USDA Natural Resources Conservation Service

Ecological site R042AC244TX
Gravelly, Desert Grassland

Accessed: 05/04/2024

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

R042AC247TX	**Igneous Hill and Mountain, Desert Grassland** The Gravelly – DG will be found below the Igneous Hill & Mountain sites.
R042AC249TX	**Limestone Hill and Mountain, Desert Grassland** The Gravelly site will be found below Limestone Hill & Mountain Site.

Similar sites

R042AB735TX	**Gravelly, Hot Desert Shrub** Similar landscape position and soil morphology, but found at lower elevations. The Gravelly Hot Desert Shrub is drier, less productive, and has some unique plants.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The sitel occurs on gravelly alluvial fans from igneous and limestone hills and mountains. Slopes range from 1 to 16 percent, mainly having 2 to 10 percent slopes. Elevation ranges from 3,600 to 4,400 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Inset fan (3) Pediment
Flooding frequency	None
Ponding frequency	None
Elevation	1,097–1,341 m
Slope	1–16%
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation ranges from 12 to 14 inches and highly variable from 3 to 32 inches. Approximately 75 percent 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.

The optimum growing season ranges from July 1 through September, but is governed by time and amount of rainfall. Although frost-free days begin in April, sufficient moisture for growing plants to reach maturity is usually not available until late summer or early fall. Mean annual air temperature is 64° F. Daytime temperatures near 100º F are common from May through August. 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 85 inches.

Table 3. Representative climatic features

Frost-free period (average)	232 days
Freeze-free period (average)	255 days
Precipitation total (average)	356 mm

Influencing water features

None.

Soil features

The site consists of very shallow to deep, well drained, moderately permeable soils that formed mostly from gravelly alluvium of mixed sources. The Boludo soil series, however, formed in residuum weathered from the Mitchell Mesa Ignimbrite (welded tuff). A slowly permeable petrocalcic horizon and hard ignimbrite are the root restricting layers found in shallow soils.

The associated soil series for this ecological site include, Boludo, Chilicotal, Cienega, Crossen, and Paisano.

Table 4. Representative soil features

Parent material	(1) Alluvium–rhyolite
Surface texture	(1) Very gravelly fine sandy loam (2) Extremely gravelly loam (3) Very gravelly clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	13–203 cm
Surface fragment cover <=3"	30–60%
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	2.54–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	2–50%

Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	20–60%
Subsurface fragment volume >3" (Depth not specified)	3–12%

Ecological dynamics

The Historic Climax Plant Community (HCPC) on the Gravelly (Desert Grassland) 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, antelope, 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. Overgrazing 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. For example, in 1944 the southernmost portion of the Trans-Pecos area was set aside as Big Bend National Park. Grazing activities with livestock ceased. In 1944, most of the Gravelly Desert Grassland sites 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 however are able to utilize steeper slopes. 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.

Lehmann’s lovegrass (*Eragrostis lehmanniana*) can occur within the, Desert Grassland and Mixed Prairie Land Resource Units. This non-native species has the potential to displace native species.

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

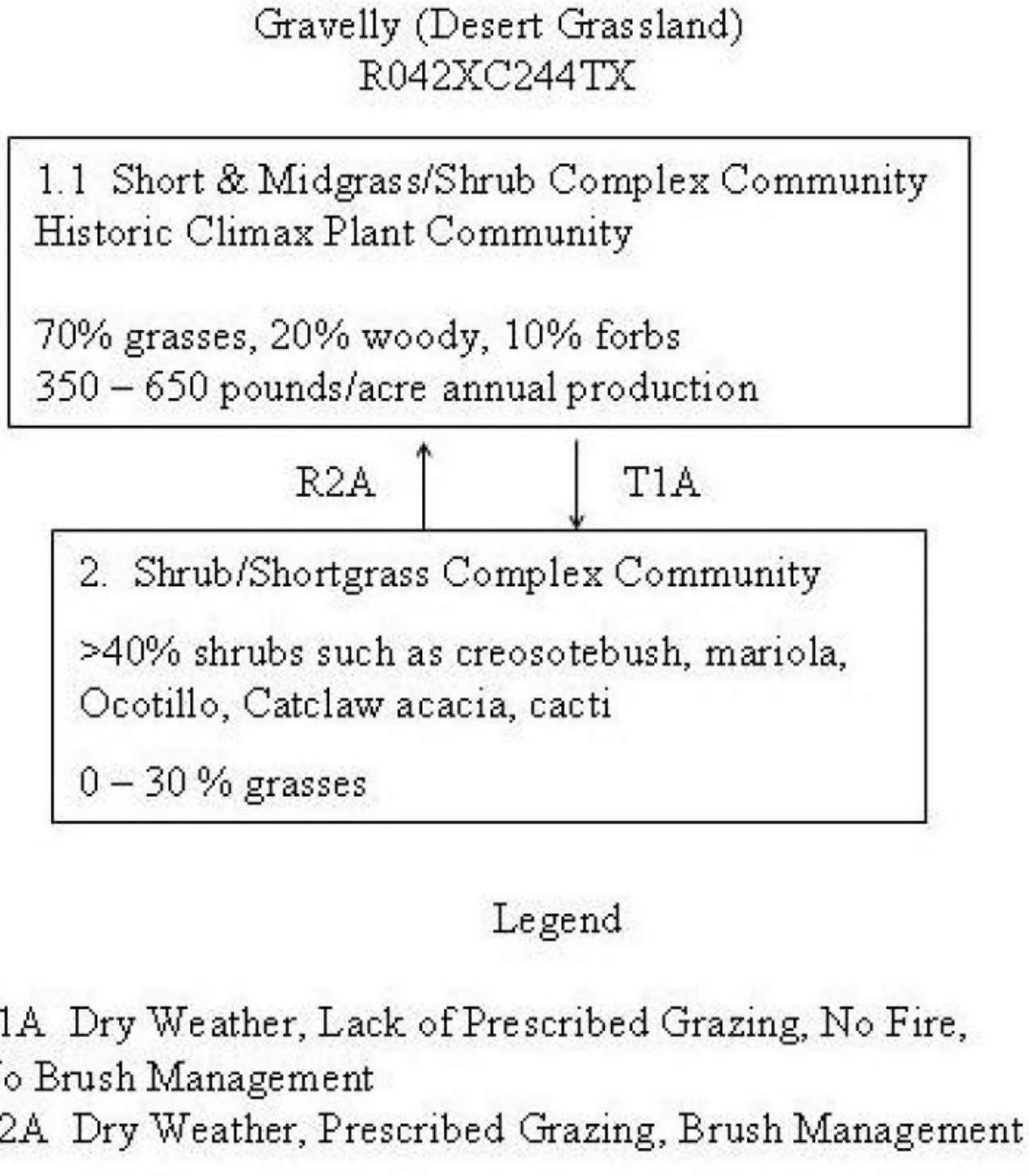

Figure 4. MLRA 42 - Gravelly (Desert Grassland) State & Tran

State 1
Short-Midgrass/Shrub Complex State

Community 1.1
Short & Midgrass/Shrub Complex Community

Figure 5. 1.1 Short & Midgrass/Shrub Complex Community

The Historic Climax Plant Community (HCPC) on the Gravelly (Desert Grassland) site consists of bunch and stoloniferous shortgrasses along with occasional midgrasses. This is the reference community for the site. The vegetation occurs as thin stands with an abundance of bare soil and rocks among sparsely distributed plants. Small, slightly depressed “micro-sites” occur within the site and support midgrasses. The HCPC contains about 70% grasses, including bush muhly (*Muhlenbergia porteri*) and black grama (*Bouteloua eriopoda*), slim tridens (*Tridens muticus*), perennial threeawns (Aristida spp.) and blue grama (*Bouteloua gracilis*). Cane bluestem (*Bothriochloa barbinodis*), sideoats grama (*Bouteloua curtipendula*), Arizona cottontop (*Digitaria californica*), and plains bristlegrass (*Setaria vulpiseta*) compose a small percentage of the HCPC. Perennial forbs such as menodora (Menodora spp.), perennial bladderpod (Lesquerella spp.), and hairy tubetongue (Siphonoglossa pilosella) are important forbs. Plants such as range ratany (*Krameria erecta*), creosotebush (*Larrea tridentata*), and ephedra (Ephedra spp.) are an important part of the woody component. Bare ground is less than 10% in the HCPC. Even a small amount of erosion can be significant due to the shallow nature of the soil. Infiltration is moderate. Runoff occurs during heavier rainfall, but is slowed by rocks covering the soil and vegetative ground cover. Concentrated water flow patterns are very rare. Episodic climate, grazing/browsing by historic wildlife, and very rare periodic fire were natural processes that maintained this historic plant community. This plant community is useful for grazing, depending on slope and surface rock cover, but stocking rates must remain very conservative to maintain the HCPC. Drought poses a very prominent risk factor of overstocking as this climate can be described as “continually below normal rainfall with occasional above average rainfall years”. If livestock are not carefully managed, the grazing impact is likely to cause changes from the Short and Midgrass/Shrub Community (1.1) to the Shrub/Shortgrass Community (2.1). Free roaming wildlife will continue to graze the site under drought conditions and should be managed accordingly to stay within carrying capacity. The site also contains food and cover for dove, quail, and other types of wildlife. Below average rainfall coupled with overgrazing drives the transition to the Shrub/shortgrass community. A lack of viable brush management options allows woody plants to increase unchecked. Removal of grasses also precludes the occasional naturally occurring fire.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	314	471	628
Shrub/Vine	90	135	179
Forb	90	135	179
Tree	–	–	–
Total	**494**	**741**	**986**

Figure 7. Plant community growth curve (percent production by month). TX0014, Shortgrass/Midgrass/Shrubs Community. Mid and short grasses with shrubs – Growth is predominately mid and short grasses with 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
Shrub/Shortgrass Complex State

Community 2.1
Shrub/Shortgrass Complex Community

Figure 8. 2.1 Shrub/Shortgrass Complex Community

Secondary herbaceous species and shrubs are replacing grasses and palatable forbs in the Shrub/Shortgrass Complex Community (2.1). Extended low precipitation, overgrazing, and no brush management exacerbate the change. The historically dominant grass species decline and are replaced by species such as burrograss (*Scleropogon brevifolius*), false grama (*Cathestecum erectum*), fluffgrass (*Tridens texanus*), broom snakeweed (*Gutierrezia sarothrae*), and annuals. Shrubs such as creosotebush, mariola (*Parthenium incanum*), ocotillo (*Fouquieria splendens*), catclaw acacia (*Acacia greggii*), and cacti (Opuntia spp.) increase to more than 40% of the vegetation. Creosotebush often becomes dominant and has been documented to be allelopathic. The amount of bare ground increases to greater than 30%. Loss of vegetation is significant and exposes the surface. Bare ground causes a chain reaction of increases in soil temperature, soil crusting, the potential for erosion, and a decrease in infiltration. Runoff increases and signs of erosion become more apparent. At this point, the gravel acts as a ”desert pavement” with is a very stable situation. This plant community is still useful for grazing, but stocking rates must be kept lower than under the HCPC. Brush management can help to slow woody encroachment but options are limited and the economics are questionable. In all cases prescribed grazing is an essential component of recovery. The site also contains food and cover for mule deer, dove, quail, and other types of wildlife. Wildlife populations should also be managed at carrying capacity. The Shrub/Shortgrass Complex Community (2.1) may possibly be returned to something resembling the HCPC provided focused management including some form of brush management underpinned by prescribed grazing. Range planting can accelerate the recovery but comes with an element of high risk in this climate. A number of years will most likely be needed for establishment. . Seeding is risky because of the episodic nature of the rainfall. If the erosion and loss of topsoil are severe, then the site is unlikely to ever return to the HCPC (1.1).

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	135	202	269
Grass/Grasslike	67	101	135
Forb	22	34	45
Tree	–	–	–
Total	**224**	**337**	**449**

Figure 10. Plant community growth curve (percent production by month). TX0015, Shrub/Shortgrass Community. Shrubs dominant with few shortgrasses present..

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

Transition T1A
State 1 to 2

With dry weather conditions, lack of prescribed grazing, no fires, and no brush management, the Short-Midgrass/Shrub Complex State will transition to Shrub/Shortgrass Complex State.

Restoration pathway R2A
State 2 to 1

With Dry Weather, Prescribed Grazing and Brush Management, the Shrub/Shortgrass State can be restored to Short-Midgrass/Shrub State.

Conservation practices

Brush Management
Prescribed Grazing

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Shortgrasses**			101–179	
	black grama	BOER4	*Bouteloua eriopoda*	56–135	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	56–135	–
2	**Shortgrasses**			56–112	
	threeawn	ARIST	*Aristida*	28–78	–
	slim tridens	TRMU	*Tridens muticus*	28–78	–
3	**Shortgrass**			0–34	
	blue grama	BOGR2	*Bouteloua gracilis*	0–34	–
4	**Midgrasses**			28–56	
	sideoats grama	BOCU	*Bouteloua curtipendula*	11–56	–
	Arizona cottontop	DICA8	*Digitaria californica*	11–56	–
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	11–56	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	11–34	–
5	**Midgrasses**			17–34	
	spike dropseed	SPCO4	*Sporobolus contractus*	0–28	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–28	–
	mesa dropseed	SPFL2	*Sporobolus flexuosus*	0–28	–
6	**Shortgrasses**			22–45	
	tobosagrass	PLMU3	*Pleuraphis mutica*	22–45	–
	burrograss	SCBR2	*Scleropogon brevifolius*	22–45	–
	fall witchgrass	DICO6	*Digitaria cognata*	0–22	–
7	**Shortgrasses**			17–28	

	red grama	BOTR2	*Bouteloua trifida*	0–34	–
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	0–34	–
8	**Shortgrasses**			3–7	
	low woollygrass	DAPU7	*Dasyochloa pulchella*	0–7	–
	ear muhly	MUAR	*Muhlenbergia arenacea*	0–7	–
9	**Annual Grasses**			0–7	
	Grass, annual	2GA	*Grass, annual*	0–7	–
Forb					
10	**Forbs**			39–73	
	Forb, annual	2FA	*Forb, annual*	0–28	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–28	–
	Gregg's tube tongue	JUPI5	*Justicia pilosella*	6–22	–
	bahia	BAHIA	*Bahia*	0–22	–
	croton	CROTO	*Croton*	0–22	–
	menodora	MENOD	*Menodora*	6–22	–
	Rocky Mountain zinnia	ZIGR	*Zinnia grandiflora*	0–22	–
	globemallow	SPHAE	*Sphaeralcea*	0–17	–
	bladderpod	LESQU	*Lesquerella*	6–11	–
Shrub/Vine					
11	**Shrubs/Vines**			78–146	
	creosote bush	LATR2	*Larrea tridentata*	56–112	–
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	22–56	–
	pricklypear	OPUNT	*Opuntia*	22–56	–
	mariola	PAIN2	*Parthenium incanum*	22–56	–
	western honey mesquite	PRGLT	*Prosopis glandulosa var. torreyana*	28–56	–
	yucca	YUCCA	*Yucca*	22–56	–
	lotebush	ZIOB	*Ziziphus obtusifolia*	22–56	–
	catclaw acacia	ACGR	*Acacia greggii*	22–56	–
	javelina bush	COER5	*Condalia ericoides*	22–56	–
	jointfir	EPHED	*Ephedra*	22–56	–
	American tarwort	FLCE	*Flourensia cernua*	22–56	–
	ocotillo	FOSP2	*Fouquieria splendens*	22–56	–
	crown of thorns	KOSP	*Koeberlinia spinosa*	22–56	–
	littleleaf ratany	KRER	*Krameria erecta*	22–56	–
	whitethorn acacia	ACCO2	*Acacia constricta*	11–34	–

Animal community

The historic Short & Midgrass/Shrub Community (1.1) was habitat for mule deer, songbirds, birds of prey, small mammals, and predators such as coyote, bobcat, and mountain lion. As the site changes to the Shrub/Shortgrass Community (2.1), it becomes less suitable to many species due to the increase in bare ground and erosion and the invasion of introduced grasses. It often presents habitat for various songbirds and tree nesting birds.

Cattle find the best forage in the Short & Midgrass/Shrub Community (1.1). As this site reaches the Shrub/Shortgrass Community (2.1), they usually cannot 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.

Mule deer find good overall habitat on the Gravelly (Desert Grassland) site. They need to eat high protein forbs and browse to survive. They cannot utilize the lower protein grasses. Quail and dove prefer a combination of low shrubs, bunch grass, bare ground, and forbs. Game bird species such as mourning and white dove and scaled and bob-white 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.

Achieving a balance between brushy cover and more open plant communities on this and adjacent sites is important to wildlife management. The Texas Parks and Wildlife Department is a resource for additional information about managing for wildlife in the Trans-Pecos.

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.

Plant Preference by Animal:
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 (Desert Grassland) site is a well-drained and stony upland. Its soils are moderately permeable. Under historic climax condition the vegetation intercepted and utilized much of the incoming rainfall. There was little runoff during torrential rains; even on the sites having the greatest slope. Having a moderate ground cover kept runoff clear and slow and allowed limited deep percolation. 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 Gravelly (Desert Grassland) site is well suited for many outdoor recreational uses including hunting, hiking, and bird watching. Its scenic beauty and topography make it a unique site and colorful forbs can be found on or near the site throughout the spring and summer. Big Bend National Park is found in the southern portion of MLRA 42. It is well known for its scenic mountain desert grass and shrub lands, including many Gravelly Desert Grassland sites.

Wood products

None.

Other products

None.

Other information

None.

Type locality

Location 1: Brewster County, TX	
UTM zone	N
UTM northing	3246319
UTM easting	669283
General legal description	Big Bend National Park - at Basin Junction on State Highway 118

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, ESI Specialist, NRCS, Texas
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:** 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.

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 1-5% bare ground.

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

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

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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 associated with high intense rainfall.

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

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

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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 70% of total plant compostion by weight. Shrubs will comprise about 20% by weight.

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

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Warm-season perennial short stoloniferous grasses = cresotebush >

    Sub-dominant: Warm-season perennial mid stoloniferous grasses > Warm-season perennial mid/short bunchgrasses = Shrubs >

    Other: Subshrubs = perennial forbs = semi/succulents > annual forbs = Misc grasses

    Additional:

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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.

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

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

production): 440-880 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:** Dry climate generally prevents non-native species to encroach on this site. However, lehmann's lovegrass is known to invade some moist locations. Creosotebush, mariola, and whitethorn acacia are typical increasers within this site.

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17. **Perennial plant reproductive capability:** All species should be capable of reproducing except during severe drought conditions, heavy natural herbivory and wildfires.
