USDA Natural Resources Conservation Service

Ecological site F116CY008MO
Claypan Basin Flatwoods

Last updated: 9/24/2020
Accessed: 05/03/2024

General information

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

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 116C–St. Francois Knobs and Basins

The St Francois Knobs and Basins is the structural center of the Ozark Dome. Elevation ranges from about 450 feet along the rivers in the southern part of the area, to 1,772 feet on the summit of Taum Sauk Mountain, the highest point in Missouri. Prominent features of this MLRA are the Precambrian igneous knobs and hills that rise conspicuously to various elevations, interspersed with smooth-floored basins and valleys overlying dolomite and sandstone. Ecological Sites defined for this MLRA are associated with the igneous parent materials, either in knob or basin positions. Areas influenced primarily by dolomite and/or sandstone are included in ecological sites within MLRA 116A (Ozark Highlands).

Classification relationships

Terrestrial Natural Community Type (Nelson, 2010):
The reference state for this ecological site is most similar to an Upland Flatwoods.

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 Post Oak Woodland.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus stellata / Cinna arundinacea Flatwoods Forest (CEGL002405).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs primarily within the following Land Type Associations:
Roselle Oak Woodland Upland Igneous Plain
St. Francois Igneous Glade/Oak Forest Knobs

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. As additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”.

Claypan Basin Flatwoods occur mainly in the north part of the area, and in outlying igneous basins in adjacent counties. Soils have a silty clay subsoil that perches water in the spring, and affects rooting depth. These sites are typically adjacent to Fragipan Basin Woodland ecological sites, which on slightly higher, more convex positions and are not as wet. The reference plant community is woodland with an overstory dominated by white oak and post oak and a ground flora of wet-tolerant grasses, sedges and forbs.

Associated sites

F116CY009MO	**Fragipan Basin Woodland** Fragipan Basin Woodlands are on higher, more convex positions within the basin landscape.

Similar sites

F116CY009MO	**Fragipan Basin Woodland** Fragipan Basin Woodlands are on higher, more convex positions within the basin landscape but have similar canopy structure and composition.

Table 1. Dominant plant species

Tree	(1) *Quercus velutina* (2) *Quercus stellata*
Shrub	(1) *Hypericum hypericoides*
Herbaceous	(1) *Schizachyrium scoparium* (2) *Carex*

Physiographic features

This site is in both basin and mountain landscapes, on broad upland summit interfluves and divides, with slopes of 0 to 5 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Brown and Gregg, 1991) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the igneous basins. It is within the area labeled “1”.

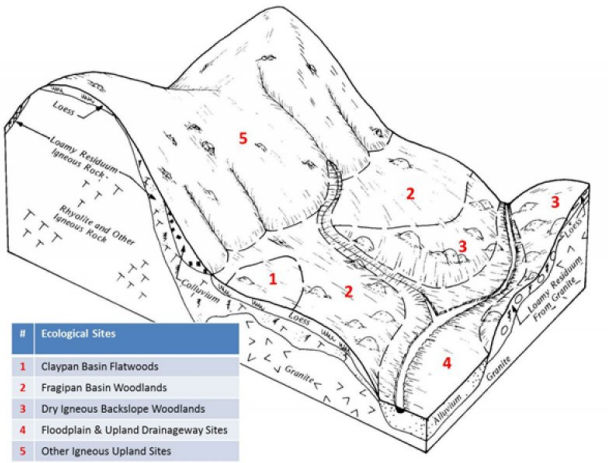


Figure 2. Major ecological sites of the igneous basins

Table 2. Representative physiographic features

Landforms	(1) Divide (2) Interfluve
Flooding frequency	None
Elevation	152–366 m
Slope	0–5%
Water table depth	38–51 cm
Aspect	Aspect is not a significant factor

Climatic features

The St. Francois Knobs and Basins have 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 St. Francois Knobs and Basins experience few regional differences in climates. The average annual precipitation in this area is 42 to 46 inches. The average annual temperature is about 54 to 56 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 somewhat along a west to east gradient. The rainfall is fairly evenly distributed throughout the year. Snow falls nearly every winter, but the snow cover lasts for only a few days.

During years when precipitation is normal, moisture is stored in the soil profile 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. For example, air drainage at night may produce temperatures several degrees lower in this and in nearby basin ecological sites relative to upslope sites. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in this ecological site. Upslope Glade ecological sites may have higher daytime temperatures due to bare rock and higher reflectivity of these un-vegetated surfaces. Finally, the climate within closed-canopy woodland communities is measurably different from the climate of open-canopy woodlands within this ecological site.

References:
University of Missouri Climate Center - http://climate.missouri.edu/climate.php;

United States Department of Agriculture, Natural Resources Conservation Service. 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.

Table 3. Representative climatic features

Frost-free period (characteristic range)	137-145 days
Freeze-free period (characteristic range)	164-169 days
Precipitation total (characteristic range)	1,143-1,194 mm
Frost-free period (actual range)	136-148 days
Freeze-free period (actual range)	163-170 days
Precipitation total (actual range)	1,143-1,194 mm
Frost-free period (average)	141 days
Freeze-free period (average)	166 days
Precipitation total (average)	1,168 mm

Climate stations used

- (1) FREDERICKTOWN [USC00233038], Fredericktown, MO
- (2) ARCADIA [USC00230224], Arcadia, MO
- (3) FARMINGTON [USC00232809], Farmington, MO

Influencing water features

This ecological site is influenced by a seasonal high-water table, perched on the clayey subsoil. Some depressional areas pond for short periods of time, mostly in the spring. Unaltered areas were Emergent Palustrine Temporarily Flooded and Intermittently Flooded wetlands (Cowardin et al., 1979).

Soil features

These soils have an abrupt textural change to silty clay or clay at about 18 inches, which impedes but does not exclude rooting. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. They have silt loam surface horizons, and silty clay to clay subsoils. Parent material is loess over pedisediment weathered from acidic volcanic rock such as granite. A seasonal high water table is perched above the abrupt textural change during the spring months in most years. Soil series associated with this site include Ogborn and Loughboro.

Table 4. Representative soil features

Parent material	(1) Loess (2) Pedisediment (3) Residuum–granite
Surface texture	(1) Silt loam
Family particle size	(1) Clayey
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Very 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)	3.5–6
Subsurface fragment volume <=3" (Depth not specified)	0–1%
Subsurface fragment volume >3" (Depth not specified)	0–1%

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.

Claypan Basin Flatwoods are dominated by short (40 to 60 feet) open grown black oak, with scattered white, post and northern red oaks. Canopy closure is 50 to 80 percent. Historically this was the one of the most open of the Ozark woodland communities. The understory canopy is also open with a dense ground flora of native grasses and forbs.

The claypan soil subsoil perches water in the spring and affects rooting depth of this ecological site limiting the growth of trees and supporting an abundance of native grasses and forbs in the understory. Fire played an important role in the maintenance of these systems as well. It is likely that these ecological sites, along with adjacent glades and woodlands burned at least once every 5 to 10 years. These periodic fires would have kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs.

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

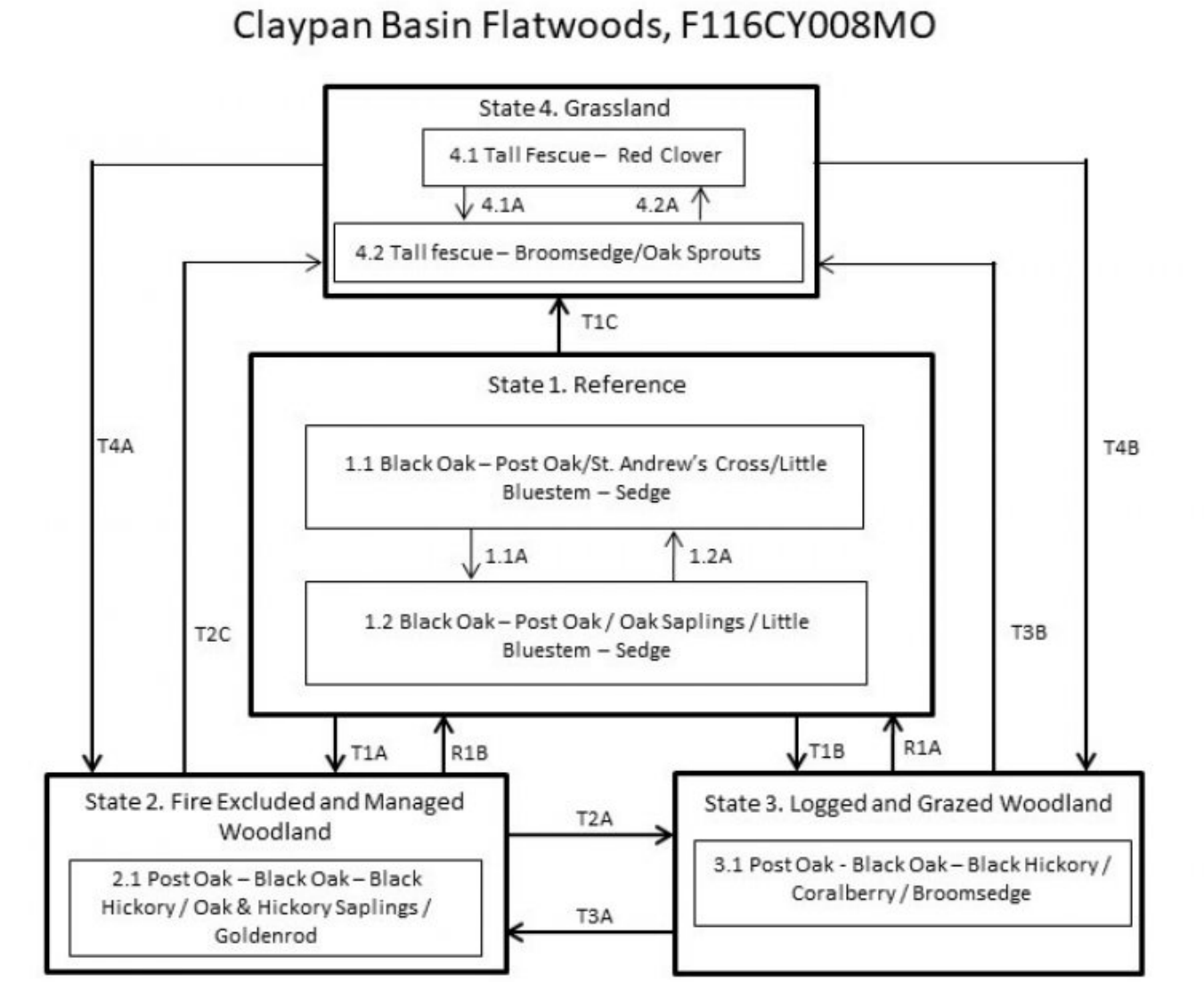
In the long term absence of fire, woody species have encroached into these woodlands. Once established, these woodies can quickly fill the woodland system. Most occurrences today are dense, and shady with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective management tools. Domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as coralberry, gooseberry, and Virginia creeper. It also promotes the invasion of eastern redcedar. These grazed sites also have a more open understory in addition to soil compaction, soil erosion and lower productivity problems. Timber harvesting is very limited on these sites because of the poor tree quality and size but are excellent wildlife sites.

Timber harvesting is very limited on these altered sites because of the poor tree quality and size. They are excellent wildlife sites.

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	Fire suppression; managed timber harvest
T1B	Fire suppression; high grading timber harvest; uncontrolled domestic grazing
T1C, T2C, T3B	Clearing; grassland planting; grassland management
T2A	Uncontrolled domestic grazing; high grading harvests
T3A	Exclude domestic grazing; forest stand improvement
T4A	Tree planting; long-term succession; grazing exclusion
T4B	Grazing reduction; long-term succession

Code	Event/Activity/Process
1.1A	Fire-free interval, 5-10 years
1.2A	Fire 2-5 years
4.1A	Over grazing; no fertilization
4.2A	Brush management; prescribed grazing

Code	Event/Activity/Process
R1A	Exclude domestic grazing; thinning; prescribed fire 2-5 years; long-term succession
R1B	Thinning; prescribed fire 2-5 years

Figure 9. State and transition diagram for this ecological site

State 1

Reference

These open woodland reference sites were strongly influenced by fire. Herbivory by native (now expatriated) ungulates, such as bison and elk, also played a role. Consequently, drought and fire-tolerant post oak and black oak stand over a ground flora of tallgrass prairie grasses, sedges and wildflowers. There are two phases associated with this reference state. Community Phase 1.1 The overstory in this phase is dominated by post oak and black oak, with scattered blackjack oak and black hickory. This open woodland community typically has a two-tiered structure, with canopy height of 35 to 50 feet and 50 to 70 percent closure. The abundant herbaceous layer is dominated by little bluestem and sedges. Fire frequency was likely every 1 to 5 years. This continued fire and natural native grazing would have maintained the open canopy and profusion of ground flora species. Community Phase 1.2 The overstory in this phase is dominated by post oak and black oak, with scattered blackjack oak and black hickory. This brushy woodland community typically has a three-tiered structure, with 60 to 80 percent closure. It is characterized by a thick understory of oak saplings, and shrubs. The herbaceous layer is dominated by little bluestem. Fire-free intervals likely ranged from 5 to 10 years.

Community 1.1
Black Oak – Post Oak/Fragrant Sumac/Little Bluestem – Sedge

Forest overstory. Post oak and black oak are typical overstory species. Other oak species and hickories are also usually present. Canopy cover can range from 40 percent to nearly 70 percent. The Overstory Species list is based commonly occurring species listed in Nelson (2010).

Forest understory. Little bluestem dominates the dense ground layer. Numerous forbs are also present and locally abundant. The Understory Species list is based commonly occurring species listed in Nelson (2010).

Community 1.2
Black Oak – Post Oak / Oak Saplings / Little Bluestem – Sedge

Pathway P1.1A
Community 1.1 to 1.2

Fire-free interval, 5-10 years

Pathway P1.2A
Community 1.2 to 1.1

Fire every 2-5 years

State 2
Fire Excluded and Managed Woodland

Most current areas of Claypan Basin Flatwoods have experienced fire exclusion for decades. In the absence of fire, ongoing recruitment of trees into the canopy develops a closed canopy, shading out the rich herbaceous ground flora. Black oak and mid-story species increase. Herbaceous cover and diversity greatly diminishes, leaf litter builds up, and more shade-tolerant woodland species persist, such as elmleaf goldenrod, panicgrass and spreading aster. The understory also develops with oak and hickory saplings along with sassafras and some black cherry.

Dominant resource concerns

- Plant structure and composition

Community 2.1
Post Oak – Black Oak – Black Hickory / Oak & Hickory Saplings / Goldenrod

State 3
Logged and Grazed Woodland

Many sites have been heavily grazed by domestic livestock at some point in their history. Grazing decreases the

cover and abundance of saplings, shrubs and herbaceous ground flora, opening up the understory. Weedy native shrubs and vines, such as coralberry, gooseberry, poison ivy and Virginia creeper, often flourish after grazing, and exotic species like tall fescue and sericea lespedeza increase in abundance. Poorly managed grazing can cause compaction and denudation of the soil surface, allowing mats of lichens and mosses to flourish. Soil compaction may also further limit height growth of trees. With poorly managed grazing, this can result in an increase in weedy natives such as broom sedge, and exotics such as sericea lespedeza if they are present. Single-tree timber harvesting also occurred, resulting in a high grading of the canopy structure, creating many stands with poorly formed trees.

Dominant resource concerns

- Sheet and rill erosion
- 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 3.1
Post Oak - Black Oak – Black Hickory / Coralberry / Broomsedge

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Plant pest pressure

State 4
Grassland

Claypan Basin Flatwoods are often converted into wide, open tall fescue grasslands, adjacent to densely overgrown and grazed woodlots. A return from this condition to a flatwoods state requires enormous cost and management inputs.

Dominant resource concerns

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

Community 4.1
Tall Fescue – Red Clover

Dominant resource concerns

- 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; prescribed grazing

Transition T1A
State 1 to 2

Fire suppression; managed timber harvest

Transition T1B
State 1 to 3

Fire suppression; high grading timber harvest; uncontrolled domestic grazing

Restoration pathway R1B
State 2 to 1

Thinning; prescribed fire 2-5 years

Transition T2A
State 2 to 3

Uncontrolled domestic grazing; high grading harvests

Transition T2C
State 2 to 4

Clearing; grassland planting; grassland management

Restoration pathway R1A
State 3 to 1

Exclude domestic grazing; thinning; prescribed fire 2-5 years; long-term succession

Transition T3A
State 3 to 2

Exclude domestic grazing; forest stand improvement

Transition T3B
State 3 to 4

Clearing; grassland planting; grassland management

Transition T4A
State 4 to 2

Tree planting; long-term succession; grazing exclusion; forest stand improvement

Transition T4B
State 4 to 3

Grazing reduction; long-term succession;

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							
post oak	QUST	*Quercus stellata*	Native	–	20–40	–	–
black oak	QUVE	*Quercus velutina*	Native	–	20–40	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	0–10	–	–
blackjack oak	QUMA3	*Quercus marilandica*	Native	–	0–10	–	–
black hickory	CATE9	*Carya texana*	Native	–	0–10	–	–
white oak	QUAL	*Quercus alba*	Native	–	0–10	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	0–10	–	–
pignut hickory	CAGL8	*Carya glabra*	Native	–	0–10	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	5–10
shallow sedge	CALU5	*Carex lurida*	Native	–	5–10
fuzzy wuzzy sedge	CAHI6	*Carex hirsutella*	Native	–	5–10
poverty oatgrass	DASP2	*Danthonia spicata*	Native	–	5–10
ribbed sedge	CAVI4	*Carex virescens*	Native	–	5–10
rosy sedge	CARO22	*Carex rosea*	Native	–	5–10
cypress panicgrass	DIDID	*Dichanthelium dichotomum var. dichotomum*	Native	–	5–10
rock muhly	MUSO	*Muhlenbergia sobolifera*	Native	–	5–10
Forb/Herb					
common cinquefoil	POSI2	*Potentilla simplex*	Native	–	5–20
narrowleaf mountainmint	PYTE	*Pycnanthemum tenuifolium*	Native	–	5–20
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	5–20
skyblue aster	SYOO	*Symphyotrichum oolentangiense*	Native	–	5–20
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	5–20
violet lespedeza	LEVI6	*Lespedeza violacea*	Native	–	5–20
prairie blazing star	LIPY	*Liatris pycnostachya*	Native	–	5–20
white wild indigo	BAAL	*Baptisia alba*	Native	–	5–20
American ipecac	GIST5	*Gillenia stipulata*	Native	–	5–20
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	5–20
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	5–20
St. Andrew's cross	HYHY	*Hypericum hypericoides*	Native	–	5–20

Animal community

Wildlife (MDC 2006)
Oaks on this site provide abundant hard mast; scattered shrubs provide soft mast; native legumes provide high-quality wildlife food.

Sedges and native cool-season grasses provide green browse; native warm-season grasses provide cover and nesting habitat; and a diversity of forbs provides a diversity and abundance of insects.

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

Bird species associated with early-successional stages of this ecological site include Northern Bobwhite, Painted Bunting, Prairie Warbler, Field Sparrow, Blue-winged Warbler, Yellow-breasted Chat, Brown Thrasher, and Bachman’s Sparrow;

Birds associated with mid- to late successional woodlands include Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Summer Tanager, Eastern Wood-Pewee, Whip-poor-will, Chuck-will’s widow, and Red-eyed Vireo.

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

Other information

Forestry
Management: Estimated site index values for oaks and shortleaf pine range from 45 to 60. Timber management opportunities are fair. These sites have an abrupt textural change which impedes rooting. Reduced rooting depth restricts tree growth and increases windthrow hazards. These groups respond well to even-aged management. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. These sites respond well to prescribed fire as a management tool.

Limitations: Restricted rooting depth; seasonal wetness. Unsurfaced roads and traffic areas tend to be slippery and form ruts easily. Graveling roads facilitates year-round use. Equipment use when wet may compact soil and damage tree roots. Planting is difficult during wet spring periods. Seedling mortality may be high due to excess seasonal wetness, shallow effective rooting depths or sodium. Ridging the soil and planting on the ridges may increase survival. The use of equipment can become restricted in spring and other excessively wet periods.

Inventory data references

Potential Reference Sites: Claypan Basin Flatwoods

No quality reference sites are known to exist.

Other references

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Contributors

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Approval

Nels Barrett, 9/24/2020

Acknowledgments

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

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	

Date	09/11/2020
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:

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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:**
