USDA Natural Resources
Conservation Service

Ecological site F115XB007MO
Loamy Limestone/Dolomite Upland Woodland

Accessed: 05/04/2024

General information

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

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

The Central Mississippi Valley Wooded Slopes, Western Part (area outlined in red on the map) consists mainly of the deeply dissected, loess-covered hills bordering the Missouri and Mississippi Rivers as well as the floodplains and terraces of these rivers. It wraps around the northeast corner of the Ozark Uplift, and constitutes the southern border of the Pre-Illinoisan-aged till plain. Elevation ranges from about 320 feet along the Mississippi River near Cape Girardeau in the south to about 1,020 feet on the highest ridges near Hillsboro, MO in the east. Local relief varies from 10 to 20 feet in the major river floodplains, to 50 to 100 feet in the dissected uplands, with bluffs of 200 to 350 feet along the Mississippi and Missouri Rivers. Underlying bedrock is mainly Ordovician-aged dolomite and sandstone, with Mississippian-aged limestone north of the Missouri River.

Classification relationships

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

NOTE: This is a “provisional” Ecological Site Description (ESD) that is under development. It contains basic ecological information that can be used for conservation planning, application and land management. After additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”.

Loamy Limestone/Dolomite Upland Woodlands (green areas on the map) 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 1 to 15 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.

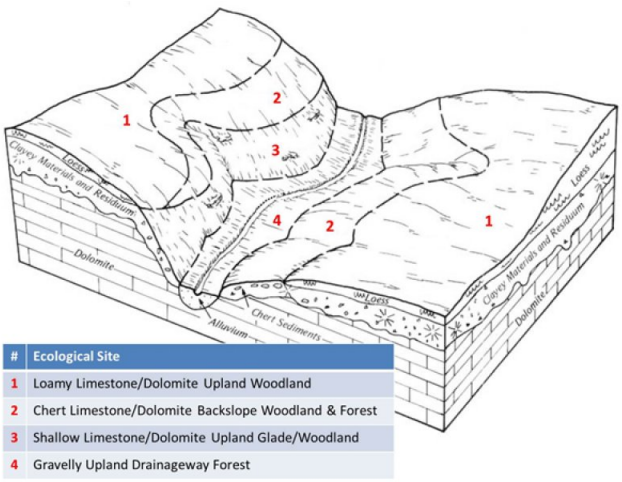


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Interfluve (3) Hill
Flooding frequency	None
Ponding frequency	None
Slope	1–15%
Water table depth	36–114 cm
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 (average)	175 days
Freeze-free period (average)	200 days
Precipitation total (average)	1,168 mm

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–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	51–102 cm
Surface fragment cover <=3"	0–9%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0

Soil reaction (1:1 water) (0-101.6cm)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	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.
In the long term absence of fire, woody species, such as eastern red cedar and hickory have encroached into these ecological sites. Most of these ecological sites today are dense, and shady with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration methods.

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 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.

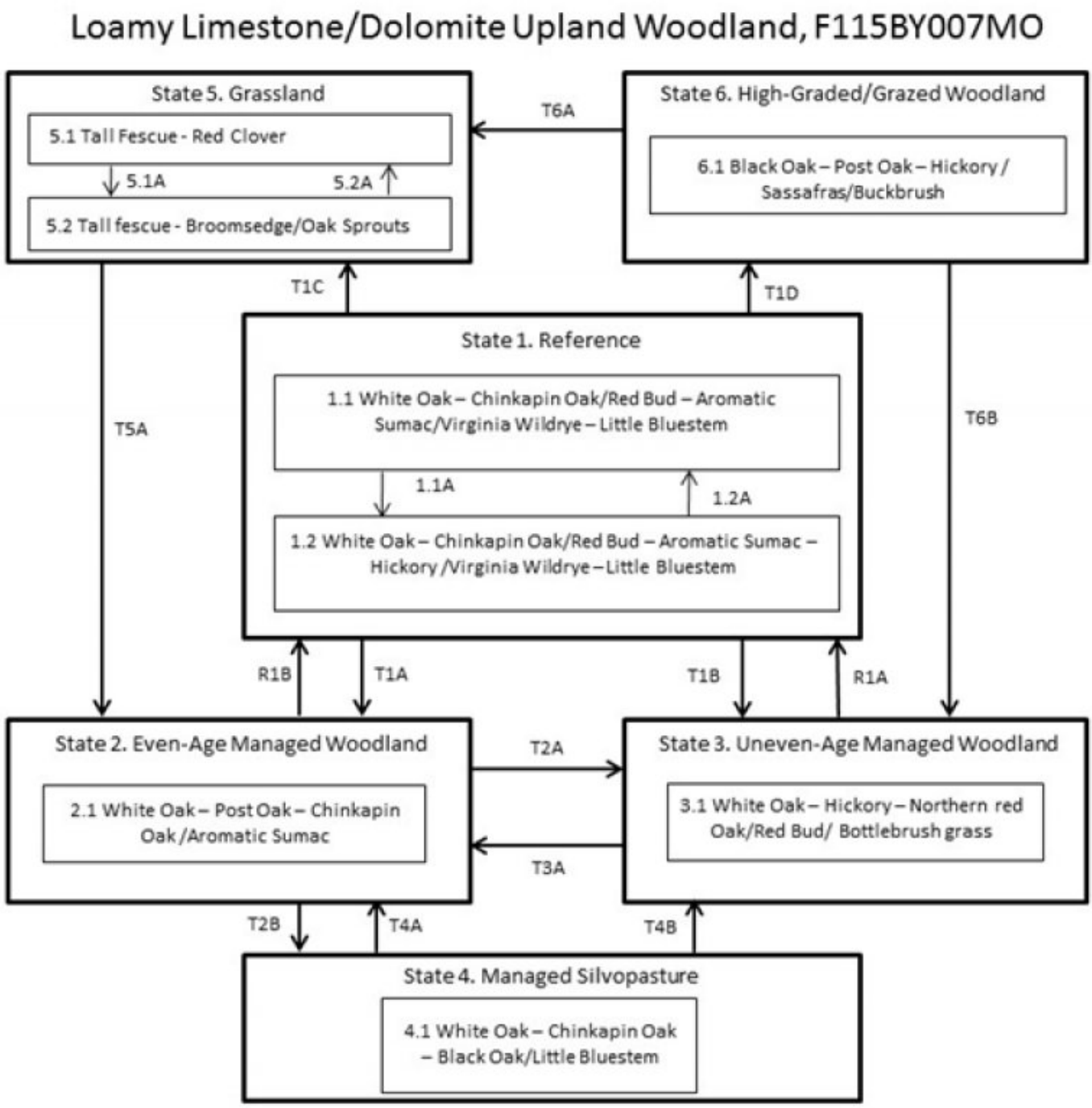
Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as buckbrush, gooseberry, and Virginia creeper. It also promotes the invasion of eastern red cedar. Grazed sites have a more 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
T1B	Fire suppression; uneven-age management
T2B	Prescribed fire; thinning; grazing management
T1C, T6A	Clearing & pasture planting
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+ yrs)
1.2A	Disturbance (fire, wind, ice) < 10 yrs
5.1A	Over grazing; no fertilization
5.2A	Brush management; grassland seeding; grassland management

Code	Event/Process
R1A	Prescribed fire & extended rotations
R1B	Uneven-age mgt, extended rotations

Figure 7. State and transition diagram for this ecological s

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.

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

Figure 8. 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 – Aromatic 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.

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.

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.

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.

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.

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.

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.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
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 (M)	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 particular site if timber management is the primary objective. Favor white oak, northern red oak, chinkapin oak, and black oak.

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

Loamy Limestone/Dolomite Upland Woodland – Potential Reference – F115BY007MO

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

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Contributors

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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	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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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:

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17. **Perennial plant reproductive capability:**
