Ecological site F115XB013MO
Chert Upland 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 Chert 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

Chert Upland Woodlands are in scattered locations in the uplands of the Missouri River watershed, as well as in areas north of the MLRA in the Mississippi River watershed. Soils are typically very deep, with an abundance of chert fragments. The reference plant community is woodland with an overstory dominated by white oak and black

oak and a ground flora of native grasses and forbs.

Associated sites

F115XB005MO	**Loamy Upland Woodland** Loamy Upland Woodlands are upslope on summits and gentle backslopes slopes.
F115XB014MO	**Chert Limestone/Dolomite Protected Backslope Forest** Chert Limestone/Dolomite Protected Backslope Forests are downslope on north and east aspects.
F115XB046MO	**Chert Limestone/Dolomite Exposed Backslope Woodland** Chert Limestone/Dolomite Exposed Backslope Woodlands are downslope on south and west aspects.

Similar sites

F115XB005MO	**Loamy Upland Woodland** Loamy Upland Woodlands are on upland slope positions but are more productive and generally upslope.

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus velutina*
Shrub	(1) *Rhus aromatica*
Herbaceous	(1) *Schizachyrium scoparium*

Physiographic features

This site is on upland summit crests, shoulders and backslopes with slopes of 1 to 15 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The accompanying figure (adapted from Skaer, 2004) 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 hillslope shoulders and upper backslopes. Chert Backslope sites are on steep lower backslopes, included in the area. Sites that are shallower to limestone or dolomite bedrock are typically downslope, such as the Chert Limestone/Dolomite Backslope sites shown in the figure. Shallow Limestone/Dolomite glade sites are also common downslope.

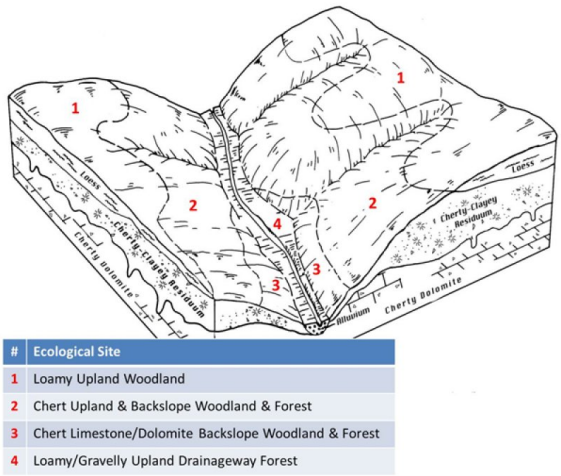


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hill (3) Interfluve

Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	350–1,200 ft
Slope	1–15%
Water table depth	30–60 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)	144-163 days
Freeze-free period (characteristic range)	174-194 days
Precipitation total (characteristic range)	41-43 in
Frost-free period (actual range)	138-164 days
Freeze-free period (actual range)	168-195 days
Precipitation total (actual range)	41-44 in
Frost-free period (average)	153 days
Freeze-free period (average)	184 days
Precipitation total (average)	42 in

Climate stations used

- (1) FESTUS [USC00232850], Crystal City, MO
- (2) FREEDOM [USC00233043], Linn, MO
- (3) BOWLING GREEN 1 E [USC00230856], Bowling Green, MO
- (4) ST LOUIS SPRT OF S L AP [USW00003966], Chesterfield, 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. (Vano 2005).

Soil features

These soils have no rooting restrictions, and subsoils are not low in bases. A few areas have dolomite or limestone bedrock below 40 inches. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is slope alluvium over residuum weathered from limestone and dolomite. They have gravelly or very gravelly silt loam surface horizons, and skeletal subsoils with high amounts of chert gravel and cobbles. These soils are not affected by seasonal wetness. Soil series associated with this site include Beemont, Goss, Rueter, and Swiss.

The accompanying picture of the Goss series shows a thin, light-colored surface horizon underlain by very cobbly reddish clay. Scale is in inches. Picture from Henderson (2004).

Figure 9. Goss series

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and dolomite (2) Alluvium–limestone and dolomite
Surface texture	(1) Very gravelly silt loam (2) Gravelly silt loam (3) Very gravelly loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Very slow to moderately slow
Soil depth	40–72 in
Surface fragment cover <=3"	15–50%
Surface fragment cover >3"	0–35%
Available water capacity (0-40in)	3–6 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)	35–60%
Subsurface fragment volume >3" (Depth not specified)	3–50%

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 and black oak. The canopy is moderately tall (60 to 75 feet) but less dense (65 to 85 percent canopy) than protected slopes and the understory canopy is poorly developed with less structural diversity. Increased light causes a diversity of ground flora species to flourish. 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.

This ecological site was 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.

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, 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 can be a problem and lower productivity.

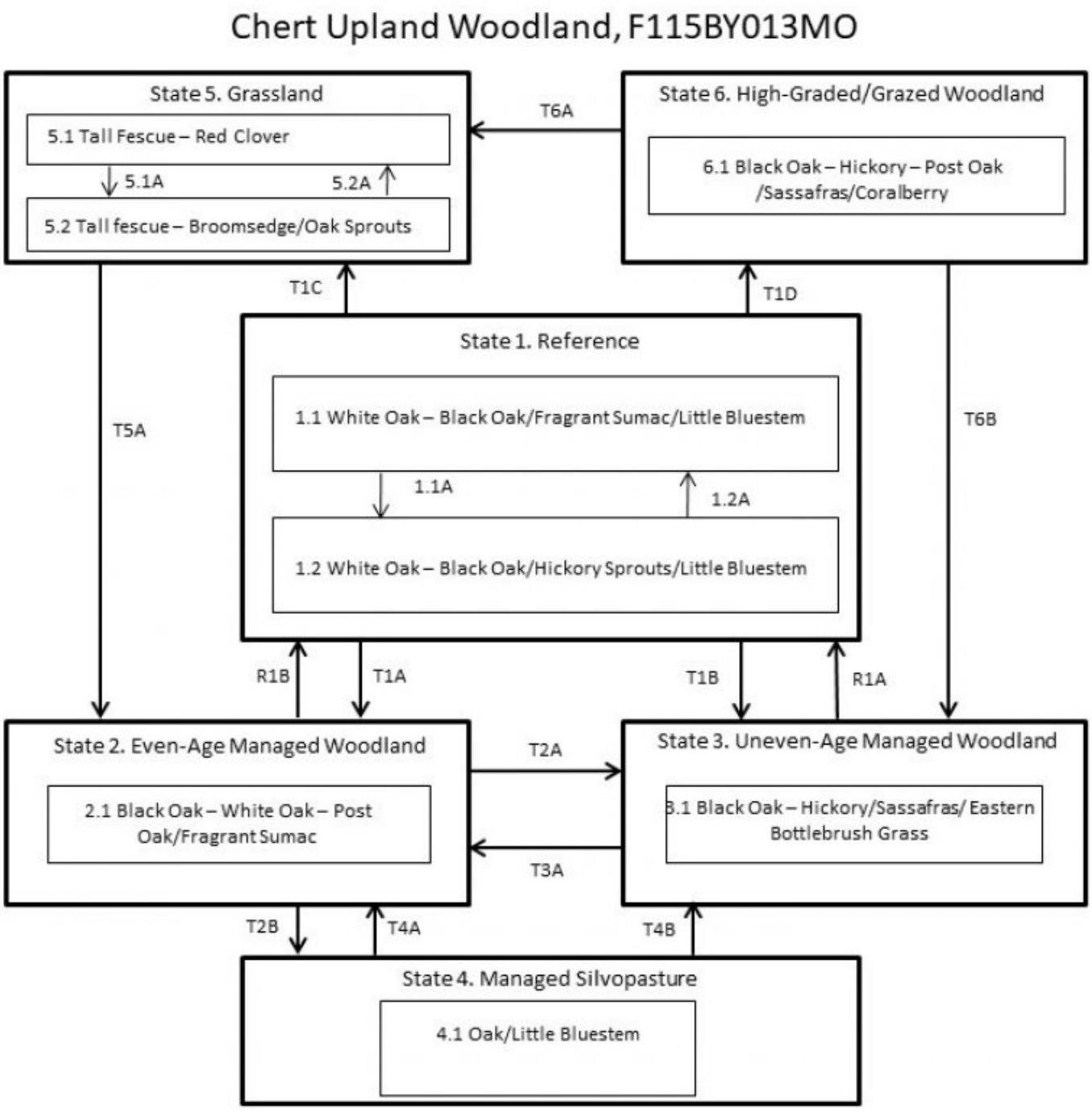
These ecological sites are only moderately productive, especially when compared to adjacent protected slopes and deeper loess covered units. Oak regeneration is typically problematic. Sugar maple, red elm, and hickory are often dominant competitors in the understory. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects.

Single tree selection timber harvests are common 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 prescribed burning 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	Event/Process
T1A	Even-aged management; fire suppression
T1B	Fire suppression; uneven-age management
T2B	Prescribed fire; thinning; prescribed grazing
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; fire suppression
T4B	Even-age management; no grazing; fire suppression

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 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 black 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 the reference state, with shifts between phases based on disturbance frequency. Reference states are 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
- black oak (*Quercus velutina*), tree
- fragrant sumac (*Rhus aromatica*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
White Oak - Black Oak/Fragrant Sumac/Sedge - Little Bluestem

This phase has an overstory that is dominated by white oak and black oak with hickory and post oak also present. 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 white oak and black oak 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 - Black Oak/Hickory/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.

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).

Pathway P1.1A
Community 1.1 to 1.2

This pathway is the result of a disturbance-free interval greater than 10 years.

Pathway P1.2A
Community 1.2 to 1.1

This pathway is the result of a fire, 5 to 10-year disturbance cycle, being reestablished.

State 2

Even-Age Managed Woodland

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

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

Community 2.1
Black Oak – White Oak – Post Oak/Fragrant 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 black oak and post 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

The biggest difference for this state is tree age, most being only 50 to 90 years old. Composition is also likely altered from the reference state depending on tree selection during harvest. In addition, 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. Uneven Age Managed Woodland is more dense because of fire suppression, and more so than the Even-Age Managed state. Consequently, the woodland ground flora is more suppressed and structural diversity is lower. Without periodic disturbance, stem density and fire intolerant species, like hickory, increase in abundance.

Dominant plant species

- black oak (*Quercus velutina*), tree
- shagbark hickory (*Carya ovata*), tree
- mockernut hickory (*Carya tomentosa*), tree
- sassafras (*Sassafras albidum*), tree
- eastern bottlebrush grass (*Elymus hystrix*), grass

Community 3.1
Black Oak – Hickory/Sassafras/ Eastern 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 black oak and hickory. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4
Managed Silvopasture

The Silvopasture State results from managing woodland communities with prescribed fire and prescribed grazing. This state can resemble the reference state, but with younger maximum tree ages and lower ground flora diversity.

Dominant plant species

- oak (*Quercus*), tree
- little bluestem (*Schizachyrium scoparium*), grass

Community 4.1
Oak/Little Bluestem

This phase results from managing woodland communities with prescribed fire, canopy thinning, and prescribed grazing.

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.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- red clover (*Trifolium pratense*), 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 P
Community 5.2 to 5.1

State 6
High-Graded, Grazed Woodland

Wooded sites subjected to repeated, high-graded timber harvests and uncontrolled 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.

Dominant plant species

- black oak (*Quercus velutina*), tree
- shagbark hickory (*Carya ovata*), tree
- mockernut hickory (*Carya tomentosa*), tree
- post oak (*Quercus stellata*), tree
- sassafras (*Sassafras albidum*), tree
- coralberry (*Symphoricarpos orbiculatus*), shrub

- eastern poison ivy (*Toxicodendron radicans*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

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

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 forest 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 forest 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 pasture species. Soil erosion can be extensive in this process, along with loss of organic matter. Liming and fertilizing associated with pasture management typically raises the soil pH and increases the cation concentration (such as calcium and magnesium) of the upper soil horizons.

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.

Transition T2A
State 2 to 3

This transition typically results from uneven-age forest 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. Forest stand improvement may also be used.

Transition T3A
State 3 to 2

This transition typically results from even-age forest 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, no grazing, and fire suppression.

Transition T4B
State 4 to 3

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

Transition T6B
State 6 to 3

This transition typically results from uneven-age forest management practices, such as single tree or group selection harvest and cessation of grazing. 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 grassland species. Soil erosion can be extensive in this process, along with loss of organic matter. Liming and fertilizing associated with pasture management typically raises the soil pH and increases the cation concentration (such as calcium and magnesium) of the upper soil horizons.

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							
white oak	QUAL	*Quercus alba*	Native	–	–	–	–
post oak	QUST	*Quercus stellata*	Native	–	–	–	–
black oak	QUVE	*Quercus velutina*	Native	–	–	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	–	–	–
sassafras	SAAL5	*Sassafras albidum*	Native	–	–	–	–
mockernut hickory	CATO6	*Carya tomentosa*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	–
oval-leaf sedge	CACE	*Carex cephalophora*	Native	–	–
Muhlenberg's sedge	CAMU4	*Carex muehlenbergii*	Native	–	–
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	–
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	–
Forb/Herb					
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	Native	–	–
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	–
bristly buttercup	RAHI	*Ranunculus hispidus*	Native	–	–
fire pink	SIVI4	*Silene virginica*	Native	–	–
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	–
manyray aster	SYAN2	*Symphyotrichum anomalum*	Native	–	–
smooth small-leaf ticktrefoil	DEMA2	*Desmodium marilandicum*	Native	–	–
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	–
Arkansas bedstraw	GAAR4	*Galium arkansanum*	Native	–	–
spotted geranium	GEMA	*Geranium maculatum*	Native	–	–
American ipecac	GIST5	*Gillenia stipulata*	Native	–	–
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	–
rue anemone	THTH2	*Thalictrum thalictroides*	Native	–	–
fourleaf milkweed	ASQU	*Asclepias quadrifolia*	Native	–	–
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	–
Shrub/Subshrub					
leadplant	AMCA6	*Amorpha canescens*	–	–	–
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	–
Blue Ridge blueberry	VAPA4	*Vaccinium pallidum*	Native	–	–
Tree					
flowering dogwood	COFL2	*Cornus florida*	Native	–	–

Animal community

Wildlife (MDC 2006):

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Oaks 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 – herbaceous cover habitat important for turkey poults and quail chicks.

Bird species associated with early-successional Woodlands are Northern Bobwhite, Prairie Warbler, Field Sparrow,

Blue-winged Warbler, Yellow-breasted Chat, and Brown Thrasher.

Bird species associated with mid- to late successional Woodlands 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 associated with Woodlands 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 average 58 for black oak. Timber management opportunities are moderate. 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 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: Coarse fragments throughout the profile; Surface stones and rocks 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, which leaves a greater amount of coarse fragments on the surface. Hand planting or direct seeding may be necessary. Seedling mortality due to low available water capacity may be high. Mulching or providing shade can improve seedling survival. Mechanical tree planting will be limited. 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: Chert Upland Woodland

Plot WESPCA02 – Goss soil
Located in Weldon Springs Conservation Area in St. Charles County, MO
Latitude: 38.6751
Longitude: -90.772959

Plot DANVCA09 – Swiss soil
Located in Danville CA, Montgomerey County, MO
Lattitude: 38.866563
Longitude: -91.50026

Plot LILOCA_JK01 – Swiss soil
Located in Little Lost Creek CA, Warren County, MO
Lattitude: 38.866563
Longitude: -91.2884480

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Contributors

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Approval

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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:**