

Ecological site F116BY015MO Loamy Terrace Woodland

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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.

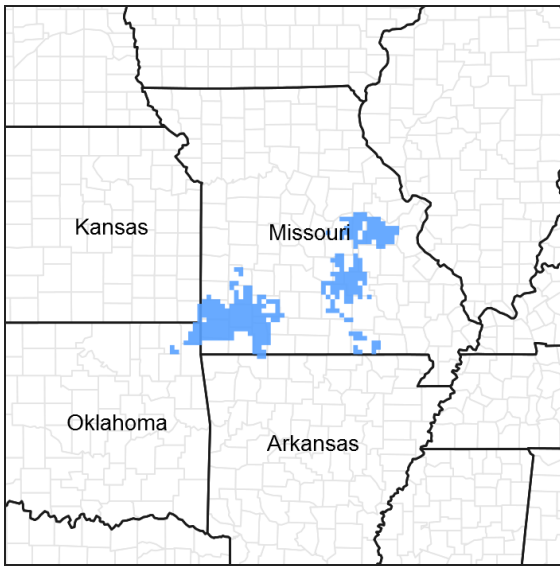


Figure 1. Mapped extent

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): 116B–Springfield Plain

The Springfield Plain is in the western part of the Ozark Uplift. It is primarily a smooth plateau with some dissection along streams. Elevation is about 1,000 feet in the north to over 1,700 feet in the east along the Burlington Escarpment adjacent to the Ozark Highlands. The underlying bedrock is mainly Mississippian-aged limestone, with areas of shale on lower slopes and structural benches, and intermittent Pennsylvanian-aged sandstone deposits on the plateau surface.

Classification relationships

Terrestrial Natural Community Type in Missouri (Nelson, 2010):

The reference state for this ecological site is most similar to a Mesic Bottomland Woodland.

Missouri Department of Conservation Forest and Woodland Communities (Missouri Department of Conservation, 2006):

The reference state for this ecological site is most similar to a Mixed Hardwood Mesic Bottomland Forest.

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

The reference state for this ecological site is most similar to an *Acer saccharum* - *Quercus rubra* - *Carya cordiformis*

/ *Asimina triloba* Forest (CEGL002060).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):

This ecological site occurs primarily within the following Land Type Associations:

Shoal Creek Oak Savanna/Woodland Low Hills

Spring River Prairie/Savanna Dissected Plain

Upper Sac River Oak Savanna/Woodland Low Hills

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”.

Loamy Terrace Woodlands occur on floodplain steps and low stream terraces throughout the Springfield Plain. Soils are very deep and loamy, and are subject to flooding. The historic reference condition is a woodland dominated by an overstory of Shumard oak and white oak.

Associated sites

F116BY002MO	Loamy Floodplain Forest Loamy Floodplain Forests and other floodplain ecological sites are downslope.
F116BY006MO	Chert Limestone Upland Woodland Chert Limestone Upland Woodlands and other upland ecological sites are upslope.
F116BY014MO	Wet Terrace Woodland Wet Terrace Woodlands are often adjacent, where soils are somewhat poorly drained.

Similar sites

F116BY013MO	Loamy Footslope Woodland Loamy Footslope Woodlands were higher on the landscape but species composition was generally similar. The sites were generally less productive.
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Table 1. Dominant plant species

Tree	(1) <i>Quercus alba</i> (2) <i>Quercus shumardii</i>
Shrub	(1) <i>Cercis canadensis</i>
Herbaceous	(1) <i>Elymus virginicus</i> (2) <i>Carex</i>

Physiographic features

This site is on floodplain steps with slopes of 0 to 1 percent. The site generates some runoff to adjacent lower floodplain sites, and receives some runoff from higher stream terraces and uplands. Although this site is subject to flooding, ecological processes more closely resemble those of stream terrace systems.

The following figure (adapted from Kichler and Henderson, 1999) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites. This site is within the area labeled “4”, and is typically on floodplain steps, above the level of the most active floodplain, labeled “5”, and adjacent to the uplands, labeled “1”. In some areas a Wet Terrace Woodland ecological site is present, directly above the Loamy Terrace site, labeled on the figure as “3”.

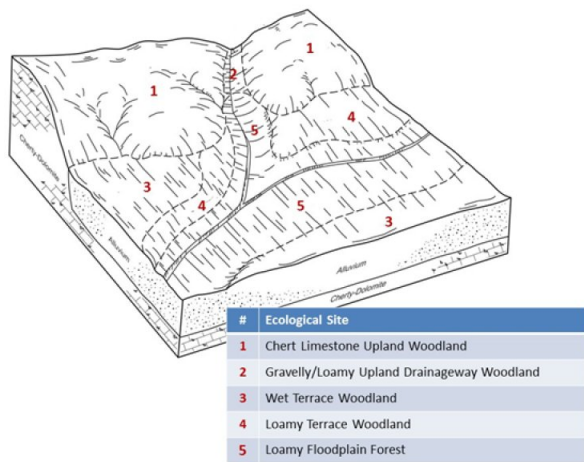


Figure 2. Landscape relationships for this ecological site

Table 2. Representative physiographic features

Landforms	(1) Flood-plain step (2) Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Occasional
Ponding frequency	None
Slope	0–1%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

The Springfield Plain 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 Springfield Plain experiences few regional differences in climates. The average annual precipitation in this area is 41 to 45 inches. Snow falls nearly every winter, but the snow cover lasts for only a few days. The average annual temperature is about 55 to 58 degrees F. The lower temperatures occur at the higher elevations. Mean July maximum temperatures have a range of only one or two degrees across the area.

Mean annual precipitation varies along a west to east 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)	149-162 days
Freeze-free period (characteristic range)	185-194 days
Precipitation total (characteristic range)	1,143-1,194 mm
Frost-free period (actual range)	143-162 days
Freeze-free period (actual range)	182-196 days
Precipitation total (actual range)	1,143-1,219 mm
Frost-free period (average)	155 days
Freeze-free period (average)	189 days
Precipitation total (average)	1,168 mm

Climate stations used

- (1) NEOSHO [USC00235976], Neosho, MO
- (2) CARTHAGE [USC00231356], Carthage, MO
- (3) SPRINGFIELD [USW00013995], Springfield, MO

Influencing water features

This ecological site is typically associated with, but not adjacent to, a perennial stream. Stream levels typically respond quickly to storm events, especially in watersheds where surface runoff is dominant. Short- to medium-duration flooding is common in many areas, particularly during spring and early summer storm events. However, scour and deposition are uncommon, so the effects on ground flora are minimal. Constructed levees, often accompanied by stream channelization, have altered the hydrology and flooding dynamics in many places.

Soil features

These soils have no rooting restriction. They were formed under a mixture of prairie and woodland vegetation. Parent material is alluvium. They have silt loam surface horizons, and loamy subsoils that may be skeletal. They are not affected by seasonal wetness. Soil series associated with this site include Bearthicket and Secesh.

The accompanying picture of the Secesh series shows a dark brown loam surface horizon over a brown silty clay loam subsoil. Very gravelly, loamy sediments are below about 30 inches in this picture. Scale is in feet. Picture courtesy of Dennis Meinert, Missouri Department of Natural Resources.



Figure 9. Secesh series

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow
Soil depth	183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	17.78–20.32 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)	5.1–7.3
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.

Loamy Terrace Woodlands occur along most streams throughout the region. The historic reference condition is woodland dominated by an overstory of Shumard oak and white oak, with scattered bur oak and hickory. The

canopy is moderately tall but somewhat closed with a dense understory of native grasses and forbs. Increased light from the more open canopy causes a diversity of woodland ground flora species to flourish. Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving 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, and tree height growth.

Because of their proximity to prairies, fire played a significant role in the maintenance of these systems. It is likely that these ecological sites burned at least once every 3 to 5 years. 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.

Loamy Terrace Woodlands were also subjected to occasional disturbances from flooding, 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 native herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction and woodland ground flora species.

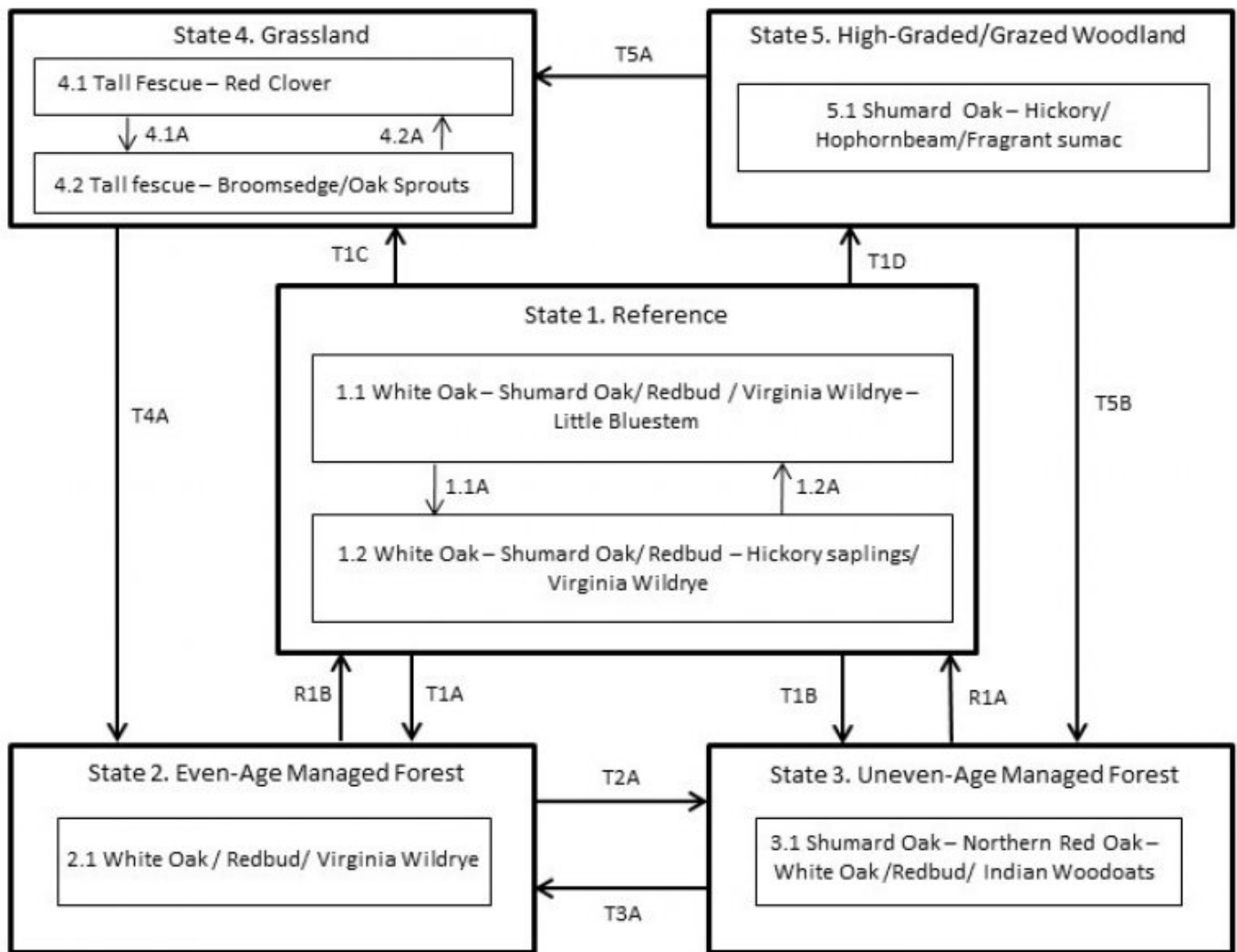
Today, these ecological sites have been cleared and converted to pasture or cropland or have undergone repeated timber harvest and domestic grazing. Most existing forested ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices. In the long term absence of fire, woody species, especially hickory and sugar maple, encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration means.

These ecological sites are productive. Oak regeneration is typically problematic. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects. Single tree selection timber harvests are common in this region and often results in removal of the most productive trees (high grading) in the stand leading to poorer quality timber and a shift in species composition away from more valuable oak species. Better planned single tree selection or the creation of group openings can help regenerate and maintain more desirable oak species and increase vigor on the residual trees.

Clearcutting also occurs and results in dense, even-aged stands dominated by 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 and application of prescribed fire, the ground flora diversity can be shaded out and diversity of the stand may suffer.

State and transition model

Loamy Terrace Woodland, F116BY015MO



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

Code	Activity/Event/Process
1.1A	No disturbance (10+ years)
1.2A	Disturbances (fire, wind, ice) 3-5 years
4.1A	Over grazing; no fertilization
4.2A	Brush management; grassland seeding; grassland management

Code	Activity/Event/Process
R1A, R1B	Extended rotations; prescribed fire; forest stand improvement

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The reference state was dominated by white oak and black oak. Periodic disturbances from fire, wind or ice maintained the dominance of oaks by opening up the canopy and allowing more light for oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as hickory and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency. The reference state is rare today. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvest coupled with uncontrolled domestic livestock grazing (State 5). Fire suppression has also 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 – Shumard Oak/ Eastern Redbud / Virginia Wildrye – Little Bluestem

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 – Black Oak/Eastern Redbud – Hickory/ Virginia Wildrye – Sedge

Pathway P1.1A

Community 1.1 to 1.2

No disturbances (10+ years)

Pathway P1.2A

Community 1.2 to 1.1

Disturbances (fire, wind, ice) 3-5 years

State 2

Even-Age Managed Forest

These former woodland are now rather dense, with an under developed 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 structure and composition
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

Community 2.1

White Oak – Black Oak/ Red Bud/ Wildrye

State 3

Uneven-Age Managed Forest

Composition and age are 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 hickory and white oak will become less dominant.

Dominant resource concerns

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

Community 3.1

Shumard Oak – Northern Red Oak – White Oak /Redbud/ Indian Woodoats

State 4

Grassland

Conversion of forests to planted, non-native pasture species such as tall fescue has been common in this MLRA. Steep slopes, 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, over time, to State 2 (Even-Age).

Community 4.1

Tall Fescue - Red Clover

Dominant resource concerns

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

Community 4.2

Tall fescue - Broomsedge/Oak Sprouts

Dominant resource concerns

- Sheet and rill erosion
- 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

Over grazing; no fertilization

Pathway P4.2A

Community 4.2 to 4.1

Brush management; grassland seeding; grassland management

State 5

High-Graded/Grazed Woodland

Woodland 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. Exclusion of livestock from sites in this state coupled with uneven-age management techniques will cause a transition to State 3 (Uneven-Age).

Dominant resource concerns

- Ephemeral gully erosion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

Community 5.1

Black Oak – Hickory/ Hophornbeam/Buckbrush

Transition T1A

State 1 to 2

Harvesting; even-aged management; fire suppression

Transition T1B

State 1 to 3

Harvesting; uneven-age management; fire suppression

Transition T1C

State 1 to 4

Clearing; grassland planting; grassland management

Transition T1D

State 1 to 5

High-grade harvesting; uncontrolled grazing

Restoration pathway R1B

State 2 to 1

Extended rotations; prescribed fire; forest stand improvement

Transition T2A

State 2 to 3

Uneven-age management

Restoration pathway R1A

State 3 to 1

Extended rotations; prescribed fire; forest stand improvement

Transition T3A

State 3 to 2

Even-age management; thinning

Transition T4A

State 4 to 2

Tree planting; long-term succession; no grazing

Transition T5B

State 5 to 3

Uneven-age management; tree planting; no grazing

Transition T5A

State 5 to 4

Clearing; grassland planting; 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							
northern red oak	QURU	<i>Quercus rubra</i>	Native	–	10–20	–	–
mockernut hickory	CATO6	<i>Carya tomentosa</i>	Native	–	10–20	–	–
bitternut hickory	CACO15	<i>Carya cordiformis</i>	Native	–	10–20	–	–
white oak	QUAL	<i>Quercus alba</i>	Native	–	10–20	–	–
shellbark hickory	CALA21	<i>Carya laciniosa</i>	Native	–	10–20	–	–
Shumard's oak	QUSH	<i>Quercus shumardii</i>	Native	–	10–20	–	–
bur oak	QUMA2	<i>Quercus macrocarpa</i>	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)					
Virginia wildrye	ELVI3	<i>Elymus virginicus</i>	Native	–	5–20
eastern star sedge	CARA8	<i>Carex radiata</i>	Native	–	5–20
eastern bottlebrush grass	ELHY	<i>Elymus hystrix</i>	Native	–	5–20
James' sedge	CAJA2	<i>Carex jamesii</i>	Native	–	5–20
Indian woodoats	CHLA5	<i>Chasmanthium latifolium</i>	Native	–	5–20
American beakgrain	DIAM	<i>Diarrhena americana</i>	Native	–	5–20
Forb/Herb					
American hogpeanut	AMBR2	<i>Amphicarpaea bracteata</i>	Native	–	5–20
American bellflower	CAAM18	<i>Campanulastrum americanum</i>	Native	–	5–20
eastern beebalm	MOBR2	<i>Monarda bradburiana</i>	Native	–	5–20
eastern purple coneflower	ECPU	<i>Echinacea purpurea</i>	Native	–	5–20
cutleaf coneflower	RULA3	<i>Rudbeckia laciniata</i>	Native	–	5–20
roundleaf ragwort	PAOB6	<i>Packera obovata</i>	Native	–	5–20
clustered blacksnakeroot	SAOD	<i>Sanicula odorata</i>	Native	–	5–20
bur-reed sedge	CASP3	<i>Carex sparganioides</i>	Native	–	5–20
bearded shorthusk	BRER2	<i>Brachyelytrum erectum</i>	Native	–	5–20
Shrub/Subshrub					
eastern redbud	CECA4	<i>Cercis canadensis</i>	Native	–	5–10
American hazelnut	COAM3	<i>Corylus americana</i>	Native	–	5–10
burningbush	EUAT5	<i>Euonymus atropurpureus</i>	Native	–	5–10

Animal community

Wildlife Species (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.

Birds associated with late-successional woodlands are Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Yellow-billed Cuckoo, Summer Tanager, Wood Thrush, Red-eyed Vireo, Scarlet Tanager, Black-and-white Warbler (Ozark Border), Northern Parula (near streams), and Louisiana Waterthrush (near streams).

Reptiles and amphibians associated with these sites include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, small-mouthed salamander, three-toed box turtle, ground skink, western worm snake, western earth snake, and American toad.

Other information

Forestry (NRCS 2002; 2014)

Management: Estimated site index values range from 60 to 70. 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 small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Maintain adequate riparian buffer areas.

Limitations: No major limitations or restrictions. Occasional periods of seasonal wetness; Use of equipment may be restricted in spring and other excessively wet periods. Equipment use when wet may compact soil and damage tree roots. Tree planting may be difficult during spring flooding periods.

Inventory data references

Potential Reference Sites: Loamy Terrace Woodland

No quality reference sites are known to exist

Other references

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Contributors

Doug Wallace
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Approval

Nels Barrett, 10/07/2020

Acknowledgments

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

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	09/24/2020
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**
