USDA Natural Resources Conservation Service

Ecological site R042CY007NM
Draw

Accessed: 05/05/2024

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 Draw 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 Draw Ecological Site has mostly taken the place of the Draw Ecological Site that was traditionally used in MLRA 70D.

It is possible, though very rare, that the Draw Ecological Site may occur outside of this proposed 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: Draw 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: Draw 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: Draw Ecological Site<24b Chihuahuan Desert Grasslands<24 Chihuahuan Deserts. (Griffith, et al., 2006)

Ecological site concept

The Draw Site occurs along washes and floodplains within the Guadalupe Ridge and Hills area, west of Carlabad. The soils are sandy skeletal (greater than 35% by volume rock fragments greater than 2 mm) and are deep.

Associated sites

R042CY902NM	**Limestone Hills** This site has slopes > 25% and make up hillsides above the Draw Ecological Site
R042CY003NM	**Shallow** This site is associated with the Limestone Hills and is positioned on fan remnants. The Shallow Ecological Site has a shallow petrocalcic horizon.
R042CY004NM	**Gravelly** This site is associated with the Draw 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 Draw Ecological Site occurs on floodplain steps of mountain valley bottoms at elevations of 3,500 to 5,500 feet, within LRU 42.8. Soil depth is deep to very deep (>100 cm).Slopes range from 1 to 6%. Aspect plays a minor role on this site.

The Draw Ecological Site is made up of sandy and gravelly alluvium that is derived from mostly limestone and dolomite with some other sedimentary rocks. The Draw Ecological site is most closely associated with Gravelly, Shallow, and Limestone Hills Ecological Sites. The Shallow Ecological site occurs on associated areas where a root restricting petrocalcic horizon is less than one meter deep. The Gravelly Ecological site is situated on terrace treads above the floodplains that contain deep gravelly alluvium. The Limestone Hills Ecological Site is located on hill slopes that are shallow to limestone bedrock.

Geology: The primary geologic formations that make up the parent material for the Draw Ecological Site include the Seven Rivers, Tansil, Yates, and to a lesser extent, the Capitan Limestone. 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.

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 Tansill is characterized by clastic sediments such as siltstone and sandstone as well as layers of dolomite. Unlike the Yates, however, the Tansill 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, Tansill, 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, ephemeral streams have wound themselves through the Guadalupe hills and mountains, depositing alluvium and building gravelly terraces. The Draw Ecological Site is the fluvial system that continues to transport alluvium down from the mountains.

Ecological Site Key for LRU 42.8 and 42.9, Northeastern 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 red berry juniper)
2. Soils are loamy and not skeletal, and reside in low areas on stream terraces and fan remnants. - Loamy Terrace ESD
2. Soils are skeletal (Greater than 35% by volume rock fragments greater than 2 mm)
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 fan remnant.-Gravelly ESD
4. Site exists on steep slopes in 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. (It 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).

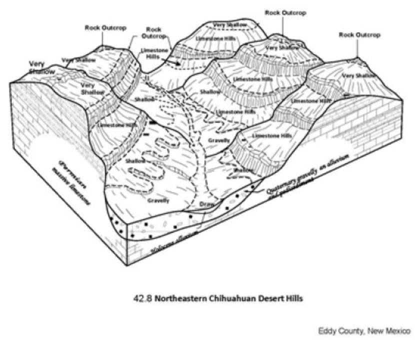

Figure 2. 42.8 Northeastern Chihuahuan Desert Hills

Table 2. Representative physiographic features

Landforms	(1) Valley
Flooding duration	Brief (2 to 7 days) to very brief (4 to 48 hours)
Flooding frequency	Occasional to frequent
Elevation	1,067–1,676 m
Slope	1–6%
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 Draw 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 climatic 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 or 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 Draw ecological site contains the stream channel component which is ephemeral and usually braided. It has a moderate width-to-depth ratio and moderate sinuosity. It is classified as a “Riverine” system. The dominant water sources are overbank flow from the channel and overland flow from adjacent uplands during intense rain storm events (NRCS, 2008).

The Rosgen stream type classification is “DA4”. This classification states that there are multiple channels with a moderate width/depth ratio, moderate sinuosity, and with gravel/sand channel material (Rosgen, 1996).

Soil features

The Draw Ecological Site is tied to the Dunaway component of map units CC7 and DR1 within LRU 42.8. These two map units are almost identical and consist of complexes of soil components which are dominated by about 40 percent Dunaway, 30 percent river wash (or channel), and 25 percent Bascal (which is the Gravelly Ecological Site.) Bascal soils exist on stream terraces, often in the same drainages as Dunaway soils.

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 Dunaway component is somewhat excessively drained. Runoff is quite uncommon. However, flash floods of very brief duration caused by rapid runoff from rainstorms in the adjacent mountains are common.

Dunaway soils formed in Holocene-age stratified sandy and gravelly alluvium derived from mostly limestone and dolomite with some other sedimentary rocks. Soil reaction is slightly alkaline to moderately alkaline. The taxonomic class is: Sandy-skeletal, carbonate, thermic Ustic Torrifluvents.

TYPICAL PEDON: Dunaway extremely cobbly loamy sand -- in wilderness and national park land. (Colors are for dry soil unless otherwise noted.) There are 50 percent gravels, 20 percent cobbles, 10 percent stones and 2 percent boulders on the surface.

AC--0 to 9 cm (0.0 to 3.5 in); pale brown (10YR 6/3) extremely cobbly loamy sand, brown (10YR 5/3), moist; 90 percent sand; 4 percent clay; single grain; loose, loose, nonsticky, nonplastic; common fine and very fine roots and few medium roots; common medium vesicular and common very fine interstitial pores; 5 percent stones and 25 percent gravels and 40 percent cobbles; strong effervescence; slightly alkaline, pH 7.7; clear smooth boundary.

C1--9 to 87 cm (3.5 to 34.3 in); light brownish gray (10YR 6/2) extremely gravelly loamy coarse sand, dark grayish brown (10YR 4/2), moist; 95 percent sand; 3 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine, fine, and medium roots and few coarse roots; common fine medium and coarse vesicular pores; 5 percent stones and 20 percent cobbles and 60 percent gravels; strong effervescence; slightly alkaline, pH 7.7; gradual wavy boundary.

C2--87 to 200 cm (34.3 to 78.7 in); very dark brown (10YR 2/2) extremely gravelly coarse sandy loam, dark grayish brown (10YR 4/2), moist; 90 percent sand; 6 percent clay; massive; very friable, soft, nonsticky, nonplastic; few fine and medium roots and common very fine roots; few fine and common medium and coarse vesicular pores; 10 percent stones and 25 percent cobbles and 50 percent gravels; strong effervescence; slightly alkaline, pH 7.6.

TYPE LOCATION: Eddy County, New Mexico; from the parking lot for Slaughter Canyon trailhead at the end of Hwy 418 in Carlsbad Caverns National Park, travel about .85 miles up the sometimes poorly marked Slaughter Canyon trail and then 30 yards to the east; Approximately 12 miles WSW of Whites City, USGS 7.5 minute Quadrangle: Grapevine Draw, New Mexico. UTM Zone13, 591633 3304608, NAD 83.

Figure 5. Dunaway Component

Table 4. Representative soil features

Parent material	(1) Alluvium–dolomite
Surface texture	(1) Extremely cobbly loamy sand (2) Extremely stony sandy loam (3) Extremely gravelly coarse sand
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Moderate to rapid
Soil depth	102–254 cm
Surface fragment cover <=3"	15–65%
Surface fragment cover >3"	10–40%
Available water capacity (0-101.6cm)	2.54–3.81 cm
Calcium carbonate equivalent (0-101.6cm)	40–85%
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)	15–60%
Subsurface fragment volume >3" (Depth not specified)	10–55%

Ecological dynamics

The historic range of variability for the Draw Ecological Site is affected by both fire and hydrologic processes. Fire is a consistent disturbance regime that reduces succulents and a few shrubs while stimulating grasses and forbs. During intervals 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).

Hydrologic processes are affected by the geomorphology or “fluvial surfaces” of riparian systems. Stream type is characterized by the shape, gradient, width, side-slope gradient, and aspect of the landforms. Fluvial surfaces consist of landform positions such as: alluvial bars, stream banks, floodplains, overflow channels, and terraces (Stringham & Repp, 2010).

In the case of the Draw Ecological Site, the channels are multiple, braided, moderate in sinuosity, moderate in width to depth ratio, and highly ephemeral, sometimes carrying large quantities of water following intense rainfall events. Stream types fluctuate between “DA4” on the Rosgen Scale, to “D3b.” DA4 characterizes the stream system years after a large flooding event. The floodplain is stable and its plant community often reflects that of the “diagnostic community phase.” After a large flooding event, the system can quickly change to a “D3b”. This is a stream system where bars are cut, or swept away, sinuosity decreases, slope increases, and some established plant communities are lost (Rosgen, 1996).

As the channel both incises and meanders away from a floodplain, the floodplain becomes increasingly elevated relative to the channel, transitioning from an active floodplain to a stream terrace. Concurrently, the soil on this position gradually develops: from the Dunaway component on a floodplain to the Bascal component on a terrace. One can traverse a gradient in soil-development, from new to old, as one moves from the channel towards a canyon wall. As soils become more developed, water holding capacity increases, allowing plants to draw on moisture for longer periods of time.

There are three main landforms that occur within the Draw Ecological site, each supporting its own stage of soil development and related plant community. The first major landform consists of the channel and its related components, such as bars, banks, and bends. The second landform is the active floodplain, and the third is the first terrace, consisting of a riser and a tread. The majority of the acres that comprise the Draw Ecological Site are tied to the active floodplain, which is intermediate in soil development between the channel and the first terrace.

A stream system is dynamic, always in motion. These three landform positions will always occur, but a large flood will quickly reposition and alter the shape and size of fluvial landforms. For the sake of this state and transition model, a point in space will be described. A soil will start out as raw material, newly deposited from a flooding event. Over time it will develop. As the channel moves, and the landform on which the soil occurs transitions to an active floodplain, it will support an increasingly heavy shrub and tree plant community. Over a number of years, the soil might end up on the first terrace, transitioning towards supporting a Gravelly ESD plant community. At any time in the course of this development, a flood may occur and be strong enough to set the area back to an early stage of development.

State and transition model

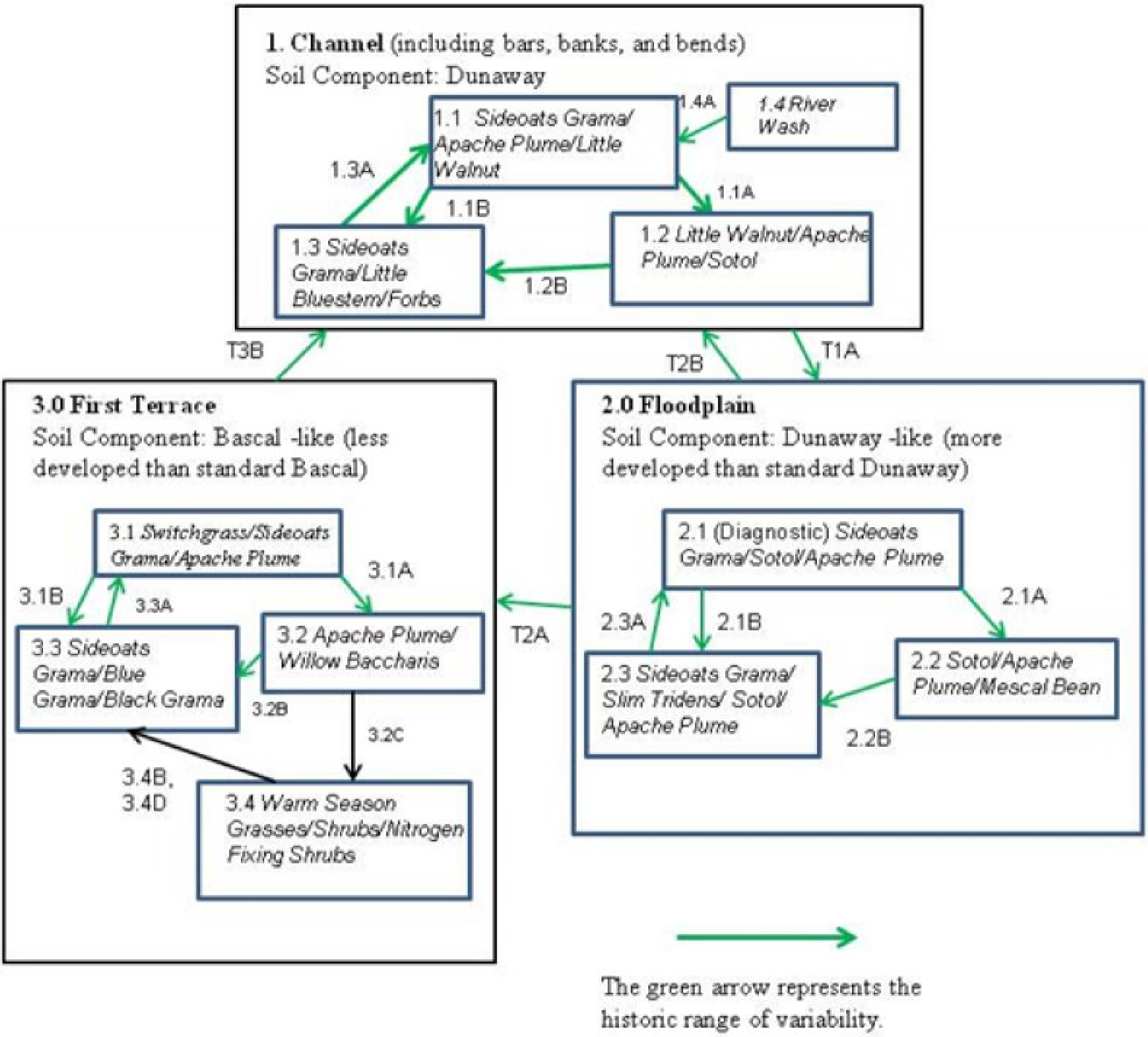

Figure 6. Draw State and Transition Model

State 1
Channel

1.1 Sideoats Grama/Apache Plume/Little Walnut: This site is located within/adjacent to the channel (or wash). Total foliar cover is around 35%. 1.1A Community Pathway: This pathway represents intervals between fires and major floods where natural processes increase shrub and succulent vigor. 1.1B Community Pathway: This pathway represents fire. Fire suppresses succulents and many shrubs, giving grasses a competitive advantage. 1.2 Little Walnut/Apache Plume/Sotol: Over time, foliar cover of shrubs and succulents increase and warm season grasses decrease. 1.2B Community Pathway: This pathway represents fire. Fire sets back succulents and many shrubs, giving grasses a competitive advantage. 1.3 Sideoats Grama/Little Bluestem/Forbs: This site exists after fire. Grasses, respond well to fire, while many shrubs and succulents are suppressed. 1.3A Community Pathway: This pathway represents intervals between fires and major floods where natural processes increase shrub and succulent vigor. 1.4 River Wash: This is the segment of the channel that has no plants. 1.4A Community Pathway: This pathway represents natural processes where soil begins to develop and plants begin to grow. T1A Transition: This transition is the slow process of soil development and landform development. Eventually what is currently the channel becomes the floodplain. The flood plain accumulates organic matter and fine textured particles within interstitial matrix of the soil. The flood plain supports a greater diversity of plants. 2.0 Floodplain 2.1 Sideoats Grama/Sotol/Apache Plume: This plant community exists on the major active floodplain of the Draw. It is considered the "Diagnostic" plant community of this ecological site. 2.1A Community Pathway: This pathway represents time between fires and major floods, during which natural processes increase shrub and succulent vigor. 2.1B Community Pathway: This pathway represents fire. Fire sets back succulents, shrubs, and trees, giving a competitive advantage to grasses. 2.2 Sotol/Apache Plume/Mescal Bean: Over time foliar cover of shrubs and succulents increase, while grass vigor is suppressed. 2.2B Community Pathway: This pathway represents fire. Fire suppresses succulents, shrubs, and trees, giving a competitive advantage to grasses. 2.3 Sideoats Grama/Slim Tridens/Sotol/Apache Plume: This site exists after fire. Grasses, respond well to fire, while many shrubs and succulents are suppressed. 2.3A Community Pathway: This pathway represents intervals between fires and major floods during which natural processes increase shrub and succulent vigor. T2A Transition: This transition is the slow process of landform elevation and soil development. What, is at one time, the floodplain gradually becomes the first terrace. The soil shows increasingly dark colors and supports more of a grassland community. T2B Transition: A large scale flooding event that cuts a channel through the floodplain. Sinuosity decreases, water flow speeds up, and massive amounts of rock and gravel are moved down stream. 3.0 First Terrace 3.1 Switchgrass/Sideoats Grama/Apache Plume: This plant community exists on the first small terrace of the draw. It is slightly above the floodplain, but has not developed enough to be considered the Gravelly Ecological Site. 3.1A Community Pathway: This pathway represents time between fire and major floods, during which natural processes increase shrub and succulent vigor. 3.1B Community Pathway: This pathway represents fire. Fire sets back succulents, shrubs, and trees, giving a competitive advantage to grasses. 3.2 Apache Plume/Willow Baccharis: Over time the foliar cover of shrubs increases and grasses decrease. 3.2B Community Pathway: This pathway represents fire. Fire sets back succulents, shrubs, and trees, giving a competitive advantage to grasses. 3.2C Community Pathway: This pathway represents a growing competitive advantage from nitrogen fixing shrubs due to slow changes in soil chemistry and hydrology. 3.3 Sideoats Grama/Blue Grama/Black Grama: This site exists after fire. Grasses, respond well to fire, while many shrubs and succulents decrease. 3.3A Community Pathway: This pathway represents time between fire and major floods, during which natural processes increase shrub and succulent vigor.

Community 1.1
Sideoats Grama/Apache Plume/Little Walnut

Figure 7. Community 1.1; Channel in Slaughter Canyon; Carlsb

This plant community occurs within and adjacent to the stream channel. It is dominated by a mix of sideoats grama, shrubs, and succulents. Foliar cover is between 30 and 40 percent; basal cover is between 2 and 5 percent; and bare ground is around 3 percent. Warm season grasses make up about 10 percent foliar cover; forbs 3 percent; and shrubs/trees, about 20 percent. Annual production averages around 300 lbs/ac, but can span between 250 and 350 lbs/ac, depending on annual weather patterns. This community exists approximately 5-7 years after fire and at least 4-5 years after a major channel altering flood. Shrubs and trees are prevalent on this site. Common shrubs and trees include: little walnut, desert willow, mescal bean, apache plume, and mariola.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	127	151	179
Grass/Grasslike	112	135	157
Tree	34	40	45
Forb	8	10	11
Total	**281**	**336**	**392**

Table 6. Ground cover

Tree foliar cover	3-7%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	2-4%
Non-vascular plants	1%
Biological crusts	0%
Litter	40-50%
Surface fragments >0.25" and <=3"	50-70%
Surface fragments >3"	30-40%
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	1-2%	1-3%	2-5%	1-3%
>0.15 <= 0.3	1-2%	1-3%	2-5%	1-2%
>0.3 <= 0.6	1-2%	2-4%	2-6%	–
>0.6 <= 1.4	1-3%	3-7%	–	–
>1.4 <= 4	2-4%	1-3%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 9. Plant community growth curve (percent production by month). NM4287, Draw Channel.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	5	7	10	25	25	15	8	2	0

Community 1.2
Little Walnut/Apache Plume/Sotol

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 30 and 40 percent; basal cover is between 5 and 10 percent; and bare ground is around 3 percent. Warm season grasses make up about 5 percent foliar cover; shrubs/trees, 25 percent; and succulents, 5%. Annual production averages around 250 lbs/ac. This community exists approximately 14-18 years after fire. Trees and shrubs make up most of the cover. Abundant trees and shrubs include: little walnut, desert willow, apache plume, mariola, roemers acacia, catclaw acacia, and mescal bean. 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 out-competing grasses for water and nutrients. As shrubs increase, fine-root turnover decreases and energy flow begins to lessen, 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.

Community 1.3
Sideoats Grama/Little Bluestem/Forbs

Figure 11. Community 1.3; Walnut Canyon; CCNP; 3-15-11

This community phase is fairly sparse. There is some growth from warm season grasses, especially sideoats grama and little bluestem. Forbs are a larger percentage of the mix, especially white eye phlox, desert verbena, and fleabane daisy. Shrubs, trees, and succulents are greatly suppressed, and will take four to five years to recover. 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, fine root turnover increases, creating greater soil organic matter, infiltration, and plant available water. Over time, shrubs, trees, and succulents re-establish on the site.

Community 1.4
River Wash

This is the segment of the channel that has no plants.

Pathway 1.1A
Community 1.1 to 1.2

Sideoats Grama/Apache Plume/Little Walnut

Little Walnut/Apache Plume/Sotol

This pathway is the slow movement from Community 1.1 to 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 greater than 20 percent. Shrubs and trees, which have greater access to moisture deep within the soil profile, grow increasingly dominant during intervals between fires.

Pathway 1.1B
Community 1.1 to 1.3

Sideoats Grama/Apache Plume/Little Walnut

Sideoats Grama/Little Bluestem/Forbs

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. Note: This species list reflects the model concept for community phase 1.1. 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.

Pathway 1.2B
Community 1.2 to 1.3

Little Walnut/Apache Plume/Sotol

Sideoats Grama/Little Bluestem/Forbs

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 historic range of variability. Many shrubs and succulents take a while to respond after a fire event. They must re-grow from root systems or come back from seed. Grasses can colonize quickly after a fire event through tillering, especially when precipitation follows closely after fire.

Pathway 1.3A
Community 1.3 to 1.1

Sideoats Grama/Little Bluestem/Forbs

Sideoats Grama/Apache Plume/Little Walnut

This pathway is the movement (about five years) from Community 1.3 to 1.1. This pathway represents intervals between fires where natural processes increase shrub, tree, and succulent vigor. Shrub, tree, and succulent vigor increases as grass vigor decreases due to various ecological processes. One such process is through direct competition for resources. Shrubs and trees have a competitive advantage between fires because of their greater access to moisture deep within the soil profile. The resulting decrease in grass vigor leads to a slow decrease in labile carbon, thus decreasing soil organic matter, and plant available water which further diminishes grass vigor.

State 2
Floodplain

This state exists on the major active floodplain of the Draw. Plant community 2.1 is considered the "Diagnostic" plant community of this ecological site.

Community 2.1
Sideoats Grama/Sotol/Apache Plume (Diagnostic Plant Community)

Figure 12. Community 2.1; Dark Canyon; 7-11-11

This plant community is considered to be the diagnostic plant community for the Draw Ecological Site. It is located on the major floodplain and encompasses about 70 percent of the site. This plant community is a mix of warm season grasses, shrubs, trees, and succulents. Because this landform gets disturbed often from fire and flood, there is a significant percentage of nitrogen fixing shrubs which seems to take advantage of disturbed areas. These shrubs seem to prefer the more developed soils of the floodplain versus those of the channel. Foliar cover is between 40 and 80 percent, basal cover is between 5 and 20 percent, and bare ground is around 2 to 4 percent. Warm season grasses make up about 25 percent foliar cover; shrubs/trees 25 percent; succulents, 10 percent; and forbs, 5 percent. Annual production averages around 800 lbs/ac, but can span between 400 and 1200 lbs/ac, depending on annual weather patterns and the frequency of flooding events. The density of cobbles and boulders on the soil surface can influence production at a small scale. Sotol is very prevalent on this site. Its deep root system can take advantage of water deep in the soil matrix. The soils are extremely gravelly and cobbly, and floods may occur every three to eight years spreading more sotol seed. Lehmann's lovegrass is an introduced species that, in some places, has found a niche on this site. This grass species can be grazed through spring and early summer with cattle. It often spreads when brush control practices are implemented.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	224	448	673
Shrub/Vine	211	421	632
Tree	54	179	269
Forb	13	27	40
Total	**502**	**1075**	**1614**

Table 9. Ground cover

Tree foliar cover	5-15%
Shrub/vine/liana foliar cover	25-35%
Grass/grasslike foliar cover	20-30%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1%
Litter	45-55%
Surface fragments >0.25" and <=3"	45-55%
Surface fragments >3"	15-25%
Bedrock	0%
Water	0%
Bare ground	1-5%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	1-2%	3-7%	1-3%
>0.15 <= 0.3	1-2%	1-3%	3-7%	1-3%
>0.3 <= 0.6	1-3%	7-11%	10-20%	1-2%
>0.6 <= 1.4	1-3%	5-11%	–	–
>1.4 <= 4	1-2%	2-6%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 14. Plant community growth curve (percent production by month). NM4288, Draw Floodplain.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	5	7	10	25	25	15	8	2	0

Community 2.2
Sotol/Apache Plume/Mescal Bean

Figure 15. Community 2.2; Walnut Canyon; CCNP; 5-17-11

This community phase combines a mix of shrubs, succulents and warm season grasses. Foliar cover is between 50 and 80 percent; basal cover is between 5 and 15 percent; and bare ground is around 3 percent. Warm season grasses make up about 15 percent foliar cover; shrubs/trees, 30 percent; and succulents, 20 percent. Annual production averages around 700 lbs/ac. This community exists approximately 14-18 years after fire. Shrubs and succulents make up most of the cover. Abundant shrubs and succulents include: sotol, sacahuista, apache plume, mescal bean, mariola, roemers acacia, catclaw acacia, catclaw mimosa, and redberry juniper. Common grasses include: sideoats grama, threeawn, and slim tridens. This plant community develops 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, fine-root turnover decreases, causing a decrease in 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.

Community 2.3
Sideoats Grama/Slim Tridens/Sotol/Apache Plume

Figure 16. Community 2.3; Walnut Canyon; CCNP; 4-8-12

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, reducing succulents and shrubs and creating a competitive advantage for grasses. Foliar cover is between 30 and 50 percent, depending on how recent and how severe the fire had been, and if precipitation following fire is adequate for growth to resume. Basal cover is between 7 and 15 percent, and bare ground is around 3 to 6 percent. Warm season grasses make up about 20 percent foliar cover; shrubs/trees, 10 percent; and succulents, 10 percent. Annual production averages around 450 lbs/ac, but can span between 300 and 600 lbs/ac, depending on annual weather patterns. This community exists approximately one to six years after fire. It is a mixed grass and shrub site, with basal sprouting shrubs scattered across the site. Sideoats grama, slim tridens, and threeawn are the dominant grasses in this community. Redberry juniper and apache plume grow quickly after fire and tends to be the dominant shrubs. 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, creating greater soil organic matter, infiltration, and plant available water. Over time shrubs and succulents move back onto the site.

Pathway 2.1A
Community 2.1 to 2.2

Sideoats Grama/Sotol/Apache Plume (Diagnostic Plant Community)

Sotol/Apache Plume/Mescal Bean

This pathway is the slow movement, from Community 2.1 to 2.2 often accompanied by minor flood events. This pathway represents time between fires within the historic range of variability, as it will take 10 to 14 years, after fire, for shrubs, trees, and succulents to achieve foliar cover greater than 35 percent. Shrubs and trees have a competitive advantage during intervals between fires because they have greater access to moisture deep within the soil profile.

Pathway 2.1B
Community 2.1 to 2.3

Sideoats Grama/Sotol/Apache Plume (Diagnostic Plant Community)

Sideoats Grama/Slim Tridens/Sotol/Apache Plume

This pathway represents a single fire event driving plant Community 2.1 to 2.3. 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 either re-grow from root systems or come back from seed. Grasses can colonize quickly, after a fire event through tillering, especially when precipitation follows closely after fire.

Pathway 2.2B
Community 2.2 to 2.3

Sotol/Apache Plume/Mescal Bean

Sideoats Grama/Slim Tridens/Sotol/Apache Plume

This pathway represents a single fire event driving plant Community 2.2 to 2.3. 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 either re-grow from root systems or else come back from seed. Grasses can colonize quickly via tillering after a fire event, especially when precipitation follows closely after fire.

Pathway 2.3A
Community 2.3 to 2.1

Sideoats Grama/Slim Tridens/Sotol/Apache Plume

Sideoats Grama/Sotol/Apache Plume (Diagnostic Plant Community)

This pathway is the slow movement, from Community 1.3 to 1.1. This pathway represents intervals between fires, during which natural processes increase shrub and succulent vigor and decrease grass species production and composition. Shrub and succulent vigor increase as grasses decrease due to various ecological processes. One such process is through direct competition for resources. Shrubs are at a competitive advantage during this interval due to their greater access to moisture deep in interstices within the subsoil. Another process is the slow decrease in labile carbon, thus decreasing soil organic matter which suppresses plant available water and inhibits grass vigor.

State 3
First Terrace

This state exists on the first small terrace of the draw. It is slightly above the floodplain, but has not developed enough to be considered the Gravelly Ecological Site.

Community 3.1
Switchgrass/Sideoats Grama/Apache Plume

Figure 17. Community 3.1; Franks Canyon; 7-11-11

The first terrace develops over time. As the area becomes more stabilized and less prone to flooding, the soils become darker with greater water holding capacity than those of the floodplain. The plant community has abundant grasses and shrubs, but also tends to be affected by management. Nitrogen fixing shrubs may increase on this site. The First Terrace only makes up about 15 percent of the Draw Ecological Site. This community phase is dominated by a mix of grasses and shrubs. Foliar cover is between 60 and 80 percent; basal cover is between 10 and 25 percent, and bare ground is around 5 percent. Warm season grasses make up about 30 percent foliar cover; forbs 5 percent; shrubs 30 percent; and succulents 5 percent. The average surface soil stability rating (Herrick, et al., 2001), 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 to 7 years following fire. It is one of the few places a tall warm season grass, like switchgrass, is capable of receiving enough nutrients and moisture to produce abundantly in the desert. A mix of shrubs and succulents are common and vary based on soil development. Mariola seems to be 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 diversity of root systems takes 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 needed for plant vigor.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	538	807	1076
Shrub/Vine	269	404	538
Tree	63	94	126
Forb	27	40	54
Total	**897**	**1345**	**1794**

Table 12. Ground cover

Tree foliar cover	1-3%
Shrub/vine/liana foliar cover	25-30%
Grass/grasslike foliar cover	25-35%
Forb foliar cover	3-7%
Non-vascular plants	1%
Biological crusts	1-3%
Litter	35-45%
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%	2-4%	3-7%	1-3%
>0.15 <= 0.3	0-1%	5-9%	3-7%	2-4%
>0.3 <= 0.6	1-2%	9-13%	10-20%	–
>0.6 <= 1.4	1-2%	5-9%	5-15%	–
>1.4 <= 4	1-2%	1-5%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 3.2
Apache Plume/Willow Baccharis

Figure 19. Community 3.2; Franks Canyon; 7-11-12

This community phase combines a mix of shrubs, succulents, and warm season grasses. Foliar cover is between 50 and 80 percent, basal cover is between 10 and 20 percent, and bare ground is around 8 percent. Warm season grasses make up about 25 percent foliar cover; shrubs/trees, 30 percent; and succulents, 10 percent. Annual production averages around 1000 lbs/ac. This community exists approximately 14-18 years after fire. Shrubs and succulents make up most of the cover. Abundant shrubs and succulents include: apache plume, willow baccharis, skunkbush sumac, catclaw mimosa, redberry juniper, sandpaper oak, and mariola. Common grasses include: sideoats grama, plains bristlegrass, threeawn, blue grama, and black grama. Switchgrass and vine mesquite are in decline. 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 grass for water and nutrients. As shrubs increase, energy flow begins to lessen, fine-root turnover decreases, causing a decrease in labile carbon and soil organic matter. Fire is the natural event that keeps shrub species from gaining a competitive advantage and stimulates colonization by grasses.

Community 3.3
Sideoats Grama/Blue Grama/Black Grama

Figure 20. Community 3.3; Walnut Canyon; CCNP; 3-15-11

This community phase combines 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 and if adequate precipitation following fire has resumed growth. 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. 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 area. Blue grama, black grama, and sideoats grama are the dominant grasses in this community phase. Redberry juniper and apache plume are the dominant shrubs. Sotol is the dominant succulents. This plant community is the ecological site's response to fire on the first terrace. 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, soil organic matter increases. This leads to improved infiltration, and increased plant available water. Over time shrubs and succulents move back onto the site.

Community 3.4
Warm Season Grasses/Shrubs/Nitrogen Fixing Shrubs

Figure 21. Community 3.4; McKittrick Canyon; GMNP; 7-12-11

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, but 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 600 lbs/ac, but can span between 300 and 900 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 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 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. By having 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 nitrogen fixing shrub seed and can lessen plant vigor and soil organic matter through continuous grazing and over-utilization. As grasses and some shrubs decrease in vigor, 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 a degraded state. 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 garden plant. Invasive species control (chemical, biological, and/or mechanical) can be an option to control these invasive species. For example, Lehmann’s lovegrass can be grazed in the spring by cattle when palatability is high.

Pathway 3.1A
Community 3.1 to 3.2

Switchgrass/Sideoats Grama/Apache Plume

Apache Plume/Willow Baccharis

This pathway is the slow movement from Community 3.1 to 3.2. This pathway represents intervals between fires within the historic range of variability. It will take 10 to 14 years after fire for shrubs, trees, and succulents to achieve foliar cover greater than 30 percent. Shrubs have greater access to moisture deep within the soil profile giving them a competitive advantage during intervals between fires.

Pathway 3.1B
Community 3.1 to 3.3

Switchgrass/Sideoats Grama/Apache Plume

Sideoats Grama/Blue Grama/Black Grama

This pathway represents a single fire event driving plant Community 3.1 to 3.3. 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 root systems or come back from seed. Grasses can colonize quickly via tillering following a fire event, especially when precipitation follows closely after fire.

Pathway 3.2B
Community 3.2 to 3.3

Apache Plume/Willow Baccharis

Sideoats Grama/Blue Grama/Black Grama

This pathway represents a single fire event driving plant Community 3.2 to 3.3. 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 either re-grow from root systems or else come back from seed. Grasses can colonize quickly, through tillering after a fire event, especially when precipitation follows closely after fire.

Pathway 3.2C
Community 3.2 to 3.4

Apache Plume/Willow Baccharis

Warm Season Grasses/Shrubs/Nitrogen Fixing Shrubs

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. This community pathway is outside the historic range of variability.

Pathway 3.3A
Community 3.3 to 3.1

Sideoats Grama/Blue Grama/Black Grama

Switchgrass/Sideoats Grama/Apache Plume

This pathway is the slow movement from community 3.3 to 3.1. This pathway represents time between fires where natural processes increases shrub and succulent vigor and decreases grass species production and composition. Shrub and succulent vigor increases as grasses decrease due to various ecological processes. One such process is through direct competition for resources. Shrubs have a competitive advantage during intervals between fires due to their greater access to moisture deep in the subsoil. The second is a slow decrease in labile carbon, thus decreasing soil organic matter which leads to suppression of grass vigor.

Pathway 3.4B
Community 3.4 to 3.3

Warm Season Grasses/Shrubs/Nitrogen Fixing Shrubs

Sideoats Grama/Blue Grama/Black Grama

This pathway represents a single fire event driving plant Community 3.4 to 3.3. 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 3.4D
Community 3.4 to 3.3

Warm Season Grasses/Shrubs/Nitrogen Fixing Shrubs

Sideoats Grama/Blue Grama/Black Grama

A change in livestock grazing management to allow for decreased shrub competition, improved litter accumulation, an increase in labile carbon, an increase in plant available water, and improved grass vigor.

Transition TIA
State 1 to 2

This transition is the slow process of soil development and landform development. A point in space which was at one time located in the channel is gradually elevated in relation to the incising channel, until it eventually lies on a floodplain. The soil becomes increasingly less coarse and surface cobble and gravel decrease. Concurrently, plant diversity increases as the landform is elevated.

Transition T2B
State 2 to 1

large scale flooding event that cuts a channel through the floodplain. Sinuosity decreases, water flow speeds up, and massive amounts of rock and gravel are moved down stream.

Transition T2A
State 2 to 3

This transition is the slow process of landform elevation and concurrent soil development. What is at one time the floodplain gradually becomes the first terrace. The soil exhibits increasingly dark colors and supports more of a grassland community.

Transition T3B
State 3 to 1

A large scale flooding event that cuts a channel through the first terrace. Soil of the first terrace is washed downstream and replaced by massive amounts of rock and gravel.

Additional community tables

Table 14. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			28–39	
	little bluestem	SCSC	*Schizachyrium scoparium*	10–37	1–3
	Indiangrass	SONU2	*Sorghastrum nutans*	3–17	1–2
2	**Warm Season Midgrasses**			84–118	
	sideoats grama	BOCU	*Bouteloua curtipendula*	50–84	3–9
	purple threeawn	ARPU9	*Aristida purpurea*	17–50	2–4
Forb					
3	**Perennial Forbs**			8–13	
	balloonbush	EPWI2	*Epixiphium wislizeni*	2–6	1–2
	threadleaf phlox	PHME2	*Phlox mesoleuca*	2–6	1–2
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	1–2	1
4	**Annual Forbs**			2–4	
Shrub/Vine					
5	**Shrubs**			84–118	
	Apache plume	FAPA	*Fallugia paradoxa*	50–84	4–10
	mescal bean	SOSE3	*Sophora secundiflora*	17–50	1–2
	mariola	PAIN2	*Parthenium incanum*	10–44	1–2
	catclaw acacia	ACGR	*Acacia greggii*	7–20	1–2
6	**Half-Shrubs**			7–13	
	damianita	CHME3	*Chrysactinia mexicana*	7–13	1–2
8	**Yucca-like plants**			7–13	
	green sotol	DALE2	*Dasylirion leiophyllum*	7–13	1–5
Tree					
7	**Trees**			56–78	
	Arizona walnut	JUMA	*Juglans major*	3–67	5–15
	desert willow	CHLI2	*Chilopsis linearis*	10–24	3–8

Table 15. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			25–81	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	11–33	1–3
	little bluestem	SCSC	*Schizachyrium scoparium*	11–33	1–3
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	1–21	1–2
2	**Warm Season Midgrasses**			126–404	
	sideoats grama	BOCU	*Bouteloua curtipendula*	43–108	3–11
	purple threeawn	ARPU9	*Aristida purpurea*	21–65	2–4
	slim tridens	TRMU	*Tridens muticus*	11–54	1–3
	plains lovegrass	ERIN	*Eragrostis intermedia*	11–54	1–2
	green sprangletop	LEDU	*Leptochloa dubia*	11–54	1–2
	curlyleaf muhly	MUSE	*Muhlenbergia setifolia*	11–33	1–2
	bullgrass	MUEM	*Muhlenbergia emersleyi*	0–21	0–1
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–21	0–1
	sand dropseed	SPCR	*Sporobolus cryptandrus*	6–16	1
3	**Warm Season Shortgrasses**			50–161	
	streambed bristlegrass	SELE6	*Setaria leucopila*	11–33	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	11–33	1–2
	black grama	BOER4	*Bouteloua eriopoda*	0–21	1–2
	blue grama	BOGR2	*Bouteloua gracilis*	0–21	0–2
	hairy grama	BOHI2	*Bouteloua hirsuta*	6–21	1–2
	nineawn pappusgrass	ENDE	*Enneapogon desvauxii*	0–21	0–1
	sand muhly	MUAR2	*Muhlenbergia arenicola*	0–21	0–1
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	6–16	1
Forb					
4	**Perennial Forbs**			15–48	
	croton	CROTO	*Croton*	6–16	1–2
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	6–16	1–2
	James' nailwort	PAJA	*Paronychia jamesii*	0–6	0–2
	spreading fleabane	ERDI4	*Erigeron divergens*	0–6	0–2
	threadleaf phlox	PHME2	*Phlox mesoleuca*	0–6	0–1
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	0–6	0–1
	silver prairie clover	DABIA	*Dalea bicolor var. argyrea*	0–6	0–1
	balloonbush	EPWI2	*Epixiphium wislizeni*	0–6	0–1
5	**Annual Forbs**			1–11	
	common sunflower	HEAN3	*Helianthus annuus*	0–6	0–1
12	**Fern**			6–16	
	Cochise scaly cloakfern	ASCO42	*Astrolepis cochisensis*	6–16	1–2
Shrub/Vine					
6	**Shrubs**			150–484	
	Apache plume	FAPA	*Fallugia paradoxa*	65–108	3–11

	Apache plume	FAPA	*Fallugia paradoxa*	65–108	3–11
	pungent oak	QUPU	*Quercus pungens*	0–65	0–4
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	11–54	2–6
	mariola	PAIN2	*Parthenium incanum*	11–54	1–5
	mescal bean	SOSE3	*Sophora secundiflora*	0–43	1–2
	resinbush	VIST	*Viguiera stenoloba*	11–33	1–3
	algerita	MATR3	*Mahonia trifoliolata*	11–33	1–2
	catclaw acacia	ACGR	*Acacia greggii*	11–33	1–2
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	11–33	1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–21	0–1
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–21	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–21	0–1
	skunkbush sumac	RHTRT	*Rhus trilobata var. trilobata*	0–6	0–1
	featherplume	DAFO	*Dalea formosa*	0–6	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–6	0–1
7	**Half-Shrubs**			0–43	
	damianita	CHME3	*Chrysactinia mexicana*	0–43	0–4
9	**Cactus**			10–33	
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	6–16	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	0–6	0–1
11	**Yucca-like plants**			75–242	
	green sotol	DALE2	*Dasylirion leiophyllum*	43–215	2–14
	Texas sacahuista	NOTE	*Nolina texana*	0–21	0–2
	lechuguilla	AGLE	*Agave lechuguilla*	6–16	1
Tree					
8	**Trees**			25–81	
	Arizona walnut	JUMA	*Juglans major*	0–86	0–8
	desert willow	CHLI2	*Chilopsis linearis*	0–21	0–2
10	**Yucca**			10–33	
	Torrey's yucca	YUTO	*Yucca torreyi*	0–43	1–2

Table 16. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm Season Tallgrasses**			135–269	
	switchgrass	PAVI2	*Panicum virgatum*	27–242	2–8
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	13–67	1–3
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	0–27	0–2
	little bluestem	SCSC	*Schizachyrium scoparium*	0–27	0–1
2	**Warm Season Midgrasses**			215–430	
	sideoats grama	BOCU	*Bouteloua curtipendula*	81–242	3–9
	purple threeawn	ARPU9	*Aristida purpurea*	40–94	1–5

	plains lovegrass	ERIN	*Eragrostis intermedia*	13–67	1–4
	green sprangletop	LEDU	*Leptochloa dubia*	13–40	1–3
	vine mesquite	PAOB	*Panicum obtusum*	7–20	1–2
	sand dropseed	SPCR	*Sporobolus cryptandrus*	7–20	1–2
	slim tridens	TRMU	*Tridens muticus*	7–20	1–2
3	**Warm Season Shortgrasses**			179–359	
	blue grama	BOGR2	*Bouteloua gracilis*	54–135	2–8
	black grama	BOER4	*Bouteloua eriopoda*	40–121	1–5
	streambed bristlegrass	SELE6	*Setaria leucopila*	13–40	1–3
	Hall's panicgrass	PAHA	*Panicum hallii*	13–40	1–2
	hairy grama	BOHI2	*Bouteloua hirsuta*	13–40	1–2
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	7–20	1
Forb					
4	**Perennial Forbs**			36–72	
	threadleaf phlox	PHME2	*Phlox mesoleuca*	7–20	1–2
	silver prairie clover	DABIA	*Dalea bicolor var. argyrea*	7–20	1–2
	Davis Mountain mock vervain	GLBIC	*Glandularia bipinnatifida var. ciliata*	7–20	1–2
	James' nailwort	PAJA	*Paronychia jamesii*	0–1	0–1
	spreading fleabane	ERDI4	*Erigeron divergens*	0–1	0–1
	hawkweed buckwheat	ERHI3	*Eriogonum hieraciifolium*	0–1	0–1
	croton	CROTO	*Croton*	0–1	0–1
5	**Annual Forbs**			0–2	
	common sunflower	HEAN3	*Helianthus annuus*	0–1	0–1
Shrub/Vine					
6	**Shrubs**			224–448	
	Apache plume	FAPA	*Fallugia paradoxa*	54–135	5–15
	willow baccharis	BASA	*Baccharis salicina*	27–108	1–9
	Pinchot's juniper	JUPI	*Juniperus pinchotii*	13–67	1–5
	pungent oak	QUPU	*Quercus pungens*	0–54	0–4
	mariola	PAIN2	*Parthenium incanum*	13–40	1–5
	resinbush	VIST	*Viguiera stenoloba*	13–40	1–3
	skunkbush sumac	RHTRT	*Rhus trilobata var. trilobata*	13–40	1–2
	mescal bean	SOSE3	*Sophora secundiflora*	0–27	0–24
	algerita	MATR3	*Mahonia trifoliolata*	0–27	0–1
	catclaw acacia	ACGR	*Acacia greggii*	0–27	0–1
	roundflower catclaw	ACRO	*Acacia roemeriana*	0–1	0–1
	featherplume	DAFO	*Dalea formosa*	0–1	0–1
	whitethorn acacia	ACCO2	*Acacia constricta*	0–1	0–1
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–1	0–1
	prairie sumac	RHLA3	*Rhus lanceolata*	0–1	0–1
	littleleaf sumac	RHMI3	*Rhus microphylla*	0–1	0–1
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–1	0–1

7	**Half-Shrubs**			0–27	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–27	0–2
9	**Cactus**			18–36	
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	7–20	1–2
	tree cholla	CYIMI	*Cylindropuntia imbricata var. imbricata*	7–20	1–2
	purple pricklypear	OPMAM	*Opuntia macrocentra var. macrocentra*	0–1	0–1
10	**Yucca**			0–54	
	Torrey's yucca	YUTO	*Yucca torreyi*	0–54	0–2
11	**Yucca-like plants**			13–94	
	green sotol	DALE2	*Dasylirion leiophyllum*	13–94	1–8
Tree					
8	**Trees**			27–84	
	Arizona walnut	JUMA	*Juglans major*	0–81	0–4
	netleaf hackberry	CELAR	*Celtis laevigata var. reticulata*	0–1	0–1
	desert willow	CHLI2	*Chilopsis linearis*	0–1	0–1

Animal community

Part I: Wildlife

The Draw Ecological Site lies at the northern extent of the Chihuahuan Desert and is home to many different wildlife species.

Species of Special Interest:

The following are species of special interest that have habitat needs associated with the Draw 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, March, 2007).

Texas Horned Lizard: Texas horned lizards 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). Mature lizards are capable of eating 70 to 100 ants per day. Feeding may occur at nest entrances or on ant foraging trails. 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 cactus. Summer habitat in the Guadalupes seems to be linked to juniper and oak plant communities. During breading 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 an alarm reaction, it is believed that skunks may feed extensively on rattlesnakes. In search of food, the 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. The abundance of shrubs in plant community two is ideal 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 bundle 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 3.1 and 3.2 provide ideal for nesting habitat for white-throated wood rats.

Other species associated with the Draw 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
Collared Peccary
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 Draw 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 Draw 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 first terrace landform to plant community 3.3, which is primarily a grassland plant community. The loss of goat production probably plays a role in the overall increase in shrubs, especially in nitrogen fixing shrubs.

Hydrological functions

The Dunaway soil component is in hydrologic group A. This soil has a low runoff potential when thoroughly wet. Water is transmitted freely through the soil. 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. Conversely, fibrous and tap root systems only take advantage of moisture and nutrients in the top meter of the soil. This site floods on a regular basis bringing water, sediment and debris from higher in the mountains.

Recreational uses

The Draw 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 descent 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 production, ground cover, and canopy cover estimates. 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	540760
UTM easting	3553971
General legal description	The tier three sample data was collected in Slaughter Canyon about a mile up from the trailhead on CCNP.

Other references

Coauthors:

Aaron Miller-MLRA 70 Project Leader, NRCS
Logan Peterson-MLRA 70 Soil Scientist, NRCS

Special Contributors:

Steve Daly-Soil/Range Conservationist, Carlsbad Field Office, BLM
Herman Garcia-Ecological Site Inventory Specialist, Southwest Region 8, NRCS
Tracy Hughes-Range Conservation Technician, Carlsbad Field Office, NRCS
Darren James-Researcher, USDA, Jornada ARS

Reviewers:

Steve Daly-Soil Conservationist, Carlsbad Field Office, BLM
Herman Garcia-Ecological Site Inventory Specialist, Southwest Region 8, NRCS
Mark Moseley-Ecological Site Inventory Specialist, Texas Region 9, NRCS
Richard Strait-State Soil Scientist, New Mexico NRCS
John Tunberg-State Rangeland Management Specialist, New Mexico NRCS
Renee West-Biologist, Carlsbad Caverns National Park

ESD Workgroup:

Lu Burger-Natural Resource Specialist, State Office, BLM
Steve Daly-Soil Conservationist, Carlsbad Field Office, BLM
Samuel Denman-Cultural Resource Specialist, Carlsbad Caverns National Park
Garth Grizzle, District Conservationist, Area Range Conservationist, NRCS, retired
Charles Hibner-MLRA 70 SS Leader, NRCS, retired
Tracy Hughes-Range Conservation Technician, Carlsbad, NRCS
Laurie Kincaid-Rancher, Carlsbad
Michael McGee- Hydrologist, Roswell Field Office, BLM
Aaron Miller-MLRA 70 Project Leader, NRCS
Susan Norman-GIS Specialist, Carlsbad Caverns National Park
Logan Peterson-MLRA 70 Soil Scientist, NRCS
Mark Sando-Rangeland Management Specialist, Guadalupe District, USFS
Kent Schwartzkopf-Chief, Stewardship and Science Div., Carlsbad Caverns National Park
Renee West-Biologist, Carlsbad Caverns National Park
Pete Biggam-Soils Program Manager, National Park Service, Lakewood Colorado

References:

Ahlstrand, G., 1981. Ecology of fire in the Guadalupe Mountains and adjacent Chihuahuan Desert. Carlsbad(New Mexico): Carlsbad Caverns and Guadalupe Mountains National Park.

Bestelmeyer, et al., 2010. Practical Guidance for Developing State-and-Transition Models. Rangelands, p. 26.

Buie, L., 2003. Hog-nosed skunk. [Online]
Available at: http://itech.pensacolastate.edu/sctag/hn_skunk/index.htm
[Accessed 26 10 2012].

Burger, P., 2007. Walking Guide to the Geology of Carlsbad Cavern. Carlsbad, NM: Carlsbad Caverns and Guadalupe Mountains Association.

Burkett, B., Version 1.1. A Field Guide to Pedoderm and Pattern Classes, Las Cruces, New Mexico: USDA-ARS Jornada Experimental Range.

Cleland, D. T. et al., 2007. Ecological Subregions: Sections and Subsections of the Conterminiuos United States.. s.l.:United States Forest Service.

Cougar. (2013, September 8). In Wikipedia, The Free Encyclopedia. Retrieved 21:37, September 19, 2013, from http://http://en.wikipedia.org/w/index.php?title=Cougar&oldid=571991990

Duniway, Bestelmeyer, Tugel, 2010. Soil Processes and Properties That Distinguish Ecological Sites and States. Rangelands, pp. 9-15.

Gebow, B. S., 2001. Search, Compile, and Analyze Fire Literature and Research Associated with Chihuahuan Desert Uplands, Tuscon: The University of Arizona.

Goldstein and Rominger, 2003. Plan for the Recovery of Desert Bighorn Sheep in New Mexico, Santa Fe: New MExico Department of Game and Fish.

Griffith, et al., 2006. Ecoregions of New Mixico. Reston(Virginia): U.S. Geological Survey.

Henke and Fair, 1998. Management of Texas Horned Lizards, Kingsville, Tx.: Caesar Kleberg WIldlife Research Institute.

Herrick, Whiteford, De Soyza, Van Zee, Havstad, Seybokd, Walton, 2001. Soil aggregate stability kit for field-based soil quality and rangeland health evalutations.. s.l.:s.n.

Kayser, D. W., 2010. Prehistory: SHort and Seet. "Different peoples over a long period of time vistied, used the abundant resoruces or lived here at CASVE.", s.l.: s.n.

Kelley, V., 1971. Geology of the Pecos Country, Southeastern New Mexico. s.l.:New Mexico bureau of Mines and Mineral Resources.

Keys to Soil Taxonomy; United States Department of Agriculture, Natural Resources Conservation District; Eleventh Edition; 2010

New Mexico Game and Fish, n.d. Wildlife Notes-Ringtail, s.l.: New Mexico Game and Fish.

NRCS, 2008. Hydrogeomorphic Wetland Classification System: An OVerview and Modification to Better Meet the Needs of the Natural Resources Conservation Service. s.l.:s.n.

Pellant, Pyke, Shaver, Herrick, 2005. Interpreting Indicators of Rangeland Health. Version 4 ed. Denver(CO.): United States Department of the Interior, Bureau of Land Managment, National science and Technology Center, Division of Science Integration.

Peterson, F. F., 1981. Landforms of the Basin and Range Province, Reno: Nevada Agricultural Experiment Station.

Pierce, L. J., 2007. Gray Vireo (Vireo vicinior) Recovery Plan, Santa Fe, NM: New Mexico Department of Game and Fish.

Rosgen, D., 1996. Applied river morphology. Pagosa Springs: Wildland Hydrology.

Schoeneberger, P.J., and Wysocki, D.A. 2012. Geomorphic Description System, Version 4.2. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

Spomer, Hoback, Golick, Higley, 2006. Biology, Lifecycle, and Behavior. [Online]
Available at: http://drshigley.com/lgh/netigers/index.htm
[Accessed 26 10 2012].

Stringham & Repp, 2010. Ecological Site Descriptions: Consideration for Riparian Systems. Rangelands, December.pp. 43-48.

SWCA Environmental Consultants, 2007. Carlsbad Caverns National Park, Environmental Assessment, s.l.: U.S. Department of Interior.

United States Department of Agriculture, Natural Resources Conservation Service, 2006. Land Resource Regions and Major Land Resource Areas of the United States, the caribbean, and the Pacific Basin. s.l.:s.n.

Contributors

Scott Woodall

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:**