USDA Natural Resources Conservation Service

# Ecological site F116AY002MO
# Chert Protected Backslope Forest

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## 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-Mesic Chert Forest.

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

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

The reference state for this ecological site is most similar to a Quercus alba / Cornus florida Unglaciated Forest (CEGL002066).

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 Chert Protected Backslope Forests occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Chert Exposed Backslope Woodland ecological site. This ecological site is common throughout the Ozark Highlands where major streams have dissected deeply into the Salem Plateau. Soils are typically very deep, with an abundance of chert fragments. The reference plant community is forest with an overstory dominated by white oak, an understory dominated by flowering dogwood and blackgum, and a rich herbaceous ground flora.

## Associated sites

| | |
|---|---|
| F116AY004MO | **Fragipan Upland Woodland**<br>Fragipan Upland Woodlands are upslope, on summit crests that have a fragipan in the subsoil. |
| F116AY008MO | **Loamy Upland Woodland**<br>Loamy Upland Woodlands are upslope, on summits and shoulders. |
| F116AY011MO | **Chert Upland Woodland**<br>Chert Upland Woodlands are upslope, on gently sloping shoulders and upper backslopes. |
| F116AY016MO | **Chert Dolomite Protected Backslope Forest**<br>Chert Dolomite Protected Backslope Forests are downslope in places, on steep lower backslopes. |
| F116AY037MO | **Gravelly/Loamy Upland Drainageway Forest**<br>Gravelly/Loamy Upland Drainageway Forests are downslope. |
| F116AY062MO | **Chert Exposed Backslope Woodland**<br>Chert Exposed Backslope Woodlands are mapped in complex with this ecological site, on steep backslopes with southern to western aspects. |

## Similar sites

| | |
|---|---|
| F116AY019MO | **Loamy Dolomite Protected Backslope Forest**<br>Loamy Dolomite Protected Backslope Forests have similar overstory composition and aspects positions but are less productive due to a shallower soil depth. |
| F116AY030MO | **Loamy Protected Backslope Forest**<br>Loamy Protected Backslope Forests occur on similar north and west aspects. Productivity on these sites is generally higher. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Quercus alba*<br>(2) *Quercus rubra* |
| Shrub | (1) *Cornus florida* |
| Herbaceous | (1) *Aristolochia serpentaria*<br>(2) *Claytonia virginica* |

## Physiographic features

This site is on upland backslopes with slopes of 15 to 70 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 Larsen & Cook, 2002) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites. It is within the area labeled “2” on the figure, on lower backslopes with northerly to easterly exposures. Chert Exposed Backslope Woodland sites are on the corresponding southerly to westerly exposures. Upper slopes and shoulders within the area are in the Chert Upland Woodland ecological site. In one area of the figure, the thickness of the residuum decreases downslope, resulting in Chert Dolomite Backslope ecological sites, labeled “3”. Upslope crests that have a layer of loess may be Loamy Upland Woodland sites, labeled “1”, or Fragipan Upland Flatwoods sites.

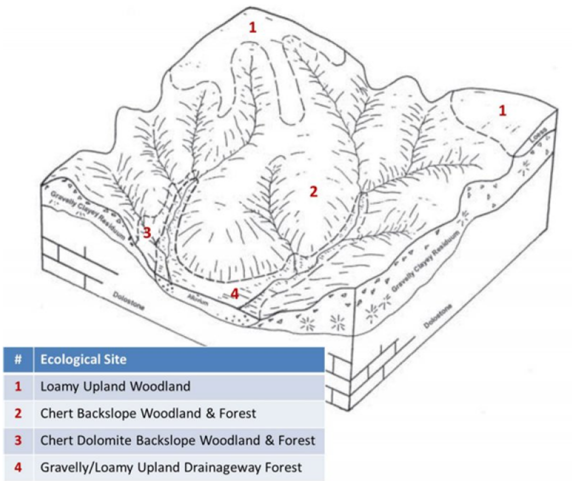



**Figure 2. Landscape relationships for this ecological site.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Hill<br>(2) Hillslope |
| Flooding frequency | None |
| Ponding frequency | None |
| Slope | 15–70% |
| Water table depth | 69–152 cm |
| 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) | 147-155 days |
| Freeze-free period (characteristic range) | 183-191 days |
| Precipitation total (characteristic range) | 1,118-1,194 mm |
| Frost-free period (actual range) | 144-156 days |
| Freeze-free period (actual range) | 182-193 days |
| Precipitation total (actual range) | 1,092-1,245 mm |
| Frost-free period (average) | 151 days |
| Freeze-free period (average) | 188 days |
| Precipitation total (average) | 1,168 mm |

## Climate stations used

- (1) GROVESPRING 1NE [USC00233483], Grovespring, MO
- (2) BENTONVILLE 4 S [USC00030586], Bentonville, AR
- (3) VERSAILLES 2W [USC00238603], Versailles, MO
- (4) EVENING SHADE 1 NNE [USC00032366], Evening Shade, AR
- (5) MTN GROVE 2 N [USC00235834], Mountain Grove, MO
- (6) POTOSI 4 SW [USC00236826], Potosi, 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 flow 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

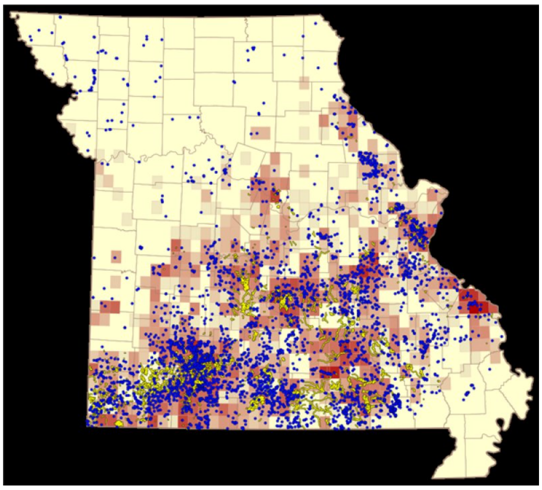


**Figure 9. Distribution of karst-related features in Missouri**

## Soil features

These soils have no rooting restriction, and subsoils are not low in bases. 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 or very gravelly silt loam surface horizons, and skeletal subsoils with high amounts of chert gravel and cobbles. They are not affected by seasonal wetness. Some soils have bedrock between 40 and 60 inches, but this does not significantly affect native vegetation. Soil series associated with this site include Alred, Beemont, Gepp, Gobbler, Goss, Hailey, Mano, Niangua, Ocie, Rueter, and Swiss.

The accompanying picture of the Goss series shows a thin, light-colored surface horizon underlain by very cobbly reddish clay. Scale is in inches. Picture from Henderson (2004).

**Figure 10. Goss series**

**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 loam |
| Family particle size | (1) Clayey |
| Drainage class | Moderately well drained to somewhat excessively drained |
| Permeability class | Very slow to moderately slow |
| Soil depth | 102–183 cm |
| Surface fragment cover <=3" | 15–50% |
| Surface fragment cover >3" | 0–39% |
| Available water capacity (0-101.6cm) | 5.08–15.24 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0% |
| Electrical conductivity (0-101.6cm) | 0–2 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 0 |
| Soil reaction (1:1 water) (0-101.6cm) | 4.5–7.3 |
| Subsurface fragment volume <=3" (Depth not specified) | 35–60% |
| Subsurface fragment volume >3" (Depth not specified) | 2–30% |

## 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.

Chert Protected Backslope Forests occur in the most protected landscape positions on lower, steep slopes in the deeper valleys furthest from the prairie uplands. The historic reference community for Chert Protected Backslope Forests is a well-developed forest canopy (80 to 100 feet tall and 90 to 100 percent canopy closure) and subcanopy dominated by white oak, a structurally diverse understory and an abundant forest ground flora. While the upland prairies and savannas had an estimated fire frequency of 1 to 3 years, Chert Protected Backslope Forests burned less frequently (estimated 10 to 25 years) and with lower intensity.

The composition and structure of the Chert Backslope ecological sites varies in relation to slope aspect. Exposed, south and west facing slopes are doughtier and more fire-prone than are the protected north and east facing slopes, which are relatively cool and moist. These two ecological sites intergrade on neutral, northwest and southeast exposures.

Historically, grazing by native large herbivores, such as bison, elk, and white-tailed deer, and periodic fires kept understory conditions more open. In addition, these ecological types were subject to occasional disturbances from wind and ice, which opened the canopy up by knocking over trees or breaking substantial branches of canopy trees.

Today, these communities have been cleared and converted to pasture, or have undergone repeated timber harvest and domestic grazing. Most existing occurrences have a younger (50 to 80 years) canopy whose composition has been altered by timber harvesting practices. An increase in hickory over historic conditions is common. In addition, in the absence of fire, the canopy, sub-canopy and woody understory layers are better developed. The absence of periodic fire has allowed more shade-tolerant tree species, such as sugar maple, white ash, or hickory to increase in abundance.

Domestic grazing has diminished the diversity and cover of woodland ground flora species, and has introduced weedy species such as gooseberry, coralberry, poison ivy and Virginia creeper created a more open understory and increased soil compaction.

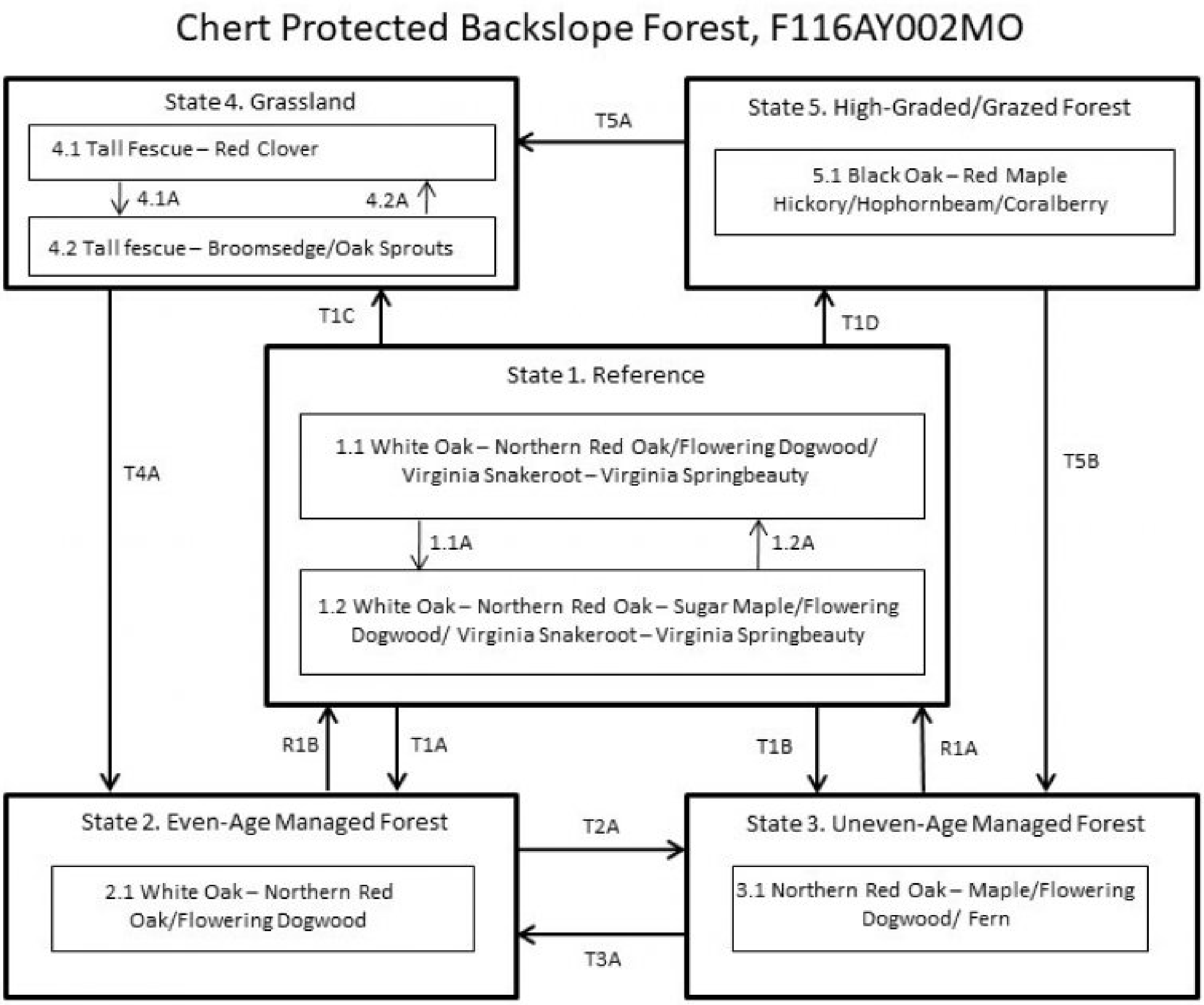
Chert Protective Backslope Forests are some of the most productive timber sites in the Ozark Highlands. Carefully planned single tree selection or the creation of small group openings can help regenerate more desirable oak species and increase vigor on the residual trees. Clear-cutting does occur and results in dense, even-aged stands of primarily oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands, the ground flora diversity can be shaded out and productivity of the stand may suffer.

Prescribed fire can play a beneficial but limited role in the management of this ecological site. The higher productivity of these sites makes it more challenging than on other forest sites in the region. Protected aspect forests did evolve with some fire, but their composition often reflects more closed, forested conditions, with fewer woodland ground flora species that can respond to fire.

Consequently, while having protected aspects in a burn unit is acceptable, targeting them solely for woodland restoration is not advisable.

A State and Transition 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




| Code | Event/Process |
|---|---|
| T1A | Harvesting; even-aged management |
| T1B | Harvesting; uneven-age management |
| T1C, T5A | Clearing; pasture planting |
| T1D | High-grade harvesting; uncontrolled grazing |
| T2A | Uneven-age management |
| T3A | Even-age management |
| T4A, T5A | Tree planting; long-term succession; no grazing |
| T5B | Uneven-age management; tree planting; no grazing |

| Code | Event/Process |
|---|---|
| 1.1A | No disturbance (10+ yrs) |
| 1.2A | Disturbance (fire, wind, ice) < 10 yrs |
| 4.1A | Over grazing; no fertilization |
| 4.2A | Brush management; grassland seeding; grassland management |

| Code | Event/Process |
|---|---|
| R1A | Extended rotations |
| R1B | Uneven-age mgt, extended rotations |

**Figure 11. State and transition diagram for this ecological site**

## State 1

## Reference

The reference state was dominated by white oak and northern red oak. Periodic disturbances from fire, wind or ice maintained the dominance of white oak by opening the canopy and allowing more light for white oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency. Existing reference states are uncommon. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvest coupled with domestic livestock grazing (State 5). Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Many reference sites have been managed for timber harvest, resulting in either even-age (State 2) or uneven-age (State 3) forests.

### Community 1.1
### White Oak – Northern Red Oak/Flowering Dogwood/ Virginia Snakeroot – Virginia Springbeauty

**Figure 12. Reference state at St. Joe State Park, Park Hills, Missouri; photo credit - Dennis Meinert, MDNR**

This community is one of the more productive upland forests in the MLRA. While the overstory is dominated by white oak, northern red oak, black gum can also be common. This forest community has a multi-tiered structure, and a canopy that is tall with 80 to 100 percent closure. The sub-canopy and understory are well developed, with flowering dogwood as a dominant understory tree and sapling. A moderate abundance of shade tolerant forest generalists, such as mayapple, Christmas fern, ticktrefoil and Virginia snakeroot, cover the ground. Periodic disturbances, including fire, ice and wind create canopy gaps, allowing white oak to successfully reproduce and enter the canopy. Periodic disturbances, including fire, ice and wind create canopy gaps, allowing white oak to successfully reproduce and enter the canopy.

**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
### White Oak – Northern Red Oak – Sugar Maple/Flowering Dogwood/ Virginia Snakeroot – Virginia Springbeauty

The overstory is a mixture of white oak and more shade tolerant species such as northern red oak, sugar maple, hickory, white ash and others. This forest community has a multi-tiered structure, and a canopy that is 75 to 100 feet tall with 90 to 100 percent closure. In the absence of disturbance, more shade tolerant species such as northern red oak, sugar maple, hickory, white ash and others increase in importance and add increased structural diversity to the system. In addition, more shade-loving forest shrub (e.g., northern spicebush) and herbaceous (e.g., bloodroot) species also increase.

### Pathway P1.1A
### Community 1.1 to 1.2

This pathway is a gradual transition that results from extended, disturbance-free periods of roughly 50 years or longer.

### Pathway P1.2A
### Community 1.2 to 1.1

This pathway is a transition that results from extended, disturbance periods returning, such as native fires.

### State 2
### Even-Age Managed Forest

These forests tend to be rather dense, with an underdeveloped understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. Continual timber management, depending on the practices used, will either maintain this state, or convert the site to uneven-age (State 3) forests.

#### Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

### Community 2.1
### White Oak - Northern Red Oak/Flowering Dogwood

This is an even-aged forest management phase. Logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak. Large group, shelterwood or clearcut harvests create a more uniform age class structure throughout the canopy layer while also opening up the understory and allowing more sunlight to reach the forest floor.

### State 3
### Uneven-Age Managed Forest

Uneven-Age Managed forests can resemble the reference state. The biggest difference is tree age, most being only 50 to 90 years old. Composition is also 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 such as sugar maple and white oak will become less dominant.

#### Dominant resource concerns

- Plant productivity and health
- Plant structure and composition

- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

### Community 3.1
### Northern Red Oak – Maple/Flowering Dogwood/ Fern

This is an uneven-aged forest management phase. Selective logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak and sugar maple. Densities numbers, especially more shade tolerant species, are increasing in the lower size-class levels.

### State 4
### Grassland

Type conversion of forests to planted, non-native pasture species such as tall fescue has been common in this MLRA. Steep slopes, abundant surface fragments, low organic matter contents and soil acidity make non-native pastures challenging to maintain in a healthy, productive state on this ecological site. If grazing and active pasture management is discontinued, the site will eventually transition to State 2 (Even-Age).

### Community 4.1
### Tall Fescue - Red Clover

This phase is a well-managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring. The effects of long-term liming on soil pH, and calcium and magnesium content, is most evident in this phase. Studies show that these soils have higher pH and higher base status in soil horizons as much as two feet below the surface, relative to poorly managed grassland and to woodland communities (where liming is not practiced).

#### Dominant resource concerns

- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates

### Community 4.2
### Tall Fescue - Broomsedge/Oak Sprouts

This phase is the result of poor grassland management. Over grazing and inadequate or no fertility application has allowed tall fescue, multi-flora rose, thistle and other weedy species to increase in cover and density reducing overall forage quality and site productivity. Clovers will decrease or go away with no fertilization and overgrazing. Soil pH and bases such as calcium and magnesium are lower, relative to well-managed pastures.

#### Dominant resource concerns

- Ephemeral gully erosion
- Nutrients transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

### Pathway P4.1A
### Community 4.1 to 4.2

This pathway is the result of over grazing and lack of proper grassland management.

### Pathway P4.2A
### Community 4.2 to 4.1

This pathway is the result of brush management, grassland re-seeding and proper grassland management.

## State 5
## High-Graded / Grazed Forest

Forested sites subjected to repeated, high-graded 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.

**Dominant resource concerns**

- Ephemeral gully erosion
- Nutrients transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

## Community 5.1
## Black Oak – Red Maple Hickory/Hophornbeam/Coralberry

This is the only phase associated with this state at this time. See the corresponding state narrative for details.

## Transition T1A
## State 1 to 2

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

## Transition T1B
## State 1 to 3

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

## Transition T1C
## State 1 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

## Transition T1D
## State 1 to 5

This transition is the result of high-grade harvesting and uncontrolled domestic livestock grazing. .

## Restoration pathway R1B
## State 2 to 1

This restoration pathway generally requires uneven-age timber management practices, such as single tree or group selection harvest, with extended rotations that allow mature trees to exceed ages of about 120 years.

## Transition T2A

### State 2 to 3

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

### Restoration pathway R1A
### State 3 to 1

This restoration transition is the result of extended rotations and minimal disturbance.

### Transition T3A
### State 3 to 2

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

### Transition T5B
### State 5 to 3

This transition typically results from uneven-age timber management practices, such as single tree or group selection harvest, tree planting and no grazing.

### Transition T5A
### State 5 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

## Additional community tables

**Table 5. Community 1.1 forest overstory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (M) | Canopy Cover (%) | Diameter (Cm) | Basal Area (Square M/Hectare) |
|---|---|---|---|---|---|---|---|
| **Tree** | | | | | | | |
| white oak | QUAL | *Quercus alba* | Native | – | 20–40 | – | – |
| northern red oak | QURU | *Quercus rubra* | Native | – | 20–40 | – | – |
| shagbark hickory | CAOV2 | *Carya ovata* | Native | – | 10–20 | – | – |
| red maple | ACRU | *Acer rubrum* | Native | – | 10–20 | – | – |
| sugar maple | ACSA3 | *Acer saccharum* | Native | – | 10–20 | – | – |
| shortleaf pine | PIEC2 | *Pinus echinata* | Native | – | 10–20 | – | – |
| black oak | QUVE | *Quercus velutina* | Native | – | 10–20 | – | – |

**Table 6. Community 1.1 forest understory composition**

| Common Name | Symbol | Scientific Name | Nativity | Height (M) | Canopy Cover (%) |
|---|---|---|---|---|---|
| **Grass/grass-like (Graminoids)** | | | | | |
| slender woodland sedge | CADI5 | *Carex digitalis* | Native | – | 2–5 |
| rock muhly | MUSO | *Muhlenbergia sobolifera* | Native | – | 2–5 |
| poverty oatgrass | DASP2 | *Danthonia spicata* | Native | – | 2–5 |
| hairy woodland brome | BRPU6 | *Bromus pubescens* | Native | – | 2–5 |
| **Forb/Herb** | | | | | |
| nakedflower ticktrefoil | DENU4 | *Desmodium nudiflorum* | Native | – | 1–5 |
| manyray aster | SYAN2 | *Symphyotrichum anomalum* | Native | – | 1–5 |

| | | | | | |
|---|---|---|---|---|---|
| manyray aster | SYAN2 | *Symphyotrichum anomalum* | Native | – | 1–5 |
| eastern beebalm | MOBR2 | *Monarda bradburiana* | Native | – | 1–5 |
| largebract ticktrefoil | DECU | *Desmodium cuspidatum* | Native | – | 1–5 |
| late purple aster | SYPA11 | *Symphyotrichum patens* | Native | – | 1–5 |
| elmleaf goldenrod | SOUL2 | *Solidago ulmifolia* | Native | – | 1–5 |
| fourleaf milkweed | ASQU | *Asclepias quadrifolia* | Native | – | 1–5 |
| American hogpeanut | AMBR2 | *Amphicarpaea bracteata* | Native | – | 1–5 |
| gravelweed | VEHE | *Verbesina helianthoides* | Native | – | 1–5 |
| Virginia snakeroot | ARSE3 | *Aristolochia serpentaria* | Native | – | 1–5 |
| Virginia springbeauty | CLVI3 | *Claytonia virginica* | Native | – | 1–5 |
| lesser yellow lady's slipper | CYPAP4 | *Cypripedium parviflorum var. parviflorum* | Native | – | 1–5 |
| white fawnlily | ERAL9 | *Erythronium albidum* | Native | – | 1–5 |
| hepatica | HENO2 | *Hepatica nobilis* | Native | – | 1–5 |
| goldenseal | HYCA | *Hydrastis canadensis* | Native | – | 1–5 |
| feathery false lily of the valley | MARA7 | *Maianthemum racemosum* | Native | – | 1–5 |
| wild blue phlox | PHDI5 | *Phlox divaricata* | Native | – | 1–5 |
| mayapple | POPE | *Podophyllum peltatum* | Native | – | 1–5 |
| toadshade | TRSE2 | *Trillium sessile* | Native | – | 1–5 |
| largeflower bellwort | UVGR | *Uvularia grandiflora* | Native | – | 1–5 |
| **Fern/fern ally** | | | | | |
| rattlesnake fern | BOVI | *Botrychium virginianum* | Native | – | 1–5 |
| Christmas fern | POAC4 | *Polystichum acrostichoides* | Native | – | 1–5 |
| lowland bladderfern | CYPR4 | *Cystopteris protrusa* | Native | – | 1–5 |
| ebony spleenwort | ASPL | *Asplenium platyneuron* | Native | – | 1–5 |
| **Shrub/Subshrub** | | | | | |
| northern spicebush | LIBE3 | *Lindera benzoin* | Native | – | 2–5 |
| common serviceberry | AMAR3 | *Amelanchier arborea* | Native | – | 2–5 |
| fragrant sumac | RHAR4 | *Rhus aromatica* | Native | – | 2–5 |
| Blue Ridge blueberry | VAPA4 | *Vaccinium pallidum* | Native | – | 2–5 |
| **Tree** | | | | | |
| blackgum | NYSY | *Nyssa sylvatica* | Native | – | 2–5 |
| hophornbeam | OSVI | *Ostrya virginiana* | Native | – | 2–5 |
| flowering dogwood | COFL2 | *Cornus florida* | Native | – | 2–5 |
| **Vine/Liana** | | | | | |
| Virginia creeper | PAQU2 | *Parthenocissus quinquefolia* | Native | – | 1–5 |
| cat greenbrier | SMGL | *Smilax glauca* | Native | – | 1–5 |
| summer grape | VIAE | *Vitis aestivalis* | Native | – | 1–5 |

## 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.

Bird species associated with early-successional community stages are Prairie Warbler, Field Sparrow, Brown

Thrasher, Blue-winged Warbler, White-eyed Vireo, Blue-gray Gnatcatcher, Yellow-breasted Chat, Indigo Bunting, and Eastern Towhee. Birds associated with mid-successional stages include Whip-poor-will and Wood Thrus while birds associated with late-successional stages include Worm-eating warbler, Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Wood Thrush, Red-eyed Vireo, Northern Parula, Louisiana Waterthrush (near streams), and Broad-winged Hawk.

Reptile and amphibian species associated with mature forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, three-toed box turtle, western worm snake, western earth snake, and American toad.

## Other information

Forestry (NRCS 2002, 2014)

Management: Field measured site index values range from 48 to 75 for oak. Timber management opportunities are good. 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 should be used with caution on a particular site if timber management is the primary objective. Favor white oak and northern red oak.

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: Chert Protected Backslope Forest

Plot HATOSP03 - Alred soil
Located in Ha Ha Tonka State Park, Camden County, MO
Latitude: 37.979681
Longitude: -92.75488949

Plot ALSPNP04 - Rueter soil
Located in Alley Springs National Park Service, Shannon County, MO
Latitude: 37.155582
Longitude: -91.43861515

Plot CAMOCA03 - Ocie soil
Located Caney Mountain CA, Ozark County, MO
Latitude: 36.679196
Longitude: -92.38845

Plot CAMOCA04 - Mano soil
Located Caney Mountain CA, Ozark County, MO
Latitude: 36.699935
Longitude: -92.436296

Plot ONONSP04 - Alred soil
Located Onondaga Cave State Park, Crawford County, MO
Latitude: 38.056048
Longitude: -91.237138

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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 | 12/08/2023 |
| 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:

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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):**

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**

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