USDA Natural Resources Conservation Service

Ecological site R083CY012TX Ramadero

Last updated: 9/19/2023
Accessed: 05/21/2024

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.

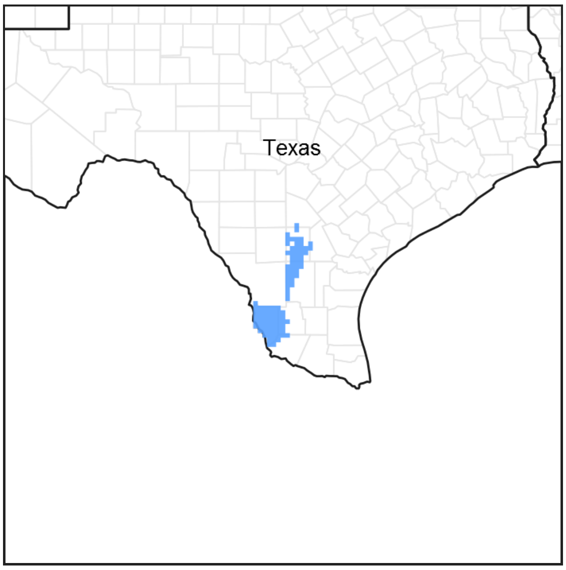

Figure 1. Mapped extent

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): 083C–Central Rio Grande Plain

Major Land Resource Area (MLRA) 83C makes up about 4,275 square miles (11,075 square kilometers). The towns of Freer, George West, and Hebbronville are in this area. The town of Alice is on the east edge of the area. U.S. Highways 59 and 281 cross the area. This area is comprised of inland, dissected coastal plains.

Classification relationships

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

Ecological site concept

The Ramadero site is very deep with loamy soils. The sites are on upland drains and are in a water receiving position. This typically allows better moisture availability than nearby uplands.

Associated sites

R083CY004TX	**Shallow Sandy Loam**
R083CY019TX	**Gray Sandy Loam**

Similar sites

R083AY012TX	**Loamy Draw**
R083BY012TX	**Ramadero**
R083DY012TX	**Ramadero**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Celtis ehrenbergiana* (2) *Prosopis*
Herbaceous	(1) *Setaria vulpiseta* (2) *Digitaria californica*

Physiographic features

These nearly level soils are found on long narrow upland drainageways of inland, dissected Coastal Plains. Surfaces are concave to linear and slopes are commonly less than one percent. These soils formed in alkaline loamy alluvium. Slopes range from 0 to 1 percent. Runoff is low to medium. Flooding is occasional to frequent with very brief to brief durations.

Table 2. Representative physiographic features

Landforms	(1) Coastal plain > Drainageway
Runoff class	Negligible to low
Flooding duration	Extremely brief (0.1 to 4 hours) to brief (2 to 7 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	46–262 m
Slope	0–1%
Aspect	Aspect is not a significant factor

Climatic features

MLRA 83C 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. 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)	255-291 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	584-660 mm

Frost-free period (actual range)	255-347 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	533-660 mm
Frost-free period (average)	283 days
Freeze-free period (average)	365 days
Precipitation total (average)	635 mm

Climate stations used

- (1) CHOKE CANYON DAM [USC00411720], Three Rivers, TX
- (2) FREER [USC00413341], Freer, TX
- (3) MCCOOK [USC00415721], Edinburg, TX
- (4) CALLIHAM [USC00411337], Calliham, TX
- (5) HEBBRONVILLE [USC00414058], Hebbronville, TX

Influencing water features

This site is in a water receiving position on the landscape. It provides an avenue in which to transport water from the uplands to the bottomlands.

Wetland description

N/A.

Soil features

The Ramadero site is very deep, well drained and moderately permeable. These soils formed in alkaline loamy alluvium. The surface layer is brown to very dark grayish brown sandy clay loam. The surface alkalinity ranges from neutral to moderately alkaline. Soil series correlated to this site include Jaboncillos, Racombes, Ramadero, and Tela.

Table 4. Representative soil features

Parent material	(1) Alluvium–sedimentary rock
Surface texture	(1) Sandy clay loam (2) Loam (3) Loamy fine sand
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderate
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	15.24–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–8

Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	2–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Climatic variation and topoedaphic heterogeneity interact to influence vegetation responses to disturbances such as fire and grazing. Plants of the reference plant community evolved with and are generally well adapted to grazing and fire. Prior to European settlement, fires would likely have been frequent, between 5 and 10 years. These fires would have resulted from lightning during the hot, dry summer months or were set by Native Americans. The occurrence of fire promotes grasses while making it difficult for woody plants to achieve dominance. During the Pleistocene, there were significant populations of large-bodied grazers and browsers. Most of these went extinct, so that by the Holocene (about 10,000 years ago) only bison (Bos bison), white-tailed deer (Odocoileus virginianus), and antelope (Antilocapra americana) remained. Archeological evidence indicates that bison occurred in the region, but there is also evidence of centuries of absence. In addition, their numbers may have varied seasonally as herds migrated. When present, bison may have grazed certain areas heavily, but then moved on. Activities of other native herbivores (termites, cutter ants, soil nematodes, kangaroo rats (Dipodomys spp.)) also influenced vegetation productivity and dynamics.

Accounts of earlier explorers and settlers suggest the Rio Grande Plains was likely a mosaic of grasslands, savannahs, shrublands, and woodlands. Historical photographs suggest the nature of the vegetation structure likely varied from place-to-place depending on topography, soil properties and time since the last major disturbances (such as drought or fire). However, the occurrence of extensive grasslands and grassland fauna (antelope, for example) is mentioned in numerous historical accounts. Plants likely at the time of European settlement included little bluestem (*Schizachyrium scoparium*), false Rhodes grass (Chloris crinata), and multiflower false Rhodes grass (Chloris pluriflora), Arizona cottontop (*Digitaria californica*), plains bristlegrass (*Setaria vulpiseta*), and pink pappusgrass (*Pappophorum bicolor*). The composition and productivity of grass communities would have varied with annual rainfall, soil depth and the extent of argillic horizon development. Many sites are now dominated by mesquite (*Prosopis glandulosa*), various acacias (Acacia spp.), granjeno (Celtis pallida), condalia (Condalia obovata), lime prickly ash, and prickly pear (Opuntia spp.). These woody plants are not new arrivals, but are native to the region and have increased in size and abundance within their historic ranges.

Grazing and fire are two factors that critically influence the relative abundance of grasses and woody plants through time. By the early 1800's cattle and sheep numbers appear to have been quite high in the Rio Grande Plains, resulting in heavy, year-round grazing. The resulting reduction in abundance of late seral grasses lead to a decline in soil organic matter, a reduction in fire frequency/intensity (due to lack of fine fuels), and a shift from midgrass domination to shortgrass, like hooded windmill grass (*Chloris cucullata*), three-awns (Aristida spp.) and forbs, like orange zexmenia (Wedelia hispida), and croton (Croton spp.). These changes would have favored woody plants, most of which are unpalatable to livestock, and enabled them to establish and attain dominance. This would be especially true for leguminous shrubs such as mesquite, whose seeds are widely spread by livestock.

The shift from grass to woody plant domination became the impetus for brush management practices. By the 1950's, large-scale mechanized clearing was common and by the 1970's, aerial herbicide applications were widespread. However, by the 1980's it was clear that brush management practices were often treating symptoms rather than underlying problems and having undesirable environmental consequences, including adverse effects on wildlife populations. Sites cleared of brush regenerated rapidly and often formed thickets that were denser and of lower diversity than the original stands. This realization, coupled with the fact that brush management treatments were typically short-lived, lead to the development of Integrated Brush Management Systems (IBMS). The IBMS approach takes a holistic, large-scale, long-term, whole-farm, ecosystem-based approach to brush management and recognizes multiple-use options for rangeland resources. Shrublands developing on former grasslands have other potential socioeconomic values that should be considered when contemplating brush management. These include alternate classes of livestock, lease hunting, deer and exotic game ranching, and ecotourism.

While shrublands have traditionally been viewed as degraded from a livestock production standpoint, it is important to recognize that they are not necessarily degraded from the ecological perspectives of primary productivity, nutrient cycling and biodiversity. The productivity of shrublands may be comparable to the grassland they replaced. In addition, shrubs modify soils and microclimate to increase levels of organic matter and nutrients in the upper four inches of the soil profile. This nutrient enrichment by shrubs can offset grazing-induced losses of soil nutrients and contribute to enhance grass production when shrub cover is reduced by natural or management-induced means. While the development of shrub communities may have adverse impacts on grasses and grassland fauna, other plants and animals may benefit. Thus, while ecosystem biodiversity certainly changes, it does not necessarily decrease with a shift from grass to woody plant domination.

State and transition model

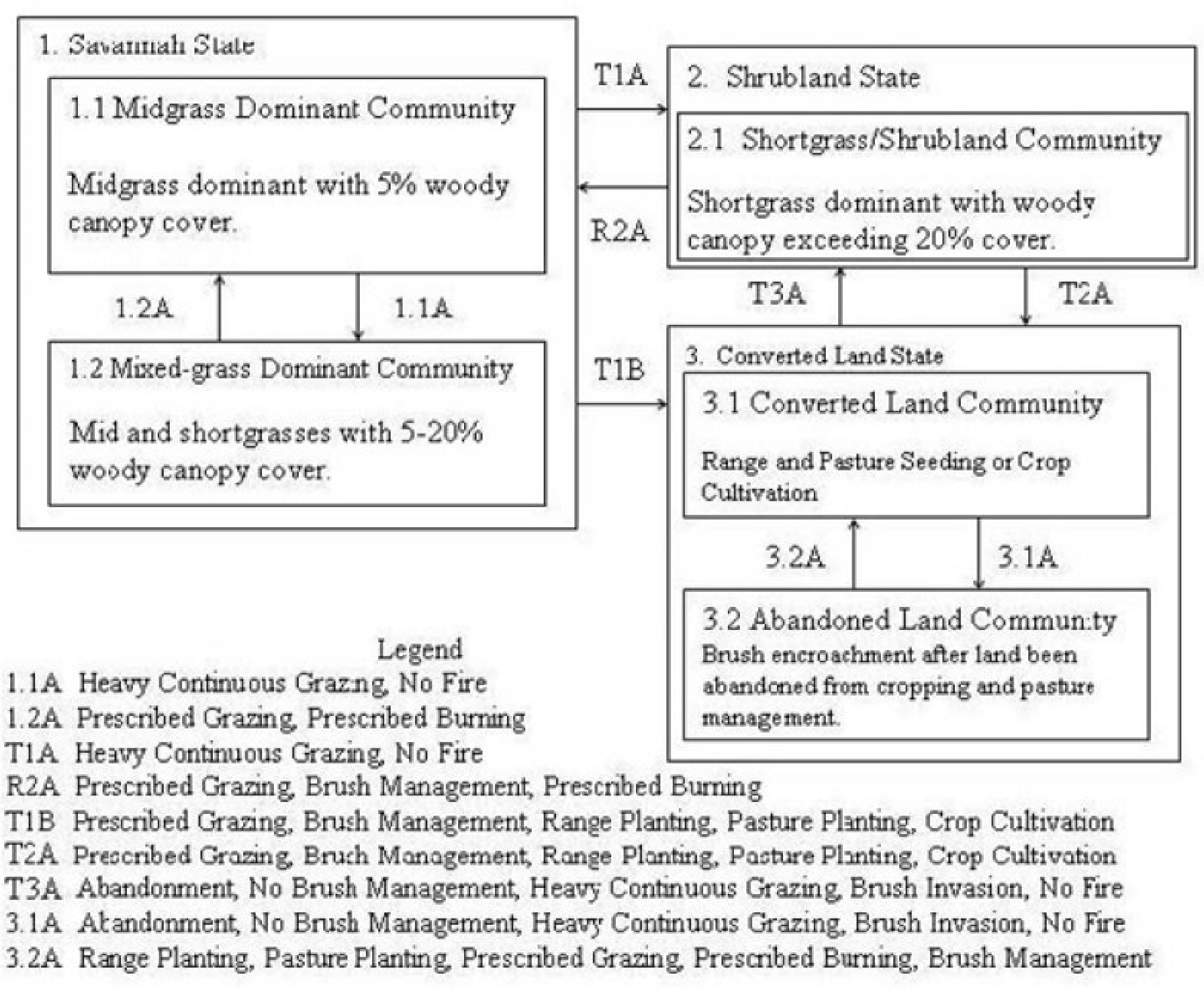

Figure 8. STM

State 1
Savannah

Dominant plant species

- multiflower false Rhodes grass (*Trichloris pluriflora*), grass
- plains bristlegrass (*Setaria vulpiseta*), grass

Community 1.1
Midgrass Dominant

This community represents the reference plant community. The community is a fire climax, midgrass plant community that has less than a five percent canopy of woody plants. The grasses are multi-flowered false Rhodesgrass, plains bristlegrass, Southwestern bristlegrass, Arizona cottontop, sideoats grama (*Bouteloua curtipendula*), silver bluestem, lovegrass tridens (*Tridens eragrostoides*), big cenchrus, hooded windmillgrass, vine mesquite (*Panicum obtusum*), pappusgrass, buffalograss, and curlymesquite. The woody plants are mesquite, spiny hackberry, sugar hackberry, and elm. Forbs are Engelmann's daisy, bushsunflower, yellow neptunia, sensitivebriar, and numerous annuals. Recurrent fire and occasional grazing by small herds of bison (Bos bison) and other wildlife were natural components of the ecosystem.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2438	4539	6053
Shrub/Vine	224	252	336
Forb	140	252	336
Tree	–	–	–
Total	**2802**	**5043**	**6725**

Figure 10. Plant community growth curve (percent production by month). TX4525, Midgrass Dominant, 5% woodies. Midgrass plant community with less than a 5 percent canopy of woody plants. Growth occurs with peak in spring and fall seasons..

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
Mixed-grass Dominant

This phase of the Savannah State still exhibits a savannah plant structure with the woody species canopy being as high as 20 percent. This is a result of fire being removed as a component of the site. Heavy continuous grazing takes many of the midgrasses out of the site and they are replaced by shortgrasses such as hooded windmillgrass, pappusgrass, buffalograss, and curly-mesquite. If heavy continuous grazing occurs, tumble windmillgrass, whorled dropseed, Hall’s panicum, perennial three-awn, and tumblegrass increase on the site. Other common woody increasers and invaders to the site are mesquite, whitebrush, huisache, lotebush, and spiny hackberry.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1121	2242	3363
Shrub/Vine	673	560	560
Forb	280	560	560
Tree	–	–	–
Total	**2074**	**3362**	**4483**

Figure 12. Plant community growth curve (percent production by month). TX4527, Mixed-Grass Savannah with 5-20% Woodies. Mixed-Grass Savannah Community with the woody canopy cover may be as high as 20%..

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 1.2A
Community 1.2 to 1.1

This phase can still be managed back to the Midgrass Dominant Community (1.1) but will take the reintroduction of fire to the ecosystem or some method of brush management that allows selective removal of the plants. A prescribed grazing plan will be essential to reverse the trend toward the Shrubland State. Increasing the midgrasses in the plant community over an extended time will take the application of sound grazing management principles.

State 2
Shrubland

Dominant plant species

- honey mesquite (*Prosopis glandulosa*), shrub

Community 2.1
Shortgrass/Shrubland

This plant community is a result of a transition from the Savannah State (1) to the Shrubland State (2). This threshold is passed when the woody canopy restricts herbaceous growth and insufficient fuel is produced to carry a fire that will control the woody canopy. The understory is very limited in production due to the competition for sunlight, water, and nutrients. There is an increase in mesquite, whitebrush, huisache, lotebush, and spiny hackberry to the point that they dominate the site. At this point there is very little understory production. There is much bare ground that has crusted to the point that there is little water infiltration and little seedling emergence. Water infiltration does occur directly under some of the woody species such as mesquite as it moves down the trunk of the tree to the base. During the growing season, light showers are captured in the canopy of the shrubs and evaporate. Energy flow and nutrient capture is predominantly by the shrubs. Winter rains can produce understory forage by the cool-season annual forbs and grasses.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	757	1345	2522
Grass/Grasslike	224	841	1121
Forb	28	56	280
Tree	–	–	–
Total	**1009**	**2242**	**3923**

Figure 14. Plant community growth curve (percent production by month). TX4535, Shortgrass/Shrubland Community, 20-50% woodies. Shortgrasses and Shrubs dominate the plant community..

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

- Bermudagrass (*Cynodon dactylon*), grass

Community 3.1
Converted Land

Any of the prior plant communities can be converted to alternative plants through brush management and seeding. The site can be planted to either native mixtures or to introduced plants depending upon management objective. Introduced grasses commonly seeded on the site include bermudagrass (*Cynodon dactylon*) and kleingrass (*Panicum coloratum*). The introduced species will require a concerted management effort to keep the stands pure because of the seedbank of woody species. Native plantings will require some form of brush removal such as individual plant treatment, prescribed fire, broadcast treatments, or mechanical treatments to maintain a grassland.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2802	5044	6725
Shrub/Vine	–	–	–
Tree	–	–	–
Forb	–	–	–
Total	**2802**	**5044**	**6725**

Figure 16. Plant community growth curve (percent production by month). TX4530, Converted Land Community. Community converted into warm-season grass seed mixtures..

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

Figure 17. 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 agriculture that has been abandoned. Due to the lack of fire or some other method of brush management, shrub seedlings establish and spread. If the seedlings are not controlled, this plant community will transition to the Shrubland State (2) and will require some form of brush management via machinery or herbicides to reduce the canopy. Production on the Abandoned Land Community depends on the grazing management and brush 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, grasses and forb production will be reduced accordingly.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2438	4539	6053
Shrub/Vine	224	252	336
Forb	140	252	336
Tree	–	–	–
Total	**2802**	**5043**	**6725**

Figure 19. 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 3.2A

Community 3.2 to 3.1

Many land managers may want to utilize this site as cropland or pastureland. To achieve this transition land clearing practices such as land clearing, dozing and raking will be necessary. After the land has been cleared and an appropriate seedbed prepared, the crop or pasture can be planted.

Transition T1A
State 1 to 2

If heavy continuous grazing occurs with the exclusion of fire, the phase will transition to the Shrubland State (2). Drought will hasten the process. Once the woody canopy exceeds approximately 20 percent, a threshold is crossed. In this case, energy in the form of heavy equipment and/or herbicides will be required along with prescribed grazing to shift the plant community back to the Savannah State (1). Once the woody plants pass this threshold, grazing management alone will not reverse the woody plant population.

Transition T1B
State 1 to 3

The Savannah State (1) can be converted to the Converted Land State (3) by controlling the brush and seeding to native or introduced grasses. It may also be plowed and converted to cropland.

Restoration pathway R2A
State 2 to 1

Brush management is the key driver in restoring the Shrubland State (2) back to the Savannah State (1). Reduction in woody canopy below 20 percent will take large energy inputs depending on the canopy cover. A prescribed grazing plan and prescribed burning plan will keep the state functioning.

Transition T2A
State 2 to 3

The Shrubland State (2) can be converted to the Converted Land State (3) by controlling the brush and seeding to native or introduced grasses. It may also be plowed and converted to cropland.

Transition T3A
State 3 to 2

If the Abandoned Land Community (3.2) is left alone, eventually the woody plants will create a moderate to heavy canopy. At this point, the desired understory grasses, forbs, and/or crops will be shaded out and the site will transition into a Shrubland State (2).

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**			1121–3475	
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	1121–2802	–
	multiflower false Rhodes grass	TRPL3	*Trichloris pluriflora*	1121–2242	–
	southwestern bristlegrass	SESC2	*Setaria scheelei*	560–1681	–
2	**Midgrasses**			841–1793	
	Arizona cottontop	DICA8	*Digitaria californica*	560–1345	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	560–1345	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	560–1345	–
	vine mesquite	PAOB	*Panicum obtusum*	280–1121	–
	big sandbur	CEMY	*Cenchrus myosuroides*	280–841	–
	hooded windmill grass	CHCU2	*Chloris cucullata*	280–841	–
	lovegrass tridens	TRER	*Tridens eragrostoides*	112–560	–
	pink pappusgrass	PABI2	*Pappophorum bicolor*	280–560	–
3	**Shortgrasses**			140–336	
	buffalograss	BODA2	*Bouteloua dactyloides*	56–336	–
	curly-mesquite	HIBE	*Hilaria belangeri*	56–336	–
4	**Cool-season grasses**			112–448	
	Forb, annual	2FA	*Forb, annual*	112–448	–
Forb					
5	**Forbs**			140–336	
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	28–140	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	28–140	–
	yellow puff	NELU2	*Neptunia lutea*	28–140	–
	awnless bushsunflower	SICA7	*Simsia calva*	28–140	–
	Forb, annual	2FA	*Forb, annual*	0–56	–
Shrub/Vine					
6	**Shrubs/Vines**			224–336	
	spiny hackberry	CEEH	*Celtis ehrenbergiana*	56–168	–
	netleaf hackberry	CELAR	*Celtis laevigata var. reticulata*	56–168	–
	mesquite	PROSO	*Prosopis*	56–168	–
	elm	ULMUS	*Ulmus*	56–168	–

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.

Tree/Shrubland (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 can be described as an upland drainage. The site occupies a position to receive both water and sediment, but rarely ponds water due to being well drained. The runoff water, along with the sediment received, makes this site productive in terms of plant biomass when compared to surrounding sites upslope. When the site is in the Shrubland State (2), much of the small rainfall events are trapped in the canopy only to evaporate before reaching the soil. In higher rainfall events, the rain is channeled down to the ground via the trunks and stems of the woody plants, fostering the development of cool-season plants.

Recreational uses

Hunting and photography are common activities.

Inventory data references

The data contained in this document is derived from analysis of inventories, clipping studies, and ecological interpretation from field evaluations.

Other references

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., C. Scifres, C. R. Bassham, and R. Maggio. 1988. Autogenic succession in a subtropical savanna: conversion of grassland to thorn woodland. Ecological Monographs 58(2):110-127.

Archer, S. 1990. Development and stability of grass/woody mosaics in a subtropical savanna parkland, Texas, USA. Journal of Biogeography 17: 453-462.

Bond, W. J. What Limits Trees in C4 Grasslands and Savannas? Annual Review of Ecology, Evolution, and Systematics. 39:641-659.

De Leon, A. 2003. Itineraries of the De Léon Expeditions of 1689 and 1690. In Spanish Exploration in the Southwest, 1542-1706. Edited by H. E. Bolton. Charles Scribner's Sons, New York, NY.

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

Duaine, C. L. 1971. Caverns of Oblivion. Packrat Press, Oak Harbor, WA.

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.
Ford, J. S. 2010. Rip Ford's Texas. University of Texas Press. Austin, TX.

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. and F. C. Bryant. 2003. The Wild Horse Desert: climate and ecology. The Ranch Management, 35-58.

Gilbert, L. E. 1982. An ecosystem perspective on the role of woody vegetation, especially mesquite, in the Tamaulipan biotic region of South Texas. Proceeding Symposium of the Tamaulipan Biotic Province, Corpus Christi, TX.

Hanselka, C. W., D. L. Drawe, and D. C. Ruthven, III. 2004. Management of South Texas Shrublands with prescribed fire. In Proceedings: Shrubland dynamics -- fire and water, 57-61.

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.

Jurena, P.N., and S. Archer. 2003. Woody Plant Establishment and Spatial Heterogeneity in Grasslands Ecology, 84(4):907-919.

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. 1969. Forgotten legions: sheep in the Rio Grande Plains of Texas. Texas Western Press, University of Texas at El Paso, El Paso, TX.

McGinty, A. and D. N. Ueckert. 2001. The Brush Busters success story. Rangelands Archives, 23(6):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

Neilson, R. P. 1987. Biotic regionalization and climatic controls in western North America. Vegetatio, 70(3): 135-147.

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.

Parvin, R. W. 2003. Rio Bravo Resource Conservation and Development. Llanos Mestenos South Texas Heritage Trail. Zapata, TX.

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

Schmidley, D. J. 1983. Texas mammals east of the Balcones Fault zone. Texas A&M University Press. 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., 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., J.W. McAtee, and D. L. Drawe. 1980. Botanical, Edaphic, and Water Relationships of Gulf Cordgrass (Spartina spartinae [Trin.] Hitchc.) and Associated Communities The Southwestern Naturalist 25(3):397-409.

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

Vavra, M., W. A. Laycock, R. D. Pieper. 1994. Ecological Implications of livestock herbivory in the West. Society for Range Management. Denver, CO.

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.

Contributors

Gary Harris, MSSL, NRCS, Robstown, Texas

Approval

Bryan Christensen, 9/19/2023

Acknowledgments

Reviewers and Contributors:
Shanna Dunn, RSS, NRCS, Corpus Christi, Texas
Mark Moseley, RMS, NRCS, San Antonio, Texas
Justin Clary, RMS, NRCS, Temple, Texas

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	05/21/2024
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:**