USDA Natural Resources Conservation Service

Ecological site R042AB735TX
Gravelly, Hot Desert Shrub

Accessed: 05/07/2024

General information

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

Figure 1. Mapped extent

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

Associated sites

R042AB264TX	**Igneous Hill and Mountain, Hot Desert Shrub** The Gravelly Hot Desert Shrub will be found below Igneous Hill and Mountain Desert Shrub.
R042AB737TX	**Limestone Hill and Mountain, Hot Desert Shrub** The Gravelly Hot Desert Shrub does not have the limestone rocks in the surface.

Similar sites

R042AC244TX	**Gravelly, Desert Grassland** The Gravelly (DG) is found at higher elevations and slightly more production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Gravelly (Hot Desert Shrub) Ecological Site consists of soils that are very deep and soils that are very shallow and shallow to a restrictive layer such as a petrocalcic horizon, shale, or tuff parent material. They formed in calcareous loamy materials containing gravel from mixed sources. These soils are on nearly level, hilly uplands fan piedmonts. Slope ranges from 0 to 30 percent. Elevations range from 1950 to 3500 feet.

Table 2. Representative physiographic features

Landforms	(1) Inset fan (2) Fan remnant (3) Alluvial fan
Flooding frequency	None
Ponding frequency	None
Elevation	594–1,189 m
Slope	0–30%
Water table depth	13–183 cm

Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation ranges from 10 to 13 inches and highly variable from 2 to 21 inches. Most of the precipitation occurs as widely scattered thunderstorms of high intensity and short duration during the summer. Occasional precipitation occurs as light rainfall during the cool season. Negligible amounts of precipitation falls in the form of sleet or snow.

Mean annual air temperature is 70° F. Daytime temperatures exceeding 100° F are common from May through September. Frost free period ranges from 254 to 295 days.

The average relative humidity in mid-afternoon is about 25 percent. Relative humidity is higher at night, and the average at dawn is about 57 percent. The sun shines 81 percent of the time in summer and 75 percent in winter. The prevailing wind is from the southwest. Average wind speed is highest, around 11 miles per hour, in March and April.

The combination of low rainfall and relative humidity, warm temperatures, and high solar radiation creates a significant moisture deficit. The annual Class-A pan evaporation is approximately 94 inches.

Table 3. Representative climatic features

Frost-free period (average)	295 days
Freeze-free period (average)	334 days
Precipitation total (average)	330 mm

Influencing water features

None.

Soil features

The site consists of very shallow to very deep soils that formed in gravelly alluvium derived from igneous bedrock. Soils with restrictive layers such as a petrocalcic horizon will have very slow permeability in these layers. Runoff is low to medium on slopes less than 1 percent and very high on slopes greater than 20 percent.

The associated soil series include Agust, Corazones, Equipaje, Redford, and Ojinaga

This soil is classified as “Hyperthermic”, meaning that the Mean Annual Soil Temperature typically measured at 20 inches depth is >72 degrees F based on the summary of a 5-year soil temperature study near La Linda, Texas.

Table 4. Representative soil features

Parent material	(1) Alluvium–trachyte
Surface texture	(1) Very gravelly sandy loam (2) Very gravelly loam (3) Very gravelly fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderate
Soil depth	15–203 cm
Surface fragment cover <=3"	42–70%
Surface fragment cover >3"	2–16%

Available water capacity (0-101.6cm)	2.54–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0–80%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–10
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.4
Subsurface fragment volume <=3" (Depth not specified)	10–50%
Subsurface fragment volume >3" (Depth not specified)	1–7%

Ecological dynamics

The Historic Climax Plant Community (HCPC) on the Gravelly (Hot Desert Shrub) site consists of bunch and stoloniferous grasses along with a variety of perennial forbs and woody shrubs.

Probably the factor that most influenced the historic vegetative composition of the site was extended dry weather. High rainfall events did occur but were episodic. However, insects and grazers such as rodents, deer, and infrequent fire certainly played a part. Bison were not documented in the historical record as being present in any significant amount. A lack of water was probably a contributing factor. The perennial grasses dominating the site could survive the periodic droughts as long as the density of woody plants did not become excessive, and top-removal of the grass plants did not occur too frequently. Over grazing amplifies the effects of drought.

Early historical records do not always provide information specific to a site but can provide insight as to conditions existing in a general vicinity. Accounts suggest cattle, sheep, and horses were introduced into the southwest from Mexico in the mid-1500's. However, extensive ranching did not begin in the Trans-Pecos region until the 1880s. Early explorers described the vegetation as they traveled over parts of the Trans-Pecos. For instance, Captain John Pope in 1854 described a portion of the Trans-Pecos area as “…destitute of wood and water, except at particular points, but covered with a luxuriant growth of the richest and most nutritious grasses known to this continent…”. Other early travelers describe the scattered springs and water sources that were found in the region. Wagon travel could only be accomplished, along trails that had both water and forage sufficient for overnight stops. Livestock numbers peaked in the late 1880’s following the arrival of railroads. Some historical accounts document ranches with stocking rates as high as one animal unit per four acres; however, this was far from sustainable in this environment.

Decades of overgrazing with loss of vegetation and erosion make it a slow process to return to the HCPC community. In 1944 the southernmost portion of the Trans-Pecos area was set aside as Big Bend National Park. Grazing activities with livestock ceased. For example, in 1944, most of the Igneous Hill and Mountain Desert Grassland sites accessible to livestock were probably degraded and dominated by woody shrubs. After 60 years of no grazing, the majority of sites have not recovered to the historic plant community which provides insight into the length of time it takes for recovery in this environment.

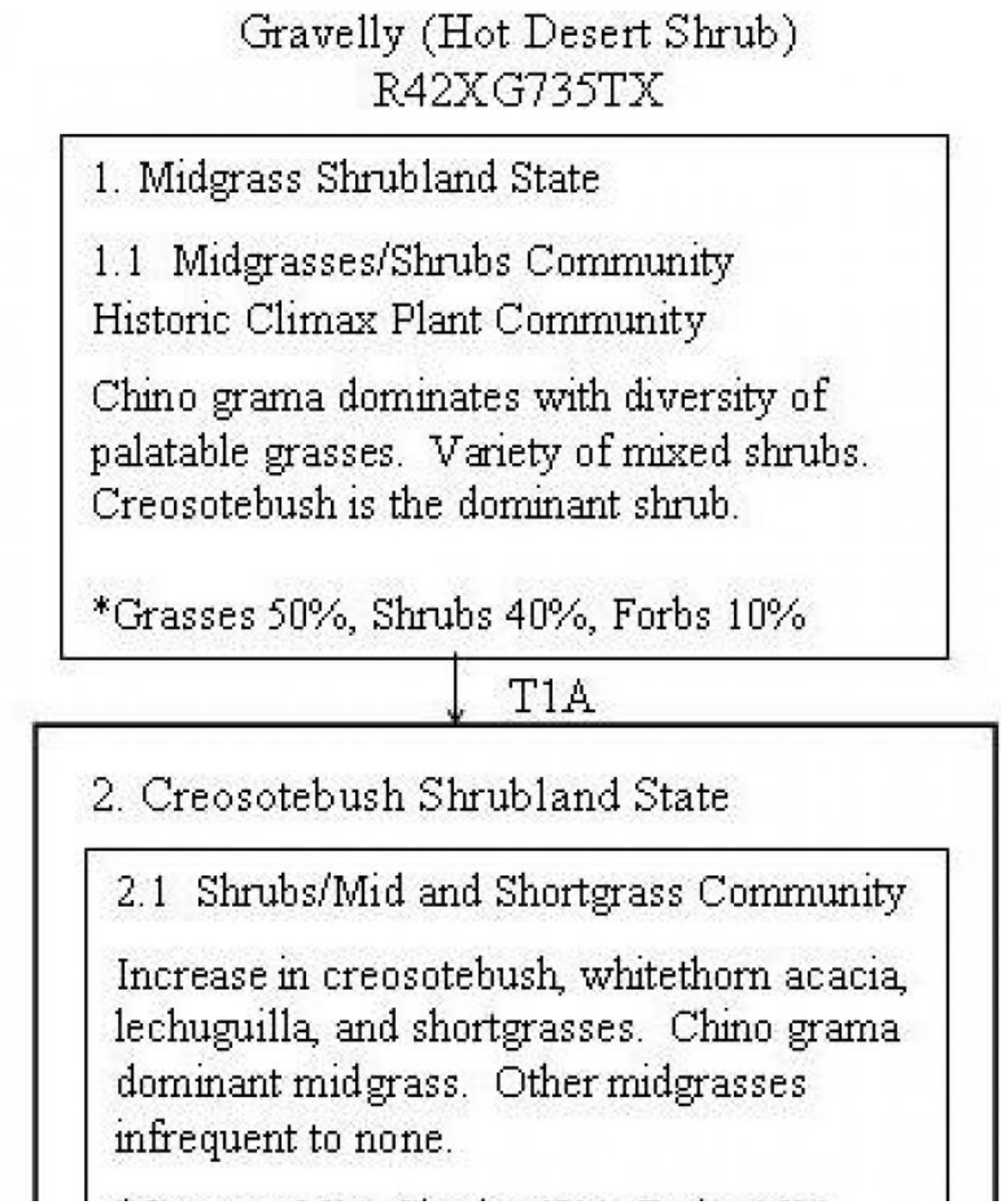
The large livestock herds brought in during the favorable years, mainly sheep, could not be sustained during the drought. Overgrazing became a major issue as the extended dry weather was a harsh taskmaster to the early stock growers.

Cattle use on rangeland declines significantly on slopes steeper than 15 percent, however cattle numbers were never very large. Sheep and goats are however able to utilize slopes up to about 45 percent and can negotiate the surface rock cover better than cattle. It should be noted that abusive grazing by different kinds and classes of livestock will result in different impacts on the site. One effect of the removal of vegetated cover was to expose bare ground to erosion. Another effect was the deterioration of perennial grasses which removed the source of fine fuel

to sustain periodic fires. More than likely, fires were not very frequent and when they did occur, the burn pattern was a mosaic governed by terrain and vegetative features.

The following diagram suggests general pathways that the vegetation on this site might follow. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances; it does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State and transition model



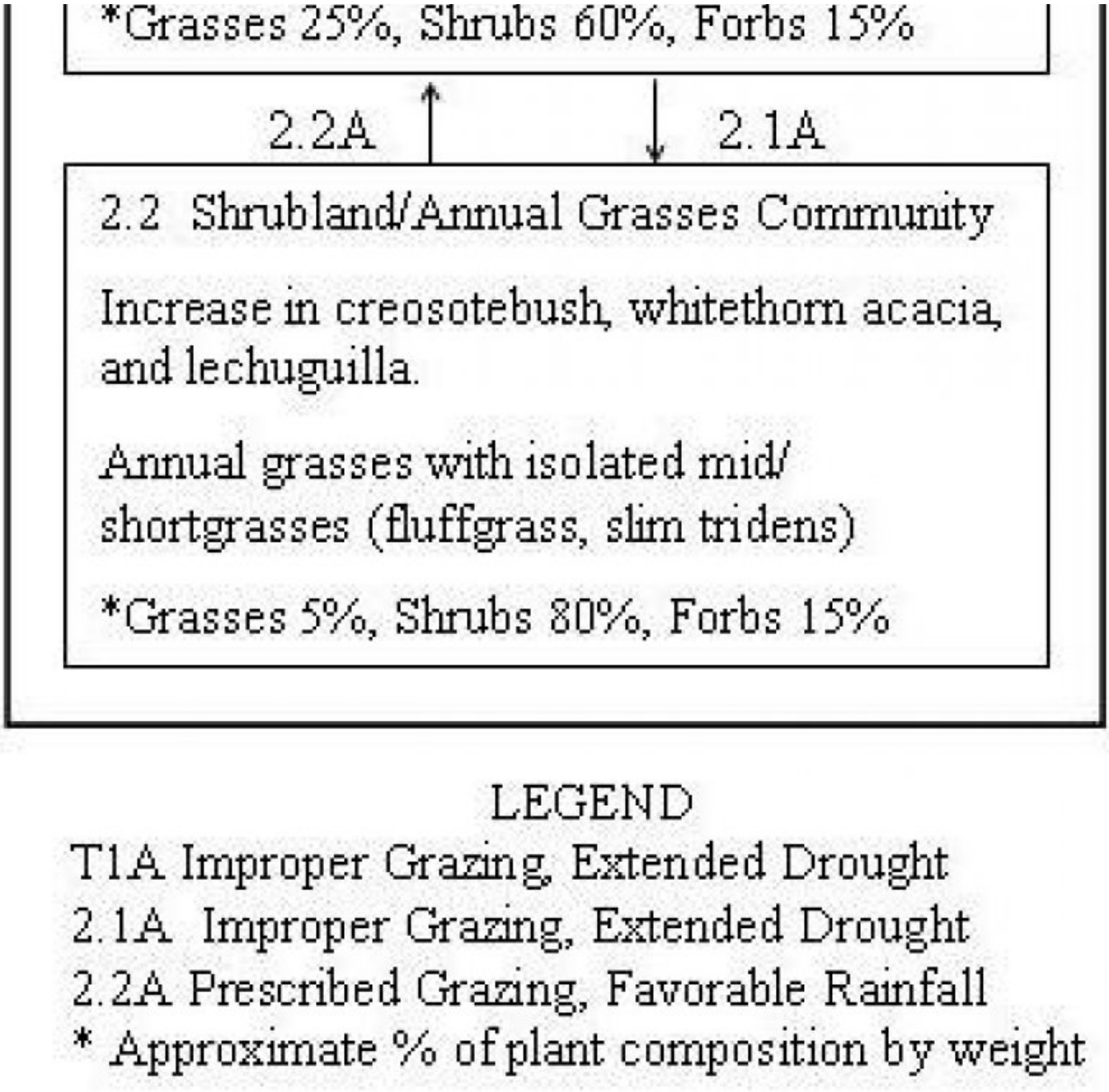


Figure 4. Gravelly (Hot Desert Shrub) - State & Transition D

State 1
Midgrass Shrubland State

Community 1.1
Midgrass/Shrub Community

The Midgrass/Shrub Community (1.1) is the reference plant community for the Gravelly (Hot Desert Shrub) Ecological Site. Grasses in the HCPC total approximately 60% of the species composition by air dry weight, while shrubs and forbs account for 30% and 10% respectively. Chino grama dominates the midgrasses along with a diversity of other palatable mid and shortgrasses. Creosotebush is the most common shrub as it thrives in gravelly and calcareous soils. A diversity of subshrubs, succulents, and forbs are also present. The characteristically high surface cover of gravels of the site helps reduce soil erosion. The diversity of plants provides necessary food and cover for native wildlife. Extended dry weather causes an overall decline in grass cover and production and can cause some retrogression. However, the HCPC evolved with plants that have drought tolerance. Long term retrogression is triggered primarily by abusive grazing which causes an immediate decrease and eradication of the most palatable plants black grama, sideoats grama, Arizona cottontop, and bush muhly. Resulting from the inherently low production potential of the site, shrub encroachment following grass removal is slow. Annual forbs, grasses, and succulents are the first to increase following a decrease in perennial grass cover Conservation

practices such as prescribed grazing can help maintain ecological integrity in the HCPC. Stocking rates need to be flexible and adjusted to carrying capacity because of sporadic rainfall.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	135	235	336
Shrub/Vine	67	118	168
Forb	22	39	56
Tree	–	–	–
Total	**224**	**392**	**560**

Figure 6. Plant community growth curve (percent production by month). TX0009, Chino Grama/Creosotebush Complex Community. Shortgrasses and shrubs dominate – Growth is predominately shortgrasses and shrubs from May through October with peak growth from July to September..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

State 2
Creosotebush Shrubland State

Community 2.1
Shrubs/Mid and Shortgrass Community

Figure 7. 2.1 Shrubs/Mid and Shortgrass Community

This plant community is the result of improper grazing (high stocking rates). Extended drought exacerbates the transition from HCPC. A compositional and irreversible threshold has been crossed. The vast majority of the most palatable grasses, forbs, and sub-shrubs have been eradicated from the plant community. Although palatable when green, Chino grama increases following the decrease of other midgrasses. It becomes the dominant, and in some places, the only perennial bunchgrass observed. Fluffgrass is an unpalatable shortgrass that increases following disturbance. Some perennial forbs and succulents increase such as dogweed, coldenia, pricklypear, and lechuguilla. Because of the inherently low productivity of the site, shrub encroachment following perennial grass reduction is very slow if at all. Climate, soil temperatures and properties, are some of the major factors limiting the restoration of the HCPC. Continued overgrazing will transition this plant community to a Shrubland/Annual Grasses community (2.2). Prescribed grazing will help maintain the ecologic integrity of the community. Stocking rates need to be flexible and adjusted to carrying capacity because of sporadic rainfall.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	135	235	336
Grass/Grasslike	56	99	140
Forb	34	58	84
Tree	–	–	–
Total	**225**	**392**	**560**

Figure 9. Plant community growth curve (percent production by month). TX0010, Mixed Shrub Dominated Community (Shortgrasses/Shrubs). Shrubs and shortgrasses dominate – Growth is predominately shrubs and shortgrasses from May through October with peak growth from July to September..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

Community 2.2
Shrubland/Annual Grasses Community

Figure 10. 2.2 Shrubland/Annual Grasses Community

Plant community 2.2 is the result of excessive overutilization of plant resources. Annual and shortgrasses dominated the herbaceous layer. Few isolated Chino grama plants can be observed. Succulents and unpalatable perennial forbs increase. Because of the inherently low productivity of the site, shrub encroachment following perennial grass reduction is very slow if at all. The appearance of this community is a very sparse shrubland. Shrubs are scattered and not overlapping. Overall canopy cover is low. With several years of prescribed grazing and favorable rainfall, some areas of this plant community have the potential to return to a Shrub mid/shortgrass community (2.1). Some areas within the lowest elevations of the site's range, may not be able to transition back to community 2.1.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	90	224	359
Forb	17	43	67
Grass/Grasslike	6	13	22
Tree	–	–	–
Total	**113**	**280**	**448**

Figure 12. Plant community growth curve (percent production by month). TX0022, Shrubs/Annual Grasses Community. Shrubs dominant with annual

grasses and isolated mid/shortgrasses..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	2	2	2	8	8	20	25	15	15	1

Pathway 2.1A
Community 2.1 to 2.2

Shrubs/Mid and Shortgrass Community

Shrubland/Annual Grasses Community

Improper Grazing and Extended Drought Conditions lead to Shrubland/Annual Grasses Community.

Pathway 2.2A
Community 2.2 to 2.1

Shrubland/Annual Grasses Community

Shrubs/Mid and Shortgrass Community

Prescribed Grazing and favorable rainfall can help the community revert back to the Shrubs/Mid and Shortgrass Community.

Conservation practices

Prescribed Grazing

Transition T1A
State 1 to 2

Improper Grazing and Extended Drought leads to Creosotebush Shrubland State.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Midgrass**			78–196	
	Chino grama	BORA4	*Bouteloua ramosa*	78–196	–
2	**Mid/Shortgrasses**			29–73	
	black grama	BOER4	*Bouteloua eriopoda*	11–28	–
	false grama	CAER2	*Cathestecum erectum*	11–28	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	7–17	–
3	**Mid/Shortgrasses**			18–45	
	Arizona cottontop	DICA8	*Digitaria californica*	9–22	–
	nineawn pappusgrass	ENDE	*Enneapogon desvauxii*	4–11	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	4–11	–

4	**Mid/Shortgrasses**			9–22	
	slim tridens	TRMU	*Tridens muticus*	4–11	–
	threeawn	ARIST	*Aristida*	2–6	–
	red grama	BOTR2	*Bouteloua trifida*	1–3	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1–3	–
Shrub/Vine					
5	**Shrubs**			40–101	
	creosote bush	LATR2	*Larrea tridentata*	22–56	–
	western honey mesquite	PRGLT	*Prosopis glandulosa var. torreyana*	4–11	–
	whitethorn acacia	ACCO2	*Acacia constricta*	2–6	–
	jointfir	EPHED	*Ephedra*	2–6	–
	American tarwort	FLCE	*Flourensia cernua*	2–6	–
	ocotillo	FOSP2	*Fouquieria splendens*	2–6	–
	Texas lignum-vitae	GUAN	*Guaiacum angustifolium*	2–6	–
	crown of thorns	KOSP	*Koeberlinia spinosa*	2–6	–
6	**Subshrubs**			16–39	
	littleleaf ratany	KRER	*Krameria erecta*	7–17	–
	woody crinklemat	TICAC	*Tiquilia canescens var. canescens*	4–11	–
	plumed crinklemat	TIGR	*Tiquilia greggii*	4–11	–
	featherplume	DAFO	*Dalea formosa*	2–6	–
	black prairie clover	DAFR2	*Dalea frutescens*	2–6	–
7	**Fibrous/Succulent**			11–28	
	leatherstem	JADI	*Jatropha dioica*	0–17	–
	pricklypear	OPUNT	*Opuntia*	4–11	–
	yucca	YUCCA	*Yucca*	2–6	–
	lechuguilla	AGLE	*Agave lechuguilla*	2–6	–
	Christmas cactus	CYLE8	*Cylindropuntia leptocaulis*	2–6	–
Forb					
8	**Perennial**			22–47	
	Forb, perennial	2FP	*Forb, perennial*	3–6	–
	croton	CROTO	*Croton*	2–6	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	2–6	–
	menodora	MENOD	*Menodora*	2–6	–
	bicolor fanmustard	NECA3	*Nerisyrenia camporum*	2–6	–
	polygala	POLYG	*Polygala*	1–3	–
	woolly paperflower	PSTA	*Psilostrophe tagetina*	1–3	–
	globemallow	SPHAE	*Sphaeralcea*	1–3	–
	pricklyleaf dogweed	THAC	*Thymophylla acerosa*	1–3	–
	vervain	VERBE	*Verbena*	1–3	–
9	**Annual**			0–11	
	Forb, annual	2FA	*Forb, annual*	0–9	–
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	0–1	–

	vervain		*ciliata*		
	bladderpod	LESQU	*Lesquerella*	0–1	–

Animal community

The historic Midgrass/Shrub Community (1.1) was part of the habitat for mule deer, songbirds, birds of prey, small mammals, and predators such as coyote, bobcat, and mountain lion. As the site changes through the Midgrass/Shrub Community (1.1) toward the Creosotebush Shrubland Community (2.1), it becomes less suitable to many animal species due to the increase in bare ground and erosion and subsequent lack of food and cover.

Many species of wildlife utilize this site for at least a portion of their habitat needs. It is also important to balance wildlife populations with carrying capacity. Mule deer need high protein forbs and browse. Quail and dove prefer a combination of low shrubs, bunchgrasses, bare ground, and forbs. Game bird species such as mourning and white dove and scaled and bobwhite quail are usually present on the site. Smaller mammals present include rodents, jackrabbit, cottontail rabbit, raccoon, skunk, possum, and armadillo. Mammalian predators like coyote, bobcat, and mountain lion are likely to be found at the site. Numerous species of snakes and lizards are native to the site.

Non-game species of birds found on this site include songbirds and birds of prey. Habitat on this site that provides a large diversity of grasses, forbs, and shrubs will support a variety and abundance of songbirds. Birds of prey are important to keep the numbers of rodents, rabbits, and snakes in balance.

Cattle find the best forage in the Midgrasses/Shrub Community (1.1). As this site reaches the Creosotebush Shrubland Community (2.1), it becomes difficult to find enough forage to thrive. An assessment of vegetation is needed to determine the site's current carrying capacity in order to avoid overgrazing. Carrying capacity in the Trans-Pecos will vary greatly from year to year depending on the episodic precipitation.

These preferences are somewhat general in nature as the preference for a plant is dependent upon animals grazing experience, time of year, availability of choices, and total forage supply.

Preferred – Percentage of plant in animal diet is greater than it occurs on the land
Desirable – Percentage of plant in animal diet is similar to the percentage composition on the land
Undesirable – Percentage of plant in animal diet is less than it occurs on the land
Not Consumed – Plant would not be eaten under normal conditions. Plants are only consumed when other forages are not available.
Toxic – Rare occurrence in diet and, if consumed in any tangible amounts results in death or severe illness in animal

Hydrological functions

The Gravelly Hot Desert Shrub site is a well-drained, very shallow to very deep gravelly upland. Its soils are moderately slow to moderately rapidly permeable. Under historic climax condition the vegetation intercepted and utilized much of the incoming rainfall. There was runoff during torrential rains due to the limited water holding capacity of the soil. The presence of rocks enhances the effectiveness of rainfall, especially small rainfall events, by concentrating it on a smaller surface area. When the site changes from grassland to shrub community there is a structural change resulting in faster runoff that carries soil particles away. Less of the rainfall is intercepted and infiltrates into the soil.

Recreational uses

The site is used for camping and hiking mostly in areas of low relief

Wood products

None.

Other products

None.

Other information

None.

Contributors

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Rangeland health reference sheet

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

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Date	02/15/2011
Approved by	Mark Moseley, ESD Specialist, Boerne, Texas
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** None, except following high intesity storms, when short (less than 1 m) and discontinuous flow patterns may appear. Flow patterns in drainages are linear and continuous.

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):** 2-5% bare ground.

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):** In drainages, there can be significant amounts of litter moved long distances. On most of the site, minimal and short distance (<5ft) of litter movement.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability values anticipated to be 2-3 in the interspaces and 3-4 under plant canopies. Values need verification at reference sites.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 0-2 inches thick, pale brown surface horizon with a weak fine subangular blocky structure. Data from Corazones soil series description

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** A high canopy cover of midgrass bunch and stoliniferous grasses will help minimize runoff and maximize infiltration. Grasses should comprise approximately 60% of total plant compostion by weight. Shrubs will comprise about 30% by weight.

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: Warm-season perennial mid bunchgrass >>

    Sub-dominant: Warm-season perennial mid/short stoloniferous = Mid/tall Shrubs >

    Other: subshrubs = perennial forbs = semi succulents > annual forbs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All grasses will show some mortality and decadence in addition to annual forbs. Mid/tall perennial shrubs will show some mortality or decadence only after prolonged and severe droughts. Subshrubs will be less resistant to severe droughts than mid/tall perennial shrubs.

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

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 200-500 lbs/acre

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: Dry climate prevents non-native species to encroach on this site. Creosotebush will increase some but will still remain in a widely spaced pattern.

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17. **Perennial plant reproductive capability:** All species should be capable of reproducing.
