USDA Natural Resources Conservation Service

# Ecological site F116AY013MO
# Low-Base Chert Protected Backslope Woodland

Last updated: 9/24/2020
Accessed: 04/19/2024

## 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 like a Dry-Mesic Chert Woodland.

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this Ecological Site is most like a Mixed Oak and Pine Oak Woodlands.

National Vegetation Classification System Vegetation Association (NatureServe, 2010): The reference state for this ecological site is most like the Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium Woodland (CEGL002150).

Geographic relationship to the Atlas of Missouri Ecoregions classification system (Nigh and Schroeder, 2002): This ecological site is found throughout most subsections of the Ozark Highlands Section (OZ).

## 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 Protected Backslope Woodlands occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Low-base Chert Exposed Backslope Woodlands ecological site. Low-base Chert Backslopes 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. The reference plant community is woodland with an overstory dominated by white oak and black oak, with shortleaf pine in the historic pine range and a ground flora of native grasses and forbs.

## Associated sites

| | |
|---|---|
| F116AY004MO | **Fragipan Upland Woodland**<br>Fragipan Upland Woodlands are upslope, on summits. |
| F116AY012MO | **Low-Base Chert Upland Woodland**<br>Low-base Chert Upland Woodlands are upslope, on shoulders and upper backslopes. |
| F116AY037MO | **Gravelly/Loamy Upland Drainageway Forest**<br>Gravelly/Loamy Upland Drainageway Forests are often downslope. |
| F116AY049MO | **Low-Base Chert Exposed Backslope Woodland**<br>Low-base Chert Exposed Backslope Woodlands are mapped in complex with this ecological site, on steep lower backslopes with southern to western exposures. |

## Similar sites

| | |
|---|---|
| F116AY049MO | **Low-Base Chert Exposed Backslope Woodland**<br>Low-base Chert Exposed Backslope Woodlands are mapped in complex with this ecological site, on steep lower backslopes but with southern to western exposures. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus alba*<br>(2) *Quercus velutina* |
| Shrub | (1) *Amelanchier arborea* |
| Herbaceous | (1) *Desmodium* |

## Physiographic features

This site is on upland backslopes with slopes of 15 to 60 percent. It is on protected aspects (north, northeast, and east), which receive significantly less solar radiation than the exposed 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 northerly to easterly exposures. Low-base Chert Exposed Backslope Woodland sites are on the corresponding southerly to westerly 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”.

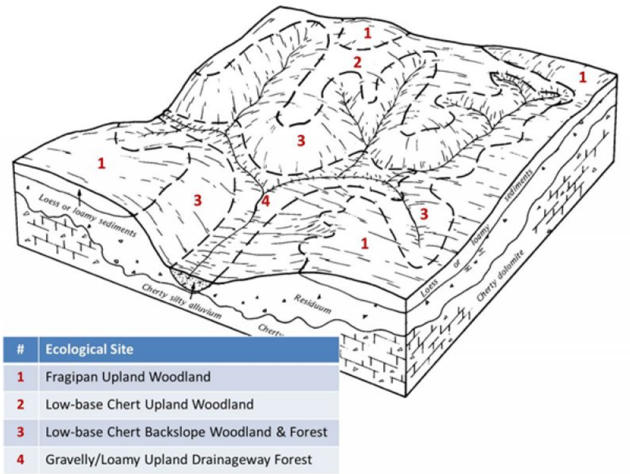



**Figure 2. Landscape relationships for this ecological site.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Hill<br>(2) Hillslope |
| Flooding frequency | None |
| Ponding frequency | None |
| Slope | 15–60% |
| Water table depth | 24–60 in |
| Aspect | NW, N, NE, E |

## 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) | 147-174 days |
| Freeze-free period (characteristic range) | 177-202 days |
| Precipitation total (characteristic range) | 46-48 in |
| Frost-free period (actual range) | 139-185 days |
| Freeze-free period (actual range) | 163-218 days |
| Precipitation total (actual range) | 46-50 in |
| Frost-free period (average) | 162 days |
| Freeze-free period (average) | 191 days |
| Precipitation total (average) | 48 in |

## Climate stations used

- (1) GILBERT [USC00032794], Saint Joe, AR
- (2) TAHLEQUAH [USC00348677], Tahlequah, OK
- (3) POPLAR BLUFF [USC00236791], Poplar Bluff, MO
- (4) WAYNESVILLE 5 W [USC00238777], Waynesville, MO
- (5) FAYETTEVILLE EXP STN [USC00032444], Fayetteville, AR

## 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.

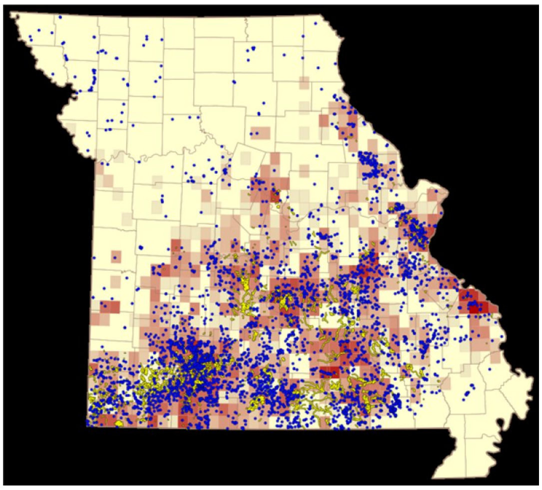


**Figure 9. Distribution of karst-related features in Missouri. Image from Wikimedia Commons developed from the Missouri Department of Natural Resources, Division of Geology and Land Survey.**

## Soil features

These soils have acidic subsoils that are low in bases. Soils having low concentrations of calcium and containing few calcium bearing minerals along with increased levels of aluminum may also be vulnerable to base depletion by timber harvesting, plant uptake, and leaching. 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 limestone and 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 soil profile**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Slope alluvium–limestone and dolomite<br>(2) Residuum–limestone and dolomite |
| Surface texture | (1) Gravelly silt loam<br>(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<br>(0-40in) | 3–6 in |
| Calcium carbonate equivalent<br>(0-40in) | 0% |
| Electrical conductivity<br>(0-40in) | 0–2 mmhos/cm |
| Sodium adsorption ratio<br>(0-40in) | 0 |
| Soil reaction (1:1 water)<br>(0-40in) | 3.5–6.5 |
| Subsurface fragment volume <=3"<br>(Depth not specified) | 30–70% |
| Subsurface fragment volume >3"<br>(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 varied for this ecological site based on its relative location to the Ozark Highlands historic native shortleaf pine range. See the map adapted from Fletcher and McDermott (1957), under Reference community 1.2. Fragmentary evidence from old records indicates that the original timber stands in the Ozark Highlands contained a large volume of shortleaf pine on small, scattered areas, (green area on map) but a relatively small volume of shortleaf pine on extensive areas (cross-hatching on map). 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 post oak. Within the historic native pine range, the community phase is characterized as Oak-Pine Woodland, with shortleaf pine as a common overstory species. Extreme soil chert, low soil bases and complicated landscape complexes are unifying soil features of these rather divergent community phases. Woodlands are distinguished from forests by their relatively open understory and the presence of sun-loving ground flora species.

The Oak Woodland phase of Low-Base Chert Protected Backslope Woodland is very similar to Chert Upland Woodlands, except that it may be less dense and productive. The canopy is rather tall (60 to 80 feet) and more dense (65 to 85 percent closure) than corresponding exposed slopes and the understory is better developed with more structural diversity. Decreased light from the denser canopy and northern aspect causes the diversity of ground flora species to diminish. Within the historical native 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 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 legumes, asters, sunflowers and other forbs. Most of this oak-pine community was cleared by extensive logging around 1890 to1920. Consequently, persistent sprouting of oak species, especially black and scarlet oak, replaced the pine.

Fire played an important role in the maintenance of these community phases. Their landscape positions likely supported a fire frequency of every 5 to 10 years on the edge of central plateau to over 10 years on ridges in the river breaks. Fire frequency and intensity was generally lower than adjacent uplands and near-by exposed backslopes. 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.

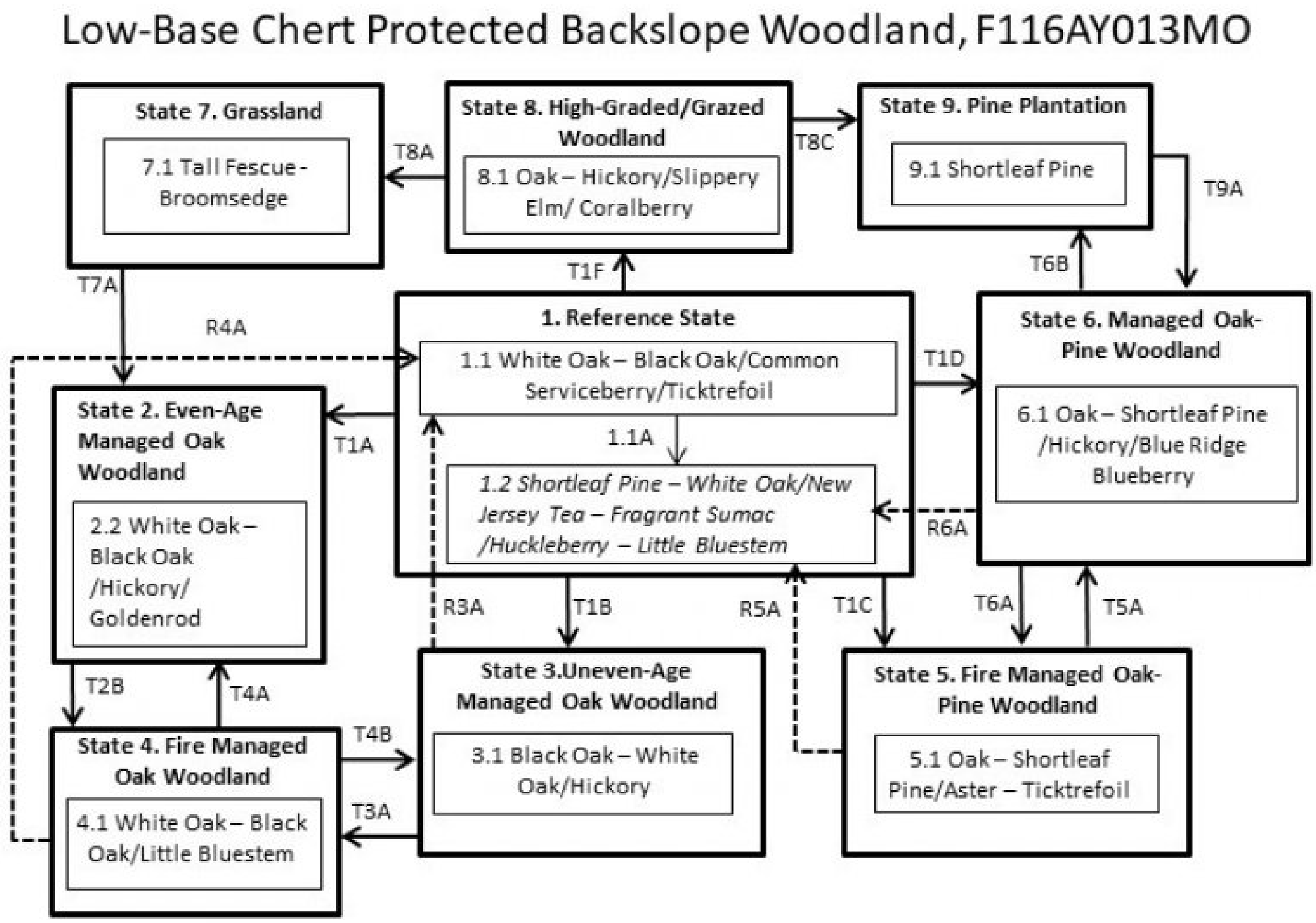
This ecological site was also historically subjected to occasional disturbances from wind and ice, as well as grazing by native large herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches 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 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. Scarlet oak, black oak, and post oak now share dominance with hickory species and an occasional white oak and shortleaf pine.

These ecological sites are only 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 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 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 native pine range; prescribed fire; managed harvests |
| T1D | Within native pine range; fire suppression; managed harvests |
| T1F | Poorly planned harvest (high grading); uncontrolled grazing; fire suppression |
| 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 Model for this ecological site**

## State 1

## Reference State

The 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 scarlet oak or with shortleaf pine as a common overstory component within the Ozark historic pine range. Periodic disturbances from fire, wind or ice maintained the woodland structure and diverse ground flora species. 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 two phases. Within the native shortleaf pine range phase 1.2 was dominant.

### Community 1.1
### White Oak – Black Oak/Common Serviceberry/Ticktrefoil

This phase was an oak woodland or oak-pine woodland. This phase was dominated by black oak, post oak and scarlet oak or with shortleaf pine as a common overstory component within the Ozark historic shortleaf pine range.

**Forest overstory.** Forest 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.** Forest 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 – White Oak/New Jersey Tea – Fragrant Sumac /Huckleberry – Little Bluestem

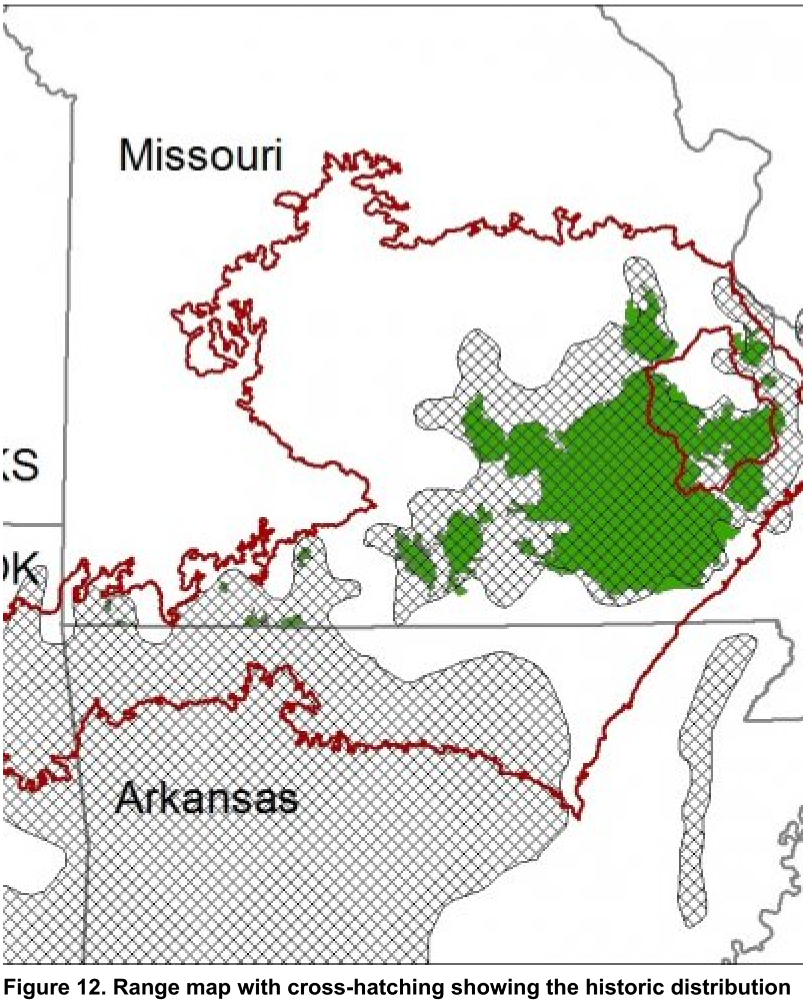



**Figure 12. Range map with cross-hatching showing the historic distribution of shortleaf pine in the Midwest. Green shading show areas where shortleaf pine was a dominate overstory species.**

The reference phases 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.

### Pathway 1.1A
### Community 1.1 to 1.2

This pathway is the result of being within the native shortleaf pine range.

### Pathway 1.2A
### Community 1.2 to 1.1

This pathway results from ecological disturbances such as fire, ice storms, or violent wind storms. Historically, native grazers such as bison provided disturbance events as well.

### 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
### White Oak – Black 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 oak, most being only 50 to 90 years old and denser understory. Composition is also likely altered from the reference state depending on tree selection during harvest. Scarlet oak is often more abundant than historically. 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-White Oak/Hickory

### State 4
### Fire Managed Oak Woodland

Where pine is removed from the system, the Fire Managed Oak Woodland state will result 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
### White Oak-Black 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. But without planting or seeding of pine, they will not return to the reference state. In addition, it will take time to recover older maximum tree ages and ground flora diversity and cover.

### Community 5.1

**Oak – Shortleaf Pine/Aster – Ticktrefoil**

## 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 densities. 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/Blue Ridge Blueberry

## 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 pine. If grazing and pasture management is discontinued, oak sprouts will occur and 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
## Oak – Hickory/Slippery Elm/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 brushy understory of oaks and hickories 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

This transition is the result of clearing the woodland community and planting pasture species. Soil erosion can be extensive in this process, along with loss of organic matter. Liming and fertilizing associated with pasture management typically raises the soil pH and increases the cation concentration (such as calcium and magnesium) of the upper soil horizons.

### 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

Transition activities include poorly planned harvest (high grading); uncontrolled grazing; fire suppression

### 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 to community phase 1.1A include thinning; prescribed fire; managed harvests

### Transition T3B
### State 3 to 4

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

### 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.

### 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 1.2A include fire suppression; managed harvests; retention of shortleaf pine

### 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 1.2A include prescribed fire; uneven-age management; extended rotations; pine retention

### 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 clearing the woodland communities and planting pasture species. Soil erosion can be extensive in this process, along with loss of organic matter. Liming and fertilizing associated with pasture management typically raises the soil pH and increases the cation concentration (such as calcium and magnesium) of the upper soil horizons.

### Transition T6B
### State 6 to 9

Transition activities include clearing and conversion to shortleaf pine plantation

### Transition T7A
### State 7 to 2

Transition activities include tree planting; long-term succession (+50-60 years)

### Transition T8A
### State 8 to 7

Transition activities include clearing ; pasture planting; prescribed grazing

## Transition T8C
## State 8 to 9

Transition activities include clearing and conversion to shortleaf pine plantation

## Transition T9A
## State 9 to 6

Transition activities include thinning; oak sprouting; fire suppression

## 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** | | | | | | | |
| white oak | QUAL | *Quercus alba* | Native | – | – | – | – |
| post oak | QUST | *Quercus stellata* | Native | – | – | – | – |
| black oak | QUVE | *Quercus velutina* | Native | – | – | – | – |
| shortleaf pine | PIEC2 | *Pinus echinata* | Native | – | – | – | – |
| scarlet oak | QUCO2 | *Quercus coccinea* | Native | – | – | – | – |
| black hickory | CATE9 | *Carya texana* | Native | – | – | – | – |
| bitternut hickory | CACO15 | *Carya cordiformis* | 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 | – | – |
| Virginia wildrye | ELVI3 | *Elymus virginicus* | Native | – | – |
| fuzzy wuzzy sedge | CAHI6 | *Carex hirsutella* | Native | – | – |
| eastern star sedge | CARA8 | *Carex radiata* | Native | – | – |
| **Forb/Herb** | | | | | |
| trailing lespedeza | LEPR | *Lespedeza procumbens* | Native | – | – |
| panicledleaf ticktrefoil | DEPA6 | *Desmodium paniculatum* | Native | – | – |
| elmleaf goldenrod | SOUL2 | *Solidago ulmifolia* | Native | – | – |
| stiff tickseed | COPA10 | *Coreopsis palmata* | Native | – | – |
| largeflower yellow false foxglove | AUGR | *Aureolaria grandiflora* | Native | – | – |
| American hogpeanut | AMBR2 | *Amphicarpaea bracteata* | 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 | – | – |
| elmleaf goldenrod | SOUL2 | *Solidago ulmifolia* | Native | – | – |
| manyray aster | SYAN2 | *Symphyotrichum anomalum* | Native | – | – |
| rue anemone | THTH2 | *Thalictrum thalictroides* | Native | – | – |
| **Fern/fern ally** | | | | | |
| northern maidenhair | ADPE | *Adiantum pedatum* | Native | – | – |
| Christmas fern | POAC4 | *Polystichum acrostichoides* | Native | – | – |
| **Shrub/Subshrub** | | | | | |
| fragrant sumac | RHAR4 | *Rhus aromatica* | Native | – | – |
| Blue Ridge blueberry | VAPA4 | *Vaccinium pallidum* | Native | – | – |
| deerberry | VAST | *Vaccinium stamineum* | Native | – | – |
| American hazelnut | COAM3 | *Corylus americana* | Native | – | – |
| New Jersey tea | CEAM | *Ceanothus americanus* | Native | – | – |
| leadplant | AMCA6 | *Amorpha canescens* | Native | – | – |
| **Tree** | | | | | |
| flowering dogwood | COFL2 | *Cornus florida* | Native | – | – |
| common serviceberry | AMAR3 | *Amelanchier arborea* | Native | – | – |

## Animal community

Wildlife (MDC 2006):

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Oaks provide abundant hard mast; scattered shrubs provide soft mast; native legumes provide high-quality wildlife food.

Sedges and native cool-season grasses provide green browse.

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

Bird species associated with early-successional oak woodlands are Northern Bobwhite, Prairie Warbler, Field Sparrow, Blue-winged Warbler, Yellow-breasted Chat, and Brown Thrasher.

Bird species associated with mid- to late successional oak woodlands are Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Summer Tanager, Eastern Wood-Pewee, Whip-poor-will, Chuck-will's widow, Red-eyed Vireo, Rose-breasted Grosbeak, Yellow-billed Cuckoo, and Broad-winged Hawk.

Reptile and amphibian species associated with woodlands include ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, six-lined racerunner, flat-headed snake, rough earth snake, 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 60 for white oak, 63 for black oak and 64 for shortleaf pine. Timber management opportunities are generally good. These groups respond well to management. 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 or group selection cuttings of ½ to 1 acre 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, may not be fitting, or should be used with caution on a particular site if timber management is the primary objective.

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 Protected Backslope Woodland

Plot ALSPNP02 - Bendavis soil
Located in Alley Spring National Park Service, Shannon County, MO
Latitude: 37.161118
Longitude: -91.44978

Plot BISPNP02 - Poyner soil
Located Big Spring National Park Service, Carter County, MO
Latitude: 36.941947
Longitude: -91.001787

Plot PODIFS02 - Clarksville soil
Located Potosi District MTNF, Crawford County, MO
Latitude: 37.995986
Longitude: -91.25698

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### Contributors

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### Approval

Nels Barrett, 9/24/2020

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### Rangeland health reference sheet

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

| | |
|---|---|
| Author(s)/participant(s) | |
| Contact for lead author | |
| Date | 04/19/2024 |
| Approved by | Nels Barrett |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

### Indicators

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

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

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

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

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

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

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

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

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

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

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

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:**