USDA Natural Resources
Conservation Service

Ecological site R040XD003CA
Rocky Slopes 2-4" p.z.

Last updated: 2/08/2019
Accessed: 11/02/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 040X–Sonoran Basin and Range

Site Type: Rangeland

MLRA Description:
Major land resource area (MLRA) 31 is the Lower Colorado Desert. This area is in the extreme southeastern part of California, in areas along the Colorado River, and in Western Arizona. The area is comprised of rough, barren, steep, and strongly dissected mountain ranges, generally northwest to southwest trending that are separated by intermontane basins. Elevation ranges from approximately 275 feet below sea level at the lowest point in the Salton Trough to 2700 feet along low northwest to southeast trending mountain ranges. The average annual precipitation is 2 to 6 inches with high temporal and spatial variability. Winter temperatures are mild, summer temperatures are hot, and seasonal and diurnal temperature fluctuations are large. Monthly minimum temperature averages range from 40 to 80 degrees F (4 to 27 degrees C). Monthly maximum temperature averages range from 65 to 110 degrees F (18 to 43 degrees C). Temperatures are rarely below 28 degrees F, and extremely rarely fall below 24 degrees F. Precipitation is bimodal, with approximately 20 to 40 percent of annual precipitation falling between July and September. This summer rainfall, in combination with very hot temperatures and very few to no days of hard freeze are what characterize this MLRA and distinguish it from the Mojave Desert (MLRA 30).

Ecological Site Concept -

This ecological site occurs on primarily on south facing hill and slopes, but may also occur on ballenas, and steep side slopes of fan remnants. Slopes range from 15 to 50 percent, and elevations are between 460 and 2030 feet. Soils are typically very shallow to shallow, but may be very deep soils on the alluvial soils of the ballenas and fan remnants.

Production reference value (RV) is 250 pounds per acre, and depending on precipitation and annual forb production, ranges from 100 to 400 pounds per acre. Brittlebush (Encelia farinosa) and creosote bush (Larrea tridentata) dominate the site. Hot soil temperatures on warm landscape positions favor dominance by the drought-tolerant but cold-intolerant brittlebush.

Data ranges in the physiographic data, climate data, water features, and soil data sections of this Ecological Site Description are based on major components only (15 percent of map unit or greater).

Classification relationships

NDDB/Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California - Mojave Creosotebush Scrub. ; Sawyer, J.O. and T. Keeler-Wolf. 1995. Manual of California Vegetation - Brittlebush Series.

Ecological site concept

This description was copied from and is equivalent to R031XY003CA. There is ongoing LRU concept development and designation where a request was made by the Region 8 Ecological Site Specialist to avoid using the default XY LRU.

Associated sites

R040XD010CA	**Valley Wash** This ephemeral stream has a large drainage basin, and is in broad valleys, which are distal from the mountains. Desert willow and blue paloverde are common.
R040XD001CA	**Limy Hill 4-6" p.z.** This ecological site is on north facing hills, burrobush and creosote bush are dominant.
R040XD017CA	**Steep Granitic Slope 4-6" p.z.** This ecological site occurs on hills with burrobush, teddybear cholla, creosote bush, and a mix of other species.

Similar sites

R030XD003CA	**Hyperthermic Steep South Slopes** This ecological site is on hyperthermmic soils in the Mojave Desert, it has higher production, but similar species.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Encelia farinosa* (2) *Larrea tridentata*
Herbaceous	(1) *Eriogonum deflexum* (2) *Plantago ovata*

Physiographic features

This site occurs on hills, ballenas and steep side slopes of fan remnants. It is typically associated with south facing slopes, but at lower elevations may occur on all aspects. Slopes range from 15 to 50 percent, and elevations range from 460 to 2030 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Ballena
Flooding frequency	None
Ponding frequency	None
Elevation	460–2,030 ft
Slope	15–50%
Aspect	SE, S, SW

Climatic features

The Colorado Desert of California represents the northwestern most portion of the Sonoran Desert. The subtropical Colorado Desert results from the descent of cold air which is heated by compression and arrives hot and dry at the earth's surface. Precipitation is frontal in nature during the winter and convectional in the summer. Reduced summer rainfall and high potential evapo-transpiration make the Colorado Desert one of the most arid regions in North America. Summer temperatures frequently exceed 105 degrees F. The average annual precipitation ranges from 2 to 6 inches with most falling as rain. Snowfall is rare. Approximately 35% of annual precipitation occurs from July to September as a result of intense convection storms. Spring months are the windiest.

Table 3. Representative climatic features

Frost-free period (average)	365 days
Freeze-free period (average)	365 days
Precipitation total (average)	6 in

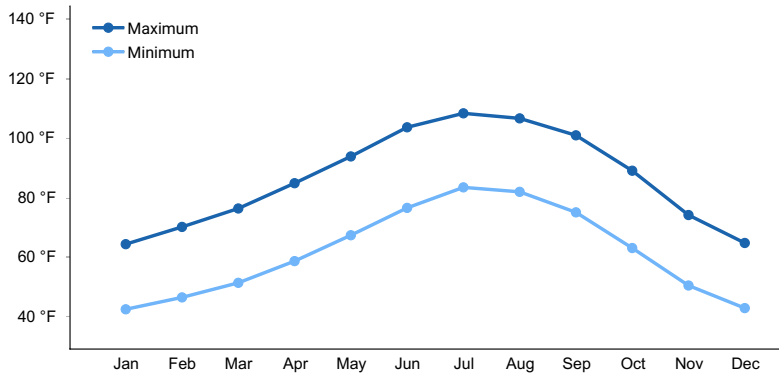

Figure 1. Monthly average minimum and maximum temperature

Influencing water features

Soil features

The soils associated with this ecological site range from very shallow over bedrock to very deep. Soils typically have minimal soil development, and are skeletal, with gravel surface textures and very gravelly or extremely gravelly subsurface textures. These soils are well to somewhat excessively drained with moderate to rapid permeability. The soils associated with this ecological site occur on hillslopes and formed from colluvium and residuum derived from granitoid or andesitic rockor basalt; or soils occur on steep sideslopes of fan remnants formed in alluvium from granitoid or gneiss parent material; or on ballenas formed in alluvium derived from granitic sources.

The associated soil series that are 15 percent or greater of any one map unit are: Emptygun (sandy-skeletal, mixed, hyperthermic Typic Haplocalcids); Goldroad (loamy-skeletal, mixed, superactive, calcareous, hyperthermic Lithic Torriorthents); Sunrock (loamy-skeletal, mixed, superactive, calcareous, hyperthermic Lithic Torriorthents), and Whipple (loamy-skeletal, mixed, superactive, hyperthermic Lithic Haplargids). The Emptygun soils are very deep and formed in alluvium on fan remnants or ballenas. They have a sandy skeletal particle control section. The Goldrose and Sunrock soils are very shallow to shallow with loamy skeletal particle control sections. The Goldrose and Sunrock soils differ in that the Sunrock soils are dominated by fine and medium sand in the particle control section and formed form volcanic parent material rather than granitoid. The Whipple soils have an argillic horizon, from 2 to 14 inches over bedrock, with an extremely gravelly sandy loam or extremely gravelly loam texture.

NOTE: The Goldrose and Sunrock soils correlated below in CA803 need to be updated. They are MLRA 30 (Mojave Desert) soils, and need to be developed as MLRA31 (Colorado Desert) soils.

This ecological site has been correlated to the following mapunits in the Colorado Desert Area Soil Survey (CA803):

1200; Goldroad very gravelly sandy loam, 15 to 50 percent slopes; Goldroad;; 80
1211;Stormjade-Whipple complex, 8 to 50 percent slopes;Whipple;warm;151400; Sunrock complex, 8 to 50 percent slopes;Sunrock;warm;25
1402;Sunrock-Cheme family-Rock outcrop association, 8 to 50 percent slopes;Sunrock;warm;3
1403;Sunrock-Emptygun-Rock outcrop association, 8 to 50 percent slopes;Sunrock;warm;45
2002; Emptygun association, 8 to 60 percent slopes; Emptygun; warm; 5

This ecological site has been correlated to the following mapunits in the Joshua Tree National Park Soil Survey (CA794):
2003; Emptygun fine sandy loam, 15 to 50 percent slopes; Emptygun;; 100

Table 4. Representative soil features

Parent material	(1) Colluvium–granite
Surface texture	(1) Very gravelly sandy loam (2) Extremely gravelly loamy sand (3) Very gravelly fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	4 in
Surface fragment cover <=3"	60–85%
Surface fragment cover >3"	3–25%
Available water capacity (0-40in)	0.1–2.7 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	20–75%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

Abiotic Factors

The most important abiotic factors driving this site are a hot climate with hyperthermic soil temperatures, steep slopes and skeletal soils. This ecological site is associated with hot landscape positions, so at higher elevations and more westerly positions, this site is associated with south-facing aspects, but at lower elevations this site may occur on all aspects. These factors favor dominance by the extremely drought-tolerant, but cold-intolerant brittlebush, with creosote bush as an important secondary shrub.

Throughout its range, brittlebush is most abundant on steeper south-facing slopes (McAuliffe and Devender 1998, Martre et al. 2002). When dominant on lower landscape positions, such as alluvial fans, it is generally a disturbance community (Sawyer et al. 2009). Steeper slopes experience greater degrees of water stress (Monson et al. 1992, Martre et al. 2002),and brittlebush is more competitive in these positions (Ehleringer 1988). Brittlebush is an extremely drought-tolerant, drought-deciduous shrub. Adaptations in degree of leaf pubescence and leaf size allow brittlebush to occupy sites ranging from relatively mesic coastal environments to extremely arid deserts (Ehleringer and Cook 1990, Sandquist and Ehleringer 1997, Housman et al. 2002, Sandquist and Ehleringer 2003).. Desert plants have smaller, more pubescent leaves, and a more compact growth form. Smaller more pubescent leaves reduce leaf temperatures and increases water use efficiency. The tradeoff is that plant productivity declines because smaller leaves have less surface area available for photosynthesis, and because pubescence reduces the absorption of solar radiation (Housman et al. 2002, Sandquist and Ehleringer 2003).

While leaf and shoot-adaptations allow brittlebush to withstand hot temperatures and extreme aridity, freezing temperatures restrict brittlebush. Frosts cause branch die-back and mortality in adult brittlebush (Sandquist and Ehleringer 1996), and reduce seedling establishment (Bowers 1994). Brittlebush seedlings emerge over multiple pulses in response to cool season rains, with emergence triggered by a minimum of 19 mm of precipitation, and

seedlings are killed if freezing temperatures occur within nine days of the trigger event (Bowers 1994). Warm, south-facing slopes experience fewer and less severe frosts, allowing brittlebush populations to persist without damage. Further, optimal soil temperatures for root growth of established brittlebush occur over winter, and conditions are more favorable on warm, south-facing slopes (Martre et al. 2002).

This site is associated with skeletal soils and gravelly textures. Throughout its range, brittlebush dominance is associated with rocky soils and is not dominant on clayey or sandy soils (Tesky 1993). This is probably because brittlebush has less of a competitive advantage on these soils, and other species are better able to dominate.

Disturbance Dynamics

The disturbances impacting this ecological site include drought, invasion by non-native species and fire.

Desert regions are characterized by low mean annual precipitation and extreme variability in the amount of precipitation received in any year or decade (Hereford et al. 2006). Thus, episodic mortality in response to periods of drought is important in shaping desert community dynamics (Hereford et al. 2006, Miriti et al. 2007). This ecological site is buffered from severe drought-induced impacts by the physiological adaptations of brittlebush. Brittlebush can vary the degree of leaf pubescence in response to periods of drought, where each successive leaf cohort produces more pubescence over the course of a drought (Sandquist and Ehleringer 2003). Individuals are able to continue photosynthesizing during drought, although at reduced rates of production.

The hot temperatures and skeletal soils of this ecological site reduce available soil moisture, which limits the susceptibility of this site to invasion by non-native annuals. However, microsites that are sheltered by large rock fragments and/or that receive additional run-on are susceptible to invasion by non-native annuals including red-stemmed stork's bill (Erodium cicutarum) and Mediterranean grass (*Schismus barbatus*). These non-native annuals may usurp space from native annuals that also depend on these microsites for establishment.

The low potential for high biomass of annual species limits the continuity of fine fuels in this site, and reduces the susceptibility of this site to fire. However brittlebush can reach high densities, and since this site occurs on steep slopes over which fire may rapidly move, this site may burn during conditions of extreme fire behavior. If this ecological site does burn, a brittlebush dominated community recovers rapidly (Brown and Minnich 1986, Steers and Allen 2011), so this ecological site is not considered at risk of transitioning to a fire-altered State.

State and transition model

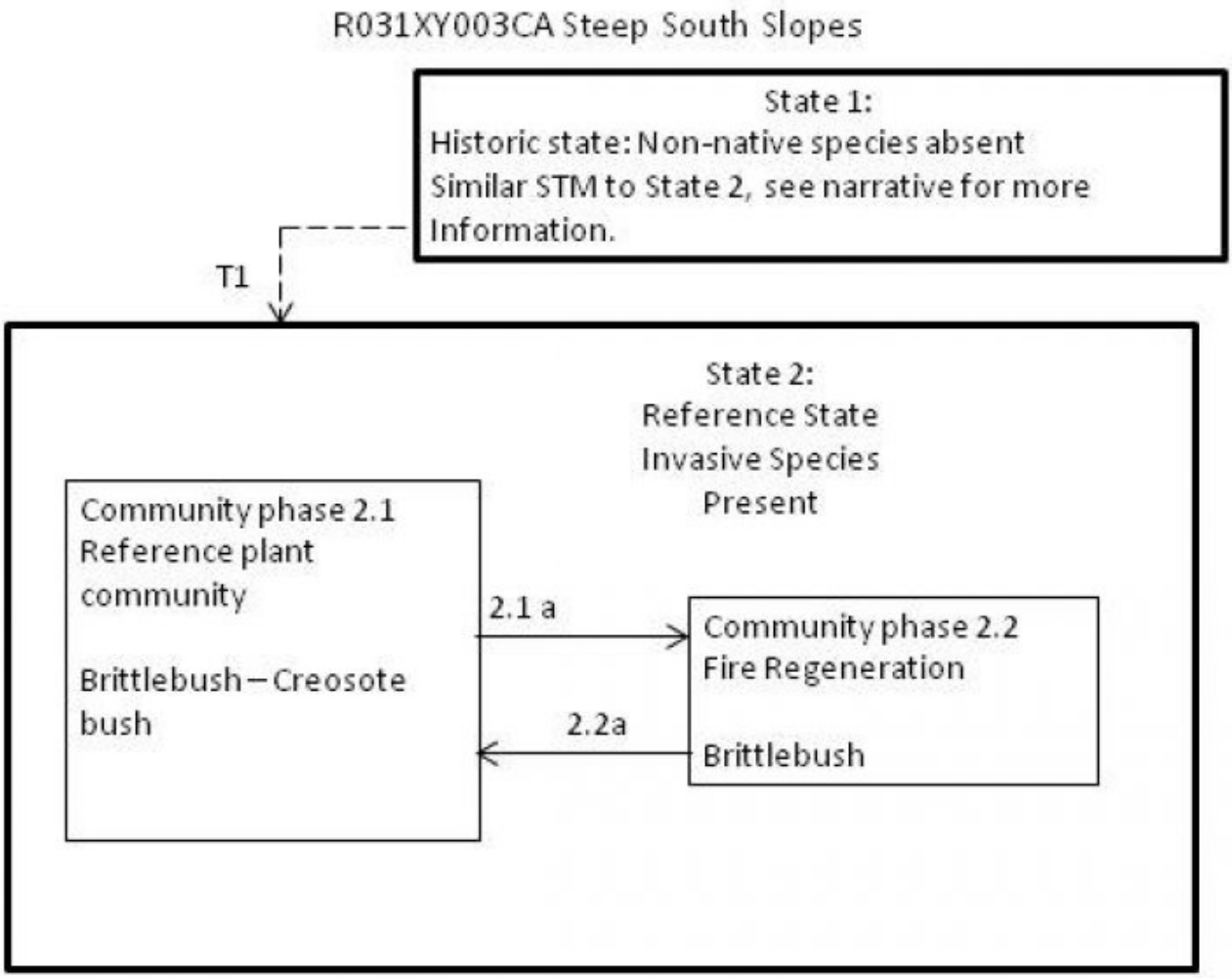

Figure 2. R031XY003CA Model

State 1
Historic State

State 1 represents the historic range of variability for this ecological site. This state no longer exists due to the ubiquitous naturalization of non-native species in the Colorado Desert. Drought and very rare fire were the natural disturbances influencing this ecological site. Data for this State does not exist, but it would have been similar to State 2, except with only native species present. See State 2 narrative for more detailed information.

State 2
Reference State

State 2 represents the current range of variability for this site. Non-native annuals, including Mediterranean grass (*Schismus barbatus*) are naturalized in this plant community. Abundance varies with precipitation, but it is at least sparsely present (as current year's growth or present in the soil seedbank).

Community 2.1
Reference Community

Figure 3. Reference Community

The reference community is characterized by widely spaced shrubs less than a 3 feet tall occurring on hot, dry, rocky slopes. It is dominated by brittlebush and creosote bush. Secondary shrubs are present at low levels, and include burrobush (*Ambrosia dumosa*), white ratany (*Krameria grayi*), pygmycedar (*Peucephyllum schottii*), ocotillo (*Fouquieria splendens*). Cacti may be sparsely present and include spinystar (*Escobaria vivipara*), beavertail pricklypear (*Opuntia basilaris*), California barrel cactus (*Ferocactus cylindraceus*), and strawberry cactus (Mammilaria dioica). Annuals species, though present, have relatively low abundance and biomass in this ecological site. Low soil moisture limits the production of annual species, high surface fragment cover limits microsites available for annuals, and the canopy of the short-lived brittlebush does not provide suitable habitat for annuals (Muller 1953). Though not abundant, winter annuals are seasonally present, and commonly include trailing windmills (*Allionia incarnata*), bristly fiddleneck (*Amsinckia tessellata*), largebract spiderling (*Boerhavia wrightii*), cryptanthas (Cryptantha spp.), flatcrown buckwheat (*Eriogonum deflexum*), sowthistle desertdandelion (*Malacothrix sonchoides*), Emory's rockdaisy (*Perityle emoryi*), and desert Indianwheat (*Plantago ovata*). Perennial forbs include California fagonbush (*Fagonia laevis*) and Parry’s false prairie clover (*Marina parryi*). Grass cover is low but may include arrowfeather threeawn (*Aristida purpurascens*), low woollygrass (*Dasyochloa pulchella*), sixweeks threeawn (*Aristida adscensionis*), and sixweeks grama (*Bouteloua barbata*). The non-native Mediterranean grass (Schismus sp.) is often sparsely present. Declines in cover and production occur in response to prolonged or severe periods of drought in this community phase, but remain within the natural range of variation. Bowers (2005) measured no effect of drought on mortality rates of brittlebush during modest drought in the 1950s, but approximately 26% increased mortality during severe drought in the early 2000s. Creosote bush exhibits branch-pruning, but low mortality in response to drought in the Mojave Desert (Webb et al. 2003, Miriti et al. 2007). In the Sonoran desert, mortality of creosote bush due to severe drought may be more pronounced, but still less than 5% (Bowers 2005). These rates remain within the natural range of variability for the ecological site. This ecological site may also experience declines in cover and production due to freezing events. Brittlebush may die, or exhibit branch die-back in response to freezing (Sandquist and Ehleringer 1996).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	93	216	336
Forb	2	20	40
Grass/Grasslike	5	14	24
Total	**100**	**250**	**400**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	15-20%
Grass/grasslike foliar cover	3-5%
Forb foliar cover	5-7%

Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	8-10%
Grass/grasslike basal cover	1-2%
Forb basal cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	3-5%
Surface fragments >0.25" and <=3"	75-80%
Surface fragments >3"	0%
Bedrock	10-15%
Water	0%
Bare ground	2-3%

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	3-5%	2-3%
>0.5 <= 1	–	–	–	3-4%
>1 <= 2	–	10-15%	–	–
>2 <= 4.5	–	3-5%	–	–
>4.5 <= 13	–	1-2%	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 2.2
Fire Regeneration

This community phase is characterized by the loss of creosote bush from the plant community. Brittlebush rapidly colonizes burned areas, and reaches dominance before associated shrub species (Brown and Minnich 1986, Steers and Allen 2011). In burned creosote bush scrub in the Colorado Desert, brittlebush seedlings overwhelmingly dominated shrub succession within the first year after burning, and within 3 to 5 year dominated total cover (Brown and Minnich, 1986). By twelve years after fire, pre-burn cover and density is reached, and is dominated by brittlebush (Steers and Allen 2011). By twenty years, there is sparse cover of creosote bush and other secondary shrubs with brittlebush (Steers and Allen 2011).

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with moderate to severe fire.

Pathway 2.2a
Community 2.2 to 2.1

This community pathway occurs with time without fire.

Additional community tables

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			86–320	
	brittlebush	ENFA	*Encelia farinosa*	41–150	–
	creosote bush	LATR2	*Larrea tridentata*	14–90	–
	burrobush	AMDU2	*Ambrosia dumosa*	13–50	–
	Schott's pygmycedar	PESC4	*Peucephyllum schottii*	4–15	–
	white ratany	KRGR	*Krameria grayi*	1–15	–
2	**Cacti**			3–14	
	California barrel cactus	FECY	*Ferocactus cylindraceus*	0–5	–
	strawberry cactus	MADI3	*Mammillaria dioica*	0–4	–
	beavertail pricklypear	OPBA2	*Opuntia basilaris*	1–3	–
	spinystar	ESVI2	*Escobaria vivipara*	0–2	–
8	**Ocotillo**			0–2	
	ocotillo	FOSP2	*Fouquieria splendens*	0–2	–
Grass/Grasslike					
4	**Perennial grasses**			3–15	
	purple threeawn	ARPU9	*Aristida purpurea*	1–10	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	1–5	–
5	**Annual Grasses**			2–6	
	sixweeks threeawn	ARAD	*Aristida adscensionis*	1–3	–
	sixweeks grama	BOBA2	*Bouteloua barbata*	1–3	–
9	**Non-native grass**			0–3	
	Mediterranean grass	SCHIS	*Schismus*	0–3	0–2
Forb					
6	**Perennial Forbs**			4–20	
	Parry's false prairie-clover	MAPA7	*Marina parryi*	0–20	0–20
	California fagonbush	FALA	*Fagonia laevis*	0–20	–
7	**Annual Forbs**			2–20	
	sowthistle desertdandelion	MASO	*Malacothrix sonchoides*	0–15	–
	cryptantha	CRYPT	*Cryptantha*	0–10	–
	desert Indianwheat	PLOV	*Plantago ovata*	1–5	–
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	1–3	–
	Emory's rockdaisy	PEEM	*Perityle emoryi*	0–3	–
	trailing windmills	ALIN	*Allionia incarnata*	0–3	–
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–3	–
	largebract spiderling	BOWR	*Boerhavia wrightii*	0–3	–

Animal community

This site provides habitat for small mammals such as canyon mice, long-tailed pocket mice, white-tailed antelope squirrels and desert woodrats. This site also provides habitat for reptiles such as the western whiptail, desert collared lizard, side-blotched lizard and the chuckwalla. The depth to bedrock is a restrictive feature to burrowing reptiles such as the desert tortoise. Birds that may frequent this site include common ravens, rock wrens, Says phoebes, species of sparrows and raptors.

Recreational uses

This site is highly valued for open space and those interested in desert ecology. Uses include mountain biking, hiking, bird watching and botanizing. Desert tortoise and wildflowers may also attract visitors during the spring.

Inventory data references

The following plot is from Joshua Tree National Park.

1247710310

The type location for the ecological site is listed below in the Chemehuevi OHV Area.

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3802439
UTM easting	720120
Latitude	34° 20′ 23″
Longitude	114° 36′ 25″
General legal description	This site is located several miles east of West Well in Chemehuevi Wash OHV area.

Other references

Bowers, J. E. 1994. Natural conditions for seedling emergence of three woody species in the northern Sonoran Desert. Madroño 41:73-84.

Bowers, J. E. 2005. Effects of drought on shrub survival and longevity in the northern Sonoran Desert. Journal of the Torrey Botanical Society 132:421-431.

Brown, D. E. and R. A. Minnich. 1986. Fire and Changes in Creosote Bush Scrub of the Western Sonoran Desert, California. American Midland Naturalist 116:411-422.

Ehleringer, J. R. 1988. Comparative ecophysiology of Encelia farinosa and Encelia frutescens I. Energy balance considerations. Oecologia 76:553-561.

Ehleringer, J. R. and C. S. Cook. 1990. Characteristics of Encelia species differing in leaf reflectance and transpiration rate under common garden conditions. Oecologia 82:484-489.

Hereford, R., R. H. Webb, and C. I. Longpre. 2006. Precipitation history and ecosystem response to multidecadal precipitation variability in the Mojave Desert region, 1893-2001. Journal of Arid Environments 67:13-34.

Housman, D. C., M. V. Price, and R. A. Redak. 2002. Architecture of coastal and desert Encelia farinosa (Asteraceae): consequences of plastic and heritable variation in leaf characteristics. American Journal of Botany 89:1303-1310.

Martre, P., G. B. North, E. G. Bobich, and P. S. Nobel. 2002. Root deployment and shoot growth for two desert species in response to soil rockiness. American Journal of Botany 89:1933-1939.

McAuliffe, J. R. and T. R. V. Devender. 1998. A 22,000-year record of vegetation change in the north-central Sonoran Desert. Paleography, Palaeoclimatalogy, Paleoecology 141:253-275.

Miriti, M. N., S. Rodriguez-Buritica, S. J. Wright, and H. F. Howe. 2007. Episodic death across species of desert shrubs. Ecology 88:32-36.

Monson, R. K., S. D. Smith, J. L. Gehring, W. D. Bowman, and S. R. Szarek. 1992. Physiological differentiation within an Encelia farinosa population along a short topographic gradient in the Sonoran Desert. Functional Ecology 6:751-759.

Muller, C. H. 1953. The association of desert annuals with shrubs. American Journal of Botany 40:53-60.

Sandquist, D. R. and J. R. Ehleringer. 1997. Intraspecific variation in leaf pubescene and drought response in Encelia farinosa associated with contrasting desert environments. New Phytologist 135:635-644.

Sandquist, D. R. and J. R. Ehleringer. 2003. Population- and family-level variation of brittlebush (Encelia farinosa, Asteraceae) pubescence: its relation to drought and implications for selection in variable environments. American Journal of Botany 90:1481-1486.

Sandquist, J. R. and J. R. Ehleringer. 1996. Potential adaptability and constraints of response to changing climates for Encelia farinosa var. phenicodonta from southern Baja California, Mexico. Madroño 43:465-478.

Sawyer, J. O., T. Keeler-Woolf, and J. M. Evans. 2009. A manual of California vegetation. 2nd edition. California Native Plant Society, Sacramento, California.

Steers, R. J. and E. B. Allen. 2011. Fire effects on perennial vegetation in the western Colorado Desert, USA. Fire Ecology 7:59-74.

Tesky, J. L. 1993. Hymenoclea salsola. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.

Webb, R. H., M. B. Muroy, T. C. Esque, D. E. Boyer, L. A. DeFalco, D. F. Haines, D. Oldershaw, S. J. Scoles, K. A. Thomas, J. B. Blainey, and P. A. Medica. 2003. Perennial vegetation data from permanent plots on the Nevada Test Site, Nye County, Nevada. U.S. Geological Society, Tucson, AZ.

Western Regional Climate Center, Desert Research Institute, Reno, Nevada (http://www.wrcc.dri.edu/index.html)

Approval

Scott Woodall, 2/08/2019

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)	P Novak-Echenique; Dustin Detweiler
Contact for lead author	State Rangeland Management Specialist
Date	07/19/2010
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few rills can be expected on steeper slopes in areas recently subjected to summer convection storms. Rock fragments armor the surface.

2. **Presence of water flow patterns:** Water flow patterns are none to rare but can be expected in areas recently subjected to summer convection storms, usually on steeper slopes.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 2-5%; there is very little bare ground due to high gravel, cobble, stone and boulder cover.

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move until trapped under surface fragments or other plants. Persistent litter (large woody material) will remain in place except during catastrophic events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 1 to 4 on most soil textures found on this site. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically moderate thick platy to weak fine subangular blocky structure. Soil surface colors are light brown and soils are typified by an ochric epipedon. Organic matter of the surface horizon is typically <1 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Shrub canopy and associated litter break raindrop impact.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are not typical.

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: Mojave Desert shrubs

Sub-dominant: perennial forbs > annual forbs > perennial grasses > annual grasses

Other:

Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 25% of total woody canopy.

---

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces up to 5%.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season ± 250 lbs/ac.

---

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:** Invaders on this site include red-stem filaree, red brome, and Mediterranean grass.

---

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years.
