome.aspx

NatureServe, 2010. Vegetation Associations of Missouri (revised). NatureServe, St. Paul, Minnesota.

Nelson, Paul W. 2010. The Terrestrial Natural Communities of Missouri. Missouri Department of Conservation, Jefferson City, Missouri.

Nigh, Timothy A. and Walter A. Schroeder. 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation, Jefferson City, Missouri.

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. 682 pgs.

United States Department of Agriculture, Natural Resources Conservation Service. 2022. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture, Agriculture Handbook 296.

University of Missouri Climate Center - http://climate.missouri.edu/climate.php; accessed June 2012

Vano, Julie A. 2005. Land Surface Hydrology in Northern Wisconsin: Influences of climatic variability and land cover. University of Wisconsin-Madison.

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Approval

Suzanne Mayne-Kinney, 12/30/2024

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Missouri Department of Conservation and Missouri Department of Natural Resources personnel provided significant and helpful field and technical support in the development of this ecological site.

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	05/13/2025

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:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
