USDA Natural Resources Conservation Service

Ecological site R115XB009MO
Shallow Limestone/Dolomite Upland Glade/Woodland

Accessed: 05/05/2024

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 Limestone Glade.

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 Schizachyrium scoparium - Bouteloua curtipendula - Rudbeckia missouriensis - Mentzelia oligosperma Wooded Herbaceous Vegetation (CEGL002251).

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

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”.

Shallow Limestone/Dolomite Upland Glade/Woodlands (green areas on the map) are mainly in the central part of

the MLRA and adjacent areas. They commonly occur on Ordovician-aged dolomite, and are typically associated with Chert Limestone/Dolomite and Calcareous Limestone/Dolomite ecological sites. Soils are very shallow to limestone or dolomite bedrock. The reference plant community ranges from open areas of grasses and forbs interspersed with bare bedrock, to areas with shrubs and widely scattered chinkapin and post oak.

Associated sites

F115XB014MO	**Chert Limestone/Dolomite Protected Backslope Forest** Chert Limestone/Dolomite Protected Backslope Forests are generally upslope on north and east aspects.
F115XB046MO	**Chert Limestone/Dolomite Exposed Backslope Woodland** Chert Limestone/Dolomite Exposed Backslope Woodlands are generally upslope on south and west aspects.

Similar sites

R115XB052MO	**Shallow Sandstone Backslope Glade/Woodland** Shallow Sandstone Backslope Glade/Woodlands are on shallow soils but over sandstone bedrock.

Table 1. Dominant plant species

Tree	(1) *Quercus muehlenbergii*
Shrub	(1) *Celtis tenuifolia* (2) *Rhus aromatica*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua curtipendula*

Physiographic features

This site is on upland crests, shoulders and moderate backslopes with slopes predominantly in the 3 to 15 percent range. The site generates runoff to adjacent, downslope ecological sites, and in places receives runoff from upslope summit and shoulder sites. This site does not flood.

The following figure (adapted from Held, 1978) 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 “3”. These sites are typically associated with Chert Limestone/Dolomite and Calcareous Limestone/Dolomite ecological sites, as well as the Chert Upland and Backslope sites shown in the figure (labeled “2”). Loamy Upland Woodland sites (labeled “4”) include different soils formed in both sandstone and limestone. Loess Upland sites (labeled “1”) north of the Missouri River are commonly underlain by a thin layer of till, as shown in the figure.

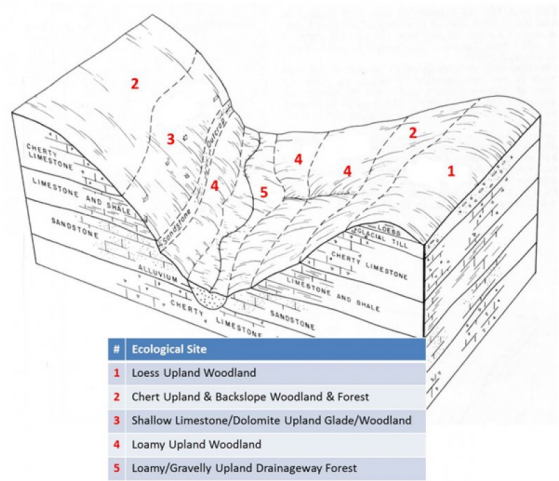


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hill
Flooding frequency	None
Slope	3–50%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

The Iowa and Missouri Heavy Till Plain MLRA 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.

This MLRA experiences small regional differences in climates that grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line from north to south. Both mean annual temperature and precipitation exhibit fairly minor gradients along this line.

Mean January minimum temperature follows the north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the region. Mean July maximum temperatures have a range of only two to three degrees across the region.

Mean annual precipitation varies along the same gradient as temperature – lower annual precipitation in the north, higher in the south. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages four to five times greater than January precipitation.

During years when precipitation is normal, moisture is stored in the soil profile during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly influences ecological communities by limiting water supplies, especially at times of high temperatures and high evaporation rates. Drought indirectly affects ecological communities by increasing plant and animal susceptibility to the probability and severity of fire. Frequent fires encourage the development of grass/forb dominated communities and understories.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. 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. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier, supporting more grass dominated communities than adjacent north- and-east-facing slopes that are cooler and moister that support more woody dominated communities. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

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

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

Table 3. Representative climatic features

Frost-free period (average)	167 days
Freeze-free period (average)	194 days

Precipitation total (average)	1,168 mm

Climate stations used

- (1) FULTON [USC00233079], Fulton, MO
- (2) ROSEBUD [USC00237300], Gerald, MO
- (3) UNION [USC00238515], Union, MO
- (4) FESTUS [USC00232850], Crystal City, MO

Influencing water features

High temperatures, intense solar radiation, and dry conditions prevail throughout much of the growing season, although soils may be saturated in spring, winter and late fall. Frost upheaval frequently disrupts these shallow soils during the dominant season. While evapotranspiration remains the most constant water feature, evapotranspiration rates typically peak in the summer and become dominant. The surface runoff pulse is greatly influenced by extreme events.

Soil features

These soils are underlain with limestone and/or dolomite bedrock at less than 20 inches. The soils were formed under prairie vegetation, and have dark, organic-rich surface horizons. Parent material is limestone and dolomite residuum. These soils are loamy to clayey and are skeletal, with high amounts of limestone/dolomite gravel, channers and flagstones. They are not affected by seasonal wetness. Soil series associated with this site include Gasconade, Moko, and Ranacker.

The accompanying picture of a roadcut in the Moko series shows the shallow depth to the fractured limestone/dolomite bedrock that characterizes this ecological site. Picture from Baker (1998).

Figure 7. Moko series

Table 4. Representative soil features

Parent material	(1) Residuum–dolomite
Surface texture	(1) Gravelly clay loam (2) Very gravelly silty clay loam (3) Very cobbly loam
Family particle size	(1) Clayey
Drainage class	Well drained to somewhat excessively drained
Permeability class	Very slow

Soil depth	10–51 cm
Surface fragment cover <=3"	7–55%
Surface fragment cover >3"	2–60%
Available water capacity (0-101.6cm)	2.54–5.08 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)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	5–40%
Subsurface fragment volume >3" (Depth not specified)	5–50%

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.

Glades are open, rocky areas with very shallow soils dominated by drought-adapted herbaceous flora, generally occurring on south-and west-facing slopes of otherwise wooded sites. The shallow soils of this ecological site limit the growth and abundance of trees and support the native grasses and forbs that dominate these systems. The following conditions are general characteristic of most limestone/dolomite glades (Nelson and Ladd 1983; Nelson et al. 2013):
• Calcareous bedrock at or near the surface as a result of major erosional activity and resistance to weathering;
• Moderate to steep slopes in deeply dissected drainages or hilly to mountainous terrain with a southern or western exposure with intense solar radiation;
• Extremely thin soil cover interspersed with abundant rock fragments and rock outcrops;
• Exceptionally dry conditions throughout much of the growing season, although soils may be seasonally saturated in spring, winter, and fall;
• Peripheral areas and sometimes large expanses of the glades themselves characterized by a mosaic of stunted, often gnarled trees and shrubs.

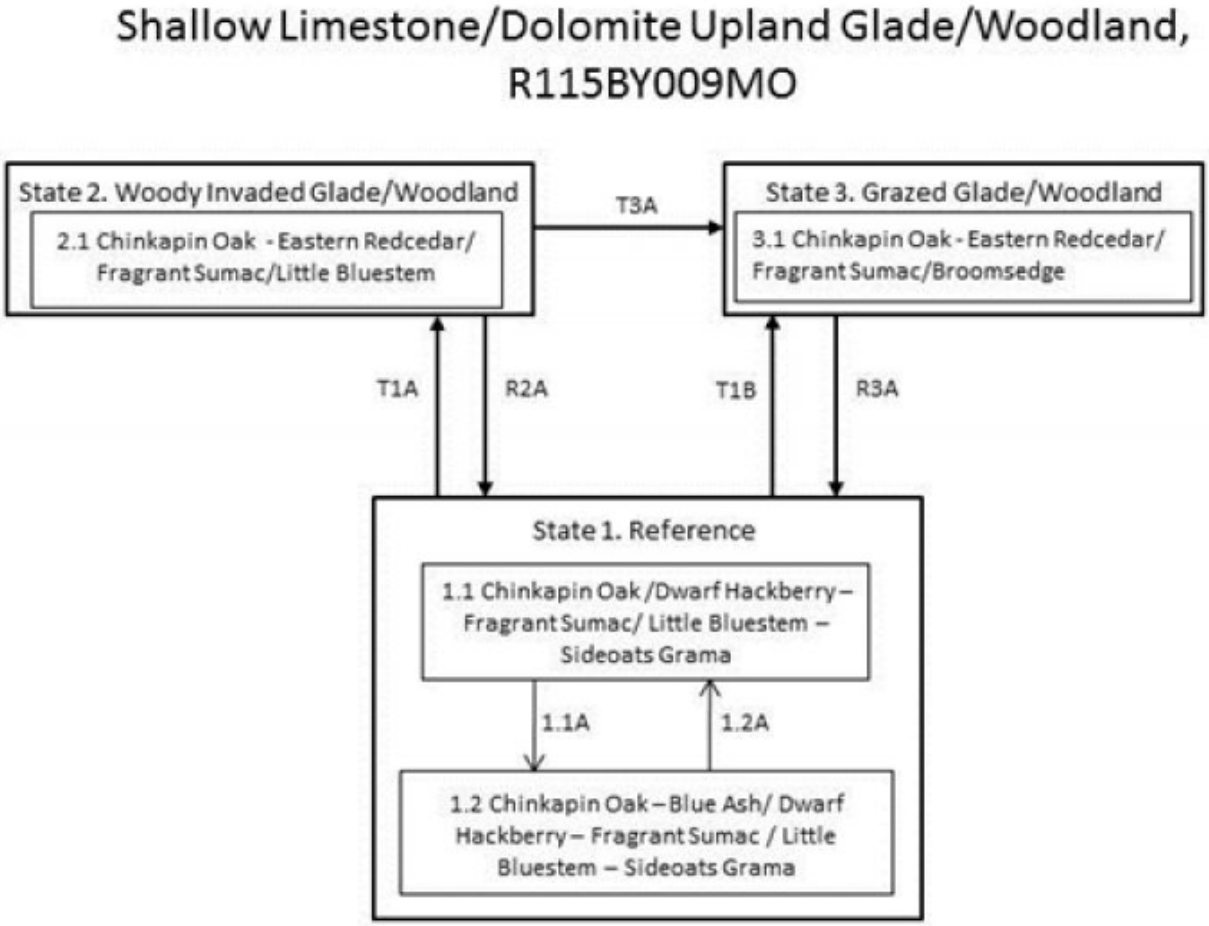
Fire played an important role in the maintenance of these systems, as well. It is likely that these sites burned at least once every five years. These periodic fires removed the litter and stimulated the growth and flowering of the grasses and forbs. They also further limited the growth and dominance of trees, especially eastern redcedar. Fire tolerant chinkapin oak and post oak occupied islands and edges where the deeper range of the soil component occurred, creating a complex mosaic of open glade and low-density woodland. During fire-free intervals, woody species increased, but not to densities on over-grazed glades.

In the absence of fire, woody species, especially eastern redcedar, quickly occupy the site. This is especially true after grazing has reduced grass cover and exposed more surface to the dispersal of cedar seeds by birds. Once established, cedars can quickly fill in a glade/woodland system, especially if grazing has diminished the vigor of the diverse flora. Many glades have been heavily grazed and suffer substantial redcedar invasion. Removal of the redcedar and the application of prescribed fire have proven to be an effect way to management these systems.

Glade/Woodland complexes harbor a wide diversity of plants and animals. Grasses such as little bluestem, Indian grass, and sideoats grama, are also found on prairies. But other species, such as Missouri coneflower and calamint are only found on these limestone/dolomite glades. Desert-adapted animals, like scorpions and tarantulas, also occupy healthy glades.

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/Activity
T1A	Fire suppression (>20 years)
T1B	Uncontrolled grazing; fire suppression
T3A	Uncontrolled grazing
R2A	Cedar removal; prescribed fire
R3A	Grazing exclusion; prescribed fire; woody removal
1.1A	Fire-free interval (10-20 years)
1.2A	Fire interval (3-10 years)

Figure 8. State and transition diagram for this ecological s

State 1

Reference

Glade/Woodland Complexes harbor a wide diversity of plants and animals. Many, like the dominant grasses little bluestem, Indian grass, and sideoats grama, are also found on prairies. But others, such as Missouri coneflower, calamint, and federally listed Missouri bladder-pod, are only found on limestone/dolomite glades. Desert-adapted animals, like scorpions and tarantulas, also occupy healthy glades. The glade/woodland complexes range from wide open grassy areas with shallow soils and bare bedrock, to areas with widely scattered chinquapin and post oaks on soils 12-20 inches deep. While most have suffered from grazing and fire suppression, good examples can be found.

Community 1.1
Chinkapin Oak /Dwarf Hackberry – Fragrant Sumac/ Little Bluestem – Sideoats Grama

This phase has widely scattered stunted chinkapin oak and post oak with little bluestem, side oats grama, and dropseeds dominating the open ground layer. Numerous forbs and lichens are also present and locally abundant. Bedrock outcropping is common.

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
Chinkapin Oak – Blue Ash/ Dwarf Hackberry – Fragrant Sumac / Little Bluestem – Sideoats Grama

This phase is similar to community phase 1.1 but post oak, chinkapin oak and numerous shrubs are increasing due to longer periods of fire suppression. Some displacement of grasses and forbs may be occurring due to shading and competition from the increased densities of shrubs and oaks.

State 2
Woody Invaded Glade/Woodland

This state is dominated by eastern redcedar. These can form relatively even-age stands, dating to when fire suppression became the dominant management characteristic on the site. Canopy closures can approach 100% with little or no ground flora.

Community 2.1
Chinkapin Oak - Eastern Redcedar/ Fragrant Sumac/Little Bluestem

This phase is dominated by eastern redcedar and numerous shrub species. They can form relatively even-age stands, dating to when fire suppression began. This phase can occur relatively quickly (10 to 20 years). Canopy closures can approach 50 to 80 percent with little or no ground flora under the overstory canopy. Without active management, such as prescribed fire and woody removal, these sites will continue increasing in canopy coverage except on the shallowest soil and open bedrock areas where droughty conditions often keep woody invasion in check.

State 3
Grazed Glade/Woodland

Grazing has reduced the cover, diversity and vigor of the native glade/woodland flora. Woody species encroachment, particularly by eastern redcedar, has increased the woodland density relative to the reference state,

Community 3.1
Chinkapin Oak - Eastern Redcedar/ Fragrant Sumac/Broomsedge

Due to long periods of domestic livestock grazing grass the forb diversity and ground cover are severely reduced

increasing the potential for soil erosion and increased water runoff. This phase may also have increased densities of eastern redcedar, oak, and shrubs. Other weedy species such as non-native grasses and forbs also increase.

Restoration pathway R2A
State 2 to 1

Restoration requires cutting most of the eastern redcedar, accompanied by prescribed fire.

Conservation practices

Prescribed Burning
Firebreak
Forest Stand Improvement

Restoration pathway R3A
State 3 to 1

Restoration requires exclusion of cattle grazing, accompanied by prescribed fire.

Conservation practices

Prescribed Burning
Firebreak
Access Control
Prescribed Grazing

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							
dwarf hackberry	CETE	*Celtis tenuifolia*	Native	–	5–10	–	–
post oak	QUST	*Quercus stellata*	Native	–	5–10	–	–
eastern redcedar	JUVI	*Juniperus virginiana*	Native	–	5–10	–	–
blue ash	FRQU	*Fraxinus quadrangulata*	Native	–	0–10	–	–
chinquapin oak	QUMU	*Quercus muehlenbergii*	Native	–	5–10	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
sideoats grama	BOCU	*Bouteloua curtipendula*	Native	–	10–20
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	10–20
Indiangrass	SONU2	*Sorghastrum nutans*	Native	–	5–20
big bluestem	ANGE	*Andropogon gerardii*	Native	–	5–20
puffsheath dropseed	SPNE2	*Sporobolus neglectus*	Native	–	5–20
Mead's sedge	CAME2	*Carex meadii*	Native	–	10–20
Forb/Herb					
butterfly milkweed	ASTU	*Asclepias tuberosa*	Native	–	5–20
Ontario blazing star	LICY	*Liatris cylindracea*	Native	–	5–20
fringeleaf wild petunia	RUHU	*Ruellia humilis*	Native	–	5–20
birdfoot violet	VIPE	*Viola pedata*	Native	–	5–20
purple prairie clover	DAPU5	*Dalea purpurea*	Native	–	5–20
Missouri orange coneflower	RUMI	*Rudbeckia missouriensis*	Native	–	5–20
prairie rosinweed	SITE	*Silphium terebinthinaceum*	Native	–	5–20
limestone calamint	CLAR5	*Clinopodium arkansanum*	Native	–	5–20
devil's-tongue	OPHU	*Opuntia humifusa*	Native	–	5–20
hoary puccoon	LICA12	*Lithospermum canescens*	Native	–	5–20
common goldstar	HYHI2	*Hypoxis hirsuta*	Native	–	5–20
wild quinine	PAIN3	*Parthenium integrifolium*	Native	–	5–20
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	5–20
Nonvascular					
fishscale lichen	PSDE60	*Psora decipiens*	Native	–	5–20
	THCO12	*Thyrea confusa*	Native	–	–
sarcogyne lichen	SARE18	*Sarcogyne regularis*	Native	–	–
Russell's fishscale lichen	PSRU3	*Psora russellii*	Native	–	–

Animal community

Wildlife*

Wildlife habitat: oaks provide hard mast; numerous native legumes provide high-quality wildlife food; native warm-season grasses provide extensive 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.

Game species that utilize this ecological site include:
Northern Bobwhite will utilize this ecological site for food (seeds, insects), cover needs (escape, nesting and roosting cover) and brood-rearing habitat.

Cottontail rabbits will utilize this ecological site for food (seeds, soft mast) and cover needs.

Turkey will utilize this ecological site for food (seeds, green browse, soft mast, insects) and nesting and brood-rearing cover. Turkey poults feed heavily on insects provided by this site type.

White-tailed Deer will utilize this ecological site for browse (plant leaves in the growing season, seeds and soft mast in the fall/winter). This site type also can provide escape cover.

Bird species associated with this ecological site's reference state condition:Field Sparrow, Yellow-breasted Chat, White-eyed Vireo, Brown Thrasher, Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Prairie Warbler, and Eastern Towhee.

Amphibian and reptile species that may be associated with this ecological site's reference state: collared lizard (Crotaphytus collaris collaris), five-lined skink (Eumeces fasciatus), six-lined racerunner (Cnemidophorus sexlineatus), flat-headed snake (Tantilla gracilis), eastern coachwhip (Masticophis flagellum flagellum), red milk snake (Lampropeltis triangulum syspila), eastern narrow-mouthed toad (Gastrophyne carolinensis), coal skink (Eumeces anthracinus pluvialis), ground snake (Snora semiannulata), and prairie ring-necked snake (Diadophis punctatus arnyi).

Small mammals likely associated with this ecological site's reference state condition: eastern woodrat (Neotoma floridana) and peromyscus species.

Invertebrates – Many native insect species are likely associated with this ecological site's reference state condition, especially native bees, ants, beetles, butterflies and moths, and crickets, grasshoppers and katydids.

Insect species likely associated with this ecological site's reference state condition: dusted skipper butterfly (Atrytonopsis hianna), cobweb skipper butterfly (Hesperia metea), pepper and salt skipper butterfly (Amblyscirtes hegon), Delaware skipper butterfly (Atryone logan logan), crossline skipper butterfly (Polites origenes), native ants (Crematogaster lineolata, Monomorium minimum, Forelius pruinosus Paratrechnia terricola), and native bees (Colletes aestivalis, Andrena helianthiformis, Protandrena rudbeckiae, Lasioglossum coreopsis, Anthidium psoraleae and Dianthidium subrufulum).

Other invertebrates: black widow spider (Latrodectus mactans) and striped bark scorpion (Centruroides vittatus)

*This section prepared by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013

Other information

Forestry (NRCS 2002, 2014):

Management: Field collected site index values on the deeper soil depth range of this ecological site average 49 for oak. Productivity is low. Very limited to no timber management opportunities exist. These sites are valuable for wildlife purposes and watershed protection. Severely reduced rooting depth restricts tree growth and increases windthrow hazards. These sites respond well to prescribed fire as a management tool.

Limitations: Surface stones and surface rock; very shallow soil depth. Surface stones and rocks are problems for efficient and safe equipment operation. Severe seedling mortality due to high soil surface temperatures and low available water holding capacity is possible. Machine planting and mechanical site preparation is not recommended. Hard bedrock at shallow depths may interfere with equipment operation. Rock outcrops may cause breakage of timber when harvesting. Surface stones and rocks will make equipment use extremely difficult. 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

Shallow Limestone/Dolomite Upland Glade/Woodland – Potential Reference – R115BY009MO

Plot CLRAPR_KS01 - Gasconade soil
Located in Clatterbuck Ranch, Private, Boone County, MO

Plot CURISP04 - Gasconade soil
Located in Cuivre River State Park, Lincoln County, MO
Latitude: 39.060405

Longitude: -90.935438

Plot DABOCA_JK22 – Gasconade soil
Located in Daniel Boone CA, Warren County, MO
Latitude: 38.79299
Longitude: -91.38276969

Plot DANVCA_JK06 – Gasconade soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.86289
Longitude: -91.50324015

Plot DANVCA_JK12 – Gasconade soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.867359
Longitude: -91.50323862

Plot DANVCA02 – Moko soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.885252
Longitude: -91.542625

Plot DANVCA03 – Moko soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.885118
Longitude: -91.543205

Plot DANVCA04 - Moko soil
Located in Danville CA, Montgomery County, MO
Latitude: 38.885364
Longitude: -91.544045

Plot GRCASP_KS08 – Gasconade soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.907637
Longitude: -91.573711

Plot GRCASP_KS09 - Gasconade soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.906939
Longitude: -91.574059

Plot GRCASP02 – Moko soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.907295
Longitude: -91.570453

Plot GRCASP03 - Moko soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.907018
Longitude: -91.570538

Plot GRCASP05 - Gasconade soil
Located in Graham Cave State Park, Montgomery County, MO
Latitude: 38.907833
Longitude: -91.571617

Plot WESPCA_JK01 - Gasconade soil

Located in Weldon Springs CA, St. Charles County, MO
Latitude: 38.672197
Longitude: -90.76325637

Plot WESPCA_JK02 - Gasconade soil
Located in Weldon Springs CA, St. Charles County, MO
Latitude: 38.672739
Longitude: -90.76287169

Plot LILOCA_JK03 - Gasconade soil
Located in Little Lost Creek CA, Warren County, MO
Latitude: 38.77275
Longitude: -91.29329

Plot LILOCA_JK04 - Gasconade soil
Located in Little Lost Creek CA, Warren County, MO
Latitude: 38.765964
Longitude: -91.28219

Plot REIFCA_JK04 - Gasconade soil
Located in Reifsnider CA, Warren County, MO
Latitude: 38.77437
Longitude: -91.09952164

Plot REIFCA_JK10 - Gasconade soil
Located in Reifsnider CA, Warren County, MO
Latitude: 38.77195
Longitude: -91.09762

Other references

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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:**

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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):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

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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:**