Ecological site F115XB008MO
Loamy Limestone/Dolomite Protected Backslope Forest

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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 Mesic Limestone/Dolomite Forest.

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

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus alba - Quercus rubra - Acer saccharum - Carya cordiformis / Lindera benzoin Forest (CEGL002058).

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 Limestone/Dolomite Protected Backslope Forests occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Loamy Limestone/Dolomite Exposed Backslope Woodland ecological site. These sites are in scattered locations throughout the MLRA, in uplands that are not adjacent to the

Missouri or Mississippi River floodplains. They are often associated with both Chert and Calcareous Limestone/Dolomite Woodland and Forest ecological sites. Loess or Loamy ecological sites are often upslope. Soils are typically moderately deep over limestone/dolomite bedrock, with loamy surfaces and clayey subsoils. The reference plant community is forest dominated by northern red oak, white oak, white ash, bitternut hickory, sugar maple, American elm and black walnut, with a well-developed understory and a rich herbaceous ground flora.

Associated sites

F115XB003MO	**Deep Loess Protected Backslope Forest** Deep Loess Protected Backslope Forests sites are directly upslope on northerly and easterly aspects.
F115XB043MO	**Deep Loess Exposed Backslope Woodland** Deep Loess Exposed Backslope Woodlands sites are directly upslope on southerly and westerly aspects.
F115XB045MO	**Loamy Limestone/Dolomite Exposed Backslope Woodland** Loamy Limestone/Dolomite Exposed Backslope Woodland are mapped in complex with the Loamy Limestone/Dolomite Protected Backslope Forest.

Similar sites

F115XB045MO	**Loamy Limestone/Dolomite Exposed Backslope Woodland** Loamy Limestone/Dolomite Exposed Backslope Woodland are mapped in complex with the Loamy Limestone/Dolomite Protected Backslope Forest.

Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus rubra*
Shrub	(1) *Lindera benzoin*
Herbaceous	(1) *Polystichum acrostichoides*

Physiographic features

This site is on upland backslopes with slopes of 15 to 60 percent. It is on protected aspects (north, northeast, and east), which receive significantly less solar radiation than the exposed aspects. The site receives runoff from upslope summit and shoulder sites, and generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Young et al., 2003) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites in the uplands adjacent to the Missouri River. The site is within the area labeled “2”, on steep backslopes with northerly and easterly aspects. Deep Loess Backslope sites are directly upslope, and are included within the area labeled “1”.

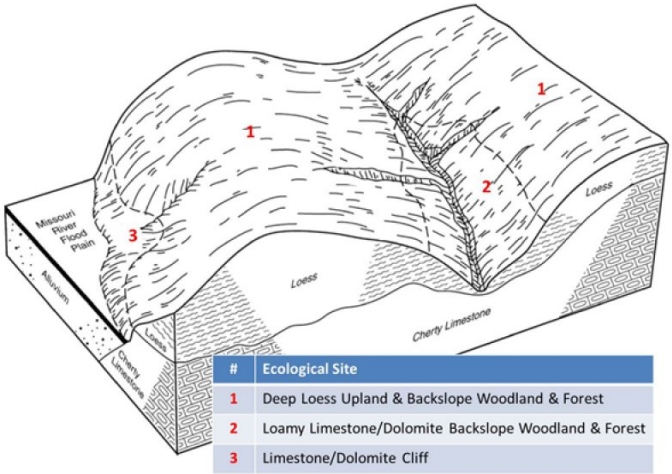


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Hillslope
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	510–900 ft
Slope	15–60%
Water table depth	33–60 in
Aspect	NW, N, NE, E

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)	163-172 days
Freeze-free period (characteristic range)	195-209 days
Precipitation total (characteristic range)	44-48 in
Frost-free period (actual range)	163-176 days
Freeze-free period (actual range)	193-214 days
Precipitation total (actual range)	43-49 in
Frost-free period (average)	168 days
Freeze-free period (average)	202 days
Precipitation total (average)	46 in

Climate stations used

- (1) FESTUS [USC00232850], Crystal City, MO
- (2) JACKSON [USC00234226], Jackson, MO
- (3) COLUMBIA U OF M [USC00231801], Columbia, 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 60 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 loamy or clayey subsoils that have low to moderate amounts of chert gravel and cobbles. They are not affected by seasonal wetness. Soil series associated with this site include Bonnefemme, Caneyville, and Chilhowie.

The accompanying picture of the Bonnefemme series shows a silt loam surface horizon to about 9 inches over a yellowish brown silty clay loam subsoil. Soft dolomite bedrock is at 40 inches. Scale is in inches. Picture courtesy of Fred Young, NRCS.

Figure 9. Bonnefemme series

Table 4. Representative soil features

Parent material	(1) Residuum–limestone and dolomite
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	20–40 in
Surface fragment cover <=3"	0–8%
Surface fragment cover >3"	0%
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)	0–40%
Subsurface fragment volume >3" (Depth not specified)	0–15%

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.

Loamy Limestone/Dolomite Protected Backslope Forests have a well-developed forest canopy and subcanopy

dominated by a mixture of oaks and other hardwoods adapted to the cooler, more mesic conditions. White oak and northern red oak are common, along with, sugar maple, bitternut hickory, white ash, elm and black walnut. This ecological site exhibits a structurally diverse understory and an abundant forest ground flora. While similar to deeper Chert Protected Backslope Forests, the shallower carbonate soils limit tree height, but create an environment where a wider variety of species occur in a more complex structural arrangement.

Loamy Limestone/Dolomite Protected Backslope Forests occur in rather protected landscape positions on steep slopes in the deeper valleys furthest from the prairie uplands. While the upland prairies and savannas had an estimated fire frequency of 1 to 3 years, this ecological site likely burned less frequently (estimated 10 to 25 years) and with lower intensity. The moderately deep soils and occasional fires make this community transitional between forest and woodland, with more open woodland conditions being created briefly after the periodic fires. Site conditions overall, however, favor shade and moisture loving forest species that quickly redevelop after fire.

Loamy Limestone/Dolomite Protected Backslope Forests would have also been subjected to occasional disturbances from wind and ice, as well as grazing by large native 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. Such canopy disturbances allowed more light to reach the ground and favored reproduction of the dominant oak species. Grazing by native large herbivores would have kept understory conditions more open, also creating conditions more favorable to oak reproduction.

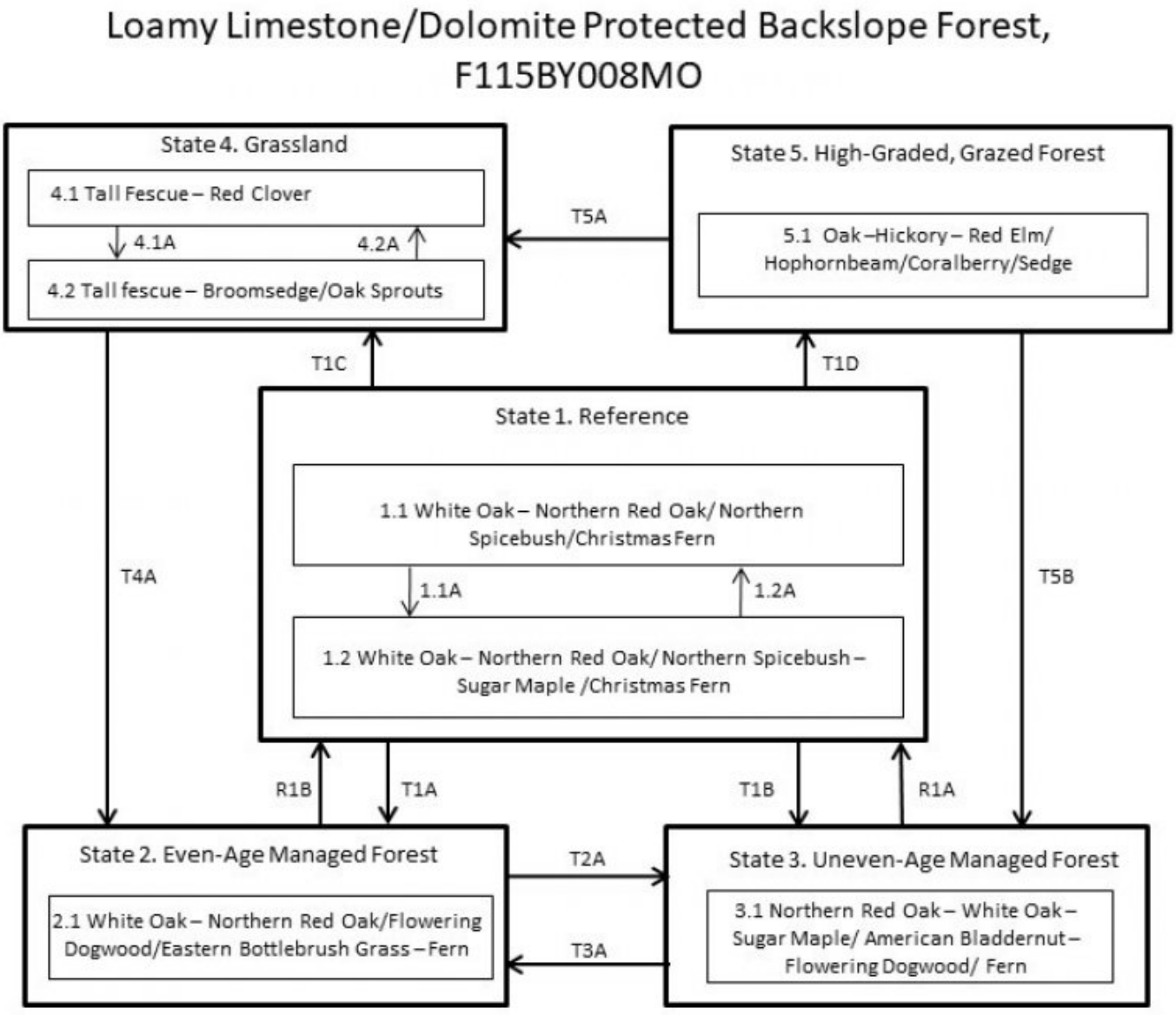
Today, these communities have been cleared and converted to pasture, or have undergone repeated timber harvest and domestic grazing. Most existing occurrences have a younger (50 to 80 years) canopy layer whose composition has been altered by timber harvesting practices. An increase in hickories over historic conditions is common. In addition, in the absence of fire, the canopy, sub-canopy and woody understory layers are better developed. The absence of periodic fire has allowed more shade-tolerant tree species, such as sugar maple, white ash, or hickory to increase in abundance.

Uncontrolled domestic grazing has diminished the diversity and cover of woodland ground flora species, and has introduced weedy species such as gooseberry, coralberry, poison ivy and Virginia creeper created a more open understory and increased soil compaction. Loamy Limestone/ Dolomite Protected Backslope Forests are moderately productive timber sites. Carefully planned single tree selection or the creation of small group openings can help regenerate more desirable oak species and increase vigor on the residual trees. Clear-cutting does occur and results in dense, even-aged stands of primarily 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, the ground flora diversity can be shaded out and productivity of the stand may suffer.

Oak regeneration is typically problematic. Sugar maple, red elm, hophornbeam, hickory, grape, pawpaw and northern spicebush are often dominant competitors in the understory. Maintenance of the oak component will require disturbances that will impair the cool, moist, shaded conditions, so trade-offs will have to be made carefully. Prescribed fire can play a beneficial role in the management of this ecological site. The higher productivity of these sites makes it more challenging than on other forest sites in the region. Protected aspect forests did evolve with some fire, but their composition often reflects more closed, forested conditions, with fewer woodland ground flora species that can respond to fire. Consequently, while having protected aspects in a prescribed burn unit is acceptable, targeting them solely for woodland restoration is not advisable.

A State and Transition Diagram model 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	Harvesting; even-aged management
T1B	Harvesting; uneven-age management
T1C, T5A	Clearing; pasture planting
T1D	High-grade harvesting; uncontrolled grazing
T2A	Uneven-age management
T3A	Even-age management
T4A, T5A	Tree planting; long-term succession; no grazing
T5B	Uneven-age management; tree planting; no grazing

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

Code	Event/Process
R1A	Extended rotations
R1B	Uneven-age mgt, extended rotations

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The reference state was dominated by white oak associated with northern red oak and other mixed hardwoods. Maximum tree age was likely 150 to 300 years. Periodic disturbances from fire, wind or ice maintained the dominance of white oak by opening up the canopy and allowing more light for white oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency. The reference state can be found in scattered locations throughout the MLRA. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvests coupled with uncontrolled domestic livestock grazing (State 5). Fire suppression throughout the region has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Many reference sites have been effectively managed for timber harvesting, resulting in either even-age (State 2) or uneven-age (State 3) managed forests depending upon the removal intensity and the species selection.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- sugar maple (*Acer saccharum*), tree
- northern spicebush (*Lindera benzoin*), shrub
- Christmas fern (*Polystichum acrostichoides*), other herbaceous

Community 1.1
White Oak – Northern Red Oak/ Northern Spicebush/Christmas Fern

Figure 11. Reference site at Reifsnider Conservation Area, Warren County, Missouri

This phase is a forest dominated by an overstory of white oak, northern red oak, white ash and scattered sugar maple. The canopy and understory are well developed with great structural and species diversity. This phase experienced some periodic burning (estimated 10 to 25 years) but with low intensity.

Forest overstory. Forest Overstory Composition based on Nelson (2010) and field surveys.

Forest understory. Forest Understory Composition based on Nelson (2010) and field surveys.

Community 1.2
White Oak – Red Oak/ Northern Spicebush – Sugar Maple /Christmas Fern

Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple with increased canopy density, which has affected the abundance and diversity of ground flora.

Pathway P1.1A
Community 1.1 to 1.2

This pathway is a gradual transition that results from extended, disturbance-free periods of roughly 20 years or longer.

Pathway P1.2A
Community 1.2 to 1.1

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

State 2
Even-Age Managed Forest

This forest tends to be rather dense with an even-aged overstory and an under developed understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. Continual managed timber harvesting, depending on the practices used and age classes removed, will either maintain this state, or convert the site to uneven-age (State 3) forests.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- flowering dogwood (*Cornus florida*), tree
- eastern bottlebrush grass (*Elymus hystrix*), grass
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- lowland bladderfern (*Cystopteris protrusa*), other herbaceous
- northern maidenhair (*Adiantum pedatum*), other herbaceous

Community 2.1
White Oak – Northern Red Oak/Flowering Dogwood/Eastern Bottlebrush Grass – Fern

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 Forest

An uneven-age managed forest can resemble the reference state. The primary difference 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 harvests and disturbance activities. Without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species such as sugar maple and white oak will become less dominant.

Dominant plant species

- northern red oak (*Quercus rubra*), tree

- white oak (*Quercus alba*), tree
- sugar maple (*Acer saccharum*), tree
- flowering dogwood (*Cornus florida*), tree
- American bladdernut (*Staphylea trifolia*), shrub
- lowland bladderfern (*Cystopteris protrusa*), other herbaceous
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- northern maidenhair (*Adiantum pedatum*), other herbaceous

Community 3.1
Northern Red Oak – White Oak – Sugar Maple/ American Bladdernut – Flowering Dogwood/ Fern

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 sugar maple. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4
Grassland

Conversion of forests to planted, non-native cool season grasses and legumes has been common. Without proper grassland management these ecological sites are challenging to maintain in a healthy, productive state. With over grazing and cessation of active pasture management, tall fescue, white clover and multi-flora rose will increase in density.

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 P4.1A
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 Forest

Reference or managed forested states subjected to repeated, high-grading timber harvests and uncontrolled cattle grazing transition to this degraded state. This state 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 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. Cessation of active logging and exclusion of livestock from sites in this state will create an idle phase that experiences an increase in black cherry and Ohio buckeye in the understory layer.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- chinquapin oak (*Quercus muehlenbergii*), tree
- slippery elm (*Ulmus rubra*), tree
- hophornbeam (*Ostrya virginiana*), shrub
- coralberry (*Symphoricarpos orbiculatus*), shrub
- multiflora rose (*Rosa multiflora*), shrub
- sedge (*Carex*), other herbaceous
- eastern poison ivy (*Toxicodendron radicans*), other herbaceous

Community 5.1
Oak – Hickory – Red Elm/ Hophornbeam/Coralberry/Sedge

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 harvests 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 harvests and fire suppression.

Transition T1C
State 1 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

Transition T1D
State 1 to 5

This transition is the result of high-grade harvesting and uncontrolled domestic livestock grazing.

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 T3A
State 3 to 2

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

Transition T4A
State 4 to 2

This transition is the result of tree planting, long-term succession and no grazing.

Transition T5A
State 5 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

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							
northern red oak	QURU	*Quercus rubra*	Native	–	10–95	–	–
sugar maple	ACSA3	*Acer saccharum*	Native	–	2–75	–	–
white oak	QUAL	*Quercus alba*	Native	–	2–50	–	–
chinquapin oak	QUMU	*Quercus muehlenbergii*	Native	–	1–25	–	–
American basswood	TIAM	*Tilia americana*	Native	–	5–25	–	–
slippery elm	ULRU	*Ulmus rubra*	Native	–	0.1–10	–	–
bitternut hickory	CACO15	*Carya cordiformis*	Native	–	1–2	–	–
black walnut	JUNI	*Juglans nigra*	Native	–	1–2	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	–	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	2–5
eastern woodland sedge	CABL	*Carex blanda*	Native	–	1–2
pubescent sedge	CAHI5	*Carex hirtifolia*	Native	–	1–2
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	1–2
slender looseflower sedge	CAGR8	*Carex gracilescens*	Native	–	–
oval-leaf sedge	CACE	*Carex cephalophora*	Native	–	–
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	–
hairy wildrye	ELVI	*Elymus villosus*	Native	–	–
Forb/Herb					
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	2–10
American hogpeanut	AMBR2	*Amphicarpaea bracteata*	Native	–	1–10
beaked agrimony	AGRO3	*Agrimonia rostellata*	Native		2–5

beaked agrimony	AGRO3	*Agrimonia rostellata*	Native	–	2–3
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	Native	–	1–2
Canadian blacksnakeroot	SACA15	*Sanicula canadensis*	Native	–	1–2
common blue wood aster	SYCO4	*Symphyotrichum cordifolium*	Native	–	1–2
lady's slipper	CYPRI	*Cypripedium*	Native	–	1–2
wild blue phlox	PHDI5	*Phlox divaricata*	Native	–	0.1–2
bloodroot	SACA13	*Sanguinaria canadensis*	Native	–	1–2
largeflower bellwort	UVGR	*Uvularia grandiflora*	Native	–	0.1–2
hepatica	HENO2	*Hepatica nobilis*	Native	–	–
eastern greenviolet	HYCO6	*Hybanthus concolor*	Native	–	–
Canadian woodnettle	LACA3	*Laportea canadensis*	Native	–	–
cutleaf toothwort	CACO26	*Cardamine concatenata*	Native	–	–
Virginia snakeroot	ARSE3	*Aristolochia serpentaria*	Native	–	–
Virginia springbeauty	CLVI3	*Claytonia virginica*	Native	–	–
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	Native	–	–
toadshade	TRSE2	*Trillium sessile*	Native	–	–
harbinger of spring	ERBU	*Erigenia bulbosa*	Native	–	–
white fawnlily	ERAL9	*Erythronium albidum*	Native	–	–
green dragon	ARDR3	*Arisaema dracontium*	Native	–	–
Canadian wildginger	ASCA	*Asarum canadense*	Native	–	–
eastern waterleaf	HYVI	*Hydrophyllum virginianum*	Native	–	–
Fern/fern ally					
lowland bladderfern	CYPR4	*Cystopteris protrusa*	Native	–	1–5
Christmas fern	POAC4	*Polystichum acrostichoides*	Native	–	2–5
northern maidenhair	ADPE	*Adiantum pedatum*	Native	–	1–2
Shrub/Subshrub					
hophornbeam	OSVI	*Ostrya virginiana*	Native	–	1–50
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	2–5
northern spicebush	LIBE3	*Lindera benzoin*	Native	–	–
American bladdernut	STTR	*Staphylea trifolia*	Native	–	–
Tree					
flowering dogwood	COFL2	*Cornus florida*	Native	–	1–25
common serviceberry	AMAR3	*Amelanchier arborea*	Native	–	1–5
eastern redbud	CECA4	*Cercis canadensis*	Native	–	1–5
pawpaw	ASTR	*Asimina triloba*	Native	–	–
hophornbeam	OSVI	*Ostrya virginiana*	Native	–	–
Vine/Liana					
Virginia creeper	PAQU2	*Parthenocissus quinquefolia*	Native	–	–
summer grape	VIAE	*Vitis aestivalis*	Native	–	–

Table 7. Community 2.1 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	–	–	–	–
eastern redcedar	JUVI	*Juniperus virginiana*	Native	–	–	–	–
sugar maple	ACSA3	*Acer saccharum*	Native	–	–	–	–

Table 8. Community 2.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Shrub/Subshrub					
Carolina buckthorn	FRCA13	*Frangula caroliniana*	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.

Birds associated with this ecological site include Worm-eating warbler, Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Wood Thrush, Red-eyed Vireo, Northern Parula, Louisiana Waterthrush (near streams), and Broad-winged Hawk.

Reptile and amphibian species associated with mature forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, three-toed box turtle, western worm snake, western earth snake, and American toad

Other information

Forestry (NRCS 2002):

Management: Estimated site index values range from 50 to 60 for oak. Timber management opportunities are generally 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: Low to moderate amounts of coarse fragments in lower profile; bedrock is within 60 inches. Surface stones and rocks may be a problem 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. 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: Loamy Limestone/Dolomite Protected Backslope Forest

Plot RUBECA_JK05 - Chilhowie soil
Located in Rudolf Bennitt CA, Randolph County, MO
Latitude: 39.273466
Longitude: -92.478063

Plot DABOCA_JK18 – Chilhowie soil
Located in Daniel Boone CA, Warren County, MO
Latitude: 38.79025
Longitude: -91.381403

Plot HACRCA_KS01 – Bonnefemme soil – no veg cover
Located in Hart Creek CA, Boone County, MO
Latitude: 38.713062
Longitude: -92.324736

Plot REIFCA_JK18 – Chilhowie soil
Located in Reifsnider CA, Warren County, MO
Latitude: 38.78688
Longitude: -91.108378

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Contributors

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Approval

Suzanne Mayne-Kinney, 12/30/2024

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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:**

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

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

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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):**

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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):**

---

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):**

---

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:**
