

# Ecological site R109XY046MO Till Upland Savanna

Accessed: 05/19/2024

## General information

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



Figure 1. Mapped extent

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

## MLRA notes

Major Land Resource Area (MLRA): 109X—Iowa and Missouri Heavy Till Plain

The Iowa and Missouri Heavy Till Plain (area outlined in red on the map) is an area of rolling hills interspersed with interfluvial divides and alluvial valleys. Elevation ranges from about 660 feet along the lower reaches of rivers, to about 980 feet on stable interfluvial summits in southern Iowa. Relief is about 80 to 160 feet between major streams and adjacent interfluvial summits. Most of the till plain drains south to the Missouri River via the Grand and Chariton River systems, but the northeastern portion drains southeast to the Mississippi River. Loess caps the pre-Illinoian aged till on interfluvial divides, whereas the till is exposed on side slopes. Mississippian aged limestone and Pennsylvanian aged sandstone and shale crop out on lower slopes in some areas.

Mollic Till Upland Savannas are within the green areas on the map (Missouri portion only; Iowa distributions are currently under review). These sites are widespread in the MLRA. Soils are very deep, with dense till subsoils that are mainly clay loam.

## Classification relationships

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

The reference state for this ecological site is most similar to a Dry-Mesic Loess/Glacial Till Savanna.

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

The reference state for this ecological site is most similar to *Quercus macrocarpa* - (*Quercus alba*, *Quercus stellata*)

/ *Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL002159).

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

This ecological site occurs throughout the Central Dissected Till Plains 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. As additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”.

Till Upland Savannas are within the green areas on the map. These sites are widespread in the MLRA. Soils are very deep, with dense till subsoils that are mainly clay loam. The reference plant community is savanna with scattered bur oak, swamp white oak, post oak, American hazelnut, prairie willow and wild plum, shrubs, and a ground flora of grasses such as big bluestem, little bluestem, Indiangrass, switch grass, and eastern gamagrass, and a wide variety of prairie wildflowers.

## Associated sites

R109XY002MO	<b>Loess Upland Prairie</b> Loess Upland Prairies are upslope, on summits and shoulders.
R109XY008MO	<b>Till Backslope Savanna</b> Till Backslope Savannas are downslope, on steep lower backslopes.
R109XY029MO	<b>Wet Upland Drainageway Prairie</b> Wet Upland Drainageway Prairies are downslope.

## Similar sites

R109XY008MO	<b>Till Backslope Savanna</b> Till Backslope Savannas are similar in composition and structure and are usually adjacent to Till Upland Savannas but occur lower on the landscape.
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Table 1. Dominant plant species

Tree	(1) <i>Quercus macrocarpa</i>
Shrub	(1) <i>Ceanothus americanus</i> (2) <i>Prunus americana</i>
Herbaceous	(1) <i>Andropogon gerardii</i> (2) <i>Schizachyrium scoparium</i>

## Physiographic features

This site is on upland summits, shoulders and backslopes with slopes of 2 to 14 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Ferguson, 1997) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites of the uplands. The site is within the area labeled “2”, and is typically downslope from the Loess Upland Prairie ecological site on summits. Steeper backslope sites are downslope in some areas. In many areas this site is directly upslope from Wet Upland Drainageway Prairie sites as shown in this figure.

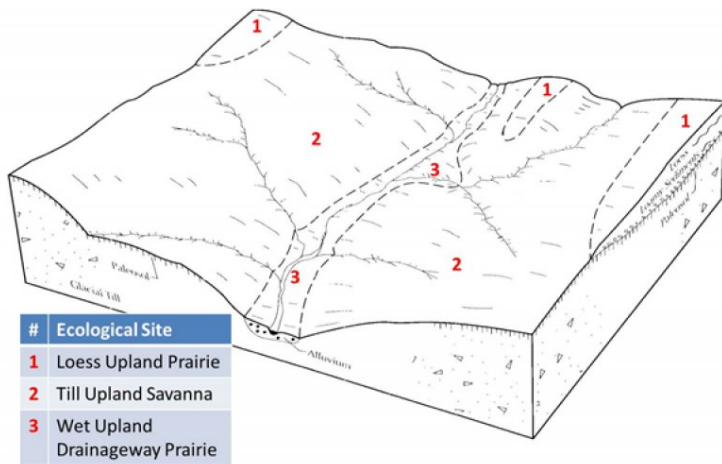


Figure 2. Landscape relationships for this ecological site

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Interfluvium (3) Hill
Flooding frequency	None
Ponding frequency	None
Slope	2–14%
Water table depth	15–122 cm
Aspect	Aspect is not a significant factor

### Climatic features

The Iowa and Missouri Heavy Till Plain MLRA 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.

This MLRA experiences small regional differences in climates that grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line from north to south. Both mean annual temperature and precipitation exhibit fairly minor gradients along this line.

Mean January minimum temperature follows the north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the region. Mean July maximum temperatures have a range of only two to three degrees across the region.

Mean annual precipitation varies along the same gradient as temperature – lower annual precipitation in the north, higher in the south. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages four to five times greater than January precipitation.

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 influences ecological communities by limiting water supplies, especially at times of high temperatures and high evaporation rates. Drought indirectly affects ecological communities by increasing plant and animal susceptibility to the probability and severity of fire. Frequent fires encourage the development of grass/forb dominated communities and understories.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. 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. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier, supporting more grass dominated communities than adjacent north- and-east-facing slopes that are cooler and moister that support more woody dominated communities. Finally, the cooler microclimate within a canopied forest is measurably different from the climate of a more open and warmer grassland or savanna area.

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 (average)	154 days
Freeze-free period (average)	180 days
Precipitation total (average)	1,067 mm

### **Climate stations used**

- (1) UNIONVILLE [USC00238523], Unionville, MO
- (2) CHARITON 1 E [USC00131394], Chariton, IA
- (3) BROOKFIELD [USC00230980], Brookfield, MO
- (4) GRANT CITY [USC00233369], Grant City, MO
- (5) DONNELSON [USC00132299], Donnellson, IA
- (6) KEARNEY 3E [USC00234382], Kearney, MO

### **Influencing water features**

This ecological site is not influenced by wetland or riparian water features. However, seeps may occur in headslope positions, particularly in the spring, and following heavy rainfall events. These seeps are source areas for first-order ephemeral streams, typically within Upland Drainageway ecological sites downslope. Where present, these headslope seeps are in the SLOPE wetlands class of the Hydrogeomorphic (HGM) classification system (Brinson, 1993).

### **Soil features**

These soils have no rooting restrictions. The soils were formed under prairie vegetation, and have dark, organic-rich surface horizons. Parent material is till. They have loam surface layers, with dense subsoils that are mainly clay loam and silty clay. Some soils are affected by seasonal wetness in spring months from a water table perched on the clayey subsoil. Soil series associated with this site include Armster, Armstrong, Bucknell, Gara, Purdin, and Rinda.

The accompanying picture of the Armstrong series shows a dark, organic-rich, loamy surface horizon overlying the brown clayey till. Masses of calcium carbonate are below about 110 centimeters in this profile. Picture courtesy of Kim Worth, NRCS; scale is in centimeters.



Figure 7. Armstrong series

Table 4. Representative soil features

Surface texture	(1) Loam (2) Clay loam
Family particle size	(1) Clayey
Drainage class	Poorly drained to moderately well drained
Permeability class	Very slow to slow
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–17.78 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)	0–10%
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.

The reference plant community is characterized as till upland oak savanna unit dominated by big and little bluestem, Indian grass, switch grass, eastern gamagrass and a wide variety of prairie wildflowers. Trees and shrubs such as bur oak, swamp white oak, post oak, American hazelnut, prairie willow and wild plum occurred in groves or as scattered individuals across the ecological site. In addition, prairie species such as switch grass,

Culver's root, Michigan lily, and bunchflower were added to the mix of upland species in areas where more moisture was present.

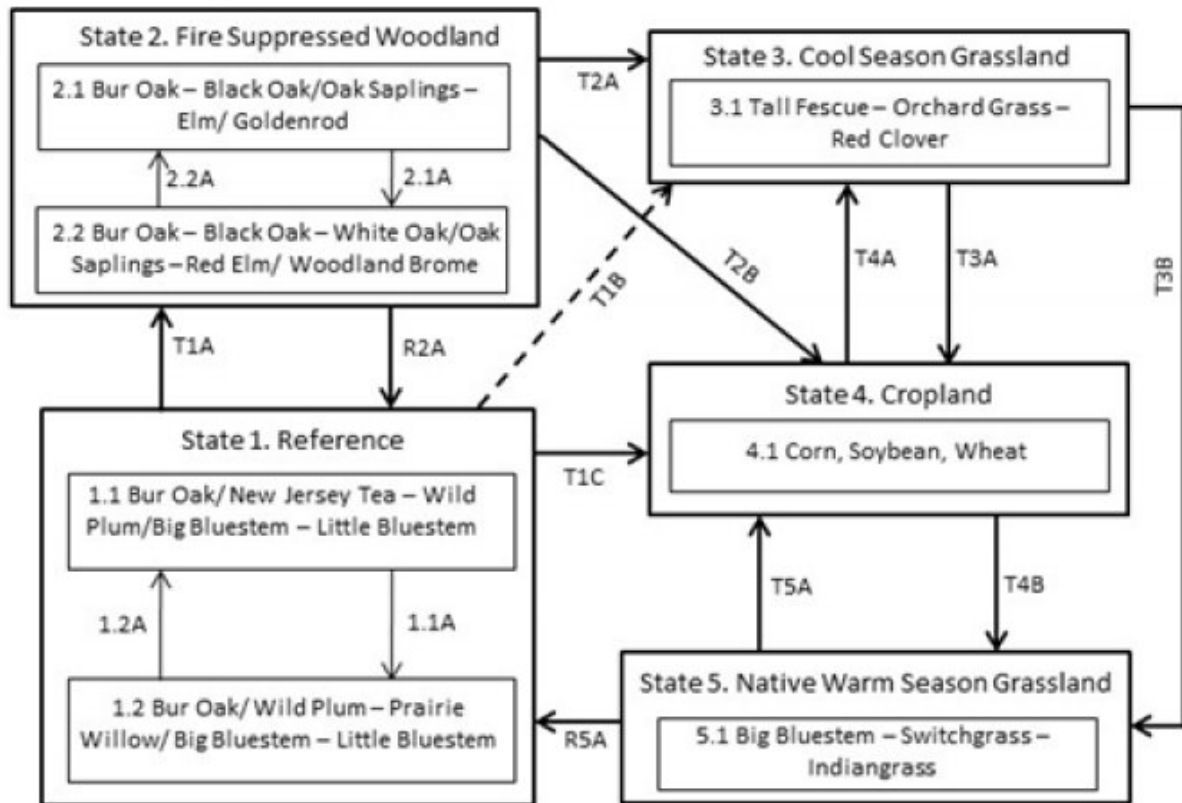
While not as typically dry and fire prone as the Claypan and Loess Prairies, this ecological site still burned every 1 to 3 years. Fire removed dead plant litter and provided room for a lush growth of prairie vegetation. Fire also kept woody species at bay. Grazing by native large herbivores, such as bison, elk, and deer, also impacted these sites. Their activities altered the composition, fuel loads and structure of the vegetation, creating a diversity of structure and composition. The partially wooded draws would have burned less intensely and less frequently. During fire free intervals woody species would have increased in abundance and spread out onto the prairie.

Today, Till Upland Savannas are nearly extirpated from the region as the former prairies and savannas have been converted to intensive agriculture. A few known remnants exist but are degraded by fire suppression and grazing by domestic livestock. While re-establishing prairie and savanna on agriculture sites is beneficial to wildlife, restoration to the reference state from agricultural land is a long term proposition with uncertain outcomes.

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**

## Till Upland Savanna, R109XY046MO



Code	Event/Activity/Process
T1A	Fire suppression > 20 years; woody invasion
T1B	Tillage; vegetative seeding; grassland management
T1C, T3A, T5A	Tillage; conservation cropping system
T2A	Woody removal; tillage; vegetative seeding; grassland management
T2B	Woody removal; tillage; conservation cropping system
T4A	Vegetative seeding; grassland management
T3B, T4B	Vegetative seeding; prescribed fire; grassland management
1.1A	Fire-free interval 10+ years
1.2A	Fire interval 1-3 years
2.1A	Fire suppression > 40 years; woody invasion
2.2A	Thinning; timber harvesting
R2A	Woody removal; prescribed fire 1-3 years
R5A	Vegetative seeding; prescribed fire 1-3 years

Figure 8. State and transition diagram for this ecological s

**State 1**

## Reference

This state is native oak savanna is dominated by an understory of big bluestem, little bluestem and a wide variety of prairie forbs. This state occurs on level to gently sloping soils. Bur oak, swamp white oak, post oak, black oak, white oak, American hazelnut, prairie willow and wild plum occurred in small groves or as scattered individuals across the landscape. Two phases can occur that will transition back and forth depending on fire frequencies. Longer fire free intervals will allow woody species to increase such as prairie willow, dogwoods and wild plum. When fire intervals shorten these woody species will decrease. This state is very rare. Nearly all former reference states have been converted to cool season grassland and intensive agriculture cropland or reverted to a woodland community.

### Community 1.1

#### **Bur Oak/ New Jersey Tea – Wild Plum/Big Bluestem – Little Bluestem**

This phase is a savanna dominated by big bluestem, Eastern gamagrass and a wide variety of prairie wildflowers. Bur oak, swamp white oak, single oak, elm, American hazelnut, prairie willow and wild plum occur in small groves or as scattered individuals across the open landscape.

**Forest overstory.** The Forest Overstory Species list is based commonly occurring species listed in Nelson (2010).

**Forest understory.** The Forest Understory list is based on reconnaissance-level plots, as well as commonly occurring species listed in Nelson (2010). Most of the species identified from plot data include cover percentages. Species not found in plots, but listed in Nelson, do not include cover percentages. All species are in the 0.3 - 7 foot canopy height class.

### Community 1.2

#### **Bur Oak/ Wild Plum – Prairie Willow/ Big Bluestem – Little Bluestem**

This phase is similar to community phase 1.1 but oaks and shrubs are increasing due to longer periods of fire suppression. Some displacement of grasses and forbs may be occurring due to shading and competition from the increased canopy cover.

## State 2

### **Fire Suppressed Woodland**

Degraded reference states that have experienced fire suppression and woody invasion for 20 or more years will transition to this state. With fire suppression, woody species such as bur oak, post oak, black oak and swamp white oak will begin to increase transitioning this state from a savanna to an open woodland. Native herbaceous ground cover will also decrease. Over time if natural disturbances are continued to be absent, a second phase will develop. This phase will have a further increase in canopy cover to a more closed woodland. Black oak and white oak will move into the upper canopy and ground cover diversity will continue to decrease.

### Community 2.1

#### **Bur Oak – Black Oak/Oak Saplings – Elm/ Goldenrod**

With fire suppression, woody species such as bur oak, post oak, black oak and swamp white oak will begin to increase transitioning this phase to an open woodland.

### Community 2.2

#### **Bur Oak – Black Oak – White Oak/Oak Saplings – Red Elm/ Woodland Brome**

Over time if natural disturbances are continued to be absent, this phase will develop with an increase in canopy cover to a more closed woodland. Black oak and white oak will move into the upper canopy and ground cover diversity will continue to decrease.

## State 3

### **Cool Season Grassland**

Conversion of other states to non-native cool season species such as tall fescue and red clover has been common



in this area. Occasionally, these pastures will have scattered bur oaks and/or swamp white oak. Long term uncontrolled grazing and a lack of grassland management can cause significant soil erosion and compaction and increases in less productive species such as Kentucky bluegrass and weedy forbs such as ironweed. A return to the reference state may be impossible, requiring a very long term series of management options.

### Community 3.1

#### Tall Fescue – Orchard Grass – Red Clover

### State 4

#### Cropland

This is the dominant State that exists currently with intensive cropping of corn, wheat and soybeans occurring. Some conversion to cool season hayland occurs for a limited period of time before transitioning back to cropland. Limited acres are sometimes converted to native warm season grassland through federal set-aside programs.

### Community 4.1

#### Corn, Soybean, Wheat

### State 5

#### Native Warm Season Grassland

Conversion from the Cool Season Grassland (State 3) or the Cropland (State 4) to this state is increasing due to renewed interest in warm season grasses as a supplement to cool season grazing systems or as a native restoration activity. This state can be transformed back to a Reference State. Substantial restoration time and management inputs will still be needed.

### Community 5.1

#### Big Bluestem – Switchgrass – Indiangrass

### 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)
<b>Tree</b>							
swamp white oak	QUBI	<i>Quercus bicolor</i>	Native	–	5–10	–	–
bur oak	QUMA2	<i>Quercus macrocarpa</i>	Native	–	5–10	–	–
post oak	QUST	<i>Quercus stellata</i>	Native	–	5–10	–	–
shingle oak	QUIM	<i>Quercus imbricaria</i>	Native	–	0–10	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
<b>Grass/grass-like (Graminoids)</b>					
big bluestem	ANGE	<i>Andropogon gerardii</i>	Native	–	10–75
little bluestem	SCSC	<i>Schizachyrium scoparium</i>	Native	–	0.1–75
prairie dropseed	SPHE	<i>Sporobolus heterolepis</i>	Native	–	10–25
eastern gamagrass	TRDA3	<i>Tripsacum dactyloides</i>	Native	–	5–10
whip nutrush	SCTR	<i>Scleria triglomerata</i>	Native	–	0.1–1
marsh bristlegrass	SEPA10	<i>Setaria parviflora</i>	Native	–	0.1–1
sedge	CAREX	<i>Carex</i>	Native	–	0.1–1

rosette grass	DICHA2	<i>Dichantheium</i>	Native	–	0.1–1
switchgrass	PAVI2	<i>Panicum virgatum</i>	Native	–	–
Indiangrass	SONU2	<i>Sorghastrum nutans</i>	Native	–	–
<b>Forb/Herb</b>					
ashy sunflower	HEMO2	<i>Helianthus mollis</i>	Native	–	2–10
compassplant	SILA3	<i>Silphium laciniatum</i>	Native	–	2–5
button eryngo	ERYU	<i>Eryngium yuccifolium</i>	Native	–	2–5
narrowleaf mountainmint	PYTE	<i>Pycnanthemum tenuifolium</i>	Native	–	0.1–5
Richardson's alumroot	HERI	<i>Heuchera richardsonii</i>	Native	–	0.1–5
Nuttall's sensitive-briar	MINU6	<i>Mimosa nuttallii</i>	Native	–	1–2
purple milkwort	POSA3	<i>Polygala sanguinea</i>	Native	–	1–2
Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	Native	–	1–2
roundhead lespedeza	LECA8	<i>Lespedeza capitata</i>	Native	–	0.1–2
broadleaf enchanter's nightshade	CILU	<i>Circaea lutetiana</i>	Native	–	0.1–1
common yarrow	ACMI2	<i>Achillea millefolium</i>	Native	–	0.1–1
annual ragweed	AMAR2	<i>Ambrosia artemisiifolia</i>	Native	–	0.1–1
field pussytoes	ANNE	<i>Antennaria neglecta</i>	Native	–	0.1–1
Indianhemp	APCA	<i>Apocynum cannabinum</i>	Native	–	0.1–1
slimleaf milkweed	ASST	<i>Asclepias stenophylla</i>	Native	–	0.1–1
wild quinine	PAIN3	<i>Parthenium integrifolium</i>	Native	–	0.1–1
sessileleaf ticktrefoil	DESE	<i>Desmodium sessilifolium</i>	Native	–	0.1–1
thoroughwort	EUPAT	<i>Eupatorium</i>	Native	–	0.1–1
wholeleaf rosinweed	SIIN2	<i>Silphium integrifolium</i>	Native	–	0.1–1
purple prairie clover	DAPU5	<i>Dalea purpurea</i>	Native	–	0.1–1
hairy hawkweed	HILO2	<i>Hieracium longipilum</i>	Native	–	0.1–1
Virginia strawberry	FRVI	<i>Fragaria virginiana</i>	Native	–	0.1–1
downy gentian	GEPU5	<i>Gentiana puberulenta</i>	Native	–	0.1–1
fringeleaf wild petunia	RUHU	<i>Ruellia humilis</i>	Native	–	0.1–1
Canada goldenrod	SOAL6	<i>Solidago altissima</i>	Native	–	0.1–1
gray goldenrod	SONE	<i>Solidago nemoralis</i>	Native	–	0.1–1
white heath aster	SYER	<i>Symphotrichum ericoides</i>	Native	–	0.1–1
Baldwin's ironweed	VEBA	<i>Vernonia baldwinii</i>	Native	–	0.1–1
sensitive partridge pea	CHNI2	<i>Chamaecrista nictitans</i>	Native	–	0.1–1
sericea lespedeza	LECU	<i>Lespedeza cuneata</i>	Introduced	–	0.1–1
stiff goldenrod	OLRI	<i>Oligoneuron rigidum</i>	Native	–	–
New England aster	SYNO2	<i>Symphotrichum novae-angliae</i>	Native	–	–
sawtooth sunflower	HEGR4	<i>Helianthus grosseserratus</i>	Native	–	–
swamp lousewort	PELA2	<i>Pedicularis lanceolata</i>	Native	–	–
Virginia mountainmint	PYVI	<i>Pycnanthemum virginianum</i>	Native	–	–
prairie milkweed	ASSU3	<i>Asclepias sullivantii</i>	Native	–	–
pinnate prairie coneflower	RAPI	<i>Ratibida pinnata</i>	Native	–	–
butterfly milkweed	ASTU	<i>Asclepias tuberosa</i>	Native	–	–
white wild indigo	BAAL	<i>Baptisia alba</i>	Native	–	–
eastern purple coneflower	ECPU	<i>Echinacea purpurea</i>	Native	–	–

hoary puccoon	LICA12	<i>Lithospermum canescens</i>	Native	–	–
Michigan lily	LIMI9	<i>Lilium michiganense</i>	Native	–	–
prairie blazing star	LIPY	<i>Liatris pycnostachya</i>	Native	–	–
skyblue aster	SYOO	<i>Symphotrichum oolentangiense</i>	Native	–	–
wild bergamot	MOFI	<i>Monarda fistulosa</i>	Native	–	–
Culver's root	VEVI4	<i>Veronicastrum virginicum</i>	Native	–	–
Virginia bunchflower	VEVI5	<i>Veratrum virginicum</i>	Native	–	–
Texas goldentop	EUGY	<i>Euthamia gymnospermoides</i>	Native	–	–
partridge pea	CHFA2	<i>Chamaecrista fasciculata</i>	Native	–	–
tall tickseed	COTR4	<i>Coreopsis tripteris</i>	Native	–	–
white prairie clover	DACA7	<i>Dalea candida</i>	Native	–	–
<b>Shrub/Subshrub</b>					
American hazelnut	COAM3	<i>Corylus americana</i>	Native	–	1–2
leadplant	AMCA6	<i>Amorpha canescens</i>	Native	–	0.1–2
New Jersey tea	CEAM	<i>Ceanothus americanus</i>	Native	–	1–2
Carolina rose	ROCA4	<i>Rosa carolina</i>	Native	–	0.1–1
northern dewberry	RUFL	<i>Rubus flagellaris</i>	Native	–	0.1–1
roughleaf dogwood	CODR	<i>Cornus drummondii</i>	Native	–	0.1–1
gray dogwood	CORA6	<i>Cornus racemosa</i>	Native	–	0.1–1
prairie willow	SAHU2	<i>Salix humilis</i>	Native	–	–
American plum	PRAM	<i>Prunus americana</i>	Native	–	–
<b>Tree</b>					
bur oak	QUMA2	<i>Quercus macrocarpa</i>	Native	–	1–2
dwarf chinquapin oak	QUPR	<i>Quercus prinoides</i>	Native	–	1–2
American elm	ULAM	<i>Ulmus americana</i>	Native	–	0.1–1
<b>Vine/Liana</b>					
grape	VITIS	<i>Vitis</i>	Native	–	–

## Animal community

### Wildlife

#### Prairie Phase:

Game species that utilize this ecological site include:

Northern Bobwhite will utilize this ecological site for food (seeds, insects) and cover needs (escape, nesting and roosting cover).

Cottontail rabbits will utilize this ecological site for food (seeds, soft mast) and cover needs.

Turkey will utilize this ecological site for food (seeds, green browse, soft mast, insects) and nesting and brood-rearing cover. Turkey poults feed heavily on insects provided by this site type.

White-tailed Deer will utilize this ecological site for browse (plant leaves in the growing season, seeds and soft mast in the fall/winter). This site type also can provide escape cover.

Bird species associated with this ecological site's reference state condition:

Breeding birds as related to vegetation structure (related to time since fire, grazing, haying, and mowing):

Vegetation Height Short (< 0.5 meter, low litter levels, bare ground visible):

Grasshopper Sparrow, Horned Lark, Upland Sandpiper, Greater Prairie Chicken, Northern Bobwhite

Mid-Vegetation Height (0.5 – 1 meter, moderate litter levels, some bare ground visible):

Eastern Meadowlark, Dickcissel, Field Sparrow, Upland Sandpiper, Greater Prairie Chicken, Northern Bobwhite, Eastern Kingbird, Bobolink, Lark Sparrow

Tall Vegetation Height (> 1 meter, moderate-high litter levels, little bare ground visible):

Henslow's Sparrow, Dickcissel, Greater Prairie Chicken, Field Sparrow, Northern Bobwhite, Sedge Wren, Northern Harrier

Brushy – Mix of grasses, forbs, native shrubs (e.g., *Rhus copallina*, *Prunus americana*, *Rubus* spp., *Rosa carolina*) and small trees (e.g., *Cornus racemosa*): Bell's Vireo, Yellow-Breasted Chat, Loggerhead Shrike, Brown Thrasher, Common Yellowthroat

Winter Resident: Short-Eared Owl, Le Conte's Sparrow

Amphibian and reptile species associated with this ecological site's reference state condition: prairies with or nearby to fishless ponds/pools (may be ephemeral) may have Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*) and Western Chorus Frog (*Pseudacris triseriata triseriata*); prairies with crawfish burrows may have Northern Crawfish Frog (*Rana areolata circulosa*); other species include Northern Prairie Skink (*Eumeces septentrionalis septentrionalis*), Ornate Box Turtle (*Terrapene ornata ornata*), Western Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*), Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*), Prairie Ring-necked Snake (*Diadophis punctatus arnyi*), and Bullsnake (*Pituophis catenifer sayi*).

Small mammals associated with this ecological site's reference state condition: Least Shrew (*Cryptotis parva*), Franklin's Ground Squirrel (*Spermophilus franklinii*), Plains Pocket Gopher (*Geomys bursarius*), Prairie Vole (*Microtus ochrogaster*), Southern Bog Lemming (*Synaptomys cooperi*), Meadow Jumping Mouse (*Zapus hudsonius*), Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*) and Badger (*Taxidea taxus*).

Invertebrates:

Many native insect species are likely associated with this ecological site, especially native bees, ants, beetles, butterflies and moths, and crickets, grasshoppers and katydids. However information on these groups is often lacking enough resolution to assign them to individual ecological sites.

Insect species known to be associated with this ecological site's reference state condition: Regal Fritillary butterfly (*Speyeria idalia*) whose larvae feed primarily on native prairie violets (*Viola pedata*, *V. pedatifida*, and *V. sagittata*); Mottled Dusky Wing butterfly (*Erynnis martialis*), Golden Byssus butterfly (*Problema byssus kumskaka*), Delaware Skipper butterfly (*Atryone logan logan*), and Crossline Skipper butterfly (*Polites origenes*). The larvae of the moth *Eucosma bipunctella* bore into compass plant (*Silphium laciniatum*) roots and feed and the larvae of the moth *Eucosma giganteana* bore into a number of *Silphium* species roots and feed. Native bees, important pollinators, that may be associated with this ecological site's reference condition include: *Colletes brevicornis*, *Andrena beameri*, *A. helianthiformis*, *Protandrena rudbeckiae*, *Halictus parallelus*, *Lasioglossum albipennis*, *L. coreopsis*, *L. disparilis*, *L. nymphaeum*, *Ashmeadiella buconis*, *Megachile addenda*, *Anthidium psoraleae*, *Eucera hamata*, *Melissodes coloradensis*, *M. coreopsis*, and *M. vernoniae*. The Short-winged Katydid (*Amblycorypha parvipennis*), Green Grasshopper (*Hesperotettix speciosus*) and Two-voiced Conehead katydid (*Neoconcephalus bivocatus*) are possible orthopteran associates of this ecological site.

Other invertebrate associates include the Grassland Crayfish (*Procambarus gracilis*).

Savanna Phase:

Oaks and hickories provide an important food source for many animals including White-tailed Deer, Wild Turkey, and Fox Squirrel.

Both snags and live cavity or den trees provide important food and cover for vertebrate wildlife. Snags are also very important to invertebrate species. Fox Squirrel, Red-headed Woodpecker and Eastern Bluebird utilize snags and den trees for foraging, nesting or shelter. "Wolf" trees are a particularly valuable type of live cavity tree. These large diameter, often open-grown, old-ages, hollow trees provide both cavities for wildlife and usually hard or soft mast food sources. Large diameter snags and den trees are particularly important wildlife habitat features to retain.

Game species that utilize this ecological site include:

Northern Bobwhite will utilize this ecological site for food (seeds, insects) and cover needs (escape, nesting and roosting cover).

Cottontail rabbits will utilize this ecological site for food (seeds, soft mast) and cover needs.

Turkey will utilize this ecological site for food (seeds, green browse, soft mast, insects) and nesting and brood-rearing cover. Turkey poults feed heavily on insects provided by this site type.

White-tailed Deer will utilize this ecological site for browse (plant leaves in the growing season, seeds and soft mast in the fall/winter). This site type also can provide escape cover.

Bird species associated with this ecological site's reference state condition:

Breeding birds: Northern Bobwhite, Eastern Kingbird, Eastern Bluebird, Brown Thrasher, White-eyed Vireo, Prairie Warbler, Field Sparrow, Eastern Towhee, Red-headed Woodpecker, Great Crested Flycatcher, Loggerhead Shrike

Winter resident: American Tree Sparrow, Harris' Sparrow

Amphibian and reptile species likely associated with this ecological site's reference state condition: Ornate Box Turtle (*Terrapene ornata ornata*), Northern Fence Lizard (*Sceloporus undulatus hyacinthinus*), Five-lined Skink (*Eumeces fasciatus*), Western Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*), Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*), Prairie Ring-necked Snake (*Diadophis punctatus arnyi*), and Rough Green Snake (*Opheodrys aestivus aestivus*). Sites containing or nearby to fishless or ephemeral ponds/pools may support the Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*).

Small mammals likely associated with this ecological site's reference state condition: Fox Squirrel (*Sciurus niger*), Woodland Vole (*Microtus pinetorum*), Least Shrew (*Cryptotis parva*), and Indiana Bat (*Myotis sodalis*). Indiana bats utilize suitable live, dying or dead roost trees for summer habitat and raising young. Suitable roost trees typically have exfoliating or flaking bark and are larger in diameter.

Invertebrates – Many native insect species are likely associated with this phase of this ecological site's reference state condition, especially native bees, ants, beetles, butterflies and moths, and crickets, grasshoppers and katydids. However we don't have enough information on these groups to assign them to this phase of this ecological site's reference state condition at this time.

(References for this section: Fitzgerald and Pashley. 2000b; Heitzman and Heitzman 1996; Jacobs 2001; Johnson 2000; Pitts and McGuire 2000; Schwartz and others 2001)

## **Other information**

### Forestry

Management: Site index values for oak range from 65 for black oak and 60 for white oak. Timber management opportunities are fair to 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. These sites respond well to prescribed fire as a management tool.

Limitations: Clay in the soil profile; seasonal wetness. Clayey soils have reduced traction and compact easily when wet. Unsurfaced roads and skid trails may be impassable during rainy periods. Restrict activities to dry periods or surfaced areas. Seedling mortality may be high during the summer because of lack of adequate soil moisture, especially on south facing slopes. The use of equipment is restricted in spring and other wet periods. The surface layer is firm when dry and sticky when wet and becomes cloddy if tilled. Erosion is a hazard when slopes exceed 15 percent.

## **Inventory data references**

Tier II Reconnaissance: Potential Reference

Plot BUHOCA01 – Armster soil  
Bunch Hollow CA, Carroll County, MO  
Latitude: 39.584623  
Longitude: -93.578696

Plot HEPRCA\_KS01 – Armstrong soil – species list, no cover  
Helton Prairie CA, Harrison County, MO  
Latitude: 40.255025  
Longitude: - 93.103417

Plot MOPRCA02 – Armstrong soil  
Morris Prairie CA, Sullivan County, MO  
Latitude: 40.255025  
Longitude: - 93.834331

Plot TAPRCA\_KS01 – Armstrong soil – species list, no cover  
Tarkio Prairie CA, Atchison County, MO  
Latitude: 40.501551  
Longitude: - 95.21556

Plot TAPRCA\_KS02 – Armstrong soil – species list, no cover  
Tarkio Prairie CA, Atchison County, MO  
Latitude: 40.501588  
Longitude: - 95.21267

Plot TUPRUM03 – Armstrong soil  
Tucker Prairie NA, Callaway County, MO  
Latitude: 38.946614  
Longitude: - 91.993367

Alternate state – (not included in data summaries):

Plot NOCOPR\_KS01 – Gara soil – obs. pt. (Bur oak with fescue)  
Nodaway County, MO  
Latitude: 40.471984  
Longitude: - 94.115252

Plot BUHOCA03 – Armstrong soil – obs. pt. (old field with post oaks)  
Bunch Hollow CA, Carroll County, MO  
Latitude: 39.584836  
Longitude: -93.5771098

Plot DURANC01\_KS01 – Gara soil - Native Warm Season Grassland (plowed, degraded, reseeded)  
Dunn Ranch TNC, Adair County, MO  
Latitude: 40.476808  
Longitude: - 94.102321

Plot DURANC01\_KS02 – Gara soil - Native Warm Season Grassland (plowed, degraded, reseeded)  
Dunn Ranch TNC, Adair County, MO  
Latitude: 40.476726  
Longitude: - 94.103417

## **Other references**

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.

Ferguson, Henry J. 1997. Soil Survey of Adair County, Missouri. U.S. Dept. of Agric. Natural Resources Conservation Service.

Fitzgerald, J.A. and D.N. Pashley. 2000b. Partners in Flight bird conservation plan for the Dissected Till Plains. American Bird Conservancy.

Heitzman, J.R. and J.E. Heitzman. 1996. Butterflies and moths of Missouri. 2nd ed. Missouri Department of Conservation, Jefferson City.

Jacobs, B. 2001. Birds in Missouri. Missouri Department of Conservation, Jefferson City.

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Nelson, Paul W. 2010. The Terrestrial Natural Communities of Missouri. Missouri Department of Conservation, Jefferson City, Missouri.

Nigh, Timothy A., & Walter A. Schroeder. 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation, Jefferson City, Missouri.

Pitts, D.E. and W.D. McGuire. 2000. Wildlife management for Missouri landowners. 3rd ed. Missouri Department of Conservation, Jefferson City.

Schwartz, C.W., E.R. Schwartz and J.J. Conley. 2001. The wild mammals of Missouri. University of Missouri Press, Columbia and Missouri Department of Conservation, Jefferson City.

## Contributors

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Fred Young

## 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	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

### 1. Number and extent of rills:

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

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

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

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

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

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

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

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

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

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

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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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