USDA Natural Resources
Conservation Service

Ecological site R078AY125TX
Shallow 25-28" PZ

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General information

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

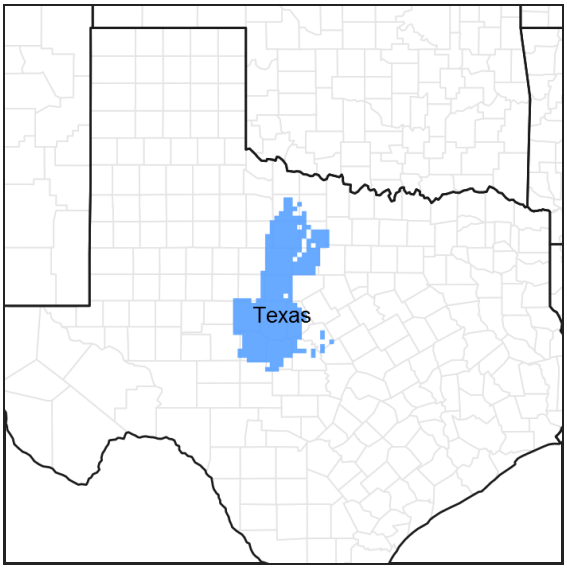


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 078A–Rolling Limestone Prairie

MLRA 78A is characterized by erosional plains with terraces adjacent to perennial and intermittent streams. Loamy and clayey soils range from shallow to deep over limestones and shales of Permian and Pennsylvanian age. Loamy soils are also associated with stream terraces.

LRU notes

NA

Classification relationships

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

Ecological site concept

This site occurs over shallow loam or clay loam soils on uplands. The reference vegetation includes midgrasses with shortgrasses, forbs, and very few woody species. Abusive grazing practices can lead to a reduction of the

more palatable plants and a change in the plant community. Without fire or other brush management, woody species may increase on the site.

Associated sites

R078AY119TX	**Clay Loam 25-28" PZ** Site differs greatly in species composition and productivity. Soils are deep and plant -soil–air-moisture relationships are more favorable.

Similar sites

R078AY128TX	**Very Shallow 25-28" PZ** The Very Shallow Site is closely associated, generally upslope of the Shallow Site. It has shallower soils. Plant communities are similar, but Very Shallow Site has significantly lower annual production. Soils are shallower and more droughty.

Table 1. Dominant plant species

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

Physiographic features

The Shallow Ecological Site is an upland site occurring on nearly level to gently sloping terrain, including hillsides, hilltops, and divides. It contains shallow clayey to loamy soils. The soils are underlain by indurated caliche and hard limestone, with occasional limestone outcrops and surface fragments. Slopes are smooth to convex and range from 0 to 8%. The site often occurs as a continuum lying between the very shallow and the clay loam sites. Elevation ranges from 1000 to 2800 feet.

Table 2. Representative physiographic features

Landforms	(1) Plains > Stream terrace (2) Plains > Hillslope (3) Plains > Plateau
Runoff class	Medium to high
Elevation	305–853 m
Slope	0–8%
Aspect	Aspect is not a significant factor

Climatic features

The climate of MLRA 78A is subtropical subhumid, with hot, dry summers and mild, dry winters. The Precipitation is similar north to south throughout the area, but decreases slightly from east to west. Temperature is similar east to west, but warmer from north to south. The area is clear to partly cloudy 80 percent of the time during the summer and 60 percent during the winter. Prevailing winds usually occur from a southerly direction and from north to northwest during passage of fall and winter cool fronts. March and April are the windiest months of the year.

Most precipitation occurs during the warmer months from April to October, in the form of rainfall during thunderstorms, often of short duration and high intensity, with considerable variation in amounts of rain and the area covered. Lightening, strong winds and hail frequently accompany the thunderstorms. Occasional tornadoes are not uncommon. Precipitation distribution is bimodal, with peaks occurring in May-June and September-October. The annual precipitation is about 25 to 28 inches. Timeliness and amount of rainfall are critical to plant growth. Rainfall events of one-fourth inch or less have limited effectiveness. High temperatures and dry winds reduce precipitation effectiveness. Snowfall represents only a small part of the annual precipitation. Snowfall of one inch or more occurs

about one in five years, while snowfall of greater than five inches occurs only about one in ten years. Snow cover generally is of short duration (i.e. one to three days). Probability of snowfall is greater in the northern part of MLRA 78A.

Rainfall in the region is highly erratic, usually with more years below than above average. Periodic droughts of both temporary and prolonged duration are common to the area, although not predictable. Some of the more severe droughts of the past century in this region occurred during 1918-1919, early 1930's, early to mid 1950's, and mid to late 1990's. High temperatures and dry winds accentuate the effects of drought. The extremes in climate have greater influence on plant communities than averages. Historic wet and dry cycles of extended duration likely influenced the evolution of drought hardiness and other survival traits in the endemic flora and fauna of the area.

Temperatures range from 31 degrees F in January to 96 degrees F in July, based on the 30-year average from 1971-2000, although considerably lower and higher temperatures for these months, respectively, have been recorded for some years. Periods of excessive heat, exceeding 100 degrees F, are not uncommon during July and August. Temperatures in the winter are generally mild, but abrupt and large drops in temperature can occur when polar air masses plunge southward across the area. The duration of freezing temperatures usually does not last more than three to five days. Temperatures in the spring are mild, both daytime and nighttime. Summer temperatures are hot, with highs generally in the 80's to mid 90's during the daytime, cooling down to the upper 70's during the night. Fall is usually pleasant with mild, sunny days and crisp, cool nights, as cool northers periodically begin moving south this time of year. The area has a frost-free period of approximately 225 to 233 days and a freeze-free period of about 248 to 259 days. The primary growing season for warm-season plants is approximately 233 to 246 days, increasing from north to south. The first frost generally occurs around November 15 and the last frost occurs around March 15. These dates will vary from north to south and from year to year.

The average relative humidity ranges from 35 to 50 percent in mid-afternoon as diurnal air temperature nears maximum. As nighttime air temperature drops, relative humidity rises, averaging 70 to 80 percent by dawn.

Table 3. Representative climatic features

Frost-free period (characteristic range)	197-210 days
Freeze-free period (characteristic range)	222-244 days
Precipitation total (characteristic range)	686-737 mm
Frost-free period (actual range)	195-216 days
Freeze-free period (actual range)	221-260 days
Precipitation total (actual range)	686-762 mm
Frost-free period (average)	204 days
Freeze-free period (average)	235 days
Precipitation total (average)	711 mm

Climate stations used

- (1) CONCHO PK/IVIE RSVR [USC00411934], Millersview, TX
- (2) COLEMAN [USC00411875], Coleman, TX
- (3) PUTNAM [USC00417327], Baird, TX
- (4) ALBANY [USC00410120], Albany, TX
- (5) THROCKMORTON 7NE [USC00419016], Throckmorton, TX

Influencing water features

There are no water features in the Shallow Ecological site.

Wetland description

NA

Soil features

The soils of the Shallow Site have low available soil water capacity. Permeability is very slow to moderately slow. The surface layer is dark grayish brown clay, about 17 inches thick. Below the surface layer is indurated caliche and hard limestone bedrock. These soils are usually well drained and have slow surface runoff. Soil blowing hazard is slight and water erosion is moderate. The site typically has a shallow rooting zone and is quite droughty. Plant-soil-air-moisture relationships are fair. In healthy condition, rills, ephemeral gullies, pedestals, and wind scoured areas, are present in small quantities on the site. The soils are more suitable for range and wildlife habitat, but some are arable.

Soil surveys often delineate two or more kinds of soil in a single mapping unit, due to their geographical association in the landscape, intricate patterns, or size, making it is impractical to map them separately at the selected scale for a given soil survey. Such groupings of soils are referred to as either associations or complexes. Ecological sites may or may not correspond to the all soil series contained in the association or complex.

The Shallow Ecological Site is associated with the following soil series and/or associations and complexes in MLRA 78A: Kavett, Mereta, Purves.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Gravelly clay (2) Stony clay loam (3) Very stony loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow
Soil depth	20–66 cm
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0–1%
Available water capacity (0-101.6cm)	3.81–6.35 cm
Calcium carbonate equivalent (0-101.6cm)	5–20%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.4
Subsurface fragment volume <=3" (Depth not specified)	2–21%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

An ecological site is a distinctive kind of land with specific physical characteristics, which differs from other kinds of land in its ability to produce a distinctive kinds and amounts of vegetation. A specific site has the potential to produce characteristic plant communities on a recurring basis under the prevailing climate and limitations of the soils supporting such plant communities. Productivity, kind of plants, plant species composition, and kind of soil are the primary criteria used to distinguish ecological sites within the same climatic regime. Natural plant communities of ecological sites are dynamic entities within a more comprehensive ecosystem. Ecological sites were shaped by

abiotic (non-living) influences of climate, soils, topography, and fire, as well as biotic factors of flora and fauna, including man. The biotic community evolved through a synergistic relationship among the endemic flora and fauna, including grazing and browsing by large herbivores, as well as rodents and herbivorous insects. The community functions through the capture of energy from the sun through photosynthesis by green plants and the cycling of water, minerals, and nutrients. Plants are the producer organisms, which form the base of the food chain. Consumer organisms at all levels (i.e. herbivores and carnivores) are dependent, directly or indirectly, upon the producers. Decomposer organisms in the soil are essential links to cycling and the flow of energy within the system. The amount of energy captured and the efficiency of energy flow within the system determine the degree of functionality of the system. The reference plant community of the Shallow Ecological Site functioned accordingly, as a component of such a system, prior to the intervention of European man.

The Shallow Ecological Site contained numerous micro-sites, such as slight depressions, level areas, shallow areas, outcrops of caliche or rock, shaded areas, and open sunny areas, as well as others. Shady areas with good mulch cover would be cooler and favor growth of cool-season (C-3) grasses, such as Texas wintergrass (*Nassella leucotricha*) while open, sunny areas would be more conducive to the warm-season (C-4) grasses, such as little bluestem (*Schizachyrium scoparium*). The deeper-rooted mid-grasses, such as cane bluestem (Bothriochola barbinodis), would take advantage of areas with deeper soil, where they would be more competitive with the shallow-rooted shortgrasses, such as curlymesquite (Hilaria berlangeri). However, all endemic species, or groups of plants with similar functionality, would successfully occupy niches within the overall plant community. Some plant species are either physiologically or morphologically adapted to withstand prolonged drought, extreme temperatures, heavy grazing pressure, fire, and other stresses. Extremes in environmental factors were more significant than short-term events in establishing resistance and resilience of the plant community. Different types of reproductive methods (i.e. seeds, stolons, rhizomes, and tubers) among the species are inherent characteristics, which further aid in perpetuating the plant community.

Fire played a major role in grassland ecology, based upon historical accounts and research on tree rings and charcoal remnants. Periodic fires perpetuated the grassland state of the historic climax plant community by suppressing the increase and invasion of woody plants. Sparsely distributed woody plants and mottes occurred within the grassland, where they had escaped past fires, due to their location near rock outcrops and terrain breaks, or in the protection of woody mottes, lacking sufficient fine fuel in the understory, or in heavily grazed areas lacking sufficient fine fuel. Lightning started wildfires, and Native Americans occasionally used burning as a tool in hunting. Fires, whether started naturally of by man, occurred only when sufficient fine fuel with continuity of cover was available, primarily during years of more abundant rainfall and grazing deferment. In years of low rainfall or heavy grazing, the Shallow Ecological Site probably remained unburned or partially burned.

This reference plant community functioned under the influence of multi-species herbivory by endemic herbivores, including bison, elk, pronghorn, white-tailed deer and javelina. Just as plants filled niches in the plant community, so did animals. Smaller herbivores of the Shallow Ecological Site include: jackrabbit, cottontail rabbit, black-tailed prairie dog, Mexican ground squirrel and many species of smaller rodents. Animal preferences for food and cover determined the degree of use of the Shallow Ecological Site in association with other sites. Changes in patterns and degree of use by the various kinds of animals caused major changes in plant communities, as well as degree of competition among animal species for habitat requirements. Grazing and browsing preferences of native herbivores were significant factors in maintaining a healthy, well-balanced plant community. Diets of the different species of animals varied from one-another in plant species, proportions, and seasonally.

The bison was the largest herbivore grazing the reference plant community. Large herds of bison migrated from the northern and central plains into this area annually, for wintering. Bison probably grazed the Shallow Ecological Site intermittently in association with surrounding sites. They selectively grazed specific areas or sites, often heavily, before moving to other areas of more abundant forage. Burned areas were strongly preferred by bison, and such areas were often heavily grazed. Long deferment periods allowed the plant community to recover before the next migration into the area. During the early to mid 1800’s, bison populations were decimated through indiscriminate slaughter, thousands for their hides and tongues alone. Very few bison remained in the area after 1860, and the great migrations ceased.

Large resident populations of pronghorn occupied the area year-round, but others migrated into the area from farther north during severe winters. The reference plant community of the Shallow Ecological Site was ideal for the pronghorn, due to its openness, position in the landscape, and its large variety of forbs. The pronghorn preferred wide, open spaces, using keen eyesight and fleet-footed running ability instead of woody cover for security.

Following European settlement, the pronghorn was extirpated from the immediate region and no longer occurs as a stable, free-roaming population.

White-tailed deer occurred in significant numbers, as more sedentary resident populations. The Shallow Ecological Site provided edge-effect and a wide variety of preferred browse and forbs. They were both browsers and grazers on a seasonal basis, using considerable amounts of forbs and cool-season grasses, especially in winter and early spring. Unlike the other larger herbivores, white-tailed deer populations have increased in the region since early settlement.

The gregarious prairie dog often established large towns throughout the region. The prairie dog towns occurred on various sites, especially those with deeper soils and good visibility. The Shallow Ecological Site would have been used in conjunction with adjacent sites, especially in areas of deeper soils. The prairie dog effectively suppressed woody plants in the vicinity of their towns, but kept the plant community in a low seral stage. The very short vegetation and large amounts of bare ground created major firebreaks, which may have played a role in reducing the severity and size of prairie fires. Very few active prairie dog towns remain in the region.

Predation was a natural phenomenon in maintaining the balance of biotic communities and the flow of energy in the ecosystem. The Shallow Ecological Site provided an abundance of prey species for all of the predators, common to the area. Mammalian predators using the site include: the gray wolf, coyote, red fox, gray fox, bobcat, ocelot and mountain lion. Since European settlement, the wolf and the ocelot have been totally extirpated from Texas and the mountain lion occurs only as an occasional transient in this region. Smaller carnivores included black-footed ferret, badger and ringtail. The smaller carnivores preyed primarily on small rodents, snakes, lizards and insects. The prairie dog was the main prey of the black-footed ferret. Coinciding with the precipitous decline of the prairie dog population, the black-footed ferret was extirpated from the region and is now near extinction. Loss of major predators from an ecosystem results in population increases of the principal prey species, often primary consumers (herbivores), which in turn increases competition for available resources, adversely impacting the plant community and natural flow of energy in the system.

The Native Americans lived in harmony as a component of the natural ecosystem, which included the endemic flora and fauna. Under that regime the historic climax plant community was perpetuated and functioned as a dynamic entity within the ecosystem. Unfortunately, the historic climax plant community did not fare so well under the influence of Europeans who indiscriminately decimated or displaced endemic animal populations, introduced domestic livestock, and suppressed fire. The European settlers might be likened to an exotic plant species invading a plant community. Invading species are successful in establishing themselves through their ability to outcompete endemic species for space, water, and nutrients. So, the Europeans entered (invaded) a naturally functioning ecosystem, eliminated critical components, and displaced the endemic people, through competition for natural resources and warfare with superior technology. These events were precursors leading to degradation of the historic climax plant community, as a component of the larger ecosystem.

Spanish explorers and missionaries were the first Europeans to influence the plant communities of the Rolling Plains. The early explorers introduced the horse, which was their means of transportation. Some horses escaped and plains Indians captured others. Historical accounts refer to thousands of wild horses roaming the plains and prairies of this region, well before other kinds of domestic livestock were introduced. As early as 1732, Spanish missions were established in the region, and missionaries brought sheep, goats, oxen, and burros. The livestock were herded or free-roaming at short distances from primary water sources in close proximity to the mission stockades. Some of these livestock became feral and expanded their ranges from the missions. Horses and sheep probably exerted the earliest livestock grazing pressure on rangeland plant communities in the region. Subsequent European pioneers from the East brought more livestock to graze the open range.

Grazing pressure on the plant community increased during the historic cattle drives of the mid to late 1800s, as large herds of longhorn cattle from South Texas passed through the area enroute to northern rail heads in Kansas and other points north. Grazing pressure further intensified as land in this region was privatized, and landowners began establishing local herds and flocks of cattle, goats and sheep. Sheep were well established in the region by the late 1800’s and exerted tremendous grazing pressure on rangelands, perhaps, greater than that of cattle. The Spanish type goat was maintained initially in small herds for local meat production on the ranches. The Angora goat was not brought into the area until the early 1900’s, and small herds were raised primarily for mohair. The introduction of fencing, windmills and railroads had tremendous impacts on the condition of rangelands in the region. Fencing and water developments allowed livestock to be confined on the same area of land in a continuous

grazing regime, with especially heavy concentration in the vicinity of water. With the coming of the railroad, better marketing capabilities encouraged landowners to increase their herds and flocks for short-term economic gain, resulting in still heavier grazing pressure on plant communities.

The early settlers' knowledge of land management was primarily agronomic-based and in more humid regions. The science and art of rangeland management, based upon ecological principles, had not yet evolved. Therefore, their stewardship of rangeland resources was largely trial and error. By the time the settlers gained knowledge about conservation of natural resource, considerable damage had already occurred in many natural plant communities.

Under abusive grazing, livestock repeatedly graze their preferred species. This reduces the leaf area of plants, thus preventing them from capturing sufficient sunlight for growth and development of new tillers and leaves. Also, overgrazing reduces the plant's ability to replace carbohydrates in the base and stems of the plant. Stored carbohydrates provide energy for respiration during dormancy and to initiate regrowth following winter dormancy, heavy grazing or drought.

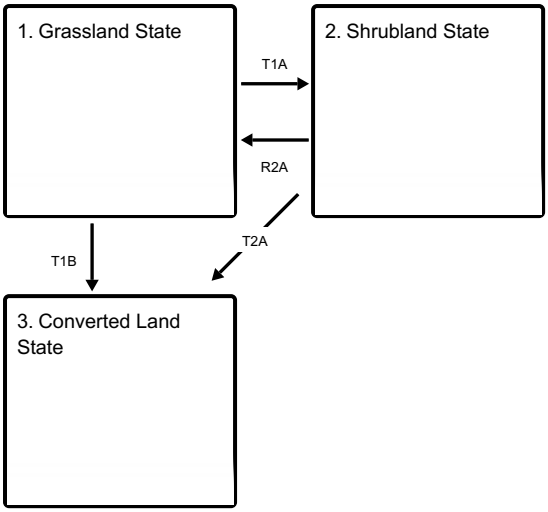
Palatability of plant species influences their susceptibility to grazing and browsing pressure. Excessive grazing or browsing of the more palatable species over prolonged periods results in loss of plant health and vigor, reduction of root mass, and eventually plant mortality. Under these conditions, other less palatable species within the community tend to increase their dominance. Overgrazing, droughts, extremes in temperature, lack of fire or untimely fire, are factors contributing to further degradation of the plant community. Also, species from other sites or exotics may invade the community and outcompete the endemic species. Increase or invasion of woody plants often replaces grass as the dominant vegetation. Bare ground generally increases under such conditions and annual species become more abundant. In association with vegetation degradation, soils also become degraded, resulting in accelerated erosion, reduction in infiltration, excessive runoff, and loss of organic matter. At this point the integrity of the plant community is damaged or lost and may require supplemental energy to shift it back to the original plant community. Maintenance of a functional site or repair of a damaged site requires management focused on soil stability, nutrient cycling, and vegetation enhancement. Site degradation beyond the point of self-repair represents the crossing of a threshold in space and time, which is not reversible on a practical time scale without substantial inputs of energy from outside the community. This energy input may be in the form of reclamation practices, such as chemical or mechanical brush management, prescribed burning, or prescribed grazing.

The vegetative state is represented by a persistent plant community that is recognizable, resistant in its ability to maintain its identity while external conditions change, and resilient in its ability to recover after it has been changed. The reference vegetative state represented the vegetative state of the Shallow Ecological Site, during the presettlement period, prior to the intervention of European man.

The following diagram illustrates some of the more commonly recognized vegetative states and associated plant communities occurring on the Shallow Ecological Site. There may be possibly other vegetative states or plant communities, not shown. Also, in some situations, differences in composition or production may represent only temporary fluctuations, due to the natural dynamics of the community.

State and transition model

Ecosystem states



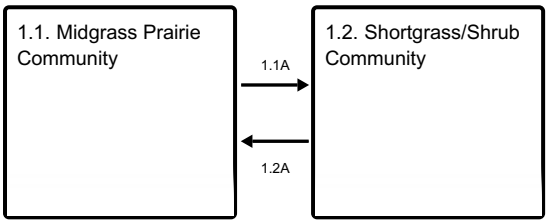
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

T1B - Extensive soil disturbance followed by seeding

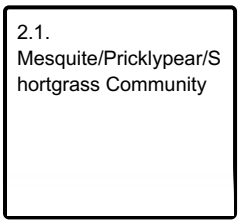
R2A - Adequate rest from defoliation, followed by reintroduction of historic disturbance regimes

T2A - Extensive soil disturbance followed by seeding

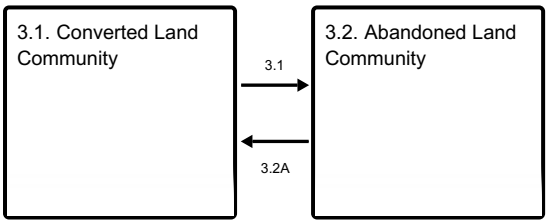
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Grassland State

The Midgrass Prairie Community (1.1) is the reference plant community of the Shallow Ecological Site. It is estimated to have been an open prairie, dominated primarily by warm-season midgrasses, such as little bluestem, sideoats grama, and plains bristlegrass, with scattered tallgrasses, such as big bluestem and Indiangrass, as well as a fair component of cool-season plants including Texas wintergrass and sedges. Shortgrasses, such as curlymesquite and buffalograss made up a minor component of the plant community. The plant community also included a wide variety of perennial forbs such as bushsunflower, Engelmann’s daisy, dotted gayfeather, and halfshrub sundrop. The site would have had less than 5% woody canopy, including low shrubs and a few scattered trees. The tallgrasses and woody species usually occurred in the vicinity of limestone outcrops, drainageways, and

hillside crests. The Shortgrass/Shrub-Dominant Community (1.2) was dominated by less palatable species of shortgrasses. Woody species, including honey mesquite, catclaw and lotebush increase in canopy cover and density. Texas wintergrass increased considerably in the shadier understory and became a co-dominant with the shortgrasses, which began to dominate the more open areas.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Community 1.1
Midgrass Prairie Community

Figure 8. 1.1 Midgrass Prairie Community

The Midgrass Prairie Community (1.1) is the reference plant community of the Shallow Ecological Site. It is estimated to have been an open prairie, dominated primarily by warm-season midgrasses, such as little bluestem, sideoats grama (*Bouteloua curtipendula*), plains bristlegrass (*Setaria vulpiseta*), and cane bluestem; with scattered tallgrasses, such as big bluestem (*Andropogon gerardii*) and Indiangrass (Sorgastrum nutans), as well as a fair component of cool-season plants including Texas wintergrass and sedges (Cyperus spp.). Shortgrasses, such as curlymesquite, buffalograss (*Bouteloua dactyloides*), slim tridens (*Tridens muticus*), hairy grama (Bouteloua hirsuita) and halls panicum (*Panicum hallii*) made up a minor component of the plant community. The plant community also included a wide variety of perennial forbs such as bushsunflower (Simsa calva), Engelmann's daisy (Engelmannia pinatifida), dotted gayfeather (*Liatris punctata*) and halfshrub sundrop (*Calylophus berlandieri*). Annual grasses and forbs occupied bare areas following rainfall, but persisted only as long as shallow surface moisture was available. The site would have had less than 5% woody canopy, including low shrubs, such as elbowbush (Foresteria pupescens), catclaw (*Acacia greggii*), skunkbush (*Rhus trilobata*) and feather dalea (*Dalea formosa*), and a few scattered trees, such as hackberry (Ulmus laveagatum) and occasional liveoak (Quercus virginanus) in some areas. The tallgrasses and woody species usually occurred in the vicinity of limestone outcrops, drainageways, and hillside crests. The plant community was seasonally balanced due to the presence of cool-season species. Productivity of the Shallow Ecological Site was limited by low available water capacity, due to the shallow soils with restrictive layers of hard caliche and limestone, as well as, limestone cobbles in the soil profile and on the surface. Plant species composition was quite similar to that of the Very Shallow Ecological Site, with the exception of some tallgrasses on the Shallow Ecological Site. However, productivity of the Shallow Ecological Site was significantly greater than the Very Shallow Site, which was the primary vegetative criterion in distinguishing the two sites, as well as somewhat deeper soil above the restrictive layers in the former. This was a droughty site, although not as severe as the Very Shallow Site. A plant community shift occurs in the reference plant community when it was exposed to heavy continuous grazing over a period of many years. At the same time, fire was suppressed, through both intentional control and as a result of insufficient fine fuel loads to carry fire. Major shifts occurred in species composition as the more palatable species of midgrasses, such as little bluestem, sideoats grama, and plains bristlegrass decreased, while Texas wintergrass and less palatable species of shortgrasses, such as slim tridens, threeawns (Aristida spp.), and red grama (*Bouteloua trifida*), increased. Woody species, including honey mesquite (*Prosopis glandulosa* var. glandulosa), catclaw, and lotebush (*Ziziphus obtusifolia*) increased, as did pricklypear (Opuntia spp.). In the the absence of fire or brush management to suppress the increase and invasion of woody species, canopy cover may have increased to about 10-20%. The loss of ground cover in the

understory increased soil erosion and subsequently caused the deterioration of rangeland health. These changes occurred over a period of years, depending upon prevailing climatic conditions, severity of grazing pressure, and degree of fire suppression. Although a major threshold had not yet been crossed, the character of the plant community shifted to a dominance of shortgrasses and woody vegetation, resulting in the Shortgrass/Shrub-Dominant Community (1.2).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1429	2287	2858
Forb	168	269	336
Shrub/Vine	67	108	135
Tree	17	27	34
Total	**1681**	**2691**	**3363**

Figure 10. Plant community growth curve (percent production by month). TX2514, Midgrass Prairie Community. Midgrass Prairie Community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	12	25	20	5	5	14	8	2	1

Community 1.2
Shortgrass/Shrub Community

Figure 11. 1.2 Shortgrass/Shrub Community

The Shortgrass/Shrub Community (1.2) was dominated by less palatable species of shortgrasses, including slim tridens, threeawns, Texas grama (*Bouteloua rigidiseta*), hairy tridens (*Erioneuron pilosum*), red grama, and sand dropseed (Sporobolus cyptandrus). Woody species, including honey mesquite, catclaw and lotebush increased, as did pricklypear. Texas wintergrass increased considerably in the shadier understory and became a co-dominant with the shortgrasses, which began to dominate the more open areas. The Shortgrass/Shrub Community (1.2) still had sufficient resilience and plasticity to continue functioning for a number of years with temporary fluctuations toward and away from the reference plant community. With limited supplemental energy inputs, such as prescribed grazing, brush management using individual plant treatment, and prescribed burning, this community could be transformed back to one resembling the reference plant community. Lack of brush management, continuation of heavy continuous grazing, lack of fire, and accelerated brush invasion, would cause further degradation of the plant community and soil. Under these conditions the Shortgrass/Shrub Community (1.2) eventually would be pushed across a threshold, resulting in a significantly different plant community, referred to as the Mesquite/Pricklypear/Shortgrass Community (2.1).

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1009	1345	1681
Forb	135	179	224
Shrub/Vine	135	179	224
Tree	67	90	112
Total	**1346**	**1793**	**2241**

Figure 13. Plant community growth curve (percent production by month). TX2515, Shortgrass/Shrub Dominant Community. Shortgrasses and Shrubs dominate this plant community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	4	10	10	20	20	5	5	10	8	2	3

Pathway 1.1A
Community 1.1 to 1.2

Midgrass Prairie Community **Shortgrass/Shrub Community**

With heavy continuous grazing, no brush management, and no fires, the Midgrass Prairie Community will shift to the Shortgrass/Shrub Community.

Pathway 1.2A
Community 1.2 to 1.1

Shortgrass/Shrub Community **Midgrass Prairie Community**

With the application of various conservation practices such as Prescribed Grazing, Brush Management (Individual Plant Treatment), and Prescribed Burning, the Shortgrass/Shrub Community can be reverted back to the Midgrass Prairie Community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Shrubland State

The Mesquite/Pricklypear/Shortgrass Community would be dominated by an overstory of honey mesquite. The increased canopy of woody plants would create a cooler understory, in which Texas wintergrass would increase significantly. Pricklypear, tasajillo, and Texas wintergrass would co-dominate the understory, replacing many of the remaining warm-season midgrasses. Shortgrasses, including curlymesquite, buffalograss, slim tridens, and hairy tridens would greatly increase and become the dominant warm-season grass component of this plant community. Midgrasses, which dominated the reference plant community, will be scarce but remnants will remain due to their

resilience and presence in soil seed banks. The tallgrasses would no longer occur in this degraded state. The more palatable forbs would be replaced by less preferred species.

Dominant plant species

- mesquite (*Prosopis*), shrub
- pricklypear (*Opuntia*), shrub
- Texas wintergrass (*Nassella leucotricha*), grass

Community 2.1
Mesquite/Pricklypear/Shortgrass Community

Figure 14. 2.1 Mesquite/Pricklypear/Shortgrass Community

The Shortgrass/Shrub Community (1.2) would give way to a Shrubland state, represented by the Mesquite/Pricklypear/Shortgrass Community (2.1). This plant community would be dominated by an overstory of honey mesquite. The increased canopy of woody plants would create a cooler understory, in which Texas wintergrass would increase significantly. Pricklypear, tasajillo (*Cylindropuntia leptocaulis*), and Texas wintergrass would co-dominate the understory, replacing many of the remaining warm-season midgrasses. Shortgrasses, including curlymesquite, buffalograss, slim tridens, halls panicum, hairy tridens, Texas grama (*Bouteloua rigidiseta*) and red grama would greatly increase and become the dominant warm-season grass component of this plant community. Midgrasses, which dominated the historic climax plant community, will be scarce but remnants, such as silver bluestem, green sprangletop (*Leptochloa dubia*), sideoats grama, and plains bristlegrass will remain, due to their resilience and presence in soil seed banks. The tallgrasses would no longer occur in this degraded state. The more palatable forbs, such as bushsunflower, purple prairieclover (*Dalea purpurea* var. purpurea), Engelmann's daisy, low menodora (*Menodora heterophylla*), and gaura (Gaura spp.) would be replaced by less preferred species, such as broom snakeweed (*Gutierrezia sarothrae*), croton (Croton spp.), gray coldenia (Coldenia canescens), plains zinnia (*Zinnia grandiflora*), twinleaf senna (*Senna roemeriana*) and dogweed (Dyssodia pentachaeta). Woody plants with total canopy cover of 40% or greater would dominate the overstory of the community. In addition to mesquite, other woody plants would include catclaw acacia, lotebush (*Ziziphus obtusifolia*), javelinabush (*Condalia ericoides*), pricklyash (*Zanthoxylum hirsutum*), algerita, and juniper (Juniperus spp). Productivity of the community will be much lower than the reference plant community, as well as the Shortgrass/Shrub Community (1.2), due to loss of many of the warm-season midgrasses and increase of woody plants and pricklypear. The site in this state would be producing total annual biomass of only about 800 to 1,200 pounds (dry weight) per acre, including woody plants and pricklypear. This plant community could be rejuvenated through high-level energy inputs, including brush management, prescribed grazing and prescribed burning. This would reverse the trend in degradation and return to the Shortgrass/ Shrub Community of the Grassland State, or depending upon the extent of brush suppression, a midgrass-shortgrass state somewhat similar in production and functionality as the historic climax plant community. However, due to soil degradation and possible loss of some of the species, it likely would never exactly resemble the reference plant community.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	583	701	874
Tree	135	168	202
Shrub/Vine	135	168	202
Forb	45	56	67
Total	**898**	**1093**	**1345**

Figure 16. Plant community growth curve (percent production by month). TX2516, Mesquite/Pricklypear/Shortgrass. Mesquite/Pricklypear/Shortgrass community..

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

State 3
Converted Land State

The Native Seeding Community is the use of adapted native grass mixtures, such as sideoats grama, plains bristlegrass, and green sprangletop which are commonly used. Forbs and shrubs, such as bush sunflower and fourwing saltbush (*Atriplex canescens*), respectively, have been used in native mixtures, with limited success. Commercial seed sources of adapted forbs and shrubs generally are scarce. Seeded range provides forage production similar to or sometimes greater than most natural grassland communities of the Shallow Ecological Site. Annual production generally ranges from 2000 to 3000 pounds air-dry biomass per acre. Native grasses can successfully compete with the annual grasses and forbs, which often appear during initial establishment. Native grasses are somewhat slower than some of the introduced pasture grasses in establishing viable stands. However, once established and with proper grazing management, native grasses have greater longevity and sustained productivity without high-level energy inputs. The Introduced Seeding Community is a management-induced vegetative state. It is the result of intensive cultural practices designed to speed the vegetative transformation of a natural plant community, primarily to produce a more economically desired plant community. Seeded pasture usually consists of a monoculture of grasses, such as kleingrass, old-world bluestem, or weeping lovegrass, or a mixture of two or three compatible species. These are generally introduced or improved cultivars, having characteristics desired for forage, erosion control, water conservation, or wildlife habitat. In most cases seeded pastureland is management-oriented for forage production, but may have secondary benefits. Such plant communities usually provide higher levels of production than degraded natural plant communities on this site. Although this vegetative state may provide productive and seasonally nutritious forage for livestock, it may lack the biodiversity of natural plant communities, more essential to many wildlife species. The Annual Crop Community is a management-induced state produced through transformation of a natural plant community or another management-induced plant community, through plowing and cultivation. These areas are seeded to cash or forage crops, primarily small grains, forage sorghum, and grain sorghum. Small grains generally include wheat and oats, either for grain or forage, and sometimes both in years of favorable rainfall. Many of these areas have been successfully cultivated for production of small grains, forage sorghums, and grain sorghum. Cool-season crops generally do better than warm-season crops, due to the droughty nature of the site.

Community 3.1
Converted Land Community

Figure 17. 3.1 Converted Land Community (Native Seeding)

Figure 18. 3.1 Converted Land Community (Introduced Seeding)

Figure 19. 3.1 Converted Land Community (Small Grain/Forage S

The Native Seeding Community is a management-induced component of the Converted Land State. This community is the result of artificial revegetation of a degraded natural plant community in an effort to speed vegetative transformation to a native grassland state. This community is produced through the application of mechanical brush management (BM), range planting (RP), and prescribed grazing (PG). Mechanical brush management is used to obtain more effective control of a broader spectrum of brush species and to facilitate seedbed preparation. In areas with significant amounts of pricklypear, mechanical treatments may be integrated with chemical treatment and/or post-seeding prescribed burning (PB) to reduce density of these plants. Adapted native grass mixtures, such as sideoats grama, plains bristlegrass, and green sprangletop are commonly used. Forbs and shrubs, such as bush sunflower and fourwing saltbush (*Atriplex canescens*), respectively, have been used in native mixtures, with limited success. Commercial seed sources of adapted forbs and shrubs generally are scarce. Seeded range provides forage production similar to or sometimes greater than most natural grassland communities of the Shallow Ecological Site. Annual production generally ranges from 2000 to 3000 pounds air-dry

biomass per acre. Native grasses can successfully compete with the annual grasses and forbs, which often appear during initial establishment. Native grasses are somewhat slower than some of the introduced pasture grasses in establishing viable stands. However, once established and with proper grazing management, native grasses have greater longevity and sustained productivity without high-level energy inputs. In most cases the Native Seeding Community is management-oriented for forage production, but also has secondary benefits. Such plant communities usually provide higher levels of production than degraded natural plant communities on this site. Although this vegetative state may provide productive and seasonally nutritious forage for livestock, it may lack the biodiversity of natural plant communities, more essential to many wildlife species. However, native grass plantings can be integrated with other vegetative states to enhance wildlife habitat, while still providing other resource benefits. Native seeding (range planting) is generally applicable under conditions where rangeland plant communities have regressed severely, especially in association with heavy brush invasion. This could include plant communities, such as the Mesquite/Pricklypear/Shortgrass Community (2.1) or the Abandoned Land Community (3.2). Another consideration in the decision to implement range planting would be the availability of remnant grass and forbs for natural revegetation over a feasible period of time to meet resource management objectives. Annual Crop Community or deteriorated introduced pastureland may also be converted to the Native Seeding Community. The Native Seeding Community requires less intensive cultural inputs for maintenance, than the Introduced Pasture Seeded Plant Community (5). The primary practices needed to maintain native seeded areas are prescribed grazing (PG), including initial deferment following seeding, subsequent periodic deferments or rotational grazing, and proper degree of utilization. Prescribed burning or brush management, using individual plant treatment (IPT) may be needed periodically to suppress brush and prickly pear invasion. Without maintenance, the Native Seeding Community would deteriorate, with loss of plant vigor, productivity, and general health. Woody species would invade, along with low successional perennial and annual plants. The community would eventually move the Abandoned Land Community (3.2). The Introduced Seeding Community is a management-induced vegetative state. It is the result of intensive cultural practices designed to speed the vegetative transformation of a natural plant community, primarily to produce a more economically desired plant community. Seeded pasture usually consists of a monoculture of grasses, such as kleingrass, old-world bluestem, or weeping lovegrass, or a mixture of two or three compatible species. These are generally introduced or improved cultivars, having characteristics desired for forage, erosion control, water conservation, or wildlife habitat. In most cases seeded pastureland is management-oriented for forage production, but may have secondary benefits. Such plant communities usually provide higher levels of production than degraded natural plant communities on this site. Although this vegetative state may provide productive and seasonally nutritious forage for livestock, it may lack the biodiversity of natural plant communities, more essential to many wildlife species. However, management practices have been developed to integrate seeded pastureland in juxtaposition with native rangeland to enhance wildlife habitat, while still providing other resource benefits. Native rangeland of any vegetative state may be converted to seeded pastureland. However, the energy inputs required for such conversions generally do not justify the conversion of functional native plant communities of the higher seral stages, such as those in the Grassland State. The Shrubland State (2) or the Abandoned Land Community (3.2) are the more likely candidates for conversion to the Introduced Seeding Community. The Annual Crop Community is a management-induced state produced through transformation of a natural plant community or another management-induced plant community, through plowing and cultivation. These areas are seeded to cash or forage crops, primarily small grains, forage sorghum, and grain sorghum. Small grains generally include wheat and oats, either for grain or forage, and sometimes both in years of favorable rainfall. Some components of the Shallow Site, such as the Kavett soils, generally are not suited to cultivation, due to being too cobbly, too shallow, or having limestone bedrock outcrops. However, other components, such as the Mereta soils, are arable but production is limited by low available water capacity. Many of these areas have been successfully cultivated for production of small grains, forage sorghums, and grain sorghum. Cool-season crops generally do better than warm-season crops, due to the droughty nature of the site. Cool-season small grains yield 1200 to 1500 pounds of vegetation while warm-season small grains yield 2000 to 2500 pounds of vegetation. In some cases, changes in management objectives make this site more desirable for perennial forages. The Annual Crop Community can be readily converted to either Native or Introduced Seeding Communities, through plowing and planting with adapted perennial grasses. Cultivated areas of this site sometimes do not maintain a suitable level of production from annual cropping to justify increased energy inputs for long-term use as cropland. This is usually due to excessive erosion, loss of topsoil, and low fertility. Under these circumstances, it is not unusual for the Cropland Community to be abandoned and allowed to undergo secondary succession, leading to the Abandoned Land Community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1793	2690	3363
Forb	112	168	224
Tree	–	–	–
Shrub/Vine	–	–	–
Total	**1905**	**2858**	**3587**

Figure 21. Plant community growth curve (percent production by month). TX2501, Introduced Seeding - Pastureland. Introduced Seeding on Pasturelands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	12	25	20	5	5	14	8	2	1

Figure 22. Plant community growth curve (percent production by month). TX2508, Cool Season Small Grain. Cool-season small grains such as wheat and oats..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	5	10	10	5	0	0	0	20	25	15	5

Figure 23. Plant community growth curve (percent production by month). TX2510, Warm Season Forage Sorghum. Warm Season crops such as Forage and Grain Sorghum..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	20	25	20	10	10	5	2	0	0

Figure 24. Plant community growth curve (percent production by month). TX2511, Native Seeding Range. Native seed mix on rangelands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	12	25	20	5	5	14	8	2	1

Community 3.2
Abandoned Land Community

Figure 25. 3.2 Abandoned Land Community

The Abandoned Land Community results from the abandonment of cropland, rangeland or pastureland. It may also result from the lack of pasture management, including pest management and brush management on pastureland. The Abandoned Land Community (3.2) is undergoing secondary plant succession toward higher seral stages of natural plant communities. Such areas slowly become naturally revegetated with native species. The initial stage

will be primarily annual grasses and forbs, then eventually establishment of pioneer perennials, such as sand dropseed, tumblegrass (*Schedonnardus paniculatus*), red grama, halls panicum, croton, scurfpea (Psoralea spp.), curlycup gumweed (*Grindelia squarrosa*), Cutleaf happlopappus (Happlopappus spinoulosis), and verbena (Verbena spp.). Buffalograss will begin colonizing some areas in small circular patterns, and curlymesquite will increase. Midgrasses would be much slower in reestablishing on the degraded soils. Silver bluestem, which migrates easily with its feathery seeds, would be one of the earlier midgrasses to return. Sideoats grama, green sprangletop, and plains bristlegrass may return slowly, depending upon level of grazing management, since these are palatable species for livestock. Many of the midgrasses formerly found on the site would not return in significant amounts, due to the degraded soils and competitive advantage of reinvading woody plants. Texas wintergrass, a cool-season midgrass, would return early and continue to increase, along with mesquite and pricklypear. This vegetative state would eventually resemble the Mesquite/Pricklypear/Shortgrass Community (2.1), unless management practices are implemented to alter natural ecological processes. Go-back land could be improved to the point of a subdued grassland state of low productivity, through chemical brush management, using individual plant treatment (IPT), and prescribed grazing. However, due to degradation of soils, low fertility, limited organic matter, and altered soil structure, the Abandoned Land Community (3.2) would not return to the higher seral stages, nor resemble the original prairie grassland of the past. The Abandoned Land Community (3.2) could be returned to either Native Range Seeding or Introduced Pasture Seeding Communities through plowing, brush management, range planting or pasture planting, and pest management (weed control), followed by prescribed grazing on either range or pasture. Plowing and cultivation would be required to return the Abandoned Land Community (3.2) to the Annual Crop Community.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	308	493	616
Forb	168	269	336
Shrub/Vine	56	90	112
Tree	28	45	56
Total	**560**	**897**	**1120**

Figure 27. Plant community growth curve (percent production by month). TX2517, Go Back Land - Mesquite/Pricklypear. Go Back Land with increase of mesquite and pricklypear..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	5	12	25	20	5	5	14	8	2	1

Pathway 3.1
Community 3.1 to 3.2

Converted Land Community **Abandoned Land Community**

When the Converted Land Community becomes abandoned, idled, no brush management, no pest management and brush encroachment of undesirable species, the community will shift to the Abandoned Land Community.

Pathway 3.2A
Community 3.2 to 3.1

Abandoned Land Community Converted Land Community

Go-back land could be improved to the point of a subdued grassland state of low productivity, through chemical brush management, using individual plant treatment (IPT), and prescribed grazing. However, due to degradation of soils, low fertility, limited organic matter, and altered soil structure, the Abandoned Land Community (3.2) would not return to the higher seral stages, nor resemble the original prairie grassland of the past. The Abandoned Land Community (3.2) could be returned to either Native Range Seeding or Introduced Pasture Seeding Communities through plowing, brush management, range planting or pasture planting, and pest management (weed control), followed by prescribed grazing on either range or pasture. Plowing and cultivation would be required to return the Abandoned Land Community (3.2) to the Annual Crop Community.

Conservation practices

Brush Management
Conservation Crop Rotation
Forage and Biomass Planting
Prescribed Grazing
Range Planting
Nutrient Management
Integrated Pest Management (IPM)

Transition T1A
State 1 to 2

With heavy continuous grazing, no brush management, brush invasion, and no fires, the Grassland State will transition into the Shrubland State.

Transition T1B
State 1 to 3

With the conversion of the Grassland State to the Converted Land State, various treatments are needed: Pasture Planting, Crop Cultivation, Range Planting, Pest Management, Nutrient Management, Plowing, and Prescribed Grazing.

Restoration pathway R2A
State 2 to 1

With the implementation of various conservation practices including Prescribed Grazing, Brush Management (IPT), Range Planting, and Prescribed Burning, the Shrubland State can be restored to the Grassland State.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Range Planting

Transition T2A
State 2 to 3

With the conversion of the Shrubland State to the Converted Land State, various treatments are needed such as Pasture Planting, Crop Cultivation, Range Planting, Pest Management, Nutrient Management, Plowing, and Prescribed Grazing in order for the transition to occur.

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	**Tallgrass**			252–504	
	little bluestem	SCSC	*Schizachyrium scoparium*	252–504	–
2	**Tallgrasses**			84–168	
	big bluestem	ANGE	*Andropogon gerardii*	84–168	–
	Indiangrass	SONU2	*Sorghastrum nutans*	84–168	–
3	**Midgrasses**			504–1009	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	504–1009	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	504–1009	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	504–1009	–
	Arizona cottontop	DICA8	*Digitaria californica*	504–1009	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	504–1009	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	504–1009	–
	green sprangletop	LEDU	*Leptochloa dubia*	504–1009	–
	vine mesquite	PAOB	*Panicum obtusum*	504–1009	–
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	504–1009	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	504–1009	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	504–1009	–
4	**Shortgrasses**			168–336	
	buffalograss	BODA2	*Bouteloua dactyloides*	168–336	–
	curly-mesquite	HIBE	*Hilaria belangeri*	168–336	–
5	**Shortgrasses**			202–404	
	threeawn	ARIST	*Aristida*	202–404	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	202–404	–
	hooded windmill grass	CHCU2	*Chloris cucullata*	202–404	–
	fall witchgrass	DICO6	*Digitaria cognata*	202–404	–
	Hall's panicgrass	PAHA	*Panicum hallii*	202–404	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	202–404	–
	slim tridens	TRMU	*Tridens muticus*	202–404	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	202–404	–
6	**Shortgrasses**			34–67	
	Texas grama	BORI	*Bouteloua rigidiseta*	34–67	–
	red grama	BOTR2	*Bouteloua trifida*	34–67	–
	Australian windmill grass	CHVE	*Chloris ventricosa*	34–67	–

	hairy woollygrass	ERPI5	*Erioneuron pilosum*	34–67	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	34–67	–
7	**Cool Season Grasses**			168–336	
	cedar sedge	CAPL3	*Carex planostachys*	168–336	–
	Canada wildrye	ELCA4	*Elymus canadensis*	168–336	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	168–336	–
8	**Annuals**			17–34	
	Grass, annual	2GA	*Grass, annual*	17–34	–
Forb					
9	**Forbs**			151–303	
	Indian mallow	ABUTI	*Abutilon*	151–303	–
	angel's trumpets	ACLO2	*Acleisanthes longiflora*	151–303	–
	Drummond's onion	ALDR	*Allium drummondii*	151–303	–
	dozedaisy	APHAN3	*Aphanostephus*	151–303	–
	aster	ASTER	*Aster*	151–303	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	151–303	–
	croton	CROTO	*Croton*	151–303	–
	Texas croton	CRTE4	*Croton texensis*	151–303	–
	purple dalea	DALA4	*Dalea lasiathera*	151–303	–
	bundleflower	DESMA	*Desmanthus*	151–303	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	151–303	–
	perfumeballs	GASU	*Gaillardia suavis*	151–303	–
	beeblossom	GAURA	*Gaura*	151–303	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	151–303	–
	gumhead	GYGL	*Gymnosperma glutinosum*	151–303	–
	Chalk Hill hymenopappus	HYTE2	*Hymenopappus tenuifolius*	151–303	–
	Gregg's tube tongue	JUPI5	*Justicia pilosella*	151–303	–
	trailing krameria	KRLA	*Krameria lanceolata*	151–303	–
	dotted blazing star	LIPU	*Liatris punctata*	151–303	–
	low menodora	MEHE2	*Menodora heterophylla*	151–303	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	151–303	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	151–303	–
	groundcherry	PHYSA	*Physalis*	151–303	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	151–303	–
	snoutbean	RHYNC2	*Rhynchosia*	151–303	–
	wild petunia	RUELL	*Ruellia*	151–303	–
	twoleaf senna	SERO8	*Senna roemeriana*	151–303	–
	awnless bushsunflower	SICA7	*Simsia calva*	151–303	–
	silverleaf nightshade	SOEL	*Solanum elaeagnifolium*	151–303	–
	Texas nightshade	SOTR2	*Solanum triquetrum*	151–303	–
	globemallow	SPHAE	*Sphaeralcea*	151–303	–
	greenthread	THELE	*Thelesperma*	151–303	–

	rue of the mountains	THTE2	*Thamnosma texana*	151–303	–
	bristleleaf pricklyleaf	THTE7	*Thymophylla tenuiloba*	151–303	–
	crinklemat	TIQUI	*Tiquilia*	151–303	–
	noseburn	TRAGI	*Tragia*	151–303	–
	vervain	VERBE	*Verbena*	151–303	–
	creepingoxeye	WEDEL	*Wedelia*	151–303	–
	white sagebrush	ARLUM2	*Artemisia ludoviciana ssp. mexicana*	151–303	–
	prairie clover	DALEA	*Dalea*	151–303	–
Shrub/Vine					
10	**Shrubs/Vines**			67–135	
	catclaw acacia	ACGR	*Acacia greggii*	67–135	–
	javelina bush	COER5	*Condalia ericoides*	67–135	–
	snakewood	CONDA	*Condalia*	67–135	–
	Christmas cactus	CYLE8	*Cylindropuntia leptocaulis*	67–135	–
	featherplume	DAFO	*Dalea formosa*	67–135	–
	Texas persimmon	DITE3	*Diospyros texana*	67–135	–
	jointfir	EPHED	*Ephedra*	67–135	–
	stretchberry	FOPU2	*Forestiera pubescens*	67–135	–
	desert-thorn	LYCIU	*Lycium*	67–135	–
	algerita	MATR3	*Mahonia trifoliolata*	67–135	–
	catclaw mimosa	MIAC3	*Mimosa aculeaticarpa*	67–135	–
	Texas sacahuista	NOTE	*Nolina texana*	67–135	–
	pricklypear	OPUNT	*Opuntia*	67–135	–
	fragrant sumac	RHAR4	*Rhus aromatica*	67–135	–
	littleleaf sumac	RHMI3	*Rhus microphylla*	67–135	–
	bully	SIDER2	*Sideroxylon*	67–135	–
	yucca	YUCCA	*Yucca*	67–135	–
	Texas Hercules' club	ZAHI2	*Zanthoxylum hirsutum*	67–135	–
	lotebush	ZIOB	*Ziziphus obtusifolia*	67–135	–
Tree					
11	**Trees**			17–34	
	netleaf hackberry	CELAR	*Celtis laevigata var. reticulata*	17–34	–
	juniper	JUNIP	*Juniperus*	17–34	–
	honey mesquite	PRGL2	*Prosopis glandulosa*	17–34	–
	live oak	QUVI	*Quercus virginiana*	17–34	–

Animal community

The animal community, like the plant community, is a component of a larger and more complex ecosystem. The animal community includes the primary consumer organisms, which interface directly with the vegetative component of the ecological site, as well as the secondary and tertiary consumers (carnivores and scavengers). All play a vital role in maintaining the cycling of nutrients and flow of energy in the ecosystem. Some animal species were site-specific, but many species common to the region used various ecological sites in association with one-another.

The animal community changed dramatically from the early 1800s to early 1900s, as a result of overexploitation of various wildlife species through unregulated market hunting, trapping, poisoning, and wanton destruction. Some of

the most drastic changes in animal communities include the extinction of populations, species, and subspecies, changes in geographical distribution, and the introduction of non-endemic species. In the past century, changes in animal populations have been more related to loss or fragmentation of critical habitat. Loss of habitat is usually the major cause of population declines or even extinction of some species. Cultivation has been the demise of many wildlife species, such as the prairie chicken and certain kinds of waterfowl, while still other species, such as the pronghorn, have been displaced geographically. However, the problem does not always result from total destruction of habitat, but often involves the loss of one or more critical habitat components, such as mating and nesting habitat for certain birds, or in other cases the reduction in area or continuity of desirable habitat.

The major problem affecting many wildlife species of the Shallow Ecological Site was and continues to be degradation of the plant community and soils. As this site changed from a midgrass dominant community to a shortgrass and shrub dominant plant community, the animal component also changed. The true grassland animal species decreased their use of the site with loss of the prairie midgrasses and increase of woody cover. The site would have become less desirable for species, such as pronghorn, lesser prairie chicken, and certain species of grassland sparrows. Some of the mice and other small rodents migrated into the Mesquite/Pricklypear/Shortgrass Community, as well as the Converted Land Community Community, because they were more adapted to such habitats. Conversion of the natural plant communities of the Shallow Ecological Site to the Converted Land Community results in major habitat destruction and habitat fragmentation. Many wildlife species will use some crops as a food source, but still need cover and water in close proximity for survival. Conversion of the natural plant communities to the Converted Land Community also has a major impact on resident wildlife, since grass monocultures do not provide suitable habitat for many wildlife species. On-the-other-hand, such conversions can have positive benefits for domestic livestock, in terms of increased forage production, seasonally, and nutrition. Species having limited tolerance to habitat change abandoned certain vegetative states for more suitable habitat in another community, or in some cases were extirpated from the region.

The reference plant community of the Shallow Ecological Site was used by a diversity of indigenous wildlife which preferred grassland habitat. The larger grazing and browsing herbivores included bison, elk, pronghorn and white-tailed deer. The smaller mammals included prairie dog, badger, jackrabbit, cottontail rabbit, skunk, ground squirrel and various other species of small rodents. Transient species, such as bats, occasionally used the site intermittently or incidental to more preferred or associated sites. Carnivores included the wolf, coyote, bobcat, fox, black-footed ferret, ocelot and mountain lion. Birds included lesser prairie chicken, wild turkey, bobwhite quail, scaled quail, doves, nighthawk, roadrunner, and numerous species of sparrows, eagles, hawks and vultures. Various snakes and lizards, including the rattlesnake and horned lizard, also occurred in the historic climax plant community.

The migratory bison was the largest herbivore grazing the historic climax plant community. Bison probably grazed the Shallow Ecological Site intermittently in association with surrounding sites. They were selective grazers, preferring primarily grasses, while utilizing only a few forbs and very little woody browse. Bison often grazed an area heavily, but it was primarily during winter dormancy of the warm-season prairie grasses, and long deferment periods occurred before the next migration into the area. Unlike bison grazing, earlier domestic livestock grazing was both heavy and continuous. Domestic cattle eventually replaced the endemic bison and became the principal larger grazing herbivore, after 1860.

The elk, another large migratory herbivore, used the Shallow Ecological Site on an intermittent basis during the winter. The elk was primarily a grazer, using grasses and forbs in this wintering location, although newer leader growth of some shrubs would have been used. The elk probably did not impact the plant community to the extent of the bison. Like the bison, elk were eventually extirpated from this region, due to over exploitation, competition with domestic livestock, and land use practices after European settlement.

Local populations of pronghorn occupied the area year-round, prior to European settlement. The pronghorn was primarily a grazer, with strong preference for forbs, while using considerably less woody browse and grasses. Pronghorn populations are believed to have decreased in the Rolling Plains, due to extirpation of the larger predators, the increase of brush on the prairies, competition with domestic sheep, and the introduction of netwire fencing. The pronghorn has been displaced geographically and no longer inhabits the immediate region. Individuals or small groups of pronghorn may occasionally wander into this region from farther west.

White-tailed deer was another non-migratory herbivore with a considerably smaller home range than the antelope. The white-tailed deer is considered to be primarily a browser but also utilizes large quantities of forbs, including cool-season annuals, and some cool-season grasses in winter and early spring, while using very limited amounts of

warm-season grasses in any season. The Shallow Ecological Site provided a wide variety of preferred food items of the white-tailed deer, and scattered woody shrubs and motes provided edge-effect and screening cover. The site was used in association with other sites in the area. Since European settlement, the white-tailed deer population has increased dramatically. The increase in the white-tailed deer population may be attributed to extirpation of the wolf and mountain lion, primary predators of the deer, increase of woody vegetation, eradication of the screwworm fly, and intensive predator control, as well as early regulatory restrictions on harvest of does. During the past three decades (1970-2004), great progress has been made in wildlife management, through habitat improvement, as well as selective population controls (primarily through hunting), including harvest of does and manipulation of buck:doe ratios. The white-tailed deer has become the most popular large game species in the region, and contributes immensely to local economies.

The reference plant community of the Shallow Ecological Site was marginally suitable to the javelina. It prefers habitat with dense woody cover and cacti. The site actually became more favorable to the javelina, following retrogression of the plant community, in which woody species and cacti increased in abundance. Pricklypear and mesquite beans are highly preferred dietary items. Interest in the javelina as a game species has grown in recent years, especially among bow hunters.

Smaller herbivores of the Shallow Ecological Site include jackrabbit, cottontail rabbit, black-tailed prairie dog, Mexican ground squirrel and many species of smaller rodents. Their diets consisted of herbage, seeds, and mast. Also occurring on the site, usually in association with other sites, were the striped skunk, raccoon, and opossum, which are omnivorous with mixed diets of insects, arthropods, roots, tubers, mast, fish, occasional rodents and carrion. Small carnivores included black-footed ferret, badger and ringtail with diets of rodents and insects. The black-footed ferret, which preyed primarily on the prairie dog when it was abundant, has been extirpated from the region and is near extinction.

The prairie dog was despised by European settlers, leading to large-scale control of the rodent by shooting and poisoning, in association with natural dieoffs from disease. These events led to major reductions in prairie dog populations throughout the region. Very few active prairie dog towns remain in the region. These relict prairie dog towns are small and very sparsely dispersed throughout the region. The vegetative state of the prairie dog towns represented degraded plant communities from higher seral stages. Since abandonment of prairie dog towns, the sites have been undergoing long-term secondary plant succession.

Lesser prairie chicken used the Shallow Ecological Site for feeding, nesting, and brood rearing, as long as the taller midgrasses were plentiful. Vegetation structure usually was more important than plant species in the life cycle of this bird and many others. The taller, standing dry grasses from previous year’s growth were important to nesting success. Openings among the taller bunchgrasses provided ease of movement by young chicks and protection from avian predators. The chicks and juveniles fed primarily upon protein-rich insects, which were abundant and easily accessible on recently burned areas. Prairie chickens used the open shortgrass or bare areas, and recently burned areas for leks, where the males performed their courtship ritual. Even after loss of midgrass dominance the prairie chicken continued to use the same historical leks on this and other sites, until rendered undesirable by excessive brush encroachment. The lesser prairie chicken no longer occurs in this immediate region, now relegated to only isolated populations farther north and northwest. All prairie chicken species and subspecies were true prairie birds, which have been so strongly affected by loss and fragmentation of grassland habitat, that some are now rare or on the brink of extinction.

Many other species of birds still inhabit the Shallow Ecological Site in the alternate vegetative states, although species composition differs considerably from that found in the reference plant community. Wild turkey, bobwhite quail, and scaled quail still occur in one or more of the communities, but the lesser prairie chicken has been extirpated. Many species of grassland passeriformes, including songbirds such as larks and sparrows, have been displaced due to increase in woody cover and cacti. The community has become more desirable for other species, such as wrens and thrashers, which prefer habitat with more woody cover. The roadrunner is a unique bird from the past, which thrives in vegetative states with abundance of woody vegetation and cacti such as the Mesquite/Pricklypear/Shortgrass Community. It feeds upon a variety of items including lizards, snakes, insects, and pricklypear tunas, common to such plant communities. The roadrunner nests in thorny shrubs and sometimes in larger pricklypear plants. Numerous species of hawks, many migratory, still use this site, due to the abundance of rodents and rabbits.

Birds of prey associated with the Shallow Ecological Site, included eagles, hawks and falcons. Some of the

common hawks, included Swainson's hawk, red-tailed hawk and Harris' hawk. The American kestrel was a small falcon using the site. The golden eagle was common and fed mostly on jackrabbits and other small mammals, as well as young lambs and kid goats. After settlement of the area, the golden eagle population was extirpated from this ecosystem and now only infrequently ventures into this region from farther west. The bald eagle occurred primarily around perennial streams and lakes, since their primary prey was fish. The bald eagle became endangered during the mid twentieth century. Although still rare, the bald eagle has recovered sufficiently enough to be removed from the endangered species list. Law now protects all eagles and hawks.

Both turkey and black vultures were and still are common to the Shallow Ecological Site and surrounding sites in the area. They are not site specific. Vultures are scavengers, feeding primarily on dead animals and birds. These tertiary consumers are important in accelerating nutrient cycling and flow of energy in the ecosystem. Although not commonly known, federal and state law also protects the vultures.

Snakes, lizards and tortoise are still important components of the Shallow Ecological Site. Many of the reptiles are important prey species of predators and omnivores. The rattlesnake, a remnant from the historic climax plant community or far beyond, was the only poisonous snake endemic to the site. Occasional rock outcrops on this site provided dens for the rattlesnake and its prey. The unique horned lizard, another remnant from past eras, also occurred on this site. It preferred bare or sparsely vegetated areas, especially where its primary dietary item, the red harvester ant, was abundant. The horned lizard has become rare during the late twentieth century, due to reduction of major dietary items within its very small home range, increased predation, and human activities.

Larger mammalian predators using the Shallow Ecological Site included the gray wolf, coyote, red fox, gray fox, ocelot, bobcat and occasional mountain lion. Wolves and ocelot were common to the area before European settlement, but declined rapidly thereafter and no longer occur in the area. All of these species did not coexist in harmony, but from time to time each found a survival niche in the community. The wolf and mountain lion preyed primarily on deer and antelope, but also took some of the smaller mammals, including other predators. After ranching was begun in the area, all of the larger predators preyed upon domestic livestock. The gray fox population tends to increase as the coyote population declines and visa versa. The Shallow Ecological Site was used for denning by coyote and fox, but not simultaneously at the same location. The wolf and ocelot have been extirpated the entire state, and the mountain lion now is only as an occasional transient in this region. Viable populations of coyote, gray fox, and bobcat still exist in the area, while the red fox occurs occasionally. Coyote and bobcat predation on domestic livestock can be a problem, especially where sheep and goats are raised.

The animal component of the plant community has changed drastically since settlement and the introduction of domestic livestock, including cattle, sheep and goats. All current vegetative states of the Shallow Ecological Site are now used for the production of domestic livestock, as well as native wildlife. Domestic livestock have largely replaced the endemic large herbivores, with the exception of white-tailed deer. Cattle have replaced bison as the principal grazers, utilizing approximately 85 percent grass, 10 percent forbs, and 5 percent woody plants. Sheep have replaced pronghorn, with their strong preference for forbs, approximately 85 %, while using only about 10 % grasses and 5% browse. There is strong competition between sheep and deer for forbs, especially during late winter and spring. Spanish goats are heavy browsers with diets consisting of approximately 80% woody plants, 10% forbs, and 10 % grasses. This places them in strong competition with white-tailed deer for woody browse. Angora goats and Borer goats utilize considerably less browse than the Spanish goat, with the balance of their diets consisting of about equal proportions of forbs and grass. Both Spanish and Angora goats have been used for biological control of certain woody species, especially in conjunction with mechanical brush management and prescribed burning. Tables of plant preferences for the major kinds of animals are provided following this section.

The Shallow Ecological Site is one of the lower producing sites with considerable amounts of woody plants, especially in the Brushland and Go-back Vegetative States. These vegetative states would be less desirable for cattle, but highly desirable for Spanish goats and white-tailed deer, since both are strong browsers. The abundance of pricklypear in these states provides large amounts of pricklypear tunas (fruits). Deer and other animals utilize large amounts of pricklypear tunas when available from late summer to winter. The wide variety of forbs preferred by deer would be desirable during winter and early spring thus placing deer and sheep in strong competition. Areas with large amounts of catclaw and catclaw mimosa are undesirable for Angora goats, and to a lesser degree for sheep, due to snagging of mohair and wool. Kid goats sometimes become entangled in these shrubs and die from overexposure to heat or cold, starvation, or predation. The site also provides cover for white-tailed deer, in conjunction with other sites.

Numerous exotic herbivores have been introduced to this region, primarily from Africa and Asia. They now graze and browse the Shallow Ecological Site, in association with other sites, usually confined by high fences. Some of the more common exotic animals include axis deer, blackbuck antelope, gazelle, red deer, fallow deer, ibex, and eland. Some of the exotics compete directly with the native white-tailed deer, as well as domestic livestock. The feral hog is an exotic, invader species sometimes associated with this site. It often is destructive to rangeland through its feeding habits, which cause major soil disturbance and damage to perennial vegetation. The feral hog is considered omnivorous and sometimes preys on young lambs and kid goats, as well as ground nests of birds.

Recreational hunting is a decimating factor of wildlife species which are also considered to be game animals. Game hunting substitutes for natural predation of earlier times. Hunting can be a useful management tool when based upon sound ecological principles. On the contrary, it can be detrimental to wildlife populations, if not based upon sound principles. Hunting can be used for population control, to manipulate sex ratios, and to enhance quality of certain attributes within a population. State game laws regulate seasons and bag limits of non-migratory species, while Federal game laws take precedent over state laws in regulating the harvest of migratory species. Most exotic species using this site are hunted as an economic enterprise and are not regulated by law as to seasons or bag limits. Whitetail deer, a non-migratory species, is the only native big game animal hunted in association with the Shallow Ecological Site. Non-migratory game birds of this site are the Rio Grande wild turkey, bobwhite quail, and scaled quail. Migratory game birds using this site include the mourning dove, and more recently the white-winged dove. Wildlife management takes the form of habitat conservation and habit manipulation, as well as balancing populations with available habitat. It requires knowledge of the natural history of individual species and their specific habitat requirements. Brief statements follow, regarding some of the preferences and habitat requirements for principle native game species using the Shallow Ecological Site.

White-tailed deer prefer an edge-effect mosaic, but will readily adapt to other vegetation types or plant community states. They require cover for protection from predators (including hunters), bedding areas, travel corridors, and thermoregulation of body temperature. White-tailed deer are strong browsers, utilizing large amounts of certain woody plants on a seasonal basis. White-tailed deer also utilize large amounts of forbs and some cool-season grasses, especially during late fall, winter, and early spring. Some of the preferred perennial forbs are used during the summer and fall. They are, however, very selective as to species (see table of preference ratings).

The Rio Grande turkey prefers to locate in the vicinity of roost trees, but they range over large areas while feeding. They would use this site in conjunction with others for feeding and cover. The wild turkey feeds on seeds and mast of many plants occurring on the Shallow Ecological Site. They also use large amounts of herbaceous plant material, including lush green grass, especially Texas wintergrass, during fall, winter, and spring. Turkeys would nest among the taller midgrasses of this site when it is in a higher stage of plant succession. Structure is the key vegetation attribute for most ground nesting birds, with the exception of the nighthawk and killdeer.

Bobwhite quail prefer edge-effect, and scattered shrubs with underspace, such as lotebush and littleleaf sumac, which provide loafing areas and cover from raptors. Combinations of bunchgrasses and low shrubs provide good nesting cover. The Shallow Ecological Site supports many plants, especially the leguminous forbs and shrubs, which produce hard seeds preferred by quail. Many of the annual forbs also produce desirable foods of the bobwhite quail. The scaled (blue) quail prefers the more regressed plant communities of this site to higher seral stages of dense grass cover. It prefers openness in the understory, bare ground, and shortgrasses, which facilitates their running nature and their preference or tolerance for more woody cover and cacti. They use many of the same foods as bobwhites, in addition to fruits of the tasajillo and pricklypear. Both species also use considerable amounts of leafy herbage in their diets.

Additional information on both game and non-game species is available from local offices of Natural Resources Conservation Service, Texas Agricultural Extension Service, Texas Parks and Wildlife Department, or range, wildlife, and biology departments of various universities.

Hydrological functions

The reference plant community of the Shallow Ecological Site, with its abundance of deep-rooted bunchgrasses, good surface mulch, moderately high soil organic matter, and limited erosion, contributed to optimum hydrologic functions, within limitations of the prevailing climate, geology, and soils. Infiltration and percolation of water to plant root zones was good, and runoff was medium. Permeability was moderate to slow in surface layers, depending on depth and amounts of hardened layers beneath the surface and amounts of cobbles in the soil profile. The soils of

this site are well drained, but have low available water capacity. Therefore, this was and still is a droughty site, requiring more frequent rainfall to maintain adequate moisture for plant growth. The soils' low available water capacity and medium runoff limit precipitation effectiveness. Light showers are ineffective in benefiting the deeper-rooted midgrasses, although the short grasses and annuals may have short-term benefits. Deep percolation beyond the root zone is limited, due to low annual precipitation and hardened subsurface layers of caliche and limestone. However, where limestone is fractured, some water would reach greater depths during higher rainfall events, provided adequate surface cover is available to reduce runoff. The Shallow Ecological Site would not be considered a major contributor for recharging underground aquifers or water tables, although greater than the Very Shallow Ecological Site. In some vegetative states, the site supports various woody shrubs, having limited effect on deep percolation. However, deep-rooted trees, such as the mesquite may actually provide root channels that aid deeper percolation, although this is probably offset by mesquite's heavy demand for water in its life cycle. In some instances spring flows have been revived after many years of dormancy, following removal of mesquite and juniper over large areas of a contributing watershed.

Loss of herbaceous vegetative cover, especially the larger bunchgrasses, accompanied by loss of mulch and soil organic matter, reduces infiltration and increase runoff. This occurs under heavy continuous grazing, prolonged drought and cessation of fire or untimely fire. As the deep-rooted midgrasses, such as little bluestem, sideoats grama, and cane bluestem, decrease, the shortgrasses, such as buffalograss, curlymesquite, and slim tridens, increase. Shallow-rooted, sod-forming grasses, such as buffalograss and curlymesquite, are less effective than bunchgrasses in promoting good water infiltration and reducing runoff. Increased runoff results in less infiltration, less water for plant growth, and accelerated soil erosion. Under intensive rainfall, the degraded site can contribute to down slope flooding, sedimentation, and poor water quality in streams and rivers. As degradation of the plant community and soil becomes increasingly more severe, water dynamics are more negatively impacted, resulting in impairment of the normal water cycle associated with this site.

Brush management and prescribed grazing will help improve hydrologic function over a period of several years, through increase of deep-rooted midgrasses and surface cover, which will improve water infiltration and percolation to the root zone; also reduce raindrop splash and soil erosion. Woody plants use larger amounts of water than grasses per unit of biomass produced and usually out compete grasses for available water. Reduction of woody plants through chemical versus mechanical methods will avoid soil disturbance and give grasses a competitive advantage for limited moisture. Reduction of brush canopy also will reduce evaporation of precipitation intercepted by woody canopies, thus allowing more water to reach the surface and infiltrate to replenish soil moisture for plant growth. Although hydrologic functions can be improved along with improvement in the plant community, neither will return to that of the historic climax plant community, if excessive soil loss has occurred in association with site degradation, leading to the crossing of ecological thresholds.

Soil Surveys of Concho County (1988) and Tom Green County (1976) placed the principal soils of the Shallow Ecological Site in Hydrologic Groups C and D.

Recreational uses

The Shallow Ecological Site is used for hunting, birding, hiking, camping, and horseback riding. The site provides aesthetic appeal from wildlife, and from colorful spring wildflowers. In some locations the site contains artifacts and other historical evidence of past civilizations. Interesting fossils of past fauna and flora sometimes occur in limestone outcrops and surface fragments.

Wood products

Mesquite from the Shallow Ecological Site can be used as firewood and for specialty wood work, including furniture and flooring. Blueberry juniper can be used for fence posts and stays, but redberry juniper is less desirable.

Other products

The Shallow Ecological Site contains caliche, which is mined for roadfill and construction of ranch roads. Occasional limestone boulders and flagstone occurring on the site are used in landscaping. The site may be used for honey production from some of the woody shrubs, such as catclaw and mesquite, which produce blooms favored by honeybees.

Other information

None.

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Acknowledgments

Site Development and Testing Plan:

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

Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

Rangeland health reference sheet

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

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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:** Some water flow patterns are expected.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0 to 5 percent bare ground. Small and non-connected areas.

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

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

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

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):** Dark brown (10 YR 4/3) clay loam, weak, medium, subangular blocky structure, hard, firm, few caliche fragments and few rounded quartzitic pebbles, calcareous, moderately alkaline. Soil Organic Matter is 1 to 4 percent.

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 soils, shallow with 0 to 5 percent slopes which are less susceptible to high runoff and erosion rates.

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

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: Warm-season tallgrasses > Warm-season midgrasses > Trees > Shrubs/Vines > Forbs >

    Other: Cool-season midgrasses

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

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):** 1200 to 2500 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 species are capable of reproduction except during periods of prolonged drought conditions, heavy natural herbivory or intense wildfires.
