USDA Natural Resources Conservation Service

Ecological site R042CY004NM
Gravelly

Accessed: 05/17/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

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): 042C–Central New Mexico Highlands

To view this ESD in its most complete form refer to the PDF Version found in the New Mexico NRCS Field Office Technical Guide, section 2.

The Gravelly Ecological Site predominantly occurs in LRU 42.8, which is a subunit of MLRA 42 (Southern Desertic Basins, Plains, and Mountains)

LRU 42.8 was carved out of the Guadalupe Mountains portion of what used to be MLRA 70D. This Gravelly Ecological Site has mostly taken the place of the Gravelly Ecological Site that was traditionally used in MLRA 70D.

It is possible, though very rare, that the Gravelly Ecological Site may occur outside of this LRU boundary.

To identify locations where this ESD has been mapped, refer to the most current natural resource soil survey data on Web Soil Survey or contact your local NRCS Conservation District field office.

Classification relationships

NRCS & BLM: Gravelly Ecological Site < LRU 42.8 Northeastern Chihuahuan Desert Hills< Major Land Resource Area 42, Southern Desertic Basins, Plains, and Mountains< Land Resource Region D, Western Range and Irrigated Region (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS: Gravelly Ecological Site < Artesia Plains Desert Grass-Shrubland Subsection < Pecos Valley Section < Southwest Plateau and Plains Dry Steppe and Shrub Province (Cleland, et al., 2007).

EPA: Gravelly Ecological Site<24b Chihuahuan Desert Grasslands<24 Chihuahuan Deserts (Griffith, et al., 2006).

Ecological site concept

The soils are skeletal (grater than 35% by volume rock fragments greater than 2 mm). Soil depth is deep to very deep (> 100 cm).This site is positioned on alluvial fans and stream terraces along the Guadalupe Ridge between Carlsbad, New Mexico and Texas.

Associated sites

R042CY902NM	**Limestone Hills** This site has slopes > 25% which make up hillsides above the Shallow Ecological Site and occasionally the Gravelly.
R042CY003NM	**Shallow** This site is associated with the Gravelly within a complex on piedmont slopes. The Shallow has a shallow petrocalcic horizon
R042CY007NM	**Draw** This site is associated with the Gravelly along stream systems. The Gravelly site occupies stream terraces above the Draw.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Gravelly Ecological Site is positioned across alluvial fans, stream terraces, and fan piedmonts within LRU 42.8. Elevation ranges from 3500 to 5500 feet. Soil depth is deep to very deep (>100 cm).Slopes range from 1 to 25 percent but are normally less than 15 percent. Aspect plays a minor role on this site.

The Gravelly Ecological Site is made up of gravelly alluvium that is derived from limestone parent material. The Site is most closely associated with the Shallow, Limestone Hills, and Draw Ecological Sites. The Shallow Ecological Site occurs on associated areas where a root restricting petrocalcic horizon is less than one meter deep. The Draw Ecological site is situated in an active floodplain that sits below an old gravelly terrace or fan remnant which is occupied by the Gravelly Ecological site.

Ecological Site Key for LRU 42.8 and 42.9, Northeastern Chihuahuan Hills and Mountains

1. Site is within LRU 42.8, which is within the ustic-aridic soil moisture regime, and the thermic soil temperature regime (often contains red berry juniper).
2. Soils are loamy and not skeletal, and reside in low areas that are stream terraces and fan remnants. - Loamy Terrace ESD
2. Soils are skeletal (Greater than 35% by volume rock fragments greater than 2mm)
3. Soils are deep to very deep (greater than 100 cm to root restrictive layer).
4. Site exists in an active floodplain.-Draw ESD
4. Site exists on a stream terrace or alluvial fan-Gravelly ESD
4. Site exists on steep slopes on limestone colluvium over gypsum residuum.-Limy Gyp Escarpment
3. Soils are very shallow to moderately deep (5-100 cm).
5. Root restrictive layer is a petrocalcic horizon.-Shallow ESD
5. Root restrictive layer is bedrock.
6. Slopes are less than 25%-Very Shallow ESD
6. Slopes are greater than 25%- Limestone Hills ESD
1. Site is located within LRU 42.9, which is in the aridic-ustic soil moisture regime and the mesic soil temperature regime (often contains alligator juniper and/or pinon pine).
7. Slopes are less than 25%- Shallow Limestone ESD
7. Slopes are greater than 25%- Limestone Mountains ESD

Glossary:

Colluvium: “Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, concentrated runoff” (Schoenberger, et al., 2012).

Petrocalcic Horizon: The petrocalcic horizon is an illuvial horizon in which secondary calcium carbonate or other carbonates have accumulated to the extent that the horizon is cemented or indurated (Keys to Soil Taxonomy, 2010).

Residuum: “Unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place” (Schoenberger, et al., 2012).

Soil moisture regime: Refers to the presence or absence either of ground water or of water held at a tension of less than 1500 kPa in the soil or in specific horizons during periods of the year. Water held at a tension of 1500 kPa or more is not available to keep most mesophytic plants alive. Major differences in soil moisture are often reflected in different vegetative communities. The two major soil moisture regimes for the Guadalupe Mountains are Aridic and Ustic (Keys to Soil Taxonomy, 2010).

Soil Temperature Regime: This is the range of temperatures experienced by a soil at a depth of 50 cm. When the average temperature of a soil falls between 46 degrees F and 59 degrees, it falls into the mesic soil temperature regime. The thermic soil temperature regime falls between 59 degrees F and 72 degrees (Keys to Soil Taxonomy, 2010).

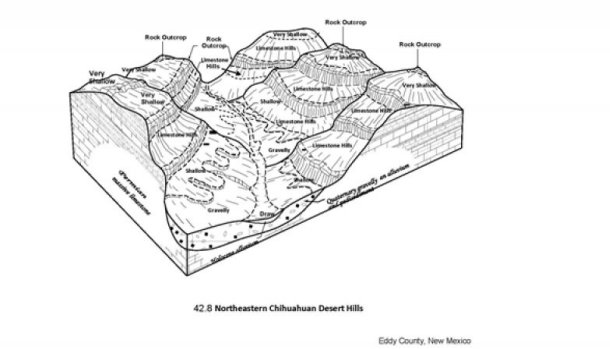


Figure 2. 42.8 Northwestern Chihuahuan Desert Hills

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Fan remnant (3) Stream terrace
Flooding frequency	None
Elevation	1,067–1,676 m
Slope	1–25%
Aspect	Aspect is not a significant factor

Climatic features

The mean annual precipitation is 10.4 inches to 18.3 inches, occurring mostly as high intensity, short-duration afternoon thunderstorms from July through September. Mean annual air temperature is 55 to 70 degrees F, and the frost-free season is 207 to 243 days.

Annual weather patterns, influenced by global climate events, such as El Nino and La Nina, affect and alter production and composition across the Gravelly Ecological Site. In general, because precipitation is minimal through the winter but increases during the summer, warm-season (C4) plants dominate the landscape. However, from year to year the production and composition can greatly shift due to variable weather patterns. The years that produce the most species richness and production are those that get slow, steady moisture through the months of May,

June, and July. Late summer thunderstorms may induce heavy runoff on this site, creating flash-flooding in the draws, drainages, and canyons below.

The climate trend of the area is one toward warmer temperatures and lower precipitation. According to the Carlsbad Caverns Climate Station, during the years 2001-2011, five years received less than 10 inches of rain. Three of those years, (2003, 2005, and 2011) were below 5 inches of rain. And 2011 was both the lowest rainfall and hottest year on record. Similarly, in 1947-1957, 6 out of 11 years were below the mean low of 10.4 inches. But in that stretch, only one year, 1951, was below 5 inches. To put this in perspective, in the dry 1930's only 2 years were below the mean low of 10.4 and none were below 5 inches. The 2001-2011 decade has been much warmer and drier than any in recorded history. In addition, during the two years of 2010 and 2011, Carlsbad Caverns National Park experienced extreme events of drought, wildfire, and flash flooding which have led to shifts in plant communities.

Table 3. Representative climatic features

Frost-free period (average)	243 days
Freeze-free period (average)	263 days
Precipitation total (average)	457 mm

Influencing water features

The Gravelly Ecological Site is not associated with a wetland or riparian system; it is an upland ecological site.

Soil features

The Gravelly Ecological Site is tied to the Bascal component of map units CC7, DR1, CC8, KB1, and KB2 within LRU 42.8, Northeastern Chihuahuan Desert Hills. The CC8 and KB2 map units are almost identical and consists of complexes of soil components which are dominated by about 50 percent Kimrose (the Kimrose component is associated with the Shallow Ecological Site) and 40 percent Bascal (Gravelly Ecological Site). The CC7 and DR1 map units are associated with 40 % Dunaway, 30% River wash, and 25% Bascal. Map unit CC7 is associated with stream systems, and CC8 is associated with alluvial fans. The complex between the Gravelly and Shallow Ecological Sites (Bascal and Kimrose components) in map unit CC8 is based on the undulating depth of the petrocalcic horizon.

The Bascal component is formed from deep gravelly alluvium derived from limestone and dolomite parent material.

In normal years this soil is driest during the winter. It is moist in the upper part for over 90 cumulative days, but fewer than 90 consecutive days during the growing season. The soil moisture regime is aridic bordering on ustic. The mean annual soil temperature: is 59 to 66 degrees F, which is classified as the thermic temperature regime.

The Bascal component is well drained, formed in gravelly fan alluvium and occurs on low to moderately sloping dissected alluvial fan remnants and stream terraces. The Bascal taxonomic class is: Loamy-skeletal, carbonatic, thermic Ustic Haplocalcids. The Bascal component has about 1.65-3.3 % organic matter in the "A horizon" which means that it probably formed under grassland conditions. Effervescence is strong.

TYPICAL PEDON: Bascal gravelly loam, on an east-facing, 7 percent slope in rangeland at an elevation of 1,380 m (4,527 ft). (Colors are for dry soil unless otherwise noted).

TYPE LOCATION: Eddy County, New Mexico; from the parking area for Yucca Canyon trailhead in Carlsbad Caverns National Park, 100 yards east, down slope. (Grapevine Draw NM USGS topographic quadrangle: UTM coordinates, NAD 83 datum, 13 N. 539068N 3551272W.

A--0 to 9 cm, (0.0 to 3.5 inches); dark grayish brown (10YR 4/2) very gravelly loam, very dark brown (10YR 2/2), moist; 45 percent sand; 20 percent clay; weak medium subangular blocky parts to moderate coarse granular structure; slightly hard, friable, , slightly sticky, slightly plastic; many very fine roots and common fine roots; common very fine interstitial and common fine interstitial pores; 1 percent nonflat subrounded indurated 600 to 1200

millimeter limestone fragments and 5 percent nonflat subrounded indurated 250 to 600 millimeter limestone fragments and 10 percent nonflat subrounded indurated 75 to 250 millimeter limestone fragments and 25 percent nonflat rounded indurated 2 to 75 millimeter limestone fragments; strong effervescence, by HCl, 1 normal; slightly alkaline, pH 7.6 by pH meter; clear smooth boundary.

Bk1--9 to 37 cm, (3.5 to 14.6 inches); dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2), moist; 35 percent sand; 22 percent clay; weak medium subangular blocky parts to moderate fine subangular blocky structure; slightly hard, friable, , slightly sticky, slightly plastic; common very fine roots and few medium roots and common fine roots; common very fine interstitial and few fine interstitial pores; 2 percent fine prominent irregular weakly cemented carbonate nodules on bottom of rock fragments and 3 percent fine prominent irregular carbonate masses on faces of peds; 3 percent nonflat subrounded indurated 75 to 250 millimeter limestone fragments and 25 percent nonflat rounded indurated 2 to 75 millimeter limestone fragments of which 15 percent are 2 to 20 millimeters; strong effervescence, by HCl, 1 normal; moderately alkaline, pH 7.9 by pH meter; clear wavy boundary.

Bk2--37 to 59 cm, (14.6 to 23.2 inches); brown (10YR 4/3) extremely cobbly loam, dark brown (10YR 3/3), moist; 35 percent sand; 24 percent clay; weak medium subangular blocky parts to moderate fine subangular blocky structure; slightly hard, friable, , moderately sticky, moderately plastic; common very fine roots and few medium roots and few fine roots; many very fine interstitial and common fine interstitial pores; 3 percent fine prominent irregular weakly cemented carbonate nodules on bottom of rock fragments and 5 percent fine prominent irregular carbonate masses throughout; 10 percent nonflat subrounded indurated 250 to 600 millimeter limestone fragments and 25 percent nonflat subrounded indurated 75 to 250 millimeter limestone fragments and 30 percent nonflat rounded indurated 2 to 75 millimeter limestone fragments of which 18 percent are 2 to 20 millimeters; violent effervescence, by HCl, 1 normal; moderately alkaline, pH 7.9 by pH meter; gradual wavy boundary.

Bk3--59 to 200 cm, (23.2 to 78.7 inches); brown (10YR 5/3) extremely stony sandy clay loam, dark yellowish brown (10YR 4/4), moist; 65 percent sand; 22 percent clay; weak fine subangular blocky structure; slightly hard, friable, , slightly sticky, slightly plastic; common very fine roots and few medium roots and few fine roots; common fine interstitial pores; 10 percent fine prominent irregular carbonate masses throughout and 5 percent medium prominent irregular weakly cemented carbonate nodules on bottom of rock fragments; 10 percent nonflat subrounded indurated 250 to 600 millimeter limestone fragments and 25 percent nonflat subrounded indurated 75 to 250 millimeter limestone fragments and 40 percent nonflat rounded indurated 2 to 75 millimeter limestone fragments of which 24 percent are 2 to 20 millimeters; violent effervescence, by HCl, 1 normal; moderately alkaline, pH 7.9 by pH meter;

Typical Surface Fragments <=3" (% Cover): 25-35%

Typical Surface Fragments > 3" (% Cover): 25-35%

Typical Subsurface Fragments <=3" (% Volume): 30-50%

Typical Subsurface Fragments > 3" (%% Volume): 30-50%

Calcium Carbonate Equivalent (percent):
A horizon-2 to 25
Bk1 horizon-20 to 52
Bk2 horizon-30 to 70

Total Average Available Water Capacity (cm H2O/cm soil): 4.43 cm

Figure 5. Profile of the Bascal soil from the Kimrose-Bascal

Table 4. Representative soil features

Parent material	(1) Alluvium–dolomite
Surface texture	(1) Gravelly loam (2) Very gravelly silt loam (3) Extremely gravelly clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	102–254 cm
Surface fragment cover <=3"	15–45%
Surface fragment cover >3"	15–50%
Available water capacity (0-101.6cm)	3.81–5.08 cm
Calcium carbonate equivalent (0-101.6cm)	2–70%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.2
Subsurface fragment volume <=3" (Depth not specified)	20–70%
Subsurface fragment volume >3" (Depth not specified)	25–70%

Ecological dynamics

There are only a couple of variables that have historically exerted minor influences on plant communities on the Gravelly Ecological Site: elevation and fire frequency. Regardless of elevation, the Gravelly Ecological Site is dominated by black and blue grama. At the lower end of the range, (about 3500 feet) temperatures are warmest and driest and tend to promote more succulents and Chihuahuan desert species, such as creosote and mariola. As elevation increases, plant communities show a slight shift with a scattering of lotebush and winterfat coming in at the highest elevations (about 5500 feet).

Fire is a consistent disturbance regime that reduces succulents and a few shrubs while stimulating grasses and

forbs. Over time, between fires, shrubs encroach on the site, slowly spreading and out-competing grasses and forbs for water and nutrients. Fire re-balances the system by providing a boost for grass and forb colonization. Not all fires are equal. According to Gebow, “Fire effects in the same location will vary, especially with fire timing, both seasonally and within the scheme of year-to-year moisture variation. Precipitation during seasons before and after fire has a major effect on recovery of plants. Fire researchers in the area and region suggest a 10-to-15-year fire regime is common” (Gebow, 2001).

Small and more frequent fires were more common before the mid-1800’s, with the Apache likely responsible for many small burns. With colonization by Europeans, intervals between fires have lengthened and the average fire size has increased. (Ahlstrand, 1981) Small fires are important for creating a patchy mosaic across the landscape, which provides beneficial habitat for many different animal species.

Human caused disturbance such as recreation, livestock grazing, and infrastructure for oil and gas production has recently (over the last 100 years), promoted a species shift to favor the colonization of nitrogen fixing shrubs, especially whitethorn acacia and mesquite. These nitrogen fixing shrubs affect soil chemistry and hydrology, altering the dynamics of the site.

State and transition model

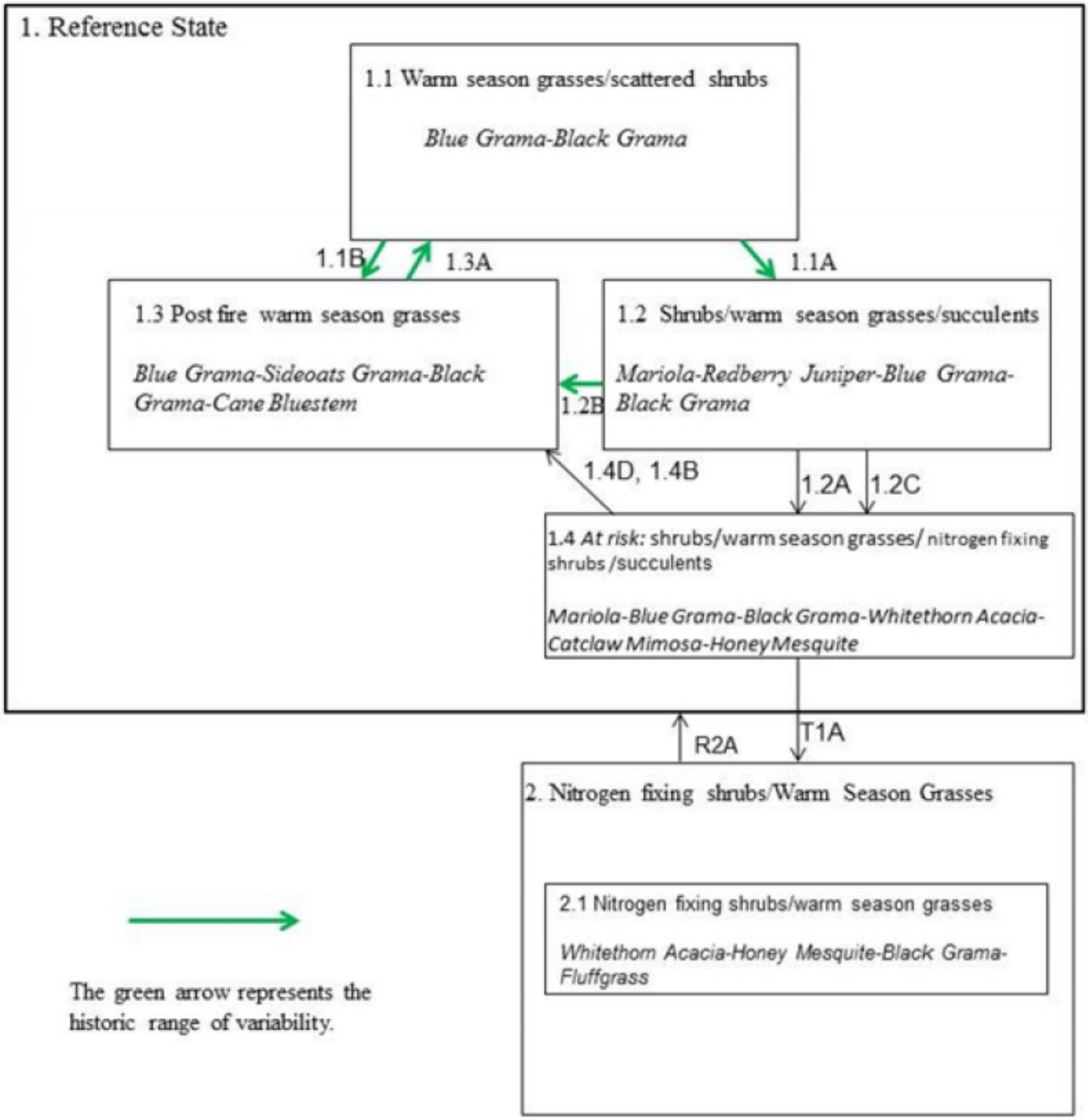


Figure 6. Gravelly State and Transition Model

State 1
Reference State

1.1 Warm season grasses/scattered shrubs (diagnostic plant community) A mix of grasses, shrubs and succulents is present. Total foliar cover is > 75%. 1.1A Community Pathway: This pathway represents intervals between fires; during which natural processes increase shrub and succulent vigor and decreases grass production and percent composition. 1.1B Community Pathway: This pathway represents fire. Fire sets suppresses succulents and many shrubs, giving grasses a competitive advantage. 1.2 Shrubs/warm season grasses/succulents: Over time, foliar cover of shrubs and succulents increases and that of warm season grasses decrease. 1.2A Community Pathway: This pathway represents an interval between fires, which is longer than the historic range of variability. Fire suppression, whether through loss of fuel load due to herbivory or from fighting natural wildfires, has increased shrub and succulent vigor and decreased grass species production and composition. 1.2B Community Pathway:

This pathway represents fire. Fire suppresses succulents and many shrubs, giving grasses a competitive advantage. 1.2C Community Pathway: This pathway represents a growing competitive advantage for nitrogen fixing shrubs due to slow changes in soil chemistry and hydrology. 1.3 Post fire warm season grasses: This site exists after fire. Grasses respond well to fire, while many shrubs and succulents decrease. 1.3A Community Pathway: This pathway represents intervals between fires during which natural processes increase shrub and succulent vigor and decreases grass species production and composition. 1.4 At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents: Due to gradual changes in hydrologic function and soil chemistry, succulents and shrubs increase over time. The increased abundance of native nitrogen fixing shrubs such as whitethorn and catclaw mimosa is a key indicator that this community phase is “at risk.” 1.4B Community Pathway: This pathway represents fire. Fire sets back succulents and many shrubs, giving grasses a competitive advantage. 1.4D Community Pathway: A change in livestock grazing management promotes grass vigor and decreases shrub competition. This accelerates the turnover of fine roots, causing an increase in labile carbon, acceleration in decomposition, and a resulting increase in plant available water. T1A Transition one: Slow variables: Continued encroachment by whitethorn acacia, coupled with the loss of herbaceous plant species causes a decrease in soil organic matter, leading to a decrease in plant available water. Trigger event: A severe drought causes loss of soil organic carbon. Threshold: A hydrologic function/soil chemistry threshold is crossed. 2.0 Nitrogen fixing shrubs/warm season grasses State 2.1 Nitrogen fixing shrubs/warm season grasses: Nitrogen fixing shrubs have become prominent plants on the site. Foliar cover has decreased to < 40%. A higher Nitrogen turnover rate increases the invasiveness and stability of whitethorn and various catclaw. This community has a mix of shrubs, succulents, and warm season grasses. R2A Restoration Process: An increase in the competitive advantage of non-nitrogen fixing species through physical, chemical, and biological management practices.

Community 1.1
Warm season grasses/scattered shrubs (diagnostic plant community)

Figure 7. Community 1.1; Slaughter Canyon; Carlsbad Caverns

This community phase is dominated by a mix of black and blue grama. Foliar cover is between 75 and 85 percent, basal cover is between 15 and 25 percent, and bare ground is around 5 percent. Warm season grasses make up about 70 percent foliar cover; forbs 5 percent; and scattered shrubs, about 5 percent. The average surface soil stability rating is 5.5 under the canopy and 5 in the interspaces. Annual production averages around 1200 lbs/ac, but can span between 800 and 1600 lbs/ac, depending on annual weather patterns. This community exists approximately 5-7 years after low intensity fire. Blue and black grama are dominant, making up over half of the annual perennial growth. Scattered shrubs and succulents are common, and vary based on elevation. Mariola is fairly dominant in the lower, warmer elevations while redberry juniper is common in the upper elevations. This plant community phase optimizes energy flow, hydrologic function and nutrient cycling. The diverse root systems take advantage of moisture from both close to the surface as well as deep in the profile. Decomposition is active, creating soil organic matter, which enhances plant available water and mineralization needed for plant vigor.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	762	1143	1524
Shrub/Vine	90	135	179
Forb	45	67	90
Total	**897**	**1345**	**1793**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	7-11%
Grass/grasslike foliar cover	60-80%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1-3%
Litter	60-70%
Surface fragments >0.25" and <=3"	25-35%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-2%	5-15%	1-3%
>0.15 <= 0.3	–	1-3%	30-40%	1-3%
>0.3 <= 0.6	–	1-3%	20-30%	1-2%
>0.6 <= 1.4	–	2-4%	–	–
>1.4 <= 4	–	1-2%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 9. Plant community growth curve (percent production by month). NM4284, Gravelly Reference State.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	8	7	10	27	25	15	5	0	0

Community 1.2
Shrubs/warm season grasses/succulents

Figure 10. Community 1.2; Guadalupe Mountain National Park (G

This community phase combines a mix of shrubs, succulents and warm season grasses. Foliar cover is between 70 and 80 percent, basal cover is between 10 and 20 percent, and bare ground is around 3 to 8 percent. Warm season grasses make up about 30 percent foliar cover; shrubs, 25 percent; and succulents, 15 percent. The average surface soil stability rating is 5 under canopy and 4.5 in the interspaces. Annual production averages around 1000 lbs/ac, but can span between 800 and 1200 lbs/ac. This community exists approximately 14-18 years after fire. Blue and black grama are the dominant grasses in all elevations. Shrub diversity is mixed with creosote and mariola being abundant at the lowest elevations and redberry juniper, sandpaper oak, and lotebush growing at the highest elevations. This plant community has developed due to an increase in shrub vigor and a decrease in grass vigor. As shrubs increase they gain a competitive advantage, primarily by out-competing the grasses for water and plant nutrients. As shrubs increase, energy flow begins to lessen, and fine-root turnover decreases, causing a decrease in decomposition, labile carbon and soil organic matter. Fire is the natural event that keeps mature shrub species from gaining a competitive advantage and stimulates colonization by grasses.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	448	560	673
Grass/Grasslike	404	504	605
Forb	45	56	67
Total	**897**	**1120**	**1345**

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	35-45%
Grass/grasslike foliar cover	25-35%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1-3%
Litter	55-65%
Surface fragments >0.25" and <=3"	25-35%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	2-6%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	2-6%	3-7%	1-3%
>0.15 <= 0.3	–	4-8%	20-30%	1-3%
>0.3 <= 0.6	–	6-10%	–	1-2%
>0.6 <= 1.4	–	12-17%	–	–
>1.4 <= 4	–	5-9%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.3
Post Fire Warm season grasses

Figure 12. Community 1.3; Slaughter Canyon; CCNP; 4-5-11

This community phase consists of a mix of warm season grasses, shrubs, and succulents. This plant phase exists shortly after fire has burned the site, suppressing succulents and shrubs and creating a competitive advantage for grasses. Foliar cover is between 60 and 80 percent, depending on how recent and how severe the fire had been. Also, precipitation following fire is needed for growth to resume. Basal cover is between 10 and 15 percent, and bare ground is around 5 to 7 percent. Warm season grasses make up about 55 percent foliar cover; shrubs, 10 percent; and succulents, 5 percent. The average surface soil stability rating is 5 under canopy and 4.5 in the interspaces. Annual production averages around 900 lbs/ac, but can span between 600 and 1200 lbs/ac, depending on annual weather patterns. This community exists approximately one to six years after fire. It is a grass dominated site, with basal sprouting shrubs scattered across the site. Blue grama, black grama, and sideoats grama are the dominant grasses in this community phase. Redberry juniper re-grows quickly after fire and tends to be the dominant shrub. Sotol and sacahuista are the dominant succulents and are present at all elevations. This plant community is the ecological site's response to fire within the reference state. Fire is the natural event that keeps shrub species from gaining a competitive advantage and stimulates colonization by grasses. As grasses respond with greater density following fire, decomposition speeds up, leading to greater soil organic matter, infiltration, and plant available water. Over time shrubs and succulents move back onto the site.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	504	757	1009
Shrub/Vine	121	182	242
Forb	47	71	94
Total	**672**	**1010**	**1345**

Table 12. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	50-60%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1-3%
Litter	60-70%
Surface fragments >0.25" and <=3"	25-35%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	3-7%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-3%	5-15%	1-3%
>0.15 <= 0.3	–	4-8%	25-35%	2-4%
>0.3 <= 0.6	–	5-9%	10-20%	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.4
At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents

Figure 14. Community 1.4; Double Canyon; BLM; 3-13-12

This community phase consists of a mix of shrubs, succulents and warm season grasses along with an increase in nitrogen fixing shrubs. It is no longer within the “historic range of variability” as management has created an “at risk” community phase. However, it is still within the reference state, meaning it has not crossed a threshold. Thus, intensive management (i.e., accelerating practices) is not yet required to push the system back into the historic range of variability (Bestelmeyer, et al., 2010) . Foliar cover is between 35 and 65 percent, basal cover is between 5 and 15 percent, and bare ground is around 5 to 15 percent. Warm season grasses make up about 27 percent foliar cover; shrubs, 20 percent; and succulents, 5 percent. The average surface soil stability rating is 4.5 below canopy and 4 in the interspaces. Annual production averages around 550 lbs/ac, but can span between 300 and 800 lbs/ac. This community exists due to past management and disturbance, primarily fire suppression coupled with loosely managed livestock grazing over many years. More short, warm season grass species tend to occur in this community phase along with a greater percentage of nitrogen fixing shrubs such as whitethorn acacia, honey mesquite, and catclaw mimosa. This plant community phase has developed over time due to a number of slow ecological variables. One management practice that influences ecology is fire suppression. Shrubs gain a competitive advantage through fire suppression. Through deeper root systems, shrubs can take advantage of moisture stored deep into the soil, while grasses struggle with the slow decline of soil organic matter and the decrease of plant available water. Also, due to the decrease in soil organic matter, aggregate stability diminishes, causing a decrease in infiltration and an increase in runoff. Livestock contribute to the distribution of seed and can lessen plant vigor and soil organic matter through continuous grazing and over-utilization. As grass and some shrub vigor decrease, nitrogen fixing plants start to increase and begin to change the chemistry and hydrology of the site. This site is “at risk” of crossing a threshold into state two. Non-native invasive species can spread throughout this community phase. Lehmann’s lovegrass (*Eragrostis lehmanniana*) has spread through areas in the lower elevation range of this ecological site. Places such as Slaughter Draw and Slaughter Canyon show invasion by this species. In the upper elevation range, horehound (*Marrubium vulgare*) has found a niche on degraded sites. This plant was historically introduced as a plant for gardens. Invasive species control (chemical, biological, and/or mechanical) can be options to control these invasive species. Lehmann’s lovegrass can be grazed in the spring by cattle when palatability is high.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	185	336	493
Shrub/Vine	135	247	359
Forb	17	34	45
Total	**337**	**617**	**897**

Table 15. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	25-30%

Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	2-6%
Litter	35-45%
Surface fragments >0.25" and <=3"	25-35%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	5-15%

Table 16. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	2-6%	5-15%	1-3%
>0.15 <= 0.3	–	5-9%	6-10%	2-4%
>0.3 <= 0.6	–	7-11%	1-3%	–
>0.6 <= 1.4	–	5-9%	–	–
>1.4 <= 4	–	2-4%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

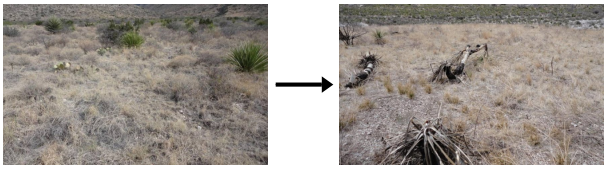
Pathway 1.1A
Community 1.1 to 1.2

Warm season grasses/scattered shrubs (diagnostic plant community)

Shrubs/warm season grasses/succulents

This pathway is the slow movement from Community 1.1 to Community 1.2. This pathway represents intervals between fires within the historic range of variability. It will take 10 to 14 years, after fire for shrubs and succulents to achieve foliar cover > 20%. Shrub and succulent vigor increase as grass vigor decreases due to various ecological processes. The first is through direct competition for resources. Shrubs have greater access to moisture deep within the soil profile. The second is a slow decrease in labile carbon, thus decreasing soil organic matter. This, in turn, leads to a decrease in water-holding capacity and a resulting decrease in grass vigor.

Pathway 1.1B
Community 1.1 to 1.3

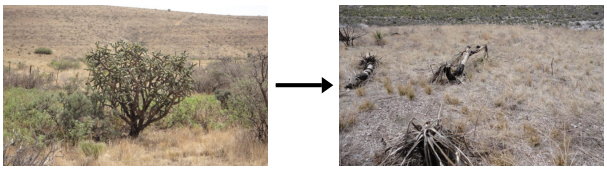


Warm season grasses/scattered shrubs (diagnostic plant community)

Post Fire Warm season grasses

This pathway represents a single fire event driving plant Community 1.1 to 1.3. Grasses respond fairly quickly after fire, while shrubs and succulents are suppressed. This pathway occurs within the historic range of variability. Many shrubs and succulents take a while to respond after a fire event. They must re-grow from below ground root systems or come back from seed. Grasses can colonize quickly after a fire event, via tillering, especially when precipitation follows closely after fire. Note: This species list reflects the model concept of the diagnostic plant phase. Inventory data from multiple plots and sources were used to compile this list. Note: Ranges reflect variability based on soils, temperature and moisture caused by factors such as elevation, and based on average moisture year conditions. Note: Species annual production is given in pounds per acre. Note: A zero in the species production column indicates that the species does not occur at the high or low elevation range of the ecological site. (I.e. tanglehead does not occur at 5500 feet)

Pathway 1.2B
Community 1.2 to 1.3



Shrubs/warm season grasses/succulents

Post Fire Warm season grasses

This pathway represents a single fire event driving plant Community 1.2 to 1.3. Grasses respond fairly quickly after fire, while shrubs and succulents are suppressed. This pathway occurs within the range of historic variability. Many shrubs and succulents take a while to respond after a fire event. They must re-grow from below ground root systems or come back from seed. Grasses can colonize quickly through tillering after a fire event, especially when precipitation follows closely after fire.

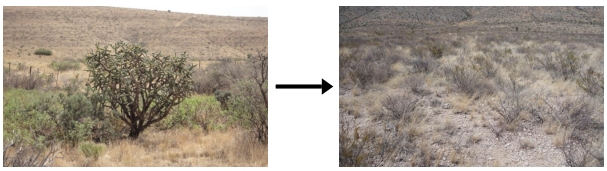
Pathway 1.2C
Community 1.2 to 1.4

Shrubs/warm season grasses/succulents

At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents

This pathway represents a growing competitive advantage from nitrogen fixing shrubs due to slow changes in soil chemistry and hydrology. Nitrogen fixing shrubs such as whitethorn acacia, catclaw acacia, and catclaw mimosa will start to increase in vigor, creating immediate competition with grasses and eventually other shrubs.

Pathway 1.2A
Community 1.2 to 1.4



Shrubs/warm season grasses/succulents

At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents

This pathway is the slow movement from Community 1.2 to Community 1.4. This pathway represents intervals between fires, which are longer than the historic range of variability. Fire suppression, whether through loss of fuel load due to herbivory or from fighting natural wildfires, has increased shrub and succulent vigor and decreased grass production and composition. Shrub and succulent vigor increases as grass vigor decreases due to various ecological processes. One such process is direct competition for resources. Shrubs have greater access to nutrients and moisture deep in the gravelly alluvium. Another process is a slow decrease in labile carbon, resulting in a

decrease in soil organic matter. This, in turn, leads to a decrease in water-holding capacity and a consequential decrease in grass vigor.

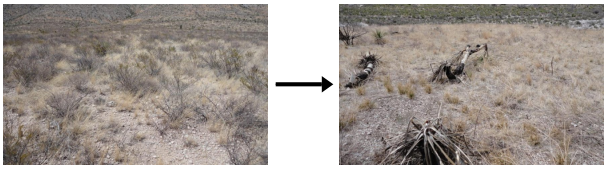
Pathway 1.3A
Community 1.3 to 1.1

Post Fire Warm season grasses

Warm season grasses/scattered shrubs (diagnostic plant community)

This pathway is the slow movement, from Community 1.3 to Community 1.1. This pathway represents intervals between fires where natural processes increase shrub and succulent vigor and decreases grass species production and composition. Shrub and succulent vigor increases as grass vigor decreases due to various ecological processes. The first of these is direct competition for resources. Shrubs have greater access to moisture deep within the gravelly alluvium. The second is a slow decrease in labile carbon, which diminishes plant available water and, as a result, leads to a decrease in grass vigor.

Pathway 1.4B
Community 1.4 to 1.3



At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents

Post Fire Warm season grasses

This pathway represents a single fire event driving plant Community 1.4 to 1.3. Grasses respond fairly quickly after fire, while shrubs and succulents are suppressed. This pathway coupled with a change in livestock grazing will lead back to the historic range of variability.

Pathway 1.4D
Community 1.4 to 1.3

At risk: shrubs/warm season grasses/nitrogen fixing shrubs/succulents

Post Fire Warm season grasses

A change in livestock grazing management promotes grass vigor and decreases shrub competition. This accelerates the turnover of fine roots, causing an increase in labile carbon, acceleration in decomposition, and an increase in plant available water.

State 2
Nitrogen fixing shrubs/warm season grasses State

Nitrogen fixing shrubs have become prominent plants on the site. Foliar cover has decreased to < 40%. A higher Nitrogen turnover rate increases the invasiveness and stability of whitethorn and various catclaw. This community has a mix of shrubs, succulents, and warm season grasses.

Community 2.1

Nitrogen fixing shrubs/warm season grasses

Figure 16. Community 2.1; further degradation; Slaughter Cany

This community phase consists of a mix of nitrogen fixing shrubs and warm season grasses. It is no longer within the reference state as the site has crossed a threshold into a degraded state. Because the site has crossed a threshold, intensive management (i.e., accelerating practices) are required to restore the system. Foliar cover is between 30 and 50 percent, basal cover is between 3 and 12 percent, and bare ground is around 5 to 20 percent. Warm season grasses make up about 20 percent foliar cover, shrubs, 20 percent, and forbs, 5 percent. The average surface soil stability rating is 3.5 under canopy and 3 in the interspaces. Annual production averages around 300 lbs/ac, but can span between 150 and 450 lbs/ac, depending on annual weather patterns. This community exists due to past management and disturbance, primarily fire suppression coupled with grazing management that decreases grass competition. After many years of slow retrogression a trigger event such as a severe drought could cause this site to cross a threshold where ecological processes and soil properties keep it in a degraded state. With fire suppression, shrubs gain a competitive advantage due to more extensive root systems that can access resources deeper in the profile. Grasses struggle with the slow decline of soil organic matter and the decrease of plant available water. Also, due to the decrease in soil organic matter, aggregate stability diminishes causing a decrease in infiltration and an increase in runoff. Livestock contribute to the distribution of nitrogen fixing plant seed and can lessen plant vigor and soil organic matter through continuous grazing and over-stocking. As grass vigor decreases, shrubs gain a competitive advantage. As nitrogen fixing shrubs, especially whitethorn, increase, a change in the chemistry and hydrology of the system occurs. This site suffers from low labile carbon and high nitrogen turnover, ultimately slowing the nutrient cycle and reducing plant available water. Without a change in management, it is possible for this plant community to degrade further, to a state in which only whitethorn, a few scattered shrubs and fluffgrass exists. Lehmann’s lovegrass is an introduced species that has found a niche on this degraded site. This grass species can be grazed through spring and early summer with cattle. It often spreads when brush control practices are implemented.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	93	185	278
Shrub/Vine	69	138	206
Forb	6	13	20
Total	**168**	**336**	**504**

Table 18. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-24%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	3-7%
Non-vascular plants	1%

Biological crusts	2-6%
Litter	25-35%
Surface fragments >0.25" and <=3"	25-35%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	10-20%

Table 19. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-3%	6-10%	1-3%
>0.15 <= 0.3	–	3-7%	8-12%	1-3%
>0.3 <= 0.6	–	5-9%	1-3%	1-2%
>0.6 <= 1.4	–	4-8%	–	–
>1.4 <= 4	–	2-4%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Transition T1A
State 1 to 2

This transition moves the site across a threshold to state two. Slow variables: Continued encroachment by nitrogen fixing shrubs, coupled with the loss of the herbaceous plant community. Both a chemical and hydrological shift occurs as the C:N decreases creating an increase in the nitrogen turnover rate and creating an on-going competitive advantage for nitrogen fixing shrubs. Trigger event: A severe drought, causing a loss of organic carbon. Threshold: A hydrologic function/soil chemistry threshold is crossed.

Restoration pathway R2A
State 2 to 1

An increase in the competitive advantage of non-nitrogen fixing species through physical, chemical, and biological management practices. Various facilitating and management practices can be used to restore this ecological site back to reference. Chemical, mechanical, and biological practices can all be used to suppress whitethorn and other leguminous shrubs. Also, range seeding, winter feeding, and high intensity-short duration livestock grazing can help bring grass seed and organic matter back into the system and start restoring soil carbon and microbial levels. Eventually, once proper fuel loads are achieved, prescribed burning will help suppress shrub competition and improve grass vigor. Monitoring foliar cover by species will help inform the land manager if plant composition is responding to management.

Additional community tables

Table 20. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrases**			72–143	
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	27–108	1–5

	cane bluestem	BOBA3	*Bothriochloa barbinodis*	13–67	1–4
2	**Warm Season Midgrasses**			233–466	
	sideoats grama	BOCU	*Bouteloua curtipendula*	94–175	6–14
	plains lovegrass	ERIN	*Eragrostis intermedia*	27–108	1–9
	slim tridens	TRMU	*Tridens muticus*	40–67	3–5
	purple threeawn	ARPU9	*Aristida purpurea*	27–54	1–3
	vine mesquite	PAOB	*Panicum obtusum*	13–40	1–3
	sand dropseed	SPCR	*Sporobolus cryptandrus*	13–40	1–2
	tanglehead	HETER6	*Heteropogon*	0–13	0–2
	green sprangletop	LEDU	*Leptochloa dubia*	1	1
3	**Warm Season Shortgrasses**			421–843	
	blue grama	BOGR2	*Bouteloua gracilis*	135–350	6–21
	black grama	BOER4	*Bouteloua eriopoda*	135–323	8–14
	sand muhly	MUAR2	*Muhlenbergia arenicola*	13–40	1–5
	Hall's panicgrass	PAHA	*Panicum hallii*	13–40	2–4
	hairy grama	BOHI2	*Bouteloua hirsuta*	13–40	2–4
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	13–40	1–3
	common wolfstail	LYPH	*Lycurus phleoides*	7–20	1–2
	ear muhly	MUAR	*Muhlenbergia arenacea*	7–20	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	7–20	1–2
	bush muhly	MUPO2	*Muhlenbergia porteri*	7–20	1–2
	streambed bristlegrass	SELE6	*Setaria leucopila*	7–20	1–2
	tobosagrass	PLMU3	*Pleuraphis mutica*	0–1	0–1
Forb					
4	**Perennial Forbs**			45–90	
	polygala	POLYG	*Polygala*	7–20	1–2
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	7–20	1–2
	croton	CROTO	*Croton*	7–20	1–2
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	7–20	1–2
	plains blackfoot	MELE2	*Melampodium leucanthum*	1	1
	spreading fleabane	ERDI4	*Erigeron divergens*	1	1
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	1	1
5	**Annual Forbs**			1	
	common sunflower	HEAN3	*Helianthus annuus*	0–1	0–1
Shrub/Vine					
6	**Shrubs**			54–108	
	mariola	PAIN2	*Parthenium incanum*	0–54	0–4
	pungent oak	QUPU	*Quercus pungens*	0–27	0–2
	resinbush	VIST	*Viguiera stenoloba*	7–20	1–3
	algerita	MATR3	*Mahonia trifoliolata*	7–20	1–2
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	13–18	2–6
	littleleaf ratany	KRER	*Krameria erecta*	1	1
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1

	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–1	0–1
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–1	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
	Wright's beebrush	ALWR	*Aloysia wrightii*	0–1	0–1
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–1	0–1
	desert myrtlecroton	BEOB	*Bernardia obovata*	0–1	0–1
	javelina bush	COER5	*Condalia ericoides*	0–1	0–1
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	0–1
	American tarwort	FLCE	*Flourensia cernua*	0–1	0–1
7	**Half-Shrubs**			9–18	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–20	1–3
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–1	0–1
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
	dyssodia	DYSSO	*Dyssodia*	1	1
8	**Cactus**			27–54	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	13–40	1–3
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	0–27	0–2
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	7–20	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1
9	**Yucca**			9–18	
	Torrey's yucca	YUTO	*Yucca torreyi*	7–20	1–3
	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
10	**Yucca-like plants**			27–54	
	green sotol	DALE2	*Dasylirion leiophyllum*	0–54	0–4
	Texas sacahuista	NOTE	*Nolina texana*	7–20	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	0–1	0–1
	Parry's agave	AGPAN6	*Agave parryi ssp. neomexicana*	0–1	0–1

Table 21. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			27–40	
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	11–34	1–3
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	6–17	1–2
2	**Warm Season Midgrasses**			135–202	
	sideoats grama	BOCU	*Bouteloua curtipendula*	56–78	3–5
	plains lovegrass	ERIN	*Eragrostis intermedia*	11–56	1–3
	slim tridens	TRMU	*Tridens muticus*	22–45	1–3

	purple threeawn	ARPU9	*Aristida purpurea*	11–34	1–3
	sand dropseed	SPCR	*Sporobolus cryptandrus*	6–17	1–2
	vine mesquite	PAOB	*Panicum obtusum*	1	1
3	**Warm Season Shortgrasses**			242–363	
	blue grama	BOGR2	*Bouteloua gracilis*	45–179	3–11
	black grama	BOER4	*Bouteloua eriopoda*	34–101	2–8
	hairy grama	BOHI2	*Bouteloua hirsuta*	11–34	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	11–34	1–2
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	11–34	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	11–34	1–2
	common wolfstail	LYPH	*Lycurus phleoides*	6–17	1
	streambed bristlegrass	SELE6	*Setaria leucopila*	6–17	1
	low woollygrass	DAPU7	*Dasyochloa pulchella*	6–17	1
	ear muhly	MUAR	*Muhlenbergia arenacea*	0–1	0–1
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–1	0–1
Forb					
4	**Perennial Forbs**			45–67	
	polygala	POLYG	*Polygala*	6–17	1–2
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	6–17	1–2
	croton	CROTO	*Croton*	6–17	1–2
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	6–17	1–2
	plains blackfoot	MELE2	*Melampodium leucanthum*	1	1
	spreading fleabane	ERDI4	*Erigeron divergens*	1	1
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	1	1
5	**Annual Forbs**			0–1	
	common sunflower	HEAN3	*Helianthus annuus*	0–1	0–1
Shrub/Vine					
6	**Shrubs**			269–404	
	mariola	PAIN2	*Parthenium incanum*	11–146	0–10
	pungent oak	QUPU	*Quercus pungens*	0–67	0–6
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	22–67	2–6
	whitethorn acacia	ACCO2	*Acacia constricta*	0–45	0–2
	creosote bush	LATR2	*Larrea tridentata*	0–45	0–2
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–45	0–2
	roundflower catclaw	ACRO	*Acacia roemeriana*	11–34	1–4
	algerita	MATR3	*Mahonia trifoliolata*	11–34	1–3
	resinbush	VIST	*Viguiera stenoloba*	11–34	1–3
	littleleaf sumac	RHMI3	*Rhus microphylla*	11–34	0–2
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–22	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–22	0–1
	American tarwort	FLCE	*Flourensia cernua*	0–1	0–1
	littleleaf ratany	KRER	*Krameria erecta*	1	1

	Wright's beebrush	ALWR	*Aloysia wrightii*	0–1	0–1
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–1	0–1
	desert myrtlecroton	BEOB	*Bernardia obovata*	0–1	0–1
	javelina bush	COER5	*Condalia ericoides*	0–1	0–1
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
7	**Half-Shrubs**			45–67	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–56	1–3
	dyssodia	DYSSO	*Dyssodia*	6–17	1–2
	desert zinnia	ZIAC	*Zinnia acerosa*	6–17	1–2
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–1	0–1
8	**Cactus**			63–94	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	22–45	2–6
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	11–34	1–3
	cactus apple	OPEN3	*Opuntia engelmannii*	0–22	0–1
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	6–17	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
9	**Yucca**			27–40	
	Torrey's yucca	YUTO	*Yucca torreyi*	11–34	1–3
	soaptree yucca	YUEL	*Yucca elata*	0–22	0–2
10	**Yucca-like plants**			45–67	
	green sotol	DALE2	*Dasylirion leiophyllum*	0–67	1–7
	Texas sacahuista	NOTE	*Nolina texana*	11–34	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	0–1	0–1
	Parry's agave	AGPAN6	*Agave parryi ssp. neomexicana*	0–1	0–1

Table 22. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			67–135	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	20–101	2–10
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	10–71	1–7
2	**Warm Season Midgrasses**			215–430	
	sideoats grama	BOCU	*Bouteloua curtipendula*	101–182	6–10
	slim tridens	TRMU	*Tridens muticus*	40–81	4–6
	plains lovegrass	ERIN	*Eragrostis intermedia*	10–50	1–3
	purple threeawn	ARPU9	*Aristida purpurea*	20–40	1–3
	vine mesquite	PAOB	*Panicum obtusum*	10–30	1–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	10–30	1–2
	tanglehead	HETER6	*Heteropogon*	0–20	0–2
	green sprangletop	LEDU	*Leptochloa dubia*	6–16	1
3	**Warm Season Shortgrasses**			208–417	
	blue grama	BOGR2	*Bouteloua gracilis*	50–151	6–10

	black grama	BOER4	*Bouteloua eriopoda*	50–111	4–10
	hairy grama	BOHI2	*Bouteloua hirsuta*	10–30	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	10–30	1–3
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	10–30	1–3
	streambed bristlegrass	SELE6	*Setaria leucopila*	10–30	1–2
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–20	0–1
	common wolfstail	LYPH	*Lycurus phleoides*	6–16	1–2
	ear muhly	MUAR	*Muhlenbergia arenacea*	6–16	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	6–16	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	6–16	1
	tobosagrass	PLMU3	*Pleuraphis mutica*	0–1	0–1
Forb					
4	**Perennial Forbs**			47–94	
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	10–30	1–2
	croton	CROTO	*Croton*	6–16	1–2
	polygala	POLYG	*Polygala*	6–16	1–2
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	6–16	1–2
	spreading fleabane	ERDI4	*Erigeron divergens*	6–16	1
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	1	1
	plains blackfoot	MELE2	*Melampodium leucanthum*	1	1
5	**Annual Forbs**			11–27	
	common sunflower	HEAN3	*Helianthus annuus*	6–16	0–1
Shrub/Vine					
6	**Shrubs**			67–135	
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	20–40	2–4
	pungent oak	QUPU	*Quercus pungens*	0–40	0–4
	mariola	PAIN2	*Parthenium incanum*	0–40	1–3
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–40	0–1
	algerita	MATR3	*Mahonia trifoliolata*	6–16	1–2
	resinbush	VIST	*Viguiera stenoloba*	6–16	1–2
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–1	0–1
	littleleaf ratany	KRER	*Krameria erecta*	1	1
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–1	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
	Wright's beebrush	ALWR	*Aloysia wrightii*	0–1	0–1
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–1	0–1
	desert myrtlecroton	BEOB	*Bernardia obovata*	0–1	0–1
	javelina bush	COER5	*Condalia ericoides*	0–1	0–1
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	0–1
	American tarwort	FLCE	*Flourensia cernua*	0–1	0–1

	American tarwort	FLCE	*Flourensia cernua*	0–1	0–1
7	**Half-Shrubs**			7–20	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–20	1–2
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–1	0–1
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
	dyssodia	DYSSO	*Dyssodia*	1	1
8	**Cactus**			20–40	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	6–16	1–3
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	6–16	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	6–16	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1
9	**Yucca**			7–16	
	Torrey's yucca	YUTO	*Yucca torreyi*	6–16	1–2
	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
10	**Yucca-like plants**			20–40	
	green sotol	DALE2	*Dasylirion leiophyllum*	0–40	0–3
	Texas sacahuista	NOTE	*Nolina texana*	6–16	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	0–1	0–1
	Parry's agave	AGPAN6	*Agave parryi ssp. neomexicana*	0–1	0–1

Table 23. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			10–30	
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	7–19	1–3
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	3–9	1–2
2	**Warm Season Midgrasses**			57–152	
	sideoats grama	BOCU	*Bouteloua curtipendula*	25–49	2–4
	slim tridens	TRMU	*Tridens muticus*	19–31	1–3
	purple threeawn	ARPU9	*Aristida purpurea*	7–19	1–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	7–19	1–2
	vine mesquite	PAOB	*Panicum obtusum*	3–9	1–2
	green sprangletop	LEDU	*Leptochloa dubia*	3–9	1
	plains lovegrass	ERIN	*Eragrostis intermedia*	3–9	1
	tanglehead	HETER6	*Heteropogon*	0–1	0–1
3	**Warm Season Shortgrasses**			104–278	
	blue grama	BOGR2	*Bouteloua gracilis*	37–99	3–9
	black grama	BOER4	*Bouteloua eriopoda*	31–93	2–8
	hairy grama	BOHI2	*Bouteloua hirsuta*	12–37	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	7–19	1–2
	streambed bristlegrass	SELE6	*Setaria leucopila*	3–9	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	3–9	1

	low woollygrass	BAPU	*Dasyochloa pulchella*	3–9	1
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	3–9	1
	common wolfstail	LYPH	*Lycurus phleoides*	3–9	1
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–1	1
Forb					
4	**Perennial Forbs**			17–45	
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	7–19	1–3
	spreading fleabane	ERDI4	*Erigeron divergens*	3–9	1–2
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	3–9	1–2
	croton	CROTO	*Croton*	1	1
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	1	1
	plains blackfoot	MELE2	*Melampodium leucanthum*	1	1
	polygala	POLYG	*Polygala*	1	1
5	**Annual Forbs**			3–9	
	common sunflower	HEAN3	*Helianthus annuus*	3–9	1–2
Shrub/Vine					
6	**Shrubs**			98–260	
	mariola	PAIN2	*Parthenium incanum*	12–62	1–7
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	7–44	2–3
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	12–37	4–6
	littleleaf sumac	RHMI3	*Rhus microphylla*	12–37	1–3
	whitethorn acacia	ACCO2	*Acacia constricta*	7–31	1–3
	honey mesquite	PRGL2	*Prosopis glandulosa*	7–19	1–3
	Wright's beebrush	ALWR	*Aloysia wrightii*	7–19	1–2
	pungent oak	QUPU	*Quercus pungens*	0–12	0–2
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–12	0–2
	resinbush	VIST	*Viguiera stenoloba*	3–9	1–2
	algerita	MATR3	*Mahonia trifoliolata*	3–9	1–2
	javelina bush	COER5	*Condalia ericoides*	1	1
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
7	**Half-Shrubs**			10–27	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–19	1–3
	dyssodia	DYSSO	*Dyssodia*	3–9	1–2
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–1	0–1
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
8	**Cactus**			20–54	
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	7–31	1–3
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	7–19	1–2
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	3–9	1
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1

9	**Yucca**			7–28	
	soaptree yucca	YUEL	*Yucca elata*	0–25	0–2
	Torrey's yucca	YUTO	*Yucca torreyi*	3–9	1
10	**Yucca-like plants**			10–31	
	green sotol	DALE2	*Dasylirion leiophyllum*	7–31	1–3
	lechuguilla	AGLE	*Agave lechuguilla*	0–1	0–1
	Parry's agave	AGPAN6	*Agave parryi ssp. neomexicana*	0–1	0–1

Table 24. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Midgrasses**			25–76	
	slim tridens	TRMU	*Tridens muticus*	13–20	2–4
	purple threeawn	ARPU9	*Aristida purpurea*	13–20	2–4
	sideoats grama	BOCU	*Bouteloua curtipendula*	7–20	1–3
	vine mesquite	PAOB	*Panicum obtusum*	0–7	1–2
2	**Warm Season Shortgrasses**			57–171	
	black grama	BOER4	*Bouteloua eriopoda*	17–37	2–8
	low woollygrass	DAPU7	*Dasyochloa pulchella*	10–30	2–4
	blue grama	BOGR2	*Bouteloua gracilis*	7–27	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	7–20	1–2
	streambed bristlegrass	SELE6	*Setaria leucopila*	7–20	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–20	0–1
	hairy grama	BOHI2	*Bouteloua hirsuta*	3–17	1–2
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	3–17	1
Forb					
3	**Perennial Forbs**			7–20	
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	2–6	1–3
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	2–6	1–2
	spreading fleabane	ERDI4	*Erigeron divergens*	2–6	1–2
	polygala	POLYG	*Polygala*	1	1
4	**Annual Forbs**			3–9	
	common sunflower	HEAN3	*Helianthus annuus*	3–9	1–2
Shrub/Vine					
5	**Shrubs**			58–177	
	whitethorn acacia	ACCO2	*Acacia constricta*	17–50	5–9
	mariola	PAIN2	*Parthenium incanum*	3–24	1–5
	honey mesquite	PRGL2	*Prosopis glandulosa*	7–20	1–3
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	3–17	1–3
	littleleaf sumac	RHMI3	*Rhus microphylla*	3–17	1–2
	creosote bush	LATR2	*Larrea tridentata*	0–13	0–2
	algerita	MATR3	*Mahonia trifoliolata*	3–10	1–2

	javelina bush	COER5	*Condalia ericoides*	3–10	1–2
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	3–10	1–2
	pungent oak	QUPU	*Quercus pungens*	0–7	0–1
	resinbush	VIST	*Viguiera stenoloba*	2–6	1
	lotebush	ZIOB	*Ziziphus obtusifolia*	2–6	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
6	**Half-Shrubs**			8–27	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–13	1–3
	dyssodia	DYSSO	*Dyssodia*	3–10	1
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
7	**Cactus**			4–16	
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	3–10	1–3
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	2–6	0–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	1	1
8	**Yucca**			1–13	
	soaptree yucca	YUEL	*Yucca elata*	0–13	0–2
	Torrey's yucca	YUTO	*Yucca torreyi*	2–6	1
9	**Yucca-like plants**			2–6	
	green sotol	DALE2	*Dasylirion leiophyllum*	2–6	1
	lechuguilla	AGLE	*Agave lechuguilla*	0–1	0–1
	Parry's agave	AGPAN6	*Agave parryi ssp. neomexicana*	0–1	0–1

Animal community

Part I: Wildlife

The Gravelly ecological site lies at the northern extent of the Chihuahuan Desert and provides habitat for many different wildlife species.

Species of Special Interest:

These are species of special interest that have habitat needs associated with the Gravelly Ecological Site.

Rock Rattlesnake: In New Mexico, the rattlesnake is limited to the southern Guadalupe Mountains and exists within all canyons throughout the Guadalupe Ridge. It is the most frequently encountered rattlesnake in CCNP and is found around exposed bedrock where it feeds on lizards, snakes, and small mammals (SWCA Environmental Consultants, 2007).

Texas Horned Lizard: Texas horned lizards have habitat needs that require healthy harvester ant communities. Harvester ants are the preferred food of horned lizards and when this food resource declines due to shifts to a degraded plant community, or through infrastructure development, lizard numbers will also decline (Henke & Fair, 1998). Feeding may occur at nest entrances or on ant foraging trails and mature lizards are capable of eating 70 to 100 ants per day. Although ants comprise a majority of the diet, Texas horned lizards are opportunistic predators and will consume crickets, grasshoppers, beetles, centipedes, bees and caterpillars. The diagnostic plant community phase (1.1) is best for providing a wide range of plant and insect species needed for Texas horned lizard habit.

Gray Vireo: The gray vireo is found in the desert Southwest. Over 80 percent of the Gray Vireo territories in New Mexico are found in 12 sites, with the largest site being found in the Guadalupe Mountains (Pierce, 2007). The Gray Vireo appears to not winter in New Mexico but move down to the Big Bend area where it is associated with various shrubs and cacti. Summer habitat in the Guadalupe's seems to be linked to juniper and oak plant communities. During breeding season, (April-July) the Gray Vireo are insectivorous, taking grasshoppers, stinkbugs, crickets, moths, and caterpillars for food. In New Mexico, nests are primarily in Juniper trees (Pierce, 2007). Plant communities within the historic range of variability are important for the Gray Vireo to find nesting, breeding, and brood-rearing cover. The birds will find nesting cover in plant communities 1.1 and 1.2, while moving to community phase 1.3 to find food.

Peregrine Falcon: The Peregrine Falcon is a species of concern that occurs throughout the west. According to experts at the "Living Desert Zoo and Gardens State park" in Carlsbad New Mexico, the peregrine falcon has only been spotted on a rare occasion in the fall or winter.

Common hog-nosed skunk:Hog-nosed skunks are distinguished from striped skunks primarily by the pelage, with a characteristic broad white marking beginning at the top of the head and extending down the back and tail. They make their dens in rocky areas, but probably utilize the Gravelly Ecological Site for hunting. They are omnivorous, and they eat differently according to the season. They mainly eat insects and grubs but also eat fruit, small mammals, snakes and carrion. Because rattlesnakes react to skunk musk with alarm, it is believed that skunks may feed extensively on rattlesnakes. In search of food, this skunk can turn over large areas of earth with its bare nose and front claws as it searches for food (Buie, 2003).

Mountain Lion: The mountain lion is an excellent stalk-and-ambush predator, pursuing a wide variety prey. Deer make up its primary food source, but they will also hunt species as small as insects and rodents. The mountain lion stalks through shrubs and across ledges before delivering a powerful leap onto the back of its prey with a suffocating neck bite. The mountain lion is capable of breaking the neck of its prey with a strong bite and momentum bearing the animal to the ground. Kills are generally estimated at around one large ungulate every two weeks. This period shrinks for females raising young, and may be as short as one kill every three days when cubs are nearly mature at around 15 months.

Only females are involved in parenting. Females are fiercely protective of their cubs, and have been seen to successfully fight off animals as large as black bears in their defense. Caves and other alcoves that offer protection are used as litter dens (Cougar, 2013).

The Very Shallow and Limestone Hills ecological sites provide the best habitat for the mountain lion life cycle. ON the Gravelly site, plant community 1.2 would be best for lions to hide and stalk prey. Mountain lions can work the edge of hill summits and position themselves above prey where they can pounce with a killing blow.

Eastern White-throated Wood Rat: This large rat is often called a packrat because of the large nest of sticks and other material that it incorporates into nests. The nocturnal rat feeds on a wide variety of plants and finds shelter around dense stands of cacti such as cholla and prickly pear. Plant communities 1.1 and 1.2 are ideal for nesting white-throated wood rats.

Other species associated with the Gravelly ecological site:

Birds:
Turkey Vulture
Mississippi Kite
Red-tailed Hawk
American Kestrel
Great Horned Owl
Spotted Towhee
Canyon Towhee
Cassin's Sparrow
Brewer's Sparrow
Black-throated Sparrow

White-crowned Sparrow
Dark-eyed Junco
Scaled Quail
White-winged Dove
Mourning Dove
Eurasian Collared Dove (introduced)
Lesser Nighthawk
Common Nighthawk
Black-chinned Hummingbird
Ladder-backed Woodpecker
Western Kingbird
Cliff Swallow
Barn Swallow
Verdin
Cactus Wren
Rock Wren
Northern Mockingbird
Curved-billed Thrasher
House Finch
House Sparrow

Mammals:
Mexican Ground Squirrel
Yellow-faced Pocket Gopher
Merriam's Kangaroo Rat
Merriam's Pocket Mouse
Western Harvest Mouse
Southern Plains Woodrat
Cactus Mouse
White-footed Mouse
White-ankled Mouse
Hispid Cotton Rat
North American Porcupine
Black-tailed Jackrabbit
Desert Cottontail
American Badger
Striped Skunk
Grey Fox
Coyote
Bobcat
Mule Deer
Elk
Ringtail

Reptiles:
Green Toad
Red-spotted toad
Rio-Grande Leopard Frog
Eastern Collared Lizard
Greater Earless Lizard
Round Tailed Horned Lizard
Crevice Spiny Lizard
Prairie Lizard
Common Side-blotched Lizard
Texas Banded Gecko
Chihuahuan Spotted Whiptail
Common Checkered Whiptail
Ring-necked Snake

Striped Whip Snake
Western Ground Snake

Note: This species list was composed with help from the Living Desert Zoo and Gardens State Park, Carlsbad, New Mexico.

Part II Livestock:

The Gravelly Ecological Site has traditionally been grazed by all kinds and classes of livestock, during all seasons of the year. In the early part of the 20th century, goats and sheep were used extensively along the Guadalupe Ridge, taking advantage of browse species. Currently, though, there are very few goat and sheep operations in the area due to many market factors. Cattle numbers are down as well due to drought and extensive wildfire from 2001-2011.

With a planned livestock grazing system, the Gravelly Ecological Site could be managed for sustained agriculture while maintaining the historic range of variability. Also, prescribed fire may be a part of the management mix to move the system to community phase 1.3, which is primarily a grassland plant community. The loss of goat production probably plays a role in the overall increase in shrub cover, especially in nitrogen fixing shrubs.

Hydrological functions

The Bascal soil component is in hydrologic group B. This soil has a moderate infiltration rate when thoroughly wet. It consists chiefly of deep, well drained soils that have moderately fine texture to moderately coarse texture.

Plant diversity is important on this site, as various types of root systems help sustain plant communities through drought. Deep rooted shrubs take advantage of water and nutrients deep in the profile. Fibrous and tap root systems take advantage of moisture and nutrients in the top meter of the soil.

Recreational uses

The Gravelly ecological site provides limited recreational use due to its lack of drinking water. Hiking is limited to day trips and should not be attempted without adequate water and a large hat. Hunting can be good on this site as elk and deer can be hunted where permitted.

Other information

Inventory data references

Data was collected during the years of 2011 and 2012. For all tier one data points, ocular methods were used to collect estimates of production, ground cover, and canopy cover. The Doman-Krajina method was used for canopy cover estimates. Soil pits were dug for verification on many tier one plots. Tier two and three protocols always were verified and analyzed with soil pits. Other methods used were line-point-intercept (LPI), double-sampling (DS), canopy gap (CG), and soil stability (SS). This ecological site had a number of tier one and tier two plots, with one tier three at the diagnostic plant community. Historic data from BLM monitoring points were used as well.

Type locality

Location 1: Eddy County, NM	
UTM zone	N
UTM northing	529378
UTM easting	3541739
General legal description	The tier 3 sample data was collected on BLM land, adjacent to calamity cove.

Other references

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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.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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

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

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**