Ecological site R073XY118KS
Blue Shale

Last updated: 10/02/2019
Accessed: 04/29/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

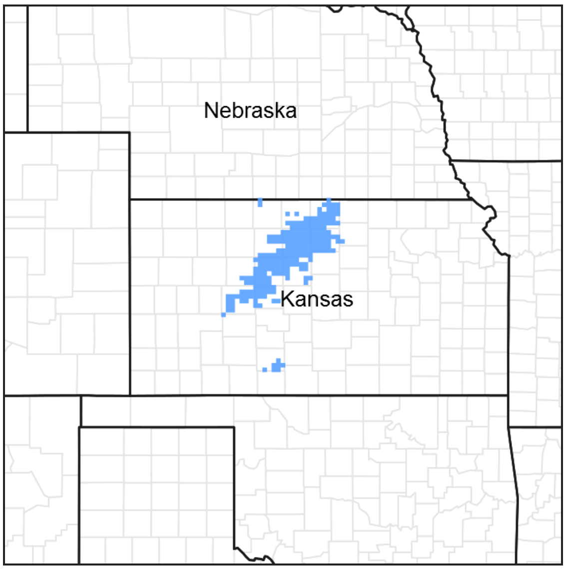


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 073X–Rolling Plains and Breaks

This ESD is located in the Rolling Plains and Breaks Major Land Resource Area (MLRA) 73 of the Central Great Plains Winter Wheat and Range Region of the United States. MLRA 73 is in Kansas (78 percent) and Nebraska (22 percent). It makes up about 21,485 square miles (13,750,400 acres). The towns of Hays, Great Bend, and Dodge City, Kansas, and Alma, Curtis, Holdrege, and McCook, Nebraska are in this MLRA. The MLRA is bisected by Interstate 70. The Platte River is at the northern edge of the area, and the Arkansas River is at the southern edge.

Classification relationships

Major Land Resource Area (MLRA) 73 Rolling Plains and Breaks

Ecological site concept

This site consists of shallow to moderately deep clayey soils over clayey shale parent material from the Carlile shale Formation. The shale is bluish gray to black in color and contains large concretions of calcium carbonate. Sometimes the shale is found outcropping the surface. Clay soil texture is found throughout the profile on the Blue Shale ecological site.

Associated sites

R073XY101KS	**Limy Slopes** The Limy Breaks ecological site is commonly located adjacent to or in coordination with the Blue Shale site. Due to geological formations and landform position, it is difficult to manage these sites separate from one another.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Schizachyrium scoparium*

Physiographic features

The western half of MLRA 73 and areas along the Arkansas River have remnants of the Tertiary river-laid sediments washed out onto the plains from erosion of the prehistoric Rocky Mountains in Colorado. In the valley of the Arkansas River, the wind reworked these sediments, forming a hummocky dune surface of eolian sand. A loess mantle occurs on the higher ground in the western half of the area. The Tertiary-age Ogallala and White River Formations cover Cretaceous Pierre Shale in the northern part of the area. The Ogallala Formation consists of loose to well cemented sand and gravel, and the White River Formation consists of ashy claystone and sandstone. Pierre Shale and Niobrara Chalk are at the surface in the valleys of the Republican, Smoky Hill, and Saline Rivers. Fort Hays limestone of the Niobrara Formation and Blue Hill shale of the Carlile Shale Formation are at the surface in the valleys of the Saline and Smoky Hill Rivers. Shale can be seen exposed in the eastern half of this MLRA, in Kansas. Quaternary and more recent sand and gravel partially cover the shale in the river valleys.

The Blue Hill shale is the upper member of the Carlile shale and is about 300 feet thick (Moore, et al., 1951). Below the Blue Hill shale is the Fairport Chalky shale which is also part of the Carlile shale. The Fairport chalky shale differs from the Blue Hill in that it is calcareous with thin layers of chalky shale while the latter is noncalcareous. Carlile shale is overlain by the Niobrara formation and rests upon the Greenhorn limestone (Zavesky, 1967).

This site is on gently sloping to moderately steep erosional shale uplands. The slopes are relatively smooth and convex with some areas dissected by drainage patterns.

The Blue Shale ecological site is normally bordered by massive escarpments of buff-colored Fort Hays limestone and the portion of the ecological site immediately below the limestone is normally very steep and eroded. Breaking away from the steep area, the ecological site then consists of relatively smooth shale ridges capped with outwash material (Zavesky, 1967).

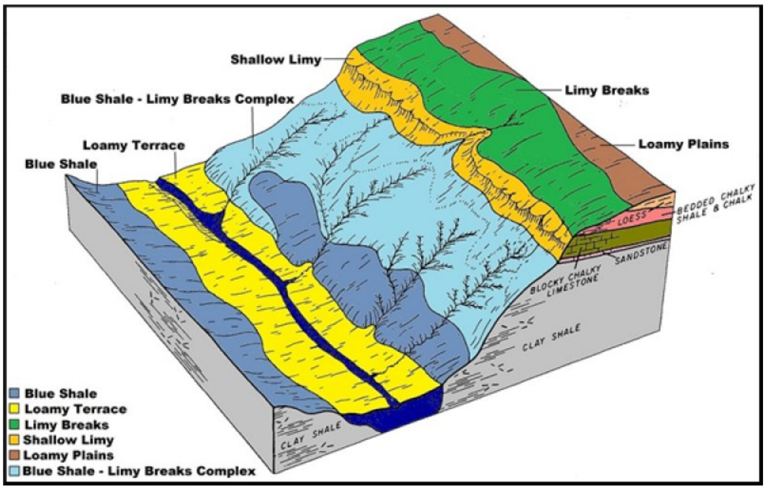


Figure 2. MLRA 73 ecological site block diagram.

Table 2. Representative physiographic features

Landforms	(1) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	488–853 m
Slope	3–30%
Ponding depth	0 cm

Climatic features

For MLRA 73 the average annual precipitation is 19 to 30 inches (48 to 76 centimeters). Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from the middle of spring to the early autumn months. Precipitation in winter occurs as snow. The annual snowfall ranges from about 17 inches (45 centimeters) in the southern part of the area to 24 inches (60 centimeters) in the northern part. The average annual temperature is 48 to 56 degrees F (9 to 14 degrees C). The freeze-free period averages 180 days and ranges from 145 to 210 days, increasing in length from northwest to southeast.

The following weather data originated from weather stations chosen across the geographical extent of the ecological site, and will likely vary from the data for the entire MLRA. The climate data derives from the Natural Resources Conservation Service (NRCS) National Water and Climate Center. The data set is from 1981-2010.

Table 3. Representative climatic features

Frost-free period (average)	154 days
Freeze-free period (average)	176 days
Precipitation total (average)	660 mm

Climate stations used

- (1) GLEN ELDER LAKE [USC00143100], Glen Elder, KS
- (2) ALTON 1 W [USC00140201], Alton, KS
- (3) PLAINVILLE 4WNW [USC00146435], Plainville, KS
- (4) LOVEWELL DAM [USC00144857], Webber, KS
- (5) HAYS 1 S [USC00143527], Hays, KS
- (6) NESS CITY [USC00145692], Ness City, KS

Influencing water features

There are no water features of the Blue Shale ecological site or adjacent wetland/riparian regimes that influence the vegetation and/or management of the site that make it distinctive from other ecological sites.

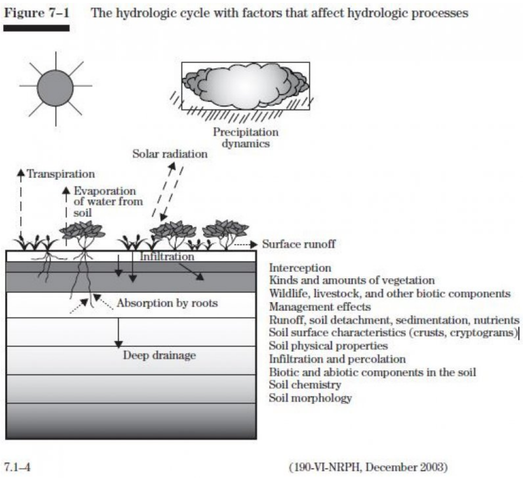


Figure 7. Fig. 7-1 from National Range and Pasture Handbook

Soil features

This site consists of shallow to moderately deep clayey soils over clayey shale parent material from the Carlile shale formation. The shale is bluish gray to black in color and contains large concretions of calcium carbonate. The soils have very slow permeability and low to very low available water capacity.

Hattin (1962) described the Blue Hill shale as a blocky to fissile, slightly silty, clayey shale that weathers into small brittle flakes. The dominant color is dark gray, but locally the rock is light to dark olive gray. Swineford, McNeal, and Crumpton (1954) described the Blue Hill shale as a gray to bluish black, noncalcareous silty shale with thin layers of sandstone in the upper part. Many calcareous septarian concretions occur throughout the Blue Hill shale, especially in the upper portion.

Soil sloughs and slips are common on the steeper sites.

Major soil series correlated to this ecological site include: Bogue and Timken

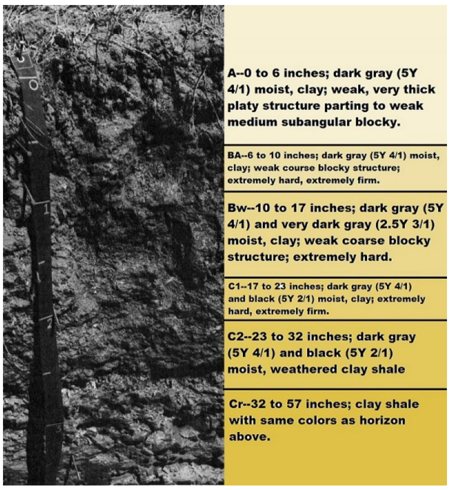


Figure 8. Bogue soil profile, Ellis County, KS

Table 4. Representative soil features

Parent material	(1) Residuum–acid shale
Surface texture	(1) Clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained
Permeability class	Moderately slow

Soil depth	25–102 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	4.32–9.65 cm
Calcium carbonate equivalent (0-101.6cm)	0–3%
Electrical conductivity (0-101.6cm)	0–1 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.4–7.7
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The grasslands of Major Land Resource Area (MLRA) 73, the Rolling Plains and Breaks, located in south central Nebraska and central Kansas, evolved under sub-humid (20-40 inch precipitation range) climates, characterized by much the same weather extremes of temperatures, rainfall, and snowfall we are familiar with today. As a result of glacial activity and other natural forces, then and later, plants have migrated from their places of origin, so that today MLRA 73 grasslands are simple-to-complex mixtures of perennial grasses and forbs, plus a few native annuals and biennials. Species composition has been modified by the introduction of Kentucky bluegrass and cool-season annual and perennial grasses, particularly Japanese brome (Launchbaugh, Owensby 1978).

Through the ages to modern times, wildfires – many started by lightning, but most by primitive people – influenced development of fire-tolerant grasses and suppressed woody vegetation (Sauer 1950). Certain woody plants, however, always were present as natural components of some grasslands. Browsing by animals and frequent prairie fires were largely responsible for maintaining “normal” amounts of woody species (Dyksterhuis 1958). In primitive time, numerous large herbivores subjected herbaceous vegetation to grazing stress. After the last glacial retreat, bison emerged as the major dominant large grazer, although the prairies and plains simultaneously supported many pronghorn antelope, elk, deer, prairie dogs, rabbits, rodents, and insects. And each exerted grazing pressures on the vegetation (Launchbaugh and Owensby 1978). There is little doubt that during and long before Spanish explorations into this area, most of the grassland was used almost continuously throughout the year by one roving herd of buffalo after another and other grazing animals (early exploration accounts reviewed by Dary in 1974; diaries of early Kansas residents cited by Choate and Fleharty in 1975). Grazing and trampling by bison and their associates were often intensive, as was uncontrolled grazing by livestock in the late 1800s after most of the wild grazers had been eliminated.

The plant communities for the Blue Shale ecological site are dynamic due to the complex interaction of many ecological processes. The interpretive plant community for this site is the Reference Plant Community. The Reference Community has been determined by the study of rangeland relic areas, areas protected from excessive disturbance, areas under long term rotational grazing strategies, literature of plant communities from the early 1900s, and local expertise. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

This ecological site is made up of a Grassland State, a Woody State, and a Tillage State. The Grassland State is characterized by non-broken land (no tillage), both warm- and cool-season bunchgrasses, sod-forming grasses, forbs, and shrubs. The Woody State is characterized by a community made up primarily of eastern redcedar and/or locust, with few remnant native grasses making up the understory and very few forbs. The Tillage State has been mechanically disturbed (broken) by equipment and includes either a variety of reseeded warm-season bunch- and sod-forming grasses, or early successional plants to include the latter as well as annual grasses and forbs.

Vegetation changes are expected within this ecological site and will be dependent upon the site's geographical location inside Major Land Resource Area (MLRA) 73. Variation in precipitation east and west is not as affected as is temperature north and south. The northern part of MLRA 73 is characterized by cooler temperatures and a shorter growing season in respect to the southern end. As a result, cool-season bunchgrasses and sod-formers proliferate. Growth of native cool-season plants begins about April 15, and continues to about June 15. Native warm-season plants begin growth about May 15, and continue to about August 15. Green up of cool-season plants may occur in September and October if adequate moisture is available (weather data from National Climate Data Center, 1980-2010).

The Blue Shale ecological site developed with occasional fires as part of the ecological processes. Historically, it is believed that the fires were infrequent, randomly distributed, and started by lightning at various times throughout the season when thunderstorms were likely to occur. It is also believed that pre-European inhabitants may have used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, deer, and pronghorn). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool in the sub-humid, High Plains and Smoky Hills area.

The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large, migratory herbivores was a primary influence. Secondary influences of herbivory by species such as prairie dogs, grasshoppers, gophers, and root-feeding organisms impacted the vegetation historically, and continue to this day.

The management of herbivory by humans through grazing of domestic livestock and/or manipulation of wildlife populations has been a major influence on the ecological dynamics of the site. This management, coupled with the High Plains and Smoky Hills climate, largely dictates the plant communities for the site.

Drought cycles were part of the natural range of variability within the site and historically have had a major impact upon the vegetation. The species composition changes according to the duration and severity of the drought cycle (Albertson and Weaver, 1940).

The vegetation on this site is impacted by topography. The percent (steepness) and aspect of the slope interact with the other ecological processes to further influence the vegetative dynamics of the site.

The Blue Shale ecological site generally occurs on the more sloping parts of the landscape. The flatter slopes of this site and the adjacent, more level sites are preferred by livestock, which can lead to grazing distribution problems. Water locations, salt placement, and other aids help to distribute grazing. Other management techniques such as concentrated grazing and/or grazing systems also help to distribute grazing more evenly.

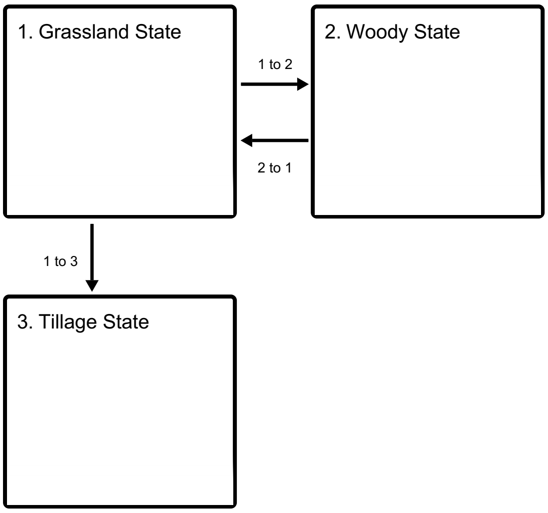
The general response of the Blue Shale ecological site to long-term, heavy, continuous grazing pressure is to gradually lose the vigor and reproductive potential of the tall- and midgrass species and shift the plant community toward midgrass, shortgrass, and/or cool-season species.

The tall- and mid-grass species generally escape excessive grazing pressure on the steeper, less accessible areas. The tall- and midgrasses maintained on the steep area help to provide a source for these species to repopulate the site after long periods of drought and/or overgrazing. The use of grazing management that includes needed distribution tools, a forage and animal balance, and adequate recovery periods during the growing season helps to restore this site to its productive potential.

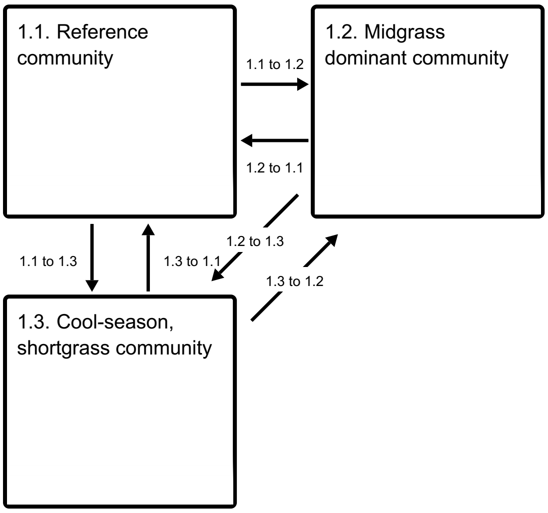
The following diagram illustrates pathways that the vegetation on this site may take, within the Grassland Reference State and beyond, as influencing ecological factors change. There may be other states or plant communities not shown in the diagram, as well as noticeable variations within those illustrated and described in the following sections.

State and transition model

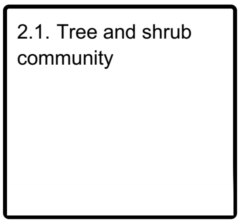
Ecosystem states



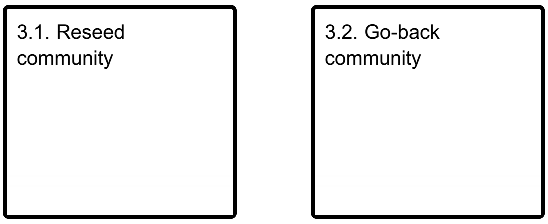
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland State

The Grassland State defines the ecological potential and natural range of variability resulting from the natural disturbance regime of the Blue Shale ecological site. This state is supported by empirical data, historical data, local expertise, and photographs. It is defined by a suite of native plant communities that are a result of periodic fire, drought, and grazing. These events are part of the natural disturbance regime and climatic process. The Reference Plant Community consists of warm-season tall- and midgrasses, cool-season and sod-forming grasses, forbs, and shrubs. The midgrass community is made up primarily of warm-season midgrasses with decreasing amounts of forbs. The cool-season and shortgrass community is dominated by cool-seasons and shortgrasses.

Community 1.1
Reference community

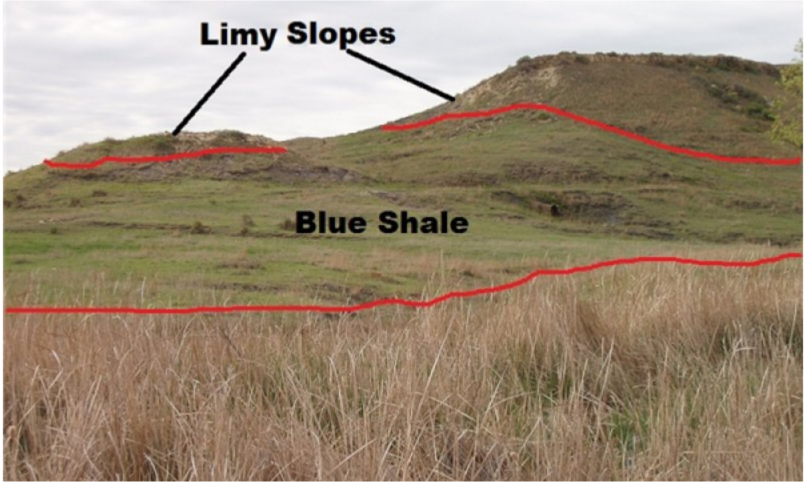


Figure 9. Blue Shale and Limy Slopes landform position

Figure 10. Blue Shale site in Ellis County, Bogue soil

Figure 11. Blue Shale site in Ellis County, Bogue soil

The Reference Community is supported by empirical data, historical data, local expertise, and photographs. The potential vegetation is a mixed grass prairie consisting of approximately 90 percent grasses, 5 percent forbs, and 5 percent shrubs. Big bluestem, Indiangrass, composite dropseed, and switchgrass make up 47 percent of this plant community. Little bluestem and sideoats grama are the midgrass subdominant group that make up 35 percent of the Reference Plant Community. Shortgrasses that include blue grama, and buffalograss make up 6% while western wheatgrass, in the cool-season group, makes up 2%. This community has a diverse forb population, most of which occur in small amounts. Some of the more prevalent forbs include Cuman ragweed, dotted blazing star, and slimflower scurfpea. Shrubs include leadplant, broom snakeweed, plains pricklypear, and soapweed yucca. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed with little movement. Decadence and natural plant mortality is very low. Total annual production ranges from 1,500 to 3,500 pounds of air-dried vegetation per acre per year and will average 2,500 pounds. These production figures are the fluctuations expected during favorable, normal and unfavorable years due to the timing and amount of precipitation and temperature. Total annual production should not be confused with species productivity, which is annual production and variability by species throughout the extent of the community phase.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1513	2522	3531
Shrub/Vine	84	140	196
Forb	84	140	196
Total	**1681**	**2802**	**3923**

Figure 13. Plant community growth curve (percent production by month). KS7301, Big Bluestem, Little Bluestem, Sideoats Grama.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	8	25	30	25	10	2	0	0	0

Community 1.2
Midgrass dominant community

Plant community phase 1.2 marks a shift in plant composition from a tallgrass plant-dominated community to a midgrass dominated plant community. The potential vegetation is dominated (>40% of plant production) by little bluestem and sideoats grama with an increase in blue grama. Big bluestem and Indiangrass have become a subdominant species group making up less than 40% of the total annual production. The tallgrasses (big bluestem, Indiangrass, switchgrass) are decreasing in plant vigor with continued defoliation. The grasses are not receiving adequate rest and recovery during the growing season in order to maintain functional and structural group dominance. These tall grasses are slowly being replaced by the midgrass plant species. The biotic integrity has been altered from the Reference Plant Community. Total annual production ranges from 1,200 to 2,800 pounds of air-dried vegetation per acre per year and will average 2,000 pounds.

Community 1.3
Cool-season, shortgrass community

This plant community develops from long term (>30 years) management of heavy, continuous grazing during the growing season, and no prescription fires. Western wheatgrass, buffalograss, and blue grama are the dominant grasses. Little bluestem and sideoats grama have decreased to levels of a minor component making up less than 10 percent of the total annual production. Forb diversity has drastically decreased. Broom snakeweed may become abundant on this site. There may be an increase in broom snakeweed under certain cyclic or climatic conditions. Biotic integrity has been altered. The dominant species (>40%) is a mix of western wheatgrass, buffalograss, and blue grama. These species have replaced little bluestem and sideoats grama which may still remain as a trace component (<2%). Recognition of this plant community will enable the land user to implement key management decisions before a significant economic/ecological threshold is crossed. In advanced stages, plant mortality can increase and erosion may eventually occur if bare ground increases especially on steeper slopes. Once this happens it will require increased energy input, in terms of cost, and management to bring back the species.

Pathway 1.1 to 1.2
Community 1.1 to 1.2

Long-term management (>10 years) without a forage and animal balance and repetitive use without adequate recovery periods between grazing events will convert the Reference Plant Community to a community of more little bluestem and sideoats grama. Drought, in combination with this type of management will quicken the rate at which the Reference Community pathways to the Midgrass Community.

Pathway 1.1 to 1.3
Community 1.1 to 1.3

The removal of prescribed fire as a management tool. Long-term (>30 years) management consisting of heavy, repetitive, continuous summer grazing with no forage and animal balance.

Pathway 1.2 to 1.1
Community 1.2 to 1.1

Management that incorporates long-term (>10 years) prescribed grazing, a forage and animal balance, and adequate rest and recovery periods will favor this plant community to move from a little bluestem, sideoats, and blue grama-dominant plant community to a tallgrass plant community found in the Reference phase. Speed of recovery depends upon remnant amounts of big bluestem and Indiangrass on site as well as climate.

Conservation practices

Prescribed Grazing

Pathway 1.2 to 1.3
Community 1.2 to 1.3

Long term (>15 years) management that includes heavy, continuous grazing with no rest and recovery during the growing season, and no forage and animal balance. There are no prescription fires used as a management tool.

Pathway 1.3 to 1.1
Community 1.3 to 1.1

Management that includes prescription fires in order to suppress the cool season species and/or any woody species encroachment. Long term (>20 years) management that includes rest and recovery of remnant midgrass or tallgrass species that were once dominant in the reference plant community. If these species are not present, this community phase pathway will not likely be feasible. This plant community pathway is dependent on the amount of big bluestem and Indiangrass present.

Conservation practices

Prescribed Grazing

Pathway 1.3 to 1.2
Community 1.3 to 1.2

This community pathway changes from a cool-season shortgrass plant community to a midgrass plant community. It entails long term (>15 years) management that includes adequate rest and recovery of the midgrass species during the growing season. Management also includes a forage and animal balance and prescribed fire in order to decrease the cool season plant community.

Conservation practices

Prescribed Grazing

State 2
Woody State

This state is dominated by a tree and shrub plant community. The increase and spread of shrubs and trees results from an absence of fire. 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 tends to hinder the establishment of most woody species and favors forbs and grasses. However, it should be pointed out that not all unburned areas have a woody plant invasion. Hydrologic function is affected by the amount of vegetative cover. Canopy interception loss can vary from 25.4% to 36.7% (Thurow and Hester, 1997). A small rainfall event usually is 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 base of trees and shrubs 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 dynamic property changes affected include biological activity, infiltration, and soil fertility. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species. In some locations the use of chemicals as a brush management tool may be desirable to initiate and accelerate this transition. Birds, small mammals, and livestock are instrumental in the distribution of seed and accelerating the spread of most shrubs common to this site. The speed of encroachment varies considerably and can occur on both grazed and non-grazed pastures. Many species of wildlife, especially bobwhite quail, turkey and white-tailed deer, benefit from the growth of shrubs for both food and cover. Conversely, the presence of trees is considered detrimental to populations of greater prairie chickens. When management for specific wildlife populations is desirable, these options should be considered in any brush management plan.

Community 2.1
Tree and shrub community

This community is dominated by shrubs and/or trees with a canopy cover usually greater than 30%. Trees characterizing this community include eastern red cedar and/or honeylocust. Coralberry and fragrant and smooth sumac are generally the most abundant shrubs. When tree and shrub encroachment occurs on areas that have been subjected to long-term continuous overgrazing, the associated grasses will usually consist of composite dropseed, purpletop tridens, purple lovegrass, Kentucky bluegrass, and Scribner’s rosette grass. Shrubs and trees will also invade areas where both grazing and fire have been excluded for many years. A heavy accumulation of plant mulch and litter retard herbage growth. This provides a favorable habitat for seed germination and establishment of many shrub species. Grass yields are significantly reduced because of competition from forbs and woody species, and vary from 10 to 30 percent of the total vegetative production. Forbs generally produce less than 5 percent. The combination of less water entering the soil and the strong ability by the trees and shrubs to extract water, means that little water has a chance to drain beneath the root zone. Therefore, invasion of trees and shrubs (primarily juniper) on large areas that were once primarily grassland has strong implications for recharge of aquifers. It can be a common occurrence to have seeps and springs stop flowing in conjunction with increases in tree and shrub cover (Thurow and Hester, 1997). In this plant community, the amount of available forage is heavily dependent upon the predominant woody species and the kind(s) of livestock and/or wildlife utilizing the site. Usually a prescribed burning program accompanied by prescribed grazing will gradually return the plant community to one dominated by grasses and forbs. Special planning will be necessary to assure that sufficient amounts of fine fuel are available to carry fires with enough intensity to control woody species. Use of labeled herbicides and mechanical removal as brush management tools will usually be necessary to reduce fire-resistant populations like honeylocust in order to accelerate the recovery of desired vegetative cover. Some landowners rely on the browsing habits of goats to suppress the woody growth.

State 3
Tillage State

The Tillage State consists of abandoned cropland that has been naturally revegetated (go-back) or planted/seeded to grassland. Many reseeded plant communities were planted with a local seeding mix under the Conservation Reserve Program (CRP) or were planted to a monoculture of sideoats grama. Go-back communities are difficult to define due to the variability of plant communities that exist. Many of these communities are represented by the genus Aristida (threeawns). This is an alternative state because the ecological functions, i.e. dynamic soil properties and plant communities, are not fully restored to that of the Reference State. 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).

Community 3.1
Reseed community

This plant community is created when the soil is tilled or farmed (sodbusted), and abandoned. All of the native plants are killed, soil organic matter and carbon reserves are reduced, soil structure is changed, and a plowpan or compacted layer can be formed, which decreases water infiltration. Synthetic chemicals may remain as a residual in the soil from farming operations. In early successional stages, this community is not stable. The potential for wind and water erosion is a concern. This plant community can vary considerably depending upon how eroded the soil was, the species seeded, the stand that was established, how long ago the stand was established, and the management of the stand since establishment. Prescribed grazing with adequate recovery periods will be necessary to maintain productivity and desirable species. Selection of grass species by grazing animals on seeded rangeland sites can be significantly different from native range sites. Typically there is a reduced production level on seeded sites compared to native sites with similar species composition. Species diversity is lower and forb species generally take longer to re-establish. Seeded rangeland should be managed separately due to the natural ecological differences.

Community 3.2
Go-back community

This plant community is created when the soil is tilled or farmed (sodbusted), and abandoned. Land that has been used for purposes other than rangeland or hayland generally will start to revegetate when left undisturbed. Due to tillage activity there are no native plants, soil organic matter and carbon reserves are reduced, soil structure has changed, and a plowpan or compacted layer can be formed, which decreases water infiltration. Many times, synthetic chemicals remain as a residual from farming operations. Erosion is a concern. The initial ground cover will primarily consist of kochia, annual bromes, pigweed, foxtail (bristlegrass), Russian thistle, witchgrass and tumblegrass, as well as other annuals. These plants give some protection from erosion and start to rebuild organic matter. The next succession of plants will be grasses such as sand dropseed, threeawn, silver bluestem, and annuals. Eventually blue grama, sideoats grama, and buffalograss will come back. These species will not regain in proportions to that of the Reference State. Soil structure, aggregate stability, and organic matter will not recover to the levels of the Reference State. Range seeding can accelerate the process of species composition and possibly production, but will be at a high cost.

Transition 1 to 2
State 1 to 2

Changes from a Grassland State to a Woody State lead to changes in hydrology, soil and site stability, forage production, and wildlife habitat. Understory plants may be negatively affected by trees and shrubs by a reduction in light, soil moisture, and soil nutrients. Increases in tree and shrub density and size have the effects of reducing understory plant cover and productivity, with desirable forage grasses often being most severely reduced (Eddleman, 1983). As vegetation cover changes from grasses to trees, a greater proportion of precipitation will leave rangeland via evaporation; therefore, less precipitation is available for producing herbaceous forage or for deep drainage or runoff (Thurow and Hester, 1997). Tree and shrub establishment becomes increasingly greater while fine fuel loads decrease. As trees and shrubs increase at levels of >30% canopy, the processes and functions that allow this state to become resilient are active and dominate over a Grassland State. Prescribed fire is an ineffective tool to eradicate the trees and shrubs due to the lack of fine fuel loads.

Transition 1 to 3
State 1 to 3

This transition is triggered by a management action as opposed to a natural event. Tillage or breaking the ground with machinery for crop production will move the Grassland State to a Tillage State.

Transition 2 to 1
State 2 to 1

Restoration efforts will be costly, labor-intensive, and can take years (if not decades) to return to a Grassland State. Once canopy levels reach greater than 20 percent, estimated cost to remove trees is very expensive and includes high energy inputs. The technologies needed in order to go from an invaded Woody State to a Grassland State include, but are not limited to: prescribed burning—the use of fire as a tool to achieve a management objective on a predetermined area under conditions where the intensity and extent of the fire are controlled; brush management—

manipulating woody plant cover to obtain desired quantities and types of woody cover and/or to reduce competition with herbaceous understory vegetation, in accordance with overall resource management objectives; prescribed grazing—the controlled harvest of vegetation with grazing or browsing animals managed with the intent to achieve a specified objective. Grazing should be limited to an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation. When a juniper tree is cut and removed, the soil structure and the associated high infiltration rate, may be maintained for over a decade (Hester, 1996). This explains why the area near the dripline usually has substantially greater forage production for many years after the tree has been cut. It also explains why runoff will not necessarily dramatically increase once juniper is removed. Rather, the water continues to infiltrate at high rates into soils previously ameliorated by junipers, thereby increasing deep drainage potential. In rangeland, deep drainage amounts can be 16 percent of the total rainfall amount per year (Thurow and Hester, 1997).

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 47%**			925–1328	
	big bluestem	ANGE	*Andropogon gerardii*	785–1121	–
	Indiangrass	SONU2	*Sorghastrum nutans*	140–280	–
	switchgrass	PAVI2	*Panicum virgatum*	45–95	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	17–34	–
2	**Midgrasses Subdominant 35%**			560–981	
	little bluestem	SCSC	*Schizachyrium scoparium*	336–560	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	224–420	–
3	**Shortgrasses minor 6%**			56–168	
	blue grama	BOGR2	*Bouteloua gracilis*	78–157	–
	buffalograss	BODA2	*Bouteloua dactyloides*	28–56	–
4	**Cool-season grasses trace 2%**			0–45	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–45	–
Forb					
5	**Forbs minor component 5%**			62–140	
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–28	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–28	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	17–28	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–28	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	6–28	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	0–28	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	6–28	–
	roundleaf bladderpod	LEOVO	*Lesquerella ovalifolia ssp. ovalifolia*	0–28	–
	dotted blazing star	LIPU	*Liatris punctata*	17–28	–
	evening primrose	OENOT	*Oenothera*	0–28	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–28	–
	beardtongue	PENST	*Penstemon*	0–28	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	17–28	–
Shrub/Vine					
6	**Shrubs minor component 5%**			84–140	
	leadplant	AMCA6	*Amorpha canescens*	84–140	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–34	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–34	–
	soapweed yucca	YUGL	*Yucca glauca*	0–34	–

Animal community

Wildlife Interpretations

This ecological site is on narrow ridge tops and on gently to moderately steep side slopes on uplands. Sites are often dissected by steep drainageways. Due to the relatively steep slopes and potential erosion hazards, much of this ecological site remains in native vegetation. This site has the potential to offer a natural mosaic of vegetative structure and species diversity due to local differences in slope, aspect, and drainage patterns. These topographical features can result in uneven utilization of forage by grazing animals across the landscape, which further contributes to vegetative structural and species diversity. Wildlife native to the site includes many species of ground-nesting birds that depend upon this complex plant diversity to meet their various life requirements. Historically, the predominance of grasses and forbs on this site supported grazers and mixed feeders such as bison, elk, and mule deer.

Shrubs such as lead plant, sandhill plum, and aromatic sumac may be locally abundant on this site. Shrub thickets offer escape and thermal cover for several species of wildlife. Dense thickets may offer nesting habitat for certain species of birds. Although tree invasion is generally low due to the rapid runoff of water on the less permeable clayey soils, woody encroachment can be detrimental to several species of native grassland nesting birds. Woody encroachment causes habitat fragmentation, which can lead to increased aerial predation and nest parasitism on ground-nesting birds that require large expanses of non-woody habitat.

Runoff that pools seasonally in the drainages and within impoundments constructed for livestock generally meets the needs of wildlife requiring open water for drinking. These areas are also locally important breeding sites for many species of amphibians.

Big Bluestem, Little Bluestem, Sideoats Grama (Reference Plant community)

The high diversity of grasses and forbs in this community provides habitat for a diverse group of insects. Areas with high forb diversity will generally support more insects such as the leaf-hoppers, important to young grassland birds such as grouse. Grasshoppers, associated with grasses, are a critical food source for birds in later stages of development. Intermittent pools provide breeding sites for plains leopard frog, western chorus frogs, and great plains toads. Historically, this plant community favored grazers such as bison, elk, pronghorn, and mule deer. The migratory nature of bison, combined with periodic wildfires, resulted in various degrees of herbaceous vegetative structure across a broad scale. This diverse plant community structure offered nesting habitat for many species within the assemblage of grassland associated ground-nesting birds. Species such as the western meadowlarks, horned larks, lark and grasshopper sparrows are common. Sites with residual grass cover in the spring, located next to lek sites, offer greater prairie chicken nesting cover. Areas with higher forb diversity and open ground provide brood-rearing habitat for prairie grouse and foraging sites for grassland birds requiring insects. Burrowing mammals such as thirteen-lined ground squirrels and plains pocket gophers are generally uncommon due to the amount of shale and clay in the soils. Prairie voles and deer mice are common and provide prey for raptors such as red-tailed hawks throughout the year, and prey for Northern Harriers and rough-legged hawks during the winter. Small mammals also provide prey for coyotes and other predators.

Animal Community – Grazing Interpretations

Historical overgrazing has been the key element that has affected the declining condition on many range sites. It is during periods of overstocking that many of the preferred species are taken out of these sites, reducing production, vigor, and diversity. Many new grazing systems are being tested and tried, utilizing stocking rates, timing, stocking density, positive animal impacts, and other factors to enhance ecological site condition.

Grazing Interpretations

Calculating Safe Stocking Rates: Proper stocking rates should be incorporated into a grazing management strategy that protects the resource, maintains or improves rangeland health, and is consistent with management objectives. In addition to usable forage, safe stocking rates should consider ecological condition, trend of the site, past grazing use history, season of use, stock density, kind and class of livestock, forage digestibility, forage nutritional value, variation of harvest efficiency based on desirability preference of plant species and/or grazing system, and site grazeability factors (such as steep slopes, site inaccessibility, or distance to drinking water).

Often the current plant community does not entirely match any particular Community Phase as described in this Ecological Site Description. Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of inventory data will permit the establishment of a safe initial stocking rate.

No two years have exactly the same weather conditions. For this reason, year-to-year and season-to season fluctuations in forage production are to be expected on grazing lands. Livestock producers must make timely adjustments in the numbers of animals or in the length of grazing periods to avoid overuse of forage plants when production is unfavorable and to make advantageous adjustments when forage supplies are above average.

Initial stocking rates should be improved through the use of vegetation monitoring and actual use records that include number and type of livestock, the timing and duration of grazing, and utilization levels. Actual use records over time will assist in making stocking rate adjustments based on the variability factors.

Average annual production must be measured or estimated to properly assess useable forage production and stocking rates.

Hydrological functions

Water is the principal factor limiting forage production on this site. Infiltration and runoff potential for this site varies from low to high. In many cases, areas with more than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff.

Recreational uses

This site provides opportunities for hunting, hiking, photography, bird watching and other activities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

None noted.

Other information

Site Development and Testing Plan: This ESD went through the approval process.

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 individuals involved in developing the Blue Shale ESD in 2002 include: Darrell Beougher, Jon Deege, Lorne Denetclaw, Sharla Schwien, Joel Willhoft, Dwayne Rice, and Bob Tricks from Kansas: and Nadine Bishop, Kristin Dickinson, Kim Stine, Dana Larson, and Chuck Markley from Nebraska.

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Contributors

Chris Tecklenburg

Approval

David Kraft, 10/02/2019

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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 12-28-2016 David Kraft, John Henry, Doug Spencer and Dwayne Rice Original Authors 2-15-2005
Contact for lead author	Chris Tecklenburg (chris.tecklenburg@ks.usda.gov)
Date	10/02/2019
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

2. **Presence of water flow patterns:** Typically none. If present (steeper slopes following intense storms) short and not connected.

3. **Number and height of erosional pedestals or terracettes:** None, due to the amount potential production and canopy cover. Pedestals and terracettes are indicators of soil being moved by water and/or wind.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 15% bare ground is found on this site, with bare patches generally less than 2-3 inches in diameter. Extended drought can cause bare ground to increase. Bare ground is the remaining ground cover after accounting for ground surface covered by vegetation (basal and foliar canopy), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** None. There are no channels that are being cut into the soil by moving water. Gullies are not a natural feature of this landscape and site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. The vegetative cover in the reference state is sufficient to limit wind-scoured or blowout areas. This site is not a depositional area for offsite wind erosion.

7. **Amount of litter movement (describe size and distance expected to travel):** None. The inherent capacity for litter movement on a soil is a function of its slope and landscape position.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant canopy is large enough to intercept the majority of raindrops. The soil characteristic of this site is susceptible to erosion. No physical crusts apparent with abundant cover and production. Soil stability scores will range from 4-6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Bogue soil series: The A horizon is 0 to 6 inches; dark gray (5Y 4/1)moist, clay; weak very thick platy structure parting to weak medium subangular blocky; upper 1/2 to 1 inch has strong fine granular structure; very hard, very firm; many fine grass roots; few fragments of calcite; neutral; gradual smooth boundary (4 to 8 inches thick).

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Diverse grass, forb, shrub canopy and root structure reduces raindrop impact and slows overland flow providing increased time for infiltration to occur.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** There is no evidence of compacted soil layers due to cultural practices.

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

    Dominant: Tallgrasses dominant 47% (1185 lbs); big bluestem 700-1000, Indiangrass 125-250, composite dropseed 15-30, switchgrass 40-85.

    Sub-dominant: Midgrasses subdominant 35% (875 lbs); little bluestem 300-500, sideoats grama 200-375.

    Other: Shortgrasses minor 6% (150); blue grama 70-140, buffalograss 25-50
    Cool-season grasses trace 2% (40); western wheatgrass 35-70

    Additional: Forbs 5% (125 lbs)
    Shrubs 5% (125 lbs)

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** The majority of plants are alive and vigorous. Some mortality and decadence is expected for the site. This in part is due to drought, unexpected wildfire or a combination of the two events. This would be expected for both dominant and sub-dominant groups.

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14. **Average percent litter cover (%) and depth (in):** Plant litter is distributed evenly throughout the site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1500-3500 lbs/acre. Representative value is 2500 lbs/forage/acre. Below normal precipitation during the growing season expect 1500 lbs/forage/acre and above normal precipitation during the growing season expect 3500 lbs/forage/acre. If utilization has occurred, estimate the annual production removed or expected and include this amount

when making the total site production estimate.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Invasive or noxious weeds should not occur in the reference community. However, cheatgrass, Russian thistle, kochia, and other non-native annuals can invade following extended drought assuming as seed source is available.

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17. **Perennial plant reproductive capability:** The number and distribution of tillers or rhizomes is assessed on perennial plants occupying the evaluation area. No reduction in vigor or capability to produce seed or vegetative tillers given the constraints of climate and herbivory.
