Ecological site F115XB007MO
Loamy Limestone/Dolomite Upland Woodland

Last updated: 12/30/2024
Accessed: 05/11/2025

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 Limestone/Dolomite Woodland.

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

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus muehlenbergii - Fraxinus (quadrangulata, americana) / Schizachyrium scoparium Woodland (CEGL002143).

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
Mississippi River Hills

Ecological site concept

Loamy Limestone/Dolomite Upland Woodlands are a few scattered locations south of the Missouri River, in uplands that are not adjacent to the Missouri or Mississippi River floodplains. Soils are typically moderately deep over limestone/dolomite bedrock, with loamy surfaces and clayey subsoils. The reference plant community is woodland with an overstory dominated by white oak with minor amounts of chinkapin oak and northern red oak and a ground

flora of native grasses and forbs with scattered shrubs.

Associated sites

F115XB014MO	**Chert Limestone/Dolomite Protected Backslope Forest** Chert Limestone/Dolomite Protected Backslope Forests are steeper downslope north and east facing slopes.
F115XB046MO	**Chert Limestone/Dolomite Exposed Backslope Woodland** Chert Limestone/Dolomite Exposed Backslope Forests are steeper downslope south and west facing slopes.
R115XB009MO	**Shallow Limestone/Dolomite Upland Glade/Woodland** Shallow Limestone/Dolomite Upland Glade/Woodlands are typically found downslope associated with rock outcropping.

Similar sites

F115XB005MO	**Loamy Upland Woodland** Loamy Upland Woodlands are on similar landscape positions but have deeper soil depths and are more productive

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus muehlenbergii*
Shrub	(1) *Cercis canadensis* (2) *Rhus aromatica*
Herbaceous	(1) *Elymus virginicus* (2) *Schizachyrium scoparium*

Physiographic features

This site is on upland summits, shoulders and backslopes with slopes of 3 to 20 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The accompanying figure (adapted from Held, 1989) 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 “1”. Sites formed in limestone or dolomite residuum are typically downslope, as shown in the figure.

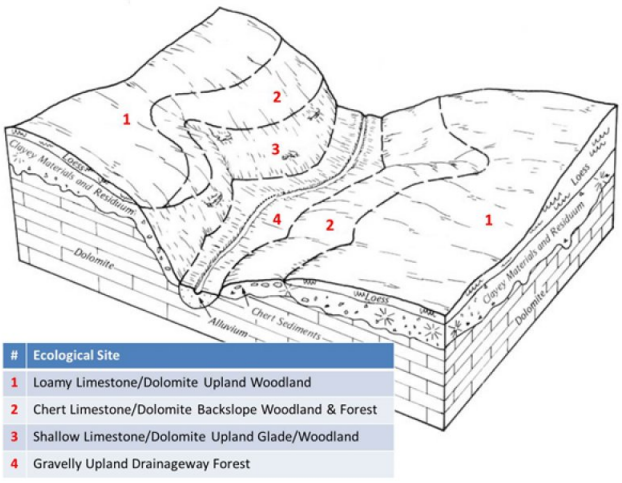


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Interfluve (3) Hill
Runoff class	High
Flooding frequency	None
Ponding frequency	None
Elevation	350–1,020 ft
Slope	1–15%
Water table depth	14–45 in
Aspect	Aspect is not a significant factor

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 comes in a fairly normal manner, moisture is stored in the top layers of the soil 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 may create distinctive environmental niches such as glades and cliffs. 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 is measurably different from the climate of a more open grassland or savanna areas.

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

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)	138-174 days
Freeze-free period (characteristic range)	176-203 days
Precipitation total (characteristic range)	41-47 in
Frost-free period (actual range)	136-187 days
Freeze-free period (actual range)	172-207 days
Precipitation total (actual range)	40-49 in
Frost-free period (average)	157 days
Freeze-free period (average)	190 days
Precipitation total (average)	44 in

Climate stations used

- (1) ST LOUIS LAMBERT INTL AP [USW00013994], Saint Louis, MO
- (2) ROSEBUD [USC00237300], Gerald, MO
- (3) BOWLING GREEN 1 E [USC00230856], Bowling Green, MO
- (4) JACKSON [USC00234226], Jackson, 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 are underlain with limestone and/or dolomite bedrock at 20 to 40 inches deep. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is a thin layer of loess, over slope alluvium, over residuum weathered from limestone and dolomite, overlying limestone or dolomite bedrock. They have silt loam surface layers, with clayey subsoils that have low to moderate amounts of chert gravel and cobbles. Some soils are affected by seasonal wetness in spring months from a water table perched on the clayey subsoil. Soil series associated with this site include Caneyville.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and dolomite
Surface texture	(1) Silt loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow
Soil depth	20–40 in
Surface fragment cover <=3"	0–9%

Surface fragment cover >3"	0%
Available water capacity (0-40in)	4–6 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–40%
Subsurface fragment volume >3" (Depth not specified)	0–3%

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 moderately deep soil of Loamy Limestone/Dolomite Upland Woodlands limits the growth of trees and supports an abundance of native grasses and forbs in the understory. While more productive than adjacent glades, these sites were only moderately tall (50 to 65 feet) with a white oak dominated a semi-open overstory with occasional chinkapin oak and northern red oak. Shrubs were scattered within a dense matrix of native grasses and forbs. 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, along with adjacent glades burned at least once every 5 years. These periodic fires kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs. They would have also further limited the growth and dominance of trees, especially eastern redcedar. During fire free intervals, woody species would have increased, and the herbaceous understory diminished. But the return of fire would have re-opened the woodlands and stimulated the ground flora.

Loamy Limestone/Dolomite Upland 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 herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction and sun-loving ground flora species.

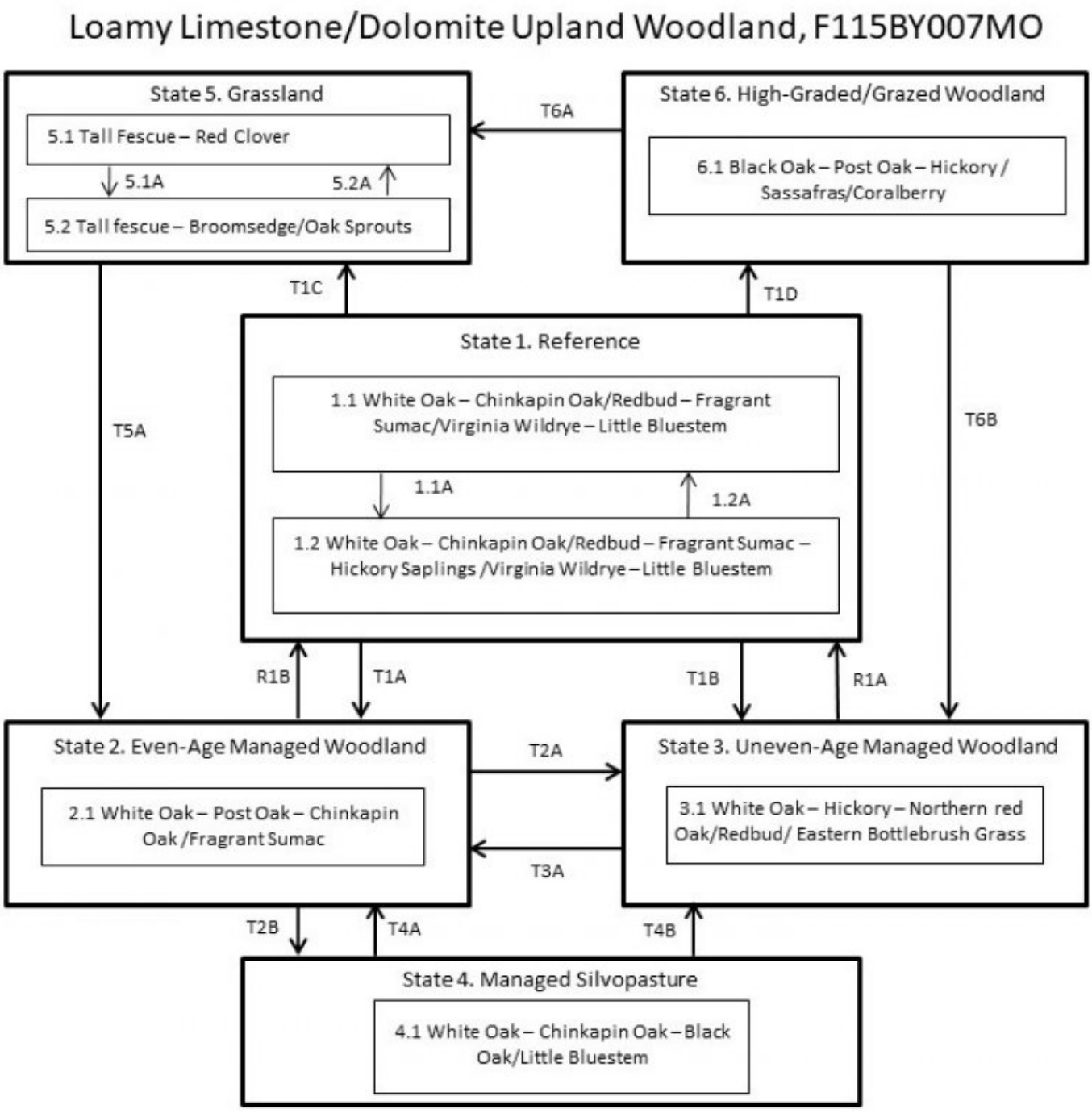
Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as coralberry, gooseberry, and Virginia creeper. It also promotes the invasion of eastern red cedar. Grazed sites have a more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

These ecological sites are marginally productive, especially when compared to protected slopes and loess covered units. Oak regeneration can be problematic. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects.

Single tree selection timber harvests are common for this ecological site 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 beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands and application of prescribed fire, the ground flora diversity can be shaded out and diversity of the stand will 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	Event/Process
T1A	Even-aged management; fire suppression
T1B	Fire suppression; uneven-age management
T2B	Prescribed fire; thinning; grazing management
T1C, T6A	Clearing; grassland planting; grassland management
T1D	Poorly planned harvest; uncontrolled grazing
T2A	Uneven-age management
T3A	Even-age management
T5A	Tree planting; long-term succession; no grazing
T6B	Uneven-age management; tree planting
T4A	Uneven-age management; no grazing
T4B	Even-age management; no grazing

Code	Event/Process
1.1A	No disturbance (10+ years)
1.2A	Disturbance (fire, wind, ice) < 10 years
5.1A	Over grazing; no fertilization
5.2A	Brush management; grassland seeding; grassland management

Code	Event/Process
R1A, R1B	Forest management; prescribed fire; extended rotations

Figure 9. 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 chinkapin oak, post oak and white oak. Maximum tree age was likely 150 to 300 years. 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 reference state, with shifts between phases based on disturbance frequency. Reference state woodlands are very rare today. Many sites have been converted to non-native pasture (State 5). Others have been subject to repeated, high-graded timber harvest coupled with domestic livestock grazing (State 6). Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora.

Dominant plant species

- white oak (*Quercus alba*), tree
- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redbud (*Cercis canadensis*), tree
- fragrant sumac (*Rhus aromatica*), shrub
- Virginia wildrye (*Elymus virginicus*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
White Oak – Chinkapin Oak/Red Bud – Fragrant Sumac/Virginia Wildrye –Little Bluestem

Figure 10. Reference Loamy Limestone/Dolomite Upland Woodland at Graham Cave State Park, near Montgomery City, Missouri

This phase is a woodland with a white oak dominated a semi-open overstory with occasional chinkapin oak and northern red oak. This woodland phase has a two-tiered structure with an open understory with scattered shrubs and a dense, diverse native herbaceous ground flora. Periodic disturbances including fire, ice and wind created canopy gaps, allowing oak species to successfully reproduce and remain in the canopy. It is likely that this phase burned at least once every 5 years.

Forest overstory. Forest Overstory Composition based on field surveys (species with cover percentages) and Nelson (2010) and field surveys.

Forest understory. Forest Understory Composition based on field surveys (species with cover percentages) and Nelson (2010) and field surveys.

Community 1.2
White Oak – Chinkapin Oak/Red Bud – Fragrant Sumac – Hickory /Virginia Wildrye – Little Bluestem

This phase is similar to community phase 1.1 but oak, hickory and shrub 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 the result of a disturbance-free interval of greater than 10 years.

Pathway P1.2A
Community 1.2 to 1.1

This pathway is the result of a fire 3 to 10-year disturbance cycle being reestablished.

State 2
Even-Age Managed Woodland

This state starts with a sequence of early seral mixed oak woodlands, which mature over time. These woodlands tend to be rather dense, with a depauperate 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. Continual timber management, depending on the practices used, will either maintain this state, or convert the site to uneven-age (State 3) woodlands.

Dominant plant species

- white oak (*Quercus alba*), tree
- post oak (*Quercus stellata*), tree
- chinquapin oak (*Quercus muehlenbergii*), tree
- fragrant sumac (*Rhus aromatica*), shrub

Community 2.1
White Oak – Post Oak – Chinkapin Oak /Aromatic Sumac

This is an even-aged forest management phase. Logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak. Large group, shelterwood or clearcut harvests create a more uniform age class structure throughout the canopy layer while also opening up the understory and allowing more sunlight to reach the forest floor.

State 3
Uneven-Age Managed Woodland

Uneven Age Managed Woodland isdense because of fire suppression, but less so than the Even-Age Managed state. Consequently, the woodland ground flora is less suppressed and structural diversity is better maintained. Without periodic disturbance, stem density and fire intolerant species, like hickory, increase in abundance. Without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species and white oak will become less dominant.

Dominant plant species

- white oak (*Quercus alba*), tree
- shagbark hickory (*Carya ovata*), tree
- northern red oak (*Quercus rubra*), tree
- eastern bottlebrush grass (*Elymus hystrix*), grass

Community 3.1
White Oak – Hickory – Northern red Oak/Red Bud/ Bottlebrush grass

This is an uneven-aged forest management phase. Selective logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak and hickory. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4
Managed Silvopasture

The Managed Silvopasture State results from managing woodland communities with prescribed fire, selective thinning, and introducing a managed grazing system with livestock. This state can resemble the reference state, with younger maximum tree ages and lower ground flora diversity.

Dominant plant species

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

Community 4.1
White Oak – Chinkapin Oak – Black Oak/Little Bluestem

This phase is an agroforestry practice that combines forestry and grazing of domesticated animals in a mutually beneficial way. Advantages of a properly managed silvopasture operation are enhanced soil protection and increased long-term income due to the simultaneous production of trees and grazing animals.

State 5
Grassland

Conversion of woodlands to planted, non-native pasture species such as tall fescue has been common in the Springfield plateau. Low available water, abundant surface fragments, low organic matter contents and soil acidity make non-native pastures difficult to maintain in a healthy, productive state on this ecological site. If grazing and active pasture management are discontinued, the site will eventually transition to State 2 (Even-Age). Timber Stand Improvement practices can hasten this process.

Dominant plant species

- black oak (*Quercus velutina*), tree
- post oak (*Quercus stellata*), tree
- shagbark hickory (*Carya ovata*), tree
- sassafras (*Sassafras albidum*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub
- eastern poison ivy (*Toxicodendron radicans*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Community 5.1
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 5.2
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 P5.1A
Community 5.1 to 5.2

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

Pathway P5.2A
Community 5.2 to 5.1

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

State 6
High-Graded, Grazed Woodland

Wooded sites subjected to repeated, high-graded timber harvests and domestic grazing transition to this State. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as buckbrush, gooseberry, poison ivy and Virginia creeper. The vegetation offers little nutritional value for cattle, and excessive stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Exclusion of livestock from sites in this state coupled with uneven-age management techniques will cause a transition to State 3 (Uneven-Age).

Community 6.1
Black Oak – Post Oak – Hickory / Sassafras/Buckbrush

Due to high-grade logging and uncontrolled grazing, this community phase exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The understory vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff.

Transition T1A
State 1 to 2

This transition typically results from even-age timber management practices, such as clear-cut, seed tree or shelterwood harvest and fire suppression..

Transition T1B
State 1 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest along with fire suppression.

Transition T1C
State 1 to 5

This transition is the result of clearing the woodland community and planting non-native grassland species. Soil erosion can be extensive in this process, along with loss of organic matter.

Transition T1D
State 1 to 6

This transition is the result of poorly planned timber harvest techniques such as high-grading, accompanied by unmanaged livestock grazing. Soil erosion and compaction often result from livestock grazing after the understory has been damaged.

Restoration pathway R1B
State 2 to 1

This restoration transition generally requires forest management practices with extended rotations that allow mature trees to exceed ages of about 100 years along with prescribed fire.

Transition T2A

State 2 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest.

Transition T2B
State 2 to 4

This transition is the result of the systematic application of prescribed fire and grazing management. Mechanical thinning may also be used.

Restoration pathway R1A
State 3 to 1

This restoration pathway is the result of the systematic application of prescribed fire. Mechanical thinning may also be used along with understory removal and extended rotations.

Transition T3A
State 3 to 2

This transition typically results from even-age timber management practices, such as clear-cut, seed tree or shelterwood harvest.

Transition T4A
State 4 to 2

This transition typically results from even-age forest management practices, such as clear-cut, seed tree or shelterwood harvest, cessation of grazing and fire suppression.

Transition T4B
State 4 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest, cessation of grazing and fire suppression.

Transition T5A
State 5 to 2

This transition results from the cessation of livestock grazing and associated pasture management such as mowing and brush management. Herbicide application, tree planting and forest stand improvement techniques can speed up this otherwise very lengthy transition.

Transition T6B
State 6 to 3

This transition typically results from uneven-age forest management practices, such as single tree or group selection harvest. Tree planting, mechanical thinning and other forest stand improvement techniques may be helpful to decrease the transition time.

Transition T6A
State 6 to 5

This transition is the result of clearing the woodland community and planting non-native grassland species. Soil erosion can be extensive in this process, along with loss of organic matter.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
chinquapin oak	QUMU	*Quercus muehlenbergii*	Native	–	1–25	–	–
post oak	QUST	*Quercus stellata*	Native	–	10–25	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	5–10	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	2–10	–	–
blue ash	FRQU	*Fraxinus quadrangulata*	Native	–	2–5	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	1–2	–	–
white oak	QUAL	*Quercus alba*	Native	–	–	–	–
black oak	QUVE	*Quercus velutina*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
rock muhly	MUSO	*Muhlenbergia sobolifera*	Native	–	5–10
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	5–10
slender woodland sedge	CADI5	*Carex digitalis*	Native	–	–
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	–
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	–
oval-leaf sedge	CACE	*Carex cephalophora*	Native	–	–
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
Forb/Herb					
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	–
tall blazing star	LIAS	*Liatris aspera*	Native	–	–
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	–
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	–
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	–
yellow pimpernel	TAIN	*Taenidia integerrima*	Native	–	–
Ozark milkvetch	ASDI4	*Astragalus distortus*	Native	–	–
butterfly milkweed	ASTU	*Asclepias tuberosa*	Native	–	–
violet lespedeza	LEVI6	*Lespedeza violacea*	Native	–	–
eastern purple coneflower	ECPU	*Echinacea purpurea*	Native	–	–
white arrowleaf aster	SYUR	*Symphyotrichum urophyllum*	Native	–	–
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	2–5
American hazelnut	COAM3	*Corylus americana*	Native	–	–
Tree					
eastern redbud	CECA4	*Cercis canadensis*	Native	–	1–2

Animal community

Wildlife (MDC 2006):

Oaks provide hard mast for wildlife; scattered shrubs provide soft mast; frequent bedrock outcrops provide reptile habitat and a patchier ground flora.

Sedges and native grasses provide green browse.

Native grasses on dry sites 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 – herbaceous cover habitat important for turkey poults and quail chicks.

Bird species associated with Limestone/Dolomite Woodlands include Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Summer Tanager, Eastern Wood-Pewee, Whip-poor-will, Chuck-will's widow, and Red-eyed Vireo.

Reptiles and amphibians associated with mature Limestone/Dolomite Woodlands include: ornate box turtle, northern fence lizard, five-lined skink, coal skink, broad-headed skink, six-lined racerunner, western slender glass lizard, prairie ring-necked snake, flat-headed snake, rough earth snake, red milk snake, western pygmy rattlesnake, and timber rattlesnake.

Other information

Forestry (NRCS 2002, 2014):

Management: Field collected site index values average 56 for oak species. Timber management opportunities are fair. 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 site if timber management is the primary objective.

Limitations: Seasonal wetness; clayey subsoil; low to moderate coarse fragments in the profile; bedrock is within 40 inches. Surface gravels are problems for efficient and safe equipment operation and will make equipment use somewhat difficult. Disturbing the surface excessively in harvesting operations and building roads increases soil losses. Hand planting or direct seeding may be necessary. Mulching or providing shade can improve seedling survival. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase, and equipment use is not recommended.

Inventory data references

Potential Reference Sites: Loamy Limestone/Dolomite Upland Woodland

Plot GRCASP04 – Caneyville soil
Located in Graham Cave SP, Montgomery County, MO
Latitude: 38.907946
Longitude: -91.570038

Plot GRCASP11 – Caneyville soil
Located in Graham Cave SP, Montgomery County, MO
Latitude: 38.90775
Longitude: -91.572934

Other references

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.

Held, Robert J. 1989. Soil Survey of Franklin County, Missouri. U.S. Dept. of Agric. Soil Conservation Service.

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

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.

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

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

Contributors

Fred Young
Doug Wallace

Approval

Suzanne Mayne-Kinney, 12/30/2024

Acknowledgments

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	05/11/2025
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:

---

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:**
