

## **Ecological site R112XY120MO Loamy Upland Drainageway**

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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.

### **MLRA notes**

Major Land Resource Area (MLRA): 112X—Cherokee Prairies

MLRA 112 (Cherokee Prairies) is in Kansas (48 percent), Oklahoma (29 percent), and Missouri (23 percent) makes up about 20,885 square miles (54,092 square kilometers).

This area is in the Osage Plains Section of the Central Lowland Province of the Interior Plains. It is a gently sloping to rolling dissected plains. Elevation ranges from 120 to 1,540 feet (30 to 470 meters). Even though the area is thoroughly dissected, local relief typically is only 3 to 10 feet (1 to 3 meters) and major valleys generally are less than 8 feet (25 meters) below the adjacent uplands.

The extent of the major hydrologic unit area is made up of major rivers such as the Neosho, Verdigris, Osage, and Marais des Cygnes. The Harry Truman reservoir lies in the western part of Lake of the Ozarks in Missouri and is on the Osage and Grand Rivers.

This area is dominantly underlain by Pennsylvanian and in some areas, Permian and Mississippian sandstone, shale, and limestone bedrock. The northern part of the area has a thin mantle of loess. The dominant soils within this region are Mollisols and Entisols. Alfisols occur in the eastern part of the MLRA. There are small areas of Vertisols throughout the MLRA. It also contains small areas of Vertisols. Soils in this region are developed in residuum, loess, colluvium, and alluvium. These soils were developed under big bluestem, little bluestem, Indiangrass, and switchgrass on the western part of this area. The eastern part of the area and the valleys in the western part support hardwoods, mainly northern red oak, white oak, and shagbark hickory with islands of tall prairie grasses being common. Major wildlife species of this area are deer, cottontail rabbit, fox squirrel, and bobwhite quail.

This MLRA is mostly rangeland, hayland, and pasture. More than two-fifths of the area supports pasture grasses and legumes. The western part of this area generally supports tall prairie grasses. Big bluestem, little bluestem, Indiangrass, and switchgrass are the main species. The cropland is used to produce winter wheat, soybeans, corn, grain sorghum, and other feed grains. The forested areas are mainly on steep valley sides and in low-lying areas on flood plains.

### **Classification relationships**

U.S. Department of Agriculture  
Major Land Resource Area (MLRA) 112 - Cherokee Prairies

US Forest Service Ecoregions (1994-1995):  
Domain name: Humid Temperate Domain  
Division name: Prairie Division  
Province name: Prairie Parkland (Temperate) Province  
Province code: 251

Terrestrial Natural Community Type in Missouri (Nelson, 2010):  
The reference state for this ecological site is most similar to a Wet-Mesic Bottomland Prairie.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):  
The reference state for this ecological site is most similar to Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus Herbaceous Vegetation (CEGL002024).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):  
This ecological site occurs throughout the Cherokee Plains Subsection, and in southern Land Type Associations of the Scarped Osage Plains Subsection.

NatureServe (2018):  
Class: Shrub & Herb Vegetation  
Subclass: Temperate & Boreal Grassland & Shrubland  
Formation: Temperate Grassland & Shrubland  
Division: Central North American Grassland & Shrubland  
Macrogroup: Central Lowlands Tallgrass Prairie  
Group: Central Tallgrass Prairie  
Alliance: Central Dry & Dry-Mesic Tallgrass Prairie

Ecological site concept

The Loamy Upland Drainageway ecological site is located in an upland water receiving position and moves concentrated water.

Associated sites

R112XY102KS	<b>Clayey Upland</b> The Clayey Upland ecological site is above the Loamy Upland Drainageway ecological site. This site is made up of poorly to moderately well drained soils with silt loam to silty clay surface layers and clayey subsoils. It has a parent material of loess over residuum and residuum from limestone and shale. It is generally on a slope range of 1 to 15 percent.
R112XY103KS	<b>Loamy Upland</b> The Loamy Upland ecological site is above the Loamy Upland Drainageway ecological site. This site is made up of somewhat poorly to well drained soils with silt loam, loam, and silty clay loam surface layers and has a parent material of loess over residuum and residuum from limestone, sandstone, and shale. It is generally on a slope range of 1 to 15 percent.

Similar sites

R112XY121MO	<b>Wet Upland Drainageway</b> The Wet Upland Drainageway ecological sites are located on similar landform positions but are wetter than the Loamy Upland Drainageway ecological sites and have a shallower water table (6-24 inches).
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Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Salix humilis</i>
Herbaceous	(1) <i>Andropogon gerardii</i> (2) <i>Tripsacum dactyloides</i>

Physiographic features

The Loamy Upland Drainageway ecological site is on upland drainageways with slopes that range from 1 to 3 percent. The site receives runoff from upland sites and is subject to flooding.

The block figure below (adapted from Preston, 1977) shows the typical landscape position of this ecological site,

and landscape relationships with other ecological sites. It is within the area labeled “4” on the figure, in narrow drainageways that include the active stream channel. A variety of ecological sites may be upslope, such as the Shallow Sandstone Uplands (2) site shown here.

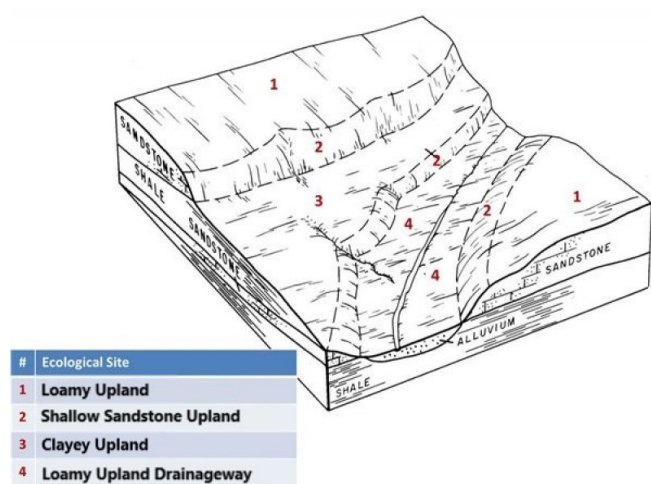


Figure 1. MLRA 112 block diagram

Table 2. Representative physiographic features

Landforms	(1) Drainageway
Runoff class	Very low to medium
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Occasional to frequent
Ponding frequency	None
Elevation	200–375 m
Slope	1–3%
Water table depth	61–183 cm
Aspect	Aspect is not a significant factor

## Climatic features

MLRA 112 (Cherokee Prairies) has a continental climate marked by strong seasonality. In winter, dry-cold air masses 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 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. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four 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.

Representative climatic features shown in Table 3 were derived from the climate stations selected for use within the MLRA.

Table 3. Representative climatic features

Frost-free period (characteristic range)	157-185 days
Freeze-free period (characteristic range)	186-205 days

Precipitation total (characteristic range)	1,092-1,168 mm
Frost-free period (actual range)	155-191 days
Freeze-free period (actual range)	178-214 days
Precipitation total (actual range)	1,067-1,194 mm
Frost-free period (average)	169 days
Freeze-free period (average)	193 days
Precipitation total (average)	1,118 mm

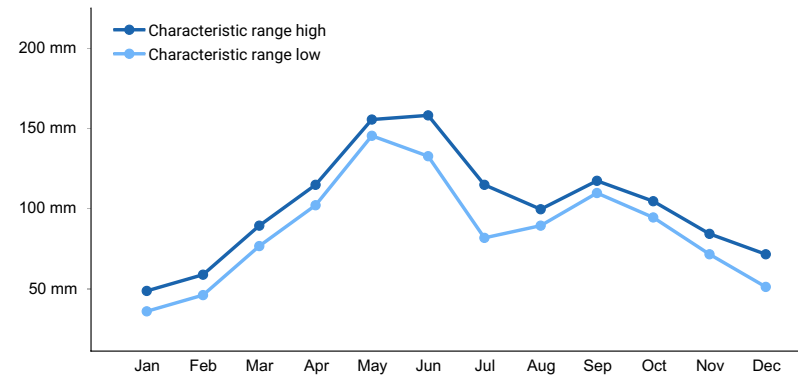


Figure 2. Monthly precipitation range

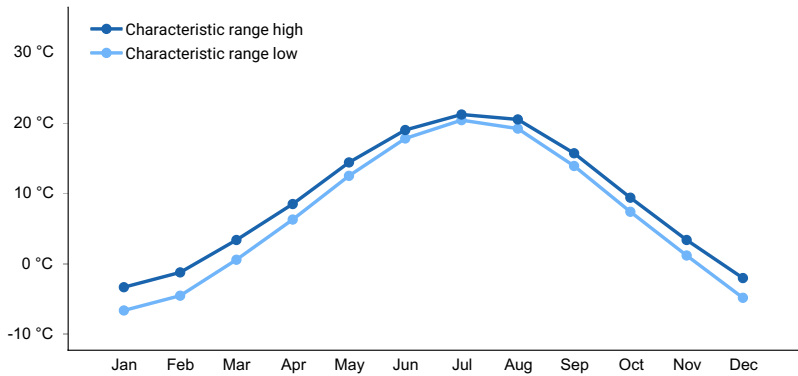


Figure 3. Monthly minimum temperature range

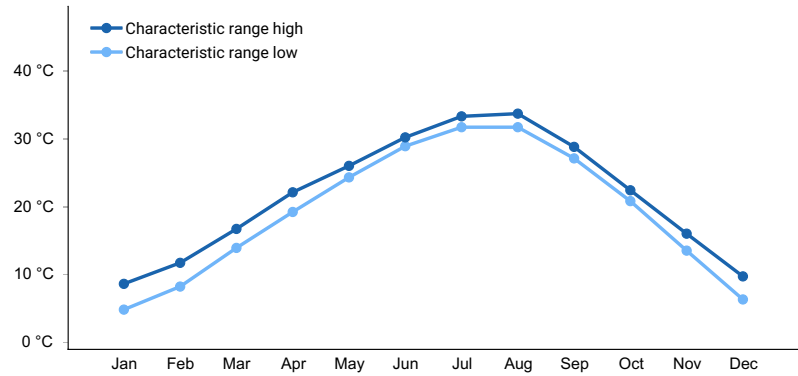
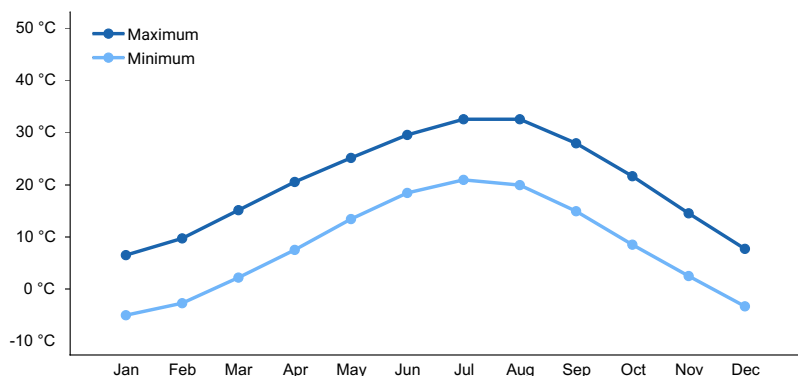
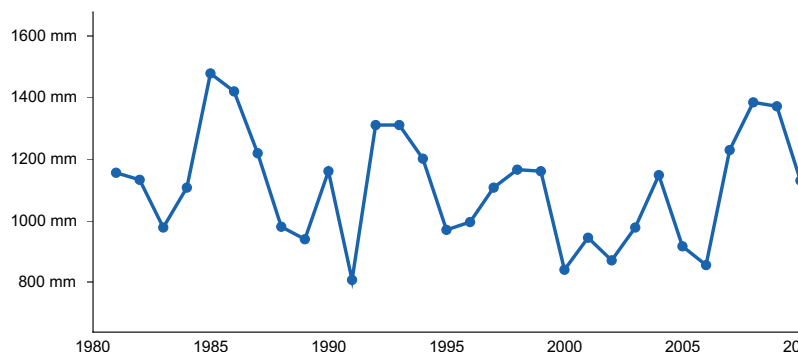


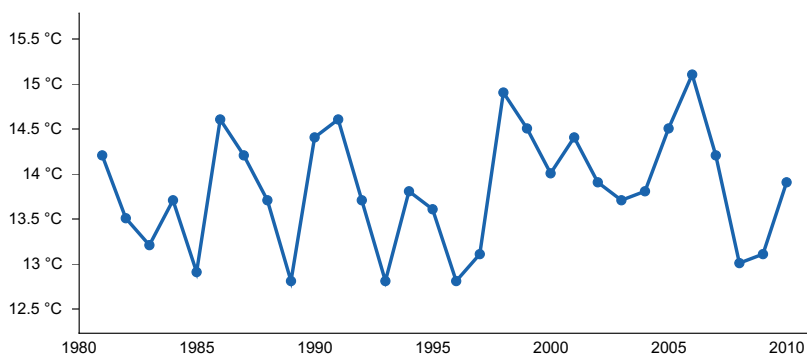
Figure 4. Monthly maximum temperature range



**Figure 5. Monthly average minimum and maximum temperature**



**Figure 6. Annual precipitation pattern**



**Figure 7. Annual average temperature pattern**

## Climate stations used

- (1) HUMBOLDT [USC00143867], Humboldt, KS
- (2) WAGONER [USC00349247], Wagoner, OK
- (3) PAOLA [USC00146209], Paola, KS
- (4) ELDORADO SPRINGS [USC00232511], El Dorado Springs, MO
- (5) HOLDENVILLE 2SSE [USC00344235], Holdenville, OK
- (6) NEVADA WTP [USC00235987], Nevada, MO
- (7) BUTLER 4W [USC00231145], Butler, MO
- (8) COFFEYVILLE MUNI AP [USW00093967], Coffeyville, KS

## Influencing water features

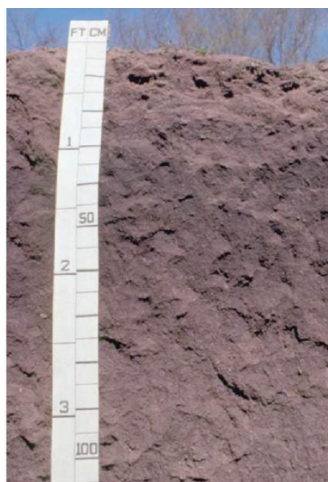
Loamy Upland Drainageway ecological sites are occasionally to frequently flooded.

## Soil features

The soils that makeup the Loamy Upland Drainageway ecological site have no rooting restriction and were formed under prairie vegetation with periodic depositional flood events. Organic matter content is high and the parent

material is alluvium. They have silt loam surface horizons and loamy substrata. These soils are not affected by seasonal wetness. Soil series associated with this site include Cleora, Radley, and Verdigris.

The accompanying picture of the Verdigris series shows the nearly uniform dark silt loam alluvium characteristic of these soils. Picture from Peer (2004).



**Figure 8. Verdigris series**

**Table 4. Representative soil features**

Parent material	(1) Alluvium
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderate to moderately rapid
Soil depth	152–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	20.32–22.86 cm
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.5–6.5
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

## Ecological dynamics

The reference community is characterized as a prairie unit with a ground cover dominated by big and little bluestem, Indiangrass, switchgrass, Eastern gamagrass, and a wide variety of prairie wildflowers. Other species such as Culver's root, Michigan lily, and bunchflower add to the mix of upland drainageway prairie species. Slightly higher areas within or at the edge of the drainageways can support scattered bur oak, pin oak, elm, shellbark hickory, and willow.

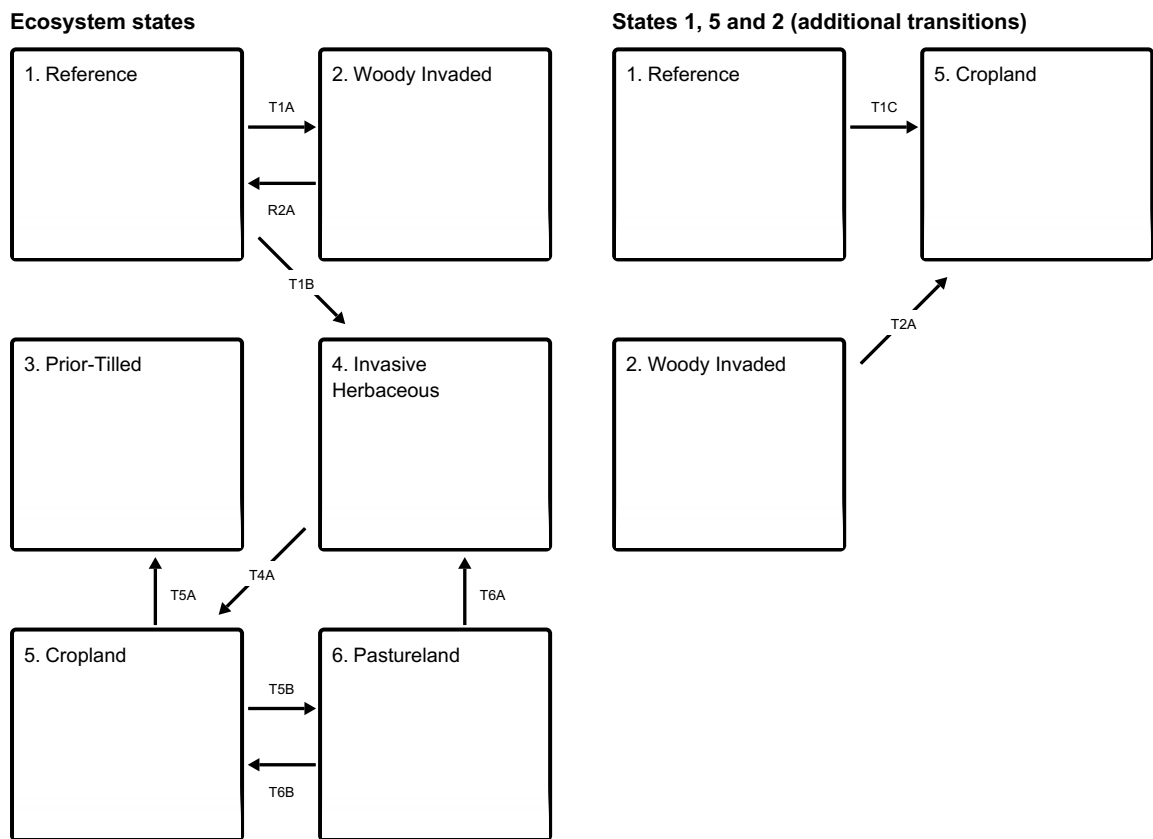
These areas flooded frequently but the duration was brief. In addition to the flooding and periodic wetness, fire played a key role, likely occurring at least once every three years. Fire removed dead plant litter and provided room for a lush growth of prairie vegetation. Fire also controlled woody species encroachment. Grazing impacted these sites by altering the composition, fuel loads, and structure of the vegetation that created a diversity of structure and composition. The partially wooded drainageway core 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. This is depicted in the Woody State.

These sites are productive. Today, Loamy Upland Drainageways are nearly extirpated from the region as the former high terrace prairies and savannas have been converted to intensive agriculture. While re-establishing prairie and savanna on converted agriculture sites is beneficial to wildlife, restoration to the reference state from agricultural land is a long term proposition with uncertain outcomes.

The state and transition model is provided to diagram the complex interactions briefly discussed here. The model includes states, plant communities, transitions, and restoration pathways detailing what experts have gathered from available experimental research, field observations, professional consensus, and interpretations. There may be other states or plant communities, with additional transitions and restoration pathways, not shown in the model, as well as noticeable variations within those illustrated.

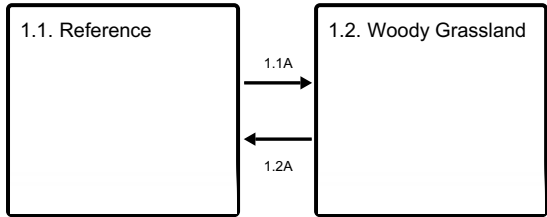
The state and transition model consists of six states and eight community phases. The Reference State (1) is typically burned every 1 to 3 years. Fire removes dead plant litter and provides room for a lush growth of prairie vegetation. Fires and intense flooding events also keep woody species from invading the rangeland. The Woody Invaded State (2) is characterized by a fire frequency and return interval greater than 20 years and a canopy cover percent between 40 and 60 percent. The Prior-Tilled State (3) consists of sites that were allowed to regenerate through natural revegetation or artificially reseeded after tillage practices have ceased. The Invasive Herbaceous State (4) is characterized by invasive, non-native grasses and forbs. The Cropland State (5) consists of land converted to agricultural cropland and dominated by row crops. The Pastureland State (6) is characterized by seeded grasses, usually cool season, that receive fertilizer and irrigation inputs to maintain the pasture, often used for grazing.

## State and transition model



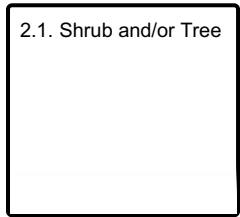
- T1B** - Invaded by non-native grasses and forbs.
- T1C** - Tillage and seeding of agricultural crops.
- R2A** - Removal of woody species by fire, mechanical methods, and/or significant floods.
- T2A** - Tillage and seeding of agricultural crops.
- T4A** - Tillage and seeding of agricultural crops.
- T5A** - Natural revegetation or reseeding
- T5B** - Seeding and establishment of pasture species and proper pasture management.
- T6A** - Invaded by non-native grasses and forbs.
- T6B** - Tillage and seeding of agricultural crops

**State 1 submodel, plant communities**

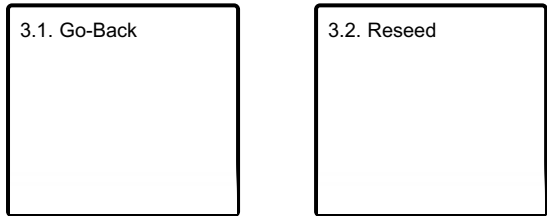


- 1.1A** - Fire free interval 10 or more years. Increase in woody species.
- 1.2A** - Fire frequency 1-3 years.

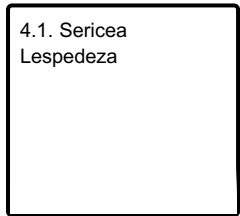
**State 2 submodel, plant communities**



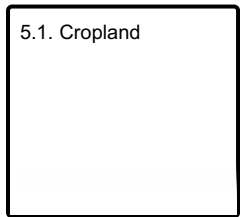
**State 3 submodel, plant communities**



**State 4 submodel, plant communities**



**State 5 submodel, plant communities**





## State 6 submodel, plant communities

6.1. Fescue, Brome,  
Bluegrass

## State 1 Reference

The Reference State is dominated by warm-season native grasses, and a wide variety of prairie forbs. In some areas, woody species occur in small groves or as scattered individuals across the landscape. This state has two plant community phases that can occur and transition back and forth depending on fire return intervals and flooding events.

**Characteristics and indicators.** An introduction and/or increase of woody plants can occur in the Reference State and initiates the transition to the Woody State. The lengthening of fire return interval, lack of fire intensity, and lack of significant flooding events, the greater the chance of woody species to establish and increase. Within the Reference State, the woody vegetation will generally be less than 15 percent canopy cover per acre. An introduction of seed from introduced or invasive plants can occur in the Reference State and is the starting point for transition to the Invasive Weedy State. If introduced or invasive plants are present, they should not exceed those percentages shown in the plant communities identified in the Invasive Weedy State. Tillage has not been a disturbance in the Reference State.

**Resilience management.** The Reference State is maintained through fire, flooding, and management. Longer fire return intervals with a lack of flooding events, will allow woody species to increase. When fire return intervals shorten, or when there is significant flooding, these woody species will decrease or be eliminated. Management will include strategies to prevent non-native seed introduction (woody or herbaceous) and scouting with targeted control methods if initial establishment occurs.

### Dominant plant species

- bur oak (*Quercus macrocarpa*), tree
- pin oak (*Quercus palustris*), tree
- shellbark hickory (*Carya laciniosa*), tree
- American hazelnut (*Corylus americana*), shrub
- New Jersey tea (*Ceanothus americanus*), shrub
- leadplant (*Amorpha canescens*), shrub
- prairie willow (*Salix humilis*), shrub
- American plum (*Prunus americana*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- eastern gamagrass (*Tripsacum dactyloides*), grass
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- switchgrass (*Panicum virgatum*), grass
- Missouri goldenrod (*Solidago missouriensis*), other herbaceous
- wild bergamot (*Monarda fistulosa*), other herbaceous

## Community 1.1 Reference

This state is native oak savanna dominated by an understory of big bluestem, eastern gamagrass and a wide variety of prairie forbs. This state occurs on loamy upland drainageways. Bur oak, pin oak, shellbark hickory, American elm, American hazelnut, prairie willow and wild plum occurred in small groves or as scattered individuals across the landscape.

### Dominant plant species

- bur oak (*Quercus macrocarpa*), tree
- prairie willow (*Salix humilis*), shrub
- big bluestem (*Andropogon gerardii*), grass
- eastern gamagrass (*Tripsacum dactyloides*), grass

## Community 1.2

### Woody Grassland

This plant community results from continued overgrazing, fire suppression, and reduced flooding. The presence of native tallgrasses, such as big bluestem and eastern gamagrass, has decreased. Numerous sedge and rush species have become established. Longer fire free intervals allowed woody species to increase such as prairie willow, dogwoods, and wild plum. When fire return intervals shorten these woody species will decrease.

#### Dominant plant species

- prairie willow (*Salix humilis*), shrub
- New Jersey tea (*Ceanothus americanus*), shrub
- American plum (*Prunus americana*), shrub
- big bluestem (*Andropogon gerardii*), grass
- eastern gamagrass (*Tripsacum dactyloides*), grass
- rush (*Juncus*), grass
- sedge (*Carex*), grass

## Pathway 1.1A

### Community 1.1 to 1.2

Fire free interval 10 or more years. Increase in woody species.

## Pathway 1.2A

### Community 1.2 to 1.1

Fire frequency 1-3 years.

## State 2

### Woody Invaded

The Woody Invaded State is dominated by a shrub and/or plant community. The increase and spread of shrubs and trees resulted from an absence of fire and/or flooding and will be accelerated by seed introduction and spread. Woody plants can increase up to 34% from a lack of fire according to a study from 1937 to 1969, in contrast to a 1% increase on burned areas (Bragg and Hulbert, 1976). Periodic burning and significant flooding events will hinder the establishment of most woody species and favor forbs and grasses. However, not all unburned areas have a woody plant invasion. Birds, small mammals, and livestock are instrumental in the distribution and spread of seed for most tree and shrub species common to this site. The speed of encroachment varies considerably.

**Characteristics and indicators.** Hydrologic function in the Woody Invaded State is affected by the amount of shrub and/or tree cover compared to the Reference State. Canopy interception loss can vary from 25.4% to 36.7% (Thurow and Hester, 1997). A small rainfall event is usually retained in the foliage and does not reach the litter layer at the base of the tree. Only when canopy storage is reached and exceeded does precipitation fall to the soil surface. Interception losses associated with the accumulation of leaves, twigs, and branches at the bases of trees are considerably higher than losses associated with the canopy. The decomposed material retains approximately 40% of the water that is not retained in the canopy (Thurow and Hester, 1997). Soil properties affected include biological activity, infiltration rates, and soil fertility. The Woody Invaded State has not had tillage as a disturbance and could have plants identified in the Invasive Herbaceous State and/or the Pastureland State present on the site.

**Resilience management.** The Woody Invaded State is characterized as a degraded reference site that has experienced fire suppression for 20 or more years, a lack of significant flooding events, and insufficient woody plant control methods such as mechanical, chemical, biological. The lack of sunlight, due to shading by the shrubs and/or trees, will favor cool-season grasses that can reduce fire intensity if fire timing is during their active growth period

and would help sustain the Woody Invaded State.

### **Dominant plant species**

- bur oak (*Quercus macrocarpa*), tree
- pin oak (*Quercus palustris*), tree
- shellbark hickory (*Carya laciniosa*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- goldenrod (*Solidago*), other herbaceous

## **Community 2.1**

### **Shrub and/or Tree**

This community is characterized as a woody invaded savanna. It has increased tree and shrub species due to fire suppression (20+ years) and a lack of flooding events. Native groundcover species such as big bluestem have decreased and non-native species such as tall fescue have increased. Common woody species include bur oak, pin oak, and shellbark hickory.

**Resilience management.** The Shrub and/or Tree Community is sustained by lack of fire and lack of woody plant control methods such as mechanical, chemical, or biological. A prescribed burning program accompanied by prescribed grazing will gradually return the plant community to one dominated by desirable grasses and Forbs. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species.

### **Dominant plant species**

- bur oak (*Quercus macrocarpa*), tree
- pin oak (*Quercus palustris*), tree
- shellbark hickory (*Carya laciniosa*), tree
- big bluestem (*Andropogon gerardii*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- goldenrod (*Solidago*), other herbaceous

## **State 3**

### **Prior-Tilled**

The Prior-Tilled State consists of abandoned cropland where the original plant community was destroyed through inversion by tillage but revegetation has occurred. Two plant communities are identified in the Prior-Tilled State and are identified by revegetation factors. The communities are identified as being naturally revegetated through succession (Go-back) or planted/seeded to species similar in composition to the reference plant community (Reseed). Plant species composition in the Prior-Tilled State is difficult to define due to the variability of plant communities that can exist.

**Characteristics and indicators.** The Prior-Tilled State is an alternative state since the energy, hydrologic, and nutrient cycles are significantly altered to that of the Reference State in its natural disturbance regime. Repeated tillage and planting of annual crops resulted in major changes in soil conditions. Reductions in organic matter, mineral levels, soil structure, oxygen levels, and water holding capacity, along with increased runoff/erosion and shifts in the populations of soil-dwelling organisms, are common in this state. The extent of these changes are dependent upon duration of cropping, crop types grown, and other management practices. Bulk density, aggregate stability, soil structure, and plant functional and structural groups are not fully restored to that of the Reference State. Mechanical tillage can destroy soil aggregation. Soil aggregates are an example of dynamic soil property change. Aggregate stability is critical for infiltration, root growth, and resistance to water and wind erosion (Brady and Weil, 2008).

**Resilience management.** The Prior-Tilled State is a result of a land use management decision and is sustained by diminished soil function. Implementation of practices that positively impact plant community diversity, energy flow, and nutrient and water cycle, should benefit rehabilitation. Documentation does not support rehabilitation to a Reference State within known management time frames.

### **Dominant plant species**

- prairie threeawn (*Aristida oligantha*), grass
- prairie cupgrass (*Eriochloa contracta*), grass
- composite dropseed (*Sporobolus compositus*), grass
- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- eastern gamagrass (*Tripsacum dactyloides*), grass
- annual ragweed (*Ambrosia artemisiifolia*), other herbaceous
- common sunflower (*Helianthus annuus*), other herbaceous
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

## **Community 3.1**

### **Go-Back**

This plant community occurs on areas that were formerly farmed. When tillage operations were discontinued, the areas were allowed to revegetate or “go back” naturally in contrast to artificial reseeding with a selected species or group of species. This is a slow, gradual process that entails many years and many successional changes or stages in the plant community. The speed and extent of revegetation depends on the size of the area, level of grazing management and the proximity of the area to existing seed sources. In the initial stages of revegetation the site is usually dominated by annual forbs such as annual ragweed, great ragweed, Canadian horseweed, common sunflower, annual marshelder and golden tickseed. Gradually these are replaced by annual grasses including prairie threeawn, crabgrass, prairie cupgrass, little barley, cheatgrass and bearded sprangletop. Usually plant succession will progress until the plant community is dominated by perennial grasses and grasslike plants including composite dropseed, foxtail barley, marsh bristlegrass, silver beardgrass, buffalograss, Torrey’s rush and sand dropseed. These plants can form a stable community. In time, with prescribed grazing management, other perennial grasses and forbs common in the Reference State return to the site. Adjoining areas with seed sources of big bluestem, Indiangrass and other tallgrasses may enhance recovery when included in a planned grazing system which includes significant growing season rest periods. Some go-back areas are invaded by trees and shrubs. The more common include Siberian elm, common hackberry, eastern redcedar, eastern cottonwood, black willow, roughleaf dogwood and coralberry. Occasional burning effectively controls these woody plants.

### **Dominant plant species**

- prairie threeawn (*Aristida oligantha*), grass
- prairie cupgrass (*Eriochloa contracta*), grass
- composite dropseed (*Sporobolus compositus*), grass
- annual ragweed (*Ambrosia artemisiifolia*), other herbaceous
- common sunflower (*Helianthus annuus*), other herbaceous

## **Community 3.2**

### **Reseed**

This plant community also occurs on areas that were formerly farmed. When farming operations ended, the area was seeded and established to a mixture of plants, usually native species common in the Reference State. Most seeding mixtures consisted of a blend of grasses that included big bluestem, Indiangrass, switchgrass and little bluestem. In some locations seed of additional plants such as eastern gamagrass, prairie bundleflower and Maximilian sunflower were included in the mixture. Once these areas become established, production is comparable to that of the Reference State. When reseeded areas and areas supporting native rangeland exist in the same pasture, they seldom are utilized at the same intensity because domestic livestock usually prefer plants on the native rangeland areas. When feasible, reseeded plant communities should be managed as separate pastures or units. These areas are also generally productive when managed for hay production. Some seeded areas are invaded by trees and shrubs during the establishment period of the desired plants. These invader species commonly include Siberian elm, common hackberry, eastern redcedar, eastern cottonwood, black willow, and roughleaf dogwood. Occasional burning is effective in controlling the establishment of these woody plants.

### Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- eastern gamagrass (*Tripsacum dactyloides*), grass
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

## State 4

### Invasive Herbaceous

The Pasture State is characterized by a significant presence of non-native grasses and forb species.

**Characteristics and indicators.** Species that define this state include sericea lespedeza. Sericea lespedeza community phases are partially defined by the total production exceeding 15% by weight on a per acre basis. Ecological processes within this state that are affected and differ from the Reference State are hydrologic cycle and nutrient cycle. Water content and infiltration rates are also affected by the species in the plant community phases.

**Resilience management.** This State is sustained through continued reduction in health and vigor of native plant species and the increase in health and vigor, including seed production, of non-native herbaceous species. Agronomic inputs from direct fertilization or nutrient-rich runoff from adjacent crop fields will provide advantages for non-native cool-season grass species growth. Ensuring a lack of forage quality due to season of grazing, type of grazing animal, or chemical composition of the non-native plants will deter grazing of non-native plant species and increase grazing pressure on native plant species. A general lack of treatment measures for individual species control, maintenance, and/or eradication will also allow persistence of this state.

### Dominant plant species

- sericea lespedeza (*Lespedeza cuneata*), shrub

## Community 4.1

### Sericea Lespedeza

Sericea lespedeza (*Lespedeza cuneata*) is present at levels exceeding 15% by weight on a per acre basis and governing the ecological processes and potential uses of this community. Sericea lespedeza is invasive and listed as a statewide noxious weed in Kansas. It competes with the native plant community for sunlight, water, and nutrients, and produces allelopathic compounds (toxic chemicals that negatively impact the germination and/or growth of other plants). It also contains tannins, that limit palatability, and produces copious amounts of seed that remain viable in the soil for decades. This species will quickly invade rangelands without proactive control measures

**Resilience management.** Sericea lespedeza (*Lespedeza cuneata*) is extremely competitive with its allelopathic nature, lower palatability compared to native species, and good seedling vigor. To prevent further loss of native plant composition, ensure native plant vigor remains high via a forage-animal balance based on forage composition and palatability, utilize spot application of herbicides to control new and existing sericea lespedeza plants, and consider diversifying grazing livestock type. Control measures for sericea lespedeza involve herbicide application following extension recommendations and product label for proper rates and timing. Utilization and control can also be provided through sheep and goat grazing. Conventional management practices such as prescribed grazing with cattle and dormant-season fire have been less than effective in preventing the spread of sericea lespedeza in rangelands. Some suppression of sericea lespedeza has been observed after mowing or summer burning. Late summer fire significantly reduces seed production the year of burn. An integrated approach is needed when treating this species. If the goal is continued presence or spread of sericea lespedeza, consider using a separate land use model such as Pasture.

### Dominant plant species

- sericea lespedeza (*Lespedeza cuneata*), shrub

## State 5

### Cropland

The Cropland State is dominated by row crops such as corn, soybeans, and wheat. It occurs on areas that have been mechanically tilled and converted to agricultural cropland. After tillage, efforts are then taken to plant various crops through a conservation cropping system. This state is common. Many sites have been converted to agricultural cropland.

**Resilience management.** This state is a result of a land use management decision.

#### Dominant plant species

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

## Community 5.1

### Cropland

This community occurs on areas where land use has been converted through mechanical tillage to intensive agriculture by conservation cropping. Primary crops are corn, soybeans, and wheat.

#### Dominant plant species

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

## State 6

### Pastureland

The Pastureland State is identified by a significant presence of non-native herbaceous plant species and is characterized by the composition of plant species, agronomic inputs from direct fertilization, and soil functions that govern the ecological processes. Sites consisting of introduced species and managed for their continued presence or spread should not be evaluated within this model and instead, consider using a separate land use model such as Pasture.

**Characteristics and indicators.** Tall fescue, smooth brome, and Kentucky bluegrass are partially defined by the total production exceeding 40% by weight on a per acre basis. Ecological processes within this state that are affected and differ from the Reference State are hydrologic cycle and nutrient cycle. Water content and infiltration rates are also affected by the species in the plant community phase.

**Resilience management.** Pastureland is sustained through continued reduction in health and vigor of native plant species and the increase in health and vigor, including seed production, of non-native herbaceous species. Agronomic inputs from direct fertilization or nutrient-rich runoff from adjacent crop fields will provide advantages for non-native cool-season grass species growth. Ensuring a lack of forage quality due to season of grazing, type of grazing animal, or chemical composition of the non-native plants will deter grazing of non-native plant species and increase grazing pressure on native plant species. A general lack of treatment measures for individual species control, maintenance, and/or eradication will also allow persistence of this state.

#### Dominant plant species

- Kentucky bluegrass (*Poa pratensis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass

## Community 6.1

### Fescue, Brome, Bluegrass

Tall fescue, smooth brome, and Kentucky bluegrass (all being cool-season grasses) are present at levels exceeding 40% by weight on a per acre basis and are governing the ecological processes and potential uses of this community. Timing of plant growth has shifted from summer (May through August) and now mostly occurs in spring and fall (March to May and September to November). Fire intensity of late spring burns can be greatly impeded due to the significant quantity of cool-season grass present. Any one or a combination of these species can be considered an invaded community. Soil dynamic property changes include biological activity and soil fertility.

**Resilience management.** Tall fescue, smooth brome, and Kentucky bluegrass are sustained or increased with nutrient additions and absence of fire. To prevent further loss of native plant composition, avoid nutrient additions, ensure native plant vigor remains high via a forage-animal balance based on forage composition and seasonal availability, utilize herbicides when natives are dormant but cool-seasons are actively growing, and utilize consecutive late spring prescribed burns. Chemical control will involve herbicide application following extension recommendations and product label for proper rates and timing. Intensifying grazing pressure (leaf removal of cool-season grasses) during the spring and fall and removing grazing pressure during the summer will reduce cool-season grass vigor and allow native warm-season plants an opportunity to maximize growth and gain vigor. Prescribed burning will require sufficient standing dead material in order to conduct a burn in late spring as warm-season grasses initiate growth. If the goal is continued presence or spread of tall fescue, smooth brome, or Kentucky bluegrass, consider using a separate land use model such as Pasture.

### **Dominant plant species**

- Kentucky bluegrass (*Poa pratensis*), grass
- tall fescue (*Schedonorus arundinaceus*), grass
- smooth brome (*Bromus inermis*), grass

### **Transition T1A**

#### **State 1 to 2**

Long term fire suppression (20+ years) and no significant flooding events will transition the Reference State to a Woody Invaded State. A lack of fire and flooding events will allow woody species to establish and increase, shifting the site to dominant trees and shrubs with a reduction in desirable grasses and forbs in the understory.

### **Transition T1B**

#### **State 1 to 4**

A transition from Reference to an Invasive Herbaceous State occurs when the site is invaded by *Sericea lespedeza* with the total production exceeding 15% by weight on a per acre basis.

### **Transition T1C**

#### **State 1 to 5**

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Reference State to a Cropland State.

### **Restoration pathway R2A**

#### **State 2 to 1**

Restoration actions to return to a Reference State may include machinery woody removal and prescribed fire every 1-3 years. A significant flooding event may also remove a large number of trees. Efforts will be costly, labor-intensive, and can take many years, if not decades. Once canopy levels reach greater than 20 percent, estimated cost to remove trees is very expensive and includes high energy inputs.

### **Transition T2A**

#### **State 2 to 5**

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Woody Invaded State to a Cropland State.

## **Transition T4A**

### **State 4 to 5**

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from an Invasive Herbaceous State to a Cropland State.

## **Transition T5A**

### **State 5 to 3**

Allowing the site to naturally revegetate as it regenerates, or reseeding the site with native grasses and forbs with proper management afterwards will transition this site from a Cropland to a Prior-Tilled State.

## **Transition T5B**

### **State 5 to 6**

Seeding of cool season grasses and forbs and proper pasture management will transition this Cropland to a Pastureland.

## **Transition T6A**

### **State 6 to 4**

A transition from Pastureland to an Invasive Herbaceous State occurs when the site is invaded by *Sericea lespedeza* with the total production exceeding 15% by weight on a per acre basis.

## **Transition T6B**

### **State 6 to 5**

Tillage (or no-till if that management style is preferred) and seeding of agricultural crops will transition this site from a Pastureland to a Cropland.

## **Additional community tables**

### **Animal community**

#### **Wildlife\***

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, and 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*).

\*This section prepared by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013

## Other information

### Forestry

Management: This ecological site is not recommended for traditional timber management activity. Historically this site was dominated by a ground cover of native prairie grasses and forbs. Some scattered open grown trees may have also been present. May be suitable for non-traditional forestry uses such as windbreaks, environmental plantings, alley cropping (a method of planting, in which rows of trees or shrubs are interspersed with rows of crops) or woody bio-fuels.

## Inventory data references

Reference and alternative states within the state-and-transition model are not yet well- documented or supported

and will require additional field sampling for refinement.

## **Other references**

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## **Approval**

Suzanne Mayne-Kinney, 11/05/2024

## **Rangeland health reference sheet**

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/12/2025
Approved by	Suzanne Mayne-Kinney
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):
- 

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:**
-