USDA Natural Resources Conservation Service

Ecological site F116AY036MO
Wet Upland Drainageway Forest

Last updated: 9/24/2020
Accessed: 05/12/2025

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.

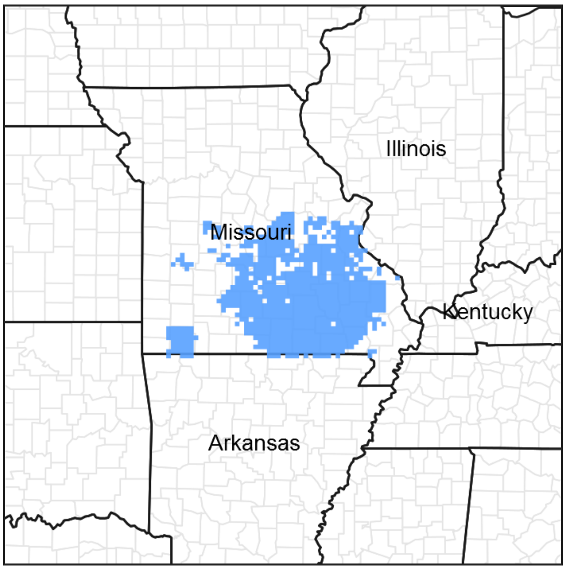


Figure 1. Mapped extent

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 Wet-Mesic Bottomland Forest.

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

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

The reference state for this ecological site is most similar to a Quercus macrocarpa – Quercus shumardii – Carya cordiformis / Chasmanthium latifolium Forest (CEGL004544).

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”.

Wet Upland Drainageway Forests are widely distributed throughout the Ozark Highland. Soils are loamy to clayey and wet, and are subject to flooding. The reference plant community is forest with an overstory dominated by a wide variety of trees including pin oak, bur oak, shellbark hickory, swamp white oak, Shumard oak, and American elm, an understory dominated by American hornbeam, northern spicebush, and Ohio buckeye and a rich herbaceous ground flora.

Associated sites

F116AY016MO	**Chert Dolomite Protected Backslope Forest** Chert Dolomite Protected Backslope Forests, and other upland ecological sites, are upslope.
F116AY018MO	**Loamy Dolomite Upland Woodland** Loamy Dolomite Upland Woodlands, and other upland ecological sites, are upslope.
F116AY048MO	**Chert Dolomite Exposed Backslope Woodland** Chert Dolomite Exposed Backslope Woodlands, and other upland ecological sites, are upslope.

Similar sites

F116AY036MO	**Wet Upland Drainageway Forest** Wet Upland Drainageway Forest has no similar sites.

Table 1. Dominant plant species

Tree	(1) *Quercus palustris* (2) *Quercus macrocarpa*
Shrub	(1) *Vitis*
Herbaceous	(1) *Impatiens capensis* (2) *Carex*

Physiographic features

This site is in narrow drainageways in the uplands, with slopes of 1 to 5 percent. The site receives runoff from adjacent upland sites. Most areas are subject to frequent, brief flooding.

The following figure (adapted from Larsen, 2002) 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. Wet Upland Drainageway forest sites are associated with a variety of upland sites, such as the Chert Dolomite and Loamy Dolomite sites shown here.

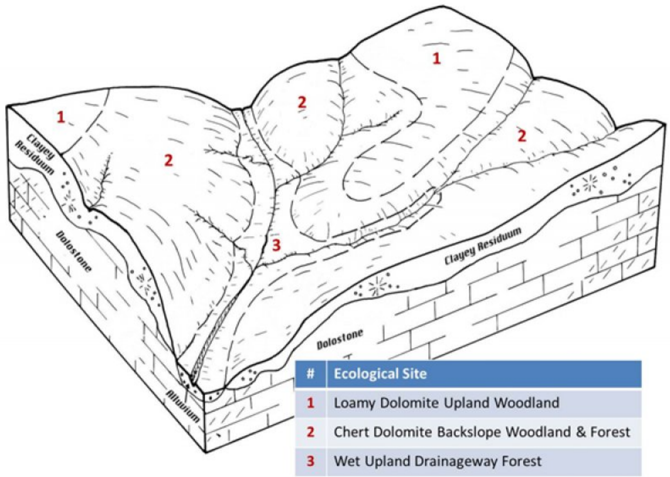


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Drainageway
Flooding duration	Extremely brief (0.1 to 4 hours) to brief (2 to 7 days)
Flooding frequency	Occasional to frequent
Ponding frequency	None
Slope	1–5%
Aspect	Aspect is not a significant factor

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)	142-156 days
Freeze-free period (characteristic range)	181-187 days
Precipitation total (characteristic range)	1,168-1,194 mm
Frost-free period (actual range)	140-160 days
Freeze-free period (actual range)	180-190 days
Precipitation total (actual range)	1,168-1,194 mm
Frost-free period (average)	149 days
Freeze-free period (average)	184 days
Precipitation total (average)	1,194 mm

Climate stations used

- (1) WEST PLAINS [USC00238880], West Plains, MO
- (2) GALENA [USC00233094], Galena, MO
- (3) LICKING 4N [USC00234919], Licking, MO

Influencing water features

This ecological site is influenced by a seasonal high water table, which is typically near the surface in late fall through spring, receding in the summer and contains first- and second-order streams, which originate from headslope positions at the upper reaches of the units, and are fed from smaller headslopes in the adjacent uplands. These streams are ephemeral in most years, with flow in the late fall, winter, and spring months, generally disappearing in the summer, or reduced to isolated pools in the lower reaches. Stream levels typically respond quickly to storm events, especially in watersheds where surface runoff is dominant. Short-duration flooding is common in many areas.

This site is in the SLOPE wetlands class of the Hydrogeomorphic (HGM) classification system (Brinson, 1993), and are Emergent Palustrine wetlands (Cowardin et al., 1979). SLOPE wetlands are found in stream headwaters, slope toes, or at outcrops of low conductivity soil or rock layers. In a stream network, they are found on stream corridor reaches upstream of higher order RIVERINE reaches.

Soil features

These soils have no rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is alluvium. They have loamy surface horizons, and loamy to clayey subsoils. They are affected by a seasonal high water table during the spring months. Soil series associated with this site include Batcave, Baylock, Deible, Falaya, Farewell, Freeburg, Gabriel, Hartville, Higdon, Lostpond, Moniteau, Racoon, Tanglenook, and Westerville.

The accompanying picture of the Deible series shows a clayey subsoil with dull gray colors, indicating seasonal wetness. Scale is in centimeters. Picture courtesy of John Preston, NRCS.

Figure 9. Deible series

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam
Family particle size	(1) Clayey
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Very slow to slow
Soil depth	183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–15.24 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)	5.2–7.3
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

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.

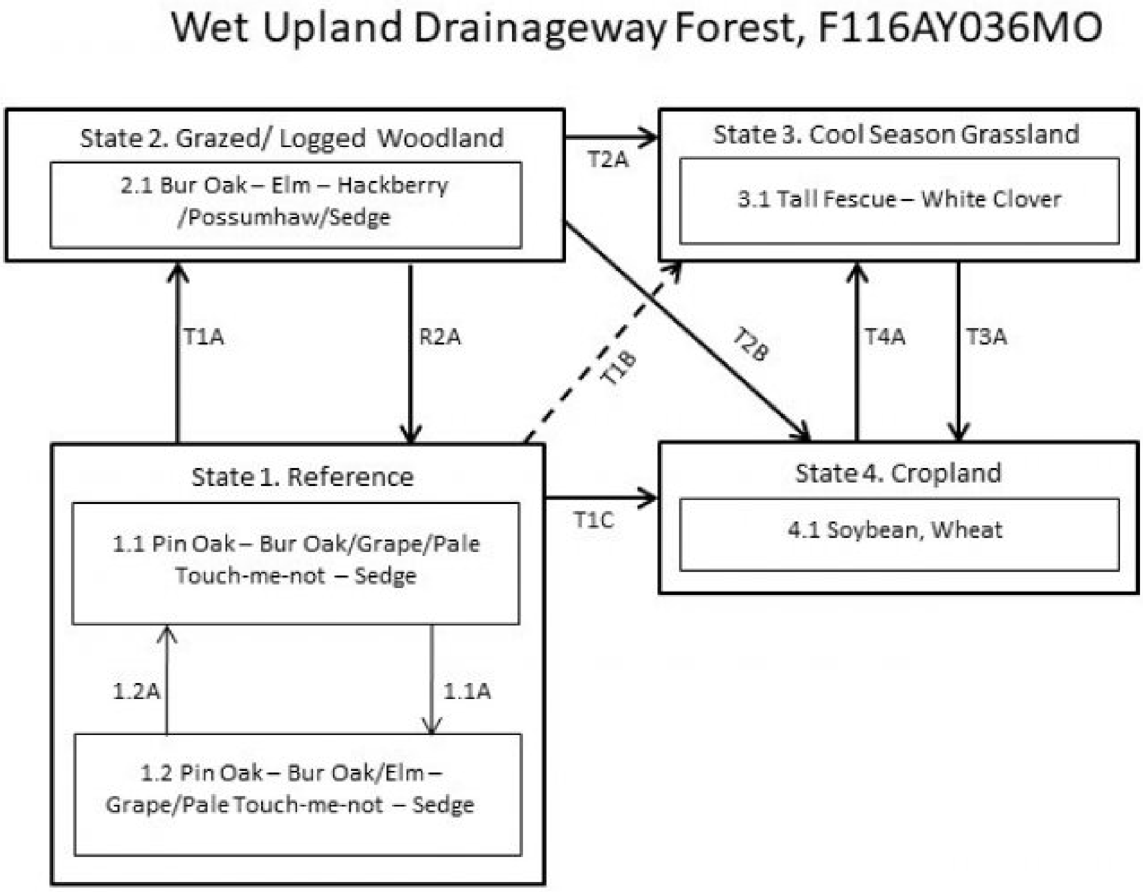
Wet Upland Drainageway Forests have loamy to clayey soil textures and are seasonally wet, limiting the density of trees, creating a more open forest structure. Historically, these forests were dominated by a wide variety of deciduous hardwood tree species, tolerant of seasonally wet conditions. These included pin oak, bur oak, shellbark hickory, swamp white oak, Shumard oak and American elm. Both historically and today, these forests are structurally and compositionally diverse, with occasional tree fall gaps and natural mortality providing opportunities for regeneration of overstory species.

Today many upland drainageways have been cleared and converted to agriculture. Where they still occur, they are denser and their composition is usually altered. However, these areas of forest still play an important role as a source of food and shelter for wildlife. In addition, they are very important in channel stabilization.

Uncontrolled grazing by domestic livestock in these remaining areas of forest damages and kills smaller trees and removes the ground cover. Carefully planned timber harvests can be tolerated on these sites, but high grading of the timber will ultimately degrade the sites. Re-establishment of these riparian forests is important for stream quality and stream health, and as critical habitat for migratory birds. Planting of later successional species on the appropriate landscape position and soils has proven to be an effective means for restoration.

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/Activity/Process
T1A	Grazing; repeated timber harvests
T3A	Tillage; conservation cropping system
T1B,T2A	Woody removal; tillage; vegetative seeding; grassland management
T1C, T2B	Woody removal; tillage; conservation cropping system
T4A	Vegetative seeding ; grassland management
1.1A	Lack of disturbance events 10+ years
1.2A	Disturbance events 2-5 years
R2A	Forest stand improvement;

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The historical reference state for this ecological site was old growth oak forest. The forest was dominated by a wide variety of deciduous hardwood tree species, tolerant of seasonally wet conditions. Periodic disturbances from flooding, fire, wind or ice as well as grazing by native large herbivores maintained the forest 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 disturbance frequency. Reference states are very rare today. Fire suppression and altered drainage have resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Most reference states are currently altered because of timber harvesting, clearing and conversion to grassland or cropland.

Dominant plant species

- pin oak (*Quercus palustris*), tree
- bur oak (*Quercus macrocarpa*), tree
- grape (*Vitis*), shrub
- sedge (*Carex*), grass
- pale touch-me-not (*Impatiens pallida*), other herbaceous

Community 1.1
Pin Oak – Bur Oak/Grape/Pale Touch-me-not – Sedge

Two community phases are recognized in the reference state, with shifts between phases based on disturbance frequency.

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
Pin Oak – Bur Oak/Elm Saplings – Grape/Pale Touch-me-not – Sedge

Two community phases are recognized in the reference state, with shifts between phases based on disturbance frequency.

Pathway P1.1A
Community 1.1 to 1.2

Lack of disturbance events 10 plus years

Pathway P1.2A
Community 1.2 to 1.1

Disturbance event 2-5 years.

State 2
Grazed/ Logged Forest

Composition is altered from the reference state depending on tree selection during harvest. This state will slowly increase in more shade tolerant species and swamp white oak and bur oak will become less dominant. Without periodic canopy disturbance, stem density and fire intolerant species, like hackberry, will increase in abundance. Some periodic grazing may be occurring.

Dominant plant species

- pin oak (*Quercus palustris*), tree

- elm (*Ulmus*), tree
- hackberry (*Celtis*), tree
- possumhaw (*Ilex decidua*), shrub
- sedge (*Carex*), grass

Community 2.1
Bur Oak – Elm – Hackberry /Possumhaw/Sedge

Forest overstory. Forest Overstory Composition species list based on Nelson (2010) and field surveys.

Forest understory. Forest Understory Composition species list based on Nelson (2010) and field surveys.

State 3
Cool Season Grassland

Conversion of other states to non-native cool season species such as tall fescue, orchard grass, and white clover has been common. Occasionally, these pastures will have scattered oaks. Long term uncontrolled grazing can cause significant soil erosion and compaction. A return to the reference state may be impossible, requiring a very long term series of management options and transitions.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- white clover (*Trifolium repens*), other herbaceous

Community 3.1
Tall Fescue – White Clover

State 4
Cropland

This is a state that exists currently with intensive cropping of primarily soybeans and wheat. Some conversion to non-native cool season hay land occurs, but when commodity prices are high, these states transition back to cropland.

Dominant plant species

- wheat (*Triticum*), grass
- soybean (*Glycine max*), other herbaceous

Community 4.1
Soybean, Wheat

Transition T1A
State 1 to 2

Lack of disturbance events greater than 20 years ; repeated timber harvests; grazing.

Transition T1B
State 1 to 3

Woody removal; tillage; vegetative seeding; grassland management.

Transition T1C
State 1 to 4

Woody removal; tillage; conservation cropping system.

Restoration pathway R2A
State 2 to 1

Forest stand improvement. prescribed fire

Transition T2A
State 2 to 3

Woody removal; tillage; vegetative seeding; grassland management.

Transition T2B
State 2 to 4

Woody removal; tillage; conservation cropping system.

Transition T3A
State 3 to 4

Tillage; conservation cropping system.

Transition T4A
State 4 to 3

Vegetative seeding; grassland management.

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							
pin oak	QUPA2	*Quercus palustris*	Native	–	–	–	–
slippery elm	ULRU	*Ulmus rubra*	Native	–	–	–	–
eastern cottonwood	PODE3	*Populus deltoides*	Native	–	–	–	–
bitternut hickory	CACO15	*Carya cordiformis*	Native	–	–	–	–
pecan	CAIL2	*Carya illinoinensis*	Native	–	–	–	–
shellbark hickory	CALA21	*Carya laciniosa*	Native	–	–	–	–
sugarberry	CELA	*Celtis laevigata*	Native	–	–	–	–
green ash	FRPE	*Fraxinus pennsylvanica*	Native	–	–	–	–
swamp white oak	QUBI	*Quercus bicolor*	Native	–	–	–	–
bur oak	QUMA2	*Quercus macrocarpa*	Native	–	–	–	–
Shumard's oak	QUSH	*Quercus shumardii*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Indian woodoats	CHLA5	*Chasmanthium latifolium*	Native	–	–
soft fox sedge	CACO13	*Carex conjuncta*	Native	–	–
Gray's sedge	CAGR5	*Carex grayi*	Native	–	–

false hop sedge	CALU3	*Carex lupuliformis*	Native	–	–
hop sedge	CALU4	*Carex lupulina*	Native	–	–
Muskingum sedge	CAMU9	*Carex muskingumensis*	Native	–	–
squarrose sedge	CASQ2	*Carex squarrosa*	Native	–	–
sweet woodreed	CIAR2	*Cinna arundinacea*	Native	–	–
fowl mannagrass	GLST	*Glyceria striata*	Native	–	–
woodland muhly	MUSY	*Muhlenbergia sylvatica*	Native	–	–
whitegrass	LEVI2	*Leersia virginica*	Native	–	–
Forb/Herb					
starry rosinweed	SIAS2	*Silphium asteriscus*	Native	–	–
hairy skullcap	SCEL	*Scutellaria elliptica*	Native	–	–
bearded shorthusk	BRER2	*Brachyelytrum erectum*	Native	–	–
hepatica	HENO2	*Hepatica nobilis*	Native	–	–
fewflower ticktrefoil	DEPA7	*Desmodium pauciflorum*	Native	–	–
panicledleaf ticktrefoil	DEPA6	*Desmodium paniculatum*	Native	–	–
Canadian lousewort	PECA	*Pedicularis canadensis*	Native	–	–
blisterwort	RARE2	*Ranunculus recurvatus*	Native	–	–
dotted smartweed	POPU5	*Polygonum punctatum*	Native	–	–
watercress	NAOF	*Nasturtium officinale*	Native	–	–
devil's beggartick	BIFR	*Bidens frondosa*	Native	–	–
Alabama supplejack	BESC	*Berchemia scandens*	Native	–	–
smallspike false nettle	BOCY	*Boehmeria cylindrica*	Native	–	–
jewelweed	IMCA	*Impatiens capensis*	Native	–	–
pale touch-me-not	IMPA	*Impatiens pallida*	Native	–	–
cutleaf coneflower	RULA3	*Rudbeckia laciniata*	Native	–	–
calico aster	SYLAA	*Symphyotrichum lateriflorum var. angustifolium*	Native	–	–
wingstem	VEAL	*Verbesina alternifolia*	Native	–	–
foxglove beardtongue	PEDI	*Penstemon digitalis*	Native	–	–
Canadian clearweed	PIPU2	*Pilea pumila*	Native	–	–
bristly buttercup	RAHI	*Ranunculus hispidus*	Native	–	–
limestone wild petunia	RUST2	*Ruellia strepens*	Native	–	–
blue skullcap	SCLA2	*Scutellaria lateriflora*	Native	–	–
giant goldenrod	SOGI	*Solidago gigantea*	Native	–	–
Fern/fern ally					
sensitive fern	ONSE	*Onoclea sensibilis*	Native	–	–
rattlesnake fern	BOVI	*Botrychium virginianum*	Native	–	–
Christmas fern	POAC4	*Polystichum acrostichoides*	Native	–	–
Shrub/Subshrub					
common buttonbush	CEOC2	*Cephalanthus occidentalis*	Native	–	–
American bladdernut	STTR	*Staphylea trifolia*	Native	–	–
gray dogwood	CORA6	*Cornus racemosa*	Native	–	–
Tree					
Ohio buckeye	AEGL	*Aesculus glabra*	Native	–	–
American hornbeam	CACA18	*Carpinus caroliniana*	Native	–	–

possumhaw	ILDE	*Ilex decidua*	Native	–	–
Vine/Liana					
eastern poison ivy	TORA2	*Toxicodendron radicans*	Native	–	–
heartleaf peppervine	AMCO2	*Ampelopsis cordata*	Native	–	–
trumpet creeper	CARA2	*Campsis radicans*	Native	–	–
riverbank grape	VIRI	*Vitis riparia*	Native	–	–
frost grape	VIVU	*Vitis vulpina*	Native	–	–

Animal community

Wildlife (MDC 2006):

Ephemeral pools provide important amphibian breeding habitat.

Bird species associated with these sites include Indigo Bunting, Willow Flycatcher, Yellow Warbler, Red-headed Woodpecker, Eastern Wood-Pewee, Great Crested Flycatcher, Tree Swallow, Orchard Oriole, and Baltimore Oriole.

Reptile and amphibian species associated with these sites include tiger salamander, small-mouthed salamander, midland brown snake, gray treefrog, plains leopard frog, southern leopard frog, and western chorus frog.

Other information

Forestry (NRCS 2002; 2014):

Management: Field measured site index values range from 55 to 70. On the wettest sites, timber management opportunities may be limited. Use seed-tree, group selection, or clear cutting regeneration methods. Harvest favoring reproduction of the less-shade tolerant species such as pin oak, swamp white oak and bur oak, sycamore, and cottonwood. Maintain adequate riparian buffer areas.

Limitations: Wetness from flooding; Use of equipment may be restricted in spring and other excessively wet periods. Restrict activities to dry periods or surfaced areas. Equipment use when wet may compact soil and damage tree roots. Unsurfaced roads and traffic areas tend to be slippery and form ruts easily. Access to forests is easiest during periods in late summer or winter when soils are frozen or dry. Planting is extremely difficult during spring periods. Seedling mortality may be high due to excess wetness. Unsurfaced roads and skid trails may be impassable during rainy periods.

Inventory data references

Potential Reference Sites: Wet Upland Drainageway Forest

Plot CURINP03 - Batcave soil
Located in Current River NPS, Shannon County, MO
Latitude: 37.120929
Longitude: -91.177394

Plot ROCRCA01 – Batcave soil
Located in Rocky Creek CA, Shannon County, MO
Latitude: 37.170924
Longitude: - -91.204562

Plot CHCRNC01 – Batcave soil
Located in Chilton Creek TNC, Carter County, MO
Latitude: 37.075494
Longitude: -91.064007

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.

Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4, U.S. Army Corps of Engineers, Engineer Waterways Experiment Station, Vicksburg, MS.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Dept. of Interior, Fish & Wildlife Service, Office of Biological Services, Washington DC.

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.

Larsen, Scott E. 2002. Soil Survey of Phelps County, Missouri. U.S. Dept. of Agric. Natural Resources Conservation Service.

Missouri Department of Conservation. 2010. 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.

NatureServe, 2010. Vegetation Associations of Missouri (revised). NatureServe, St. Paul, Minnesota.

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.

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.

Contributors

Fred Young
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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	05/12/2025
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:**
