USDA Natural Resources Conservation Service

Ecological site R078CY107TX
Sand Hills 23-31" PZ

Last updated: 9/15/2023
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General information

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

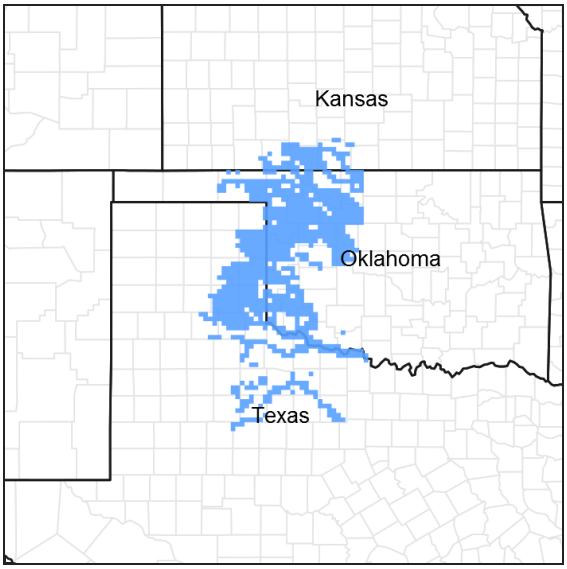


Figure 1. Mapped extent

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): 078C–Central Rolling Red Plains, Eastern Part

MLRA 78C is characterized by moderately dissected, rolling plains with prominent ridges and valleys and numerous terraces adjacent to dissecting streams. Loamy and clayey soils are generally deep, well drained, and developed in calcareous and gypsiferous sediments of Permian age.

LRU notes

NA

Classification relationships

This ecological site is correlated to soil components at the Major Land Resource Area (MLRA) level which is further described in USDA Ag Handbook 296.

Ecological site concept

These sites are on coarse textured sand dunes. The reference vegetation consists of native tallgrasses and forbs with some shrub species. Woody plant cover is kept below 25% under reference conditions. Without periodic fires to

limit brush canopy, it may exceed 25%. A carefully designed grazing management plan should be implemented on these site to ensure ground cover and prevent reactivating the dunes.

Associated sites

R078CY025OK	**Depressional Upland** Adjacent sites. Episaturated.

Similar sites

R078CY105TX	**Loamy Sand 23-31" PZ** Both sites have a fine sandy texture.
R078CY098TX	**Deep Sand 23-30" PZ** Both sites have a fine sandy texture. Higher oak canopy.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia filifolia*
Herbaceous	(1) *Calamovilfa gigantea*

Physiographic features

The Sand Hills 23-31” PZ ecological site was formed in sandy calcareous eolian Holocene sediments. These very gently sloping to undulating to steep soils are on undulating to steep sand dunes adjacent to stream terraces and flood plains of major streams and drainage ways in the Central Rolling Red Plains – Eastern Part (MLRA 78C). These soils are on long narrow undulating to hummocky dunes adjacent to present or past stream channels. Most areas of this soil are surrounded by, or are adjacent to occasionally flooded soils. Low areas of this soil are subject to rare flooding. Water runs off the surface very slowly. Slopes are complex and are 3 to 13 percent. Elevation ranges from 1000 to 2250 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial plain > Dune (2) Alluvial plain > Stream terrace (3) Alluvial plain > Sand sheet
Runoff class	Negligible to low
Flooding frequency	None
Ponding frequency	None
Elevation	213–792 m
Slope	1–30%
Water table depth	183 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 78C lies within the subtropical sub-humid climate regime, which typically has dry winters with hot and not as humid summers. MLRA 78C extends north and south from Coldwater, Kansas to just northeast of San Angelo, Texas (Ballinger, Texas), and east to west from Weatherford, Oklahoma to west of Shamrock, Texas. This regime is characterized by rapid changes in temperature; marked extremes, both daily and annual; and rather erratic rainfall. The weather is alternately influenced by cold dry air from the Arctic Circle, and warm moist air from the Gulf of Mexico.

Seasonal changes are gradual. Spring is a season of variable weather and relatively high precipitation with

prevailing winds from the southwest. Summers are generally hot with low humidity. Fall has long periods of pleasant weather interspersed with moderate to heavy rains. Winter is open and moderate to cold with winds from the north and infrequent snows.

Wind speeds average more than eleven miles an hour with prevailing southern winds. Rather strong winds can occur in all months of the year. While strong gusty winds occur, severe dust storms are rare.

Approximately 75 percent of the rainfall occurs during the warm season, and much of it comes in storms of high intensity and short duration in May and June. These rains can be particularly erosive on sites where vegetation is sparse. Occasional droughts are to be expected. Lack of rainfall and hot, dry winds often curtail forage production during July and August.

Table 3. Representative climatic features

Frost-free period (characteristic range)	146-186 days
Freeze-free period (characteristic range)	178-201 days
Precipitation total (characteristic range)	660-711 mm
Frost-free period (actual range)	142-191 days
Freeze-free period (actual range)	168-211 days
Precipitation total (actual range)	610-762 mm
Frost-free period (average)	165 days
Freeze-free period (average)	191 days
Precipitation total (average)	686 mm

Climate stations used

- (1) CHATTANOOGA [USC00341706], Chattanooga, OK
- (2) WILMORE 16SE [USC00148914], Coldwater, KS
- (3) ASHLAND [USC00140365], Ashland, KS
- (4) ALTUS IRIG RSCH STN [USC00340179], Elmer, OK
- (5) ARNETT 3NE [USC00340332], Arnett, OK
- (6) WAYNOKA [USC00349404], Waynoka, OK
- (7) VERNON [USC00419346], Vernon, TX
- (8) FORT SUPPLY 3SE [USC00343304], Fort Supply, OK

Influencing water features

None.

Wetland description

NA

Soil features

Soils are mapped for each county within the MLRA. Mapunits are representations of the major soil series component(s) and named accordingly. Each Mapunit is spatially represented on a digital soils map as polygons of different shapes and sizes. Within these Mapunits, there are often minor soil series components included. These minor components are soils that occur within a Mapunit polygon but are of small extent (15% or less of the Mapunit area). However, it is difficult to separate these minor soils spatially due to the scale of soil mapping.

Ecological sites are correlated at the component level of the soil survey. Therefore, a single Mapunit may contain multiple Ecological Sites just as it may contain multiple soil components. This is important to understand when investigating soils and Ecological Sites. A soil survey Mapunit may be correlated to a single Ecological Site based

on the major component; however, there may be inclusional areas of additional Ecological Sites which are correlated to the minor components of that particular soil Mapunit.

Representative soil components for this site include:
Jester, Southside and Tivoli.

The soils found in the Sand Hills ecological site are very deep and excessively drained. Permeability is rapid. Runoff is negligible to low on slopes less than 5 percent, very low on 5 to 20 percent slopes and low to medium on 20 to 45 percent slopes. Depth to bedrock is greater than 80 inches. The textural control section is loamy fine sand or coarser. No gravel or secondary carbonate accumulations are present within the profile. Depth to an apparent water table is 6 to 20 feet, from January to December.

Table 4. Representative soil features

Parent material	(1) Eolian sands–quartzite
Surface texture	(1) Sand (2) Fine sand (3) Loamy fine sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	102–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	2.03–11.94 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–1%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The information contained in the State and Transition Diagram (STD) and the Ecological Site Description was developed using archeological and historical data, professional experience, and scientific studies. The information presented is representative of a very complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals and ecological processes are described to inform land management decisions.

This site is found on undulating to hummocky sandy soils on uplands and in narrow dunned areas adjacent to flood plains. The soils are typically loose, fine sands highly susceptible to wind erosion and low in fertility. Considerable variation in vegetation structure can be expected because of the undulating topography and because some dunes are recent with poor soil development while others are older with more developed soils.

The reference vegetation of the Sand Hills Ecological Site is assumed to have been a Tallgrass Prairie Community (1.1) . Pre-settlement influences included grazing or browsing by endemic pronghorn antelope, deer and migratory

bison, re-occurring droughts and infrequent fires. Wildfires are thought to have occurred at return intervals of 7 to 12 years (Frost 1998) in this region. The openness of the plant community and the considerable bare ground may have reduced the frequency of fires on this site, but fire was a factor in the development of the plant communities in the region (Brown and Smith, 2006). The fires and the semi-arid climate kept woody species suppressed. Since European settlement in the late 1800s, grazing and possibly climate change (Milchunas 2006) have interacted with reduced fire frequency and intensity to give the competitive advantage to woody plant species. The interaction of these disturbances has changed the composition and structure of the HCPC dramatically where brush control has not been practiced.

Historically, the vegetation on the site consisted of tallgrasses such as sand bluestem , Indiangrass, switchgrass and giant dropseed, a five to ten percent canopy of woody species such as sand sagebrush, plum (Chickasaw or Oklahoma) and yucca and an abundance of forbs. Other characteristic grasses found in historic climax include little bluestem, giant sandreed, sand dropseed, fringed signalgrass and sand lovegrass. See the Plant Composition and Annual Production Table below for estimated composition and production of the species assumed to have been present under reference conditions.

The Tallgrass Prairie Community (1.1) developed under the prevailing climate and pre-historic fire regime until settlement by Europeans. Even before livestock grazing, the site was probably unstable because of its proximity to rivers and streams. The water source along the stream would have concentrated native wildlife use, as it did early livestock husbandry by the Europeans. Not understanding the limits of rangeland productivity most settlers, and the ranchers that followed, overstocked the area with domesticated livestock almost universally. As overgrazing occurred, there was a reduction of more palatable species, such as Indiangrass and sand bluestem, a decline in litter and soil organic matter and concurrently a reduction in frequency and intensity of fires.

Woody plant encroachment was favored by the shift in plant structure to generally shorter grasses and the decline in soil properties. The woody and herbaceous invaders were generally endemic species, released from competition and fire suppression, although human activities supplied exotic species. Yucca, sand sagebrush and plum are quick increasers on the site. Continuous heavy grazing magnifies the increase. Some studies have shown that sand sage canopy fluctuates with rainfall (Gillen, 2004). Years of above average rainfall increase canopy while die-backs of sand sage occur in extremely dry years. Mesquite infrequently invades where clayey soil horizons occur. In the resulting Mixed-grass Community (1.2), sand bluestem, Indiangrass and switchgrass give way to more grazing resistant little bluestem, dropseeds and shortgrasses. Little bluestem increases initially, but decreases under continuous heavy grazing by cattle. A good mix of tall, mid and shortgrasses dominates annual herbage production, but the encroaching woody species increase in the proportion of production compared to the Tallgrass Prairie Community (1.1).

Abusive grazing of the Mixed-grass Community (1.2) and reduction of the frequency and intensity of fires transitions the plant community into one that is increasingly occupied by woody plants. Droughts, which occur at approximately 20-year intervals in this region, magnify this situation. During the transition the less palatable or more grazing resistant plants such as silver bluestem, perennial three-awns, dropseeds, sand lovegrass and less palatable forbs begin replacing the tall grasses. As the grass cover declines, litter, mulch and soil organic matter declines while bare ground, erosion and other desertification processes increase. In this stage the site can be relatively unstable and subject to wind erosion. The occurrence of annual forbs is common because of the sparse ground cover and sandy soil. Rest from grazing and prescribed burning will generally not restore the grassland community once the woody plant community exceeds 25 percent canopy and/or the plants reach maturity or fire resistant age. When this occurs the Mixed-grass Community has transitioned into a Midgrass/Mixed-brush Community (2.1) is identifiable by an abundance of midgrasses, shortgrasses, annual forbs and more than 25 percent canopy of woody species. This threshold also marks the beginning of a new steady state, the Shrubland State (2.0).

Sand sagebrush, plums and yucca, are generally the most common shrubby species on the Midgrass/Mixed-brush Community (2.1). The characteristic grasses in this community are sand lovegrass, sand paspalum, plains bristlegrass, meadow dropseed, sand dropseed and three-awns. Common forbs include camphorweed, stickleaf mentzelia, western ragweed, mentzelia and gaura. In early stages (25-35% shrub cover) of the Shrubland state, the encroachment of invasive species can be reversed with relatively inexpensive brush control practices such as individual plant treatments (IPT) and good grazing management that allows the application of prescribed burning. If these practices are not applied and overgrazing continues, the woody species will continue to increase in dominance and ground cover until the plant community transitions into a Mixed-brush/Shortgrass/Annuals Community (2.2). Once the brush canopy exceeds 50 to 60 percent, annual production for the herbaceous species

is limited to scattered tall and midgrasses plus shortgrasses, weedy forbs and annuals. Cool-season annuals, such as wild buckwheat, may be abundant following wet winters and springs. The Mixed-brush/Shortgrass/Annuals Community (2.2) produces only small and often variable amounts of useable livestock forage. Useable livestock forage production is considerably less than the reference community due to the presence of unpalatable brush and the erosion of soil fertility during the desertification process that often occurs during the transition from grassland to shrubland. Generally, high cost brush management practices along with other restoration practices such as range planting, prescribed grazing and prescribed burning are necessary to return the Shrubland State (2) back to a Grassland State (1). The site is so fragile that extreme care must be taken to avoid this stage and in the process of renovation. The use of prescribed fire is often unsuccessful because of the lack of fine fuel for fire and the sparseness of ground cover which disrupts fire continuity. The possibility of wind erosion following fire also makes it risky. Burning should be done under good moisture conditions so that recovery happens quickly to decrease the chance of wind erosion. The site should not be cultivated.

State and Transition Diagram:
A State and Transition Diagram for the Sand Hills (R078CY107TX) site is depicted below. Thorough descriptions of each state, transition, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases. Plant communities will differ across the MLRA because of the natural variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal; other vegetative states may be desired plant communities as long as the Range Health assessments are in the moderate and above category.

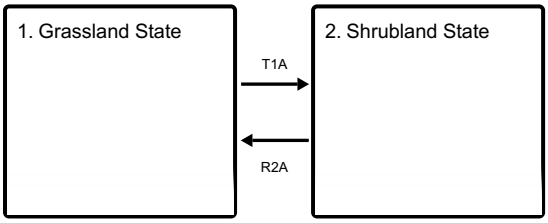
The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Composition by dry weight and percent canopy cover are provided to describing the functional groups. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs).

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model

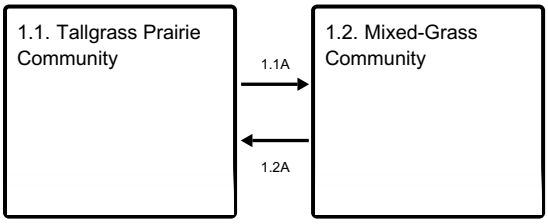
Ecosystem states



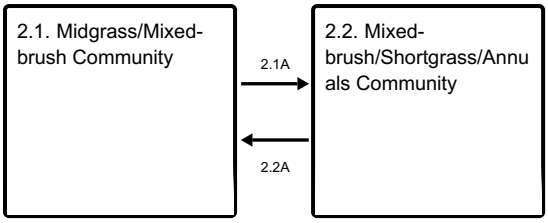
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

R2A - Adequate rest from defoliation and removal of woody canopy, followed by reintroduction of historic disturbance regimes

State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Grassland State

The Tallgrass Prairie Community (1.1) is the interpretive plant community for this site. The reference plant community is assumed to have been a tallgrass prairie with scattered motts of shrubs or trees. Indiangrass, switchgrass, sand bluestem, little bluestem, giant sandreed and giant dropseed dominated this plant community. The tall grasses and forbs were adapted to the course deep sands and good soil moisture relationship. Woody species were also adapted but apparently were kept at low levels because of frequent wildfires and occasional long droughts. The vegetation probably varied considerably because of differences in soil development and sharp changes in topography. Dune development was apparently ongoing adjacent to the streams next to which the site is found. The Mixed-Grass Community (1.2) is dominated by mid and tall grasses and being invaded by woody species. The woody plants had been held at low densities by repeated fires, droughts and competition from a vigorous grass component. Shrubby species are increasing in density. Typically, sand sagebrush, plum and yucca are early and persistent invaders. Netleaf hackberry and elm trees often dot the landscape. The preferred tall and midgrasses are being replaced by the more grazing resistant species.

Community 1.1
Tallgrass Prairie Community

Figure 8. 1.1 Tallgrass Prairie Community

The Tallgrass Prairie Community (1.1) is the interpretive plant community for this site. The reference plant community is assumed to have been a tallgrass prairie with scattered motts of shrubs or trees. Indiangrass, switchgrass, sand bluestem, little bluestem, giant sandreed and giant dropseed dominated this plant community. The tall grasses and forbs were adapted to the course deep sands and good soil moisture relationship. Woody species were also adapted but apparently were kept at low levels because of frequent wildfires and occasional long droughts. The vegetation probably varied considerably because of differences in soil development and sharp changes in topography. Dune development was apparently ongoing adjacent to the streams next to which the site is found. Woody species included yucca, sand sagebrush, Chickasaw plum, skunkbush, prickly-ash, bumelia and net-leaf hackberry. Historically, woody species are thought to have presented less than five percent canopy. Characteristic forbs included stickleaf mentzelia, spotted beebalm, western ragweed, camphorweed, gaura and Illinois bundleflower (See Plant Community Composition Table for listing of all species thought to occur). Because of low fertility soils, herbage production was relatively sparse and low and nutrient quality. There was apparently always considerable bare ground. Although the deep sand prevented much water erosion, wind erosion was possible when re-occurring fires and/or droughts reduced the tall grass cover and litter. It is estimated that the Tallgrass Prairie Community (1.1) produced as much as 3500 to 4000 pounds herbage in good moisture years and

as little as 1500 pounds to 2000 pounds in unfavorable years. Grasses and forbs contributed up to 90 to 95 percent of the total annual production in historic climax conditions. The tall grasses aided in the infiltration of rainfall and reduced runoff. Litter and organic matter buildup was limited by the dry climate and low herbage production. The Tallgrass Prairie Community (1) furnished good forage for grass-eating type animals such as bison before settlement and for horses and cattle after settlement. Near reference grassland conditions can be maintained with proper stocking, prescribed grazing and frequent prescribed burning. Little bluestem is often persistent even under moderate grazing. Stocking rates must consider the kind of livestock and balance their numbers with current annual forage production and competition from other herbivores. Proper stocking and flexibility in animal numbers is important because of the nature of the soil and the need for plant cover to guard against wind erosion. Livestock overgrazing or a decrease in intensity and frequency of fires and no brush management will allow this plant community to transition into a Mixed-Grass Community (1.2), which is relatively open grassland with various amounts of invading shrubs.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1429	2858	3811
Shrub/Vine	168	336	448
Forb	84	168	224
Tree	–	–	1
Total	**1681**	**3362**	**4484**

Figure 10. Plant community growth curve (percent production by month). TX2286, Tallgrass Prairie Community. Tallgrass with warm-season growing season dominated site..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	3	8	20	18	8	10	17	9	2	1

Community 1.2
Mixed-Grass Community

Figure 11. 1.2 Mixed-Grass Community

The Mixed-Grass Community (1.2) is dominated by mid and tall grasses and being invaded by woody species. The woody plants had been held at low densities by repeated fires, droughts and competition from a vigorous grass component. Shrubby species are increasing in density because continuous heavy grazing by livestock has reduced grass cover, caused reduction of soil cover and reduced the frequency and/or intensity of fires. Selective grazing and differential response of plants to defoliation, and possibly climate change, also causes changes in composition of the plant community. Typically, sand sagebrush, plum and yucca are early and persistent invaders. Netleaf hackberry and elm trees often dot the landscape. The preferred tall and midgrasses are being replaced by the more grazing resistant species. Switchgrass, giant sandreed, Indiangrass and sand bluestem are present but giving way to little bluestem, dropseeds, fringed signalgrass and three-awns. Most of the climax grasses and forbs persist in

this phase. The encroaching woody species are generally less than three feet tall and subject to control by prescribed burning and proper grazing management. The woody canopy varies between 10 and 25 percent depending on length and severity of grazing, timing and frequency of fires and seed availability of invading species. Annual primary production is reduced slightly relative to the reference community, ranging from 1200 to 3500 pounds per acre depending on precipitation amounts. Grasses remain the dominant producers of forage. Heavy continuous grazing reduces plant cover, litter and mulch and increases bare ground exposing the soil to wind erosion. The changes in species composition are small initially. However, unless proper grazing and prescribed burning are applied, the invading species continue to increase in size and density. When the canopy of the woody plants becomes dense enough (>20 %) or tall enough (> 3 feet) to suppress grass growth and resist fire damage, a threshold in ecological succession is crossed. This threshold can also occur when the fine fuel load provided by grasses is too low to control brush effectively with fire. This situation may occur relatively quickly under heavy grazing and/or drought due scarcity of vegetative cover. When enough shrubs become established (~20%) and prescribed burning will not maintain a low shrub density, the Mixed-Grass Community (1.2) has transitioned into the Midgrass/Mixed-Brush Shrubland Community (2.1). In that plant community, normal range management practices, such as prescribed grazing, cannot reverse the trend to woody plant dominance.

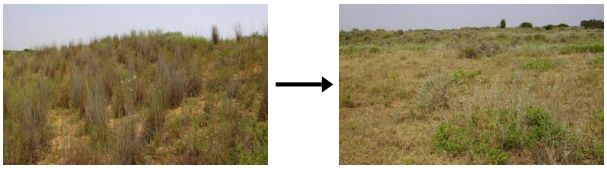
Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	942	1961	2746
Shrub/Vine	336	701	981
Forb	67	140	196
Total	**1345**	**2802**	**3923**

Figure 13. Plant community growth curve (percent production by month). TX2276, Mid/Shortgrasses with Forbs. Warm-season mid and shortgrasses, cool-season grasses, and forbs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	2	4	8	25	25	14	6	8	5	2	1

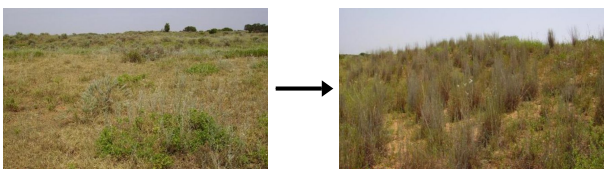
Pathway 1.1A
Community 1.1 to 1.2



Tallgrass Prairie Community **Mixed-Grass Community**

Without proper grazing management that adjusts animal numbers, to annual forage production and judicious prescribed burning, the Tallgrass Prairie Community will transition (regress) to a Mixed-grass Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1



Mixed-Grass Community **Tallgrass Prairie Community**

With the implementation of Prescribed Grazing and Prescribed Burning conservation practices, the Mixed-grass Community can be reverted back to the Tallgrass Prairie Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Shrubland State

The Midgrass/Mixed-brush Community (2.1) supports a 20 to 35 percent woody plant canopies with sand sagebrush, plum, hackberry and yucca the most common shrubs. There is a decline in diversity of the grassland component and an increase in woody species. Total plant production declines somewhat, being approximately 1000 to 3000 pounds per acre, depending on precipitation. Annual production is balanced between herbaceous plants and woody plants. Remnants of historic climax grasses and forbs and unpalatable invaders can be found in and under and between woody plants. Characteristic grasses are little bluestem, meadow dropseed, sand dropseed, hooded windmillgrass, plains bristlegrass, threeawns, sand lovegrass plus other grazing resistant historic species. The Mixed-brush/Shortgrass/Annuals Community is a shrubland community having sand sagebrush, yucca, skunkbush sumac, bumelia and sand plums. With continued heavy grazing and no brush control, the shrubs can approach 75 percent or more ground cover. Short-grasses and low seral stage annual and perennial forbs occupy the woody plant interspaces. Characteristic grasses are hooded windmillgrass, red lovegrass, gummy lovegrass, tumble lovegrass and sand dropseed. Forbs commonly found in this community include camphorweed, queen's delight, and silverleaf nightshade. Numerous annual grasses and forbs may be present.

Community 2.1
Midgrass/Mixed-brush Community

Figure 14. 2.1 Midgrass/Mixed-brush Community

The Midgrass/Mixed-brush Community (2.1) supports a 20 to 35 percent woody plant canopies with sand sagebrush, plum, hackberry and yucca the most common shrubs. This plant type is primarily the result of the interaction of selective overgrazing by livestock, the differential response of plants to defoliation and a reduction in the intensity and frequency of fires over a long period of time. There is a decline in diversity of the grassland component and an increase in woody species. Annual herbage production is reduced due to decline in soil fertility, structure and organic matter, and plant composition has shifted strongly toward the non-grass component. Total plant production declines somewhat, being approximately 1000 to 3000 pounds per acre, depending on precipitation. Annual production is balanced between herbaceous plants and woody plants. Browsing animals such as goats and deer can find fair food value and cover. Forage quantity and quality for cattle is less than in the Grassland State (1). Remnants of reference community grasses and forbs and unpalatable invaders can be found in and under and between woody plants. Characteristic grasses are little bluestem, meadow dropseed, sand dropseed, hooded windmillgrass, plains bristlegrass, threeawns, sand lovegrass plus other grazing resistant historic species. Because of grazing pressure, lowered fertility and competition for nutrients and water from the woody plants, the grassland component shows general lack of plant vigor and productivity. Common forbs include camphorweed, wild buckwheat, heath aster, western ragweed and a variety of annuals. An extended period of above average winter precipitation brings increases in cool-season species such as Texas wintergrass, Russian thistle and Japanese brome. Unless brush management and good grazing management are applied during this phase, the transition toward a dense shrubland the Mixed-brush/Shortgrass/Annuals Community (2.2) will continue.

The trend toward dense shrubland cannot be reversed with good grazing management alone. Accelerated brush management practices along with proper grazing are required to return this plant type to grassland. Brush management practices should be applied with care because the site is very fragile and erodible.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	560	1121	1681
Shrub/Vine	392	785	1177
Forb	168	336	504
Total	**1120**	**2242**	**3362**

Figure 16. Plant community growth curve (percent production by month). TX2290, Midgrass/Mixed-Brush Community. Warm-season midgrass with some cool-season grasses and up to 35% woody component..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	6	15	25	20	3	4	15	6	2	1

Community 2.2
Mixed-brush/Shortgrass/Annuals Community

Figure 17. 2.2 Mixed-brush/Shortgrass/Annuals Comm

The Mixed-brush/Shortgrass/Annuals Community is a shrubland resulting from many years of overgrazing, lack of periodic fires and little brush management. Sand sagebrush, yucca, skunkbush sumac, bumelia and sand plums are common. With continued heavy grazing and no brush control, the shrubs can approach 75 percent or more ground cover. Shortgrasses and low seral stage annual and perennial forbs occupy the woody plant interspaces. Characteristic grasses are hooded windmillgrass, red lovegrass, gummy lovegrass, tumble lovegrass and sand dropseed. Forbs commonly found in this community include camphorweed, queen’s delight, and silverleaf nightshade. Numerous annual grasses and forbs may be present. Grasses and forbs make up 30 percent or less of the annual herbage production. The Mixed-brush/Shortgrass/Annuals Community provides good cover for wildlife, but only limited preferred forage, or browse, is available for livestock or wildlife. Major high cost and high energy, accelerating practices are required to restore the Mixed-brush/Shortgrass/Annuals Community (2.2) back to a grassland state. Generally, brush management practices such as aerial herbicide application, along with other conservation practices such as range planting, grazing deferment, prescribed grazing and prescribed burning are necessary to return the shrubland state the grassland state. In practice this may not be practical or desirable depending on objectives of the land manager.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	673	1345	2018
Grass/Grasslike	280	560	841
Forb	112	224	336
Tree	56	112	168
Total	**1121**	**2241**	**3363**

Figure 19. Plant community growth curve (percent production by month). TX2291, MixedBrush/Shortgrass/Annuals Community. Spring & Fall growth of grasses, annuals and woody shrubs..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	6	10	20	22	6	8	12	10	2	1

Pathway 2.1A
Community 2.1 to 2.2

Midgrass/Mixed-brush Community

Mixed-brush/Shortgrass/Annuals Community

With heavy continuous grazing pressure, no fires, and no brush management practices implemented, the Midgrass/Mixed-brush Community can be shifted to the Mixed-brush/Annuals Woodland Community.

Pathway 2.2A
Community 2.2 to 2.1

Mixed-brush/Shortgrass/Annuals Community

Midgrass/Mixed-brush Community

With Brush Management and Prescribed Grazing, the Mixed-brush/Shortgrass/Annuals Community can be shifted back to the Midgrass/Mixed-brush Communities.

Conservation practices

Brush Management
Prescribed Grazing

Transition T1A
State 1 to 2

When enough shrubs become established (~20%) and prescribed burning will not maintain a low shrub density, the Grassland State has transitioned into the Midgrass/Mixed-brush Community (2.1).

Restoration pathway R2A
State 2 to 1

Converting the Woodland State back to the Grassland state requires extensive and expensive reclamation practices. Without major brush control and management inputs, this plant community cannot be returned to grassland. Range planting, prescribed grazing and prescribed burning, must follow intensive mechanical brush control.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Range Planting

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	**Tallgrass**			168	
1	**Tallgrasses**			925–2466	
	sand bluestem	ANHA	*Andropogon hallii*	252–673	–
	switchgrass	PAVI2	*Panicum virgatum*	252–673	–
	Indiangrass	SONU2	*Sorghastrum nutans*	252–673	–
	giant dropseed	SPGI	*Sporobolus giganteus*	112–247	–
	giant sandreed	CAGI3	*Calamovilfa gigantea*	112–247	–
2	**Midgrasses**			252–673	
	sideoats grama	BOCU	*Bouteloua curtipendula*	17–45	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	17–45	–
	Arizona cottontop	DICA8	*Digitaria californica*	17–45	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	17–45	–
	vine mesquite	PAOB	*Panicum obtusum*	17–45	–
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	17–45	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	17–45	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	17–45	–
	white tridens	TRAL2	*Tridens albescens*	17–45	–
	purpletop tridens	TRFL2	*Tridens flavus*	17–45	–
3	**Shortgrasses**			84–224	
	purple threeawn	ARPU9	*Aristida purpurea*	11–19	–
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	11–19	–
	hooded windmill grass	CHCU2	*Chloris cucullata*	11–19	–
	fall witchgrass	DICO6	*Digitaria cognata*	11–19	–
	Hall's panicgrass	PAHAH	*Panicum hallii var. hallii*	11–19	–
	thin paspalum	PASE5	*Paspalum setaceum*	11–19	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	11–19	–

	sand dropseed	SPCR	*Sporobolus cryptandrus*	11–19	–
	fringed signalgrass	URCI	*Urochloa ciliatissima*	11–19	–
4	**Cool-season grasses**			17–45	
	Canada wildrye	ELCA4	*Elymus canadensis*	17–45	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	17–45	–
	Texas bluegrass	POAR	*Poa arachnifera*	17–45	–
Forb					
5	**Forbs**			84–224	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	6–17	–
	bluestem pricklypoppy	ARALT	*Argemone albiflora ssp. texana*	6–17	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	6–17	–
	whitemouth dayflower	COER	*Commelina erecta*	6–17	–
	prairie clover	DALEA	*Dalea*	6–17	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	6–17	–
	buckwheat	ERIOG	*Eriogonum*	6–17	–
	beeblossom	GAURA	*Gaura*	6–17	–
	hoary false goldenaster	HECA8	*Heterotheca canescens*	6–17	–
	camphorweed	HESU3	*Heterotheca subaxillaris*	6–17	–
	bush morning-glory	IPLE	*Ipomoea leptophylla*	6–17	–
	blazingstar	MENTZ	*Mentzelia*	6–17	–
	littleleaf sensitive-briar	MIMI22	*Mimosa microphylla*	6–17	–
	evening primrose	OENOT	*Oenothera*	6–17	–
	queen's-delight	STSY	*Stillingia sylvatica*	6–17	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	6–17	–
Shrub/Vine					
6	**Shrubs**			168–448	
	sand sagebrush	ARFI2	*Artemisia filifolia*	17–45	–
	netleaf hackberry	CELAR	*Celtis laevigata var. reticulata*	17–45	–
	Chickasaw plum	PRAN3	*Prunus angustifolia*	17–45	–
	Oklahoma plum	PRGR	*Prunus gracilis*	17–45	–
	fragrant sumac	RHAR4	*Rhus aromatica*	17–45	–
	littleleaf sumac	RHMI3	*Rhus microphylla*	17–45	–
	bully	SIDER2	*Sideroxylon*	17–45	–
	yucca	YUCCA	*Yucca*	17–45	–
	Texas Hercules' club	ZAHI2	*Zanthoxylum hirsutum*	17–45	–

Animal community

Many types of grassland reptiles, birds and mammals use the Sand Hills Ecological Site along with adjacent sites. It was perhaps a concentration area because of its proximity to water. Small mammals include many kinds of rodents, black-tailed jackrabbit, eastern and desert cottontail, ground squirrel, badger and skunk. Predators include coyote, kit fox and bobcat. Prairie chicken, quail, doves, songbirds, and birds of prey were indigenous or frequent users. Most are still plentiful. Bison made infrequent migratory use and pronghorn antelope and deer were indigenous. Free roaming bison are no longer present, but deer still utilize the Sand Hills site in its various states.

The site is suitable for production of many kinds of wildlife and livestock. In the grassland state it is suited to primary grass eaters such as cattle. As livestock caused retrogression occurs and woody plants invade it becomes better habitat for deer and other wildlife because of the browse and forbs. Livestock should be stocked according to the available grass, forb and browse forage, keeping competition for forbs and browse with deer in mind.

Hydrological functions

The Sand Hills Ecological Site consists of undulating topography with steep slopes, but deep sandy soils with moderate to rapid permeability. There is a high water intake rate, thus only slight water erosion susceptibility. Almost no water moves off the site. Wind erosion is a hazard where the site is not protected by vegetation, however. Natural fertility and organic matter is low. Water infiltration is rapid but water holding capacity is low. The rooting zone is deeper than 60 inches on all soils of the site and most incoming water moves through the profile and into underground aquifers.

Under reference condition, the grassland vegetation intercepted and utilized much of the incoming rainfall. Hydrologic functions were representative of a tallgrass prairie. Litter and soil movement was slight except on steep slopes. However, standing plant cover, duff and soil organic matter decrease as the Tallgrass Prairie Community (1.1) transitions to the Mixed-grass Community (1.2) and continue to decline in the spaces between the shrubs of the Midgrass/Mixed-brush Community (2.1). During the transition, evaporation and interception losses are higher, resulting in less moisture reaching the soil. Fertility erosion takes place between shrubs. The deeper-rooted woody invaders are able to extract water from greater depths than the short grasses and may accumulate some windblown soil and litter. The woody plants compete for moisture with the remaining grasses and forbs further reducing production and ground cover in openings. Once the Mixed-brush/Shortgrass/Annuals Community (2.2) canopy surpasses 50 percent the hydrological and ecological processes, nutrient cycling and energy flow, stabilize within the woody plant canopy and shrubland type ecological processes dominate (Thurow 1991).

Recreational uses

The site has value from an aesthetic standpoint. The undulating topography and proximity to water make it an interesting site. Hunting, camping, hiking, bird watching, photography and horseback riding are possibilities. Good spring rainfall brings scattered stands of colorful forbs.

Wood products

None.

Other products

Honeybees may be used to make honey from flowering plants.

Other information

None.

Inventory data references

Information presented has been derived from the Sand Hills Range Sites PE 32-38 and 38-42, and an undated NRCS draft Sandhills PE 31-44 Ecological Site Description for 78C, literature, personal experience, field observations and personal contacts with range-trained personnel. Discussions were also made with Jennie Buchanan. Photos by: J.L. Schuster.

Photos 1 and 2 were taken August 15 2007 in northern Wilbarger County, Texas.
Photos 3 and 4 were taken July 30, 2007 in southern Jackson County, OK

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San Antonio, Texas and Justin Clary NRCS Temple, Texas.

This site has been correlated with the following states: Texas and Oklahoma. This site was formerly known in Oklahoma as Dune R078XY022OK and Deep Sand R078XY014OK.

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Reviewers:
Lem Creswell, RMS, NRCS, Weatherford, Texas
Steve Glasgow, GLS, NRCS, Stillwater, Oklahoma
Greg Scott, RSS, NRCS, Stillwater, Oklahoma
Other Range Management Specialists within the Weatherford NRCS Zone.

Contributors

Joe B Norris, State Range Conservationist, NRCS, Abilene, Texas
Joe Schuster, Range & Wildlife Habitat Consultants, Bryan, Texas
PES Edits by Tyson Morley, MLRA Soil Scientist, Altus, Oklahoma

Approval

Bryan Christensen, 9/15/2023

Acknowledgments

Site Development and Testing Plan
Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.
Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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)	Lem Creswell, Zone RMS, NRCS, Weatherford, Texas
Contact for lead author	817-596-2865
Date	01/01/2008
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** None to slight.

3. **Number and height of erosional pedestals or terracettes:** None to slight.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 20 to 30% bare ground.

5. **Number of gullies and erosion associated with gullies:** None to slight.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Slight to moderate extent of wind scoured areas randomly distributed.

7. **Amount of litter movement (describe size and distance expected to travel):** Under normal rainfall, little litter movement would take place due to high water intake of soil.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface not resistant to erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Fine sand single grained surface with low SOM.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Basal cover and density with moderate interspaces should make rainfall impact minimal. This site has rapid permeability, runoff is slow, and available water holding capacity is low.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No evidence of compaction under HCPC.

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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: Warm-season tallgrasses >>

    Sub-dominant:

    Other: Warm-season midgrasses > Shrubs/Vines/Trees > Warm-season shortgrasses = Forbs > Cool-season grasses

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** There should be little mortality or decadence for any functional group.

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1500 - 4000 lbs/acre

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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:** Sand sagebrush, Yucca, Plums, Skunkbush sumac, Mesquite, Juniper, Camphorweed, Annual wild buckwheat.

---

17. **Perennial plant reproductive capability:** All perennial plants should be capable of reproducing except during periods of prolonged drought conditions, heavy natural herbivory or wildfires.
