USDA Natural Resources Conservation Service

Ecological site R081BY350TX
Steep Rocky 23-31 PZ

Last updated: 9/19/2023
Accessed: 05/11/2025

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.

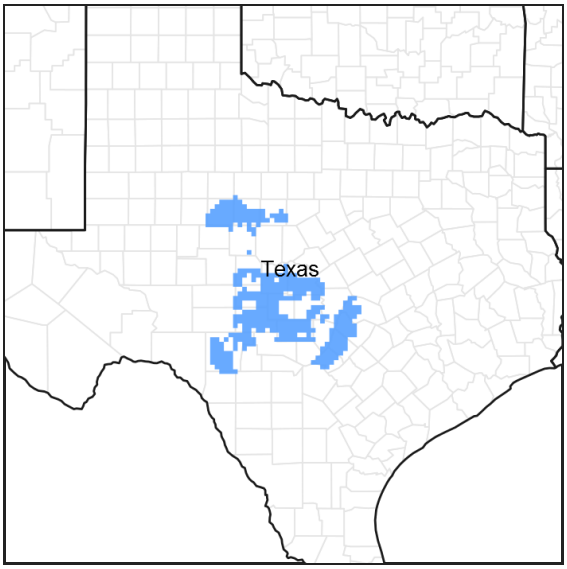


Figure 1. Mapped extent

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): 081B–Edwards Plateau, Central Part

This area is entirely in south-central Texas. It makes up about 11,125 square miles (28,825 square kilometers). The towns of Fredericksburg, Junction, Menard, Rocksprings, and Sonora are in this MLRA. Interstate 10 crosses the middle part of the area. A few State parks and State historic sites are in this MLRA.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 81B

Ecological site concept

The Steep Rocky sites are comprised of shallow soils with lithic contact. The sites are filled with gravels, cobbles, and flagstones and occur on steep slopes with greater than 20 percent slopes.

Associated sites

R081BY337TX	**Low Stony Hill 23-31 PZ** The Low Stony Hill ecological site has slopes less than 20 percent in the same areas.
R081BY343TX	**Shallow 23-31 PZ** The Shallow ecological site will be encountered downslope on stream terraces.

Similar sites

R081BY348TX	**Steep Adobe 23-31 PZ** The Steep Adobe is similar in that both sites are located on similar topography and are underlain by limestone.
R081BY337TX	**Low Stony Hill 23-31 PZ** The Low Stony Hill site has the same soils but on slopes less than 20 percent.

Table 1. Dominant plant species

Tree	(1) *Quercus virginiana*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua curtipendula*

Physiographic features

The Steep Rocky are soils on uplands of the upper slopes and summits of hills. Sites are bordered by undulating to gently rolling limestone plateau. The hillsides and scarps may be 100 to 400 yards wide and several miles long. The landscape is characterized by broad ridges and shallow valleys. The elevation ranges from 1,000 feet to 2,400 feet above sea level. Slopes range from 20 to 60 percent. Runoff is high to very high.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Ridge (2) Plateau > Plain (3) Plateau > Hillslope
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,000–2,400 ft
Slope	20–60%
Aspect	Aspect is not a significant factor

Climatic features

The climate in the MLRA 81B is subtropical subhumid on the eastern portion and subtropical steppe on the western portion of the MLRA. Winters are dry, and the summers are hot and humid. The precipitation increases from west to east and the temperatures increase from north to south. The area usually receives 65 to 70 percent sunshine each year. The majority of the rainfall occurs during the warm months of April to October. Most precipitation comes from thunderstorms that vary in the amount of water received and the areas covered. Spring is characterized by fluctuating patterns, but mild temperatures prevail. July and August are relatively dry and hot with little weather variability day-to-day. As summer progresses through fall, an increase of precipitation usually occurs in the eastern portions while a decrease of precipitation occurs to the west. Winter temperatures are mild, but polar Canadian air masses bring rapid drops in temperature. These cold spells last 2 or 3 days. Prevailing winds are southerly with March and April the windiest months.

Table 3. Representative climatic features

Frost-free period (characteristic range)	210-260 days
Freeze-free period (characteristic range)	240-280 days
Precipitation total (characteristic range)	25-28 in
Frost-free period (actual range)	210-260 days
Freeze-free period (actual range)	240-280 days
Precipitation total (actual range)	24-30 in
Frost-free period (average)	230 days
Freeze-free period (average)	260 days
Precipitation total (average)	27 in

Climate stations used

- (1) JUNCTION KIMBLE CO AP [USW00013973], Junction, TX
- (2) MENARD [USC00415822], Menard, TX
- (3) ROCKSPRINGS 1S [USC00417706], Rocksprings, TX
- (4) SAN SABA [USC00417992], San Saba, TX
- (5) EDEN [USC00412741], Eden, TX
- (6) BRADY [USC00411017], Brady, TX
- (7) FREDERICKSBURG [USC00413329], Fredericksburg, TX
- (8) FT MCKAVETT [USC00413257], Fort Mc Kavett, TX
- (9) HUNT 10 W [USC00414375], Hunt, TX
- (10) JUNCTION 4SSW [USC00414670], Junction, TX

Influencing water features

Streams or wetlands have no influence on this site.

Wetland description

N/A

Soil features

The soils are well drained, moderately permeable and underlain by limestone. The soils are moderate alkaline and calcareous throughout. The available water capacity is very low. Most areas of Steep Rocky are only suitable for rangeland since the topography is too steep and too shallow for cultivation. There are also up to 40 percent surface fragments and up to 65 percent subsurface fragments. The root zone is very shallow to shallow, and water erosion can be severe because of the steep slopes. Soil series correlated to this site include: Eckrant, Oplin, and Tarrant.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Very cobbly clay (2) Cobbly clay loam
Family particle size	(1) Loamy-skeletal (2) Clayey-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	4–20 in
Soil depth	4–20 in
Surface fragment cover <=3"	10–40%

Surface fragment cover >3"	5–40%
Available water capacity (0-20in)	0.2–1.8 in
Calcium carbonate equivalent (0-20in)	10–40%
Electrical conductivity (0-20in)	0–2 mmhos/cm
Sodium adsorption ratio (0-20in)	0
Soil reaction (1:1 water) (0-20in)	7.4–8.4
Subsurface fragment volume <=3" (4-20in)	10–40%
Subsurface fragment volume >3" (4-20in)	15–40%

Ecological dynamics

The vegetation, as was with the rest of the Edwards Plateau, developed as a mosaic of open grasslands, savannahs, and woodlands due to relatively frequent and intense fires. Lightning and Native Americans burned the hills and valleys repeatedly and prevented the development of woodlands. Research has postulated that the eastern part of the Edwards Plateau burned every 4 to 6 years and the western part burned every 7 to 12 years. Recurring severe drought compounded the effects of fire keeping trees and shrubs confined to drainages, escarpments, and other areas protected from fire. The Steep Rocky site, with its topography, rocks, and differential drainage, developed as a fire-dependent community. It supported a diverse grassland and woodland vegetation with a 15 to 30 percent canopy of woody plants. The woody plants were confined primarily to rough rocky areas on north and east slopes, which protected them from most fires. Fire and grazing by native fauna, however, were probably not as frequent, or influential, in the development of the reference plant community, due to the lack of fine fuels on the steep topography.

The Tallgrass Grassland/Oak Woodland Community (1.1), developed in recent geologic times along with the soils of the site under the influence of the prevailing semiarid/subtropical climate. The steep slopes had a major influence. Slope aspect influenced soil and vegetation development. High runoff reduced the effective precipitation, but rocks and crevices in some locations allowed enhanced soil moisture conditions in those locations. Otherwise, the site is somewhat droughty. It was in these more moist locations tallgrasses such a big bluestem (*Andropogon gerardii*), Indiangrass (Sorgastrum nutans), Eastern gamagrass (*Tripsacum dactyloides*), and trees such as live oak (*Quercus virginiana*), Texas red oak (*Quercus buckleyi*), Bigelow oak (*Quercus sinuata* var. breviloba), hackberry (*Celtis laevigata*), Texas madrone (*Arbutus xalapensis*), and escarpment black cherry (*Prunus serotina* var. eximia) thrived, especially on northerly slopes. The trees can often be found in narrow strips following ridges of hard rock outcrops. Shrubs and midgrasses such as sideoats grama (*Bouteloua curtipendula*) competed for nutrients and water in the open spaces between trees. The grassland component prevailed where the soils and moisture regime were unsuited for trees and shrubs, or because of periodic droughts and recurring fires.

Little bluestem dominated the grassland areas of the site, making up 30 to 35 percent of the grassland vegetation. Other vegetation includes, Neally grama (*Bouteloua uniflora*), green sprangletop (*Leptochloa dubia*), dropseeds (Sporobolus spp.), feathery bluestems (Bothriochloa spp.), and tridens (Tridens spp.). Important forbs are hoary blackfoot (*Melampodium cinereum* var. cinereum), Engelmann's daisy (Engelmannia pinnatifida), bushsunflower (*Simsia calva*), bundleflower (Desmanthus spp.), and sensitivebriar (Mimosa nuttalli). Shrubby species present include kidneywood (*Eysenhardtia texana*), grape (Vitis spp.), sumac (Rhus spp.), greenbriar (Smilax spp.), silktassel (Garryi spp.), shrubby boneset (Eupatorium havanense), and bumelia (Bumelia lanuginosa).

The vegetative composition of the reference community changed after European settlement in the 1800's because of animal husbandry and the arrival of fencing and windmills. Continuous overgrazing by livestock beginning by 1820's and the concomitant reduction of range fires brought about ecological retrogression and the increase of less palatable woody plants and weedy herbaceous plants. Overstocking the area with domesticated livestock has caused the vegetation to decline due to the plant community's inability to sustain heavy, long-term grazing pressure.

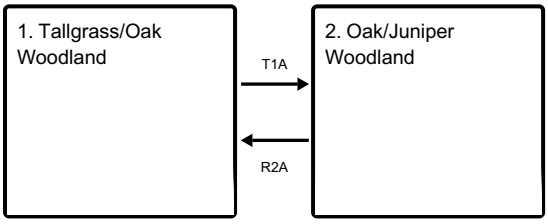
As retrogression occurs on the Steep Rocky site, the late seral tall and midgrasses give way to shortgrasses, brush, and weeds. This phase is identified as the Midgrass/Oak/Mixed-Brush Community (1.2). When retrogression is cattle induced, big bluestem, Indiangrass, green sprangletop, sideoats grama, and the more palatable forbs are replaced by the feathery bluestems, tall dropseeds, Texas wintergrass, tridens, and less palatable forbs. Plant biomass production shifts from mostly grass to a mixture of grass, forb, and woody plant production. There is little change in soil moisture, runoff, or evapotranspiration in this phase.

With continued overgrazing and absence of fire, oaks, juniper (Juniperus spp.), Texas persimmon, Mexican buckeye (*Aesculus glabra*), sumac (Rhus spp.) and other woody and weedy species will increase in size and frequency. They will eventually form dense thickets and mottes if grazing management, brush control, and prescribed fire is not initiated. The woody increasers begin to compete for nutrients, water, and space. In this stage, herbaceous forage production begins to give way to shade-tolerant species such as tall grama, Texas wintergrass (Nassella leoucotricha), and shrubby vegetation. The hydrology of the site begins to reflect more arid conditions due to evapotranspiration changes benefiting woody vegetation. If grazing management and woody plant control are not applied, a threshold is passed where the reference community cannot return through natural ecological processes alone. At this point, the site transitions into the Oak/Juniper Woodland Community (2.1).

The Oak/Juniper Woodland Community (2.1) represents a canopy with 75 percent woody plants and few grasses and forbs in the interspaces. Ashe juniper (*Juniperus ashei*) and/or redberry (*Juniperus pinchotii*) generally makes up 40 to 50 percent of the canopy due to their aggressive colonization in the absence of fire and brush management. The oaks, primarily live oak and Texas red oak, are codominant but there are numerous other tree and brushy species as well. Texas madrone (*Arbutus xalapensis*), escarpment black cherry and walnut (Juglans spp.) are rather unique species that find refuge in the deep soil pockets and rock outcrops. Primary production has shifted to woody vegetation and evapotranspiration losses from junipers causes a more arid microclimate. Juniper, having evergreen foliage, decreases production of shade-intolerant species. Browse species are also reduced, as is the food portion of the habitat for deer, goats, and sheep. The habitat is suited primarily to songbirds, small mammals, and predators for escape cover. Reclamation of the site in this state requires extensive brush management and, in many cases, may not be feasible except for management practices such as individual plant treatment (IPT) to reduce juniper, oak and brush density.

State and transition model

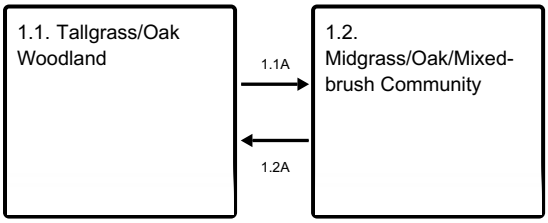
Ecosystem states



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

R2A - Reintroduction of historic disturbance return intervals

State 1 submodel, plant communities



State 2 submodel, plant communities

2.1. Oak/Juniper Woodland

State 1
Tallgrass/Oak Woodland

Dominant plant species

- live oak (*Quercus virginiana*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Community 1.1
Tallgrass/Oak Woodland

Figure 8. Tallgrass/Oak Woodland Community

The reference plant community is dominated by tallgrasses, midgrasses, and a canopy of 20 to 30 percent oaks and understory shrubs. The canopy is highly variable depending on the geologic formations. The tree canopy often follows ridges and fissures. It consists primarily of live oak, but may include Bigelow oak, Texas oak, live oak, sumac, and Texas madrone. Tall and midgrasses such as little bluestem, sideoats grama, and Nealley grama (*Bouteloua uniflora*) dominate much of the site, though a large portion of the site always supported fairly large shrub and tree mottes. Northerly slopes support as much as a 35 percent canopy of trees. Occasional fires and limited grazing by bison and other grazers were natural processes that maintained the mosaic pattern of the plant community. Nutrient cycling, as expressed by vegetative production, litter accumulation, and soil organic matter development, is postulated to have been at near maximum for the climate, soils, and topography. The density and frequency of woody vegetation are strongly dependent on the presence or absence of fractured limestone. Where non-fractured limestone parent material exists, short rooted plants were common and large deep-rooted tree vegetation rare. The integrity of the reference plant community can be maintained with limiting grazing and browsing by all classes of herbivores and brush management practices such as burning and individual plant treatment (IPT). Due to the steep topography and erosion hazards, only a few management practices are applicable. Hand cutting of seedling, or re-growth, juniper is an example of a viable practice. When overgrazing occurs, brush management is not practiced and/or fire is excluded, the site transitions toward a woodland community. This phase is known as the Midgrass/Oak/Mixed-Brush Community (1.2).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	650	1170	1625
Tree	200	360	500
Forb	100	180	250
Shrub/Vine	50	90	125
Total	**1000**	**1800**	**2500**

Figure 10. Plant community growth curve (percent production by month). TX3617, Warm Season Tallgrass Savannah. Growth is predominantly tall and midgrasses from late March through October with peak growth in May and June..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	7	13	20	15	7	5	10	7	5	5

Community 1.2
Midgrass/Oak/Mixed-brush Community

Figure 11. Midgrass/oak/Mixed-brush Community

In the Midgrass/Oak/Mixed-brush plant community, secondary herbaceous species, shrubs, and tree seedlings are replacing tallgrasses and palatable forbs. The plant community is a mixture of grassland and woodland with invading trees and shrubs. Tree and shrub canopy is as high as 40 percent, but midgrasses such as little bluestem, sideoats grama, plains lovegrass, tall (Sporobolus asper var. asper), meadow dropseed (Sporobolus asper var. drummondii), and feathery bluestems dominate forage production. Sumacs, elbowbush, acacia, and juniper are increasing in density and canopy. Less palatable forbs such as bushsunflower, scurfpea, trailing ratany, mandora, and prairie clovers flourish. This phase is highly productive for multi-species livestock and wildlife husbandry. The balance of forage is still herbaceous, and the increasing shrub component furnishes browse and cover. The hydrologic functions and ecological processes are normal for the site. Water runoff is rapid due to slope, but sediment load is very low. Maintenance of this condition, however, requires careful grazing management and maintenance brush control. Individual plant treatments and fire are the best brush management methods. Unless grazing management and brush management are practiced this phase will transition into the Oak/Juniper Dominant Community (2.1).

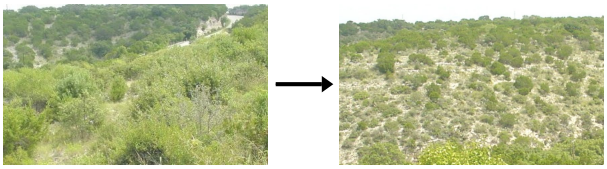
Pathway 1.1A
Community 1.1 to 1.2

Tallgrass/Oak Woodland

Midgrass/Oak/Mixed-brush Community

Heavy abusive grazing, no fire, and no brush management will transition to the Midgrass/Oak Savannah Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1



Midgrass/Oak/Mixed-brush Community

Tallgrass/Oak Woodland

Prescribed grazing, return of fire, and brush management, in the form of IPT or hand cutting, will restore the Mixed-grass/Oak Savannah Community (1.1).

State 2
Oak/Juniper Woodland

Dominant plant species

- Ashe's juniper (*Juniperus ashei*), tree
- Pinchot's juniper (*Juniperus pinchotii*), tree

Community 2.1
Oak/Juniper Woodland

Figure 12. Oak/Juniper Woodland Community

In this state, the woody canopy, especially juniper species, dominates. Woody tree canopy approaches or exceeds 75 percent with junipers occupying 40 to 50 percent. The oak species have also expanded their position and stature along ridges, crevices, and limestone outcrops. Grassland vegetation and low stature shrubs, such as pricklypear (Opuntia spp.), persimmon, algerita (Mahonia trifoliata), and skunkbush (*Rhus trilobata*) occupy the non-fractured areas and south slopes. Ashe juniper, and sometimes redberry juniper, are co-dominant if fire or appropriate brush management control is not practiced. The tallgrasses, midgrasses, and shade-intolerant forbs have given way to lesser, shade-tolerant species. Juniper, persimmon, sumac, buckeye, and other woody species form dense thickets. Low-quality forbs such as Mexican sagewort (*Artemisia ludoviciana*), threadleaf groundsel (Senecio douglasi var. longilobus), abutilon (*Abutilon incanum*), twinleaf senna (Senna roemariana), and grasses such as three-awns,

hairy tridens (*Erioneuron pilosum*), purpletop (*Tridens flavus* var. flavus), and hairy grama (*Bouteloua hirsuta*) are common in the understory and interstitial spaces. Desertification is ongoing and groundwater recharge is reduced. With its depauperate forage base, the mature Oak/Juniper Woodland Community (2.1) provides only cover and low-quality food for livestock and deer. Only expensive brush management, grazing management, and range planting can reverse this state.

Transition T1A
State 1 to 2

Continued heavy abusive grazing, lack of fire, and lack of brush management will transition the site to the Oak/Juniper Woodland Community. This is evidenced by over 40 percent canopy cover by woody species and an overall reduction in production by herbaceous species.

Restoration pathway R2A
State 2 to 1

Grazing management, prescribed fire, and brush management can potentially restore the reference community. The steep sloping nature of the site often causes difficulty with mechanical brush management. Therefore, individual plant treatments and hand cutting may be the only considerations. Range planting of native seeds can quicken the sites ability to assimilate towards the reference community.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tallgrasses**			450–1150	
	little bluestem	SCSC	*Schizachyrium scoparium*	250–650	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	200–500	–
2	**Tall/Midgrasses**			100–250	
	big bluestem	ANGE	*Andropogon gerardii*	100–250	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	100–250	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	100–250	–
	Indiangrass	SONU2	*Sorghastrum nutans*	100–250	–
3	**Midgrasses**			50–125	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	50–125	–
	tall grama	BOHIP	*Bouteloua hirsuta var. pectinata*	50–125	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	50–125	–
	green sprangletop	LEDU	*Leptochloa dubia*	50–125	–
	composite dropseed	SPCO16	*Sporobolus compositus*	50–125	–
	slim tridens	TRMU	*Tridens muticus*	50–125	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	50–125	–
4	**Mid/Cool Season grasses**			50–125	
	threeawn	ARIST	*Aristida*	50–125	–
	cedar sedge	CAPL3	*Carex planostachys*	50–125	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	50–125	–
	Reverchon's bristlegrass	SERE3	*Setaria reverchonii*	50–125	–
Forb					

5	**Forbs**			200–350	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	200–350	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	200–350	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	200–350	–
	prairie clover	DALEA	*Dalea*	200–350	–
	bundleflower	DESMA	*Desmanthus*	200–350	–
	ticktrefoil	DESMO	*Desmodium*	200–350	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	200–350	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	200–350	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	200–350	–
	dotted blazing star	LIPU	*Liatris punctata*	200–350	–
	menodora	MENOD	*Menodora*	200–350	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	200–350	–
	snoutbean	RHYNC2	*Rhynchosia*	200–350	–
	awnless bushsunflower	SICA7	*Simsia calva*	200–350	–
	vetch	VICIA	*Vicia*	200–350	–
	creepingoxeye	WEDEL	*Wedelia*	200–350	–
Shrub/Vine					
6	**Shurbs/Vines**			200–350	
	eastern redbud	CECA4	*Cercis canadensis*	200–350	–
	Texas persimmon	DITE3	*Diospyros texana*	200–350	–
	Texas kidneywood	EYTE	*Eysenhardtia texana*	200–350	–
	stretchberry	FOPU2	*Forestiera pubescens*	200–350	–
	algerita	MATR3	*Mahonia trifoliolata*	200–350	–
	fragrant sumac	RHAR4	*Rhus aromatica*	200–350	–
	prairie sumac	RHLA3	*Rhus lanceolata*	200–350	–
	evergreen sumac	RHVI3	*Rhus virens*	200–350	–
	bully	SIDER2	*Sideroxylon*	200–350	–
	greenbrier	SMILA2	*Smilax*	200–350	–
	ungnadia	UNGNA	*Ungnadia*	200–350	–
Tree					
7	**Trees**			300–500	
	Texas madrone	ARXA80	*Arbutus xalapensis*	300–500	–
	hackberry	CELTI	*Celtis*	300–500	–
	Ashe's juniper	JUAS	*Juniperus ashei*	300–500	–
	walnut	JUGLA	*Juglans*	300–500	–
	black cherry	PRSE2	*Prunus serotina*	300–500	–
	hybrid oak	QUCA	*Quercus ×caduca*	300–500	–
	pungent oak	QUPU	*Quercus pungens*	300–500	–
	bastard oak	QUSI	*Quercus sinuata*	300–500	–
	Nuttall oak	QUTE	*Quercus texana*	300–500	–
	live oak	QUVI	*Quercus virginiana*	300–500	–
	elm	ULMUS	*Ulmus*	300–500	–

Animal community

This site is used to produce domestic livestock and to provide habitat for native wildlife. Cow-calf operations are the primary livestock enterprise, although stocker cattle are also grazed. Sheep, Angora goats, and Spanish goats were formerly raised in large numbers. Sheep are still present in reduced numbers, while meat goats are now present in fairly high numbers. Boer goats have been introduced, either purebred or crossed with Spanish goats, to obtain a larger meat animal. Reports indicate that Boers do not browse as heavily as earlier breeds.

Sustainable stocking rates have declined drastically over the past 100 years due to the deterioration of the reference plant community. An assessment of vegetation is needed to determine the site's current carrying capacity. Calculations used to determine livestock stocking rate should be based on forage production remaining after determining use by resident wildlife, then refined by frequent careful observation of the plant community's response to animal foraging.

A large diversity of wildlife is native to this site. In the reference plant community, migrating bison, grazing primarily during wetter periods, pronghorn, white-tailed deer and turkey were the more predominant herbivore species. With the subsequent transformation of the plant community, due primarily to the influence of man and climate change, the kind and proportion of wildlife species have been altered.

Except for a few domestic herds, bison have been eliminated. With the eradication of the screwworm fly, increase in woody vegetation and man-suppressed natural predation, deer numbers have increased and are often in excess of carrying capacity. Where deer numbers are excessive, overbrowsing and overuse of preferred forbs causes deterioration of the plant community. Progressive management of deer populations through hunting can keep populations in balance and provide an economically important ranching enterprise. Achieving a balance between brushy cover and more open plant communities on this and adjacent sites is important to deer management. Competition among deer, sheep, and goats must be a consideration in livestock and wildlife management to prevent damage to the plant community.

Various species of exotic wildlife have been introduced on the site, including deer such as axis, sika, fallow, and red; antelope such as sable, oryx, blackbuck, and nilgai, and sheep such as barbados (mouflon) and aoudad with various degrees of success. Their numbers must be included along with livestock and native wildlife, primarily white-tailed deer, in any management plan. Feral hogs may feed on the site. They can be damaging to the plant community if their numbers are not managed. Smaller mammals include many kinds of rodents, jackrabbit, cottontail, raccoon, ringtail, skunk, and armadillo. Mammalian predators include coyote, red fox, gray fox, bobcat, and mountain lion. Wolves were common in earlier times, bears resided in some areas, and an occasional jaguar or ocelot was encountered. Many species of snakes and lizards are native to the site.

Many species of birds are found on this site including game birds, songbirds, and birds of prey. Major game birds that are economically important are turkey, bobwhite quail, scaled (blue) quail, and mourning dove. Turkeys prefer plant communities with substantial amounts of shrubs and trees interspersed with grassland. Quail prefer a combination of low shrubs, bunch grass (critical for nesting cover), bare ground, and low successional forbs. The different species of songbirds vary in their habitat preferences. Habitat on this site that provides a large diversity of grasses, forbs, and shrubs will support a good variety and abundance of songbirds. Birds of prey are important to keep the numbers of rodents, rabbits, and snakes in balance. Different species of raptors benefit from a diverse plant community as well.

Hydrological functions

Showers and light rainfall are very effective on this site in reference conditions because the rocks concentrate the water into the soil pockets. However, as the canopy of woody plants, especially juniper, increases, interception, and evaporation of rainfall increases, reducing the percentage of rainfall reaching the ground during light rains. This effectively reduces rainfall and underground storage. Because of steep slopes, the site is doughtier than the climatic zone would indicate, especially on southerly facing slopes. The rough steep topography, in combination with slowly permeable soils and limestone outcrops, causes rapid runoff from the site. Although, the site produces relatively sediment free runoff due to soil structure, plant cover, and rockiness. Localized fractures, crevices, and caverns in the underlying limestone increase infiltration rates making the site an important source of groundwater recharge.

Higher evapotranspiration losses occur as the site transitions from mainly grassland to dense woodland and then stabilize with the water cycle as the woodland reaches maturity. The rapid runoff from the steep slopes is often the cause for flooding downstream. North and northeast slopes have the best soil moisture relations and often support denser stands of oaks and other vegetation.

Recreational uses

The site is suited for all kinds of outdoor related recreation, such as hunting, hiking, picnicking, and camping. Its scenic beauty and topography make it a unique site for which the Edwards Plateau is known. In addition to steep, rocky slopes with vistas, colorful forbs dot the landscape throughout most of the year. Brilliant fall colors from oaks, sumac, and escarpment black cherry blend with evergreen sumac, live oaks, and juniper in the fall.

Wood products

Juniper, mesquite, oak, and other trees are used for posts, firewood, and specialty products.

Other products

Native Americans and early settlers used many of the acorns, fruits, and berries for food. Jams and jellies are made from many fruit-bearing species. Seeds and plants are harvested from many plants for landscaping and 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 the many flowering plants. Cedar oil is extracted from old dead juniper heartwood for use in the perfume industry.

Inventory data references

Information presented here is derived from literature, limited NRCS clipping data (417s), field observations, and personal contacts with range-trained personnel.

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Acknowledgments

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Rangeland health reference sheet

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

Author(s)/participant(s)	Joe Franklin, Zone RMS, NRCS, San Angelo, TX
Contact for lead author	325-944-0147
Date	08/11/2004
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 but are short (5 to 10 feet) due to interruption by rocks or plant bases.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals or terracettes are 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):** This site has essentially no bare ground and any patches are randomly distributed throughout the site 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):** Some litter movement expected. Under moderate events, litter will move across large fragments until interrupted by plants and large rocks. Litter of all sizes may move long distances during intense storm events due to the steepness of the site.

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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 reference conditions are resistant to erosion. Soil stability class range is expected to be 5 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Very dark grayish brown (10 YR 3/2) cobbly clay, weak fine subangular blocky and moderate very fine granular structure, slightly hard, firm, sticky and plastic, 50 percent worm casts, 40 to 80 percent of horizon and subsurface are limestone fragments, calcareous, moderately alkaline. One to four percent SOM.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** High canopy, basal cover and density with small interspaces should make rainfall impact negligible. The stones in the profile capture moisture and enter through soil profile. This site has well drained, very shallow to shallow soils with 20 to 60 percent slopes, which are susceptible to high runoff and erosion rates.

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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):** None.

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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 midgrasses

    Sub-dominant: Warm-season tallgrasses Trees Forbs

    Other: Cool-season midgrasses Shrubs/Vines

    Additional: Forbs make up 10 percent of species composition, shrubs and trees compose up to 20 percent species composition.

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

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1,000 to 3,500 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 and mesquite are the primary invaders.

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17. **Perennial plant reproductive capability:** All plants are capable of reproduction except during periods of prolonged drought conditions, heavy natural herbivory, or intense wildfires.
