

Ecological site R112XY106OK Shallow Limestone Upland

Last updated: 11/05/2024

Accessed: 11/24/2024

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 Limestone Glade.

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

The reference state for this ecological site is most similar to *Schizachyrium scoparium* - *Sorghastrum nutans* - *Bouteloua curtipendula* – *Rudbeckia missouriensis* - *Hedyotis nigricans* Wooded Herbaceous Vegetation (CEGL002398).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002): This ecological site occurs primarily 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

This site is located on upland position sites and is made up of soils that are less than 20" to limestone bedrock.

Associated sites

R112XY102KS	Clayey Upland The Clayey Upland ecological site is on similar landform positions to the Shallow Sandstone Upland ecological site. This site is made up of poorly to moderately well drained soils with a clay content greater than 40% at depths less than 12 inches from the surface. 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 on similar landform positions to the Shallow Sandstone Upland 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.
R112XY104KS	Gravelly Upland The Gravelly Upland ecological site is on similar landform positions to those of the Shallow Sandstone Upland ecological site. This site is made up of moderately well to well drained soils with silty clay loam surface layers and clayey subsoils with greater than 35% limestone or shale fragments and has a parent material of gravelly residuum from limestone and shale. It is generally on a slope range of 2 to 15 percent.

Similar sites

R112XY105OK	Shallow Sandstone Upland The Shallow Sandstone Upland ecological site is similar to the Shallow Limestone Upland ecological site because they have similar general species present. However, the Shallow Sandstone Upland formed from residuum from sandstone.
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Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Schizachyrium scoparium</i>

Physiographic features

The site generates runoff to adjacent, downslope ecological sites, and in places receives runoff from upslope summit and shoulder sites. This site does not flood.

The block figure below (adapted from Kichler & Howard, 1995) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites. It is within the area labeled “1” on the figure. A variety of upland ecological sites may be downslope, such as the Loamy Uplands (2) and Clayey Upland (3) sites shown here.

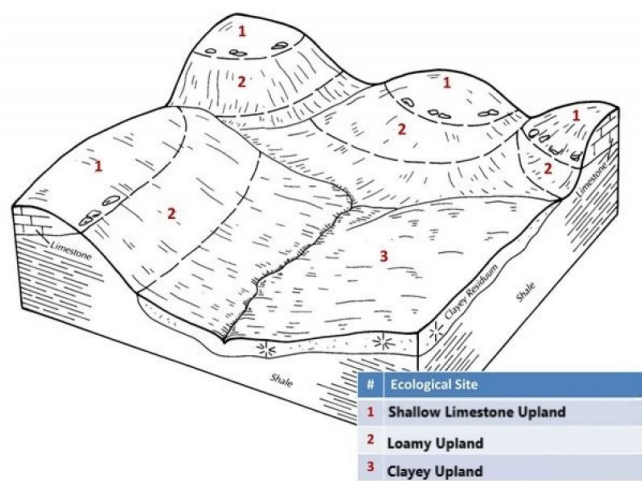


Figure 1. MLRA 112 block diagram of associated ecological sites.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	151–379 m
Slope	5–20%
Water table depth	203 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.

The annual precipitation ranges from 36 to 48 inches (900 to 1,230 millimeters) with a mean of 43 inches (1,080 millimeters). The annual temperature ranges from 53 to 62 degrees F (11.9 to 16.5 degrees C) with a mean of 57 degrees F (13.6 degrees C). The freeze-free period ranges from 190 to 245 days with a mean of 205 days. Source: United States Department of Agriculture, Natural Resources Conservation Service. 2022. Land resource regions

and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture, Agriculture Handbook 296.

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)	163-181 days
Freeze-free period (characteristic range)	192-203 days
Precipitation total (characteristic range)	1,041-1,143 mm
Frost-free period (actual range)	157-186 days
Freeze-free period (actual range)	189-211 days
Precipitation total (actual range)	991-1,143 mm
Frost-free period (average)	172 days
Freeze-free period (average)	198 days
Precipitation total (average)	1,092 mm

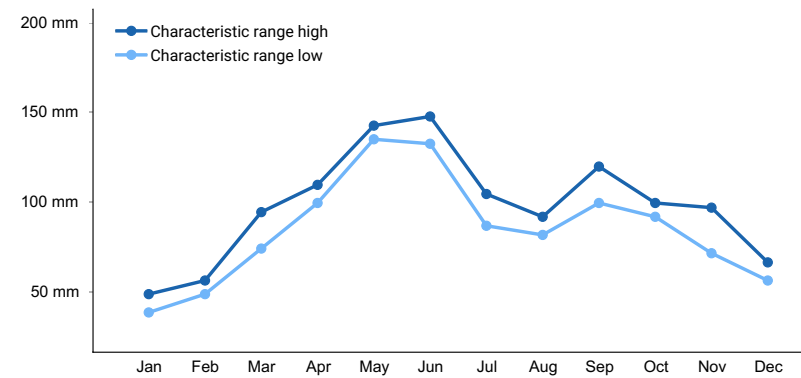


Figure 2. Monthly precipitation range

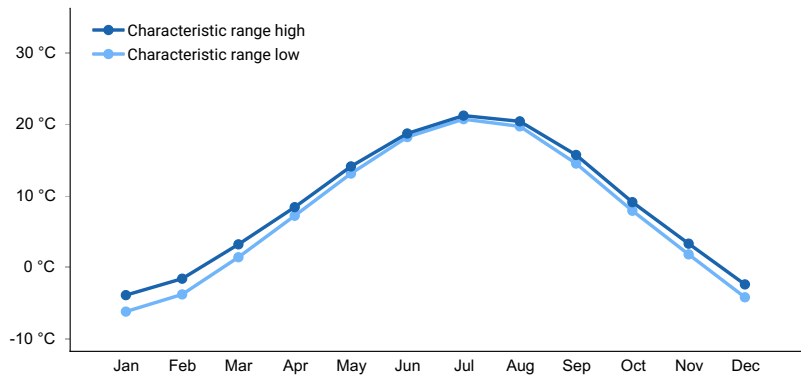


Figure 3. Monthly minimum temperature range

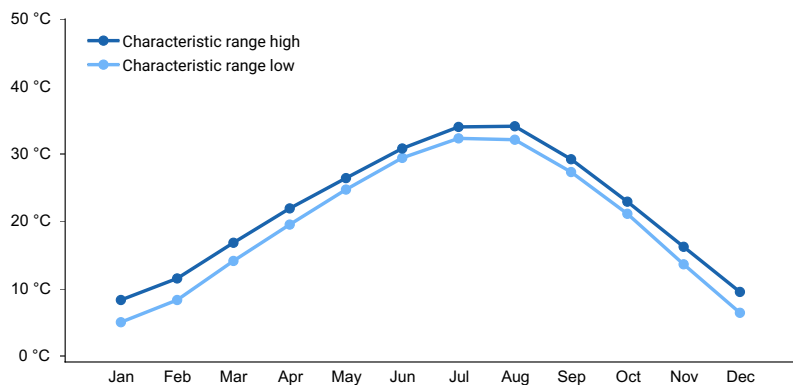


Figure 4. Monthly maximum temperature range

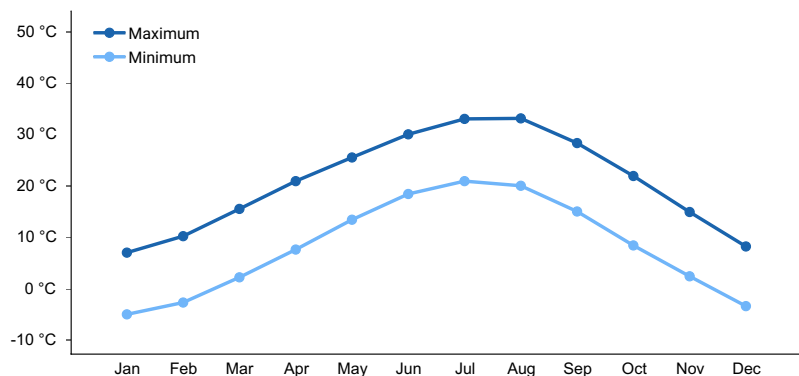


Figure 5. Monthly average minimum and maximum temperature

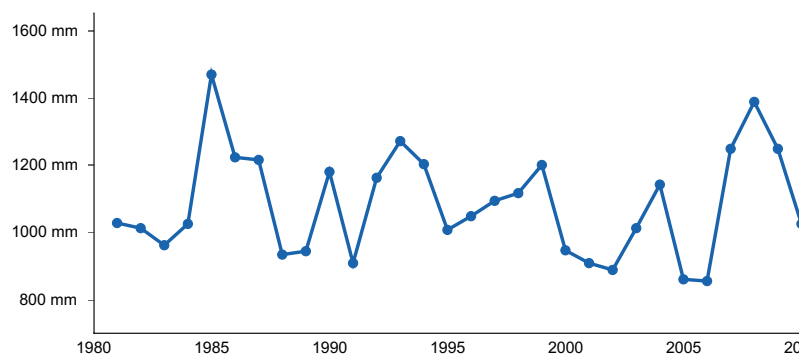


Figure 6. Annual precipitation pattern

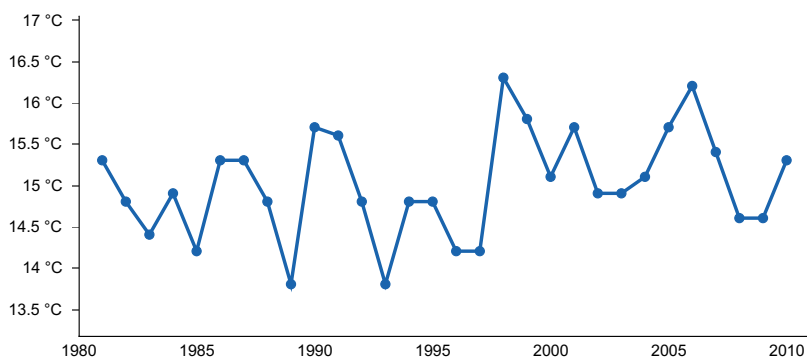


Figure 7. Annual average temperature pattern

Climate stations used

- (1) BUTLER 4W [USC00231145], Butler, MO
- (2) MIAMI [USC00345855], Miami, OK
- (3) PRYOR [USC00347309], Pryor, OK

- (4) CLAREMORE 2 ENE [USC00341828], Claremore, OK
- (5) NOWATA [USC00346485], Nowata, OK
- (6) BARTLESVILLE F P FLD [USW00003959], Bartlesville, OK
- (7) HOLDENVILLE 2SSE [USC00344235], Holdenville, OK
- (8) COFFEYVILLE MUNI AP [USW00093967], Coffeyville, KS
- (9) HILLSDALE LAKE [USC00143686], Paola, KS

Influencing water features

These sites are not influenced by riparian or wetland features.

Soil features

These soils are underlain with limestone bedrock at less than 20 inches in depth. The soils were formed under prairie vegetation, and have dark, organic-rich surface horizons. The parent material is limestone residuum. These soils are loamy or clayey and are skeletal, with high amounts of limestone gravel, channers, and flagstones. They are not affected by seasonal wetness. Soil series associated with this site include Balltown, Claremore, Kiti, and Shidler.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Very flaggy silt loam (2) Very flaggy silty clay loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to moderate
Soil depth	25–51 cm
Surface fragment cover ≤3"	5–6%
Surface fragment cover >3"	25–35%
Available water capacity (0–101.6cm)	5.08 cm
Calcium carbonate equivalent (0–101.6cm)	1–5%
Electrical conductivity (0–101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0–101.6cm)	0
Soil reaction (1:1 water) (0–101.6cm)	6.1–8.2
Subsurface fragment volume ≤3" (Depth not specified)	5–6%
Subsurface fragment volume >3" (Depth not specified)	25–35%

Ecological dynamics

Shallow Limestone Uplands are associated with limestone scarps. They occur as thin soiled rocky areas within a complex of limestone and shale prairies. The shallow soils of this ecological site limit the growth and abundance of trees and support native grasses and forbs that dominate these systems. Fire played an important role in the development and maintenance of these systems at least once every five years. These periodic fires removed the litter and stimulated the growth and flowering of the grasses and forbs. They also further limited the growth and dominance of trees, especially eastern redcedar. Fire tolerant chinkapin oak and post oak occupied islands and edges of deeper soils, creating a complex mosaic of open glade, prairie and low-density woodland in some areas of

this MLRA.

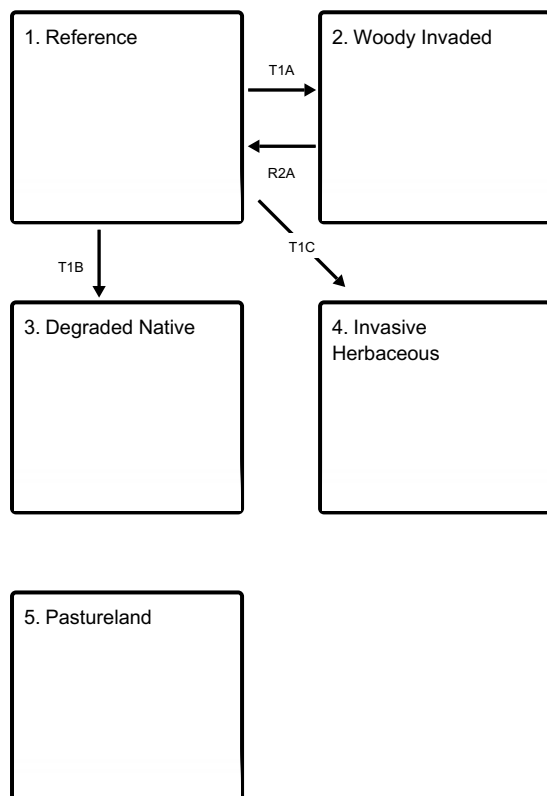
In the absence of fire, woody species, especially eastern redcedar, can quickly occupy the site. Once established, cedars can quickly fill in a glade/prairie system. Removal of the redcedar by chainsaw and the application of prescribed fire have proven to be an effective way to manage these systems.

Glade/prairie complexes harbor a wide diversity of plants and animals. Grasses such as little bluestem, Indian grass, and sideoats grama, are found on these prairies. But other species, such as Missouri coneflower, tall goldenrod, and the federally listed Missouri bladder-pod (*Lesquerella filiformis*), are only found on limestone/dolomite glades. The glade/prairie complexes range from wide open grassy areas with shallow soils and bare bedrock, to some areas with widely scattered chinquapin and post oaks on soils 12 to 20 inches deep.

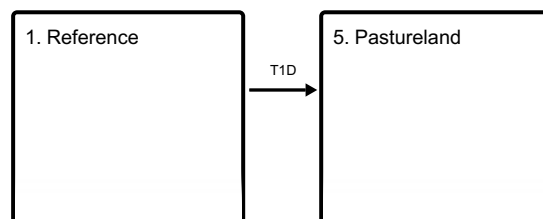
This Ecological site state and transition model consists of five states and six community phases. These states and community phases interact based on the timing, intensity, and frequency of prescribed burning and prescribed grazing, introduction of invasive species, and management practices. The Woody 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 Degraded Native State (3) consists of sites that have been overgrazed and degraded. The Invasive Herbaceous State (4) is characterized by invasive, non-native grasses and forbs. The Pastureland State (5) 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 and 5 (additional transitions)



T1A - Fire suppression greater than 20 years.

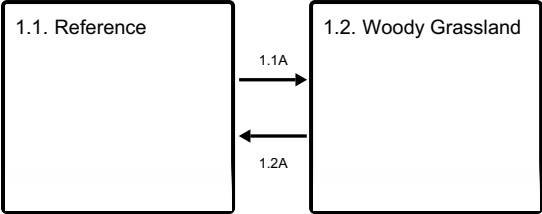
T1B - Uncontrolled grazing

T1C - Invaded by non-native grasses and forbs

T1D - Seeding of grasses and pasture management

R2A - Mechanical, chemical, or other means of cedar removal

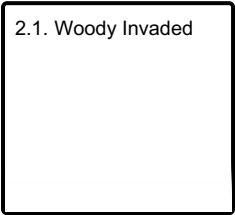
State 1 submodel, plant communities



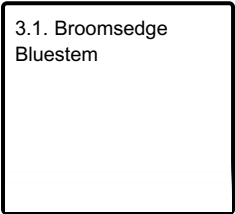
1.1A - Fire free interval return of 5-10 years.

1.2A - Fire return interval of 3-5 years.

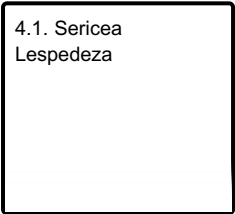
State 2 submodel, plant communities



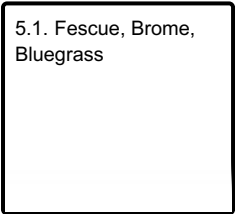
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference



Figure 8. Shallow Limestone Upland Reference State

The Reference State is dominated by warm-season perennial grasses, a composite of predominantly native species of tallgrasses and midgrasses, interspersed with numerous perennial forbs. A small component of shrubs and cool-season grasses also occur. This state has two plant community phases that are dynamic in nature and are dependent on fire frequency and grazing impacts.

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. The lengthening of fire return interval, lack of fire intensity, and lack of competition from the warm-season perennial grasses, 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. Sites that have been continuously overgrazed will transition to the Degraded Native State. 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.

Resilience management. The Reference State is maintained through fire, grazing, 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

- chinquapin oak (*Quercus muehlenbergii*), tree
- gum bully (*Sideroxylon lanuginosum*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1

Reference

The interpretive plant community for the Shallow Limestone Upland is a grassland plant community and represents the original plant community that existed prior to European settlement. The site is characterized as a grassland with a scattering of forbs and occasional shrubs and may be 10 percent or more exposed limestone rock. These areas generally occur just above the outer rim of large hills where a limestone cap or limestone layers are exposed. Big bluestem, Indiangrass, sideoats grama and little bluestem are the dominant grasses of the site. Other major grasses include composite dropseed, sedges, hairy grama, silver beardgrass, fall witchgrass and Scribner's rosette grass. Noticeable are the significant amounts of annual grasses, such as little barley and prairie threeawn, which take advantage of the droughty conditions on much of this site. The site supports a variety of legume species which are interspersed throughout the grass sward. Purple coneflower, dotted blazing star, pitcher sage, eastern daisy fleabane, and Cuman ragweed are important forbs found on this site. Numerous smaller forbs such as diamondflowers, flowering spurge, branched noseburn, small skullcap, and wooly plantain are common to the site. Leadplant and Jersey tea are low growing, fire tolerant shrubs that occur on or near this site. Even though they may occasionally survive on the deepest portions of this site, they are generally found on associated sites or on small inclusions of deeper sites. Smooth sumac and fragrant sumac are generally associated with this site, but like leadplant and Jersey tea are usually located on associated sites or inclusions of those sites. Missouri foxtail cactus and pricklypear—although not abundant—may be found scattered over the site. Frequent fires control the woody species development on these sites allowing for a diverse mix of grass and forbs.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1345	2242	3138
Forb	252	420	588
Shrub/Vine	84	140	196
Total	1681	2802	3922

Community 1.2 Woody Grassland

This plant community developed as a result of years of overgrazing and increased fire free intervals. Sideoats grama, buffalograss, western wheatgrass and Kentucky bluegrass are the dominant grasses, and may be in a lower state of vigor. Little bluestem may be significantly reduced on some sites as well. Forb production is quite variable and may range from 10 to 20 percent of the total vegetation depending on amounts and timing of rainfall events. Perennial forbs such as white sagebrush, dotted or tall blazingstar, blue wild indigo, white heath aster, fleabane species, Cuman ragweed, willowleaf sunflower, and others have replaced most of the compassplant, Nuttall's sensitive-briar, Maximilian sunflower and pitcher sage. The presence of shrub and tree species has increased due to the lack of fire. Common shrub species include winged sumac, fragrant sumac, and gum bully. Post oak, chinquapin oak, and eastern redcedar are major trees found on the site.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- post oak (*Quercus stellata*), tree
- gum bully (*Sideroxylon lanuginosum*), shrub
- winged sumac (*Rhus copallinum*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass

Pathway 1.1A

Community 1.1 to 1.2

Fire free interval return of 5-10 years.

Pathway 1.2A

Community 1.2 to 1.1

Fire return interval of 3-5 years.

State 2

Woody Invaded

This State is dominated by a shrub and/or tree plant community. The increase and spread of shrubs and trees resulted from an absence of fire and will be accelerated by seed introduction and/or 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 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 and can occur on both grazed and non-grazed sites.

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.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- chinquapin oak (*Quercus muehlenbergii*), tree
- post oak (*Quercus stellata*), tree
- winged sumac (*Rhus copallinum*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

Community 2.1

Woody Invaded

This plant community is dominated by shrubs and trees. Gum bully, coralberry, fragrant sumac, and winged sumac are generally the most abundant shrubs. Trees including post oak, chinquapin oak, and eastern redcedar have invaded and become well-established. Shrubs and trees may produce 30 to 60 percent of the total vegetation. The spread of shrubs and trees results from an absence of fire because periodic burning tends to hinder the establishment of most of these woody species and favors forbs and grasses. However, not all unburned areas are invaded by woody plants. Birds, small mammals and livestock are instrumental in distributing seed and accelerating the spread of most shrubs common to this site. When both grazing and fire have been excluded for many years, associated grasses generally are big bluestem, little bluestem, sideoats grama, composite dropseed, sedges and buffalograss. Grass yields are significantly reduced because of the shrub and tree competition and vary from 30 to 50 percent of the total vegetative production. Forbs generally produce 10 to 20 percent of the total. Major forbs include white sagebrush, white heath aster, Cuman ragweed, Baldwin ironweed, and Canada goldenrod.

Dominant plant species

- oak (*Quercus*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- winged sumac (*Rhus copallinum*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

State 3

Degraded Native

This State is a result of continuous overgrazing which allows broomsedge bluestem and other undesirable species to invade and become established. The cover, diversity and vigor of native species has decreased, and the ecological dynamics of these sites has changed. Potential physical site damage by continuous uncontrolled livestock grazing may further degrade this state.

Characteristics and indicators. This State is present when broomsedge bluestem becomes established and reaches 30-40% total production. These sites often have a significant present of woody species as well, especially eastern redcedar. Soil properties and chemistry of the site are often changed by the dominance of broomsedge, and this species can have allelopathic effects on other native species. Fertilizer is commonly suggested to help increase production in other grasses. This will further change soil chemistry from its original state. This is partly why there is no known restoration pathway back to the Reference State.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- broomsedge bluestem (*Andropogon virginicus*), grass

Community 3.1

Broomsedge Bluestem

Broomsedge bluestem (*Andropogon virginicus*) is present at levels reaching 30-40% by weight on a per acre basis and is governing the ecological processes and potential uses of this community. Sites that are dominated by broomsedge often have altered soil properties and chemistry. Broomsedge can have allelopathic effects on other native species. These sites may also have blackberry, purpletop tridens, various panicum, threeawn, and broomweed species present.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- broomsedge bluestem (*Andropogon virginicus*), grass

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. 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 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. Ensuring a lack of forage quality due to season of grazing, and type of grazing animal, 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.

Dominant plant species

- sericea lespedeza (*Lespedeza cuneata*), shrub

State 5 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
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 5.1 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

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

Transition T1A

State 1 to 2

Fire suppression greater than 20 years.

Transition T1B

State 1 to 3

Long term uncontrolled grazing will convert the Reference State to Degraded Native State

Transition T1C

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 T1D

State 1 to 5

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

Restoration pathway R2A

State 2 to 1

Mechanical, chemical, or other means of cedar removal to canopy levels less than 20%. The use of prescribed fire at return intervals 2-3 years.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Tallgrasses Dominant 40%			616–1121	
	big bluestem	ANGE	<i>Andropogon gerardii</i>	364–588	–
	Indiangrass	SONU2	<i>Sorghastrum nutans</i>	168–291	–

	switchgrass	PAVI2	<i>Panicum virgatum</i>	84–196	–
	composite dropseed	SPCOC2	<i>Sporobolus compositus</i> var. <i>compositus</i>	0–28	–
2	Midgrasses Subdominant 34%			616–953	
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	364–493	–
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	252–392	–
	silver beardgrass	BOLA2	<i>Bothriochloa laguroides</i>	0–28	–
	purple lovegrass	ERSP	<i>Eragrostis spectabilis</i>	0–28	–
	rock muhly	MUSO	<i>Muhlenbergia sobolifera</i>	0–28	–
3	Cool-season grasses Minor 4%			22–112	
	Virginia wildrye	ELVI3	<i>Elymus virginicus</i>	6–28	–
	Scribner's rosette grass	DIOLS	<i>Dichanthelium oligosanthes</i> var. <i>scribnerianum</i>	6–28	–
	sedge	CAREX	<i>Carex</i>	6–28	–
	Canada wildrye	ELCA4	<i>Elymus canadensis</i>	6–28	–
4	Shortgrasses Trace 2%			0–56	
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	0–28	–
	buffalograss	BODA2	<i>Bouteloua dactyloides</i>	0–28	–
Forb					
5	Forbs Subdominant 15%			140–420	
	American licorice	GLLE3	<i>Glycyrrhiza lepidota</i>	0–28	–
	purple coneflower	ECHIN	<i>Echinacea</i>	0–28	–
	Nuttall's sensitive-briar	MINU6	<i>Mimosa nuttallii</i>	0–28	–
	compassplant	SILA3	<i>Silphium laciniatum</i>	0–28	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	11–28	–
	Maximilian sunflower	HEMA2	<i>Helianthus maximiliani</i>	0–28	–
	purple prairie clover	DAPUP	<i>Dalea purpurea</i> var. <i>purpurea</i>	0–28	–
	rose mock vervain	GLCA2	<i>Glandularia canadensis</i>	11–28	–
	white prairie clover	DACA7	<i>Dalea candida</i>	0–28	–
	willowleaf sunflower	HESA2	<i>Helianthus salicifolius</i>	0–28	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	11	–
	aromatic aster	SYOB	<i>Symphyotrichum oblongifolium</i>	0–11	–
	Leavenworth's eryngo	ERLE11	<i>Eryngium leavenworthii</i>	0–11	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	0–11	–
	bigfruit evening primrose	OEMAM	<i>Oenothera macrocarpa</i> ssp. <i>macrocarpa</i>	0–11	–
	nettleleaf noseburn	TRUR2	<i>Tragia urticifolia</i>	0–11	–
	pitcher sage	SAAZG	<i>Salvia azurea</i> var. <i>grandiflora</i>	0–11	–
	field pussytoes	ANNE	<i>Antennaria neglecta</i>	0–11	–
	narrowleaf mountainmint	PYTE	<i>Pycnanthemum tenuifolium</i>	0–11	–
	stiff goldenrod	OLRIR	<i>Oligoneuron rigidum</i> var. <i>rigidum</i>	0–11	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–11	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	6–11	–

	common yarrow	ACMIZ	<i>Achillea millefolium</i>	0–11	–
Shrub/Vine					
6	Shrubs Minor 5%			56–140	
	fragrant sumac	RHARS	<i>Rhus aromatica var. serotina</i>	6–28	–
	coralberry	SYOR	<i>Symphoricarpos orbiculatus</i>	0–28	–
	Jersey tea	CEHE	<i>Ceanothus herbaceus</i>	6–28	–
	leadplant	AMCA6	<i>Amorpha canescens</i>	6–28	–
	pricklypear	OPUNT	<i>Opuntia</i>	0–28	–

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, 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 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

Vegetation Height Moderate (0.5 – 1 meter, moderate litter levels, some bare ground visible): Eastern Meadowlark, Dickcissel, Field Sparrow, Upland Sandpiper, Greater Prairie Chicken, Northern Bobwhite, Blue Grosbeak, Scissor-Tailed Flycatcher, Eastern Kingbird, 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*), native vines (*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, Northern Harrier, Le Conte's Sparrow, Savannah Sparrow

Amphibian and reptile species associated with this ecological site reference state condition: Ornate Box Turtle (*Terrapene ornata ornata*), Western Slender Glass Lizard (*Ophisaurus attenuatus attenuatus*), Prairie Ring-necked Snake (*Diadophis punctatus amnyi*), Prairie Kingsnake (*Lampropeltis calligaster calligaster*), Great Plains Skink (*Eumeces obsoletus*), Southern Prairie Skink (*E. septentrionalis obtusirostris*), and Bullsake (*Pituophis catenifer sayi*).

Small mammals associated with this ecological site reference state condition:

Least Shrew (*Cryptotis parva*), Prairie Vole (*Microtus ochrogaster*), Plains Pocket Gopher (*Geomys bursarius*), Meadow Jumping Mouse (*Zapus hudsonius*), Badger (*Taxidea taxus*), and Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*).

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*), Ottoe Skipper butterfly (*Hesperia ottoe*), Arogos Skipper butterfly (*Atrytone arogos iowa*), Golden Byssus butterfly (*Problema byssus kumskaka*), Delaware Skipper butterfly (*Atrytone 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*), Prairie Mole Cricket (*Gryllotalpa major*), Green Grasshopper (*Hesperotettix speciosus*) and Two-voiced Conehead katydid (*Neoconcephalus bivocatus*) are possible orthopteran associates of this ecological site. A number of leaf beetle species (*Anisostena funesta*, *Chaetocnema fuscata* and *Cryptocephalus striatulus*) may utilize this ecological site.

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

Other information

Forestry

Management: Site index values are less than 30 for eastern redcedar and generally less than 40 for oak. Productivity is very low. Very limited timber management opportunities exist. These sites are valuable for wildlife purposes and watershed protection. Severely reduced rooting depth restricts tree growth and increases windthrow hazards. These sites respond well to prescribed fire as a management tool.

Limitations: Surface stones and surface rock; very shallow soil depth. Surface stones and rocks are problems for efficient and safe equipment operation. Severe seedling mortality due to high soil surface temperatures and low available water holding capacity is possible. Machine planting and mechanical site preparation is not recommended. Hard bedrock at shallow depths may interfere with equipment operation. Rock outcrops may cause breakage of timber when harvesting. Surface stones and rocks will make equipment use extremely difficult. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Information presented here has been derived from NRCS clipping data, numerous ocular estimates and other inventory data. Field observations from experienced range-trained personnel was used extensively to develop this ecological site description.

NRCS contracted the development of MLRA 112 ESDs in 2005. Extensive review and improvements were made to those foundational ESDs since then.

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Range Site Description for Kansas, Shallow Limy, USDA-Soil Conservation Service, September, 1985.

Ecological Site Description for Kansas, Shallow Limy (R112XY028KS) located in Ecological Site Information System (ESIS), 2007

Ecological Site Description for Missouri, Shallow Limestone Upland Glade/Prairie (R112XY029MO) located in Ecological Site Information System (ESIS), 2007

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

Suzanne Mayne-Kinney, 11/05/2024

Acknowledgments

The ecological site development process is a collaborative effort, conceptual in nature, dynamic, and is never considered complete. I thank all those who set the foundational work in the mid-2000s in regard to this ESD. I thank all those who contributed to the development of this site. In advance, I thank those who would provide insight, comments, and questions about this ESD in the future.

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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)	Chris Tecklenburg/Revision 10-26-2020
Contact for lead author	State Rangeland Management Specialist for Kansas.
Date	10/26/2020
Approved by	Suzanne Mayne-Kinney
Approval date	

Indicators

1. **Number and extent of rills:** No natural rill formation common or part of the Shallow Limestone Upland ecological site.

2. **Presence of water flow patterns:** There are no water flow patterns evidenced by litter, soil, or gravel redistribution, or pedestalling of vegetation or stones that break the flow of water as a result of overland flow.

3. **Number and height of erosional pedestals or terracettes:** There is no evidence of pedestals or terracettes that would indicate the movement of soil by water and/or by wind on this site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 5% bare ground is found on this site. It is the remaining ground cover after accounting for ground surface covered by vegetation (basal and canopy [foliar] cover), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** No evidence of accelerated water flow resulting in downcutting of the soil.

6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind-scoured or blowout areas where the finer particles of the topsoil have blown away, sometimes leaving residual gravel, rock, or exposed roots on the soil surface. Also, there are no areas of redeposited soil onto this site from another site due to the wind, i.e., depositional areas.

7. **Amount of litter movement (describe size and distance expected to travel):** No evidence of litter movement (i.e., dead plant material that is in contact with the soil surface).

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surfaces may be stabilized by soil organic matter which has been fully incorporated into aggregates at the soil surface, adhesion of decomposing organic matter to the soil surface, and biological crusts. A soil stability kit will score a range from 5-6.

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

A1--0 to 18 centimeters (0 to 7 inches); very dark grayish brown (10YR 3/2) flaggy silty clay loam; very dark brown (10YR 2/2) moist; strong fine and medium granular structure; hard, friable; limestone fragments make up 30 percent by volume; slightly alkaline; abrupt irregular boundary. (10 to 51 centimeters (4 to 20 inches thick)

R--18 to 51 centimeters (7 to 20 inches); gray (10YR 6/1) hard fractured limestone; fractures are 5 mm wide and occur at intervals of about 60 cm; fractures contain soil material similar to the horizon above and extend to a depth of 46 cm.

-
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Functional and structural groups are that of the Reference Plant Community (see reference plant list and groups). Note changes to plant communities if different than that of the functional and structural group worksheet.
-
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no evidence of a compacted soil layer less than 6 inches from the soil surface. Soil structure is similar to that described in Indicator 9. Compacted physical features will include platy, blocky, dense soil structure over less dense soil layers, horizontal root growth, and increase bulk density (measured by weighing a known volume of oven-dry soil).
-
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: Group 1 Tallgrass dominant 40% 1000 lbs. big bluestem 325-525, Indiangrass 150-260, switchgrass 75-175, composite dropseed 0-25.
- Sub-dominant: Group 2 Midgrass subdominant 34% 850 lbs. sideoats grama 325-440, little bluestem 225-350, silver bluestem, purple lovegrass, rock muhly all 0-25.
- Other: Group 3 Cool-season grass minor 4% 100 lbs. Sedge 5-25, Scribner's rosette grass 5-25, Virginia wildrye 5-25, Canada wildrye 5-25
- Group 4 Shortgrass Trace 2% 50 lbs. buffalograss 0-25, hairy grama 0-25
- Additional: Group 5 forbs subdominant 15% 375 lbs. see Reference Plant community for entire list
- Group 6 shrub minor 5% 125 lbs. fragrant sumac 5-25, Jersey tea 5-25, leadplant 5-25, coralberry 0-25, pricklypear 0-25.
-
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Recruitment of plants is occurring and there is a mixture of many age classes of plants. The majority of the plants are alive and vigorous. Some mortality and decadence is expected for the site, due to drought, unexpected wildfire, or a combination of the two events. This would be expected for both dominant and subdominant groups.
-
14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site. There is no restriction to plant regeneration due to depth of litter. When prescribed burning is practiced, there will be little litter the first half of the growing season.
-
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** All species (e.g., native, seeded, and weeds) alive in the year of the evaluation, are included in the determination of total above ground production. Site potential (total annual production) ranges from 1,500 lbs in a below-average rainfall year and 3,500 lbs in an above-average rainfall year. The representative value for this site is 2,500 lbs production per year.
-

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: There are no noxious weeds present. Invasive plants make up a small percentage of plant community, and invasive brush species are < 5% canopy.
-

17. **Perennial plant reproductive capability:** Plants on site exhibit the required vigor and growth to be able to reproduce vegetatively or by seed. Current management activities do not adversely effect the capability of plants to reproduce.
-