

Ecological site R112XY122OK Wet Terrace

Last updated: 11/05/2024
Accessed: 11/21/2024

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.

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 and Scarped Osage Plains Subsections.

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 Wet Terrace ecological site is a lowland located on stream terrace and floodplain step landforms that does not flood. This site has a seasonal or perennial high water table less than 24 inches from the soil surface. These sites are widespread along the larger rivers and streams in MLRA 112. Wet Terrace sites are often associated with Loamy Floodplain ecological sites, which are typically adjacent to the stream channel.

Associated sites

R112XY102KS	Clayey Upland The Clayey Upland ecological site is above the Wet Terrace 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	Loamy Upland The Loamy Upland ecological site is above the Wet Terrace ecological site. This site is made up of somewhat poorly to well drained soils with a surface layer of silt loam, loam, and silty clay loam and a loamy or clayey subsoil. It 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.
R112XY124KS	Wet Floodplain The Wet Floodplain ecological site is slightly below the Wet Terrace ecological site. This site is made up of poorly to somewhat poorly drained soils with silty clay loam or silty clay texture surface horizons, and loamy or clayey subsoils. It has a parent material of clayey and loamy alluvium. It is generally on a slope range of 0 to 3 percent.
R112XY125KS	Loamy Floodplain The Loamy Floodplain ecological site is slightly below the Wet Terrace ecological site. This site is made up of moderately well to well drained soils with silt loam to silty clay loam surface horizons and loamy subsoils. It has a parent material of loamy alluvium. It is generally on a slope range of 0 to 2 percent.

Similar sites

R112XY123KS	Loamy Terrace The Loamy Terrace ecological site is similar in landform position but has a deeper water table at a depth of 24 to 60 inches and drier soils.
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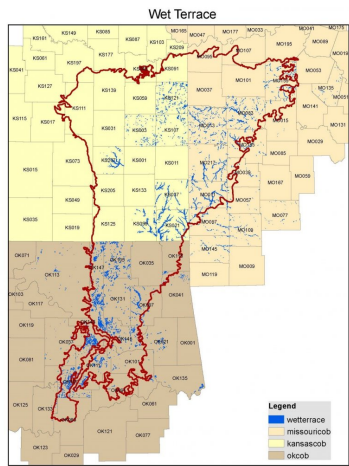


Figure 1.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Cephalanthus occidentalis</i> (2) <i>Amorpha fruticosa</i>
Herbaceous	(1) <i>Spartina pectinata</i> (2) <i>Calamagrostis canadensis</i>

Physiographic features

The Wet Terrace ecological site is located on stream terraces and floodplain steps with slopes of less than 2 percent. This site receives runoff from adjacent upland sites.

The block diagram 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 “2” on the figure and is typically on higher positions in the floodplain. Wet Floodplain (3) and Loamy, Clayey Floodplain (4) sites are often adjacent to this site, on lower positions. The dashed lines within the Wet Floodplain area on the diagram indicate the various soils included in the ecological site.

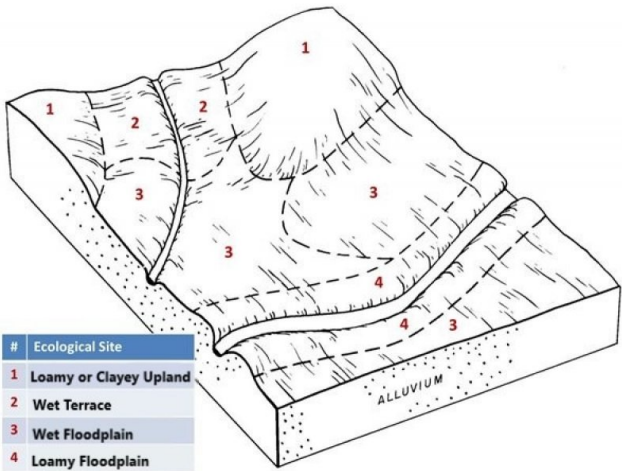


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace (2) Flood-plain step
Runoff class	Very low to medium

Flooding frequency	None to very rare
Ponding frequency	None
Elevation	151–338 m
Slope	0–2%
Water table depth	15–61 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 convective 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)	162-191 days
Freeze-free period (characteristic range)	187-215 days
Precipitation total (characteristic range)	1,067-1,143 mm
Frost-free period (actual range)	125-196 days
Freeze-free period (actual range)	152-220 days
Precipitation total (actual range)	1,041-1,168 mm
Frost-free period (average)	171 days
Freeze-free period (average)	195 days
Precipitation total (average)	1,092 mm

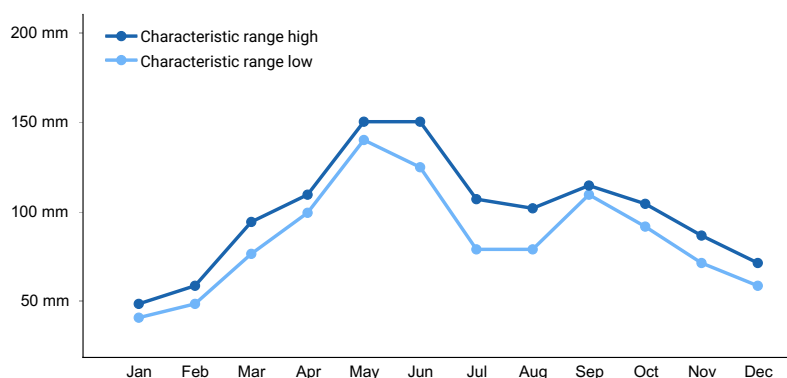


Figure 3. Monthly precipitation range

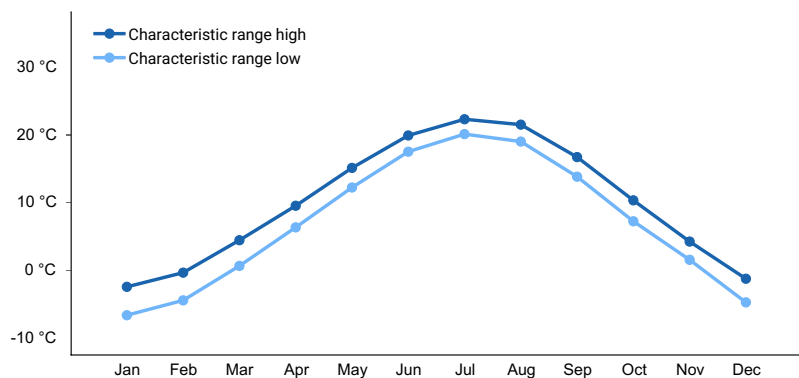


Figure 4. Monthly minimum temperature range

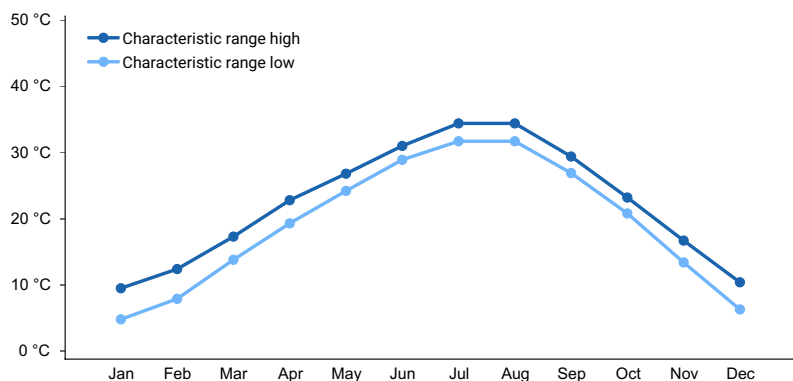


Figure 5. Monthly maximum temperature range

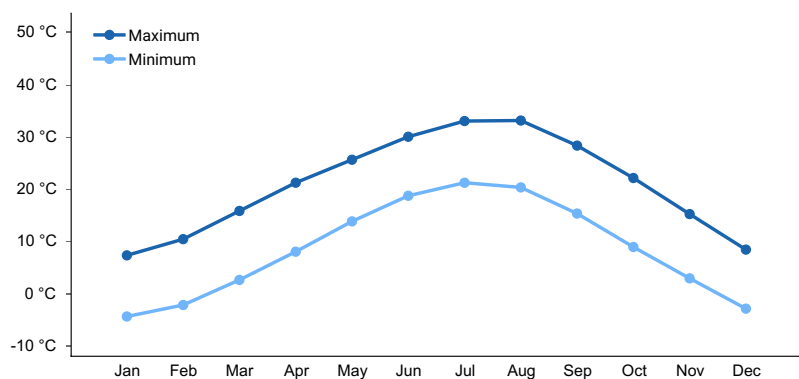


Figure 6. Monthly average minimum and maximum temperature

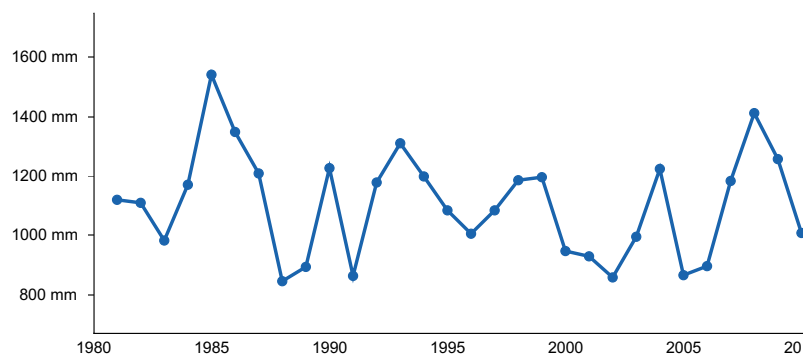


Figure 7. Annual precipitation pattern

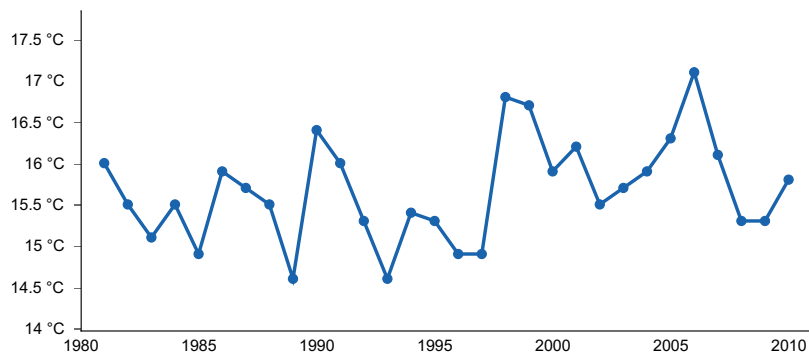


Figure 8. Annual average temperature pattern

Climate stations used

- (1) NOWATA [USC00346485], Nowata, OK
- (2) WAGONER [USC00349247], Wagoner, OK
- (3) CLINTON [USC00231711], Clinton, MO
- (4) HOLDENVILLE 2SSE [USC00344235], Holdenville, OK
- (5) PAOLA [USC00146209], Paola, KS
- (6) TULSA INTL AP [USW00013968], Tulsa, OK
- (7) ELDORADO SPRINGS [USC00232511], El Dorado Springs, MO

Influencing water features

These sites have a very rare flooding frequency. During the spring months, these sites will be affected by a seasonal high water table.

Soil features

Soils that make up the Wet Terrace ecological site have no rooting restriction and were formed under woodland vegetation. Organic matter content is variable due to flood depositional history. Parent material is alluvium. They have silt loam and silty clay loam surface horizons, and clayey subsoils. They are affected by a seasonal high-water table during the spring months, and most sites are subject to rare flooding. Soil series associated with this site include Hepler, Lamine, Muldrow, Quarles, and Urich.

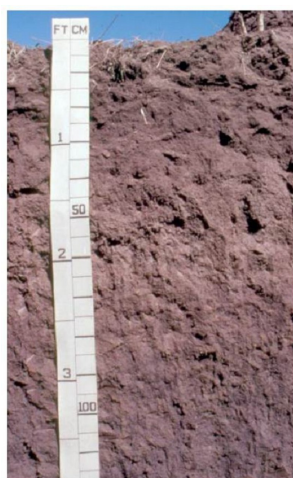


Figure 9. This picture of the Hepler series shows a dark silt loam surface horizon over a silty clay loam subsoil. Picture from Peer (2004).

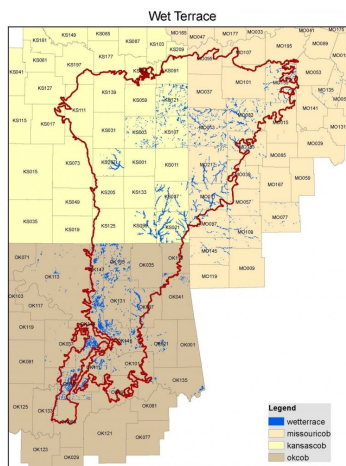


Figure 10. Wet Terrace mapunits.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Very slow to moderately slow
Soil depth	152–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–22.86 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%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Wet Terrace ecological site are associated with seasonal or perennial high water tables less than 24 inches from the soil surface. These conditions along with periodic fire have a strong influence on excluding trees. Fire during dry periods removed the dense mat of leaf litter creating opportunities for plants less aggressive than the grasses and sedges.

The Wet Terrace ecological site is dominated by a dense cover of wetland species, including prairie cord grass, sedges, and wet tolerant forbs. Slightly higher areas within or at the edge of the prairie support widely scattered elm, bur oak, pin oak, shellbark hickory, and willow.

Today most of these ecological sites have been drained and farmed. Only a few reference plant communities exist.

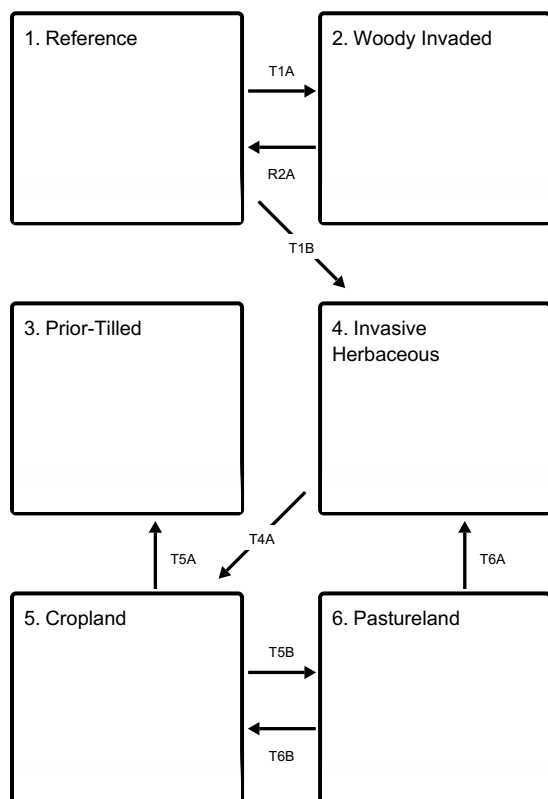
However, because of their site conditions, during wet years, they act as ephemeral farmed wetlands in the agricultural landscape. While their flood regime usually has been altered, their position and soil properties still make them good candidates for wet prairie development management.

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.

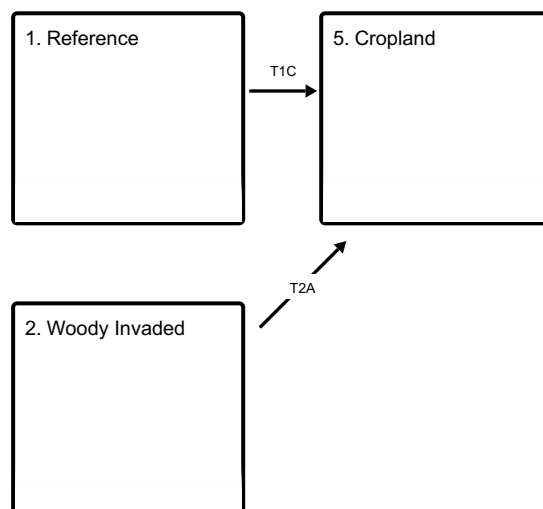
The state and transition model consists of six states and nine community phases. These states and community phases interact based on the timing, intensity, and frequency of prescribe burning and prescribed grazing, introduction of invasive species, and tillage practices. The Reference State (1) is typically burned every 1 to 3 years. Fire removes dead plant litter and provides room for a lush growth of prairie vegetation. Fire 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

Ecosystem states



States 1, 5 and 2 (additional transitions)



T1A - Fire suppression greater than 20 years; woody invasion.

T1B - Invaded by non-native grasses and forbs.

T1C - Tillage and seeding of agricultural crops.

R2A - Woody removal; prescribed fire 1-3 years.

T2A - Tillage and seeding of agricultural crops.

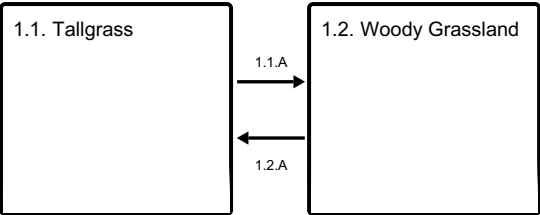
T4A - Tillage and seeding of agricultural crops.

T5A - Natural revegetation or reseeding

T5B - Seeding and establishment of pasture species and proper pasture management.

T6A - Invaded by non-native grasses and forbs.

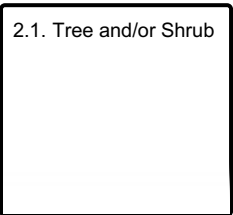
State 1 submodel, plant communities



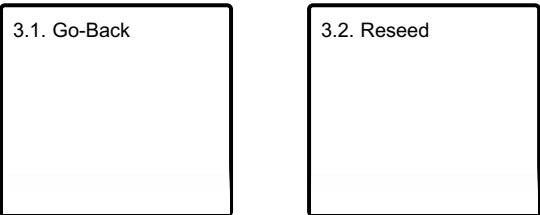
1.1.A - Fire free interval of 10 years or more.

1.2.A - Fire interval 1-3 years

State 2 submodel, plant communities



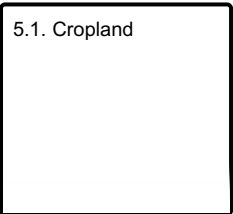
State 3 submodel, plant communities



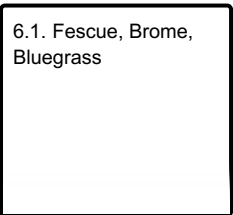
State 4 submodel, plant communities



State 5 submodel, plant communities



State 6 submodel, plant communities



The Reference State is dominated by warm season tall grasses and a wide variety of prairie forbs. In some areas, woody species occur in small groves or as scattered individuals across the landscape. Within this state are two plant community phases that can occur and will transition back and forth depending on fire return intervals and flooding events. Longer fire return intervals with a lack of flooding events, will allow woody species to increase such as prairie willow, dogwoods, and wild plum. When fire return intervals shorten, these woody species will decrease or be eliminated.

Characteristics and indicators. An introduction and/or increase of woody plants can occur in the Reference State and initiates the transition to the Woody Invaded State. With the lengthening of fire return interval, lack of fire intensity, and lack of significant flooding events, there is a greater 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, invasive or noxious plants can occur in the Reference State and is the starting point for transition to the Pastureland and/or Invasive Herbaceous State. If introduced, invasive, or noxious plants are present, they should not exceed those percentages shown in the plant communities identified in the Pastureland State and Invasive Herbaceous State. Tillage has not been a disturbance in the Reference State.

Resilience management. The Reference State is maintained through fire, grazing, flooding, and management. Fire will have a return interval of one to three years that includes the timing and intensity to negatively impact undesirable species. Grazing will include a forage-animal balance and adaptive decision-making to ensure the dominant plants within the reference plant community can maintain vigor. 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

- prairie willow (*Salix humilis*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- big bluestem (*Andropogon gerardii*), grass
- winged lythrum (*Lythrum alatum*), other herbaceous
- bearded beggarticks (*Bidens aristosa*), other herbaceous
- water knotweed (*Polygonum amphibium*), other herbaceous
- harvestlice (*Agrimonia parviflora*), other herbaceous

Community 1.1

Tallgrass

The Tallgrass Plant Community represents the original plant community that existed prior to European settlement. The site is characterized as grassland with occasional trees and large shrubs. It is dominated by tall, warm-season grasses and forbs. All of these grasses and most of the dominant forbs are strongly rhizomatous. Tallgrasses include big bluestem, Indiangrass, switchgrass, eastern gamagrass and prairie cordgrass. Little bluestem and sideoats grama are the major midgrasses. Other prevalent midgrasses and grasslike plants are Canada wildrye, Virginia wildrye, western wheatgrass, marsh bristlegrass, composite dropseed and several species of sedges and rushes. A number of very palatable forbs are found interspersed throughout the grass sward and include Maximilian sunflower, sawtooth sunflower, pitcher sage, compassplant, wholeleaf rosinweed and prairie bundleflower. Other important forbs are American licorice, Nuttall's sensitive-briar, slimflower scurfpea, common milkweed, and prairie fleabane. Water loving plants (hydrophytes) associated with this site include those of emergent wetland inclusions (hydric soils) that often occur within Wet Upland Drainage sites. Some of the more common species found might include broadfruit bur-reed, broadleaf cattail, river bulrush, field horsetail (scouringrush), arumleaf arrowhead, swamp milkweed, Pennsylvania smartweed, swamp smartweed, stalkless yellowcress, cardinalflower, cursed buttercup, curly dock, devil's beggartick, annual marshelder, rough barnyardgrass, and yellow nutsedge. Desert false indigo and common buttonbush are shrubs that commonly occur in moist-soil situations immediately adjacent to streams or wetlands. Although the major portion of the site is dominated by herbaceous plants, isolated areas do support stands of trees. Slightly higher areas within or at the edge of the prairie matrix support widely scattered elm, bur oak, pin oak, shellbark hickory, and willow. The understory supports shade-tolerant, cool-season plants such as Canada wildrye, Virginia wildrye, Kentucky bluegrass, and sedges. Woody understory plants might include pawpaw, Missouri gooseberry, Ohio buckeye, eastern poison ivy, Virginia creeper, and riverbank grape.

Resilience management. This is a stable, resilient and very productive plant community when adequately

managed. A prescribed grazing program that incorporates periods of deferment during the growing season will perpetuate the more-palatable tallgrasses and forb species. In a number of locations this plant community is managed exclusively for hay production. Mowing tends to reduce the amount of switchgrass and prairie cordgrass and favor big bluestem, Indiangrass and eastern gamagrass. This community is characterized by wet-tolerant natives. Periodic flooding and a natural fire regime control woody species.

Dominant plant species

- prairie willow (*Salix humilis*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- switchgrass (*Panicum virgatum*), grass
- big bluestem (*Andropogon gerardii*), grass

Community 1.2 Woody Grassland

This plant community results from continued overgrazing, fire suppression, and reduced flooding. The amount of tallgrasses has decreased significantly and the site is dominated by a variety of sedges and rushes. Midgrasses such as silver beardgrass, purpletop tridens, and western wheatgrass are present as well as shortgrasses such as Kentucky bluegrass and buffalograss. The most common shrubs along drainageways are desert false indigo, common buttonbush, roughleaf dogwood, prairie willow, and coralberry. Bur oak, pin oak, American elm, and shellbark hickory are the major trees found on the site. Remnant plants of big bluestem, Indiangrass, switchgrass, prairie cordgrass, eastern gamagrass and Maximilian sunflower are often found scattered throughout the site. Although usually grazed repeatedly and maintained in a low state of vigor, these plants respond favorably to periods of rest from grazing during the growing season and often regain vigor in a few years. This community is characterized by more woody species such as buttonbush, false indigo, willow due to the reduction in fire interval and reduced flooding.

Dominant plant species

- prairie willow (*Salix humilis*), shrub
- false indigo bush (*Amorpha fruticosa*), shrub
- common buttonbush (*Cephalanthus occidentalis*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- sedge (*Carex*), grass
- rush (*Juncus*), grass

Pathway 1.1.A Community 1.1 to 1.2

The site has a fire free interval of 10 years or more.

Pathway 1.2.A Community 1.2 to 1.1

The site has a return fire interval of 1-3 years.

State 2 Woody Invaded

The Woody Invaded State is dominated by a shrub and/or tree plant community. The increase and spread of shrubs and trees resulted from fire suppression and flooding reduction for 20 or more years. 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 species 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
- false indigo bush (*Amorpha fruticosa*), shrub
- prairie willow (*Salix humilis*), shrub
- prairie cordgrass (*Spartina pectinata*), grass
- Canada wildrye (*Elymus canadensis*), grass

Community 2.1

Tree and/or Shrub

This community has had longer term fire suppression and wood species are transitioning the community to a woody invaded savanna.

Dominant plant species

- pin oak (*Quercus palustris*), tree
- bur oak (*Quercus macrocarpa*), tree
- silver maple (*Acer saccharinum*), tree
- common buttonbush (*Cephalanthus occidentalis*), shrub
- broomsedge bluestem (*Andropogon virginicus*), grass

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
- composite dropseed (*Sporobolus compositus*), grass
- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- annual ragweed (*Ambrosia artemisiifolia*), other herbaceous
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

Community 3.1

Go-Back

This plant community also 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 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 ragweed, Canadian horseweed, common sunflower, annual marshelder and golden tickseed. Gradually these are replaced by annual grasses including prairie threeawn, prairie cupgrass, field brome 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 bristlegass, silver beardgrass, buffalograss, and Torrey’s rush. These plants can form a stable community. In time and with prescribed grazing management, other perennial grasses and forbs common in the Reference State return to the site. Go-back areas will be invaded by trees and shrubs. The more common include Siberian elm, common hackberry, eastern cottonwood, black willow, and roughleaf dogwood. Occasional burning is necessary to controlling these woody plants..

Dominant plant species

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

Community 3.2

Reseed

This plant community occurs on areas that were formerly farmed. When farming operations ended, the area was seeded and established to a mixture of plants. These were 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 prairie bundleflower and Maximilian sunflower were included. Once these areas become fully 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 generally manageable and productive when utilized 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 eastern redcedar, coralberry, persimmon, blackberry and common hackberry. Occasional burning is usually effective in controlling establishment of these woody plants.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- Indiangrass (*Sorghastrum nutans*), grass
- switchgrass (*Panicum virgatum*), grass
- Illinois bundleflower (*Desmanthus illinoensis*), other herbaceous
- Maximilian sunflower (*Helianthus maximiliani*), other herbaceous

State 4

Invasive Herbaceous

The Invasive Herbaceous State is identified by a significant presence of non-native herbaceous plant species and is characterized by the composition of plant species and soil functions that govern the ecological processes.

Characteristics and indicators. Species that define this state include sericea lespedeza and Caucasian bluestem. Sericea lespedeza and Caucasian bluestem 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 phase.

Resilience management. The Invasive Herbaceous 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
- Caucasian bluestem (*Bothriochloa bladhii*), grass

Community 4.1

Caucasian Bluestem

Caucasian bluestem is present at levels exceeding 15% by weight on a per acre basis and governing the ecological processes and potential uses of this community. Caucasian bluestem might be the most serious threat and most aggressive of the introduced, invasive, and noxious species of this time. Interspatial erosion can be present due to the clumpy growth of the plant which leads to a rough surface to walk or drive on. Caucasian bluestem is allelopathic (producing toxic chemicals that negatively impact the germination and/or growth of other plants) and often exists as a monoculture due to its competitive ability. Having this species present on a site can and will allow further invasion of adjacent sites if proactive prevention and control measures are not implemented. Research and trial studies are continuously being conducted on control measures for Caucasian bluestem. Soil dynamic property changes include infiltration, biological activity, and soil fertility.

Resilience management. Caucasian bluestem is extremely competitive with its allelopathic nature, lower palatability compared to native species, ability to persist with heavy utilization, and tolerance to drought. 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, and utilize spot application of herbicides to control new and existing Caucasian bluestem plants. Fire can be utilized to remove standing dead growth and increase palatability of Caucasian bluestem in a mixed plant community, especially initial spring growth. Impacts to Caucasian bluestem via alternate timing of fire (late summer) is currently being investigated. There have been cases where the native taller grasses appear to shade and out-compete the Caucasian bluestem, but more commonly, it is crowding out the native grass as it spreads. There are ungrazed places on the Konza Prairie Research and biological station where Caucasian bluestem was introduced from feeding livestock contaminated hay and it is now crowding out the native grass.

Dominant plant species

- Caucasian bluestem (*Bothriochloa bladhii*), grass

Community 4.2

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.

Dominant plant species

- *sericea lespedeza* (*Lespedeza cuneata*), shrub

State 5

Cropland

The Cropland State is dominated by row crops such as corn, wheat, and soybeans. 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.

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 to intensive agriculture cropland through mechanical tillage and a conservation cropping system. Primary crops include corn, soybeans, and wheat.

Dominant plant species

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

- tall fescue (*Schedonorus arundinaceus*), grass
- Kentucky bluegrass (*Poa pratensis*), 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

Fire suppression on the sites in excess of 20 years will allow the increase in woody species.

Transition T1B

State 1 to 4

A transition from Reference to an Invasive Herbaceous State occurs when the site is invaded by either *Sericea lespedeza* and/or Caucasian bluestem 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 to the Reference State will including the removal of woody species and the implementation of prescribed fire approximately 1-3 years to control woody species.

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 either *Sericea lespeleza* and/or Caucasian bluestem 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:

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.

Migratory Waterbirds: Sora, Common Snipe and Virginia Rail

Furbearers: Muskrat, Beaver, and Mink.

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

Breeding birds: Sedge Wren, Red-Winged Blackbird, Least Bittern, Marsh Wren, and Common Yellowthroat.

Migratory birds: Sora, Virginia Rail, Sedge Wren, Least Bittern, Yellow Rail and Common Snipe.

Amphibian and reptile species associated with this ecological site's reference state condition: Western Chorus Frog (*Pseudacris triseriata triseriata*), Plains Leopard Frog (*Rana blairi*), Graham's Crayfish Snake (*Regina grahamii*), Midland Brown Snake (*Storeria dekayi wrightorum*), and prairies with crawfish burrows may have Northern Crawfish Frog (*Rana areolata circulosa*).

Small mammals associated with this ecological site's reference state condition: Muskrat (*Ondatra zibethicus*), Southern Bog Lemming (*Synaptomys cooperi*), and Mink (*Mustela vison*).

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: Swamp Milkweed Leaf Beetle (*Labidomera clivicollis*), Cordgrass Planthopper (*Prokelisia crocea*), Dion Skipper butterfly (*Euphyes dion*), Duke's Skipper butterfly (*Euphyes dukesi*), native bees (*Lasioglossum hartii*, *Hesperapis carinata*, *Svastra atripes* and *Cemolobus ipomoeae*), Bullate Meadow katydid (*Orchelimum bullatum*) and Sedge Grasshopper (*Stethophyma celatum*).

Other invertebrates: 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.

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Approval

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	11/21/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**
