USDA Natural Resources
Conservation Service

Ecological site R116CY006MO
Shallow Igneous Knob Glade

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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): 116C–St. Francois Knobs and Basins

The St. Francois Knobs and Basins is the structural center of the Ozark Dome. Elevation ranges from about 450 feet along the rivers in the southern part of the area to 1,772 feet on the summit of Taum Sauk Mountain, the highest point in Missouri. Prominent features of this major land resource area (MLRA) are the Precambrian igneous knobs and hills that rise conspicuously to various elevations, interspersed with smooth-floored basins and valleys overlying dolomite and sandstone. Ecological sites defined for this MLRA are associated with the igneous parent materials, either in knob or basin positions. Areas influenced primarily by dolomite and/or sandstone are included in ecological sites within MLRA 116A (Ozark Highlands).

Classification relationships

Atlas of Missouri Ecoregions (Nigh and Schroeder 2002):
This ecological site occurs primarily within the following Land Type Association:
OZ10a St. Francois Igneous Glade/Oak Forest Knobs

Terrestrial Natural Community Type (Nelson, 2010):
The reference state for this ecological site is most similar to: Igneous Glade

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to: (CEGL002242) *Schizachyrium scoparium* - Aristida dichotoma - Croton willdenowii / Lichens Wooded Herbaceous Vegetation

Ecological site concept

Shallow Igneous Knob Glades occur throughout the MLRA, and on outlying igneous knobs in adjacent counties. Sites are on shoulders and backslopes of knobs and along “shut-ins” (deep, narrow, bedrock-controlled valleys with no floodplain deposition), particularly on south and west facing slopes. Soils are shallow to volcanic bedrock, and extensive areas of exposed bedrock are intermingled within the sites. These sites typically occur in complex with Dry Igneous Woodland ecological sites, which are moderately deep to bedrock and support open woodland communities. Vegetation of the reference state is a grassland/forb community dominated by grasses such as little bluestem, broomsedge, and poverty oats grass with forbs, lichens and occasional scattered shrubs and stunted eastern redcedar, blackjack oak and post oak.

Associated sites

F116CY002MO	**Igneous Upland Woodland** Igneous Upland Woodlands are on a different position on the hillslope from Shallow Igneous Knob Glades. In many places the woodland ecological sites are upslope from the glades, but in areas where glades occupy the knob crests, woodland ecological sites are downslope.
F116CY003MO	**Dry Igneous Upland Woodland** Dry Igneous Upland Woodlands are often downslope from Shallow Igneous Knob Glades. These two ecological sites are typically intermingled, and in places are mapped as a complex.

Similar sites

F116CY003MO	**Dry Igneous Upland Woodland** Dry Igneous Upland Woodlands have moderately deep soils and less exposed bedrock, with higher tree and shrub densities. Trees are generally taller and less stunted. Forb and grass species are similar to Shallow Igneous Knob Glades but ground cover levels are higher.

Table 1. Dominant plant species

Tree	(1) *Quercus marilandica*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Croton michauxii var. ellipticus*

Physiographic features

This site is on upland knob crests, shoulders and backslopes with slopes of 3 to 45 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 Simmons et al., 2006) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the igneous uplands.

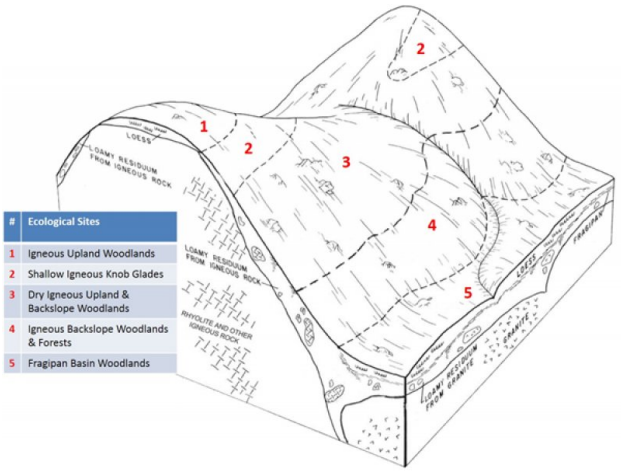


Figure 2. Major ecological sites of the igneous uplands.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Knob (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	244–539 m
Slope	3–45%
Water table depth	152 cm
Aspect	W, NW, E, SE, S, SW

Climatic features

The St. Francois Knobs and Basins have 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 St. Francois Knobs and Basins experience few regional differences in climates. The average annual precipitation in this area is 42 to 46 inches. The average annual temperature is about 54 to 56 degrees F. The lower temperatures occur at the higher elevations. Mean July maximum temperatures have a range of only one or two degrees across the area.

Mean annual precipitation varies somewhat along a west to east gradient. The rainfall is fairly evenly distributed throughout the year. Snow falls nearly every winter, but the snow cover lasts for only a few days.

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 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. For example, air drainage at night may produce temperatures several degrees lower in the basin and floodplain ecological sites downslope from this ecological site. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in basins and valleys. The high reflectivity from the

abundant bare rock within this ecological site results in higher daytime temperatures relative to adjacent woodland communities. 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.

References:
University of Missouri Climate Center. Accessed May 2012. http://climate.missouri.edu/climate.php.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Table 3. Representative climatic features

Frost-free period (characteristic range)	137-145 days
Freeze-free period (characteristic range)	164-169 days
Precipitation total (characteristic range)	1,143-1,194 mm
Frost-free period (actual range)	136-148 days
Freeze-free period (actual range)	163-170 days
Precipitation total (actual range)	1,143-1,194 mm
Frost-free period (average)	141 days
Freeze-free period (average)	166 days
Precipitation total (average)	1,168 mm

Climate stations used

- (1) ARCADIA [USC00230224], Arcadia, MO
- (2) FARMINGTON [USC00232809], Farmington, MO
- (3) FREDERICKTOWN [USC00233038], Fredericktown, MO

Influencing water features

This ecological site is not influenced by wetland or riparian 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 weather events.

Soil features

These soils are underlain with rhyolitic volcanic bedrock at less than 20 inches. The soils were formed under a mixture of prairie and woodland vegetation, and have dark, organic-rich surface horizons. Parent material is volcanic residuum. These soils are loamy and are skeletal, with high amounts of rhyolitic gravel, cobbles and stones. They are not affected by seasonal wetness. Soil series associated with this site include Taumsauk.

Table 4. Representative soil features

Parent material	(1) Residuum–rhyolite
Surface texture	(1) Cobbly silt loam
Family particle size	(1) Loamy
Drainage class	Somewhat excessively drained
Permeability class	Moderate
Soil depth	10–51 cm

Surface fragment cover <=3"	6–18%
Surface fragment cover >3"	9–40%
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)	3.5–6
Subsurface fragment volume <=3" (Depth not specified)	6–32%
Subsurface fragment volume >3" (Depth not specified)	24–45%

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.

Igneous 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 igneous glades is their unique and characteristic flora. 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 igneous glades (Nelson and Ladd 1983; Nelson et al. 2013):
• Igneous 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. Shallow Igneous Knob Glades harbor a wide diversity of lichens, plants and animals. The dominant grasses include little bluestem (*Schizachyrium scoparium*), broomsedge (*Andropogon virginicus*) and Indiangrass (*Sorghastrum nutans*). These glades are home to many unusual desert-adapted plants and animals, such as the sundrop flower (*Oenothera fruticosa*), eastern collared lizard, scorpions and black widow spider (Latrodectus mactans). The Shallow Igneous Knob Glades range from open grassy areas with very shallow soils and sometime expansive bare igneous bedrock outcrops covered with lichens, to areas with widely scattered mosaic of blackjack (*Quercus marilandica*) and post oaks (*Quercus stellata*) on locations with soil depths at the deeper extreme of the range for this soil component. On protected slopes, open woodlands are more common. Here the deeper soil depth range for this soil component and protected aspects allow more woody components to dominate. While most sites have suffered from fire suppression, good examples can still be found (Nelson and Ladd, 1980; Nelson, 2010).

The shallow soils of the Shallow Igneous Knob Glades limit the growth and abundance of trees and support the native grasses and forbs that dominate these systems. Trees found on and near glades are often stunted and express poor development because of shallow droughty soils and poor growing conditions.

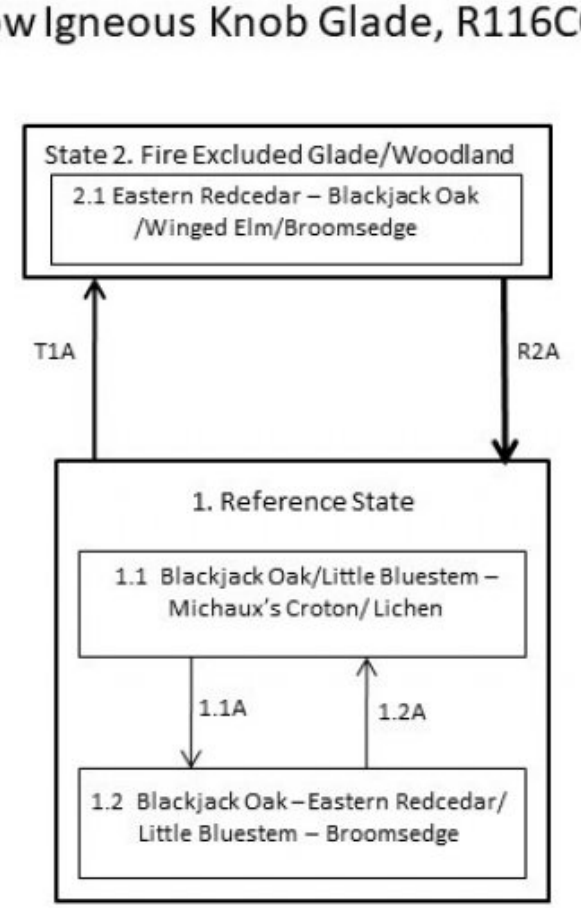
Fire also played an important role in the maintenance of these systems. These systems typically burned at least once every five years. These periodic fires removed the litter and stimulated the growth and flowering of the grasses and forbs. They also further limited the growth and dominance of trees, especially eastern redcedar (*Juniperus virginiana*). Fire tolerant blackjack oak and post oak occupied islands and microhabitats of deeper soils, creating a complex mosaic of open glade and low-density woodland (Frost, 1996; Nelson, 2010).

During fire-free intervals, woody species increased, especially on protected slopes. Once established, eastern redcedar, black hickory (*Carya texana*) and winged elm (*Ulmus alata*) can quickly fill in a glade system. Removal of the woody species and the application of prescribed fire have proven to be effective management tools.

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.

A state and transition model for the Shallow Igneous Knob Glade Ecological Site (R116CY006MO) 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



Code	Event/Process
T1A	Fire suppression > 20 years
R2A	Redcedar removal & prescribed fire
1.1A	Fire-free interval 10-15 years
1.2A	Fire interval 3-5 years

Figure 9. State and Transition Diagram

State 1

Reference State

Shallow igneous knob glades persist on the rockiest and most exposed sites in the region. Oak and shortleaf pine (*Pinus echinata*) woodlands surround the glades. Historically, the patchwork of woodlands and glades in the St. Francois Knobs region were created and maintained by periodic natural fires and droughty soil conditions. The open ground layer is interspersed with a mosaic of stunted often gnarled oaks and shrubs. Lichens are abundant on the bare rock. Desert-adapted animals, like scorpions also occupy healthy knob glades. These glades support a population of Mead's milkweed, a federally threatened tallgrass prairie plant. The igneous knob glades range from wide open grassy areas with shallow soils and sometime expansive bare igneous bedrock outcrops, to areas with widely scattered blackjack and post oaks on somewhat deeper soils. Soil fertility and site productivity is very low. While many have suffered from woody encroachment because of fire suppression, good examples can be found.

Community 1.1
Little Bluestem-Michaux croton/ Lichen

Figure 10. Open igneous glade at Hughes Mountain, MO; photo from MDC

This phase has widely scattered blackjack oak and post oak with little bluestem, broomsedge and Michaux's croton dominating the open ground layer. Numerous forbs and lichens are also present and locally abundant. Igneous bedrock outcropping is common.

Forest overstory. Canopy cover is very low to non-existent. Post oak and blackjack oak are typical species associated with this site.

Forest understory. Understory composition is dominated by scattered forbs and grasses. Lichens are very common.

Dominant plant species

- blackjack oak (*Quercus marilandica*), tree
- post oak (*Quercus stellata*), tree
- shagbark hickory (*Carya ovata*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- winged elm (*Ulmus alata*), shrub
- winged sumac (*Rhus copallinum*), shrub
- farkleberry (*Vaccinium arboreum*), shrub
- fragrant sumac (*Rhus aromatica*), shrub
- churchmouse threeawn (*Aristida dichotoma*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- broomsedge bluestem (*Andropogon virginicus*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- tapered rosette grass (*Dichanthelium acuminatum*), grass
- poverty oatgrass (*Danthonia spicata*), grass
- Bush's sedge (*Carex bushii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- Dudley's rush (*Juncus dudleyi*), grass

- densetuft hairsedge (*Bulbostylis capillaris*), grass
- poorjoe (*Diodia teres*), other herbaceous
- Michaux's croton (*Croton michauxii var. ellipticus*), other herbaceous
- scaly blazing star (*Liatris squarrosa*), other herbaceous
- twistspine pricklypear (*Opuntia macrorhiza*), other herbaceous
- lanceleaf tickseed (*Coreopsis lanceolata*), other herbaceous
- narrowleaf evening primrose (*Oenothera fruticosa*), other herbaceous
- white prairie clover (*Dalea candida*), other herbaceous
- fringeleaf wild petunia (*Ruellia humilis*), other herbaceous
- cup lichen (*Cladonia leporina*), other herbaceous
- sulphur lichen (*Fulgensia fulgens*), other herbaceous

Table 5. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0-5%
Biological crusts	0%
Litter	30-50%
Surface fragments >0.25" and <=3"	1-10%
Surface fragments >3"	1-10%
Bedrock	5-20%
Water	0%
Bare ground	1-10%

Table 6. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	0 per hectare
Tree snag count** (hard***)	0 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 7. Canopy structure (% cover)

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

Community 1.2
Blackjack Oak-Eastern Redcedar/ Little Bluestem-Broomsedge

Figure 11. Johnson Shut In's, Horseshoe Glade showing woody plant encroachment on an igneous glade; photo from MDC

This phase is similar to community phase 1.1 but eastern redcedar and blackjack oak 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 eastern redcedar and oak. Some sites may also have a few scattered shortleaf pine. Bedrock outcropping is common.

Forest overstory. Widely scattered eastern redcedar, post oak, and blackjack oak are present. Canopy cover is very open.

Forest understory. Forbs, grasses, and lichens are common. Scattered shrubs such as winged elm and fragrant sumac are also present.

Table 8. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0-5%
Biological crusts	0%
Litter	30-50%
Surface fragments >0.25" and <=3"	1-10%

Surface fragments >3"	1-10%
Bedrock	5-20%
Water	0%
Bare ground	1-5%

Table 9. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0-1%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-1%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0-1%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	0-1% N*
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	0 per hectare
Tree snag count** (hard***)	0-2 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 10. Canopy structure (% cover)

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

Pathway 1.1A
Community 1.1 to 1.2

Little Bluestem-Michaux croton/ Lichen

Blackjack Oak-Eastern Redcedar/ Little Bluestem-Broomsedge

This pathway results from fire suppression. Eastern redcedar and blackjack oak are increasing with longer periods of fire suppression. Some displacement of grasses and forbs may be occurring due to shading and competition from the increased densities of eastern redcedar and oaks.

Pathway 1.2A

Community 1.2 to 1.1

Blackjack Oak-Eastern Redcedar/ Little Bluestem-Broomsedge

Little Bluestem-Michaux croton/ Lichen

This pathway results from fire intervals that occur every 3 to 5 years.

Conservation practices

Prescribed Burning

State 2
Fire Excluded Glade/Woodland

This state is dominated by eastern redcedar and blackjack oak. 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 70 percent with little or no ground flora. 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.

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

Community 2.1
Eastern Redcedar-Blackjack Oak/Winged Elm/Broomsedge

Figure 12. Fire excluded state with significant woody plant encroachment on private property; photo from MDC

Due to long periods of fire exclusion, this phase has high densities of eastern redcedar, blackjack oak, post oak, and winged elm. Grass and forb diversity and ground cover are decreasing. Igneous bedrock outcropping is common.

Forest overstory. This phase has high densities of eastern redcedar, blackjack oak, post oak and winged elm.

Forest understory. Grass and forb diversity and ground cover are decreasing due to woody invasion. Bedrock outcropping is common.

Transition 1A
State 1 to 2

This transition is the result of fire suppression that exceeds 15 to 20 years.

Restoration pathway 2A
State 2 to 1

This restoration pathway results in eastern redcedar and other woody removal. Prescribed fire is reestablished on a periodic basis of 3 to 5 years.

Conservation practices

Brush Management
Prescribed Burning

Additional community tables

Table 11. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
eastern redcedar	JUVI	*Juniperus virginiana*	Native	0.2–3	0–5	5.1–15.2	–
blackjack oak	QUMA3	*Quercus marilandica*	Native	0.9–4.6	0–5	2.5–20.3	–
post oak	QUST	*Quercus stellata*	Native	1.5–6.1	0–5	2.5–22.9	–

Table 12. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
churchmouse threeawn	ARDI4	*Aristida dichotoma*	Native	0–0.3	5–10
porcupinegrass	HESP11	*Hesperostipa spartea*	Native	0–0.6	5–10
broomsedge bluestem	ANVI2	*Andropogon virginicus*	Native	0–0.9	5–10
western panicgrass	DIACF	*Dichanthelium acuminatum var. fasciculatum*	Native	0–0.6	5–10
poverty oatgrass	DASP2	*Danthonia spicata*	Native	0–0.3	5–10
Bush's sedge	CABU5	*Carex bushii*	Native	0–0.3	5–10
little bluestem	SCSC	*Schizachyrium scoparium*	Native	0–0.9	5–10
Indiangrass	SONU2	*Sorghastrum nutans*	Native	0–1.2	5–10
Forb/Herb					
lanceleaf tickseed	COLA5	*Coreopsis lanceolata*	Native	0.2–0.6	0–10
twistspine pricklypear	OPMA2	*Opuntia macrorhiza*	Native	0–0.3	0–10
poorjoe	DITE2	*Diodia teres*	Native	0–0.6	0–10
downy phlox	PHPI	*Phlox pilosa*	Native	0–0.6	0–10
orangegrass	HYGE	*Hypericum gentianoides*	Native	0–0.6	0–10
crowpoison	NOBI2	*Nothoscordum bivalve*	Native	0–0.3	0–10
flowering spurge	EUCO10	*Euphorbia corollata*	Native	0.1–0.9	0–10
white prairie clover	DACA7	*Dalea candida*	Native	0.1–0.3	0–10
Michaux's croton	CRMIE	*Croton michauxii var. ellipticus*	Native	0–0.3	0–10
scaly blazing star	LISQ	*Liatris squarrosa*	Native	0–0.9	0–10
Virginia threeseed mercury	ACVI	*Acalypha virginica*	Native	0–0.6	0–10
slender lespedeza	LEVI7	*Lespedeza virginica*	Native	0–0.6	0–10
gray goldenrod	SONE	*Solidago nemoralis*	Native	0–0.6	0–10
foxglove beardtongue	PEDI	*Penstemon digitalis*	Native	0–0.9	0–10
narrowleaf evening primrose	OEFR	*Oenothera fruticosa*	Native	0.1–0.6	0–2
Mead's milkweed	ASME	*Asclepias meadii*	Native	0–0.6	0–2
Shrub/Subshrub					
winged elm	ULAL	*Ulmus alata*	Native	0.6–1.5	0–10
winged sumac	RHCO	*Rhus copallinum*	Native	0.3–1.5	0–10
farkleberry	VAAR	*Vaccinium arboreum*	Native	0–0.9	0–10
fragrant sumac	RHAR4	*Rhus aromatica*	Native	0.3–0.9	0–10
Nonvascular					
punctelia	PUHY	*Punctelia hypoleucites*	Native	–	5–20
	PLCH4	*Pleopsidium chlorophanum*	Native	–	5–20
earth lichen	CALA60	*Catapyrenium lachneum*	Native	–	5–20
cup lichen	CLLE4	*Cladonia leporina*	Native	–	5–20

Table 13. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
eastern redcedar	JUVI	*Juniperus virginiana*	Native	0.2–3	5–10	2.5–15.2	–
blackjack oak	QUMA3	*Quercus marilandica*	Native	0.9–4.6	5–10	2.5–20.3	–
post oak	QUST	*Quercus stellata*	Native	1.5–6.1	5–10	2.5–25.4	–
shortleaf pine	PIEC2	*Pinus echinata*	Native	0.6–3	0–1	2.5–20.3	–

Table 14. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
broomsedge bluestem	ANVI2	*Andropogon virginicus*	Native	0–0.9	5–10
churchmouse threeawn	ARDI4	*Aristida dichotoma*	Native	0–0.3	5–10
Bush's sedge	CABU5	*Carex bushii*	Native	0–0.3	5–10
poverty oatgrass	DASP2	*Danthonia spicata*	Native	0–0.3	5–10
western panicgrass	DIACF	*Dichanthelium acuminatum var. fasciculatum*	Native	0–0.6	5–10
porcupinegrass	HESP11	*Hesperostipa spartea*	Native	0–0.6	5–10
little bluestem	SCSC	*Schizachyrium scoparium*	Native	0–0.9	5–10
Indiangrass	SONU2	*Sorghastrum nutans*	Native	0–1.2	5–10
Forb/Herb					
Virginia threeseed mercury	ACVI	*Acalypha virginica*	Native	0–0.6	0–10
lanceleaf tickseed	COLA5	*Coreopsis lanceolata*	Native	0–0.6	0–10
Michaux's croton	CRMIE	*Croton michauxii var. ellipticus*	Native	0–0.3	0–10
white prairie clover	DACA7	*Dalea candida*	Native	0.1–0.3	0–10
foxglove beardtongue	PEDI	*Penstemon digitalis*	Native	0–0.9	0–10
downy phlox	PHPI	*Phlox pilosa*	Native	0–0.6	0–10
gray goldenrod	SONE	*Solidago nemoralis*	Native	0–0.6	0–10
poorjoe	DITE2	*Diodia teres*	Native	0–0.6	0–10
flowering spurge	EUCO10	*Euphorbia corollata*	Native	0.1–0.9	0–10
slender lespedeza	LEVI7	*Lespedeza virginica*	Native	0–0.6	0–10
scaly blazing star	LISQ	*Liatris squarrosa*	Native	0–0.9	0–10
crowpoison	NOBI2	*Nothoscordum bivalve*	Native	0–0.3	0–10
twistspine pricklypear	OPMA2	*Opuntia macrorhiza*	Native	0–0.3	0–10
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	0.3–0.9	0–10
winged sumac	RHCO	*Rhus copallinum*	Native	0.3–1.5	0–10
winged elm	ULAL	*Ulmus alata*	Native	0.6–1.5	0–10
farkleberry	VAAR	*Vaccinium arboreum*	Native	0.3–0.9	0–10
Nonvascular					
earth lichen	CALA60	*Catapyrenium lachneum*	Native	–	5–20
cup lichen	CLLE4	*Cladonia leporina*	Native	–	5–20
	PLCH4	*Pleopsidium chlorophanum*	Native	–	5–20
punctelia	PUHY	*Punctelia hypoleucites*	Native	–	5–20

Animal community

Wildlife:
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 is important for turkey poults and quail chicks.

Game species that utilize this ecological site include: 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). This site type also can provide escape cover.

Bird species associated with this ecological site's reference state condition include: Field Sparrow, Yellow-breasted Chat, Blue-winged Warbler, Brown Thrasher, Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Prairie Warbler, White-eyed Vireo, Summer Tanager and Eastern Wood-Pewee.

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), Northern Fence Lizard (Sceloporus undulates hyacinthinus), Flat-headed Snake (Tantilla gracilis), Eastern Coachwhip (Masticophis flagellum flagellum), Red Milk Snake (Lampropeltis triangulum syspila), 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: Lichen Grasshopper (Trimerotropis saxatilis), a prickly pear borer moth (Melitara prodenialis), native ants (Pheidole tysoni, Formica schaufussi), 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 was developed by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013; references for this section include: Easterla, 1962; Fitzgerald and Pashley. 2000b; Heitzman and Heitzman 1996; Jacobs 2001; Johnson 2000; Pitts and McGuire 2000; Schwartz and others 2001)

Domestic livestock:
These sites are not suited for grazing due to extremely low forage production, lack of a water supply, and site sensitivity to physical damage from livestock movement and activity.

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

Bird watching and hiking are the major recreational uses of this ecological site. The igneous geological features along with panoramic vistas are key elements in the scenic beauty of the area. Numerous endemic species of plants and animals (see animal community section and plant species lists) can be observed on these sites.

Wood products

This site is very low in productivity. No wood products are generally harvested from these sites.

Other information

Forestry (NRCS 2002; 2014)

Management: Estimated site index values are less than 30 for eastern redcedar and generally less than 40 for oak. Productivity is very low. Very limited 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.

Table 15. 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
eastern redcedar	*JUVI*	15	27	15	30	60	–	–	

Inventory data references

The data contained in this document is derived from analysis of inventories, ecological interpretation from field evaluations, and various reference papers and books.

Destructive plant sampling was not allowed on the public reference sites. Site index information on woody species was collected to provide alternative estimates of site productivity.

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Sampling methods: (nested plots/transects/relevee)

Reference Inventory Plots:
HUMOCA03 Hughes Mountain CA; Taumsauk
PERACA06 Peck Ranch CA; Taumsauk
TASASP01 Taum Sauk SP; Taumsauk inclusions

Level 2 and reconnaissance inventory:

2003: Nigh/Meinert-Initial reconnaissance/mapping. Three weeks of reconnaissance on numerous 116C mountains.

2007: Reconnaissance plots on Stegall Mountain and Taum Sauk.

2012: Field stops at the Central States Forest Soils Workshop.

2013: Reconnaissance on numerous mountains working on reference plots. Taum Sauk, Hughes, Peck Ranch, Russel Mountain, Johnson Shut-Ins, Mill Mountain NA, Buford

Type locality

Location 1: Washington County, MO	
Township/Range/Section	T36N R3E S28
UTM zone	N
UTM northing	4186585
UTM easting	701513
Latitude	37° 48′ 15″
Longitude	-90° 42′ 39″
General legal description	Shallow Igneous Knob Glade at Hughes Mountain Conservation Area.
Location 2: Carter County, MO	
Township/Range/Section	T28N R2W S20
UTM zone	N
UTM northing	4105005
UTM easting	659993
Latitude	37° 4′ 39″
Longitude	-91° 12′ 0″
General legal description	Shallow Igneous Knob Glade at Peck Ranch Conservation Area.
Location 3: Iron County, MO	
Township/Range/Section	T33N R3E S5
UTM zone	N
UTM northing	4160196
UTM easting	699821
Latitude	37° 34′ 1″
Longitude	-90° 44′ 14″
General legal description	Shallow Igneous Knob Glade at Taum Sauk State Park.

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Contributors

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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.

Author(s)/participant(s)	Douglas Wallace NRCS ACES Ecologist
Contact for lead author	Parkade Center NRCS 601 Business Loop 70 West Columbia, MO 65203
Date	07/23/2014
Approved by	Nels Barrett
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.

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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%

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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.

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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):** 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 availibility. 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.

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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 wet years and seasons. Poorer in dry years and seasons.
