Ecological site R083AY003TX
Gravelly Ridge

Last updated: 9/19/2023
Accessed: 05/19/2024

General information

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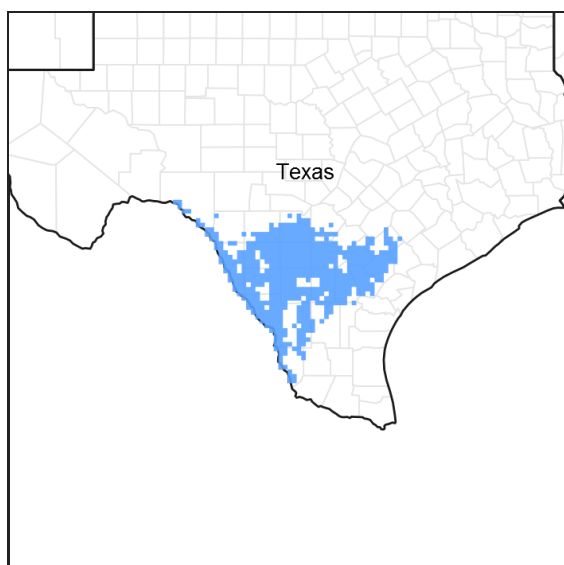

Figure 1. Mapped extent

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): 083A–Northern Rio Grande Plain

This area is entirely in Texas and south of San Antonio. It makes up about 11,115 square miles (28,805 square kilometers). The towns of Uvalde, Cotulla, and Hondo are in the western part of the area, and Beeville, Goliad, and Kenedy are in the eastern part. The town of Alice is just outside the southern edge of the area. Interstate Highways 35 and 37 cross this area. The Chase Field Naval Air Station is outside Beeville. This area is comprised of inland, dissected coastal plains.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 83A

Ecological site concept

The Gravelly Ridge sites get their name from the gravels that reside in the soil profile. Sites can be shallow to very deep located on uplands and ridges.

Associated sites

R083AY027TX	**Western Clay Loam**
R083AY024TX	**Tight Sandy Loam**
R083AY004TX	**Shallow Sandy Loam**
R083AY027TX	**Western Clay Loam**

Similar sites

R083DY003TX	**Gravelly Ridge**
R083BY003TX	**Gravelly Ridge**
R083CY003TX	**Gravelly Ridge**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Acacia berlandieri* (2) *Acacia rigidula*
Herbaceous	(1) *Setaria vulpiseta* (2) *Bouteloua repens*

Physiographic features

The soils of the Gravelly Ridge ecological site are shallow to very deep. The landform is nearly level to strongly sloping gravelly alluvium on paleoterraces and ridges of the Coastal Plains. This site is distinguished by the water-worn gravels on the surface from the Uvalde Gravel of Pliocene or early Pleistocene age. Slope shape is linear convex and range from 1 to 12 percent, but mainly less than 8 percent. Elevation ranges from 200 to 1,000 feet. This area is comprised of inland, dissected coastal plains.

Table 2. Representative physiographic features

Landforms	(1) Coastal plain > Paleoterrace (2) Coastal plain > Ridge
Runoff class	Medium to high
Elevation	84–343 m
Slope	1–8%
Aspect	Aspect is not a significant factor

Climatic features

MLRA 83A is subtropical, subhumid on the western boundary and subtropical humid on the eastern boundary. Winters are dry and mild and the summers are hot and humid. Tropical maritime air masses predominate throughout spring, summer, and fall. Modified polar air masses exert considerable influence during winter, creating a continental climate characterized by large variations in temperature. Average precipitation for MLRA 83A is 20 inches on the western boundary and 35 inches on the eastern boundary. Peak rainfall, because of rain showers, occurs late in spring and a secondary peak occurs early in fall. Heavy thunderstorm activities increase in April, May, and June. July is hot and dry with little weather variations. Rainfall increases again in late August and September as tropical disturbances increase and become more frequent. Tropical air masses from the Gulf of Mexico dominate during the spring, summer, and fall. Prevailing winds are southerly to southeasterly throughout the year except in December when winds are predominately northerly.

Table 3. Representative climatic features

Frost-free period (characteristic range)	224-251 days

Freeze-free period (characteristic range)	263-365 days
Precipitation total (characteristic range)	16,281-21,412 mm
Frost-free period (actual range)	215-265 days
Freeze-free period (actual range)	254-365 days
Precipitation total (actual range)	15,469-23,749 mm
Frost-free period (average)	237 days
Freeze-free period (average)	308 days
Precipitation total (average)	18,898 mm

Climate stations used

- (1) BEEVILLE 5 NE [USC00410639], Beeville, TX
- (2) CROSS [USC00412125], Tilden, TX
- (3) GOLIAD [USC00413618], Goliad, TX
- (4) LYTLE 3W [USC00415454], Natalia, TX
- (5) CHEAPSIDE [USC00411671], Gonzales, TX
- (6) CUERO [USC00412173], Cuero, TX
- (7) HONDO [USC00414254], Hondo, TX
- (8) NIXON [USC00416368], Stockdale, TX
- (9) CARRIZO SPRINGS 3W [USC00411486], Carrizo Springs, TX
- (10) DILLEY [USC00412458], Dilley, TX
- (11) FLORESVILLE [USC00413201], Floresville, TX
- (12) KARNES CITY 2N [USC00414696], Karnes City, TX
- (13) MATHIS 4 SSW [USC00415661], Mathis, TX
- (14) PLEASANTON [USC00417111], Pleasanton, TX
- (15) CHARLOTTE 5 NNW [USC00411663], Charlotte, TX
- (16) FOWLERTON [USC00413299], Fowlerton, TX
- (17) PEARSALL [USC00416879], Pearsall, TX
- (18) CALLIHAM [USC00411337], Calliham, TX

Influencing water features

Surface water runoff is negligible on slopes 0 to 1 percent, very low and low on slopes 1 to 5 percent, and medium to high on slopes 5 to 12 percent. Water features do not influence this site.

Wetland description

N/A

Soil features

The soils in the Gravelly Ridge ecosite are shallow to very deep, well drained, moderately slowly to moderately permeable soils on uplands. The surface color is dark reddish brown to light brown. Soil reaction is moderately acid to slightly alkaline with a noneffervescent surface. The soils were formed in thick beds of Uvalde gravel. Soil series correlated to this site include: Devine, Hindes, and Quihi, which have clayey-skeletal control sections, and Goldfinch, Lupe, Rehm, and Yolog which have loamy-skeletal control sections.

Table 4. Representative soil features

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Parent material	(1) Alluvium–conglomerate
Surface texture	(1) Very gravelly sandy loam (2) Very gravelly sandy clay loam (3) Very gravelly loam

Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	30–203 cm
Surface fragment cover <=3"	10–85%
Surface fragment cover >3"	1–20%
Available water capacity (0-101.6cm)	2.54–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–6
Soil reaction (1:1 water) (0-101.6cm)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	24–55%
Subsurface fragment volume >3" (Depth not specified)	2–14%

Ecological dynamics

The plant communities of this site are dynamic, varying in relation to grazing and drought. The reference plant community of this site was also influenced to some extent by fire and grazing by herds of buffalo and wild horses. Herds of buffalo and wild horses would come into an area, graze it down, and then leave for many months or even years. This long deferment period allowed recovery of the grasses and forbs. Periodic fires set by either Native Americans or lightning affected this site only when climatic factors were ideal for carrying fire. However, fire probably did occur often enough to keep brush from completely dominating the site. The reference plant community consists of approximately 70 to 80 percent grasses, 20 to 30 percent woody plants and 5 percent forbs. Dominant grasses are feather bluestem (Andropogon spp.), sideoats grama (*Bouteloua curtipendula*), and bristlegrass (Setaria spp.). Guajillo (*Acacia berlandieri*) and blackbrush (*Acacia rigidula*) dominate the woody shrubs on the site.

While grazing is a natural component of the ecosystem, overstocking and overgrazing by domestic animals had an impact on the site. Due to continuous overgrazing, midgrasses decrease. Grasses such as three-awn (Aristida spp.), slim tridens (*Tridens muticus*) and red grama (*Bouteloua trifida*) increase on the site. Heavy continuous grazing eliminates the possibility of fire. In a deteriorated condition, a very dense cover of brush dominated by blackbrush and guajillo will occupy the site. In this deteriorated condition, very few grasses or forbs will be visible during dry periods. However, during periods of above average rainfall, a flush of annual weeds, grasses, and a few opportunistic perennial grasses will coexist with the dense brush.

State and transition model
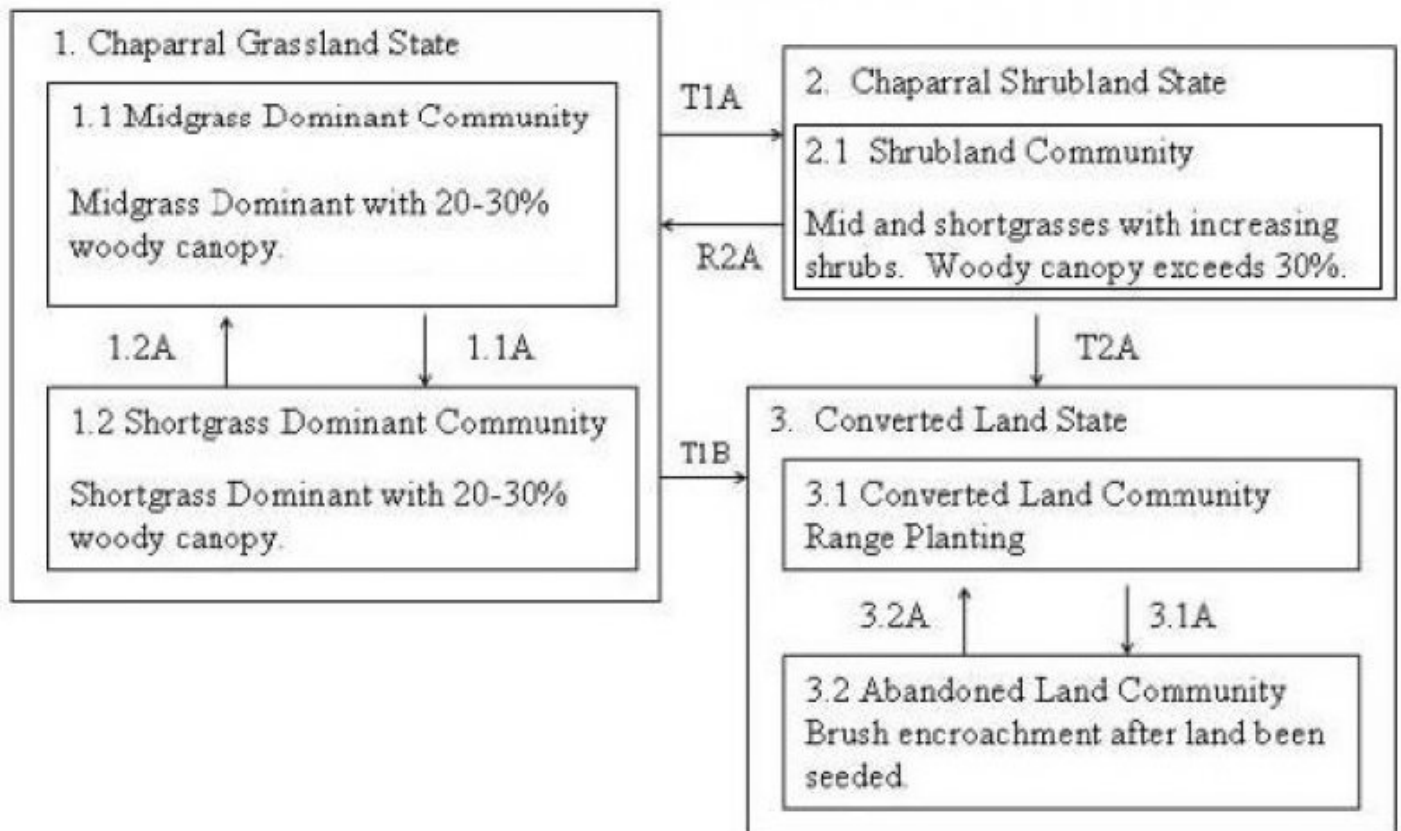
Figure 8. STM

State 1
Chaparral Grassland

Dominant plant species

- sideoats grama (*Bouteloua curtipendula*), grass
- splitbeard bluestem (*Andropogon ternarius*), grass
- bristlegrass (*Setaria*), grass

Community 1.1
Midgrass Dominant

This community represents the reference plant community. Fire did not play as important a role on this site as on deeper more productive sites. The primary reason is that the inherent grass production on this site is too low for extensive fires except when favorable rainfall provided a surplus of grass fuel. Guajillo is the dominate species of a wide variety of woody shrubs. The predominant grasses for this site are sideoats grama, feather bluestem, bristlegrass species, and Arizona cottontop (*Digitaria californica*). Arizona cottontop and plains bristlegrass (*Setaria*

macrostachya) are the more opportunistic species on this site and respond quickly to timely rainfall.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1020	1715	2421
Shrub/Vine	448	583	673
Forb	78	135	224
Tree	22	34	45
Total	**1568**	**2467**	**3363**

Figure 10. Plant community growth curve (percent production by month). TX4541, Midgrass Dominant Community, 15-30% Canopy. Midgrasses dominate the site with 15-30% woody canopy..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	2	5	10	18	15	5	9	15	9	5	5

Community 1.2
Shortgrass Dominant

This phase of the Chaparral Grassland State (1) still exhibits a chaparral plant structure with the woody species canopy as high as 30 percent. Heavy continuous grazing takes many of the midgrasses out of the site and they are replaced by shortgrasses such as slim tridens, threeawn, red grama, and curlymesquite (*Hilaria belangeri*).

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	785	1233
Shrub/Vine	448	583	673
Forb	90	135	191
Tree	22	34	34
Total	**1008**	**1537**	**2131**

Figure 12. Plant community growth curve (percent production by month). TX4542, Shortgrass Dominant Community, 15-30% canopy. Shortgrasses dominate after midgrasses decline. Woody canopy approaches 15-30%..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	2	5	10	18	15	5	9	15	9	5	5

Pathway 1.1A
Community 1.1 to 1.2

This plant community will change to Shortgrass Dominant Community (1.2) if overstocking and heavy continuous grazing occur over time. Drought will hasten the change.

Pathway 1.2A
Community 1.2 to 1.1

This phase can still be managed back to the Midgrass Dominant Community (1.1). A prescribed grazing plan, which includes proper stocking rates, will be essential to reverse the trend toward the Shrubland Community (2.1). Once the midgrass species begin to respond, it is possible to use fire when the conditions are right to suppress the brush species. Grazing management alone may not fully restore the reference plant community but can provide one

reasonably close.

State 2
Chaparral Shrubland

Dominant plant species

- blackbrush (*Coleogyne ramosissima*), shrub
- guajillo (*Acacia berlandieri*), shrub

Community 2.1
Shrubland

This plant community is a result of a transition from the Chaparral Grassland State (1) to the Chaparral Shrubland State (2). The herbaceous understory is very limited in production due to the competition for sunlight, water, and nutrients. There is an increase of woody shrubs generally dominated by blackbrush and guajillo. Other woody plants are spiny hackberry (Celtis pallida), guayacan (Guaiacum augustifolium), kidneywood (*Eysenhardtia texana*), and other acacia species. Water infiltration does occur directly under some of the woody species. Energy flow and nutrient uptake is predominantly through the shrubs. Cool-season annual forbs and grasses are produced by fall and winter rains.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	280	673	897
Shrub/Vine	560	673	729
Forb	67	112	179
Tree	22	34	34
Total	**929**	**1492**	**1839**

Figure 14. Plant community growth curve (percent production by month). TX4544, Shrubland Community, 30+% woody canopy. Shrubs dominate the site with heavy continuous grazing and no brush management. Woody canopy exceeds 30%. Grasses are in further decline..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	2	5	10	18	15	5	9	15	9	5	5

State 3
Converted Land

Dominant plant species

- buffelgrass (*Pennisetum ciliare*), grass
- kleingrass (*Panicum coloratum*), grass

Community 3.1
Converted Land

This plant community is developed by applying brush management and seeding. The conversion can actually come from any community where brush needs to be reduced and a seed source added to establish a desired plant community. The area can be seeded to grasses, forbs, or a mix of both. The most common introduced grass species are buffelgrass (Cenchrus ciliaris), kliengrass (*Panicum coloratum*), and Wilmann lovegrass (*Eragrostis superba*). It may be desirable to include forbs in these seedings. The decision of species to seed is a management decision based on clearly defined goals for livestock and wildlife. The use of introduced species does provide good forage for cattle and can provide some habitat for wildlife. However, once these species are introduced, it is difficult to remove them should objectives change.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1009	1928	2690
Shrub/Vine	448	482	673
Forb	90	135	191
Tree	22	34	34
Total	**1569**	**2579**	**3588**

Figure 16. Plant community growth curve (percent production by month). TX4531, Converted Land - Introduced Grass Seeding. Seeding Coverted Land into Introduced grass species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	10	20	15	5	10	15	10	5	5

Community 3.2
Abandoned Land

This plant community develops from the Converted Land Community (3.1). Without follow-up brush management, seedlings of shrubs establish themselves and spread. The role of prescribed grazing is to retain grass vigor to compete against seedling establishment and preserve fuel for maintenance burns. Production of the plant types depends on the grazing management that has been applied since seeding, and the canopy of the shrubs invading or spreading on the site. As the canopy of the shrubs expands, grass and forb production will be reduced.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	673	1345	2018
Shrub/Vine	560	673	785
Forb	90	135	191
Tree	22	34	34
Total	**1345**	**2187**	**3028**

Figure 18. Plant community growth curve (percent production by month). TX4534, Converted Land - Woody Seedlings Encroachment. Woody seedling encroachment on converted lands such as abandoned cropland, native seeded land, and introduced seeding lands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	2	5	10	18	15	5	9	15	9	5	5

Pathway 3.1A
Community 3.1 to 3.2

Because of the residual seed source of woody plants, encroachment is inevitable. To help maintain this plant community, prescribed grazing along with fire and some brush management will be needed. The role of prescribed grazing is to keep the grasses healthy to compete against invasion of seedlings and to preserve fuel for maintenance fires. Otherwise, this community will transition to the Abandoned Land Community (3.2).

Pathway 3.2A
Community 3.2 to 3.1

In order to transition back to Converted Land Community (3.2), control of the brush species is required. Options

include mechanical control or chemical brush removal.

Transition T1A
State 1 to 2

If heavy continuous grazing occurs, the plant community will transition to the Chaparral Shrubland State (2) with a woody canopy greater than 30 percent. When this occurs, a threshold has been crossed.

Transition T1B
State 1 to 3

The Chaparal Grassland State (1) can be changed into the Converted Land State (3) by controlling the brush and seeding to native or introduced grasses. Due to the gravelly soils of this site, care should be taken in the selection of soil disturbance equipment. Removing the brush and reseeding represents the crossing of a threshold.

Restoration pathway R2A
State 2 to 1

Full restoration back to the Chaparral Grassland is difficult and requires high energy inputs. Mechanical or chemical brush control is required to remove the woody species that have invaded the site. Range seeding may be necessary if the seed bank has been severely reduced.

Transition T2A
State 2 to 3

The Shrubland Community (2.1) can be changed into the Converted Land State (3) by controlling the brush and seeding to native or introduced grasses. Due to the gravelly soils of this site, care should be taken in the selection of soil disturbance equipment. Removing the brush and reseeding represents the crossing of a threshold.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Midgrasses**			628–1345	
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	112–448	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	112–448	–
	beardgrass	BOTHR	*Bothriochloa*	112–448	–
	Arizona cottontop	DICA8	*Digitaria californica*	112–448	–
	Texas bristlegrass	SETE6	*Setaria texana*	112–224	–
2	**Midgrasses**			157–336	
	slender grama	BORE2	*Bouteloua repens*	112–224	–
	green sprangletop	LEDU	*Leptochloa dubia*	112–224	–
	lovegrass tridens	TRER	*Tridens eragrostoides*	112–224	–
3	**Shortgrasses**			235–504	
	hooded windmill grass	CHCU2	*Chloris cucullata*	112–224	–
	fall witchgrass	DICO6	*Digitaria cognata*	112–224	–
	Hall's panicgrass	PAHA	*Panicum hallii*	112–224	–
4	**Shortgrasses**			78–168	
	threeawn	ARIST	*Aristida*	56–101	–
	slim tridens	TRMU	*Tridens muticus*	56–101	–
Forb					
5	**Forbs**			78–168	
	prairie clover	DALEA	*Dalea*	56–112	–
	awnless bushsunflower	SICA7	*Simsia calva*	56–112	–
	beeblossom	GAURA	*Gaura*	28–84	–
	snoutbean	RHYNC2	*Rhynchosia*	28–84	–
	Forb, annual	2FA	*Forb, annual*	28–84	–
Shrub/Vine					
6	**Shrubs**			314–673	
	guajillo	ACBE	*Acacia berlandieri*	224–560	–
	blackbrush acacia	ACRI	*Acacia rigidula*	224–560	–
7	**Shrubs**			78–168	
	mouse's eye	BEMY	*Bernardia myricifolia*	56–112	–
	spiny hackberry	CEEH	*Celtis ehrenbergiana*	56–112	–
	Texas lignum-vitae	GUAN	*Guaiacum angustifolium*	56–112	–
	pricklypear	OPUNT	*Opuntia*	56–112	–
	live oak	QUVI	*Quercus virginiana*	56–112	–

Animal community

As a historic tall/midgrass prairie, this site was occupied by bison, antelope, deer, quail, turkey, and dove. This site was also used by many species of grassland songbirds, migratory waterfowl, and coyotes. This site now provides forage for livestock and is still used by quail, dove, migratory waterfowl, grassland birds, coyotes, and deer.

Feral hogs (Sus scrofa) can be found on most ecological sites in Texas. Damage caused by feral hogs each year includes, crop damage by rutting up crops, destroyed fences, livestock watering areas, and predation on native wildlife, and ground-nesting birds. Feral hogs have few natural predators, thus allowing their population to grow to

high numbers.

Wildlife habitat is a complex of many different plant communities and ecological sites across the landscape. Most animals use the landscape differently to find food, shelter, protection, and mates. Working on a conservation plan for the whole property, with a local professional, will help managers make the decisions that allow them to realize their goals for wildlife and livestock.

Grassland State(1): This state provides the maximum amount of forage for livestock such as cattle. It is also utilized by deer, quail and other birds as a source of food. When a site is in the reference plant community phase (1.1) it will also be used by some birds for nesting, if other habitat requirements like thermal and escape cover are near.

Shrubland State (2): This state can be maintained to meet the habitat requirements of cattle and wildlife. Land managers can find a balance that meets their goals and allows them flexibility to manage for livestock and wildlife. Forbs for deer and birds like quail will be more plentiful in this state. There will also be more trees and shrubs to provide thermal and escape cover for birds as well as cover for deer.

Converted Land State (3): The quality of wildlife habitat this site will produce is extremely variable and is influenced greatly by the timing of rain events. This state is often manipulated to meet landowner goals. If livestock production is the main goal, it can be converted to pastureland. It can also be planted to a mix of grasses and forbs that will benefit both livestock and wildlife. A mix of forbs in the pasture could attract pollinators, birds and other types of wildlife. Food plots can also be planted to provide extra nutrition for deer.

This rating system provides general guidance as to animal preference for plant species. It also indicates possible competition between kinds of herbivores for various plants. Grazing preference changes from time to time, especially between seasons, and between animal kinds and classes. Grazing preference does not necessarily reflect the ecological status of the plant within the plant community. For wildlife, plant preferences for food and plant suitability for cover are rated. Refer to habitat guides for a more complete description of a species habitat needs.

Hydrological functions

This site is in a ridge position and does not receive runoff. Additionally, the soil profile can contain large amounts of gravel, which limits its water holding capacity. Therefore, this site is typically droughty with little available moisture to support grass production. In the Chaparral State, light showers are captured in the canopy of the shrubs and evaporate quickly, rendering these showers ineffective to grow grass. In higher rainfall event, the shrubs intercept and channel rainfall via the stems and trunks to the ground.

Recreational uses

Hunting and birdwatching are common recreational activities.

Inventory data references

Information presented was derived from the revised Range Site, literature, limited NRCS clipping data (417s), field observations, and personal contacts with range-trained personnel.

Other references

AgriLife. 2009. Managing Feral Hogs Not a One-shot Endeavor. AgNews, April 23, 2009. http://agnews.tamu.edu/showstory.php?id=903.

Archer, S. 1995. Herbivore mediation of grass-woody plant interactions. Tropical Grasslands, 29:218-235.

Archer, S. 1995. Tree-grass dynamics in a Prosopis-thornscrub savanna parkland: reconstructing the past and predicting the future. Ecoscience, 2:83-99.

Archer, S. 1994. Woody plant encroachment into southwestern grasslands and savannas: rates, patterns and proximate causes. Ecological implications of livestock herbivory in the West, 13-68.

Archer, S. and F. E. Smeins. 1991. Ecosystem-level Processes. In Grazing Management: An Ecological Perspective. Edited by R.K. Heischmidt and J.W. Stuth. Timber Press, Portland, OR.

Baen, J. S. 1997. The growing importance and value implications of recreational hunting leases to agricultural land investors. Journal of Real Estate Research, 14:399-414.

Bailey, V. 1905. North American Fauna No. 25: Biological Survey of Texas. United States Department of Agriculture Biological Survey. Government Printing Office, Washington D. C.

Bestelmeyer, B. T., J.R. Brown, K. M. Havstad, R. Alexander, G. Chavez, and J. E. Herrick. 2003. Development and use of state-and-transition models for rangelands. Journal of Range Management, 56(2):114-126.

Box, T. W. 1960. Herbage production on four range plant communities in South Texas. Journal of Range Management, 13:72-76.

Briske, B B, B. T. Bestelmeyer, T. K. Stringham, and P. L. Shaver. 2008. Recommendations for development of resilience-based State-and-Transition Models. Rangeland Ecology and Management, 61:359-367.

Brown, J. R. and S. Archer. 1999. Shrub invasion of grassland: recruitment is continuous and not regulated by herbaceous biomass or density. Ecology, 80(7):2385-2396.

Diamond, D. D. and T. E. Fulbright. 1990. Contemporary plant communities of upland grasslands of the Coastal Sand Plain, Texas. Southwestern Naturalist, 35:385-392.

Dillehay T. 1974. Late quaternary bison population changes on the Southern Plains. Plains Anthropologist, 19:180-96.

Edward, D. B. 1836. The history of Texas; or, the immigrants, farmers, and politicians guide to the character, climate, soil and production of that country. Geographically arranged from personal observation and experience. J. A. James and Co., Cincinnati, OH.

Everitt, J. H., D. L. Drawe, and R. I. Leonard. 2002. Trees, Shrubs, and Cacti of South Texas. Texas Tech University Press, Lubbock, TX.

Everitt, J. H., D. L. Drawe, and R. I. Lonard. 1999. Field Guide to the Broad-Leaved Herbaceous Plants of South Texas. Texas Tech University Press. Lubbock, TX.

Foster, J. H. 1917. Pre-settlement fire frequency regions of the United States: a first approximation. Tall Timbers Fire Ecology Conference Proceedings No. 20.

Foster, W. C., ed. 1998. The La Salle Expedition to Texas: The Journal of Henry Joutel, 1684-1687. Texas State Historical Association, Austin, TX.

Frost, C. C. 1995. Presettlement fire regimes in southeastern marshes, peatlands, and swamps. In: Prodeedings, 19th Tall Timbers fire ecology conference, 39-60. Tall Timbers Research Station, Tallahassee, FL.

Fulbright, T. E. and S. L. Beasom. 1987. Long-term effects of mechanical treatment on white-tailed deer browse. Wildlife Society Bulletin, 15:560-564.

Fulbright, T. E., J. A. Ortega-Santos, A. Lozano-Cavazos, and L. E. Ramirez-Yanez. 2006. Establishing vegetation on migrating inland sand dunes in Texas. Rangeland Ecology and Management, 59:549-556.

Fulbright, T. E., D. D. Diamond, J. Rappole, and J. Norwine. The Coastal Sand Plain of Southern Texas. Rangelands, 12:337-340.

Gould, F. W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, TX.

Grace, J. B., L. K. Allain, H. Q. Baldwin, A. G. Billock, W. R. Eddleman, A. M. Given, C. W. Jeske, and R. Moss.

2005. Effects of prescribed fire in the coastal prairies of Texas. USGS Open File Report 2005-1287.

Hamilton, W. and D. Ueckert. 2005. Rangeland Woody Plant Control: Past, Present, and Future. In: Brush Management: Past, Present, and Future, 3-16. Texas A&M University Press. College Station, TX.

Hansmire, J. A., D. L. Drawe, B. B. Wester and C.M. Britton. 1988. Effect of winter burns on forbs and grasses of the Texas Coastal Prairie. The Southwestern Naturalist, 33(3):333-338.

Heitschmidt R. K., Stuth J. W., eds. 1991. Grazing management: an ecological perspective. Timberline Press, Portland, OR.

Inglis, J. M. 1964. A history of vegetation of the Rio Grande Plains. Texas Parks and Wildlife Department Bulletin No. 45, Austin, TX.

Kneuper, C. L., C. B. Scott, and W. E. Pinchak. 2003. Consumption and dispersion of mesquite seeds by ruminants. Journal of Range Management, 56:255-259.

Kramp, B., R. Ansley, and D. Jones. 1998. Effect of prescribed fire on mesquite seedlings. Texas Tech University Research Highlights - Range, Wildlife and Fisheries Management, 29:13.

Le Houerou, H. N. and J. Norwine. 1988. The ecoclimatology of South Texas. In Arid lands: today and tomorrow. Edited by E. E. Whitehead, C. F. Hutchinson, B. N. Timmesman, and R. G. Varady, 417-444. Westview Press, Boulder, CO.

Lehman, V. W. 1965. Fire in the range of Attwater's prairie chicken. Tall Timbers Fire Ecology Conference, 4:127-143.

Lehman, V. W. 1969. Forgotten Legions: Sheep in the Rio Grande Plain of Texas. Texas Western Press, El Paso, TX.

Mann, C. 2004. 1491. New Revelations of the Americas before Columbus. Vintage Books, New York City, NY.

Mapston, M. E. 2009. Feral Hogs in Texas. Rep. Texas Cooperative Extension. 23 Apr. 2009 http://icwdm.org/Publications/pdf/Feral%20Pig/Txferalhogs.pdf

McClendon, T. 1991. Preliminary description of the vegetation of South Texas exclusive of the Coastal Saline Zones. Texas Journal of Science, 43:13-32.

McGinty A., D. N. Ueckert. 2001. The Brush Busters success story. Rangelands, 23:3-8.

McLendon, T. 1991. Preliminary description of the vegetation of south Texas exclusive of coastal saline zones. Texas Journal of Science, 43:13-32.

Norwine, J. 1978. Twentieth-century semiarid climates and climatic fluctuations in Texas and northeastern Mexico. Journal of Arid Environments, 1:313-325.

Norwine, J. and R. Bingham. 1986. Frequency and severity of droughts in South Texas: 1900-1983, 1-17. In Livestock and wildlife management during drought. Edited by R. D. Brown. Caesar Kleberg Wildlife Research Institute, Kingsville, TX.

Olmsted, F. L. 1857. A journey through Texas, or a saddle trip on the Southwest frontier: with a statistical appendix. Dix, Edwards, and co., New York, London.

Prichard, D. 1998. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas. Bureau of Land Management. National Applied Resource Sciences Center, CO.

Rappole, J. H. and G. W. Blacklock. 1994. A field guide: Birds of Texas. Texas A&M University Press, College Station, TX.

Rhyne, M. Z. 1998. Optimization of wildlife and recreation earnings for private landowners. M. S. Thesis, Texas A&M University-Kingsville, Kingsville, TX.

Schindler, J. R. and T. E. Fulbright. 2003. Roller chopping effects on Tamaulipan scrub community composition. Journal of Range Management, 56:585-590.

Schmidley, D. J. 1983. Texas mammals east of the Balcones Fault zone. Texas A&M University Press, College Station, TX.

Scifres C. J., W. T. Hamilton, J. R. Conner, J. M. Inglis, and G. A. Rasmussen. 1985. Integrated Brush Management Systems for South Texas: Development and Implementation. Texas Agricultural Experiment Station, College Station, TX.

Scifres, C. J. and W. T. Hamilton. 1993. Prescribed burning for brushland management: the South Texas example. Texas A&M Press, College Station, TX.

Scifres, C. J. 1975. Systems for improving McCartney rose infested coastal prairie rangeland. Texas Agricultural Experiment Station Bulletin MP 1225.

Smeins, F. E., S. Fuhlendorf, and C. Taylor, Jr. 1997. Environmental and Land Use Changes: A Long Term Perspective. In Juniper Symposium, 1-21. Texas Agricultural Experiment Station.

Smeins, F. E., D. D. Diamond, and W. Hanselka. 1991. Coastal prairie, 269-290. In Ecosystems of the World: Natural Grasslands. Edited by R. T. Coupland. Elsevier Press, Amsterdam, Netherlands.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database.

Snyder, R. A. and C. L. Boss. 2002. Recovery and stability in barrier island plant communities. Journal of Coastal Research, 18:530-536.

Stiles, H. R., ed. 1906. Joutel's journal of La Salle's last voyage, 1686-1687. Joseph McDonough, Albany, NY.

Stringham, T. K., W. C. Krueger, and P. L. Shaver. 2001. State and transition modeling: and ecological process approach. Journal of Range Management, 56(2):106-113.

Texas A&M Research and Extension Center. 2000. Native Plants of South Texas http://uvalde.tamu.edu/herbarium/index.html.

Texas Agriculture Experiment Station. 2007. Benny Simpson's Texas Native Trees http://aggie-horticulture.tamu.edu/ornamentals/natives/.

Texas Parks and Wildlife Department. 2007. List of White-tailed Deer Browse and Ratings. District 8.

Tharp, B. C. 1926. Structure of Texas Vegetation east of the 98th meridian. Bulletin 2606. University of Texas, Austin. TX.

Thurow, T. L. 1991. Hydrology and Erosion. In: Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.

Urbatsch, L. 2000. Chinese tallow tree (Triadica sebifera (L.) Small. USDA-NRCS Plant Guide.

USDA-NRCS Plant Database. 2018. https://plants.usda.gov/.

Van't Hul, J. T., R. S. Lutz and N. E. Mathews. 1997. Impact of prescribed burning on vegetation and bird abundance on Matagorda Island, Texas. Journal of Range Management, 50:346-360.

Vines, R. A. 1984. Trees of Central Texas. University of Texas Press, Austin, TX.

Wade, D. D., B. L. Brock, P. H. Brose, J. B. Grace, G. A. Hoch, and W. A. Patterson III. 2000. Fire in Eastern ecosystems. In Wildland fire in ecosystems: effects of fire on flora. Edited by. J. K. Brown and J. Kaplers. United States Forest Service, Rocky Mountain Research Station, Ogden, UT.

Weltz, M. A. and W. H. Blackburn. 1995. Water budget for south Texas rangelands. Journal of Range Management, 48:45-52.

Whittaker, R. H., L. E. Gilbert, and J. H. Connell. 1979. Analysis of a two-phase pattern in a mesquite grassland, Texas. Journal of Ecology, 67:935-52.

Wright, B. D., R. K. Lyons, J. C. Cathey, and S. Cooper. 2002. White-tailed deer browse preferences for South Texas and the Edwards Plateau. Texas Cooperative Extension Bulletin B-6130.

Wright, H.A. and A.W. Bailey. 1982. Fire Ecology: United States and Southern Canada. John Wiley & Sons, Inc., Hoboken, NJ.

Approval

Bryan Christensen, 9/19/2023

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)	
Contact for lead author	
Date	05/19/2024
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

_____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

_____

7. **Amount of litter movement (describe size and distance expected to travel):**

_____

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

_____

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

_____

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

_____

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

_____

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:

    Sub-dominant:

    Other:

    Additional:

_____

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

_____

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

_____

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

_____

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:

17. **Perennial plant reproductive capability:**