Ecological site R085AY183TX
Redland 30-38" PZ

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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): 085A–Grand Prairie

The Grand Prairie MLRA is characterized by predominately loam and clay loam soils underlain by limestone and shale. Topography transitions from steeper ridges and summits of the Lampasas Cut Plain on the southern end to the more rolling hills of the Fort Worth Prairie to the north. The Arbuckle Mountain area in Oklahoma is also within this MLRA.

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 occur on shallow non-calcareous soils over fractured limestone. The reference vegetation consists of native tallgrasses, midgrasses and forbs with scattered Post Oaks. Other woody species may occur on the site and may become dominant without the use of fire or other brush management. These soils have fewer carbonates in the profile and are able to support the Post Oak savannah.

Associated sites

R085AY186TX	**Steep Adobe 30-38" PZ** The Steep Adobe site often occurs upslope from the Redland site. It differs from the Redland site by its steeper slope, higher surface and subsurface fragment content, and softer limestone bedrock.

Similar sites

R085AY180TX	**Deep Redland 30-38" PZ** The Deep Redland site has similar soil texture and slope as the Redland site, but has deeper soils with high clay shrink-swell properties, and higher production potential.

Table 1. Dominant plant species

Tree	(1) *Quercus stellata* (2) *Quercus buckleyi*

Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Sorghastrum nutans*

Physiographic features

These sites occur on hillslopes and ridges. Slopes are typically less than 8 percent.

Table 2. Representative physiographic features

Landforms	(1) Hills > Ridge (2) Hills > Hillslope
Runoff class	High to very high
Elevation	152–579 m
Slope	0–8%
Aspect	Aspect is not a significant factor

Climatic features

The climate is subhumid subtropical and is characterized by hot summers and relatively mild winters. Tropical maritime air controls the climate during spring, summer and fall. In winter and early spring, frequent surges of Polar Canadian air cause sudden drops in temperatures and add considerable variety to the daily weather. The average first frost should occur around November 5 and the last freeze of the season should occur around March 19.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible during the summer and 50 percent in winter. The prevailing wind direction is from the south and highest windspeeds occur during the spring months.

Approximately two-thirds of annual rainfall occurs during the April to September period. Rainfall during this period generally falls during thunderstorms, and fairly large amounts of rain may fall in a short time. The driest months are usually July and August.

Table 3. Representative climatic features

Frost-free period (characteristic range)	194-208 days
Freeze-free period (characteristic range)	216-243 days
Precipitation total (characteristic range)	813-965 mm
Frost-free period (actual range)	190-209 days
Freeze-free period (actual range)	209-245 days
Precipitation total (actual range)	787-991 mm
Frost-free period (average)	201 days
Freeze-free period (average)	230 days
Precipitation total (average)	889 mm

Climate stations used

- (1) BENBROOK DAM [USC00410691], Fort Worth, TX
- (2) CLEBURNE [USC00411800], Cleburne, TX
- (3) WHITNEY DAM [USC00419715], Clifton, TX
- (4) DENTON MUNI AP [USW00003991], Ponder, TX
- (5) DECATUR [USC00412334], Decatur, TX
- (6) EVANT 1SSW [USC00413005], Evant, TX

- (7) BROWNWOOD 2ENE [USC00411138], Early, TX
- (8) LAMPASAS [USC00415018], Lampasas, TX

Influencing water features

This site is not influenced by water from wetland or streams.

These sites are in upland position that shed water to lower areas. The presence of reference tallgrass species should enhance infiltration of rainfall into the soil profile.

Wetland description

NA

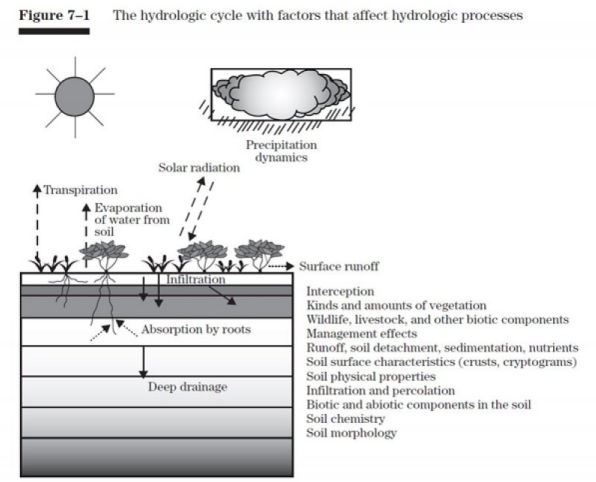


Figure 8.

Soil features

Representative soil components for this ecological site include: Evant, Hensley, Searsville, and Tarpley

The site is characterized by shallow, noncalcareous, loamy to clayey soils. These well drained soils formed in residuum derived from weathering of limestone bedrock.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone (2) Alluvium–mudstone (3) Residuum–mudstone (4) Alluvium–limestone
Surface texture	(1) Clay (2) Silty clay (3) Loam (4) Clay loam (5) Gravelly clay (6) Gravelly silty clay (7) Cobbly clay (8) Stony loam (9) Stony clay loam
Drainage class	Well drained
Permeability class	Slow
Soil depth	25–51 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–20%

Available water capacity (0-101.6cm)	2.54–7.62 cm
Calcium carbonate equivalent (0-101.6cm)	0–30%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–6
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	2–30%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

The Redland 30-38” PZ ecological site is a post oak (*Quercus stellata*) savannah site. The reference plant community of the Redland site is a fire-influenced mosaic of tallgrass and oak plant communities, interspersed with a high diversity of perennial forbs and tall and midgrasses. Grass-dominates up to 80% or more of the area and mix with groups (mottes) of oak trees (10-20% of the area) to create a mosaic of grass and shrub communities. Improper grazing will result in a reduction of tallgrasses and an increase in composition of midgrasses, unpalatable forbs, and woody species.

Continued degradation of the site will result in the site crossing a threshold to a shrubland community characterized by invasive shrubs, mid and shortgrasses, and unpalatable forbs. Bare ground, erosion, and water flow patterns will increase. Forage production will decline. Over time the size and amount of eroded areas will increase as the A horizon erodes.

Precipitation patterns are highly variable. Long-term droughts, occurring three to four times per century, cause shifts in species composition by causing die-off of seedlings, less drought-tolerant species, and/or some woody species. Droughts also reduce biomass production and create open space, which is colonized by opportunistic species when precipitation increases. Wet periods allow tallgrasses to increase in dominance.

Natural vegetation on the uplands is predominantly tall warm-season perennial bunchgrasses with lesser amounts of midgrasses and shortgrasses. This tallgrass prairie was historically dominated by little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Midgrasses such as sideoats grama (*Bouteloua curtipendula*), tall dropseed (*Sporobolus compositus*), cane bluestem (*Bothriochloa barbinodis*), and silver bluestem (*Bothriochloa laguroides*), Texas wintergrass (*Nassella leucotricha*), and slim tridens (*Tridens muticus*) make up about 25% of the production of this site. A wide variety of forbs add to the diverse native plant community. Additionally, several oak (Quercus spp.), elm (Ulmus spp.), and hackberry (Celtis spp.) tree species make up an important part of the savannah community.

The northernmost portion of the Grand Prairie MLRA is still relatively free from the widespread invasion of brush that has occurred in other parts of the state, including the southern part of the MLRA. Juniper (cedar) (Juniperus spp.), honey mesquite (*Prosopis glandulosa*), pricklypear (Opuntia spp.), and scrub oak (*Quercus sinuata*) have increased to the point of dominance in some locations, especially on shallow, rocky slopes.

Pre-settlement influences included grazing or browsing by endemic pronghorn antelope, deer and migratory bison, severe droughts, and frequent fires. Wright and Bailey (1982) reported that there are no reliable records of fire frequency in the Great Plains grasslands because there are no trees to carry fire scars from which to estimate fire frequency. A natural fire frequency of 7 to 10 years seems reasonable for this site.

Rangeland and pastureland are grazed primarily by beef cattle. Horse numbers are increasing rapidly in the region, and in recent years goat numbers have increased significantly. There are some areas where sheep are locally

important. Whitetail deer, wild turkey, bobwhite quail, and dove are the major wildlife species, and hunting leases are a major source of income for many landowners in this area.

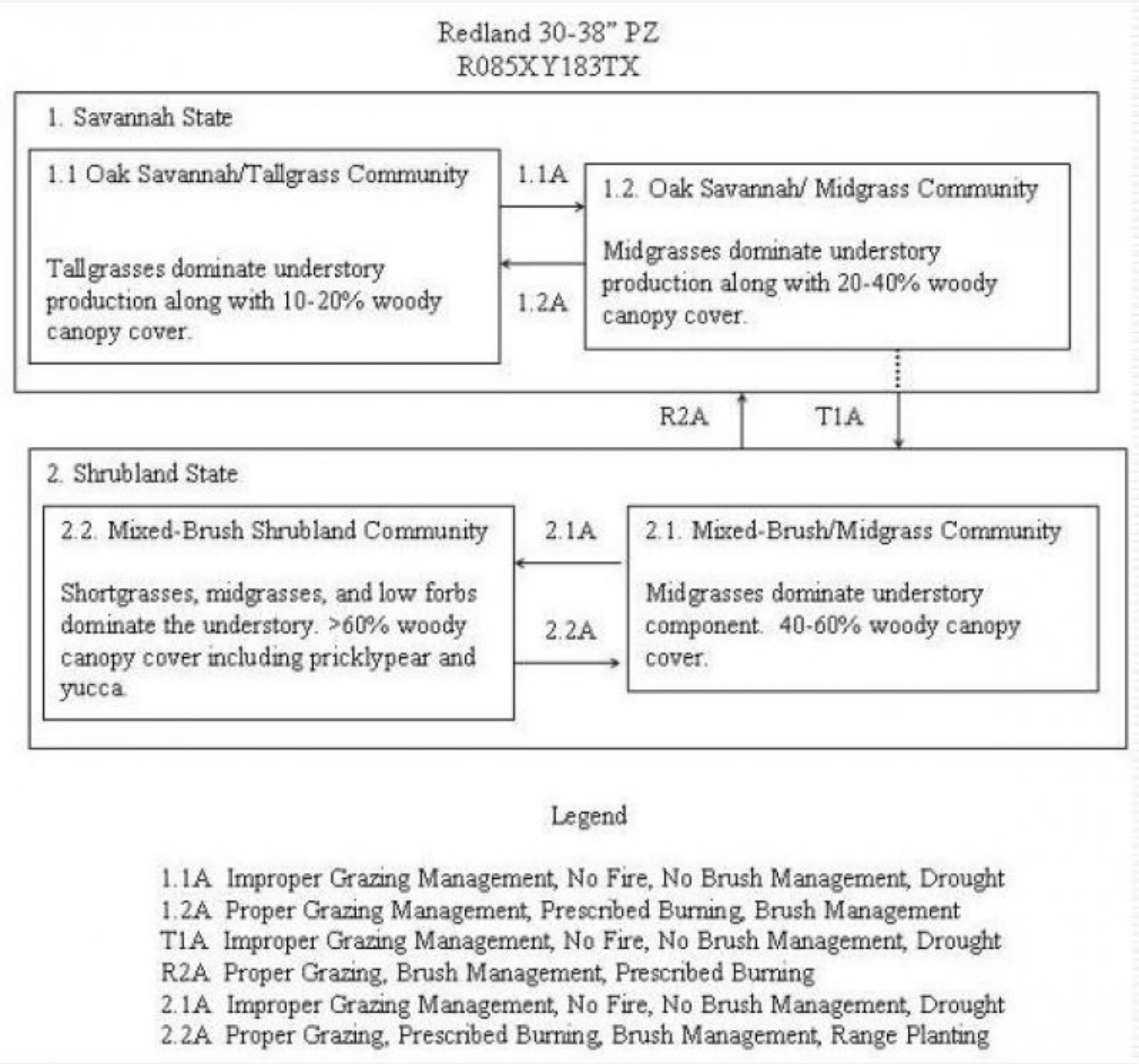
The Redland site does not lend itself to cultivation. However there are some areas within the Redland site where kleingrass (*Panicum coloratum*), King Ranch bluestem (*Bothriochloa ischaemum*), and other Old World bluestems (Bothriochloa spp.) have been seeded, either as monocultures or interseeded with native species.

Rangeland Health Reference Worksheets have been posted for this site on the Texas NRCS website (www.tx.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions.

Plant Communities and Transitional Pathways

A state and transition model for the Redland ecological site is depicted in Figure 1. A thorough description of each state and associated transition and of each plant community and associated pathway follows the model. This model is based on the available experimental research, field observations, and interpretations by experts, but is likely to change as knowledge increases. Plant community dynamics vary across the MLRA reflecting the range of variability in conditions (precipitation, elevation, aspect, and soils) and each plant community reflects that natural variability over space and time. ESD's attempt to communicate highly complex biological processes in a land management context. Therefore, ESD's do not attempt to describe the specific attributes exhibited for each state or community, but describe representative values that are important to ecological dynamics.

State and transition model



State 1
Savannah State - Reference

Dominant plant species

- post oak (*Quercus stellata*), tree
- big bluestem (*Andropogon gerardii*), grass

Community 1.1
Oak Savannah/Tallgrass Community

Figure 9. 1.1 Oak Savannah/Tallgrass Community

The Oak Savannah/Tallgrass Community (1.1) is the reference community and is characterized as a mixed oak savannah with up to 20 percent woody species canopy cover. Oak species include live oak, post oak, scrub oak, Texas oak and Bigelow oak. Elm and hackberry species are also present in the tree mottes of this community. Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy cover drives the transitions between community and states because of the influence of shade and interception of rainfall. Species composition by weight remains an important descriptor of the herbaceous community and of the community as a whole. Woody species are included in species composition for the site. Calculating Similarity Index requires use of species composition. Tallgrasses that characterize this community include little bluestem, which dominates the herbaceous component of the site, Indiangrass and big bluestem. Other important grasses are sideoats grama, tall dropseed, cane bluestem, silver bluestem, Texas wintergrass, slim tridens, and Canada wildrye (*Elymus canadensis*). Forbs commonly found on the site include awnless bushsunflower (*Simsia calva*), Engelmann's daisy (*Engelmannia peristenia*), dotted gayfeather (*Liatris punctata*), blacksamson (*Echinacea angustifolia*), Mexican sagewort (*Artemisia ludoviciana* spp. mexicana), and halfshrub sundrop (*Calylophus serrulatus*). Other shrub and tree species include eastern redbud (*Cercis canadensis*), bumelia (Sideroxylon spp.), species of sumac (Rhus spp.), elbowbush (*Forestiera pubescens*), agarito (*Mahonia trifoliolata*), and saw greenbrier (*Smilax bona-nox*). The reference savannah community will transition to the Oak Savannah/Midgrass Community (1.2) under the stresses of improper grazing and where fire does not prevent the establishment of juniper. The first species to decrease in dominance will be the most palatable and/or least grazing-tolerant grasses and forbs (including Indiangrass, big bluestem, and Engelmann's daisy). This will initially result in an increase in composition of little bluestem. If improper grazing continues, little bluestem will decrease and midgrasses such as silver bluestem and sideoats grama will increase in composition. Less palatable forbs will also increase at this stage. In reference condition, the canopy cover of shrubs and trees will increase as slope increases. When considering only the steepest portions (0-8% of the total area) of the Redland site, woody species cover may exceed 20%. The site will have overall woody species canopy cover of 10-20%, but tree mottes will have higher cover in localized areas. The soil surface of this site is often characterized by limestone fragments, cherts, cobbles, and stones. The soils of this site are shallow, noncalcareous clays, clay loams, or loams underlain by limestone. Bare soil composes 10 percent or less of the ground cover. Large fragments make up 25 to 50% of ground cover. As steepness increases, the amount of cover from large fragments also increases (from 25% on level sites to 50% on steep sites). Plant basal cover and litter make up the remainder of the ground cover. Infiltration is slow and runoff is low to moderate. The limestone rocks on the soil surface reduce evaporation, contribute additional moisture to the soil, and protect palatable grasses and shrubs from overuse. The soils are high in organic matter and desirable minerals, and the heavy plant cover contributes to increasing organic matter and soil building.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1905	3335	4287
Shrub/Vine	224	392	504
Forb	112	196	252
Total	**2241**	**3923**	**5043**

Figure 11. Plant community growth curve (percent production by month). TX6020, Tallgrass Oak Savannah Community. The plant community is a fire climax savannah composed of warm-season perennial tallgrasses and scattered post oaks..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	2	18	23	17	6	4	16	6	3	2

Community 1.2
Oak Savannah/Midgrass Community

Figure 12. 1.2 Oak Savannah/Midgrass Community

The Oak Savannah/Midgrass Community Phase (1.2) typically results from improper cattle grazing management over a long period of time. Indigenous or invading woody species increase on the site (with or without fire, except for non-sprouting juniper). In the Oak Savannah/Tallgrass Plant Community (1.1), repeated fires and competition from a vigorous grass component keep woody canopy cover restricted to mottes within the savannah and at 20 percent or less of total cover. When the Oak Savannah/Midgrass Community (1.2) is continually overgrazed and fire is excluded, the community crosses a threshold to a state that is dominated by woody plants, the Mixed-Brush/Midgrass Community (2.1). Important grasses are little bluestem, sideoats grama, Indiangrass, big bluestem, silver bluestem, tall dropseed, hairy grama (*Bouteloua hirsuta*), and Texas wintergrass. Texas wintergrass, buffalograss (*Bouteloua dactyloides*), and less palatable forbs begin replacing the midgrasses. Some of the reference community perennial forbs persist, but less palatable forbs will increase. Woody canopy increases to between 20 and 40 percent, depending on the severity of grazing, fire interval, and availability of increaser species. Numerous shrub and tree species will encroach because overgrazing by livestock has reduced the grass cover, exposed more bare soil, and reduced grass fuel for fire. Typically, trees such as oaks and elms will increase in size, while shorter stature tree and shrub species such as bumelia, sumacs, elbowbush, agarito, honey mesquite, juniper, pricklypear, and yucca (Yucca spp.) will increase in density. Brown and Archer (1999) concluded that even with a healthy and dense stand of grasses, woody species will populate the site and eventually dominate the community. To control woody species populations, prescribed grazing and/or browsing and fire can be used to control smaller shrubs and trees, and mechanical removal of larger shrubs and trees may be necessary in older stands. The time frame for woody species to dominate a healthy community with proper grazing management is unknown, but reference sites indicate this will take over 50 years (and possibly hundreds of years). Continued site degradation will lead to increases in plant bare ground, which will increase soil erosion. Litter and mulch will decrease for two reasons. First, there will be less litter as herbaceous production declines. Second, the litter present will be moved off site as the amount of runoff and length of water flow patterns increase because the number of

plant bases interrupting flow will decrease. The site crosses a threshold into the Mixed-Brush/Midgrass Plant Community (2.1) within the Shrubland State (2) once tallgrasses have decreased to less than 5% composition and woody species canopy cover exceeds 40 percent. At this point, woody shrubs within the grassland portion of the savannah will have reached a fire-resistant size (over 3 feet in height). Until the Oak Savannah/Midgrass Plant Community (1.2) crosses the threshold into the Mixed-Brush/Midgrass Community (2.1), this community can be managed so that it transitions back to the community 1.1 through the use of cultural practices including prescribed grazing, prescribed burning, and strategic brush control. It may take several years to achieve this state, depending upon climate and the aggressiveness of the treatment. Once woody species become established, returning fully to the reference community is difficult, but it is possible to return to a similar plant community. Potential exists for soils to erode to the point that irreversible damage may occur. If soil-holding herbaceous cover decreases to the point that soils are no longer stable, the shrub overstory will not prevent erosion of the A and B soil horizons. This is a critical shift in the ecology of the site. Once the A horizon has eroded, the hydrology, soil chemistry, soil microorganisms, and soil physics are altered to the point where intensive restoration is required to restore the site to another state or community. Simply changing the management of the site (improving grazing management or controlling brush) cannot create sufficient change to restore the site within a reasonable time frame. This level of erosion indicates that a threshold has been crossed to the Shrubland State.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1177	1569	2158
Shrub/Vine	336	448	616
Forb	168	224	308
Total	**1681**	**2241**	**3082**

Figure 14. Plant community growth curve (percent production by month). TX6021, Tall & Midgrass/Oak Savannah Community. The tallgrasses will start to disappear and be replaced by midgrasses. Invader brush species appears and becomes established..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	2	18	23	17	6	4	16	6	3	2

Pathway 1.1A
Community 1.1 to 1.2

Oak Savannah/Tallgrass Community

Oak Savannah/Midgrass Community

The Oak Savannah/Tallgrass Plant Community will shift to the Oak Savannah/Midgrass Plant Community when there is continued growing season stress on palatable tallgrass species. These stresses include insufficient critical growing season deferment; excess intensity of defoliation; repeated, long-term growing season defoliation; long-term drought; and/or other repeated critical growing season stress. Increaser species (midgrasses and woody species) are generally endemic species released from competition as the vigor of tallgrasses declines. Woody species canopy exceeding 20% and/or dominance of tallgrasses falling below 50% of species composition indicate a transition to the Oak Savannah/Midgrass Plant Community. Community 1.1 can be maintained through the implementation of managed grazing that provides adequate growing season deferment to allow establishment of tallgrass propagules and/or the recovery of the vigor of stressed plants. Proper grazing management may be combined with fire and/or brush management to create a shift towards or maintain the reference community.

Pathway 1.2A
Community 1.2 to 1.1

Oak Savannah/Midgrass Community

Oak Savannah/Tallgrass Community

The Oak Savannah/Midgrass Plant Community will return to the Oak Savannah/Tallgrass Plant Community under grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. The understory component may return to dominance by tallgrasses in the absence of fire; however, reduction of the woody component to reference conditions of 20% or less canopy cover will require inputs of fire and/or brush control.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Shrubland State

Dominant plant species

- post oak (*Quercus stellata*), tree
- Ashe's juniper (*Juniperus ashei*), tree
- sideoats grama (*Bouteloua curtipendula*), grass
- Texas wintergrass (*Nassella leucotricha*), grass

Community 2.1
Mixed-Brush/Midgrass Community

The Mixed-Brush/Midgrass Community (2.1) presents a 40 to 60 percent woody plant canopy. Live oak and post oak are the dominant species within the oak mottes with honey mesquite and Ashe’s juniper invading the former grassland areas. The community loses its savannah appearance as invasive shrubs fill open grassland portions of the savannah. The oak mottes remain, but are no longer the only areas with trees. This community type is the result of continuous improper grazing by livestock and a lack of fire. In areas where high deer densities occur, heavy browsing can decrease preferred woody plants. The overstory becomes increasingly dominated by the woody species present in the reference community(1.1) and low shrubs (particularly juniper, pricklypear, and yucca). This is accompanied by a continued decline in diversity of the grassland component and transitions of the understory to midgrasses (such as silver bluestem and Texas wintergrass) and unpalatable forbs (such as broomweed (Amphiachyris spp.) and western ragweed (*Ambrosia psilostachya*)). Bare ground, erosion, rilling, and the length of water flow patterns increase while litter, soil stability, and annual biomass production decrease. As the grassland vegetation declines, more soil is exposed leading to crusting and erosion. In this vegetation type, erosion can be severe. Higher rainfall interception losses by the increasing woody canopy combined with evaporation and runoff can reduce the effectiveness of rainfall. Soil organic matter and soil structure decline within the interspaces, but soil conditions may improve again under the canopy of trees and large shrubs. Annual herbage production decreases, due to a decline in soil structure and organic matter, and has shifted toward the woody component. Sideoats grama and other palatable midgrasses decrease to the point that grasses no longer form the dominant vegetative component. Shortgrasses such as buffalograss, purple threeawn (*Aristida purpurea*), sedges (Carex spp.), Texas wintergrass, and curly-mesquite (*Hilaria belangeri*) increase. Remnants of the reference community grasses and forbs along with unpalatable invaders occupy the interspaces between trees and shrubs. Cool-season species such as Texas wintergrass and sedges, plus other grazing-resistant species, can be found under and around woody plants. Plant vigor and productivity of the grassland component is reduced due to competition for nutrients and water from woody plants. Likely herbaceous species include Mexican sagewort, annual broomweed (*Amphiachyris dracunculoides*), western ragweed, upright prairie coneflower (*Ratibida columnifera*), snow-on-the-mountain (*Euphorbia marginata*), and silverleaf nightshade (*Solanum elaeagnifolium*). Unpalatable woody species increase in

size and density. Honey mesquite is an early increaser throughout the MLRA; on this site it can increase to the point of forming mesquite thickets, particularly after severe damage to the site resulting in removal of competing trees and tall grasses (i.e. failed cultivation or severe grazing to the point of soil loss). Redberry juniper (*Juniperus pinchotii*) occurs only in the southern counties of the MLRA and eastern redcedar (*Juniperus virginiana*) occurs only in the northern portion. Ashe's juniper occurs mostly in the southern portion, but can be found throughout the MLRA. Birds and small mammals contribute to the increase of juniper as its seeds are deposited under trees the animals use for perching, nesting, and feeding. Annual primary production is approximately 1000 to 2000 pounds per acre. In this plant community, annual production is balanced between herbaceous plants and woody species. Browsing animals such as goats and deer can find fair food value if browse plants have not been grazed excessively. Forage quantity and quality for cattle is low. Unless brush management and proper grazing management are applied at this stage, woody canopy will increase until it exceeds 60 percent, indicating a conversion to the Mixed-Brush Shrubland Community (2.2). The trend for increased shrub cover cannot be reversed with proper grazing management alone.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	504	757	1009
Shrub/Vine	448	673	897
Forb	168	252	336
Total	**1120**	**1682**	**2242**

Figure 16. Plant community growth curve (percent production by month). TX6022, Oak/Juniper/Midgrass Community. Consists of midgrasses with ten to twenty percent canopy of woody plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	8	20	25	19	5	3	10	4	1	1

Community 2.2
Mixed-Brush Shrubland Community

The Mixed-Brush Shrubland Community (2.2) is the result of many years of improper grazing, lack of periodic fires, and/or a lack of proper brush management. Oaks, Ashe's juniper, and/or honey mesquite dominate the Mixed-Brush Shrubland Community (2.2), which has greater than 60 percent woody canopy cover. It is now essentially a dense shrubland with remnant grasses under the canopy and within interspaces or a mosaic of shrub and tree mottes interspersed among low production open areas. Once the brush canopy exceeds 60 percent, annual production for the understory is very limited due to both competition and shading and is generally made up of unpalatable shrubs, grasses, and forbs within tree and shrub interspaces. Common understory shrubs are pricklypear, agarito, sumacs, elbowbush, and catclaw mimosa (*Mimosa aculeaticarpa*). With continued heavy cattle grazing and/or browsing and no brush control, the trees and shrubs can exceed 75 percent canopy cover, and potentially reach almost 100 percent cover. Excessive grazing by other deer or goats will create a community dominated by large trees. Few remnant midgrasses and opportunistic shortgrasses, annuals, and perennial forbs occupy the woody plant interspaces. Characteristic grasses include: Texas wintergrass, buffalograss, curly-mesquite, threeawns (Aristida spp.), sedges, hairy grama, Texas grama (*Bouteloua rigidiseta*), and annual bromes (Bromus spp.). Texas wintergrass and annuals are found in and around tree/shrub cover. Grasses and forbs make up 40 percent or less of the annual herbage production. Common forbs include western ragweed, annual broomweed, upright prairie coneflower, snow-on-the-mountain, silverleaf nightshade, milkweeds (Asclepias spp.), Leavenworth's eryngo (*Eryngium leavenworthii*), twinleaf senna (*Senna bauhinioides*), and Evax (Evax spp.). At its most extreme, this community takes on a woodland appearance interspersed with large areas of almost denuded rock where soil has eroded away. Particularly if there has been heavy browsing (by deer or goats), the site will be dominated by large trees with a marked browse line and an understory dominated by unpalatable, low production grasses, sedges, and forbs. Excessive cattle grazing tends to create a different response and structure to the community than does excessive deer or goat grazing. Excessive cattle grazing tends to accelerate invasion of shrubs because it creates conditions where young shrubs increase in vigor and size while palatable grasses decrease in vigor and abundance. Excess deer or goat grazing tends to create a dominance of large trees by removing both young shrubs and the young growth that grows below the browse line on larger shrubs and trees.

While large trees will continue to increase in size, they will have very little production below the browse line. The site becomes dominated by large trees with little forage available for livestock or wildlife. Large trees with little understory provide much less soil protection than do dense stands of grass. As soils erode, understory species have reduced potential to revegetate the site. The bare area under the browse line creates a situation that provides poor forage conditions and poor visual cover for wildlife. The shrub canopy acts to intercept rainfall and increase evapotranspiration losses, creating a more xeric microclimate. Soil fauna and organic mulch are reduced, exposing more of the soil surface to erosion in interspaces. However, within the woody canopy, hydrologic processes stabilize, and soil organic matter and mulch begin to increase and eventually stabilize under the shrub canopy. The Mixed-Brush Shrubland Community (2.2) provides good habitat cover for wildlife, but only limited forage or browse is available for livestock or wildlife. At this stage, highly intensive restoration practices are needed to return the shrubland to grassland. Alternatives for restoration include: brush control and range planting, proper stocking, prescribed grazing, and prescribed burning following restoration to maintain the desired community. If irreversible soil damage has occurred, it will be very difficult to remove brush and seed the site to a grassland community. Furthermore, it will be very difficult and expensive to restore the site to reference conditions due to the loss of the organic matter, soil horizons, soil microbes, and soil structure necessary to maintain the reference community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	336	673	1009
Grass/Grasslike	140	280	420
Forb	84	168	252
Total	**560**	**1121**	**1681**

Figure 18. Plant community growth curve (percent production by month). TX6023, Oak/Juniper/Mesquite Complex. Oak/Juniper/Mesquite complex having greater than twenty percent woody canopy dominated by juniper and mesquite..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	8	20	25	19	5	3	10	4	1	1

Pathway 2.1A
Community 2.1 to 2.2

Without fire (natural or human-caused) and/or brush control, woody density and canopy cover will increase in the Mixed-Brush/Midgrass Plant Community until it converts into the Mixed-Brush Shrubland Plant Community. Improper grazing management and/or long-term drought (or other growing season stress) will accelerate this transition. Woody species canopy exceeding 60% indicates this transition. Improper grazing management or other long-term growing season stress can increase the composition of shortgrasses and low-growing (or unpalatable) forbs in the herbaceous component. Even with proper grazing, in the absence of fire, the woody component will increase to the point that the herbaceous component will shift in composition toward shortgrasses and forbs suited to growing in shaded conditions with little available soil moisture.

Pathway 2.2A
Community 2.2 to 2.1

Brush management and/or fire can reduce the woody component below the transition level of 60% brush canopy. Continued fire and/or brush management will be required to maintain woody density and canopy below 60%. If the herbaceous component has transitioned to shortgrasses and low forbs, proper grazing management (combined with favorable moisture conditions) will be necessary to facilitate the shift of the understory component to the midgrass-dominated Mixed-Brush/Midgrass Plant Community. Range planting may accelerate the transition of the herbaceous community, particularly when combined with favorable growing conditions.

Conservation practices

Brush Management

Prescribed Burning

Transition T1A
State 1 to 2

The Savannah State is resistant to shrub dominance. However, shrubs and trees make up a portion of the plant community in this state, therefore propagules are present. The mean fire return interval in the Savannah State is 3-7 years. Even with proper grazing management and favorable climate conditions, lack of fire for 10-20 years will allow woody species to increase in canopy to reach the 40% threshold level. An infusion of invasive species (i.e. juniper or mesquite) will speed up the process. Improper grazing, prolonged drought, and warming climate will provide a competitive advantage to shrubs which will accelerate this process. Tallgrasses will decrease to less than 5% species composition.

Restoration pathway R2A
State 2 to 1

Restoration of the Shrubland State to the Savannah State requires substantial energy input. Mechanical or herbicidal brush control treatments can be used to remove woody species. A long-term prescribed fire program may sufficiently reduce brush density to a level below the threshold of the Savannah State, particularly if the woody component is dominated by species that are not fire sprouters. Brush control in combination with prescribed fire, proper grazing management, and favorable growing conditions may be the most economical means of creating and maintaining the desired plant community. If remnant populations of tallgrasses, midgrasses, and desirable forbs are not present at sufficient levels, range planting will be necessary to restore the reference plant community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

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					
1	**Tallgrasses**			785–1500	
	little bluestem	SCSC	*Schizachyrium scoparium*	785–1500	–
2	**Tallgrasses**			336–644	
	big bluestem	ANGE	*Andropogon gerardii*	280–560	–
	Indiangrass	SONU2	*Sorghastrum nutans*	280–560	–
	switchgrass	PAVI2	*Panicum virgatum*	168–308	–
3	**Midgrasses**			560–1065	
	sideoats grama	BOCU	*Bouteloua curtipendula*	392–841	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	280–560	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	280–560	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	224–448	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	224–448	–
	slim tridens	TRMU	*Tridens muticus*	168–336	–
4	**Mid/Shortgrasses**			224–426	

	Canada wildrye	ELCA4	*Elymus canadensis*	168–336	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	168–336	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	140–252	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	140–252	–
	sedge	CAREX	*Carex*	140–252	–
	curly-mesquite	HIBE	*Hilaria belangeri*	112–196	–
	buffalograss	BODA2	*Bouteloua dactyloides*	112–196	–
	fall witchgrass	DICO6	*Digitaria cognata*	84–140	–
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	84–140	–
Forb					
5	**Forbs**			112–213	
	dotted blazing star	LIPU	*Liatris punctata*	101–168	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	101–168	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	101–168	–
	awnless bushsunflower	SICA7	*Simsia calva*	101–168	–
	azure blue sage	SAAZ	*Salvia azurea*	84–140	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	84–140	–
	sensitive plant	MIMOS	*Mimosa*	84–140	–
	white sagebrush	ARLUM2	*Artemisia ludoviciana ssp. mexicana*	84–140	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	84–140	–
	prairie clover	DALEA	*Dalea*	84–140	–
	bundleflower	DESMA	*Desmanthus*	84–140	–
	ticktrefoil	DESMO	*Desmodium*	56–112	–
	smartweed leaf-flower	PHPO3	*Phyllanthus polygonoides*	56–112	–
	scurfpea	PSORA2	*Psoralidium*	56–112	–
	least snoutbean	RHMI4	*Rhynchosia minima*	56–112	–
	wild petunia	RUELL	*Ruellia*	56–112	–
	coastal indigo	INMI	*Indigofera miniata*	56–112	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	56–112	–
	fuzzybean	STROP	*Strophostyles*	56–112	–
	white heath aster	SYER	*Symphyotrichum ericoides*	56–112	–
Shrub/Vine					
6	**Shrubs/Vines/Trees**			224–426	
	post oak	QUST	*Quercus stellata*	224–392	–
	Texas live oak	QUFU	*Quercus fusiformis*	196–336	–
	bastard oak	QUSIB	*Quercus sinuata var. breviloba*	168–308	–
	Texas red oak	QUBU2	*Quercus buckleyi*	168–308	–
	elm	ULMUS	*Ulmus*	168–308	–
	hackberry	CELTI	*Celtis*	168–308	–
	eastern redbud	CECA4	*Cercis canadensis*	112–252	–
	sumac	RHUS	*Rhus*	112–252	–
	bully	SIDER2	*Sideroxylon*	112–252	–

	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	112–252	–
	stretchberry	FOPU2	*Forestiera pubescens*	112–252	–
	algerita	MATR3	*Mahonia trifoliolata*	84–168	–
	saw greenbrier	SMBO2	*Smilax bona-nox*	84–168	–
	jointfir	EPHED	*Ephedra*	84–168	–

Animal community

This site is inhabited by deer, dove, and quail. Several of the woody plants, forbs, and grasses that are endemic to the site provide cover, browse, mast and seeds for wildlife. The plants on this site are palatable to cattle because the slightly acidic nature of the soil makes phosphorus available to plants. As long as surface rock cover does not exceed ~30%, cattle will comfortably graze the site.

Hydrological functions

Site-specific data indicated that no rills are present. Some gullies may be present on side drains into perennial and intermittent streams. Gullies are vegetated and stable. Water flow patterns are common and flow across and around large fragments. Deposition or erosion is uncommon for normal rainfall conditions but may occur during intense rainfall events. Pedestals or terracettes are uncommon for this site. Expect no more than 10% bare ground randomly distributed throughout in small and non-connected areas. Expect 25-50% ground cover from large fragments (stones and boulders). Under normal rainfall conditions, little litter movement should be expected; however, litter of all sizes may move long distances during severe storm events. The soil surface under reference conditions is resistant to erosion; the stability class range is expected to be 4-6. The savannah of tallgrasses, midgrasses, and forbs having adequate litter and little bare ground can provide for maximum infiltration and little runoff under normal rainfall events.

Recreational uses

Recreational uses include recreational hunting, hiking, camping, equestrian, and bird watching.

Wood products

Honey mesquite, eastern redcedar, and some oak are used for posts, firewood, charcoal, and other specialty wood products.

Other products

Jams and jellies are made from many fruit bearing species, such as agarito. Seeds are harvested from many plants for commercial sale. Many grasses and forbs are harvested by the dried plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from many flowering plants, such as honey mesquite.

Other information

None.

Inventory data references

Information presented was derived from the revised Redland Range Site, NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel.

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Approval

Bryan Christensen, 9/21/2023

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 Zone
Contact for lead author	817-596-2865
Date	04/14/2008
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:** Water flow patterns are common and flow across and around large fragments. Deposition or erosion is uncommon for normal rainfall conditions but may occur during intense rainfall events.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes would have been uncommon for this site.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect no more than 10% bare ground randomly distributed throughout in small and non-connected areas.

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5. **Number of gullies and erosion associated with gullies:** Some gullies may be present on side drains into perennial and intermittent streams. Gullies should be vegetated and stable.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Essentially none.

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7. **Amount of litter movement (describe size and distance expected to travel):** Under normal rainfall conditions, little litter movement should be expected; however, litter of all sizes may move long distances during severe storm events.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface under HCPC is resistant to erosion. Stability class range is expected to be 5-6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0-4 inches brown loam, moderate fine granular structure, surface crusty when dry, hard, friable, many fine roots, slightly alkaline, clear smooth boundary. SOM is 1-4%.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The savannah of tallgrasses, midgrasses, and forbs having adequate litter and little bare ground can provide for maximum infiltration and little runoff under normal rainfall events.

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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):** No evidence of compaction.

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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: Warm-season midgrasses >>

    Other: Trees > Warm-season shortgrasses > Cool-season grasses > Forbs

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses and forbs due to their growth habit will exhibit some mortality and decadence, though very slight. Open spaces from disturbance are quickly filled by new plants through seedlings and reproductive reproduction (tillering).

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2500 - 3500 pounds per 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:** Ashe juniper, Honey mesquite, Pricklypear, Bermudagrass, Johnsongrass, King Ranch bluestem.

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