

Ecological site R116AY020MO Shallow Dolomite Upland Glade/Woodland

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General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

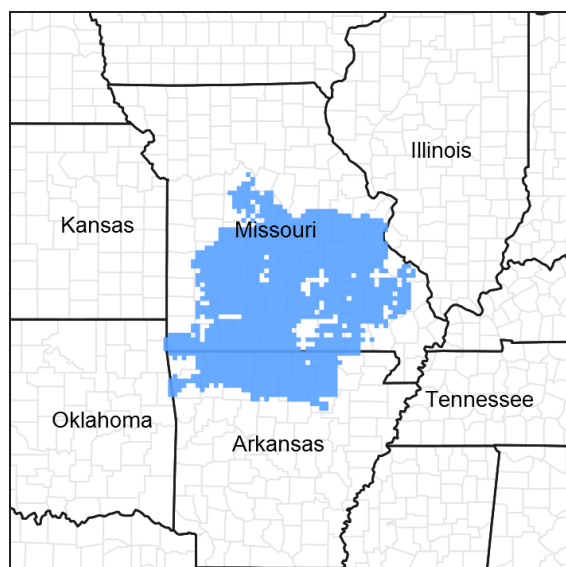


Figure 1. Mapped extent

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): 116A—Ozark Highland

The Ozark Highland constitutes the Salem Plateau of the Ozark Uplift. Elevation ranges from about 300 feet on the southeast edge of the Ozark escarpment, to about 1,600 feet in the west, adjacent to the Burlington Escarpment of the Springfield Plateau. The underlying bedrock is mainly horizontally bedded Ordovician-aged dolomites and sandstones that dip gently away from the uplift apex in southeast Missouri. Cambrian dolomites are exposed on deeply dissected hillslopes. In some places, Pennsylvanian and Mississippian sediments overlie the plateau. Relief varies, from the gently rolling central plateau areas to deeply dissected hillslopes associated with drainageways such as the Buffalo, Current, Eleven Point and White Rivers.

Classification relationships

Terrestrial Natural Community Type in Missouri (Nelson, 2010): The reference state for this ecological site is most like a Dolomite Glade.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):

The reference state for this ecological site is most like the *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* – *Rudbeckia missouriensis* - *Hedyotis nigricans* Wooded Herbaceous Vegetation

(CEGL002398) and in the White River Hills watershed *Juniperus ashei*/*Cotinus obovatus*/*Carex eburnea* - *Rudbeckia missouriensis* Woodland (CEGL007833; Ozark Ashe's Juniper Glade Woodland)

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

Geographic relationship to the Missouri Ecological Classification System (Nigh and Schroeder, 2002): This ecological site is found throughout the Ozark Highlands Section (OZ).

Ecological site concept

Shallow Dolomite Upland Glade/Woodlands ecological sites are extensive in the Ozark Highland, occupying over 750,000 acres. Large glade systems occur in the western portion of the Major Land Resource Area (MLRA), within the Osage and White River Hills ecological subsections, on the Jefferson City - Cotter dolomite. Smaller, patchy glades are common in the eastern portion of the MLRA, on the Gasconade dolomite. They are closely associated with Chert Dolomite Upland Woodland ecological sites. Soils are shallow and very shallow to dolomite bedrock. The reference plant community ranges from open areas of grasses and forbs interspersed with shallow soils and bare bedrock, to areas with shrubs and widely scattered chinkapin oak and post oak.

Associated sites

F116AY010MO	Calcareous Dolomite Protected Backslope Forest Calcareous Dolomite Protected Backslope Forests are downslope in places, on northerly and easterly exposures.
F116AY016MO	Chert Dolomite Protected Backslope Forest Chert Dolomite Protected Backslope Forests are downslope in places, on northerly and easterly exposures.
F116AY047MO	Calcareous Dolomite Exposed Backslope Woodland Calcareous Dolomite Exposed Backslope Woodlands are downslope in places, on southerly and westerly exposures.
F116AY048MO	Chert Dolomite Exposed Backslope Woodland Chert Dolomite Exposed Backslope Woodlands are downslope in places, on southerly and westerly exposures.

Similar sites

R116AY027MO	Shallow Sandstone Upland Glade/Woodland Shallow Sandstone Upland Glade/Woodlands are underlain by sandstone, resulting in differences in the reference plant community.
R116CY006MO	Shallow Igneous Knob Glade Shallow Igneous Knob Glades occur in and around the St Francois Mountains in Missouri and are underlain with igneous bedrock, resulting in differences in the reference plant community.
R115XB009MO	Shallow Limestone/Dolomite Upland Glade/Woodland Shallow Limestone/Dolomite Upland Glade/Woodlands occur along the border with the Ozark Highlands at the eastern and southern edge of the region where they are associated with the Ordovician, Jefferson City-Cotter formation.

Table 1. Dominant plant species

Tree	(1) <i>Quercus stellata</i> (2) <i>Quercus muehlenbergii</i>
Shrub	(1) <i>Bumelia lanuginosa</i> (2) <i>Rhus aromatica</i>
Herbaceous	(1) <i>Rudbeckia missouriensis</i> (2) <i>Schizachyrium scoparium</i>

Physiographic features

This site is on upland crests, shoulders and backslopes with slopes of 3 to 65 percent. 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 Dodd and Dettman, 1996) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites. It is within the area labeled “1” on the figure. The dashed lines within the area indicate the various soils included in this ecological site. Shallow Dolomite Upland Glade/Woodland sites are typically associated with Chert Dolomite Upland Woodland sites, labeled “2”.

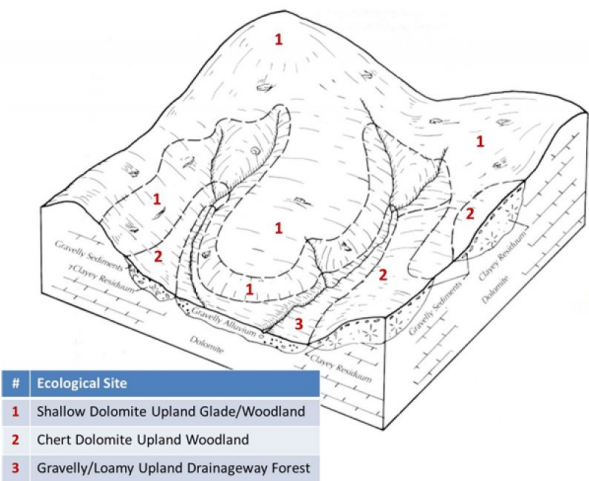


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hill (3) Hillslope
Flooding frequency	None
Slope	3–15%
Water table depth	251 cm
Aspect	W, SE, S, SW

Climatic features

The Ozark Highland 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 Ozark Highland 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 crossing the MLRA from northwest to southeast.

The average annual precipitation in almost all of this area is 38 to 45 inches. Snow falls nearly every winter, but the snow cover lasts for only a few days. The average annual temperature is about 53 to 60 degrees F. The lower temperatures occur at the higher elevations in the western part of the MLRA. Mean January minimum temperature follows a stronger north-to-south 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 a northwest to southeast gradient. 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.

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. Deep sinkholes often have a microclimate significantly cooler, moister, and shadier than surrounding surfaces, a phenomenon that may result in a strikingly different ecology. 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>; 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)	154-180 days
Freeze-free period (characteristic range)	190-207 days
Precipitation total (characteristic range)	1,118-1,194 mm
Frost-free period (actual range)	146-185 days
Freeze-free period (actual range)	186-208 days
Precipitation total (actual range)	1,092-1,219 mm
Frost-free period (average)	167 days
Freeze-free period (average)	198 days
Precipitation total (average)	1,143 mm

Climate stations used

- (1) POTOSI 4 SW [USC00236826], Potosi, MO
- (2) TRUMAN DAM & RSVR [USC00238466], Warsaw, MO
- (3) EUREKA SPRINGS 3 WNW [USC00032356], Eureka Springs, AR
- (4) MTN HOME 1 NNW [USC00035036], Mountain Home, AR

Influencing water features

This ecological site is not influenced by wetland or riparian water features. Nearly all precipitation leaves this site as runoff, due to the shallow soils and underlying impermeable dolomite bedrock. Even though soils are shallow, vegetation sparse and slopes steep, storm hydrographs show that interflow is a major contributor to total storm runoff. Unlike those from most semi-pervious areas, storm hydrographs have rapid overland flow concentration, sharp peaks, and long tapering overland flow concentration (Gates and others 1982). A small amount infiltrates the bedrock along fracture planes, recharging local groundwater and feeding Ozark springs. Management has only a minor effect on this process, as the underlying bedrock is the primary hydrologic barrier.

Soil features

These soils are underlain with dolomite bedrock at less than 20 inches. The soils were formed under prairie

vegetation, and have dark, organic-rich surface horizons. Parent material is dolomite residuum. These soils are loamy to clayey and are skeletal, with high amounts of dolomite gravel, channers and flagstones. They are not affected by seasonal wetness. Soil series associated with this site include Gasconade, Knobby, Moko, and Opequon.

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



Figure 9. 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 is representative of very complex vegetation communities. Not all scenarios or plants are included or discussed. Key indicator plants, animals and ecological processes are described to help guide 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 biological processes on this site are complex. Therefore, representative values are presented in a land management context. 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.

Dolomite 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 (Nelson 2010). One of the most striking aspects of dolomite glades is their unique and characteristic flora. Many plants have an affinity for calcareous dolomite substrates. Glade plants in general possess many adaptations enabling them to survive in a harsh environment often subject to widely fluctuating extremes of temperature and moisture. The following conditions are general characteristic of most dolomite glades (Nelson and Ladd 1983; Nelson et al. 2013):

- Calcareous dolomite 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, drought, frost upheaval, and native grazers were the primary natural disturbances on pre-settlement glades. It is likely that these sites burned at least once every 3 to five years (Guyette and McGinnes 1982). These periodic fires removed the litter and stimulated the growth and flowering of the grasses and forbs. They also limited the growth and dominance of trees, especially eastern redcedar. Fire tolerant chinkapin oak (*Quercus muehlenbergii*) and post oak (*Quercus stellata*) 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 or fire-excluded glades.

In the long term absence of fire, woody species, especially eastern redcedar (*Juniperus virginiana*), 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, eastern redcedar will quickly fill in a glade/woodland system, especially if grazing has diminished the vigor of the diverse flora. Many current glades have been heavily grazed and suffer substantial eastern redcedar invasion along with many exotic species such as yellow sweet clover (*Melilotus officinale*), tall fescue (*Schedonorus arundinaceus*) and common teasel (*Dipsacus fullonum*). Removal of the eastern redcedar and the application of herbicides and prescribed fire have proven to be an effective way to manage these systems (Nelson, et al. 2013).

Dolomite glade/woodland systems harbor a wide diversity of plants and animals. Common native prairie grasses that are present include little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), and sideoats grama (*Bouteloua curtipendula*), which are also found on deeper soil prairies. But other species, such as Missouri coneflower (*Rudbeckia missouriensis*) and calamint (*Calamintha arkansana*), shown in the photo on the left, are only found on these dolomite glades. Lichens may be locally abundant. Desert-adapted animals, like lizards, scorpions and tarantulas, also occupy healthy glades (Missouri Department of Conservation 2014; Sexton 1982).

Dolomite glades in the different watersheds in the Ozark Highlands exhibit unique subsets of characteristic species. The floral glade assemblage of the White River Hills watershed contains several southwestern species at the eastern edge of their range. These include Trelease's delphinium (*Delphinium treleasei*), Ashe's juniper (*Juniperus ashei*), soap weed (*Yucca arkansana*) and American smoke tree (*Cotinus obovatus*), along with species of conservation concern such as western soapberry (*Sapindus drummondii*), umbrella plant (*Eriogonum longifolium*), and purple tassels prairie clover (*Dalea gattingeri*). Missouri bladderpod (*Physaria filiformis*) and Bush's skullcap

(*Scutellaria bushii*) are also endemic glade plants of the Ozark highlands (Yatskievych 1999; Nelson 2010; Nelson, et al. 2013; Nigh and Schroeder 2002).

Dolomite glades of the Ozark Highlands also provide valuable habitat for priority or watch-listed bird species, including the field sparrow (*Spizella pusilla*), brown thrasher (*Toxostoma rufum*), and painted bunting (*Passerina ciris*) (Jacobs 2001). The greater roadrunner (*Geococcyx californicus*), shown in the photo, is the only bird largely restricted to the dolomite glades in southwestern Missouri. Bachman's sparrow (*Aimophila aestivalis*) is often found on dolomite glades. The Texas mouse (*Peromyscus attwateri*) is the only mammal restricted to glades in Missouri (Schwartz et al. 2001).

The presence of restricted animals, including insects, presents a challenge, when using prescribed burning as a management tool. While the use of fire existed prior to European settlement, for populations to remain viable in a fire mediated landscape, today's intensively altered watersheds may impose greater stress on certain plant and animal populations when using fire in contemporary confined landscapes (e.g. small tracts, lack of landscape connectivity, public-private conflicts) (Nelson, et al. 2013).

Finally, of growing concern are the feral hog numbers that are dramatically increasing throughout the Ozark Highlands. Feral hogs dig and overturn extensive vegetation mats on glades looking for insects, reptiles, small mammals, and plant roots. This results in extensive rutting that increases soil erosion and loss of plant and animal species diversity

A state and transition model diagram for the Shallow Dolomite Upland Glade/Woodland Ecological Site (R116AY020MO) follows this narrative. Descriptions of each state, transition, plant community, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases. The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

Shallow Dolomite Upland Glade/Woodland, R116AY020MO

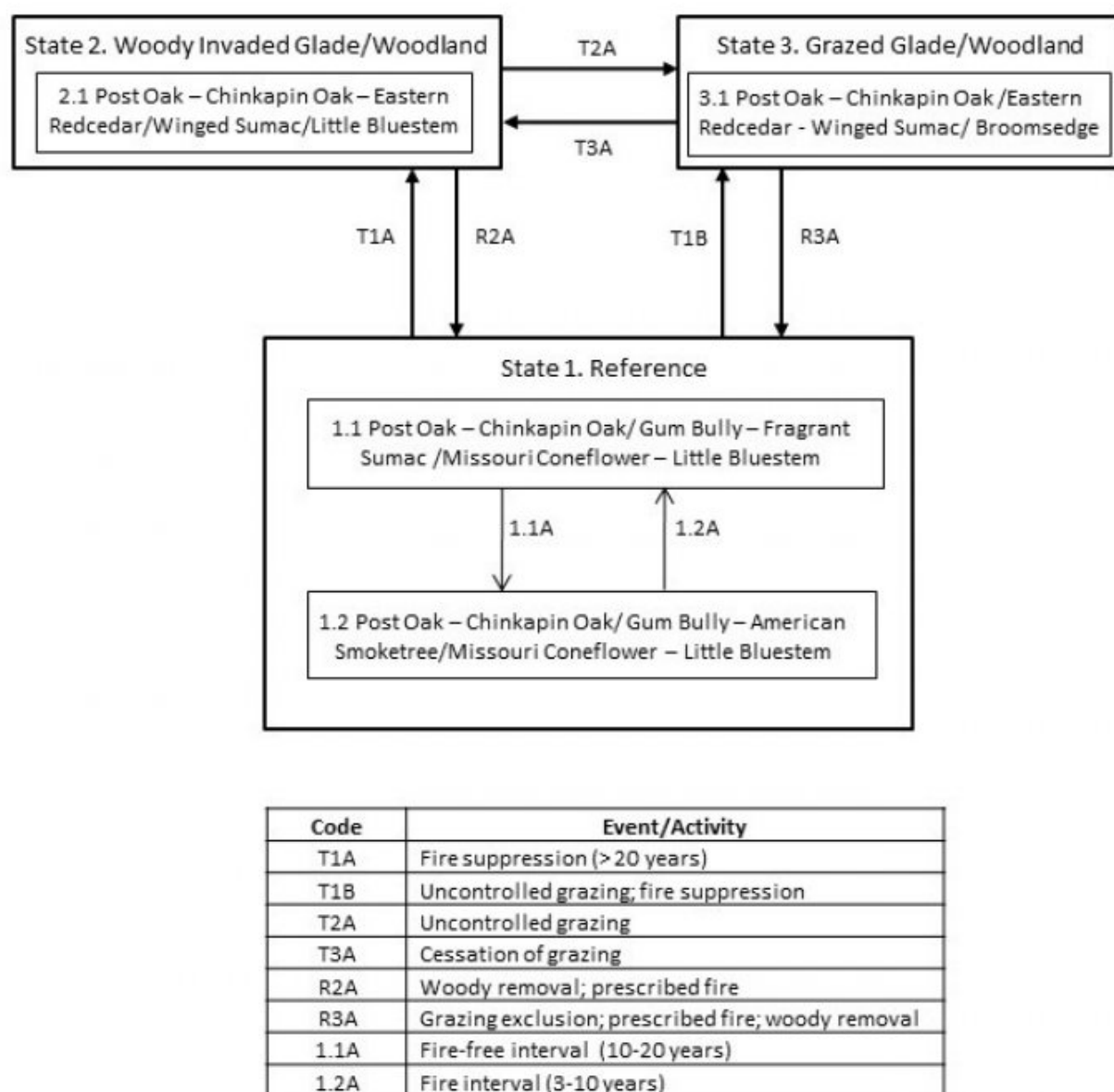


Figure 10. State and transition diagram for this ecological site.

Reference

The reference state can be found in scattered locations throughout the Ozark Highlands. The reference state ranges from wide open grassy areas with shallow soils and bare bedrock, to areas with widely scattered chinkapin oak and post oak on locations with soil depths at the deeper extreme of the range for this soil component. On protected slopes and along the outer edges of glades, open woodlands are more common. Here the deeper soil depth range for this soil component and protected aspects allow more woody components to dominate. Periodic disturbances from fire maintained the dominance of drought adapted native grasses and forbs by limiting the growth and dominance of trees, especially eastern redcedar. Long disturbance-free periods allowed an increase in woody species. Two community phases are recognized in this state, with shifts between phases based on fire frequency. With decreasing fire frequency, a shift to Community Phase 1.2 will occur and exhibit an increase in woody densities.

Community 1.1

Post Oak – Chinkapin Oak/ Gum Bully – Fragrant Sumac /Missouri Coneflower – Little Bluestem



Figure 11. Reference state glade at Peck Ranch Conservation Area, north of Fremont, Missouri. Photo credit - MDC



Figure 12. Reference state glade at Ha Ha Tonka State Park near Lake of the Ozarks in Missouri. Photo credit - MODNR

This phase has widely scattered chinkapin oak and post oak with little bluestem, side oats grama, and sedges (*Carex* spp.) dominating the open ground layer. Numerous forbs such as coneflower and lichens are also present and locally abundant. Bedrock outcropping is common.

Forest overstory. Overstory Species list is based on field reconnaissance as well as commonly occurring species listed in Nelson 2010; names and symbols are from USDA PLANTS database.

Forest understory. Understory Species list is based on field reconnaissance as well as commonly occurring species listed in Nelson 2010; names and symbols are from USDA PLANTS database.

Table 5. Ground cover

Tree foliar cover	0.00-0.99%
Shrub/vine/liana foliar cover	0.0-0.1%
Grass/grasslike foliar cover	0.1-25.0%
Forb foliar cover	0.01-2.00%
Non-vascular plants	0.01-0.99%
Biological crusts	0.01-5.00%
Litter	1-25%
Surface fragments >0.25" and ≤3"	0.01-50.00%
Surface fragments >3"	0.01-50.00%
Bedrock	0.01-50.00%
Water	0%
Bare ground	0.1-50.0%

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	1-25%
Surface fragments >0.25" and ≤3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-0% N*
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-0% N*
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-0% N*
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-0% N*
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0%
Tree snags** (hard***)	—
Tree snags** (soft***)	—
Tree snag count** (hard***)	
Tree snag count** (hard***)	0-25 per hectare

* **Decomposition Classes:** N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Table 8. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	0%	1-95%	0-25%
>0.15 <= 0.3	0-1%	0-1%	0-50%	0-25%
>0.3 <= 0.6	0-25%	0-5%	0-25%	0-25%
>0.6 <= 1.4	0-10%	0-2%	0-5%	0-2%
>1.4 <= 4	0-5%	—	—	—
>4 <= 12	1-2%	—	—	—
>12 <= 24	—	—	—	—
>24 <= 37	—	—	—	—
>37	—	—	—	—

Community 1.2

Post Oak – Chinkapin Oak/ Gum Bully – American Smoketree/Missouri Coneflower – Little Bluestem



Figure 13. Reference state with lower fire frequency at Ha Ha Tonka State Park near Lake of the Ozarks in Missouri. Photo credit - MDC

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.

Pathway 1.1A

Community 1.1 to 1.2



**Post Oak – Chinkapin Oak/
Gum Bully – Fragrant Sumac
/Missouri Coneflower – Little
Bluestem**



**Post Oak – Chinkapin Oak/
Gum Bully – American
Smoketree/Missouri
Coneflower – Little Bluestem**

This pathway results from fire suppression. With fire-free intervals of 10 to 20 years, woody species will increase in density and cover causing the community to gradually shift to phase 1.2 Some displacement of grasses and forbs may be occurring due to shading and competition from the increased densities of shrubs and oaks.

Pathway 1.2A

Community 1.2 to 1.1



Post Oak – Chinkapin Oak/
Gum Bully – American
Smoketree/Missouri
Coneflower – Little Bluestem



Post Oak – Chinkapin Oak/
Gum Bully – Fragrant Sumac
/Missouri Coneflower – Little
Bluestem

With increased fire frequencies, woody species will decrease in density and cover, and over time, this community will gradually shift back to community phase 1.1.

Conservation practices

Prescribed Burning

State 2

Woody Invaded Glade/Woodland

This state is dominated by eastern redcedar with significant increases of oak density due to extended or permanent periods of fire suppression. This state can form relatively even-age stands, dating to when fire suppression began. Canopy closures can approach 50 to 80 percent with little or no ground flora.

Community 2.1

Post Oak – Chinkapin Oak – Eastern Redcedar/Winged Sumac/Little Bluestem



Figure 14. A dolomite glade in Arkansas being invaded by woody species due to lack of fire. Photo credit - Doug Wallace, NRCS



Figure 15. Feral hog damage on a dolomite glade in the White River watershed; photo credit NRCS



Figure 16. A dolomite glade in Arkansas being invaded by woody species due to lack of fire. Photo credit - Doug Wallace, NRCS

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 stage 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 Heavily Grazed Glade/Woodland

Overgrazing can erode the shallow, fragile, original soil layer from glades. This overgrazing will decrease the number and diversity of species and cause changes in the distribution of opportunistic and conservative glade species. Eastern redcedar along with many exotic species such as yellow sweet clover (*Melilotus latissimus*), tall fescue (*Schedonorus arundinaceus*), cheat grass (*Bromus tectorum*) and common teasel (*Dipsacus laciniatus*) readily invade grazed dolomite glades. Grazing animals also reduce the quality of glade and barrens habitat through soil compaction and the selective removal of plant species essential to the survival of glade insects (Erickson et al. 1942).

Community 3.1 Post Oak – Chinkapin Oak /Eastern Redcedar - Winged Sumac/ Broomsedge



Figure 17. Heavily grazed dolomite glade near Decaturville, Missouri. Photo credit - Allison Vaughn

Due to long periods of domestic livestock grazing grass and 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.

Transition T1A
State 1 to 2

This gradual transition results from prolonged periods of fire suppression, generally over 20 years.

Conservation practices

Brush Management
Prescribed Burning

Transition T1B
State 1 to 3

This transition results from persistent cattle grazing accompanied by fire suppression.

Restoration pathway R2A
State 2 to 1

Restoration requires cutting most of the invading woody species such as eastern redcedar, accompanied by prescribed fire on a continued basis.

Conservation practices

Brush Management
Prescribed Burning

Transition T2A
State 2 to 3

This transition results from long periods of uncontrolled domestic livestock grazing.

Restoration pathway R3A
State 3 to 1

Restoration requires exclusion of livestock grazing, accompanied by prescribed burning and brush managment.

Conservation practices

Brush Management
Prescribed Burning
Access Control

Transition T3A
State 3 to 2

This gradual transition results from the sessation of grazing by domestic livestock.

Additional community tables

Table 9. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
post oak	QUST	<i>Quercus stellata</i>	Native	–	0–5	–	–
chinquapin oak	QUMU	<i>Quercus muehlenbergii</i>	Native	–	0–5	–	–
American smoketree	COOB2	<i>Cotinus obovatus</i>	Native	–	0–5	–	–
dwarf hackberry	CETE	<i>Celtis tenuifolia</i>	Native	–	0–5	–	–

Table 10. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	<i>Schizachyrium scoparium</i>	Native	–	–
puffsheath dropseed	SPNE2	<i>Sporobolus neglectus</i>	Native	–	–
big bluestem	ANGE	<i>Andropogon gerardii</i>	Native	–	–
sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	Native	–	–
rough dropseed	SPCL	<i>Sporobolus clandestinus</i>	Native	–	–
Indiangrass	SONU2	<i>Sorghastrum nutans</i>	Native	–	–
switchgrass	PAVI2	<i>Panicum virgatum</i>	Native	–	–
hairy fimbry	FIPU	<i>Fimbristylis puberula</i>	Native	–	–
Heller's rosette grass	DIOL	<i>Dichantherium oligosanthes</i>	Native	–	–
arrowfeather threeawn	ARPU8	<i>Aristida purpurascens</i>	Native	–	–
composite dropseed	SPCO16	<i>Sporobolus compositus</i>	Native	–	–
fewflower nutrush	SCPA5	<i>Scleria pauciflora</i>	Native	–	–
slender woodland sedge	CADI5	<i>Carex digitalis</i>	Native	–	–
bristleleaf sedge	CAEB2	<i>Carex eburnea</i>	Native	–	–
rock muhly	MUSO	<i>Muhlenbergia sobolifera</i>	Native	–	–
hairy woodland brome	BRPU6	<i>Bromus pubescens</i>	Native	–	–
Mead's sedge	CAME2	<i>Carex meadii</i>	Native	–	–
Crawe's sedge	CACR3	<i>Carex crawei</i>	Native	–	–
parasol sedge	CAUM4	<i>Carex umbellata</i>	Native	–	–
Forb/Herb					
Missouri orange coneflower	RUMI	<i>Rudbeckia missouriensis</i>	Native	–	–
diamond-flowers	STNI6	<i>Stenaria nigricans</i>	Native	–	–
prairie rosinweed	SITE	<i>Silphium terebinthinaceum</i>	Native	–	–
limestone calamint	CLAR5	<i>Clinopodium arkansanum</i>	Native	–	–
fewleaf sunflower	HEOC2	<i>Helianthus occidentalis</i>	Native	–	–
Ontario blazing star	LICY	<i>Liatris cylindracea</i>	Native	–	–
aromatic aster	SYOB	<i>Symphyotrichum oblongifolium</i>	Native	–	–
skyblue aster	SYOO	<i>Symphyotrichum oolentangiense</i>	Native	–	–
tall blazing star	LIAS	<i>Liatris aspera</i>	Native	–	–
widowsfrill	SIST	<i>Silene stellata</i>	Native	–	–
yellow pimpernel	TAIN	<i>Taenidia integerrima</i>	Native	–	–
golden zizia	ZIAU	<i>Zizia aurea</i>	Native	–	–

tall thoroughwort	EUAL3	<i>Eupatorium altissimum</i>	Native	—	—
Ozark milkvetch	ASDI4	<i>Astragalus distortus</i>	Native	—	—
butterfly milkweed	ASTU	<i>Asclepias tuberosa</i>	Native	—	—
spiked crested coralroot	HESP3	<i>Hexalectris spicata</i>	Native	—	—
Curtis' star-grass	HYCU5	<i>Hypoxis curtissii</i>	Native	—	—
crowpoison	NOBI2	<i>Nothoscordum bivalve</i>	Native	—	—
slimflower scurfpea	PSTE5	<i>Psoralegium tenuiflorum</i>	Native	—	—
smooth rockcress	ARLA	<i>Arabis laevigata</i>	Native	—	—
groovestem Indian plantain	ARPL4	<i>Arnoglossum plantagineum</i>	Native	—	—
groundplum milkvetch	ASCRT	<i>Astragalus crassicaupus var. trichocalyx</i>	Native	—	—
western silver aster	SYSE2	<i>Symphotrichum sericeum</i>	Native	—	—
branched noseburn	TRRA5	<i>Tragia ramosa</i>	Native	—	—
Gattinger's goldenrod	SOGA	<i>Solidago gattingeri</i>	Native	—	—
gray goldenrod	SONE	<i>Solidago nemoralis</i>	Native	—	—
fringeleaf wild petunia	RUHU	<i>Ruellia humilis</i>	Native	—	—
smooth blue aster	SYLA3	<i>Symphotrichum laeve</i>	Native	—	—
small palafox	PACA3	<i>Palafoxia callosa</i>	Native	—	—
wild quinine	PAHI8	<i>Parthenium hispidum</i>	Native	—	—
Michaux's stitchwort	MIMI2	<i>Minuartia michauxii</i>	Native	—	—
Nuttall's sensitive-briar	MINU6	<i>Mimosa nuttallii</i>	Native	—	—
hairy sunflower	HEHI2	<i>Helianthus hirsutus</i>	Native	—	—
hogwort	CRCA6	<i>Croton capitatus</i>	Native	—	—
prairie tea	CRMO6	<i>Croton monanthogynus</i>	Native	—	—
purple prairie clover	DAPU5	<i>Dalea purpurea</i>	Native	—	—
pasture heliotrope	HETE3	<i>Heliotropium tenellum</i>	Native	—	—
grooved flax	LISU4	<i>Linum sulcatum</i>	Native	—	—
common cinquefoil	POSI2	<i>Potentilla simplex</i>	Native	—	—
slimflower scurfpea	PSTE5	<i>Psoralegium tenuiflorum</i>	Native	—	—
Buckley's goldenrod	SOBU	<i>Solidago buckleyi</i>	Native	—	—
marbleseed	ONOSM	<i>Onosmodium</i>	Native	—	—
lanceleaf tickseed	COLA5	<i>Coreopsis lanceolata</i>	Native	—	—
stiff tickseed	COPA10	<i>Coreopsis palmata</i>	Native	—	—
Indianhemp	APCA	<i>Apocynum cannabinum</i>	Native	—	—
downy gentian	GEPU5	<i>Gentiana puberulenta</i>	Native	—	—
rose mock vervain	GLCA2	<i>Glandularia canadensis</i>	Native	—	—
wavyleaf purple coneflower	ECSI	<i>Echinacea simulata</i>	Native	—	—
western rough goldenrod	SORA	<i>Solidago radula</i>	Native	—	—
autumn onion	ALST	<i>Allium stellatum</i>	Native	—	—
flowering spurge	EUCO10	<i>Euphorbia corollata</i>	Native	—	—
false boneset	BREU	<i>Brickellia eupatorioides</i>	Native	—	—
hoary puccoon	LICA12	<i>Lithospermum canescens</i>	Native	—	—
Atlantic camas	CASC5	<i>Camassia scilloides</i>	Native	—	—
downy pagoda-plant	BLCI	<i>Blephilia ciliata</i>	Native	—	—
scarlet Indian paintbrush	CACO17	<i>Castilleja coccinea</i>	Native	—	—

scarlet indian paintbrush	ORCO17	<i>Castilleja coccinea</i>	Native	—	—
bastard toadflax	COUM	<i>Comandra umbellata</i>	Native	—	—
annual ragweed	AMAR2	<i>Ambrosia artemisiifolia</i>	Native	—	—
slender threeseed mercury	ACMO4	<i>Acalypha monococca</i>	Native	—	—
prairie fleabane	ERST3	<i>Erigeron strigosus</i>	Native	—	—
narrowleaf gumweed	GRLA3	<i>Grindelia lanceolata</i>	Native	—	—
slimleaf milkweed	ASST	<i>Asclepias stenophylla</i>	Native	—	—
whorled milkweed	ASVE	<i>Asclepias verticillata</i>	Native	—	—
green comet milkweed	ASVI	<i>Asclepias viridiflora</i>	Native	—	—
slender yellow woodsorrel	OXDI2	<i>Oxalis dillenii</i>	Native	—	—
violet woodsorrel	OXVI	<i>Oxalis violacea</i>	Native	—	—
narrowleaf stoneseed	LIIN2	<i>Lithospermum incisum</i>	Native	—	—
largeflower fameflower	PHCA48	<i>Phemeranthus calycinus</i>	Native	—	—
Virginia groundcherry	PHVI5	<i>Physalis virginiana</i>	Native	—	—
Nuttall's prairie parsley	PONU4	<i>Polytaenia nuttallii</i>	Native	—	—
blackeyed Susan	RUHI2	<i>Rudbeckia hirta</i>	Native	—	—
false aloe	MAVI5	<i>Manfreda virginica</i>	Native	—	—
trailing lespedeza	LEPR	<i>Lespedeza procumbens</i>	Native	—	—
creeping lespedeza	LERE2	<i>Lespedeza repens</i>	Native	—	—
slender lespedeza	LEVI7	<i>Lespedeza virginica</i>	Native	—	—
Dillenius' ticktrefoil	DEGL4	<i>Desmodium glabellum</i>	Native	—	—
sessileleaf ticktrefoil	DESE	<i>Desmodium sessilifolium</i>	Native	—	—
Lady Bird's centaury	CETE2	<i>Centaurium texense</i>	Native	—	—
partridge pea	CHFA2	<i>Chamaecrista fasciculata</i>	Native	—	—
spotted sandmat	CHMA15	<i>Chamaesyce maculata</i>	Native	—	—
stiff ticktrefoil	DEOB5	<i>Desmodium obtusum</i>	Native	—	—
poorjoe	DITE2	<i>Diodia teres</i>	Native	—	—
Bush's purple coneflower	ECPA2	<i>Echinacea paradoxa</i>	Native	—	—
shaggy dwarf morning-glory	EVNU	<i>Evolvulus nuttallianus</i>	Native	—	—
hairy bedstraw	GAPI2	<i>Galium pilosum</i>	Native	—	—
American ginseng	PAQU	<i>Panax quinquefolius</i>	Native	—	—
purple cliffbrake	PEAT2	<i>Pellaea atropurpurea</i>	Native	—	—
pale beardtongue	PEPA7	<i>Penstemon pallidus</i>	Native	—	—
thickleaf phlox	PHCA19	<i>Phlox carolina</i>	Native	—	—
pitcher's stitchwort	MIPA6	<i>Minuartia patula</i>	Native	—	—
bigfruit evening primrose	OEMA	<i>Oenothera macrocarpa</i>	Native	—	—
prairie goldenrod	OLAL2	<i>Oligoneuron album</i>	Native	—	—
Bush's skullcap	SCBU	<i>Scutellaria bushii</i>	Native	—	—
sleepy silene	SIAN2	<i>Silene antirrhina</i>	Native	—	—
prairie blue-eyed grass	SICA9	<i>Sisyrinchium campestre</i>	Native	—	—
Great Plains lady's tresses	SPMA5	<i>Spiranthes magnicamporum</i>	Native	—	—
smooth violet prairie aster	SYTU2	<i>Symphotrichum turbinellum</i>	Native	—	—
fluxweed	TRBR5	<i>Trichostema brachiatum</i>	Native	—	—
feverwort	TRPE5	<i>Triosteum perfoliatum</i>	Native	—	—

narrowleaf vervain	VESI	<i>Verbena simplex</i>	Native	—	—
common mullein	VETH	<i>Verbascum thapsus</i>	Native	—	—
birdfoot violet	VIPE	<i>Viola pedata</i>	Native	—	—
meadow zizia	ZIAP	<i>Zizia aptera</i>	Native	—	—
roundhead lespedeza	LECA8	<i>Lespedeza capitata</i>	Native	—	—
Shrub/Subshrub					
fragrant sumac	RHAR4	<i>Rhus aromatica</i>	Native	—	—
gum bully	SILA20	<i>Sideroxylon lanuginosum</i>	Native	—	—
coralberry	SYOR	<i>Symphoricarpos orbiculatus</i>	Native	—	—
winged sumac	RHCO	<i>Rhus copallinum</i>	Native	—	—
Carolina rose	ROCA4	<i>Rosa carolina</i>	Native	—	—
smooth sumac	RHGL	<i>Rhus glabra</i>	Native	—	—
leadplant	AMCA6	<i>Amorpha canescens</i>	Native	—	—
rusty blackhaw	VIRU	<i>Viburnum rufidulum</i>	Native	—	—
Tree					
chinquapin oak	QUMU	<i>Quercus muehlenbergii</i>	Native	—	—
common persimmon	DIVI5	<i>Diospyros virginiana</i>	Native	—	—
winged elm	ULAL	<i>Ulmus alata</i>	Native	—	—
Shumard's oak	QUSH	<i>Quercus shumardii</i>	Native	—	—
dwarf hackberry	CETE	<i>Celtis tenuifolia</i>	Native	—	—
slippery elm	ULRU	<i>Ulmus rubra</i>	Native	—	—
common hoptree	PTTR	<i>Ptelea trifoliata</i>	Native	—	—
Vine/Liana					
saw greenbrier	SMBO2	<i>Smilax bona-nox</i>	Native	—	—
eastern poison ivy	TORA2	<i>Toxicodendron radicans</i>	Native	—	—
Alabama supplejack	BESC	<i>Berchemia scandens</i>	Native	—	—
summer grape	VIAE	<i>Vitis aestivalis</i>	Native	—	—
fiveangled dodder	CUPE3	<i>Cuscuta pentagona</i>	Native	—	—
eastern milkpea	GARE2	<i>Galactia regularis</i>	Native	—	—
Virginia creeper	PAQU2	<i>Parthenocissus quinquefolia</i>	Native	—	—
Nonvascular					
fishscale lichen	PSDE60	<i>Psora decipiens</i>	Native	—	—
Calkins' wart lichen	VECA14	<i>Verrucaria calkinsiana</i>	Native	—	—
Russell's fishscale lichen	PSRU3	<i>Psora russellii</i>	Native	—	—

Table 11. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
post oak	QUST	<i>Quercus stellata</i>	Native	—	1–5	—	—
chinquapin oak	QUMU	<i>Quercus muehlenbergii</i>	Native	—	1–5	—	—
eastern redcedar	JUVI	<i>Juniperus virginiana</i>	Native	—	0–2	—	—

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, and 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). (Pitts and McGuire 2000; Schwartz, et al. 2001)

Breeding bird species associated with this ecological site's reference state condition:

Field Sparrow, Yellow-breasted Chat, Blue-winged Warbler, Brown Thrasher, Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Prairie Warbler, and Eastern Towhee. In the White River watershed these additional species may be present: Painted Bunting, Greater Roadrunner, and Bachman's Sparrow. (Fitzgerald and Pashley 2000a; Jacobs 2001)

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 sypila*), eastern narrow-mouthed toad (*Gastrophyne carolinensis*), coal skink (*Eumeces anthracinus pluvialis*), ground snake (*Snora semiannulata*), western pygmy rattlesnake (*Sistrurus miliarius streckeri*) and prairie ring-necked snake (*Diadophis punctatus arnyi*). (Johnson 2000)

Small mammals likely associated with this ecological site's reference state condition: eastern woodrat (*Neotoma floridana*) and *Peromyscus* species. In the White River watershed, the Texas mouse (*Peromyscus attwateri*) occurs. (Schwartz, et al. 2001)

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 (*Pheidole tysoni*, *Formica schaufussi*), and native bees (*Colletes aestivalis*, *Andrena helianthiformis*, *Protandrena rudbeckiae*, *Lasioglossum coreopsis*, *Anthidium psoraleae* and *Dianthidium subrufulum*). In the White River watershed, the largest tiger beetle in the state occurs on these sites, *Cicindela obsoleta vulturina*. (Heitzman and Heitzman, 1996)

Other invertebrates: black widow spider (*Latrodectus mactans*), Texas brown tarantula (*Aphonopelma hentzi*) and striped bark scorpion (*Centruroides vittatus*)

(This section was developed by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013)

Hydrological functions

Nearly all precipitation leaves this site as runoff, due to the shallow soils and underlying impermeable dolomite

bedrock. Even though soils are shallow, vegetation sparse and slopes steep, storm hydrographs show that interflow is a major contributor to total storm runoff. Unlike those from most semi-pervious areas, storm hydrographs have rapid overland flow concentration, sharp peaks, and long tapering overland flow concentration (Gates and others 1982). A small amount infiltrates the bedrock along fracture planes, recharging local groundwater and feeding Ozark springs. Management has only a minor effect on this process, as the underlying bedrock is the primary hydrologic barrier.

Recreational uses

Hiking and wildlife viewing are the primary recreational uses of this ecological site. Endemic plants, birds, and reptiles, wildflower displays, and often spectacular views across the Ozark landscape make well-managed sites uniquely attractive for visitors. Poorly managed sites, where fire exclusion and grazing have resulted in cedar encroachment, do not offer these features, and have limited recreational value.

Wood products

Forest Management

Field measured site index values are 22 to 34 for eastern redcedar and 34 to 38 for chinkapin oak. Productivity is very low. No practical 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.

Other information

Site 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. Equipment use is not recommended.

Table 12. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
chinquapin oak	<i>QUMU</i>	34	38	20	24	50	—	—	
eastern redcedar	<i>JUVI</i>	22	34	1	3	50	—	—	

Inventory data references

Potential Reference Sites: Shallow Dolomite Upland Glade/Woodland

Plot CAMOCA01

Located in Caney Mountain Conservation Area, Ozark County, MO.

Latitude: 36.677194

Longitude: 92.390578

Plot CAMOCA07

Located in Caney Mountain Conservation Area, Ozark County, MO

Latitude: 36.698095

Longitude: 92.455858

Plot HATOSP01

Located in Ha Ha Tonka State Park, Camden, MO.

Latitude: 37.982841

Longitude: 92.764619

Plot HATOSP02

Located in Ha Ha Tonka State Park, Camden, MO.

Latitude: 37.982616

Longitude: 92.764864

Plot HATOSP05

Located in Ha Ha Tonka State Park, Camden, MO.

Latitude: 37.96363

Longitude: 92.763162

Plot MERASP01

Located in Meramec State Park, Crawford County, MO.

Latitude: 38.194715

Longitude: 91.107875

Plot PERACA02

Located in Peck Ranch Conservation Area, Carter County, MO.

Latitude: 37.038814

Longitude: 91.161315

Plot PERACA03

Located in Peck Ranch Conservation Area, Carter County, MO.

Latitude: 37.039494

Longitude: 91.161128

May 2014: Reconnaissance work in Arkansas:

Harold E. Alexander Spring River Wildlife Management Area (Sharp County, west of Ash Flat)

Carrollton Glade (Bull Shoals Lake, NW of Lead Hill, Boone County); Jim Turbo property (NW Baxter County)

Type locality

Location 1: Carter County, MO	
Township/Range/Section	T27N R2W S3
UTM zone	N
UTM northing	4100759
UTM easting	663524
Latitude	37° 2' 19"
Longitude	91° 9' 40"
General legal description	Plot PERACA02 Peck Ranch Conservation Area Knobby pedon
Location 2: Carter County, MO	
Township/Range/Section	T27N R2W S3
UTM zone	N
UTM northing	4100835
UTM easting	663539
Latitude	37° 2' 22"
Longitude	91° 9' 40"
General legal description	Plot PERACA03 Peck Ranch Conservation Area Opequon pedon
Location 3: Ozark County, MO	
Township/Range/Section	T23N R13W S16

UTM zone	N
UTM northing	4059236
UTM easting	554453
Latitude	36° 40' 37"
Longitude	92° 23' 26"
General legal description	Plot CAMOCA01 Caney Mountain Conservation Area

Location 4: Ozark County, MO

Township/Range/Section	T23N R14W S1
UTM zone	N
UTM northing	4061520
UTM easting	548607
Latitude	36° 41' 53"
Longitude	92° 27' 21"
General legal description	Plot CAMOCA07 Caney Mountain Conservation Area

Location 5: Camden County, MO

Township/Range/Section	T38N R17W S35
UTM zone	N
UTM northing	4203937
UTM easting	520671
Latitude	37° 58' 58"
Longitude	92° 45' 52"
General legal description	Plot HATOSP01 Ha Ha Tonka State Park Knobby pedon

Location 6: Camden County, MO

Township/Range/Section	T38N R17W S35
UTM zone	N
UTM northing	4203912
UTM easting	520649
Latitude	37° 58' 57"
Longitude	92° 45' 53"
General legal description	Plot HATOSP02 Ha Ha Tonka State Park Knobby pedon

Location 7: Crawford County, MO

Township/Range/Section	T40N R2W S23
UTM zone	N
UTM northing	4229111
UTM easting	665690
Latitude	38° 11' 40"
Longitude	91° 6' 28"
General legal description	Plot MERASP01 Meramec State Park Knobby pedon

Location 8: Camden County, MO

Township/Range/Section	T37N R17W S11
UTM zone	N

UTM northing	4201806
UTM easting	520804
Latitude	37° 57' 49"
Longitude	92° 45' 47"
General legal description	Plot HATOSP05 Ha Ha Tonka State Park Knobby pedon

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Approval

Nels Barrett, 9/24/2020

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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.

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Date	07/28/2014
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Approval date	
Composition (Indicators 10 and 12) based on	Foliar Cover

Indicators

1. **Number and extent of rills:** Rills are rare due to the extensive rock outcrops and stoney nature of the surface.

2. **Presence of water flow patterns:** Water flows in interstitial areas between bedrock occurrences.

3. **Number and height of erosional pedestals or terracettes:** rare; < 1 inch in height

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Areas of bare ground exist. When present they are generally underneath and associated with woody species that have shaded out other vegetation.

5. **Number of gullies and erosion associated with gullies:** none

6. **Extent of wind scoured, blowouts and/or depositional areas:** none

7. **Amount of litter movement (describe size and distance expected to travel):** minimal - little surface litter is present

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface is minimal in most areas. Sites are dominated by rock outcrops, stones, boulders and cobbly surfaces.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0-6 inches; very dark grayish brown; SOM <2%

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Low due to low plant densities. Runoff rates can be high due to the shallow soil depths, large areas of bedrock outcropping and stoney nature of the ground surface.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None
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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: Warm season grasses > forbs > sedges

Sub-dominant:

Other: shrubs

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All plant species should be capable of reproduction depending on water availability. All plants should be vigorous, healthy and reproductive depending on disturbance (e.g., drought). Plants should have numerous seed heads, vegetative tillers etc.

The only limitations are weather-related effects, wildfire, and natural disease that may temporarily reduce reproductive capability. Plant mortality can be high due to droughty conditions and high sun exposure during summer months.

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):** less than 200 pounds per acre per year
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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:** eastern redcedar, smooth sumac, sweet clover, tall fescue, teasel
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17. **Perennial plant reproductive capability:** Better in normal to wet years and seasons. Poorer in dry years and seasons.
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