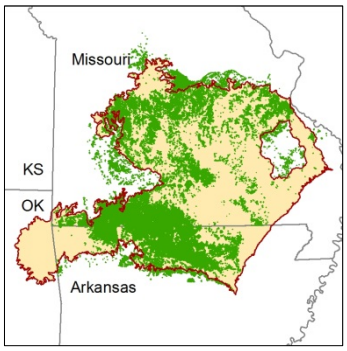
Ecological Site Description

Shallow Dolomite Upland Glade/Woodland

Major Land Resource Area 116A
Ozark Highland



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Cover photos:

Top left photo (from Missouri Department of Conservation) is a dolomite glade at Peck Ranch Conservation Area, Carter County, Missouri.

Top right photo (from Missouri Wildflowers Nursery) is the Missouri coneflower (*Rudbeckia missouriensis*) common to dolomite glades in the Ozark Highlands

Center photo (from Missouri Department of Conservation) is a large dolomite glade at Ha Ha Tonka State Park, Camden County, Missouri

Bottom left photo (from Kansas Mammal Atlas) is the Texas mouse confined to dolomite glades in the White and Elk River watersheds.

Right photo (from Ted C. MacRae) is a male prairie tiger beetle (*Cicindela obsoleta vulturina*) that is a disjunctive population (300+ miles from the main population in Texas and Oklahoma) found in the White River watershed in Missouri and Arkansas.

Top right map is the distribution map for Shallow Dolomite Upland Glade/Woodland (see page 5 for more detail).

This publication is a multi-agency effort with input from a wide range of natural resource specialists. NRCS and the Missouri Department of Conservation are leading this effort along with the University of Missouri, Missouri Department of Natural Resources, USDA Forest Service, and U.S. Fish and Wildlife Service. Ecological site information is available via the NRCS Web Soil Survey, USDA Ecological Site Information System website, and the Missouri Field Office Technical Guide. The information in this publication was developed using historical data, professional experience, field reviews, and scientific studies. The information is representative of complex communities. Key indicator plants, animals and ecological processes are described to help guide land management decisions.

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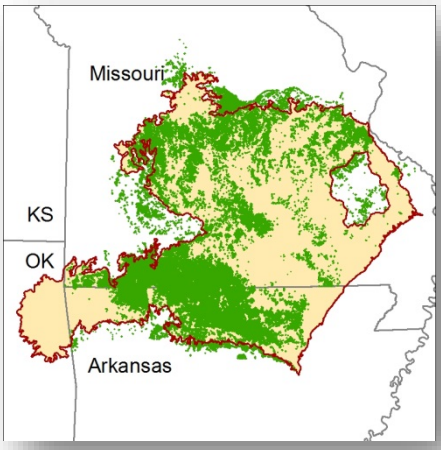
Section I: Ecological Site Characteristics

Ecological Site Identification

- *Site common name:* Shallow Dolomite Upland Glade/Woodland
- *Site biotic name*: post oak - chinkapin oak - fragrant sumac / Missouri orange coneflower - little bluestem
- *Site ID*: R116AY020MO
- *Major land resource area (MLRA):* 116A – Ozark Highland

Introduction

The Ozark Highland (area outlined in red on the map) 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.



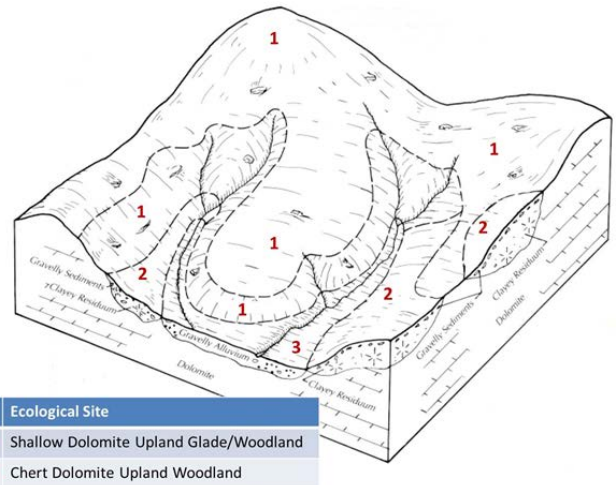
Ecological Site Concept

Shallow Dolomite Upland Glade/Woodlands (green areas on the map) 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 bare bedrock, to areas with shrubs and widely scattered chinkapin and post oaks.

Physiographic Features

This site is on upland crests, shoulders and backslopes with slopes of 3 to 100 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 adjacent 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".



#	Ecological Site
1	Shallow Dolomite Upland Glade/Woodland
2	Chert Dolomite Upland Woodland
3	Gravelly Upland Drainageway Forest

Landforms: (1) Ridge
(2) Hill

	Minimum	Maximum
Elevation (feet):	300	1600
Slope (percent):	3	15
Water table depth (inches):	>60	>60
Flooding Frequency:	None	None
Ponding Frequency:	None	None
Runoff class:	Very high	Very high
Aspect:	Not applicable on this site	

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. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these un-vegetated 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. 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/.

The following tables are a summary from the following Climate Stations:

(1) EUREKA SPRINGS 3 WNW [USC00032356], Carroll County AR 72631. Period of record 1981-2010
(2) MTN HOME 1 NNW [USC00035036], Baxter County AR 72653. Period of record 1981-2010
(3) POTOSI 4 SW [USC00236826], Washington County MO 63664. Period of record 1981-2010
(4) TRUMAN DAM RSVR [USC00238466], Benton County MO 65355. Period of record 1981-2010

	Averaged
Frost-free period (days):	183
Freeze-free period (days):	172207
Mean annual precipitation (inches):	48.77

Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	3.53	3.71	5.06	5.79	6.33	5.54	5.14	4.73	5.61	4.70	5.95	4.28
Medium	2.38	2.39	3.30	4.09	4.63	3.88	3.65	2.98	3.43	3.19	3.78	2.80
Low	1.26	1.62	2.37	2.60	3.36	2.47	1.88	1.88	1.94	1.91	2.07	1.78

Monthly Temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	43.1	48.1	58.1	68.1	75.7	83.4	88.3	88.3	80.0	69.2	57.2	45.3
Low	23.3	26.6	35.4	45.0	54.8	63.6	68.2	66.7	58.0	47.0	36.8	26.2

Influencing Water Features

This ecological site is not influenced by wetland or riparian water features.

Representative 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, and Moko.

Parent materials
Kind: Residuum
Origin: Dolomite

Surface texture: (1) Gravelly Clay loam
(2) Very gravelly Silty clay loam
(3) Very cobbly Loam

Subsurface texture group: Clayey

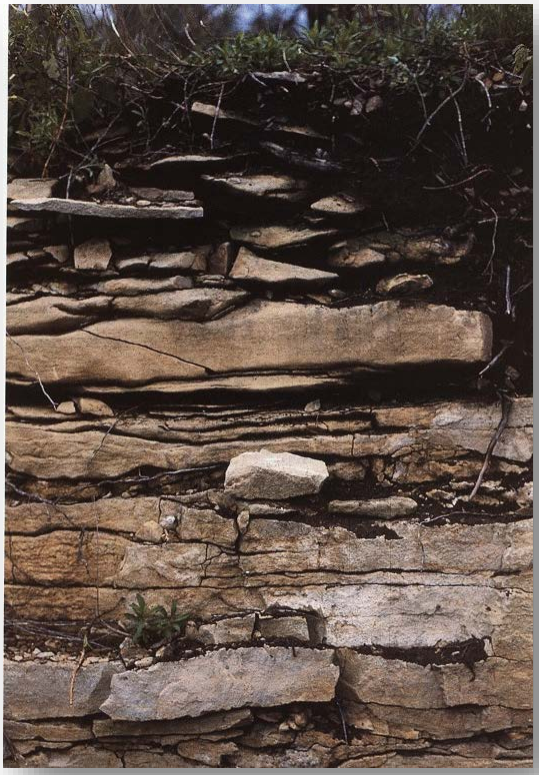
	Minimum	Maximum
Surface fragments <=3" (% cover):	7	55
Surface fragments >3" (% cover):	2	60
Subsurface fragments <=3" (% volume):	5	40
Subsurface fragments >3" (% volume):	5	50

Drainage class: Well drained to somewhat excessively drained

Permeability class: Impermeable to very slow

	Minimum	Maximum
Depth (inches):	4	20
Available water capacity (inches):	1.00	2.00
Electrical conductivity (mmhos/cm):	0	2
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent (percent):	0	0
Soil reaction (1:1 water):	6.1	7.8

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



Ecological Site 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 effect 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).

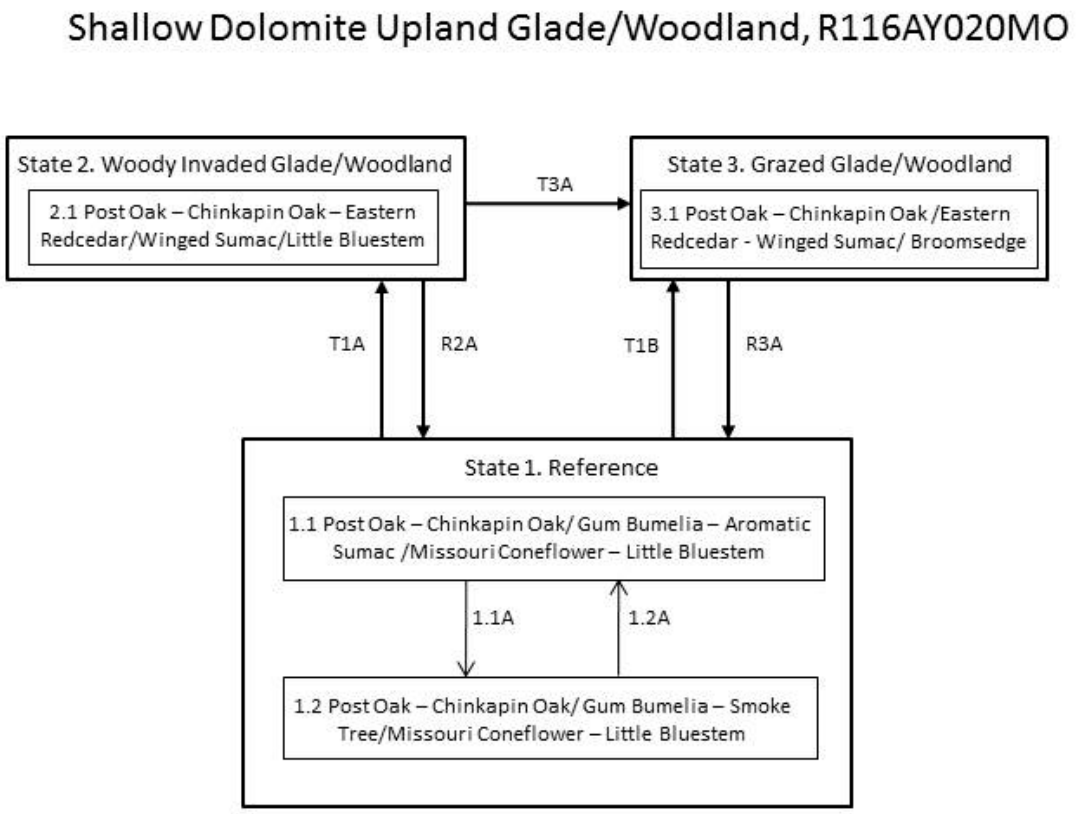
Dolomite glades of the Ozark Highlands also provide valuable habitat for priority or watch-listed bird species, including the field sparrow (*Spizella pusilla*), brown thrasher (*Toxostoma rufum*), and painted bunting (*Passerina ciris*) (Jacobs 2001). The greater roadrunner (*Geococcyx californicus*), shown in the following 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 Diagram (STD)



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

Ecological States and Community Phases

State 1: 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 and post oaks 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.

Illegal digging of glade plants and collection of animals is also resulting in the degradation of these glades. Collectors turn over large boulders and ledge rock to gather snakes and lizards. Digging in glades to collect plants steadily exposes fragile, thin, organic soil, causing erosion and leaving behind more acid gravel and rock debris. Plant species diversity and cover are diminished and recovery is slow or permanently altered because of drought conditions and species depletion (Nelson, et. al. 2013).

Community Phase 1.1: Post Oak - Chinkapin Oak/ Gum Bumelia - Aromatic Sumac /Missouri Coneflower - Little Bluestem

(Photo on left: Reference glade at Peck Ranch Conservation Area, north of Fremont, Missouri. Photo credit - MDC)

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

Community Phase Pathway 1.1A
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. *(See STD, page 9)*

Structure and Cover – Community Phase 1.1

Soil Surface Cover

Cover type	Minimum	Maximum
Litter	1%	25%

Downed woody material	Minimum	Maximum	Predominant decomposition class*
Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	0%	0.33%	N
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0%	0.33%	N
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0%	0.33%	N
Downed wood, coarse-small (3.00-8.99" diameter; 1000-hour fuels)	0%	0.1%	N
Downed wood, coarse-large (>9.00" diameter; 10000-hour fuels)	0%	0%	

Tree snags** per acre		
Soft snags***	0	10

* Decomposition classes: N=No or little integration with the soil surface. I=Partial to nearly full integration with the soil surface.
** >4" diameter at 4.5' above ground and >6' height. If diameter or height is smaller, use applicable downed wood type.
*** Hard=Tree is dead with most or all of bark intact. Soft=Most of bark has sloughed off.

Ground Cover

Vegetative cover	Minimum	Maximum
Grasses/grasslikes	0.1%	25%
Forbs	0.01%	2%
Shrubs/vines	0%	0.1%
Trees	0%	0.99%
Nonvascular plants	0.01%	0.99%
Biological crust	0.01%	5%

Non-vegetative cover	Minimum	Maximum
Litter	1%	25%
Surface fragments >0.25" and <=3"	0.01%	50%
Surface fragments >3"	0.01%	50%
Bedrock	0.01%	50%
Water	0%	0%
Bare ground	0.1%	50%

Structure of Canopy Cover

	Grasses/grasslikes		Forbs		Shrubs/vines		Trees	
Height above ground	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 foot	1%	95%	0%	25%	0%	0%	0%	0%
>0.5 to <1 foot	0%	50%	0%	25%	0%	1%	0%	1%
>1 to <=2 feet	0%	25%	0%	25%	0%	5%	0%	25%
>2 to <4.5 feet	0%	5%	0%	2%	0%	2%	0%	10%
>4.5 to <=13 feet	--	--	--	--	--	--	0%	5%
>13 to <40 feet	--	--	--	--	--	--	1%	2%
<40 to >=80 feet	--	--	--	--	--	--	--	--
>80 to <120 feet	--	--	--	--	--	--	--	--
>=120 feet	--	--	--	--	--	--	--	--

Forest Overstory

Forest Overstory Characterization Summary (trees >13 feet in height)

	Low canopy cover %	RV canopy cover %	High canopy cover %
Forest canopy:	2	5	13

Overstory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top	Tree diameter low	Tree diameter high	Basal area low	Basal area high
POST OAK *Quercus stellata*	QUST	N	0.0	5.0	5.0	30.0				
CHINKAPIN OAK *Quercus muehlenbergii*	QUMU	N	1.0	2.0	16.0	25.0	7.0	13.0	12.0	12.0

Understory

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

Understory Canopy Cover Summary *(all species <13 feet in height)*

Understory plant type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
BIG BLUESTEM *Andropogon gerardii*	ANGE	N	0.1	25.0	0.0	4.5
SIDEOATS GRAMA *Bouteloua curtipendula*	BOCU	N	0.1	10.0	0.0	2.0
HELLER'S ROSETTE GRASS *Dichanthelium oligosanthes*	DIOL	N	0.1	1.0	0.3	2.0
SWITCHGRASS *Panicum virgatum*	PAVI2	N	0.1	5.0	1.0	2.0
LITTLE BLUESTEM *Schizachyrium scoparium*	SCSC	N	0.1	50.0	0.5	2.0
ARROWFEATHER THREEAWN *Aristida purpurascens*	ARPU8	N	0.1	1.0	0.0	1.0
HAIRY FIMBRY *Fimbristylis puberula*	FIPU	N	0.1	2.0	0.0	1.0
INDIANGRASS *Sorghastrum nutans*	SONU2	N	0.1	5.0	0.5	1.0
COMPOSITE DROPSEED *Sporobolus compositus*	SPCO16	N	0.1	1.0	0.3	1.0
CRAWE'S SEDGE *Carex crawei*	CACR3	N	0.1	0.1	0.0	0.5
MEAD'S SEDGE *Carex meadii*	CAME2	N	0.0	0.1	0.0	0.5
PARASOL SEDGE *Carex umbellata*	CAUM4	N	0.1	0.1	0.3	0.5
FEWFLOWER RAZORSEDGE *Scleria pauciflora*	SCPA5	N	0.1	1.0	0.3	0.5
HIDDEN DROPSEED *Sporobolus clandestinus*	SPCL	N	0.1	10.0	0.3	0.5
PUFFSHEATH DROPSEED *Sporobolus neglectus*	SPNE2	N	0.1	25.0	0.3	0.5
HAIRY WOODLAND BROME *Bromus pubescens*	BRPU6	N	0.1	1.0		
SLENDER WOODLAND SEDGE *Carex digitalis*	CADI5	N	0.1	1.0		
BRISTLELEAF SEDGE *Carex eburnea*	CAEB2	N	0.1	1.0		
ROCK MUHLY *Muhlenbergia sobolifera*	MUSO	N	0.1	1.0		

Understory plant type: Forb/Herb

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
SESSILELEAF TICKCLOVER *Desmodium sessilifolium*	DESE	N	0.1	0.1	1.0	4.5
PRAIRIE ROSINWEED *Silphium terebinthinaceum*	SITE	N	0.1	5.0	0.0	4.5
TALL THOROUGHWORT *Eupatorium altissimum*	EUAL3	N	0.1	1.0	1.0	4.0

ROUNDHEAD LESPEDEZA *Lespedeza capitata*	LECA8	N	0.1	0.1	0.3	4.0
ROUGH GAYFEATHER *Liatris aspera*	LIAS	N	0.1	2.0	0.3	4.0
PINK WILD ONION *Allium stellatum*	ALST	N	0.1	1.0	1.0	2.0
HEMP DOGBANE *Apocynum cannabinum*	APCA	N	0.1	1.0	0.3	2.0
WHORLED MILKWEED *Asclepias verticillata*	ASVE	N	0.1	0.1	0.3	2.0
GREEN MILKWEED *Asclepias viridiflora*	ASVI	N	0.1	0.1	1.0	2.0
DOWNY PAGODA-PLANT *Blephilia ciliata*	BLCI	N	0.1	0.1	0.5	2.0
FALSE BONESET *Brickellia eupatorioides*	BREU	N	0.1	1.0	1.0	2.0
VIOLET PRAIRIE-CLOVER *Dalea purpurea*	DAPU5	N	0.1	1.0	0.5	2.0
DILLENIUS' TICKTREFOIL *Desmodium glabellum*	DEGL4	N	0.1	0.1	0.3	2.0
STIFF TICK-TREFOIL *Desmodium obtusum*	DEOB5	N	0.1	0.1	0.3	2.0
DAISY FLEABANE *Erigeron strigosus*	ERST3	N	0.1	0.1	0.3	2.0
HAIRY BEDSTRAW *Galium pilosum*	GAPI2	N	0.1	0.1	0.3	2.0
HAIRY SUNFLOWER *Helianthus hirsutus*	HEHI2	N	0.1	1.0	0.3	2.0
SLENDER LESPEDEZA *Lespedeza virginica*	LEVI7	N	0.1	0.1	0.0	2.0
ONTARIO BLAZING STAR *Liatris cylindracea*	LICY	N	0.1	2.0	0.3	2.0
CUSP BLAZING STAR *Liatris mucronata(syn)*	LIMU	N	0.1	25.0	0.0	2.0
CATCLAW SENSITIVE BRIAR *Mimosa nuttallii*	MINU6	N	0.1	1.0	0.3	2.0
PRAIRIE GOLDENROD *Oligoneuron album*	OLAL2	N	0.1	0.1	0.5	2.0
MARBLESEED *Onosmodium*	ONOSM	N	0.1	1.0	1.0	2.0
SMALL PALAFOX *Palafoxia callosa*	PACA3	N	0.1	1.0	0.0	2.0
SLIMFLOWER SCURFPEA *Psoralidium tenuiflorum*	PSTE5	N	0.1	1.0	1.0	2.0
MISSOURI ORANGE CONEFLOWER *Rudbeckia missouriensis*	RUMI	N	0.1	50.0	0.0	2.0
BUCKLEY'S GOLDENROD *Solidago buckleyi*	SOBU	N	0.1	1.0	0.5	2.0
GATTINGER'S GOLDENROD *Solidago gattingeri*	SOGA	N	0.1	1.0	0.0	2.0
SMOOTH BLUE ASTER *Symphyotrichum laeve*	SYLA3	N	0.1	1.0	0.5	2.0
AROMATIC ASTER *Symphyotrichum oblongifolium*	SYOB	N	0.1	2.0	0.0	2.0
SILKY ASTER *Symphyotrichum sericeum*	SYSE2	N	0.1	1.0	0.0	2.0

SMOOTH VIOLET PRAIRIE ASTER *Symphyotrichum turbinellum*	SYTU2	N	0.1	0.1	0.3	2.0
RAGWEED *Ambrosia artemisiifolia*	AMAR2	N	0.1	0.1	0.3	1.0
NARROWLEAF MILKWEED *Asclepias stenophylla*	ASST	N	0.1	0.1	0.0	1.0
EASTERN CAMASS *Camassia scilloides*	CASC5	N	0.1	1.0	0.3	1.0
PARTRIDGE PEA *Chamaecrista fasciculata*	CHFA2	N	0.1	0.1	0.3	1.0
FINGER COREOPSIS *Coreopsis palmata*	COPA10	N	0.1	1.0	0.5	1.0
WOOLLY CROTON *Croton capitatus*	CRCA6	N	0.1	1.0	0.5	1.0
BUSH'S PURPLE CONEFLOWER *Echinacea paradoxa*	ECPA2	N	0.1	0.1	0.0	1.0
WAVYLEAF PURPLE CONEFLOWER *Echinacea simulata*	ECSI	N	0.1	1.0	0.5	1.0
FLOWERING SPURGE *Euphorbia corollata*	EUCO10	N	0.1	1.0	0.5	1.0
DOWNY GENTIAN *Gentiana puberulenta*	GEPU5	N	0.1	1.0	0.5	1.0
NARROWLEAF GUMWEED *Grindelia lanceolata*	GRLA3	N	0.1	0.1	0.0	1.0
HOARY GROMWELL *Lithospermum canescens*	LICA12	N	0.1	1.0	0.5	1.0
NARROWLEAF GROMWELL *Lithospermum incisum*	LIIN2	N	0.1	0.1	0.3	1.0
GROOVED FLAX *Linum sulcatum*	LISU4	N	0.1	1.0	0.5	1.0
BIG-FRUIT EVENING PRIMROSE *Oenothera macrocarpa*	OEMA	N	0.1	0.1	0.0	1.0
WILD QUININE *Parthenium hispidum*	PAHI8	N	0.1	1.0	0.5	1.0
NUTTALL PRAIRIE-PARSLEY *Polytaenia nuttallii*	PONU4	N	0.1	0.1	0.0	1.0
WILD PETUNIA *Ruellia humilis*	RUHU	N	0.1	1.0	0.3	1.0
BUSH'S SKULLCAP *Scutellaria bushii*	SCBU	N	0.1	0.1	0.0	1.0
SLEEPY SILENE *Silene antirrhina*	SIAN2	N	0.1	0.1	0.3	1.0
GRAY GOLDENROD *Solidago nemoralis*	SONE	N	0.1	1.0	0.0	1.0
ROUGH GOLDENROD *Solidago radula*	SORA	N	0.1	1.0	0.3	1.0
SKYBLUE ASTER *Symphyotrichum oolentangiense*	SYOO	N	0.1	2.0	0.5	1.0
FEVERWORT *Triosteum perfoliatum*	TRPE5	N	0.1	0.1	0.3	1.0
WOOLLY MULLEIN *Verbascum thapsus*	VETH	N	0.1	0.1	0.3	1.0
SLENDER THREESEED MERCURY *Acalypha monococca*	ACMO4	N	0.1	0.1	0.3	0.5
INDIAN PAINTBRUSH *Castilleja coccinea*	CACO17	N	0.1	0.1	0.3	0.5

LADY BIRD'S CENTAURY *Centaurium texense*	CETE2	N	0.1	0.1	0.3	0.5
SPOTTED EUPHORBIA *Chamaesyce maculata*	CHMA15	N	0.1	0.1	0.3	0.5
LIMESTONE CALAMINT *Clinopodium arkansanum*	CLAR5	N	2.0	5.0	0.3	0.5
LANCE-LEAF TICKSEED *Coreopsis lanceolata*	COLA5	N	0.1	1.0	0.3	0.5
BASTARD TOADFLAX *Comandra umbellata*	COUM	N	0.1	0.1	0.3	0.5
ONESEED CROTON *Croton monanthogynus*	CRMO6	N	0.1	1.0	0.3	0.5
POORJOE *Diodia teres*	DITE2	N	0.1	0.1	0.3	0.5
NUTTALL EVOLVULUS *Evolvulus nuttallianus*	EVNU	N	0.1	0.1	0.3	0.5
ROSE VERBENA *Glandularia canadensis*	GLCA2	N	0.1	1.0	0.3	0.5
FEWLEAF SUNFLOWER *Helianthus occidentalis*	HEOC2	N	0.1	2.0	0.3	0.5
PASTURE HELIOTROPE *Heliotropium tenellum*	HETE3	N	0.1	1.0	0.3	0.5
TRAILING LESPEDEZA *Lespedeza procumbens*	LEPR	N	0.1	0.1	0.3	0.5
CREEPING LESPEDEZA *Lespedeza repens*	LERE2	N	0.1	0.1	0.3	0.5
FALSE ALOE *Manfreda virginica*	MAVI5	N	0.1	0.1	0.3	0.5
MICHAUX'S STICHWORT *Minuartia michauxii*	MIMI2	N	0.1	1.0	0.3	0.5
PITCHER'S STITCHWORT *Minuartia patula*	MIPA6	N	0.1	0.1	0.3	0.5
DILLEN OXALIS *Oxalis dillenii*	OXDI2	N	0.1	0.1	0.3	0.5
VIOLET WOODSORREL *Oxalis violacea*	OXVI	N	0.1	0.1	0.3	0.5
AMERICAN GINSENG *Panax quinquefolius*	PAQU	N	0.1	0.1	0.3	0.5
PURPLE CLIFFBRAKE FERN *Pellaea atropurpurea*	PEAT2	N	0.1	0.1	0.3	0.5
PALE PENSTEMON *Penstemon pallidus*	PEPA7	N	0.1	0.1	0.3	0.5
THICKLEAF PHLOX *Phlox carolina*	PHCA19	N	0.1	0.1	0.3	0.5
ROCK PINK FLAMEFLOWER *Phemeranthus calycinus*	PHCA48	N	0.1	0.1	0.3	0.5
VIRGINIA GROUNDCHERRY *Physalis virginiana*	PHVI5	N	0.1	0.1	0.3	0.5
CINQUEFOIL *Potentilla simplex*	POSI2	N	0.1	1.0	0.3	0.5
BLACKEYED SUSAN *Rudbeckia hirta*	RUHI2	N	0.1	0.1	0.3	0.5
WHITE EYEDGRASS *Sisyrinchium campestre*	SICA9	N	0.1	0.1	0.3	0.5
GREAT PLAINS LADY'S TRESSES *Spiranthes magnicamporum*	SPMA5	N	0.1	0.1	0.3	0.5

DIAMOND-FLOWERS *Stenaria nigricans*	STNI6	N	0.1	10.0	0.3	0.5
FLUXWEED *Trichostema brachiatum*	TRBR5	N	0.1	0.1	0.3	0.5
BRANCHED NOSEBURN *Tragia ramosa*	TRRA5	N	0.1	1.0	0.3	0.5
NARROWLEAF VERBENA *Verbena simplex*	VESI	N	0.1	0.1	0.3	0.5
BIRDFOOT VIOLET *Viola pedata*	VIPE	N	0.1	0.1	0.3	0.5
MEADOW PARSNIP *Zizia aptera*	ZIAP	N	0.1	0.1	0.3	0.5
SMOOTH ROCKCRESS *Arabis laevigata*	ARLA	N	0.1	1.0		
GROOVESTEM INDIAN PLANTAIN *Arnoglossum plantagineum*	ARPL4	N	0.1	1.0		
GROUNDPLUM MILKVETCH *Astragalus crassicarpus var. trichocalyx*	ASCRT	N	0.1	1.0		
OZARK MILK-VETCH *Astragalus distortus*	ASDI4	N	0.1	1.0		
BUTTERFLY MILKWEED *Asclepias tuberosa*	ASTU	N	0.1	1.0		
DIAMONDFLOWERS *Hedyotis nigricans(syn)*	HENI4	N	0.1	1.0		
SPIKED CRESTED-CORALROOT *Hexalectris spicata*	HESP3	N	0.1	1.0		
CURTIS' STAR-GRASS *Hypoxis curtissii*	HYCU5	N	0.1	1.0		
CROWPOISON *Nothoscordum bivalve*	NOBI2	N	0.1	1.0		
SLIMFLOWER SCURFPEA *Psoralidium tenuiflorum*	PSTE5	N	0.1	1.0		
WIDOWSFRILL *Silene stellata*	SIST	N	0.1	1.0		
YELLOW PIMPERNEL *Taenidia integerrima*	TAIN	N	0.1	1.0		
GOLDEN ALEXANDERS *Zizia aurea*	ZIAU	N	0.1	1.0		

Understory plant type: Shrub/Subshrub

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
FRAGRANT SUMAC *Rhus aromatica*	RHAR4	N	0.1	2.0	0.3	4.0
WINGED SUMAC *Rhus copallinum*	RHCO	N	0.1	1.0	0.3	4.0
GUM BULLY *Sideroxylon lanuginosum*	SILA20	N	0.1	2.0	0.3	2.0
BUCKBRUSH *Symphoricarpos orbiculatus*	SYOR	N	0.1	1.0	0.5	2.0
SOUTHERN BLACKHAW *Viburnum rufidulum*	VIRU	N	0.1	0.1	0.3	2.0
LEADPLANT *Amorpha canescens*	AMCA6	N	0.1	0.1	0.5	1.0

SMOOTH SUMAC *Rhus glabra*	RHGL	N	0.1	0.1	0.5	1.0
CAROLINA ROSE *Rosa carolina*	ROCA4	N	0.1	1.0	0.3	1.0

Understory plant type: Nonvascular

Understory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
COMMON HOPTREE *Ptelea trifoliata*	PTTR	N	0.1	0.1	0.5	8.0
WINGED ELM *Ulmus alata*	ULAL	N	0.1	2.0	0.5	8.0
DWARF HACKBERRY *Celtis tenuifolia*	CETE	N	0.1	1.0	1.0	2.0
PERSIMMON *Diospyros virginiana*	DIVI5	N	0.1	2.0	0.3	2.0
SHUMARD OAK *Quercus shumardii*	QUSH	N	0.1	1.0	0.3	2.0
SLIPPERY ELM *Ulmus rubra*	ULRU	N	0.1	1.0	0.3	2.0
CHINKAPIN OAK *Quercus muehlenbergii*	QUMU	N	0.1	5.0	0.3	1.0

Understory plant type: Vine

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
SUMMER GRAPE *Vitis aestivalis*	VIAE	N	0.1	1.0	0.3	8.0
POISON IVY *Toxicodendron radicans*	TORA2	N	0.1	2.0	0.3	4.0
EASTERN MILK-PEA *Galactia regularis*	GARE2	N	0.1	0.1	0.3	2.0
SAW GREENBRIER *Smilax bona-nox*	SMBO2	N	0.1	2.0	0.3	2.0
ALABAMA SUPPLEJACK *Berchemia scandens*	BESC	N	0.1	2.0	0.5	1.0
FIVEANGLED DODDER *Cuscuta pentagona*	CUPE3	N	0.1	0.1	0.0	1.0
VIRGINIA CREEPER *Parthenocissus quinquefolia*	PAQU2	N	0.1	0.1	0.3	1.0

Community Phase 1.2: Post Oak - Chinkapin Oak/ Gum Bumelia - Smoke Tree/Missouri Coneflower - Little Bluestem

(Photo below: 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.

Community Phase Pathway 1.2A
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.

Forest Overstory Widely scattered post oak, and chinkapin oak are present. Canopy cover is very open.

Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)

	Low canopy cover %	RV canopy cover %	High canopy cover %
Forest canopy:	5	15	25

Overstory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top	Tree diameter low	Tree diameter high	Basal area low	Basal area high
POST OAK *Quercus stellata*	QUST	N	1.0	5.0		30.0				
CHINKAPIN OAK *Quercus muehlenbergii*	QUMU	N	1.0	5.0		30.0				
EASTERN REDCEDAR *Juniperus virginiana*	JUVI	N	0.0	2.0		30.0				

Transition T1A
This gradual transition results from prolonged periods of fire suppression, generally over 20 years.

Transition T1B
This transition results from persistent cattle grazing accompanied by fire suppression.

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.

Feral hog numbers 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 (see photo on left). This results in extensive rutting that increases soil erosion and loss of plant and animal species diversity

Community Phase 2.1: Post Oak – Chinkapin Oak – Eastern Redcedar/Winged Sumac/Little Bluestem

(Photo below: A dolomite glade in Arkansas being invaded by woody species due to lack of fire. Photo credit - NRCS)

This phase is dominated by eastern redcedar, oaks, 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.

Restoration Pathway R2A
Restoration requires cutting most of the invading woody species such as eastern redcedar, accompanied by prescribed fire on a continued basis.

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, tall fescue, cheat grass and common teasel 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). Recovery of the once deeper, now eroded soils and their former diverse cover of perennial grasses, sedges and wildflowers is extremely difficult and time consuming (Nelson, et. al. 2013). If grazing activities have been extensive for long periods of time, recovery to a reference state may be impossible.

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

(Photo on left: 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 T3A
This gradual transition results from prolonged periods of fire suppression and the cessation of grazing by domestic livestock.

Restoration Pathway R3A
Restoration requires exclusion of livestock grazing, accompanied by prescribed burning and brush management. If grazing activities have been extensive for long periods of time, recovery to a reference state may be impossible.

Section II: Ecological Site Interpretations

Forest 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*	22	34	1	3	50	220	50TA	Tennessee Valley Authority. 1948. Site curves for eastern redcedar. (unpublished, processed curves based on 271 observations from plots throughout the Tennessee Valley.)
CHINKAPIN OAK	*QUMU*	34	38	20	24	50	820	50TA	Schnur, G. Luther. 1937. Yield, stand, and volume tables for even-aged upland oak forests. United States Department of Agriculture Technical Bulletin 560

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 syspila*), 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 (*Cicindela obsoleta vulturina*) in the state occurs on these sites. (Heitzman and Heitzman, 1996)

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

Domestic livestock:

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

Hydrology Functions

Nearly all precipitation leaves this site as runoff, due to the shallow soils and underlying impermeable dolomite bedrock. 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: Site index values are less than 30 for eastern redcedar and generally less than 40 for oak. Productivity is very low. No practical timber management opportunities exist.

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.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Calcareous Dolomite Protected Backslope Forest	*F116AY010MO*	Calcareous Dolomite Protected Backslope Forests are downslope in places, on northerly and easterly exposures.
	F116AY015MO	Chert Dolomite Upland Woodlands are often in a complex with Shallow Dolomite Upland Glade/Woodlands, and are often upslope.
Chert Dolomite Protected Backslope Forest	*F116AY016MO*	Chert Dolomite Protected Backslope Forests are downslope in places, on northerly and easterly exposures.
Calcareous Dolomite Exposed Backslope Woodland	*F116AY047MO*	Calcareous Dolomite Exposed Backslope Woodlands are downslope in places, on southerly and westerly exposures.
Chert Dolomite Exposed Backslope Woodland	*F116AY048MO*	Chert Dolomite Exposed Backslope Woodlands are downslope in places, on southerly and westerly exposures.

Similar Sites

Site name	Site ID	Site narrative
Shallow Limestone/Dolomite Upland Glade/Woodland	*R115BY009MO*	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.

Shallow Sandstone Upland Glade/Woodland	*R116AY027MO*	Shallow Sandstone Upland Glade/Woodlands are underlain by sandstone, resulting in differences in the reference plant community.
Shallow Igneous Knob Glade	*R116CY006MO*	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

State Correlation

This site has been correlated with the following states: AR MO

Inventory Data References

Tier II Records:
2005: Nigh – Terrestrial Biodiversity Assessment
2009: Nigh/Meinert/Steele/McKee – Reconnaissance plots at Montauk State Park and St. Francois State Park
2010, 2012: Nigh/Meinert/Steele – Ecological Landtype Training for the Interior Ozarks
2013: Nigh/Meinert/Teal/Stuber – Tier III Plot Establishment and Reconnaissance: Caney Mountain CA, Ha Ha Tonka State Park, Huzzah Conservation Area, Meramec State Park, Onondaga State Park, Peck Ranch Conservation Area
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)

Inventory Data References by Plot (Range-417, Wood-4, Wood-5)

	Sample ID					
Data source	Number	Year	State code	County code	State	County
ECS-5	5	1990	29	167	Missouri	Polk
	3	1991	29	167	Missouri	Polk
	9	1976	29	187	Missouri	St. Francois
	6	1978	29	187	Missouri	St. Francois
	12	1989	29	213	Missouri	Taney
	14	1989	29	213	Missouri	Taney
	15	1989	29	213	Missouri	Taney
	16	1989	29	213	Missouri	Taney
	17	1989	29	213	Missouri	Taney
	21	1989	29	213	Missouri	Taney
	23	1989	29	213	Missouri	Taney
	8	1989	29	213	Missouri	Taney
	9	1989	29	213	Missouri	Taney

Hierarchical Classification Relationships

Ecological Classification System in Missouri (Nigh & Schroeder, 2002):
This ecological site occurs in many Land Type Associations primarily within the following Subsections:

- Meramec River Hills
- Osage River Hills
- White River Hills

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

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

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is within the Central Interior Highlands Calcareous Glade and Barrens (CES202.691), and is most similar to *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula – Rudbeckia missouriensis - Hedyotis nigricans* Wooded Herbaceous Vegetation (CEGL002398).

Section III: Inventory Data Collection

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 estimates of site productivity.

Data References:

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- Weaver, Jennifer L. and Allan J. Bornstein. 2012. A Survey of the Vascular Flora of Some Igneous Glades at Buford Mountain Conservation Area, Missouri. Castanea, 77(3):245-256.
- Yatskievych, George A. 1999/2006/2013. Flora of Missouri. Missouri Dept. of Conservation in cooperation with Missouri Botanical Garden Press, Volumes 1-3.

*Sampling methods: (*nested plots/transects/releve)

Reference Inventory Plots:

- HUMOCA03 Hughes Mountain CA; Taumsauk
- PERACA06 Peck Ranch CA; Taumsauk
- TASASP01 Taum Sauk SP; Taumsauk inclusions

Other Inventory Data References

Data source	Number of records	Sample period	State	County
Level 2, MDC	1	July-August/2012	Missouri	Washington

Level 2 and reconnaissance inventory:

- 2003: Nigh/Meinert-Initial reconnaissance/mapping. Three weeks of reconnaissance on numerous 116C mountains.
- 2007: Reconnaissance plots on Stegall and Taum Sauk Mountains.
- 2012: Field stops at the Central States Forest Soils Workshop.
- 2013: Reconnaissance on Numerous Mountains working on reference plots. Taum Sauk, Hughes, Peck Ranch, Russell Mountain, Johnson Shut-Ins, Mill Mountain Natural Area, Buford Mountain

Type Localities for Reference State Data Plots:

State:	**MO**
County:	Camden
Township:	38N
Range:	17W
Section:	35
Datum:	WGS84
Zone:	15
Northing:	4203937
Easting:	520671
General legal description:	Plot HATOSP01; Ha Ha Tonka State Park; Knobby pedon
Latitude degrees:	37
Latitude minutes:	58
Latitude seconds:	58
Latitude decimal:	23
Longitude degrees:	92
Longitude minutes:	45
Longitude seconds:	52
Longitude decimal:	63
Universal Transverse Mercator (UTM) system:	WGS84154203937520671
State:	**MO**
County:	Camden
Township:	38N
Range:	17W
Section:	35
Datum:	WGS84
Zone:	15
Northing:	4203912
Easting:	520649
General legal description:	Plot HATOSP02; Ha Ha Tonka State Park; Knobby pedon
Latitude degrees:	37
Latitude minutes:	58
Latitude seconds:	57
Latitude decimal:	42
Longitude degrees:	92
Longitude minutes:	45
Longitude seconds:	53
Longitude decimal:	51
Universal Transverse Mercator (UTM) system:	WGS84154203912520649
State:	**MO**
County:	Camden

Township:	37N
Range:	17W
Section:	11
Datum:	WGS84
Zone:	15
Northing:	4201806
Easting:	520804
General legal description:	Plot HATOSP05; Ha Ha Tonka State Park; Knobby pedon
Latitude degrees:	37
Latitude minutes:	57
Latitude seconds:	49
Latitude decimal:	7
Longitude degrees:	92
Longitude minutes:	45
Longitude seconds:	47
Longitude decimal:	38
Universal Transverse Mercator (UTM) system:	WGS84154201806520804
State:	**MO**
County:	Carter
Township:	27N
Range:	2W
Section:	3
Datum:	WGS84
Zone:	15
Northing:	4100759
Easting:	663524
General legal description:	Plot PERACA02; Peck Ranch Conservation Area; Knobby pedon
Latitude degrees:	37
Latitude minutes:	2
Latitude seconds:	19
Latitude decimal:	73
Longitude degrees:	91
Longitude minutes:	9
Longitude seconds:	40
Longitude decimal:	73
Universal Transverse Mercator (UTM) system:	WGS84154100759663524
State:	**MO**
County:	Carter
Township:	27N
Range:	2W
Section:	3
Datum:	WGS84
Zone:	15
Northing:	4100835
Easting:	663539
General legal description:	Plot PERACA03; Peck Ranch Conservation Area; Opequon pedon
Latitude degrees:	37
Latitude minutes:	2
Latitude seconds:	22
Latitude decimal:	18

Longitude degrees:	91
Longitude minutes:	9
Longitude seconds:	40
Longitude decimal:	6
Universal Transverse Mercator (UTM) system:	WGS84154100835663539
State:	**MO**
County:	Crawford
Township:	40N
Range:	2W
Section:	23
Datum:	WGS84
Zone:	15
Northing:	4229111
Easting:	665690
General legal description:	Plot MERASP01; Meramec State Park; Knobby pedon
Latitude degrees:	38
Latitude minutes:	11
Latitude seconds:	40
Latitude decimal:	98
Longitude degrees:	91
Longitude minutes:	6
Longitude seconds:	28
Longitude decimal:	35
Universal Transverse Mercator (UTM) system:	WGS84154229111665690
State:	**MO**
County:	Ozark
Township:	23N
Range:	13W
Section:	16
Datum:	WGS84
Zone:	15
Northing:	4059236
Easting:	554453
General legal description:	Plot CAMOCA01; Caney Mountain Conservation Area
Latitude degrees:	36
Latitude minutes:	40
Latitude seconds:	37
Latitude decimal:	90
Longitude degrees:	92
Longitude minutes:	23
Longitude seconds:	26
Longitude decimal:	8
Universal Transverse Mercator (UTM) system:	WGS84154059236554453
State:	**MO**
County:	Ozark
Township:	23N
Range:	14W
Section:	1
Datum:	WGS84
Zone:	15

Northing:	4061520
Easting:	548607
General legal description:	Plot CAMOCA07; Caney Mountain Conservation Area
Latitude degrees:	36
Latitude minutes:	41
Latitude seconds:	53
Latitude decimal:	14
Longitude degrees:	92
Longitude minutes:	27
Longitude seconds:	21
Longitude decimal:	9
Universal Transverse Mercator (UTM) system:	WGS84154061520548607

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Glossary

Backslope – a hillslope profile position that forms the steepest and generally linear, middle portion of the slope.

Backswamp – marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces

Calcareous – the presence of calcium carbonate in the soil parent material within the rooting zone; relatively alkaline

Claypan – a dense, compact, slowly permeable layer in the subsoil having much higher clay content than the overlying material

Chert – hard, extremely dense or compact crystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz

Cliff – a significant vertical, or near vertical, rock exposure

Deep Loess – a geographic area characterized by thick, dissected loess deposits, formed immediately adjacent to the edges of the Missouri and Mississippi River floodplains

Dolomite – a type of sedimentary rock that is a carbonate mineral composed of calcium magnesium carbonate

Drainageway – the upper most reach of a stream channel system characterized by little meandering

Dry – a site where soil moisture is limiting during the growing season; low available water capacity

Dune – a low mound, ridge, bank or hill of loose, wind-blown sand

Exposed – steep, south and west-facing slopes, which are warmer and drier than other slope aspects

Flatwoods – a type of woodland that occurs on soils with a root restricting subsoil layer within 20 to 30 inches, resulting in very slow runoff and ponding that remains saturated for most of the winter and early spring months but dries out and becomes very dry in the summer months; plants that grow there must be adapted to both conditions

Floodplain – the nearly level plain that borders a stream and is subject to inundation under flood-stage conditions

Footslope – a hillslope position at the base of a slope where hillslope sediment (colluvium) accumulates

Forest – a vegetative community dominated by trees forming a closed canopy and interspersed with shade-tolerant understory species

Fragipan – a dense, brittle subsoil horizon that is extremely hard and compact when dry

Glade – open, rocky, barren vegetative community dominated by drought-adapted forbs and grasses, typically with scattered, stunted woody plants

Igneous – bedrock created by cooling and crystallization of magma forming igneous rock. Granite and rhyolite are typical igneous bedrocks in Missouri

Knob – precambrian ancient exposed igneous rocks of prominent rounded mountain tops

Limestone – a type of sedimentary rock composed largely of calcium carbonate

Loess – material transported and deposited by wind and consisting predominantly of silt-size particles

Loamy – soil material containing a relatively equal mixture of sand and silt and a somewhat smaller proportion of clay

Marsh – a type of wetland that is dominated by herbaceous rather than woody plant species

Moist – a site that is moderately well to well drained and has high available water capacity, resulting in a well-balanced supply of moisture (neither too dry nor too wet).

Mudstone – blocky or massive, fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal

Natric – a soil horizon that displays a blocky, columnar, or prismatic structure and has a subhorizon with an exchangeable-sodium saturation of over 15%

Outwash – stratified sediments of sand and gravel removed or "washed out" from a glacier by melt-water streams

Prairie – a vegetative community dominated by perennial grasses and forbs with scattered shrubs and very few trees

Protected – steep, north- and east-facing slopes, which are generally cooler and moister than other slope aspects

Residuum - unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place

Riser – a component of terraces and flood-plain steps consisting of the steep side slope; the escarpment

Riverfront – a vegetative community in the floodplain immediately adjacent and generally parallel to a river or stream channel

Sandy – a coarse-sized soil containing a large mixture of sand and gravels and a somewhat smaller proportion of silts and clays with excessive drainage

Sandstone – a sedimentary rock containing dominantly sand-size particles

Savanna – grasslands interspersed with open-grown scattered trees, groupings of trees, and shrubs

Shale – a sedimentary rock formed from clay, silty clay, or silty clay loam deposits and having the tendency to split into thin layers

Shallow – a site with bedrock within 20 inches of the surface

Shoulder – the slope profile position that forms the convex surface near the top of a hill slope; it comprises the transition zone from summit to backslope

Sinkhole – a closed, circular or elliptical depression, commonly funnel-shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock or by collapse of underlying caves within bedrock

Summit – the top or highest area of a hillslope

Swale – shallow, closed depressions irregularly spaced across a floodplain or terrace with an irregularly undulating surface.

Swamp – an area of low, saturated ground, intermittently or permanently covered with water, and predominantly vegetated by shrubs and trees.

Talus – rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope.

Terrace – a step-like surface, bordering a valley floor that represents the former position of a flood plain

Till – dominantly unsorted and unstratified soil material deposited directly by a glacier

Upland – a general term for the higher ground of a region, in contrast with a low-lying, adjacent land such as a valley or floodplain

Wet – a somewhat poorly, poorly or very poorly drained site that has an oversupply of moisture during the growing season

Woodland – a highly variable vegetative community with a canopy of trees ranging from 30 to 100 percent closure with a sparse midstory and a dense ground flora of grasses, sedges and forbs

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