USDA Natural Resources
Conservation Service

Ecological site R081DY592TX
Limestone Hill 8-14 PZ

Last updated: 9/19/2023
Accessed: 05/11/2025

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): 081D–Southern Edwards Plateau

This area is underlain primarily by limestones in the Austin Chalk, Boquillas Flags, Devil's River, Santa Elena, Buda, and Del Rio Clay Formations of Cretaceous age. Quaternary sand and gravel are in the river valleys.

The 81D is in the hyperthermic thermic zone.

Classification relationships

USDA-NRCS Ag Handbook 296

Ecological site concept

The site consists of shallow, well drained soils that are moderately permeable above a very slowly permeable limestone bedrock. This site is dominated by China and black grama with scattered shrubs in the reference state.

Associated sites

R042AC249TX	**Limestone Hill and Mountain, Desert Grassland** The Limestone Hill and Mountain Desert Grassland site will be encountered at higher elevations than the Limestone Hill site.
R081DY295TX	**Flagstone Hill 8-14 PZ** The Flagstone Hill site has channers and flagstones.
R081DY297TX	**Gravelly 8-14 PZ** The Gravelly site does not have cobbles and stones.

Similar sites

R042AB264TX	**Igneous Hill and Mountain, Hot Desert Shrub** The Igneous Hill and Mountain Hot Desert Shrub site is similar to the Limestone Hill, but is formed from igneous (volcanic) parent material instead of limestone parent material.
R081DY295TX	**Flagstone Hill 8-14 PZ** The Flagstone Hill site is similar to the Limestone Hill, but has channers and flagstones as the dominate fragment shape and size instead of gravels, cobbles, and stones.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Dalea formosa*
Herbaceous	(1) *Bouteloua ramosa*

Physiographic features

The Limestone Hill 8-14” PZ ecological site consists of very shallow or shallow, well drained, moderate permeable soils over very slowly permeable bedrock. The soils formed in loamy residuum over limestone bedrock. These soils are on nearly level mesas or divides to very steep hills. These nearly level to very steep upland soils have slopes ranging from 1 to 60 percent and elevation ranges from 1,100 to 3,750 feet.

Geology has been the greatest influence in the creation of the Limestone Hill site. A warm, shallow sea invaded the area during the Cretaceous Period, some 135 million years ago, and caused deposition of lime mud. Layers of limestone were formed from these muds. Near the end of the Cretaceous Period a west to east compression of the earth’s crust uplifted and folded sediments to create the Rocky Mountains. The southernmost mountain in the chain is located in Big Bend National Park. Broad uplift exposed both the erosion resistant limestones and the overlying less resistant sandstones and clays. The limestone continues to erode today while most of the sandstone and clay is gone from the mountains. The site can be found on nearly level mesas and divides, and very steep slopes.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Escarpment (2) Hills > Hill (3) Plateau > Ridge
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,100–3,750 ft
Slope	5–45%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium to very high

Flooding frequency	None
Ponding frequency	None
Elevation	1,100–5,800 ft
Slope	1–60%

Climatic features

The average annual precipitation ranges from 8 to 14 inches. The annual total can vary from two 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 246 to 256 days. Freeze-free period ranges from 277 to 290 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 4. Representative climatic features

Frost-free period (characteristic range)	240-270 days
Freeze-free period (characteristic range)	270-300 days
Precipitation total (characteristic range)	8-15 in
Frost-free period (actual range)	240-270 days
Freeze-free period (actual range)	270-300 days
Precipitation total (actual range)	8-15 in
Frost-free period (average)	255 days
Freeze-free period (average)	280 days
Precipitation total (average)	13 in

Climate stations used

- (1) LANGTRY [USC00415048], Comstock, TX
- (2) DRYDEN TERRELL CO AP [USW00003032], Dryden, TX
- (3) PERSIMMON GAP [USC00416959], Big Bend National Park, TX

Influencing water features

None.

Wetland description

N/A

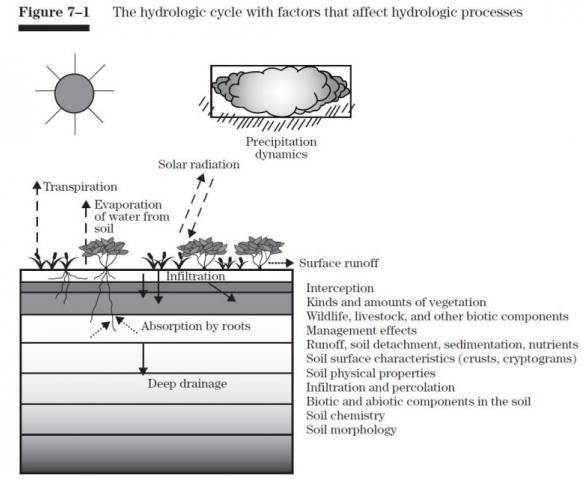


Figure 8.

Soil features

This ecological site consists of soils that are very shallow or shallow to limestone bedrock. These soils formed in residuum and colluvium derived from thick beds of Cretaceous limestone. Depths to bedrock range from 6 to 20 inches.

Soil textures are loam, silt loam, and clay loam with limestone fragments ranging from 35 to 80 percent. Textural modifiers are very gravelly or very cobbly, extremely gravelly or extremely cobbly or stony modifiers. Calcium carbonate coats rock fragments and may accumulate in lower parts of the soil as caliche fragments. Fractures in the limestone bedrock are about 4 inches apart and secondary calcium carbonate coats the sides of fractures partially sealing the bedrock from root and rainfall penetration.

Soils are well drained and moderately permeable over very slowly permeable limestone bedrock. Runoff is medium on slopes 1 to 3 percent, high on 3 to 5 percent, and very high on slopes greater than 5 percent.

This soil is classified as “Hyperthermic”, meaning that the Mean Annual Soil Temperature typically measured at 20 inches depth is 72 to 78 degrees F, based on the summary of a 5-year soil temperature study near La Linda, Texas.

The associated soil series include Blackgap.

Table 5. Representative soil features

Parent material	(1) Residuum–limestone (2) Colluvium–limestone
Surface texture	(1) Very gravelly loam (2) Very stony silt loam (3) Very cobbly clay loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Very slow
Depth to restrictive layer	6–20 in
Soil depth	6–20 in
Surface fragment cover <=3"	35–65%
Surface fragment cover >3"	5–10%
Available water capacity (0-20in)	0.3–1.2 in
Calcium carbonate equivalent (0-20in)	40–80%

Electrical conductivity (0-20in)	0–2 mmhos/cm
Sodium adsorption ratio (0-20in)	0
Soil reaction (1:1 water) (0-20in)	7.9–8.4
Subsurface fragment volume <=3" (5-20in)	35–55%
Subsurface fragment volume >3" (5-20in)	5–45%

Ecological dynamics

The reference plant community on the Limestone Hill 8-14” PZ ecological 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 records suggest cattle, sheep, and horses were introduced into the southwest from Mexico in the mid-1500s. However, extensive ranching began in the Trans-Pecos region in the 1880s. Early explorers described the lushness of vegetation in parts of the Trans-Pecos. Captain John Pope in 1854 described 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 springs and water sources that were found in the region. Wagon travel could be accomplished, under favorable conditions, with overnight stops having both water and forage. Livestock numbers peaked in the late 1880s following the arrival of railroads. Historical accounts document ranches with stocking rates as high as one animal unit per four acres.

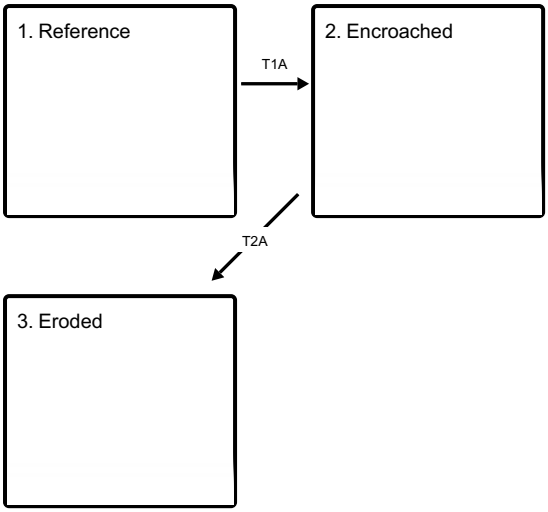
Decades of overgrazing with loss of vegetation and erosion make it a slow process to return to the reference community. In 1944 the southernmost portion of the Trans-Pecos area was set aside as Big Bend National Park. Grazing activities with cattle ceased. In 1944, most of the Limestone Hill and Mountain Hot Desert Shrub sites were probably degraded and dominated by woody shrubs. After 60 years of no grazing in the hyperthermic zone, 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 slopes up to about 45 percent. 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 vegetative 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.

State and transition model

Ecosystem states



T1A - Prolonged drought coupled with excessive grazing pressure

T2A - Prolonged drought couples with excessive grazing pressure

State 1 submodel, plant communities

1.1. 1.1 Chino/Black grama Dominant Community

State 2 submodel, plant communities

2.2. 2.1 Shortgrass/Shrub Dominant Community

State 3 submodel, plant communities

3.1. Shrub Dominant Community

State 1
Reference

The reference state is considered to be representative of the natural range of variability under pre-Euro settlement conditions. This state is characterized by the dominance of warm-season bunchgrasses, warm-season stoloniferous grasses and a variety of perennial forbs and woody shrubs. Community phase changes are primarily driven by prolonged drought.

Dominant plant species

- Chino grama (*Bouteloua ramosa*), grass
- black grama (*Bouteloua eriopoda*), grass
- bush muhly (*Muhlenbergia porteri*), grass

Community 1.1
1.1 Chino/Black grama Dominant Community

The reference community is described as a Chino/Black grama Dominant Community (1.1) containing about 75% grasses by weight, including 40% Chino grama (*Bouteloua ramosa*). A total of 15 percent of the plant community is composed of woody plants such as skeletonleaf goldeneye (*Viguiera stenoloba*), feather dalea (*Dalea formosa*), black dalea (*Dalea frutescens*), range ratany (*Krameria erecta*), and ephedra (Ephedra spp.). Bare ground is 10 to 15 percent. Interspaces between plants are lightly covered with litter. Even a small amount of erosion is significant due to the shallow nature of the soil. Erosion is kept to a minimum due to the amount of plant and rock cover. Infiltration is slow to 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. Rare periodic fire, climatic patterns, and browsing by deer and other herbivores 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 reference community. During drought years, livestock should be carefully managed on the site to avoid severe overgrazing. Wildlife continue to graze the site under drought conditions. If livestock are not carefully managed, the grazing impact is likely to cause permanent changes from the Grasses/Shrub State (1.0) to the Shortgrass/Shrub Dominant State (2.0) and thereafter possibly to the Shrub Dominant State (3.0). The site also contains food and cover for mule deer, dove, quail, and other types of wildlife. This community can be maintained with light grazing and brush management. When overgrazing occurs and/or brush management is eliminated, the site transitions toward a Shortgrass/Shrub Dominant Community (2.1). At the early stages of this change, Chino grama will dominate as black grama, sideoats grama, Arizona cottontop and cane bluestem are lost. The Chino grama will dominate until it is lost and the shortgrasses become the dominant established community.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	262	337	412
Shrub/Vine	53	68	83
Forb	35	45	55
Tree	0	0	0
Total	**350**	**450**	**550**

Figure 10. Plant community growth curve (percent production by month). TX4002, Chino grama/Shortshrub Community. Chino and black grama with less than 20% woody canopy of shrubs..

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
Encroached

The encroached state is characterized by a shift in dominant species, including increased shrubs cover and disturbance tolerant grasses. Non-native species may be present and are stable to increasing.

Dominant plant species

- slim tridens (*Tridens muticus*), grass
- hairy woollygrass (*Erioneuron pilosum*), grass

Community 2.1
2.1 Shortgrass/Shrub Dominant Community

Heavy continuous grazing, or even overstocked rotational grazing, coupled with drought will change the Chino/Black grama community (1.1) to the Shortgrasses/Shrub Community (2.1). The historically dominant grass species decline and are replaced by perennial threeawns, slim tridens (*Tridens muticus*), hairy tridens (*Erioneuron*

pilosum), and other shortgrasses that represent 50 percent of the vegetation. A variety of shrubs such increase to represent the other 50 percent of the vegetation. Lehman's lovegrass (*Eragrostis lehmanniana*) and buffelgrass (*Pennisetum ciliare*) are non-native species that may become established on this site. The buffelgrass can occur on the southern end of this site, but Lehmann's lovegrass (*Eragrostis lehmanniana*) can occur throughout MLRA 81D. These non-native species have the potential to displace native species. The amount of bare ground increases to 15 to 30 percent. (Bare ground does not include rock cover). This has several impacts. Ground cover by litter and soil organic matter decreases. Loss of vegetation exposes the soil surface. Bare ground causes increases in soil temperature, soil crusting, the potential for erosion and a decrease in water infiltration. As rainfall runs off signs of erosion become more apparent. The steep slopes of this site increase the likelihood of erosion. It is doubtful that the Shortgrass/Shrub Dominant Community (2.1) will return to the reference state within a reasonable amount of time. This plant community is still useful for grazing, but stocking rates must be kept lower than under reference conditions or grass decline will continue. The site also contains food and cover for mule deer, dove, quail, and other types of wildlife. Prescribed grazing will be needed to maintain this vegetative state. Brush management may also be necessary to arrest woody encroachment.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	175	225	275
Grass/Grasslike	140	180	220
Forb	35	45	55
Tree	0	0	0
Total	**350**	**450**	**550**

Figure 12. Plant community growth curve (percent production by month). TX4003, Shortgrass/Shrub Dominant Community. Shortgrasses dominate with 50% woody canopy of shrubs..

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 3
Eroded

The eroded state is characterized by a significant shift in dominant functional and structural groups. Woody increaser species comprise >70 percent of the total production. Bare ground has increased and litter cover and soil organic matter have decreased. Active soil erosion is occurring.

Dominant plant species

- ocotillo (*Fouquieria*), shrub
- sotol (*Dasylirion*), shrub
- acacia (*Acacia*), shrub
- creosote bush (*Larrea tridentata*), shrub

Community 3.1
Shrub Dominant Community

This community represents a significant vegetation shift, crossing the threshold from a community with at least 50 percent grass to the Shrub Dominant Community (3.1). The change is driven by continued drought conditions coupled with overstocking. The major woody increaser species, such as lechuguilla, ocotillo, sotol, acacia, and creosotebush, have multiplied until they comprise 70 to 75 percent of the total production and exert strong influence on the site. Total grass and grasslike production is severely restricted. The shortgrasses compose about 25 to 50 percent of the production, and include species such as perennial threeawns, slim tridens, and hairy tridens. Shrubs such as skeletonleaf goldeneye compose 50% of woody canopy. Ground cover by litter and soil organic matter decreases. Over 20 percent of the ground is bare. Water runoff increases and signs of erosion are more common. Rills and small pedestals may be seen in some areas. At this point, rocks may be very significant in holding some

soil on the site. This site provides cover and food for, deer, and other wildlife, including songbirds. At this stage, there is generally not enough forage for cattle. Due to the change to shrubs, and their corresponding competitive advantage, this site it will be difficult to return to the Shortgrass/Shrub Dominant Community (2.1) or the reference state.

Transition T1A
State 1 to 2

With abusive grazing practices, this site will transition to the shortgrass/shrub state(2). Long term drought may expedite this transition.

Transition T2A
State 2 to 3

With abusive grazing practices, this site will transition to the shrub state(3). Long term drought may expedite this transition.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Midgrass, bunch**			140–220	
	Chino grama	BORA4	*Bouteloua ramosa*	140–220	–
2	**Stoloniferous**			53–83	
	black grama	BOER4	*Bouteloua eriopoda*	28–44	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	25–40	–
3	**Mid/Shortgrasses**			53–83	
	sideoats grama	BOCU	*Bouteloua curtipendula*	18–28	–
	slim tridens	TRMU	*Tridens muticus*	14–22	–
	streambed bristlegrass	SELE6	*Setaria leucopila*	11–17	–
	threeawn	ARIST	*Aristida*	11–17	–
4	**Mid/Shortgrasses**			11–17	
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	7–11	–
	fall witchgrass	DICO6	*Digitaria cognata*	3–6	–
5	**Shortgrasses**			7–11	
	red grama	BOTR2	*Bouteloua trifida*	3–6	–
	nineawn pappusgrass	ENDE	*Enneapogon desvauxii*	3–6	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1–3	–
Shrub/Vine					
6	**Shrubs**			35–55	
	desert myrtlecroton	BEOB	*Bernardia obovata*	4–10	–
	resinbush	VIST	*Viguiera stenoloba*	4–10	–
	Big Bend barometerbush	LEMI4	*Leucophyllum minus*	3–8	–
	jointfir	EPHED	*Ephedra*	3–8	–
	ocotillo	FOSP2	*Fouquieria splendens*	3–8	–
	Texas lignum-vitae	GUAN	*Guaiacum angustifolium*	3–8	–
	javelina bush	COER5	*Condalia ericoides*	2–5	–
	algerita	MATR2	*Mahonia trifoliolata*	1–3	

	algerita	MATR3	*Mahonia trifoliolata*	1–3	–
	mariola	PAIN2	*Parthenium incanum*	1–3	–
	creosote bush	LATR2	*Larrea tridentata*	1–3	–
7	**Subshrubs**			7–11	
	littleleaf ratany	KRER	*Krameria erecta*	3–6	–
	plumed crinklemat	TIGR	*Tiquilia greggii*	3–6	–
	featherplume	DAFO	*Dalea formosa*	2–5	–
8	**Fibrous/Succulents**			11–17	
	lechuguilla	AGLE	*Agave lechuguilla*	2–5	–
	sotol	DASYL	*Dasylirion*	0–5	–
	candelilla	EUAN3	*Euphorbia antisyphilitica*	0–3	–
	Texas false agave	HETE7	*Hechtia texensis*	0–3	–
	leatherstem	JADI	*Jatropha dioica*	0–3	–
	pricklypear	OPUNT	*Opuntia*	1–3	–
	yucca	YUCCA	*Yucca*	1–3	–
	tree cholla	CYIM2	*Cylindropuntia imbricata*	1–3	–
Forb					
9	**Perennial**			35–50	
	Forb, perennial	2FP	*Forb, perennial*	5–15	–
	Texas persimmon	DITE3	*Diospyros texana*	5–12	–
	creosote bush	LATR2	*Larrea tridentata*	5–12	–
	mariola	PAIN2	*Parthenium incanum*	5–12	–
	croton	CROTO	*Croton*	3–7	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	1–3	–
	menodora	MENOD	*Menodora*	1–3	–
	awnless bushsunflower	SICA7	*Simsia calva*	1–3	–
	globemallow	SPHAE	*Sphaeralcea*	1–3	–
	woody crinklemat	TICAC	*Tiquilia canescens var. canescens*	1–3	–
	zinnia	ZINNI	*Zinnia*	1–3	–
10	**Annual Forbs**			0–5	
	Forb, annual	2FA	*Forb, annual*	0–5	–

Animal community

The historic Grasses/Shrub Complex 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 through the Shortgrass/Shrub Dominant Community (2.1) toward the Shrub Dominant Community (3.1), it becomes less suitable to some species due to the loss of habitat components and changes in structure.

Cattle, sheep, and goats can use this site, but the rocky ground and steep slopes make it difficult for livestock, especially cattle, to reach some forage areas. Cattle find the best forage in the Grasses/Shrub Complex Community (1.1). As this site reaches the Shrub Dominant Community (3.1), grazing opportunities for cattle are limited. 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.

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 find good overall habitat on the Limestone Hill ecological site. They need high protein forbs and browse. They generally eat a wide variety of browse, forbs and small amounts of

grass. Quail and dove prefer a combination of low shrubs, bunch grass, bare ground, and forbs. Game bird species including mourning dove, white dove, scaled quail utilize this site. Smaller mammals present include rodents, jackrabbits, cottontail rabbits, raccoons, and skunks. 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.

Hydrological functions

The site is a well-drained, shallow, stony upland. Its soils are moderately to very slowly permeable. Because of the very shallow or shallow, moderately permeable soils and the surface rock, significant amounts of rainfall run off to down slope positions. Rock outcrops in the limestone allowed limited deep percolation to ground water. The presence of stones and rock outcrops enhance the effectiveness of rainfall, especially small rainfall events, by concentrating it on a smaller surface area and reducing evaporation. When the site changes from a Grasses to Shrub community, there is a vegetative structural group change resulting in increased runoff.

Recreational uses

The site is well suited for many outdoor recreational uses including hunting, hiking, and bird watching. Its rugged scenic beauty and topography make it a unique site. Colorful forbs can be found on or near the site throughout the spring and summer.

Wood products

None.

Other products

None.

Other information

None.

Inventory data references

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

Type locality

Location 1: Brewster County, TX	
UTM zone	N
UTM northing	3231990.3
UTM easting	696487.61
General legal description	Big Bend National Park - along State Highway 118 on north facing slope of Ernst Ridge just before the tunnel towards Rio Grande Village.

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Approval

Bryan Christensen, 9/19/2023

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.

The following individuals assisted with the development of this site description:

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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	12/05/2011
Approved by	Bryan Christensen
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 associated with high intense rainfall.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values usually ranging from 4-6 under vegetation and 2-3 in the interspaces

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** 1-4 inche thick, pale brown surface horizon with a weak fine granular structure. Data from Blackgap 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 75% of total plant compostion by weight. Shrubs and forbs will comprise about 15% and 10%, respectively, 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: Mid bunchgrass (Chino grama)

    Sub-dominant: Short stoloniferous grasses > shrubs

    Other: Mid/short bunchgrasses > fibrous/succulents = perennial forbs > annual forbs/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):** 350-550 lbs/ac

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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:** None

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