USDA Natural Resources
Conservation Service

Ecological site F116AY049MO
Low-Base Chert Exposed Backslope Woodland

Last updated: 9/24/2020
Accessed: 04/24/2024

General information

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

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 116A–Ozark Highland

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

Classification relationships

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

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this ecological site is most similar to a Mixed Oak Woodland, or a Pine Oak Woodland in the historic pine range.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to Quercus stellata - Quercus marilandica - Quercus velutina - Carya texana / Schizachyrium scoparium Woodland (CEGL002149).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site is widespread across the Ozark Highlands Section.

Ecological site concept

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

The Low-base Chert Exposed Backslope Woodlands occupy the southerly and westerly aspects of steep, dissected slopes, and are mapped in complex with the Low-base Chert Protected Backslope Woodlands ecological site. Low-base Chert Backslope ecological sites are widely distributed throughout the Ozark Highland, particularly south and west of the Ozark border counties along the boundary with MLRA 115B. Soils are typically very deep, acidic, and low in bases such as calcium, with an abundance of chert fragments. Soil acidity is an important factor affecting the distribution of both tree and ground flora species and their growth. As a soil profile approaches or arrives at lower levels of pH, exchangeable aluminum comes into solution and can directly impact plant growth and composition. The reference plant community is a woodland with an overstory dominated by black oak and white oak, with shortleaf pine in the historic shortleaf pine range, and a ground flora of native grasses and forbs.

Associated sites

F116AY004MO	**Fragipan Upland Woodland** Fragipan Upland Woodlands are upslope, on summits.
F116AY012MO	**Low-Base Chert Upland Woodland** Low-base Chert Upland Woodlands are upslope, on shoulders and upper backslopes.
F116AY013MO	**Low-Base Chert Protected Backslope Woodland** Low-base Chert Protected Backslope Woodlands are mapped in complex with this ecological site, on steep lower backslopes with northern to eastern exposures.
F116AY037MO	**Gravelly/Loamy Upland Drainageway Forest** Gravelly/Loamy Upland Drainageway Forests are often downslope.

Similar sites

F116AY013MO	**Low-Base Chert Protected Backslope Woodland** Low-base Chert Protected Backslope Woodlands are mapped in complex with this ecological site, on steep lower backslopes with northern to eastern exposures.

Table 1. Dominant plant species

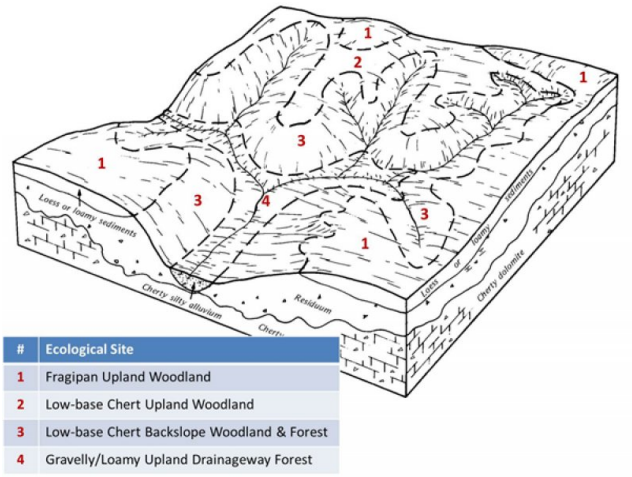
Tree	(1) *Quercus velutina* (2) *Pinus echinata*
Shrub	(1) *Vaccinium*
Herbaceous	(1) *Carex* (2) *Schizachyrium scoparium*

Physiographic features

This site is on upland backslopes with slopes of 15 to 60 percent. It is on exposed aspects (south, southwest, and west), which receive significantly more solar radiation than the protected aspects. The site receives runoff from upslope summit and shoulder sites, and generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Wolf, 1989) shows the typical landscape position of this ecological site, and

landscape relationships with other ecological sites. It is within the area labeled “3” on the figure, on lower backslopes with southerly to westerly exposures. Low-base Chert Protected Backslope Woodland sites are on the corresponding northerly to easterly exposures. Upper slopes and shoulders are in the Low-base Chert Upland Woodland ecological site, labeled “2”. Upslope crests that have a layer of loess are often Fragipan Upland Woodland sites, labeled “1”.



#	Ecological Site
1	Fragipan Upland Woodland
2	Low-base Chert Upland Woodland
3	Low-base Chert Backslope Woodland & Forest
4	Gravelly/Loamy Upland Drainageway Forest

Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Hillslope
Flooding frequency	None
Ponding frequency	None
Slope	15–60%
Water table depth	24–60 in
Aspect	W, SE, S, SW

Climatic features

The Ozark Highland has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Ozark Highland experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line crossing the MLRA from northwest to southeast.
The average annual precipitation in almost all of this area is 38 to 45 inches. Snow falls nearly every winter, but the snow cover lasts for only a few days. The average annual temperature is about 53 to 60 degrees F. The lower temperatures occur at the higher elevations in the western part of the MLRA. Mean January minimum temperature follows a stronger north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along a northwest to southeast gradient. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer.

During years when precipitation comes in a fairly normal manner, moisture is stored in the top layers of the soil during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Deep sinkholes often have a microclimate significantly cooler, moister, and shadier than surrounding surfaces, a phenomenon that may result in a strikingly different ecology. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces may create distinctive environmental niches such as glades and cliffs.

Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest is measurably different from the climate of a more open grassland or savanna areas.

Source: University of Missouri Climate Center - http://climate.missouri.edu/climate.php; Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States Department of Agriculture Handbook 296 - http://soils.usda.gov/survey/geography/mlra/

Table 3. Representative climatic features

Frost-free period (characteristic range)	154-165 days
Freeze-free period (characteristic range)	181-194 days
Precipitation total (characteristic range)	45-48 in
Frost-free period (actual range)	150-168 days
Freeze-free period (actual range)	178-196 days
Precipitation total (actual range)	44-50 in
Frost-free period (average)	160 days
Freeze-free period (average)	189 days
Precipitation total (average)	47 in

Climate stations used

- (1) GILBERT [USC00032794], Saint Joe, AR
- (2) TAHLEQUAH [USC00348677], Tahlequah, OK
- (3) ALTON 6 SE [USC00230127], Alton, MO
- (4) CAMDENTON 2 NW [USC00231212], Gravois Mills, MO
- (5) GROVESPRING 1NE [USC00233483], Grovespring, MO
- (6) CLEARWATER DAM [USC00231674], Ellington, MO

Influencing water features

Water features associated with this upland ecological site are influenced by karst landscapes throughout the area (see diagram). Rainfall enters the groundwater system through the soil or by flowing into sinkholes and streams. Springs form where land drops low enough to meet underground water tables. Dissolution of carbonate rocks along fractures and faults has produced cave systems, sinkholes (closed and open), springs, and natural tunnels in the region. These sinkholes and losing streams can rapidly transfer water from upland recharge areas to spring outlets. The most common mechanism for groundwater recharge occurs by the relatively slow downward movement of water through soil and carbonate bedrock over a large area known as diffuse recharge, which maintains a high storage volume providing a consistent supply of water to springs. In addition to diffuse recharge, aquifers in karst

terrain receive the relatively rapid transfer of water through sinkholes or losing streams connected by subsurface conduits. Surface water entering the aquifer in this fashion has very little contact with soil or rock and consequently the chemical nature of the water changes little in route. Discharge variability does not seem to be controlled by drainage area, but rather the conduit capacity of losing stream sections that can transport the entire volume of base-flow during dry periods in the year. High variability in base ?ow shows the impact of karst in the form of losing and gaining stream sections (Owen and Pavlowsky 2010).

The accompanying map depicts the distribution of these karst-related features in the state of Missouri. Relative cave density per USGS 7.5" quadrangle is depicted by shades of red, deeper red signifying a larger number of caves in the quadrangle. Stretches of losing streams are shown in yellow. Known springs are shown as blue dots. Image from Wikimedia Commons developed from the Missouri Department of Natural Resources, Division of Geology and Land Survey.

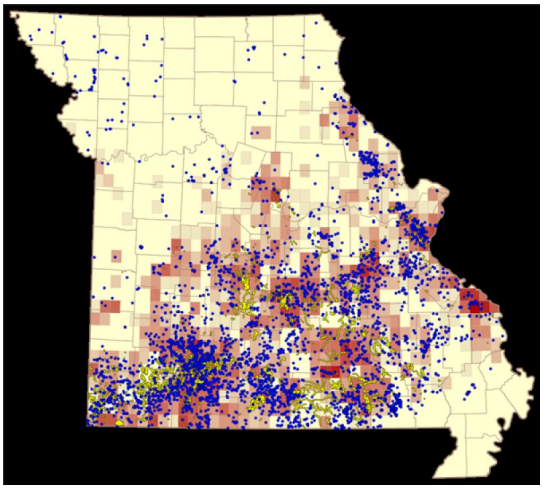


Figure 9. Distribution of karst-related features in Missouri. Image from Wikimedia Commons developed from the Missouri Department of Natural Resources, Division of Geology and Land Survey.

Soil features

These soils have acidic subsoils that are low in bases. Soil acidity is an important factor affecting the distribution of both tree and ground flora species and their growth. As a soil profile approaches or arrives at lower levels of pH, exchangeable aluminum comes into solution and can directly impact plant growth and composition. Some soils have a fragipan rooting barrier at about 24 inches, and some soils have chert bedrock at less than 60 inches. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is slope alluvium over residuum weathered from dolomite. They have gravelly to very gravelly and cobbly silt loam surface horizons, and skeletal subsoils with high amounts of chert gravel and cobbles. They are not affected by seasonal wetness. Soil series associated with this site include Bendavis, Clarksville, Doniphan, Jollymill, Nixa, Poynor, Scholten, Tick, and Wilderness.

The accompanying picture of a roadcut in the Clarksville series shows a thin, light-colored surface horizon underlain by reddish loam with a high chert fragment content. Although rooting depth is high, as is shown in this picture, plants must be adapted to these low-base soils, which are high in soluble aluminum. Picture courtesy of John Preston, NRCS.

Figure 10. Clarksville series

Table 4. Representative soil features

Parent material	(1) Slope alluvium–dolomite (2) Residuum–dolomite
Surface texture	(1) Gravelly silt loam (2) Very gravelly
Family particle size	(1) Clayey
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Very slow
Soil depth	30–72 in
Surface fragment cover <=3"	20–60%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	3–6 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	3.5–6.5
Subsurface fragment volume <=3" (Depth not specified)	30–70%
Subsurface fragment volume >3" (Depth not specified)	2–10%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Species composition and structure of the reference plant community varies for this ecological site based on its relative location to the Ozark Highlands historic native shortleaf pine range. Fragmentary evidence from old records indicate that the original timber stands in the Ozark Highlands contained a large volume of shortleaf pine on small, scattered areas, (green area on adjacent map) but a relatively small volume of shortleaf pine on extensive areas (Fletcher and McDermott, 1957). Because of this situation, this ecological site is classified into two community phases. When the ecological site occurs outside of the historic native pine range, the community phase expressed is a well-developed Oak Woodland dominated by an overstory of black oak and white oak. Within the historic native shortleaf pine range, the community phase is characterized as Oak-Pine Woodland, with shortleaf pine as a common overstory species. Extreme soil chertiness, low soil bases and complicated landscape complexes are unifying soil features of these rather divergent community phases. Soil acidity is an important factor affecting the distribution of both tree and ground flora species and their growth. As a soil profile approaches or arrives at lower levels of pH, exchangeable aluminum comes into solution and can directly impact plant growth and composition. Woodlands are distinguished from forests by their relatively open understory and the presence of sun-loving ground flora species.

This ecological site is similar to Low-Base Chert Upland Woodland, except that it may be less dense with more afternoon sunlight covering the woodland floor and less productive. The canopy is moderately tall (60 to 70 feet) but less dense (60 to 80 percent cover) than protected slopes. Increased light from the more open canopy causes a diversity of ground flora species to flourish. Within the historical native shortleaf pine range (Cross-hatched area on above map) this ecological site was dominated by drought and fire-tolerant shortleaf pine, with occasional to frequent black oak, white oak, and post oak. These oak-pine woodlands ranged from open park-like woodlands to more closed woodlands. Canopy closure likely varied from 40 to 80 percent and tree height from 70 to 100 feet. Native prairie grasses dominated the open understory, along with a diverse mix of native legume, aster, sunflower and other forbs. Most of this oak-pine community was cleared by extensive logging around 1890 to 1920. Persistent sprouting of oak species, especially black oak and scarlet oak, replaced the shortleaf pine in the overstory.

Fire played an important role in the maintenance of these community phases. Their high, flat landscape positions likely supported a high fire frequency of every 3 to 5 years on edge of central plateau to over ten years on ridges in the river breaks. These periodic fires kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs. During fire free intervals, woody understory species increased and the herbaceous understory diminished. The return of fire would open the woodlands up again and stimulate the abundant ground flora.

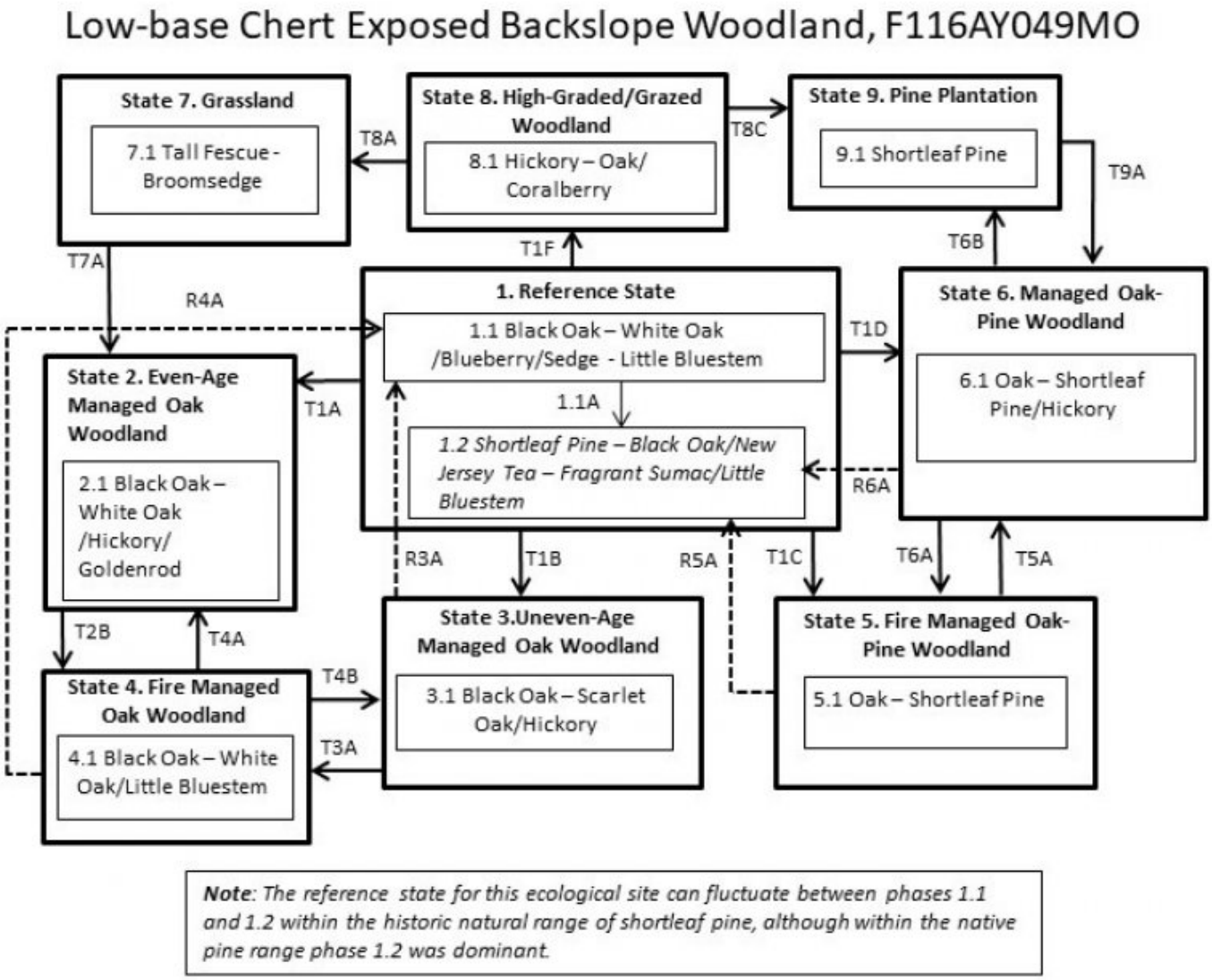
This ecological site was also historically subjected to occasional disturbances from wind and ice, as well as grazing by large native herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Grazing by large native herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction and sun-loving ground flora species.

Today, most of these ecological sites have been largely cleared and converted to pasture, undergone repeated timber harvest and uncontrolled domestic grazing or converted to shortleaf pine plantations. Most existing woodland ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices. In the long term absence of fire, woody species, such as oak and hickory, encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Most occurrences today exhibit canopy closure of 80 to 100 percent.

These ecological sites are moderately productive. Maintenance of the Oak and Oak-Pine Woodlands will require disturbances that will encourage more sun adapted species and reduce shading effects. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration methods for restoring the more open structure and increasing the diversity of the ground flora species. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees. Managed areas show exceptional resiliency. In the Oak-Pine Woodland community phase in particular, these practices encourage recruitment of shortleaf pine when mature pines are nearby to provide a seed source. Despite the widespread removal of shortleaf pine from this system, there are many areas with some pine present on this ecological site. Where present, selective cutting and prescribed fire can help recruit shortleaf pine, restore the more open structure, and increase the diversity of ground flora species.

A state-and-transition model diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

State and transition model



***Note**: The reference state for this ecological site can fluctuate between phases 1.1 and 1.2 within the historic natural range of shortleaf pine, although within the native pine range phase 1.2 was dominant.*

Code	Event/Activity
T1A	Pines absent; fire suppression; even-age management
T1B, T4B	Pines absent; fire suppression; uneven-age management
T1C	Within the native pine range; prescribed fire; managed harvests
T1D	Within the native pine range; fire suppression; managed harvests
T1F	Poorly planned harvest (high grading); uncontrolled grazing
T2B, T3A, T6A	Thinning; prescribed fire; managed harvests
T2A	Uneven-age management
T4A, T5A	Fire suppression; managed harvests
T7A	Tree planting; long-term succession (+50-60 years)
T8C, T6B	Clearing and conversion to pine plantation
T8A	Clearing ; pasture planting; prescribed grazing
T9A	Thinning; allow oak sprouting; fire suppression
R4A	Forest stand improvement; extended rotations; prescribed fire
R3A, R5A, R6A	Prescribed fire; uneven-age management; extended rotations
1.1A	Within native pine range

Figure 11. State and transition diagram for this ecological site

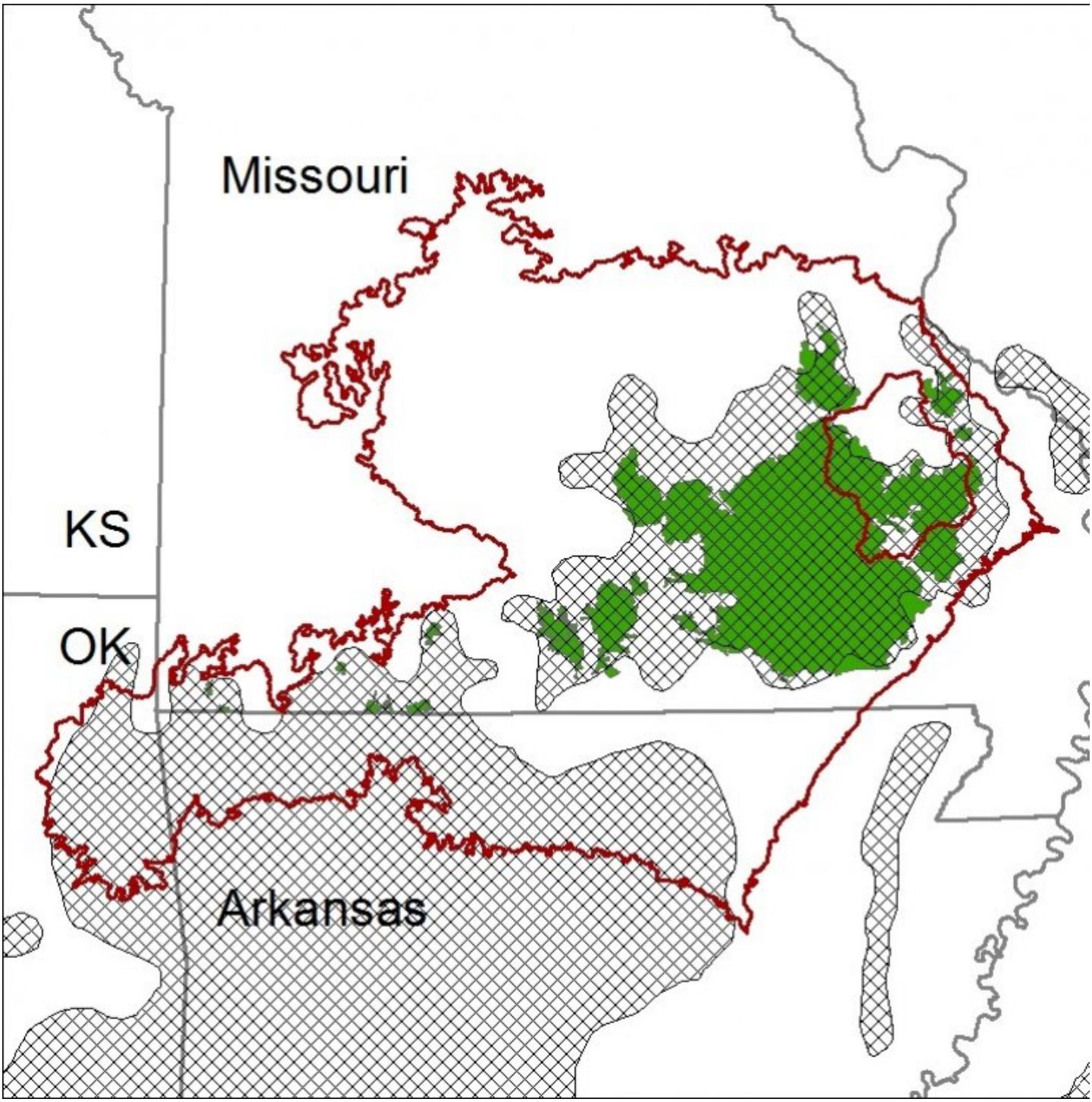


Figure 12. Range map with cross-hatching showing the historic distribution of shortleaf pine in the Midwest. Green shading show areas where shortleaf pine was a dominate overstory species.

State 1
Reference

The historical reference state for this ecological site was old growth oak or oak-pine woodland. The reference state was dominated by black oak, post oak and white oak or with shortleaf pine as a common overstory component within the Ozark historic shortleaf pine range. Periodic disturbances from fire, wind or ice maintained the woodland structure and diverse ground flora species. Occasional catastrophic fires would have set some areas back to an early seral community. Long disturbance-free periods allowed an increase in both the density of trees and the abundance of shade tolerant species. Two community phases are recognized in the reference state, with shifts between phases based on geographic location. The reference state for this ecological site can fluctuate between phases. Within the native pine range phase 1.2 was dominant.

Community 1.1
Black Oak – White Oak /Blueberry/Sedge - Little Bluestem

Figure 13. Reference site at Caney Mountain CA, Ozark County, Missouri; photo credit MDC

Periodic disturbances from fire, wind or ice maintained the woodland structure and diverse ground flora species. Occasional catastrophic fires would have set some areas back to an early seral community.

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

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

Community 1.2
Shortleaf Pine – Black Oak/New Jersey Tea – Fragrant Sumac/Little Bluestem

Two community phases are recognized in the reference state, with shifts between phases based on geographic location. Within the native pine range phase 1.2 was dominant.

Pathway P1.1A
Community 1.1 to 1.2

This community phase is within native pine range

State 2
Even-Age Managed Oak Woodland

Where all of the shortleaf pine was removed, this system became dominated by oak. These woodlands tend to be rather dense, with a sparse understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. However, in the absence of fire, the diversity and cover of the ground flora is still diminished. Prescribed fire without extensive timber harvest will, over time, cause a transition to Fire Managed Oak Woodland (State 4).

Community 2.1
Black Oak – White Oak /Hickory/ Goldenrod

State 3
Uneven-Age Managed Oak Woodland

Where pine was removed from the system, but uneven-age management was applied, this system became dominated by oaks. Composition is likely altered from the reference state depending on tree selection during harvest. In addition, without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species and white oak will become less dominant. Without periodic disturbance, stem density and fire intolerant species, like hickory, increase in abundance.

Community 3.1
Black Oak – Scarlet Oak/Hickory

State 4
Fire Managed Oak Woodland

The Fire Managed Oak Woodland state results from managing woodland communities from states 2 or 3 with prescribed fire. This state can resemble phase 1.1 of the reference state, but with younger maximum tree ages and lower ground flora diversity.

Community 4.1
Black Oak – White Oak/Little Bluestem

State 5
Fire Managed Oak-Pine Woodland

Where some shortleaf pine remained after initial harvest, this state may occur. The Fire Managed Oak-Pine Woodland state results from managing State 6 with selective thinning and prescribed fire. A more open structure with abundant ground flora can be restored. This state can resemble phase 1.2 of the reference state, but with younger maximum tree ages and lower ground flora diversity. In addition, it will take time to recover older maximum tree ages and ground flora diversity and cover.

Community 5.1
Oak-Shortleaf Pine

State 6
Managed Oak-Pine Woodland

Where some shortleaf pine remained after initial harvest, the Managed Oak-Pine Woodland state may occur. While mature pines let more light to the ground than oak, these even-aged woodlands tend to be rather dense, with a depauperate understory and ground flora due to an increase in oak and hickory density. Thinning can increase overall tree vigor and improve understory diversity. However, in the absence of fire, the diversity and cover of the ground flora is still diminished. A return to the phase 1.2 of the reference state will require prescribed fire along with no harvest or long rotations to restore uneven-age structure and pine densities and increase maximum tree age.

Community 6.1
Oak-Shortleaf Pine/Hickory

State 7
Grassland

Conversion of woodlands to non-native cool season grassland species such as tall fescue has been common. Low available water, abundant surface fragments, low organic matter contents and soil acidity make non-native grasslands difficult to maintain in a healthy, productive state on this ecological site. Occasionally, these pastures will have scattered patches of tall, mature shortleaf pine. If grazing and pasture management is discontinued, the site will eventually transition to State 2. Forest stand improvement and tree planting practices can hasten this process.

Community 7.1
Tall Fescue-Broomsedge

State 8
High-Graded/Grazed Woodland

Ecological sites subjected to repeated, high-grading timber harvests and uncontrolled domestic grazing transition to this state. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as coralberry, gooseberry, poison ivy and Virginia creeper. The vegetation offers little

nutritional value for cattle, and excessive stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. This state can be transitioned to a grassland state through clearing and grassland planting or to a pine plantation through clearing, tree planting and fire control.

Community 8.1
Hickory – Oak/Coralberry

State 9
Pine Plantation

Many areas were planted to plantations of shortleaf pine from the 1940's to the early 1960's. They are now mature plantations that are usually a mono-culture of a dense pine overstory with a brush understory of oak and hickory and a dense carpet of pine needles on the ground. They lack the diversity and structure. Restoration to phase 1.2 of the reference state is a long-term prospect, requiring extensive thinning, long-term prescribed fire, and perhaps planting of native ground flora species.

Community 9.1
Shortleaf Pine

Transition T1A
State 1 to 2

This transition typically results from even-age timber management practices, such as clear-cut, seed tree or shelterwood harvest.

Transition T1B
State 1 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest.

Transition T1C
State 1 to 5

Within the native pine range this transition is the result of prescribed fire; managed harvests

Transition T1D
State 1 to 6

This transition is the result of poorly planned timber harvest techniques such as high-grading, accompanied by unmanaged cattle grazing. Soil erosion and compaction often result from cattle grazing after the understory has been damaged.

Transition T1F
State 1 to 8

Ecological sites subjected to repeated, high-grading timber harvests and uncontrolled domestic grazing transition to this state.

Transition T2B
State 2 to 4

This transition is the result of the systematic application of prescribed fire. Mechanical thinning may also be used.

Restoration pathway R3A
State 3 to 1

Restoration activities include prescribed fire, forest stand improvement, and extended rotations.

Transition T3A
State 3 to 4

This transition typically results from even-age timber management practices, such as clear-cut, seed tree or shelterwood harvest and prescribed fire.

Restoration pathway R4A
State 4 to 1

Restoration activities to community phase 1.1A include forest stand improvement; extended rotations; prescribed fire

Transition T4A
State 4 to 2

This transition typically results from even-age timber management practices, such as clear-cut, seed tree or shelterwood harvest and fire suppression.

Transition T4B
State 4 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest.

Restoration pathway R5A
State 5 to 1

Restoration activities to community phase 1.2: prescribed fire; uneven-age management; extended rotations

Transition T5A
State 5 to 2

This transition results from the cessation of cattle grazing and associated pasture management such as mowing and brush-hogging. Herbicide application, tree planting and timber stand improvement techniques can speed up this otherwise very lengthy transition.

Transition T5A
State 5 to 6

Transition activities include fire suppression; managed harvests

Restoration pathway R6A
State 6 to 1

Restoration activities to community phase 1.2: prescribed fire; uneven-age management; extended rotations

Transition T6B
State 6 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest. Tree planting, mechanical thinning and other timber stand improvement techniques may be helpful to decrease the transition time.

Transition T6A

State 6 to 5

This transition is the result of thinning; prescribed fire; managed harvests

Transition T6B
State 6 to 9

This transition typically results from selective oak removal, maintaining existing pine, and pine planting.

Transition T7A
State 7 to 2

Transition activities include fire suppression, tree planting, long term succession (+50 to 60 years).

Transition T8A
State 8 to 7

This state can be transitioned to a grassland state through clearing, grassland planting and grassland management.

Transition T9A
State 9 to 6

This state will transition by thinning, allowing oak sprouting and fire suppression from a mature plantation that is usually a monoculture of a dense pine overstory with a brush understory of oak and hickory.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
post oak	QUST	*Quercus stellata*	Native	–	–	–	–
black oak	QUVE	*Quercus velutina*	Native	–	–	–	–
blackjack oak	QUMA3	*Quercus marilandica*	Native	–	–	–	–
black hickory	CATE9	*Carya texana*	Native	–	–	–	–
white oak	QUAL	*Quercus alba*	Native	–	–	–	–
mockernut hickory	CATO6	*Carya tomentosa*	Native	–	–	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	–	–	–
scarlet oak	QUCO2	*Quercus coccinea*	Native	–	–	–	–
sassafras	SAAL5	*Sassafras albidum*	Native	–	–	–	–
shortleaf pine	PIEC2	*Pinus echinata*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	–
oval-leaf sedge	CACE	*Carex cephalophora*	Native	–	–
Muhlenberg's sedge	CAMU4	*Carex muehlenbergii*	Native	–	–
Bosc's panicgrass	DIBO2	*Dichanthelium boscii*	Native	–	–

fuzzy wuzzy sedge	CAHI6	*Carex hirsutella*	Native	–	–
Indiangrass	SONU2	*Sorghastrum nutans*	Native	–	–
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	–
poverty oatgrass	DASP2	*Danthonia spicata*	Native	–	–
broomsedge bluestem	ANVI2	*Andropogon virginicus*	Native	–	–
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	–
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	–
Forb/Herb					
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	–
manyray aster	SYAN2	*Symphyotrichum anomalum*	Native	–	–
rue anemone	THTH2	*Thalictrum thalictroides*	Native	–	–
American ipecac	GIST5	*Gillenia stipulata*	Native	–	–
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	–
feathery false lily of the valley	MARA7	*Maianthemum racemosum*	Native	–	–
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	–
bristly buttercup	RAHI	*Ranunculus hispidus*	Native	–	–
fire pink	SIVI4	*Silene virginica*	Native	–	–
fourleaf milkweed	ASQU	*Asclepias quadrifolia*	Native	–	–
pointedleaf ticktrefoil	DEGL5	*Desmodium glutinosum*	Native	–	–
smooth small-leaf ticktrefoil	DEMA2	*Desmodium marilandicum*	Native	–	–
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	–
Arkansas bedstraw	GAAR4	*Galium arkansanum*	Native	–	–
spotted geranium	GEMA	*Geranium maculatum*	Native	–	–
late purple aster	SYPA11	*Symphyotrichum patens*	Native	–	–
flaxleaf whitetop aster	IOLI2	*Ionactis linariifolius*	Native	–	–
flowering spurge	EUCO10	*Euphorbia corollata*	Native	–	–
longbract wild indigo	BABR2	*Baptisia bracteata*	Native	–	–
Parlin's pussytoes	ANPA9	*Antennaria parlinii*	Native	–	–
slender lespedeza	LEVI7	*Lespedeza virginica*	Native	–	–
Shrub/Subshrub					
winged sumac	RHCO	*Rhus copallinum*	Native	–	–
deerberry	VAST	*Vaccinium stamineum*	Native	–	–
leadplant	AMCA6	*Amorpha canescens*	Native	–	–
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	–
Blue Ridge blueberry	VAPA4	*Vaccinium pallidum*	Native	–	–
Tree					
farkleberry	VAAR	*Vaccinium arboreum*	Native	–	–

Animal community

Wildlife (MDC 2006):

Oaks provide hard mast for wildlife; scattered shrubs provide soft mast.

Sedges and native grasses provide green browse; native grasses on dry sites provide cover and nesting habitat and a diversity of forbs provides a diversity and abundance of insects.

Post-burn areas can provide temporary bare-ground – herbaceous cover habitat important for turkey poults and quail chicks.

Bird species associated with Chert Oak Woodlands include Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Summer Tanager, Eastern Wood-Pewee, Whip-poor-will, Chuck-will's widow, and Red-eyed Vireo.

Reptiles and amphibians associated with mature Chert Oak Woodlands include: ornate box turtle, northern fence lizard, five-lined skink, coal skink, broad-headed skink, six-lined racerunner, western slender glass lizard, prairie ring-necked snake, flat-headed snake, rough earth snake, red milk snake, western pygmy rattlesnake, and timber rattlesnake.

Bird species associated with Oak-Pine Woodlands are Carolina Chickadee, Great Crested Flycatcher, Pine Warbler, White-breasted Nuthatch, Cooper's Hawk, Yellow-throated Warbler, Summer Tanager, Black-and-white Warbler, and Northern Bobwhite.

Reptile and amphibian species associated with Oak-Pine Woodlands include ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, six-lined racerunner, rough earth snake, and timber rattlesnake.

Other information

Forestry (NRCS 2002, 2014):

Management: Field measured site index values average 53 for white oak and 58 for black oak, and 60 for shortleaf pine. These site index values range from 42 to 70. Timber management opportunities are moderate. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection, group selection cuttings of ½ to 1 acre, or crop tree release are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality or should be used with caution on a site if timber management is the primary objective. These sites respond well to prescribed fire as a restoration management practice.

Limitations: Large amounts of coarse fragments throughout profile; bedrock may be within 60 inches. Surface stones and rocks are problems for efficient and safe equipment operation and will make equipment use somewhat difficult. Disturbing the surface excessively in harvesting operations and building roads increases soil losses, which leaves a greater amount of coarse fragments on the surface. Hand planting or direct seeding may be necessary. Seedling mortality due to low available water capacity may be high. Mulching or providing shade can improve seedling survival. Mechanical tree planting will be limited. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Potential Reference Sites: Low-Base Chert Exposed Backslope Woodland

Plot ALSPNP03 - Bendavis soil
Located in Alley Spring National Park Service, Shannon County, MO
Latitude: 37.160418
Longitude: -91.45072317

Plot CAMOCA05 - Poyner soil
Located in Caney Mountain CA, Ozark County, MO
Latitude: 36.705975
Longitude: -92.430688

Plot CASPFS02 - Poyner soil
Located in Carman Springs USFS, Howell County, MO
Latitude: 36.85905

Longitude: -91.27107

Other references

Anderson, R.C. 1990. The historic role of fire in North American grasslands. Pp. 8-18 in S.L. Collins and L.L. Wallace (eds.). Fire in North American tallgrass prairies. University of Oklahoma Press, Norman.

Batek, M.J., A.J. Rebertus, W.A. Schroeder, T.L. Haithcoat, E. Compas, and R.P. Guyette. 1999. Reconstruction of early nineteenth-century vegetation and fire regimes in the Missouri Ozarks. Journal of Biogeography 26:397-412.

Fletcher, P.W. and R.E. McDermott. 1957. Influence of Geologic Parent Material and Climate on Distribution of Shortleaf Pine in Missouri. University of Missouri, Research Bulletin 625. 43p.

Harlan, J.D., T.A. Nigh and W.A. Schroeder. 2001. The Missouri original General Land Office survey notes project. University of Missouri, Columbia.

Ladd, D. 1991. Reexamination of the role of fire in Missouri oak woodlands. Pp. 67-80 in G.V. Brown, James K.; Smith, Jane Kapler, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p.

Little, E.L., Jr. 1971. Atlas of United States Trees, Volume 1, Conifers and Important Hardwoods: U.S. Department of Agriculture Miscellaneous Publication 1146, 9 p., 200 maps

Missouri Department of Conservation, 2006. Missouri Forest and Woodland Community Profiles. Missouri Department of Conservation, Jefferson City, Missouri.

Natural Resources Conservation Service. 2002. Woodland Suitability Groups. Missouri FOTG, Section II, Soil Interpretations and Reports. 30 pgs.

Natural Resources Conservation Service. Site Index Reports. Accessed May 2014. https://esi.sc.egov.usda.gov/ESI_Forestland/pgFSWelcome.aspx

NatureServe. 2010. International Ecological Classification Standard: Terrestrial Ecological Classifications. Rapid Assessment Reference Condition Model, R5BSOW Interior Highlands Dry Oak/Bluestem Woodland/Glade. NatrueServe Central Databases. Arlington, VA U.S.

Nelson, Paul W. 2010. The Terrestrial Natural Communities of Missouri. Missouri Department of Conservation, Jefferson City, Missouri. 550p.

Nigh, Timothy A., and Walter A. Schroeder. 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation, Jefferson City, Missouri. 212p.

Owen, Marc R. and Robert T. Pavlowsky. 2010. Baseflow hydrology and water quality of an Ozarks spring and associated recharge area, southern Missouri, USA. Environ Earth Sci (2011) 64:169–183.

Schoolcraft, H.R. 1821. Journal of a tour into the interior of Missouri and Arkansas from Potosi, or Mine a Burton, in Missouri territory, in a southwest direction, toward the Rocky Mountains: performed in the years 1818 and 1819. Richard Phillips and Company, London.

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 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. 682 pgs.

Wolf, David W. 1989. Soil Survey of Pulaski County, Missouri. U.S. Dept. of Agric. Soil Conservation Service.

Contributors

Fred Young

Doug Wallace

Approval

Nels Barrett, 9/24/2020

Acknowledgments

Missouri Department of Conservation and Missouri Department of Natural Resources personnel provided significant and helpful field and technical support in the development of this ecological site.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/24/2024
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

---

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

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**