Ecological site R042CY003NM
Shallow

Accessed: 05/13/2025

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

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

It is possible, though very rare, that this Shallow 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: Shallow 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: Shallow 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: Shallow 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 very shallow to shallow (1-50 cm). The root restrictive layer is a cemented petrocalcic horizon. This site is positioned on alluvial fans and fan piedmonts 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.
R042CY004NM	**Gravelly** This site sits below or adjacent to the Shallow Ecological Site where depth is a meter or greater.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Shallow Ecological Site is positioned on alluvial fans and fan piedmonts within LRU 42.8. Elevation ranges from 3500 to 5500 feet. Soil depth can range from very shallow to moderately deep (0-100 cm) above a cemented petrocalcic layer. Slopes vary from 5 to 35 percent but generally range from 10 to 30 percent. Aspect plays a minor role on this site.

The Shallow Ecological Site occurs on fan remnants, which are almost always dissected by an active dry channel that varies in relief. It is made up of alluvium that is derived from limestone parent material. The Shallow Ecological site is closely associated with the Limestone Hills and Gravelly Ecological Sites. The Limestone Hills site occurs on bedrock controlled limestone greater than 25 percent slope, and the Gravelly occurs on deep alluvial fill that has a deep or non-existent petrocalcic layer.

Geology: The primary geologic formations that make up the parent material for the Shallow Ecological Site include the Capitan Limestone, Tansil, Yates, and to a lesser extent the Seven Rivers Formation. During Guadalupian time of the Permian Period, dynamic sedimentation of carbonate and evaproite rocks occurred around the rim of the Delaware basin creating an ideal environment for the development of a large coral reef. The rim was topographically high; the waters were shallow, well-ventilated, agitated, and warm. In this excellent marine-life environment the great Capitan Reef began to form. The Capitan Reef grew rapidly and flourished throughout Guadalupian time, surrounding the Delaware basin, controlling environments and influencing sedimentation (Kelley, 1971).

On the landward side of the reef (the backreef) the Seven Rivers, Yates, and Tansil formations developed. The first was the Seven Rivers Formation. The sediments of the Seven Rivers deposited at a time when conditions became drier, and the basin tended toward hypersalinity. The Seven Rivers contain gray to white dolomitic limestone, white to red gypsum, orange-red siltstone, and shale. Within the LRU, the Seven Rivers Formation is considered the surface layer on Azotea Mesa, Seven Rivers Hills, and West Hess Hills. The Seven Rivers Formation tends to contain more erodible sediments than the Tansil and Yates.

Deposited above the Seven Rivers during a quiet period within an unrestricted lagoon is the Yates Formation. The Yates is characterized by layers of very pale orange to yellowish-gray fine-grained, laminated dolomite, alternating with grayish-orange to pale yellowish-orange, calcareous quartz siltstone or very fine-grained sandstone. The Yates is the surface formation over much of Carlsbad Caverns National Park, starting at Walnut Canyon and extending North through the Cueva Escarpment and up to Living Desert State Park.

Landward of the unrestricted lagoon was a restricted lagoon, (the Tansil Formation). Here freshwater mixed with seawater. Large amounts of sediments were carried in by streams causing a hostile environment for marine organisms. Like the Yates, the Tansil is characterized by clastic sediments such as siltstone and sandstone as well as layers of dolomite. Unlike the Yates, however, the Tansil contains many thin clay layers (Burger, 2007). The Tansil Formation is the surface layer at the Carlsbad Caverns Visitor Center.

About 15 million years ago, the ancient reef rock that had been buried by younger layers of rock began to rise, creating the Guadalupe Ridge and Mountains while exposing the Seven Rivers, Tansil, and Yates Formations. Over the years, especially during the glacial periods of the Pleistocene, alluvial fan construction occurred as material from mountain drainages formed a semi conical deposit of variously sorted and stratified alluvium. The great alluvial fans along the front escarpment of the Guadalupe Ridge have also merged laterally to form a coalescent-alluvial-fan piedmont, or fan piedmont (Peterson, 1981). Over time, calcium carbonate has accumulated in the soil to form a cemented layer called a petrocalcic horizon. This layer can both be a root restricting layer and provide cracks and fissures for soil and water to accumulate.

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

1. Site is within LRU 42.8, which is the ustic-aridic soil moisture regime, and the thermic soil temperature regime (often contains redberry 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, and is represented by the aridic-ustic soil moisture regime and the mesic soil temperature regime. (often contains alligator juniper and 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).

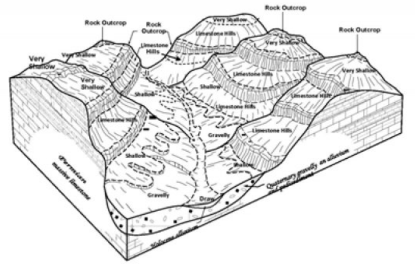

Figure 2. 42.8 Northeastern Chihuahuan Desert Hills

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan remnant (3) Fan piedmont
Flooding frequency	None
Elevation	1,067–1,676 m
Slope	5–35%
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 Shallow 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 when 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 Shallow Ecological Site is not associated with a wetland or riparian system; it is an upland ecological site.

Soil features

Every ecological site and associated soil component has static soil properties that help define the physical, chemical, and biological characteristics that make the site unique. The following soil profile information is a description of those unique soil properties for the Shallow Ecological Site. To learn about the dynamic processes of the soil component, refer to the "plant communities" section of the ESD.

The Shallow Ecological Site is tied to the Kimrose component of map units CC2, CC8, LK1, KB1, and KB2 in LRU 42.8. The CC2 and LK1 map units are almost identical and consist of complexes of soil components which are dominated by about 70% Lechuguilla, 15% Kimrose, and 15% rock outcrop. CC8 and KB2 map units are also very similar complexes with about 65% Kimrose and 35% Bascal. (The Bascal component is associated with the Gravelly Ecological Site.) The Kimrose component is formed from gravelly alluvium derived from limestone and dolomite and exists on mostly convex surfaces with a depth of very shallow to moderately deep.

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 Kimrose component is well drained formed in gravelly fan alluvium and occurs on moderately sloping to moderately steep, dissected alluvial fan remnants. The Kimrose taxonomic class is: Loamy-skeletal, mixed, superactive, thermic, shallow Calcic Petrocalcids. The Kimrose component has about 2.5% organic matter in the A horizon giving it a dark horizon, which can produce dynamic living organisms and is traditionally linked to a grassland setting. Effervescence is strong to violent.

Typical Pedon
Kimrose, very gravelly loam; UTM 539092 meters E, 3551261 meters N, zone 13. (Colors are for dry soil unless otherwise noted)

A--0 to 12 centimeters (0 to 5 in); dark grayish brown (10YR 4/2), very gravelly loam, very dark brown (10YR 2/2), moist; 40 percent sand; 25 percent clay; moderate medium subangular blocky parts to moderate fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine roots and common medium roots and common fine roots; common very fine interstitial pores; 5 percent limestone fragments, 76 to 250 mm cobbles, nonflat rounded, indurated and 50 percent limestone fragments, 2 to 75 mm gravel, nonflat, rounded, indurated; strong effervescence; slightly alkaline (pH 7.6); clear smooth boundary.

Bk1--12 to 23 centimeters (5 to 9 in); dark grayish brown (10YR 4/2), very gravelly loam, very dark brown (10YR 2/2), moist; 40 percent sand; 26 percent clay; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots and common medium roots and common fine roots; common very fine tubular pores; 15 percent medium prominent irregular carbonate masses throughout; 35 percent limestone fragments, 2 to 75 mm gravel, nonflat, rounded, indurated; violent effervescence; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bk2--23 to 33 centimeters (9 to 13 in); dark grayish brown (10YR 4/2), extremely flaggy loam, very dark brown (10YR 2/2), moist; 45 percent sand; 24 percent clay; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots and common fine roots; common medium vesicular pores; 70 percent coarse prominent irregular carbonate masses throughout; 30 percent limestone fragments, 2 to 150 mm channers, flat, angular, indurated and 40 percent limestone fragments, 151 to 380 mm flagstones, flat, angular, indurated; violent effervescence; slightly alkaline (pH 7.6); abrupt wavy boundary.

Bkm--33 to 200 centimeters (13 to 79 in); fractured at intervals of 18 to <39 inches

Typical Surface Fragments <=3" (% Cover): 35-45%

Typical Surface Fragments > 3" (% Cover): 10-20%

Typical Subsurface Fragments <=3" (% Volume): 15-25%

Typical Subsurface Fragments > 3" (%% Volume): 15-30%

Typical Soil Depth: 25-40 cm

Calcium Carbonate Equivalent (percent):
A horizons-10 to 25
Bk1 horizon-15 to 30
Bk2 horizon-30 to 50

Total Average Available Water Capacity (cm H2O/cm soil): 2.22 cm

Figure 5. Kimrose Component

Table 4. Representative soil features

Parent material	(1) Alluvium–dolomite
Surface texture	(1) Gravelly loam (2) Very gravelly fine sandy loam (3) Cobbly sandy clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderate
Soil depth	5–51 cm
Surface fragment cover <=3"	30–55%
Surface fragment cover >3"	5–30%
Available water capacity (0-101.6cm)	2.16–2.29 cm
Calcium carbonate equivalent (0-101.6cm)	10–50%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	7.4–7.8

Subsurface fragment volume <=3" (Depth not specified)	10–30%
Subsurface fragment volume >3" (Depth not specified)	5–40%

Ecological dynamics

There are numerous variables that affect plant communities on the Shallow Ecological Site. Variables include: elevation, aspect, depth to a petrocalcic layer, fracturing of the petrocalcic, and fire frequency. The first basic variable is a combination of aspect and elevation. 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 ocotillo, mariola, and various cacti. As elevation increases plant communities shift from black grama-mariola communities to curly leaf muhly-redberry juniper communities. Sandpaper oak dominates the upper portion of the site (at about 5500 feet).

Depth to the petrocalcic horizon plays a role in determining species production and diversity. The underlying petrocalcic undulates in depth from being exposed at the surface to a depth of 100 cm in a few places. The deeper the soil, the greater the ability for different plant species to access water and utilize resources. Species such as blue grama and Wrights' beebrush prefer a deeper soil, while curly leaf muhly and lechuguilla prefer very shallow soils. Cracks and fissures, associated with highly indurate cementation, provide pores for water and soil to accumulate, allowing access for shrubs (especially oaks) to absorb water and thrive well into drought years. There has also been a study to suggest that carbonate-cemented horizons may store water following extreme rainfall events, and slowly release water, over time, back into the rooting zone. This explains why observations show that perennial grasses exhibit greater resilience to drought when associated with petrocalcic horizons at a shallow depth (Duniway, et al., 2010).

Fire is a consistent disturbance regime that reduces succulents and a few shrubs while stimulating grasses and forbs. 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. Following 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 of plant communities across the landscape. Such a pattern provides beneficial, even necessary, habitat for many animal species.

State and transition model

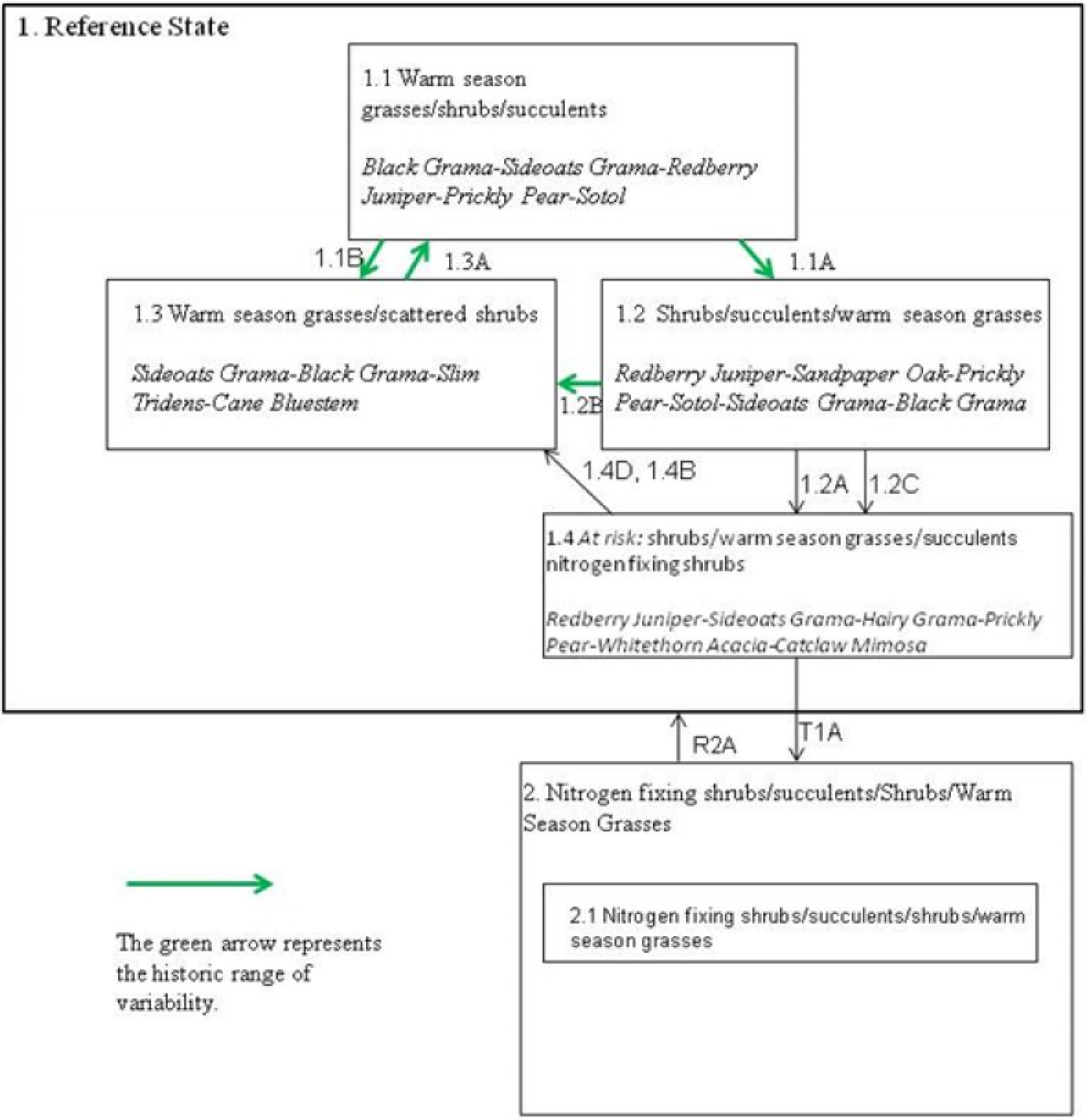

Figure 6. Shallow

State 1
Reference State

1.1 Warm season grasses/shrubs/succulents (diagnostic plant community) A mix of grasses, shrubs and succulents is present. Total foliar cover is > 65%. 1.1A Community Pathway: This pathway represents intervals between fires, during which natural processes increase shrub and succulent vigor and decrease grass production and composition. 1.1B Community Pathway: This pathway represents fire. Fire suppresses succulents and many shrubs, giving grasses a competitive advantage. 1.2 Shrubs/succulents/warm season grasses: Over time, foliar cover of shrubs and succulents increases and that of warm season grasses decreases. 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 sets back 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 Warm season grasses/scattered shrubs: This site exists after fire. Grasses respond well to fire, while many shrubs and succulents decrease. 1.3A Community Pathway: This pathway represents time between fires during which natural processes increase shrub and succulent vigor and decrease grass production and composition. Over time, plant community 1.3 shifts to 1.1. 1.4 At risk: shrubs/warm season grasses/succulents/nitrogen fixing shrubs: 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 nitrogen fixing shrubs, coupled with the loss of the herbaceous plant community due to a decrease in soil organic matter, leading to a decrease in plant available water. Trigger event: A severe drought causes a loss of organic carbon. Threshold: A hydrologic function/soil chemistry threshold was crossed. 2.0 Nitrogen fixing shrubs/succulents/shrubs/warm season grasses State 2.1 Nitrogen fixing shrubs/succulents/shrubs/warm season grasses: Nitrogen fixing shrubs have become a prominent plant on the site. Foliar cover has decreased to < 40%. A higher nitrogen turnover rate increases the invasiveness and stability of whitethorn and various leguminous shrubs. 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/shrubs/succulents (diagnostic plant community)

Figure 7. Community 1.1; Walnut Canyon; Carlsbad Caverns Nat

This community phase combines a mix of warm season grasses, shrubs and succulents. Foliar cover is between 70 and 80 percent, basal cover is between 15 and 30 percent, and bare ground is minimal due to over 45 percent surface rock fragments. Warm season grasses make up about 45 percent foliar cover; shrubs, 15 percent; and succulents, including sotol and lechuguilla, around 10 percent. The average surface soil stability rating is 5 under the canopy and 4.5 in the interspaces. Annual production averages around 1000 lbs/ac, but can span between 700 and 1300 lbs/ac, depending on soil depth, cracks in the petrocalcic horizon, and annual weather patterns. This community exists approximately 5-7 years after low intensity fire. Sideoats is a common grass at all elevations. Thermic species, such as black grama, slim tridens and hairy tridens are more dominant at lower elevations, while curly leaf muhly is common in the upper range. Redberry juniper tends to be common at all elevations while oak can become thick at the upper range. Sotol can be a dominant, especially in areas where heavy fracturing of the petrocalcic occurs. This plant community phase optimizes energy flow, hydrologic function, and nutrient cycling. The diverse root system takes advantage of moisture from both close to the surface as well as deep in the petrocalcic strata. Decomposition is active, creating soil organic matter, which enhances “plant available water” 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	549	785	1020
Shrub/Vine	196	280	364
Forb	39	56	73
Total	**784**	**1121**	**1457**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	40-50%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1-3%
Litter	50-60%
Surface fragments >0.25" and <=3"	40-50%
Surface fragments >3"	1-3%
Bedrock	0%
Water	0%
Bare ground	1-5%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-3%	3-7%	1-3%
>0.15 <= 0.3	–	2-4%	20-30%	1-3%
>0.3 <= 0.6	–	4-8%	10-20%	1-2%
>0.6 <= 1.4	–	7-11%	–	–
>1.4 <= 4	–	3-7%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 9. Plant community growth curve (percent production by month). NM4283, Shallow Reference State.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	5	10	10	25	30	12	5	0	0

Community 1.2
Shrubs/succulents/warm season grasses

Figure 10. Community 1.2; Sheep Canyon; BLM; 7-7-11

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 25 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 800 lbs/ac, but can span between 600 and 1000 lbs/ac, depending on cracks and fissures in the petrocalcic, soil depth and annual weather patterns. This community exists approximately 14-18 years after fire. Sideoats grama is the dominant grass in all elevations, while "thermic" species, such as black grama, slim tridens and hairy tridens, are more dominant at lower elevations. Redberry juniper tends to be a dominant shrub at all elevations, while sandpaper oak shows a strong presence at upper elevations. Prickly pear and sotol are the dominant succulents and are present at all elevations. This plant community has evolved 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 grasses for water and 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	336	448	560
Grass/Grasslike	303	404	504
Forb	34	45	56
Total	**673**	**897**	**1120**

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	50-70%
Surface fragments >0.25" and <=3"	40-50%
Surface fragments >3"	1-3%
Bedrock	0%
Water	0%
Bare ground	3-7%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	2-6%	3-7%	1-3%
>0.15 <= 0.3	–	4-6%	20-30%	1-3%
>0.3 <= 0.6	–	6-10%	–	1-2%
>0.6 <= 1.4	–	10-20%	–	–
>1.4 <= 4	–	5-9%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.3
Warm season grasses/scattered shrubs

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 2 to 4 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 the percentage of exposed cemented material, cracks and fissures in the petrocalcic, soil depth and annual weather patterns. This community exists approximately 1 to 6 years after fire. It is a grass dominated site, with basal sprouting shrubs scattered across the site. Sideoats grama is the dominant grass in mid to upper elevations, while “thermic” species, such as black grama, slim tridens and hairy tridens, are more dominant at lower elevations. Mariola tends to be a dominant shrub at lower to mid elevations, followed by redberry juniper at mid to upper elevations and sandpaper oak at the uppermost elevations. 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	55-75%
Surface fragments >0.25" and <=3"	40-50%
Surface fragments >3"	1-3%
Bedrock	0%
Water	0%
Bare ground	1-5%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	2-3%	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/succulents/nitrogen fixing shrubs

Figure 14. Community 1.4; Double Canyon; 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 20 percent foliar cover; shrubs, 23 percent; and succulents, 7 percent. The average surface soil stability rating is 5 below canopy and 4.5 in the interspaces. Annual production averages around 550 lbs/ac, but can span between 300 and 800 lbs/ac, depending on cracks and fissures in the petrocalcic, soil depth and annual weather patterns. 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 along with a greater percentage of nitrogen fixing shrubs such as whitethorn acacia 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 in response to fire suppression. Through deeper root systems, shrubs can take advantage of moisture stored in cracks and fissures in the petrocalcic, while grasses struggle with the slow decline of soil organic matter and the attendant decrease in 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. Another factor in creating this community is the loose management of livestock over many years. Livestock contribute to the distribution of seed and can lessen plant vigor and soil organic matter through continuous grazing and over-utilization. As the vigor of grasses and some shrubs decreases, 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.

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	25-35%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	3-5%

Litter	35-45%
Surface fragments >0.25" and <=3"	40-50%
Surface fragments >3"	1-3%
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%	3-5%	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/shrubs/succulents (diagnostic plant community)

Shrubs/succulents/warm season grasses

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 in cracks and fissures within the petrocalcic strata. The second is a slow decrease in labile carbon, which reduces 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/shrubs/succulents (diagnostic plant community)

Warm season grasses/scattered shrubs

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 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 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. sand muhly does not occur at 5500 feet)

Pathway 1.2B
Community 1.2 to 1.3

Shrubs/succulents/warm season grasses

Warm season grasses/scattered shrubs

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 after a fire event via tillering, especially when precipitation follows closely after fire.

Pathway 1.2A
Community 1.2 to 1.4

Shrubs/succulents/warm season grasses

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

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 increase as grass vigor decreases due to various ecological processes. One such process is through direct competition for resources. Shrubs have greater access to moisture deep in cracks and fissures within the bedrock strata. Another process 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 consequential decrease in grass vigor.

Pathway 1.3A
Community 1.3 to 1.1

Warm season grasses/scattered shrubs

Warm season grasses/shrubs/succulents (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 in cracks and fissures within the bedrock strata. The second is a slow decrease in labile carbon, thus decreasing soil organic matter which leads to a decrease in grass vigor.

Pathway 1.4B
Community 1.4 to 1.3

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

Warm season grasses/scattered shrubs

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/succulents/nitrogen fixing shrubs

Warm season grasses/scattered shrubs

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/succulents/shrubs/warm season grasses State

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

Community 2.1
Nitrogen fixing shrubs/succulents/shrubs/warm season grasses

Figure 16. Community 2.1; Slaughter canyon; CCNP; 4/15/12

This community phase consists of a mix of shrubs, succulents and warm season grasses along with an increase in nitrogen fixing shrubs, especially whitethorn acacia. 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) is 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 10 percent foliar cover; shrubs, 20 percent; and succulents, 8 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 the percentage of exposed cementation, cracks and fissures in the petrocalcic, soil depth and 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 deeper root systems, which take advantage of moisture stored in cracks and fissures in the bedrock, 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 begins to break down, causing a decrease in infiltration and an increase in runoff. Livestock contribute to the distribution of nitrogen fixing shrub 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, changes in the chemistry and hydrology of the system occur. This site suffers from low soil organic carbon and high nitrogen turnover, which ultimately reduces plant available water. Without a change in management, it is possible for this plant community to degrade further, to a community in which only whitethorn, a few scattered shrubs, and fluffgrass exist.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	92	185	277
Grass/Grasslike	67	135	202
Forb	9	17	26
Total	**168**	**337**	**505**

Table 18. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	25-30%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	2-4%
Non-vascular plants	1%
Biological crusts	2-6%
Litter	25-35%
Surface fragments >0.25" and <=3"	40-50%
Surface fragments >3"	1-3%
Bedrock	0%
Water	0%
Bare ground	5-15%

Table 19. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-5%	6-10%	1-3%
>0.15 <= 0.3	–	4-8%	1-3%	1-2%
>0.3 <= 0.6	–	7-11%	–	–
>0.6 <= 1.4	–	4-8%	–	–
>1.4 <= 4	–	1-5%	–	–
>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 more available nitrogen accelerates decomposition, which eventually leads to a reduction in particulate organic matter. 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 in the plant community. 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, when fuel load is high enough, prescribed burning will also help reduce 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 Tallgrasses**			78–146	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	45–112	2–4
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	11–34	1–2
	little bluestem	SCSC	*Schizachyrium scoparium*	0–22	0–2
2	**Warm Season Midgrasses**			235–437	
	sideoats grama	BOCU	*Bouteloua curtipendula*	67–157	6–10
	slim tridens	TRMU	*Tridens muticus*	67–112	4–6
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	11–78	1–6
	purple threeawn	ARPU9	*Aristida purpurea*	22–67	2–4
	plains lovegrass	ERIN	*Eragrostis intermedia*	11–34	1–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	11–34	1–2

	tanglehead	HETER6	*Heteropogon*	0–22	0–2
	vine mesquite	PAOB	*Panicum obtusum*	1	1
3	**Warm Season Shortgrasses**			220–408	
	black grama	BOER4	*Bouteloua eriopoda*	56–168	2–14
	hairy grama	BOHI2	*Bouteloua hirsuta*	34–101	2–8
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	22–45	1–4
	Hall's panicgrass	PAHA	*Panicum hallii*	22–45	1–4
	common wolfstail	LYPH	*Lycurus phleoides*	11–34	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–22	0–2
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–22	0–2
	streambed bristlegrass	SELE6	*Setaria leucopila*	6–17	1–2
	blue grama	BOGR2	*Bouteloua gracilis*	6–17	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1	1
4	**Cool Season Tallgrasses**			16–29	
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–45	0–2
Forb					
5	**Perennial Forbs**			31–58	
	croton	CROTO	*Croton*	6–17	1–2
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	6–17	1–2
	twinleaf senna	SEBA3	*Senna bauhinioides*	6–17	1–2
	pea	LATHY	*Lathyrus*	1	1
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	1	1
6	**Annual Forbs**			8–15	
	common sunflower	HEAN3	*Helianthus annuus*	0–22	0–2
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	0–1
Shrub/Vine					
7	**Shrubs**			102–189	
	pungent oak	QUPU	*Quercus pungens*	0–67	0–6
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	11–56	2–6
	resinbush	VIST	*Viguiera stenoloba*	11–34	1–3
	mariola	PAIN2	*Parthenium incanum*	6–17	1–4
	algerita	MATR3	*Mahonia trifoliolata*	6–17	1–2
	littleleaf ratany	KRER	*Krameria erecta*	6–17	1–2
	javelina bush	COER5	*Condalia ericoides*	6–17	1–2
	featherplume	DAFO	*Dalea formosa*	6–17	1–2
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	0–1
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–1	0–1
	catclaw acacia	ACGR	*Acacia greggii*	0–1	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
	Wright's beebrush	ALWR	*Aloysia wrightii*	1	1
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–1	0–1

			biuncifera		
	gray oak	QUGR3	*Quercus grisea*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	mescal bean	SOSE3	*Sophora secundiflora*	0–1	0–1
8	**Half-Shrubs**			16–29	
	dyssodia	DYSSO	*Dyssodia*	6–17	1–2
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–17	1–2
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
9	**Cactus**			31–58	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	11–34	1–3
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	6–17	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	6–17	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	horse crippler	ECTE	*Echinocactus texensis*	0–1	0–1
	nylon hedgehog cactus	ECVI2	*Echinocereus viridiflorus*	0–1	0–1
	ocotillo	FOSP2	*Fouquieria splendens*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1
10	**Yucca**			8–15	
	Torrey's yucca	YUTO	*Yucca torreyi*	6–17	1–2
	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
11	**Yucca-like plants**			39–73	
	green sotol	DALE2	*Dasylirion leiophyllum*	11–34	2–4
	Texas sacahuista	NOTE	*Nolina texana*	11–34	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	6–17	1–2
12	**Fern**			1	
	Cochise scaly cloakfern	ASCO42	*Astrolepis cochisensis*	1	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**			27–45	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	18–36	1–3
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	4–13	1
2	**Warm Season Midgrasses**			135–224	
	sideoats grama	BOCU	*Bouteloua curtipendula*	45–81	3–5
	slim tridens	TRMU	*Tridens muticus*	36–54	2–4
	purple threeawn	ARPU9	*Aristida purpurea*	18–36	2–3
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	4–31	1–3
	plains lovegrass	ERIN	*Eragrostis intermedia*	0–18	1–2
	tanglehead	HETER6	*Heteropogon*	0–18	0–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	4–13	1–2
3	**Warm Season Shortgrasses**			135–224	
	hairy grama	BOHI2	*Bouteloua hirsuta*	18–90	1–5

	hairy grama	BOHI2	*Bouteloua hirsuta*	18–90	1–5
	black grama	BOER4	*Bouteloua eriopoda*	9–81	1–6
	Hall's panicgrass	PAHA	*Panicum hallii*	9–45	1–4
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	4–31	1–4
	common wolfstail	LYPH	*Lycurus phleoides*	9–27	1–2
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–18	0–2
	streambed bristlegrass	SELE6	*Setaria leucopila*	4–13	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–1	0–1
	blue grama	BOGR2	*Bouteloua gracilis*	1	1
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1	1
4	**Cool-season Tallgrasses**			0–18	
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–18	0–2
Forb					
5	**Perennial Forbs**			27–45	
	twinleaf senna	SEBA3	*Senna bauhinioides*	1–18	1–2
	croton	CROTO	*Croton*	4–13	1–2
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	4–13	1–2
	pea	LATHY	*Lathyrus*	1	1
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	1	1
6	**Annual Forbs**			4–18	
	common sunflower	HEAN3	*Helianthus annuus*	0–20	0–2
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	0–1
12	**Fern**			0–18	
	Cochise scaly cloakfern	ASCO42	*Astrolepis cochisensis*	0–18	0–1
Shrub/Vine					
7	**Shrubs**			202–336	
	pungent oak	QUPU	*Quercus pungens*	0–108	0–10
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	18–90	1–9
	mariola	PAIN2	*Parthenium incanum*	18–54	1–6
	resinbush	VIST	*Viguiera stenoloba*	18–36	1–3
	algerita	MATR3	*Mahonia trifoliolata*	9–27	1–2
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–18	0–2
	whitethorn acacia	ACCO2	*Acacia constricta*	1–18	1–2
	catclaw acacia	ACGR	*Acacia greggii*	1–18	1–2
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–18	0–2
	Wright's beebrush	ALWR	*Aloysia wrightii*	4–13	1–2
	desert myrtlecroton	BEOB	*Bernardia obovata*	4–13	1–2
	javelina bush	COER5	*Condalia ericoides*	4–13	1–2
	featherplume	DAFO	*Dalea formosa*	4–13	1–2
	littleleaf ratany	KRER	*Krameria erecta*	4–13	1–2
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	0–1

	gray oak	QUGR3	*Quercus grisea*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	mescal bean	SOSE3	*Sophora secundiflora*	0–1	0–1
8	**Half-Shrubs**			34–56	
	dyssodia	DYSSO	*Dyssodia*	9–27	1–2
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	9–27	1–2
	desert zinnia	ZIAC	*Zinnia acerosa*	4–13	1
9	**Cactus**			34–56	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	9–27	1–3
	cactus apple	OPEN3	*Opuntia engelmannii*	0–18	0–1
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	4–13	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	4–13	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	horse crippler	ECTE	*Echinocactus texensis*	0–1	0–1
	nylon hedgehog cactus	ECVI2	*Echinocereus viridiflorus*	0–1	0–1
	ocotillo	FOSP2	*Fouquieria splendens*	0–1	0–1
10	**Yucca**			4–13	
	Torrey's yucca	YUTO	*Yucca torreyi*	4–13	1–2
	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
11	**Yucca-like plants**			61–101	
	green sotol	DALE2	*Dasylirion leiophyllum*	18–72	1–9
	Texas sacahuista	NOTE	*Nolina texana*	18–36	1–5
	lechuguilla	AGLE	*Agave lechuguilla*	0–18	1–3
	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**			81–161	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	40–101	2–4
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	20–30	1–2
	little bluestem	SCSC	*Schizachyrium scoparium*	0–20	0–2
2	**Warm Season Midgrasses**			222–444	
	sideoats grama	BOCU	*Bouteloua curtipendula*	81–161	5–9
	slim tridens	TRMU	*Tridens muticus*	61–121	2–4
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	6–76	1–10
	purple threeawn	ARPU9	*Aristida purpurea*	30–50	1–3
	plains lovegrass	ERIN	*Eragrostis intermedia*	6–36	1–2
	tanglehead	HETER6	*Heteropogon*	0–20	0–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	6–16	1–2
	vine mesquite	PAOB	*Panicum obtusum*	1	1
3	**Warm Season Shortgrasses**			202–404	

	black grama	BOER4	*Bouteloua eriopoda*	20–182	2–14
	hairy grama	BOHI2	*Bouteloua hirsuta*	30–91	2–8
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	20–61	1–4
	Hall's panicgrass	PAHA	*Panicum hallii*	20–40	1–4
	streambed bristlegrass	SELE6	*Setaria leucopila*	6–36	1–2
	blue grama	BOGR2	*Bouteloua gracilis*	6–36	1–2
	common wolfstail	LYPH	*Lycurus phleoides*	10–30	1–2
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–20	0–2
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–20	0–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1	1
4	**Cool-season Tallgrasses**			0–40	
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–40	0–2
Forb					
5	**Perennial Forbs**			20–40	
	croton	CROTO	*Croton*	6–16	1–2
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	6–16	1–2
	twinleaf senna	SEBA3	*Senna bauhinioides*	6–16	1–2
	pea	LATHY	*Lathyrus*	1	1
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	1	1
6	**Annual Forbs**			13–27	
	common sunflower	HEAN3	*Helianthus annuus*	6–16	0–2
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	0–1
12	**Fern**			6–16	
	Cochise scaly cloakfern	ASCO42	*Astrolepis cochisensis*	6–16	1–2
Shrub/Vine					
7	**Shrubs**			61–121	
	pungent oak	QUPU	*Quercus pungens*	0–40	0–6
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	10–30	2–6
	mariola	PAIN2	*Parthenium incanum*	6–16	1–4
	resinbush	VIST	*Viguiera stenoloba*	6–16	1–3
	littleleaf ratany	KRER	*Krameria erecta*	6–16	1–2
	algerita	MATR3	*Mahonia trifoliolata*	6–16	1–2
	javelina bush	COER5	*Condalia ericoides*	6–16	1–2
	featherplume	DAFO	*Dalea formosa*	6–16	1–2
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–1	0–1
	catclaw acacia	ACGR	*Acacia greggii*	0–1	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
	Wright's beebrush	ALWR	*Aloysia wrightii*	1	1
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–1	0–1
	creosote bush	LATR2	*Larrea tridentata*	0–1	0–1

	gray oak	QUGR3	*Quercus grisea*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	mescal bean	SOSE3	*Sophora secundiflora*	0–1	0–1
8	**half-shrubs**			0–7	
	dyssodia	DYSSO	*Dyssodia*	1	1–2
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	1	1–2
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
9	**Cactus**			7–16	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	6–16	1–3
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	1	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	1	1–2
	rainbow cactus	ECPE	*Echinocereus pectinatus*	0–1	0–1
	horse crippler	ECTE	*Echinocactus texensis*	0–1	0–1
	nylon hedgehog cactus	ECVI2	*Echinocereus viridiflorus*	0–1	0–1
	ocotillo	FOSP2	*Fouquieria splendens*	0–1	0–1
	cactus apple	OPEN3	*Opuntia engelmannii*	0–1	0–1
10	**Yucca**			7–16	
	Torrey's yucca	YUTO	*Yucca torreyi*	6–16	1–2
	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
11	**Yucca-like plants**			40–81	
	green sotol	DALE2	*Dasylirion leiophyllum*	10–50	2–4
	Texas sacahuista	NOTE	*Nolina texana*	10–30	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	6–16	1–2

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**			10–27	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	7–19	1–2
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	0–12	1
2	**Warm Season Midgrasses**			87–233	
	sideoats grama	BOCU	*Bouteloua curtipendula*	49–86	2–4
	slim tridens	TRMU	*Tridens muticus*	25–49	1–3
	purple threeawn	ARPU9	*Aristida purpurea*	19–31	1–2
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	3–28	1–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	7–19	1
	plains lovegrass	ERIN	*Eragrostis intermedia*	0–12	0–1
3	**Warm Season Shortgrasses**			84–224	
	hairy grama	BOHI2	*Bouteloua hirsuta*	31–81	2–6
	black grama	BOER4	*Bouteloua eriopoda*	12–49	1–3
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–25	0–3
	Hall's panicgrass	PAHA	*Panicum hallii*	7–19	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	7–19	1–2

	low woollygrass	DAPU7	*Dasyochloa pulchella*	7–19	1–2
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	7–19	1–2
	common wolfstail	LYPH	*Lycurus phleoides*	7–19	1–2
	blue grama	BOGR2	*Bouteloua gracilis*	3–9	1
Forb					
4	**Perennial Forbs**			13–36	
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	3–9	1–2
	croton	CROTO	*Croton*	3–9	1–2
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	3–9	1–2
	twinleaf senna	SEBA3	*Senna bauhinioides*	1	1
5	**Annual Forbs**			3–9	
	common sunflower	HEAN3	*Helianthus annuus*	3–9	1–2
11	**Fern**			3–9	
	Cochise scaly cloakfern	ASCO42	*Astrolepis cochisensis*	3–9	1–2
Shrub/Vine					
6	**Shrubs**			101–269	
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	7–56	2–8
	mariola	PAIN2	*Parthenium incanum*	7–56	1–7
	whitethorn acacia	ACCO2	*Acacia constricta*	19–44	2–6
	pungent oak	QUPU	*Quercus pungens*	0–37	0–4
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	7–31	1–3
	featherplume	DAFO	*Dalea formosa*	7–31	1–3
	catclaw acacia	ACGR	*Acacia greggii*	7–19	1–3
	resinbush	VIST	*Viguiera stenoloba*	7–19	1–3
	roundflower catclaw	ACRO	*Acacia roemeriana*	3–9	1–2
	algerita	MATR3	*Mahonia trifoliolata*	3–9	1–2
	longleaf jointfir	EPTR	*Ephedra trifurca*	0–1	0–1
	Wright's beebrush	ALWR	*Aloysia wrightii*	1	1
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
7	**Half-Shrubs**			1	
	desert zinnia	ZIAC	*Zinnia acerosa*	1	1
8	**Cactus**			13–36	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	7–19	1–3
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	3–9	1–2
	ocotillo	FOSP2	*Fouquieria splendens*	3–9	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	3–9	1
	horse crippler	ECTE	*Echinocactus texensis*	0–1	0–1
	nylon hedgehog cactus	ECVI2	*Echinocereus viridiflorus*	0–1	0–1
9	**Yucca**			3–9	
	Torrey's yucca	YUTO	*Yucca torreyi*	3–9	1–2

	soaptree yucca	YUEL	*Yucca elata*	0–1	0–1
10	**Yucca-like plants**			17–45	
	green sotol	DALE2	*Dasylirion leiophyllum*	12–25	1–5
	Texas sacahuista	NOTE	*Nolina texana*	3–9	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	3–9	1–2

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	
	sideoats grama	BOCU	*Bouteloua curtipendula*	13–20	1–3
	slim tridens	TRMU	*Tridens muticus*	7–13	1–2
	purple threeawn	ARPU9	*Aristida purpurea*	7–13	1–2
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	3–10	1
	sand dropseed	SPCR	*Sporobolus cryptandrus*	3–10	1
	plains lovegrass	ERIN	*Eragrostis intermedia*	0–1	1
2	**Warm Season Shortgrasses**			41–127	
	hairy grama	BOHI2	*Bouteloua hirsuta*	13–27	2–5
	black grama	BOER4	*Bouteloua eriopoda*	3–24	1–3
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	7–20	1–2
	Hall's panicgrass	PAHA	*Panicum hallii*	7–20	1–2
	low woollygrass	DAPU7	*Dasyochloa pulchella*	7–20	1
	Carolina crabgrass	DIPU9	*Digitaria pubiflora*	3–10	1
	delicate muhly	MUFR	*Muhlenbergia fragilis*	2–6	1
Forb					
3	**Perennial Forbs**			7–20	
	scarlet beeblossom	GACO5	*Gaura coccinea*	2–6	1
4	**Annual Forbs**			3–9	
	common sunflower	HEAN3	*Helianthus annuus*	3–9	1
Shrub/Vine					
5	**Shrubs**			67–202	
	whitethorn acacia	ACCO2	*Acacia constricta*	50–91	8–12
	mariola	PAIN2	*Parthenium incanum*	7–20	1–3
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	10–17	1–3
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	7–13	1–3
	roundflower catclaw	ACRO	*Acacia roemeriana*	7–13	1–3
	resinbush	VIST	*Viguiera stenoloba*	3–10	1–2
	featherplume	DAFO	*Dalea formosa*	2–6	1–2
	catclaw acacia	ACGR	*Acacia greggii*	2–6	1–2
	algerita	MATR3	*Mahonia trifoliolata*	2–6	1
6	**Half-Shrubs**			0–1	
	dyssodia	DYSSO	*Dyssodia*	0–1	1
7	**Cactus**			17–50	

	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	7–13	1–2
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	7–13	1–2
	cactus apple	OPEN3	*Opuntia engelmannii*	3–10	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	3–10	1–2
	ocotillo	FOSP2	*Fouquieria splendens*	0–1	1
8	**Yucca-like plants**			8–26	
	green sotol	DALE2	*Dasylirion leiophyllum*	7–13	1–2
	lechuguilla	AGLE	*Agave lechuguilla*	2–6	1–3
	Texas sacahuista	NOTE	*Nolina texana*	1	1

Animal community

Part I: Wildlife

The Shallow 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 Shallow Ecological Site.

Rock Rattlesnake: The rare mottled rock rattlesnake is found only in New Mexico, Texas, and Chihuahua, Mexico. 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 feed on lizards, snakes, and small mammals (SWCA Environmental Consultants, 2007).

Texas Horned Lizard: 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 habitat.

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 shallow 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 reaction, it is believed that skunks may feed extensively on rattlesnakes. In search of food, this skunk that roots 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 Shallow, the abundance of shrubs in plant community 1.2 is is 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. Mountain lions are less likely to be found on the Shallow Ecological Site.

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 Shallow 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 Shallow 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 Shallow Ecological Site could be managed for sustained agriculture while maintaining the historic range of variability. Prescribed fire may also be a part of the management mix to move the system to community phase 1.3, which is primarily a grassland plant community.

Hydrological functions

The Kimrose soil component is in hydrologic group D. This soil has a high runoff potential when thoroughly wet. For the most part the soil has a depth of less than 50 cm. These are well drained, gravelly soils. As soils become saturated there is more runoff. In some places, the Shallow Ecological Site receives runoff moisture from the Limestone Hills Ecological Site above.

While the petrocalcic horizon acts as a barrier to root growth, it can also serve as a reservoir for excess moisture, which can be released back into the rooting zone via capillary action. Pore spaces within the petrocalcic store water and provide a route for water to travel. The activities of roots and water create cracks and void spaces within the petrocalcic which provide spaces for soil and nutrient accumulation.

Recreational uses

The shallow 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 may 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 was used as well.

Type locality

Location 1: Eddy County, NM	
UTM zone	N
UTM northing	534226
UTM easting	3546177
General legal description	The tier three sample data was collected on BLM land.

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:

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

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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):**

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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:**

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17. **Perennial plant reproductive capability:**
