USDA Natural Resources
Conservation Service

Ecological site R040XD009CA
Gravelly Fan Remnants And Fan Aprons

Accessed: 05/06/2024

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.

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): 040X–Sonoran Basin and Range

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) (WRCC 2002). 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 stable, broad fan remnants and fan aprons at elevations of 540 to 2620 feet. Soils are very deep with sandy and gravelly textures, a high cover of surface gravels and cobbles, and a high percentage of subsurface rock fragments (by volume).

Production reference value (RV) is 161 pounds per acre and depending on precipitation and annual forb production, ranges from 50 to 344 pounds per acre. Shrubs are widely spaced, and creosote bush (Larrea tridentata) and Schott's dalea (Psorothamnus schottii) dominate the site. Deep soils and hyperthermic soil temperatures favor dominance by the deep-rooted creosote bush. Gravelly soils, and high surface rock fragment cover, which increases localized run-on and enhances habitat for Schott's dalea.

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 mapunit or greater).

Classification relationships

This ecological site is found within the Larrea tridentata Shrubland Alliance (Sawyer et al. 2009).

Associated sites

R040XD001CA	**Limy Hill 4-6" p.z.** R031XY001CA occurs on steep sideslopes of adjacent fan remnants. Creosote bush (Larrea tridentata) and burrobush (Ambrosia dumosa) dominate.
R040XD021CA	**Very Gravelly Wash** R031XY021CA is found on adjacent small, occasionally flooded inset fans. Brittlebush (Encelia farinosa), creosote bush (Larrea tridentata), and big galleta (Pleuraphis rigida) are dominant species.
R040XD030CA	**Extremely Stony Fan Remnants** R031XY030CA occurs on adjacent extremely stony fan remnants. Teddybear cholla (Cylindropuntia bigelovii) and creosote bush (Larrea tridentata) are dominant species.
R040XD034CA	**Gravelly, Braided, Ephemeral Stream** R031XY034CA is found on adjacent occasionally flooded, braided ephemeral drainage systems. Desert lavender (Hyptis emoryi) and burrobrush (Hymenoclea salsola) are dominant species.

Similar sites

R040XD030CA	**Extremely Stony Fan Remnants** R031XY030CA occurs on fan remnants with stony surfaces. Production and shrub diversity are higher, and teddybear cholla (Cylindropuntia bigelovii) is an important species.
R040XD200CA	**Rarely Flooded Fans** R031XY200CA is found on rarely flooded fan aprons and cobbly fan remnants. Production is higher, brittlebush (Encelia farinosa) is an important species, and Schott's dalea (Psorothamnus schottii) is trace if present.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Larrea tridentata* (2) *Psorothamnus schottii*
Herbaceous	(1) *Chorizanthe brevicornu*

Physiographic features

This ecological site occurs on stable, broad fan remnants and fan aprons at elevations of 540 to 2620 feet. Slopes range from 2 to 15 percent, but slopes less than 8 percent are typical. Runoff class is very low to low.

Table 2. Representative physiographic features

Landforms	(1) Fan remnant (2) Fan apron
Flooding frequency	None
Ponding frequency	None
Elevation	165–799 m
Slope	2–15%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this ecological site is characterized by hot temperatures, aridity, and a bimodal precipitation pattern. Precipitation falls as rain, with 30 percent falling in summer between July and October, and 60 percent falling in winter between November and March. The mean annual precipitation is 2 to 4 inches and mean annual air temperature is 73 to 79 degrees F. The frost free period is 360 to 365 days.

Maximum and minimum monthly climate data for this ESD were generated by the Climate Summarizer

(http://www.nm.nrcs.usda.gov/technical/handbooks/nrph/Climate_Summarizer.xls) using data
from the following climate stations (results are weighted averages; numbers in square brackets represent relative weights):

42598, Eagle Mountain, CA (Period of record = 1933 to 2011) [2]

43855, Hayfield Reservoir, CA (Period of record = 1933 to 2011) [1]

The data from multiple weather were combined to most accurately reflect the climatic conditions of this ecological site.

Table 3. Representative climatic features

Frost-free period (average)	365 days
Freeze-free period (average)	0 days
Precipitation total (average)	102 mm

Influencing water features

Soil features

The soils associated with this ecological site are very deep, excessively drained soils that formed in alluvium from igneous rock. These soils are sandy-skeletal in the particle size control section, and permeability is moderately rapid to rapid. Surface textures include gravelly to extremely cobbly fine sandy loam to coarse sandy loam or loamy sand, with gravelly loamy coarse sand, very gravelly loamy coarse sand to extremely gravelly coarse sand subsurface textures. Surface gravels (< 3 mm in diameter) range from 45 to 52 percent, and larger fragments range from 25 to 45 percent. Subsurface gravels by volume (for a depth of 0 to 59 inches) range from 16 to 46 percent and larger fragments by volume range from 0 to 35 percent.

This ecological site is associated with the Rizzo soils (sandy-skeletal, mixed, hyperthermic Typic Torriorthents).

This ecological site is correlated with the following map units and soil components in the Joshua Tree National Park Soil Survey:

2403;Rizzo-Rizzo, occasionally flooded complex, 2 to 8 percent slopes;Rizzo;;80
2402;Rizzo-Rizzo, frequently flooded complex, 2 to 8 percent slopes;Rizzo;;70
2440;Rizzo complex, 8 to 15 percent slopes;Rizzo;;35
2090;Deprave-Rockhound-Rizzo complex, 2 to 4 percent slopes;Rizzo;;20
2408;Rizzo complex, 2 to 8 percent slopes;Rizzo;gravelly surface;2

Table 4. Representative soil features

Surface texture	(1) Very gravelly fine sandy loam (2) Gravelly loamy coarse sand (3) Gravelly loamy fine sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	150 cm
Surface fragment cover <=3"	45–52%
Surface fragment cover >3"	25–45%

Available water capacity (0-101.6cm)	2.29–4.57 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	16–46%
Subsurface fragment volume >3" (Depth not specified)	0–35%

Ecological dynamics

Abiotic Factors

Extreme temperatures and aridity, coarse soils with high rock content by volume and a heterogeneously distributed surface rock fragment cover that increases run-on, drives the vegetation community of this ecological site. This site occurs on stable, broad fan remnants and fan aprons in an extremely arid portion of the Lower Colorado Desert. Mean annual precipitation is 2 to 4 inches, mean maximum temperatures are over 90 F for five months of the year, and strong winds are typical during the summer months. On landforms where additional water is not available, this extremely water-limiting environment can support only a sparse, low production plant community.

In arid regions, coarse textured soils have greater water availability because water quickly infiltrates the soil to depths where it is not lost to evaporation (Noy-Meir 1973, Hamerlynk et al. 2002). Thus, greater amounts of water are held for a longer duration in deep, coarse soils where the development of restrictive soil horizons (such as argillic or petrocalcic horizons) has not occurred (Hamerlynk et al. 2002, Hamerlynk and McAuliffe 2008). However, little water is available at shallow depths, which favors deep-rooted species, or species that can retain large amounts of water when it is available.

The distribution of rock fragments on the soil surface and within the soil horizon has a significant effect on the distribution and availability of soil water (Poesen and Lavee 1994, Cerda 2001, Martre et al. 2002, Li et al. 2007). Soils with greater rock content by volume have less water availability, which limits productivity relative to sandier soils (Martre et al. 2002). Small surface rock fragments can increase infiltration rates (Poesen and Lavee 1994, Cerda 2001), while large surface rock fragments increase run-on. Thus, surfaces where gravel and large fragments are heterogeneously distributed, such as this ecological site, have localized patches of relatively high water availability (i.e. patches of gravel adjacent to patches of large surface fragments). Further, large rock fragments on the soil surface and within soil horizons locally reduce evaporation rates, increasing the temporal availability of water (Martre et al. 2002, Li et al. 2007, Hamerlynk and McAuliffe 2008), and buffering soil temperatures (Cerda 2001). These provide microsites for plant establishment.

The reference plant community of this ecological site is dominated by creosote bush, and Schott's dalea is a characteristic secondary species. This site has relatively high cactus diversity, and annual species comprise 37 to 52 percent of production during years of average to above average precipitation.

Creosote bush is a long-lived, deep-rooted evergreen shrub dominant across vast areas of the North American warm deserts. Creosote bush maintains its evergreen status by using water held in deep soil layers. Creosote bush is typically the dominant shrub on deep coarse soils with little development (Hamerlynk et al. 2002, Hamerlynk and McAuliffe 2008), such as on this ecological site. Schott's dalea is a deep-rooted shrub that occurs from the southern Mojave Desert, the Colorado Desert and into the Sonoran Desert in northern Mexico. It occurs on hyperthermic soils in habitats receiving additional run-on such as rocky hill-slopes, washes, and alluvial fans with regular sheet-flow. It is an indicator of gravelly soils in the Colorado Desert region (Marks 1950). Data is lacking on the ecology of this species, but it is suggested that it requires water for dispersal and seed germination (Vogl and McHargue 1966);

although this ecological site does not receive regular flooding, run-on from large rock fragments provides enough to support Schott's dalea. Cacti are adapted to the most arid of environments with their ability to store large amounts of water with stem succulence; plasticity to expand and contract with water gain or loss; rapid root growth in response to even small amounts of moisture to capture water when it is available; spines, which are modified leaves that shade the stem and do not lose water like typical leaves; and Crassulacean acid metabolism (CAM) whereby photosynthesis occurs at night so that stomata are open during the cool of the night and water losses are minimized. Cactus can store so much water in their succulent stems that they can withstand water losses of 70 to 90 percent (Ingram 2008).

Disturbance dynamics

The primary disturbances influencing this ecological site are drought and invasion by non-native annual plants.

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 already shaped by extremely arid conditions; nevertheless, extreme drought can still have an impact. Drought can cause reductions in cover and production due to mortality of short-lived species, branch-pruning and mortality of longer-lived species, lack of recruitment, and lack of emergence of annual species (e.g. Webb et al. 2003, Bowers 2005, Hereford et al. 2006, Miriti et al. 2007). Creosote bush exhibits branch-pruning, but low mortality in response to drought in the Mojave Desert (Webb et al. 2003, Hereford et al. 2006, 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).

Non-native annual species such as red brome (*Bromus rubens*), Mediterranean grass (*Schismus barbatus*), redstem stork's bill (*Erodium cicutarium*) and Asian mustard (*Brassica tournefortii*) have become naturalized in the Colorado Desert over the past century (Brown and Minnich 1986, D'Antonio and Vitousek 1992, Brooks and Berry 2006). In lower elevations, where soil temperature regimes are hyperthermic and soil moisture is more limiting, Mediterranean grass is the dominant non-native grass (Brooks and Berry 2006). Like native annuals, nonnative annual cover and production is directly related to winter precipitation (Beatley 1969, Brooks and Berry 2006, Barrows et al. 2009). When undisturbed, the high surface rock fragment cover and low water availability at shallow depths of this ecological site restrict establishment and biomass of non-native species, but when the soil surface is disturbed, Mediterranean grass may become more abundant.

Soil disturbance, such as from construction or off-road vehicle use not only increases the susceptibility of this site to invasion by non-native species, but increases establishment opportunities for native species as well. This can lead to higher diversity, productivity and cover in this ecological site.

State and transition model

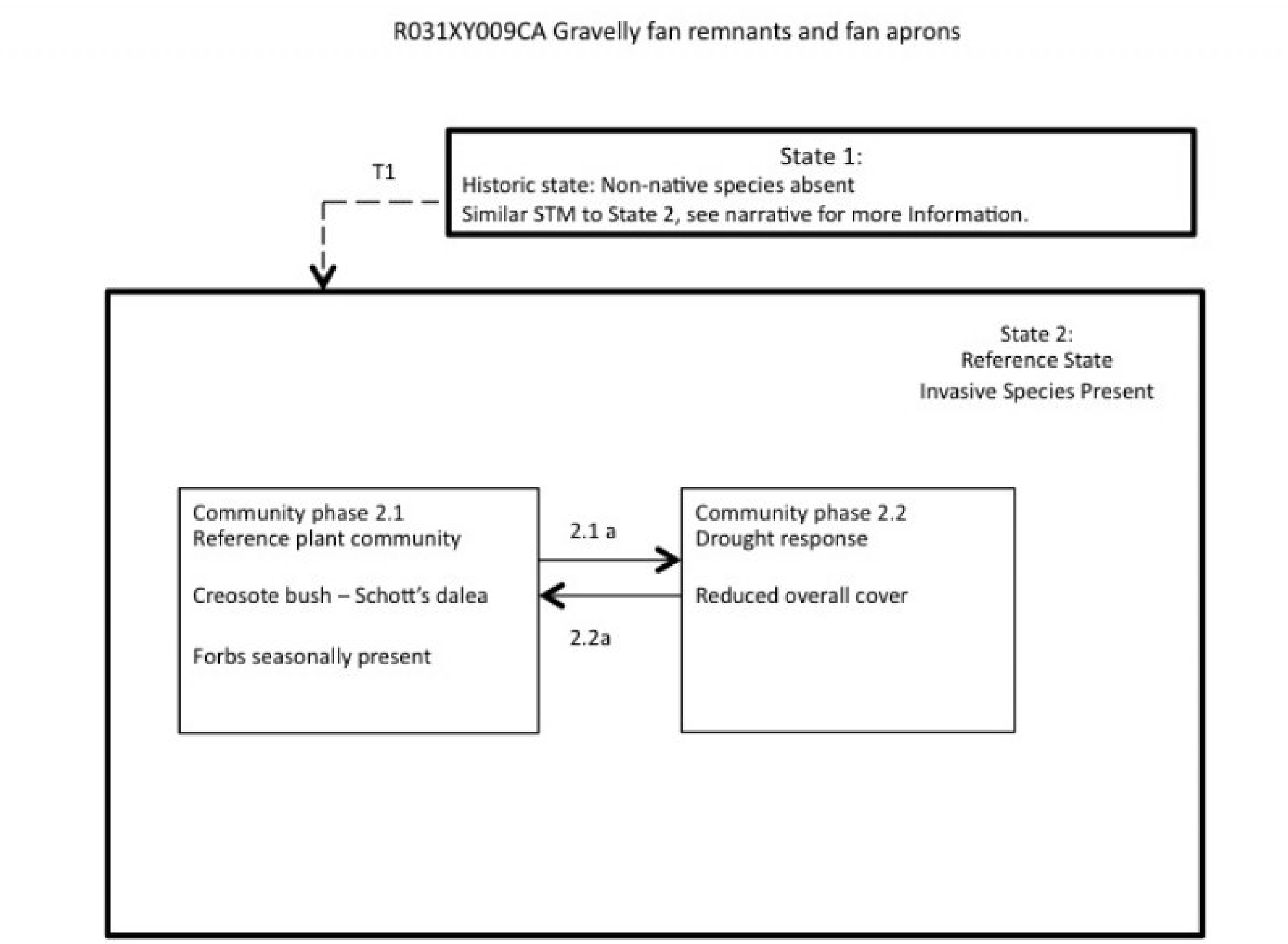

Figure 4. R031XY009CA

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. Periodic drought was the natural disturbance influencing this ecological site. Data for this state does not exist, but dynamics and composition 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 is naturalized in this plant community, but has not altered the ecological dynamics of this site.

Community 2.1
Reference plant community

Figure 5. Community Phase 2.1

The reference plant community consists of sparsely distributed, relatively small shrubs, and cactus, and relatively abundant annuals during average to high precipitation conditions. Creosote bush is dominant, and Schott's dalea is a characteristic secondary species. Minor shrubs may include brittlebush (*Encelia farinosa*), burrobush (*Ambrosia dumosa*), and ocotillo (*Fouquieria splendens*). Ironwood (*Olneya tesota*) and/or blue paloverde (*Parkinsonia florida*) dominate adjacent drainageways, and may be sparsely present in this ecological site. The subshrub California fagonbush (*Fagonia laevis*) is typically present, as is the perennial native grass purple threeawn (*Aristida purpurea*). Cactus species contribute low biomass, but are a regular component of the plant community; species include the rare foxtail cushion cactus (*Escobaria alversonii*), beavertail cactus (*Opuntia basilaris*), branched pencil cholla (*Cylindropuntia ramosissima*), and Englemann's hedgehog cactus (Echinocactus engelmanii). The annual forb community is diverse; common species include brittle spineflower (*Chorizanthe brevicornu*), western Mojave buckwheat (*Eriogonum mohavense*), Abrams' sandmat (*Chamaesyce abramsiana*), pincushion flower (*Chaenactis fremontii*), desert Indianwheat (*Plantago ovata*), and ghost flower (*Mohavea confertiflora*). The non-native annual Mediterranean grass is typically sparsely present. Shrub cover and production is highest directly adjacent to patches of large surface fragments, and annual cover is seasonally high in gravel patches.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	–	67	204
Shrub/Vine	56	102	154
Grass/Grasslike	–	11	22
Tree	–	–	6
Total	**56**	**180**	**386**

Community 2.2
Drought response

This community phase is characterized by declines in cover and production due to branch-pruning and lack of recruitment of creosote bush and Schott's dalea, mortality of short-lived species (brittlebush, burrobush, California fagonbush, purple threeawn), and lack of emergence of annual species. Cactus species have low mortality during drought, but recruitment is limited (Jordan and Nobel 1981).

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with prolonged or severe drought.

Pathway 2.2a
Community 2.2 to 2.1

This pathway occurs with time and a return to average or above average precipitation conditions.

Transition 1
State 1 to 2

This transition occurred with the naturalization of non-native species in this ecological site. Non-native species were introduced with settlement of the Southwest Desert region in the 1860s.

Additional community tables

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
1	**Trees**			0–6	
	blue paloverde	PAFL6	*Parkinsonia florida*	0–4	0–1
	desert ironwood	OLTE	*Olneya tesota*	0–2	0–1
Shrub/Vine					
2	**Native shrubs**			56–154	
	creosote bush	LATR2	*Larrea tridentata*	45–95	2–5
	brittlebush	ENFA	*Encelia farinosa*	0–56	0–3
	Schott's dalea	PSSC5	*Psorothamnus schottii*	6–28	1–3
	cushion foxtail cactus	ESAL2	*Escobaria alversonii*	0–13	0–1
	California fagonbush	FALA	*Fagonia laevis*	0–12	0–1
	ocotillo	FOSP2	*Fouquieria splendens*	0–11	0–2
	beavertail pricklypear	OPBA2	*Opuntia basilaris*	0–4	0–1
	branched pencil cholla	CYRA9	*Cylindropuntia ramosissima*	0–3	0–1
	burrobush	AMDU2	*Ambrosia dumosa*	0–2	0–1
Forb					
3	**Native forbs**			0–204	
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–163	0–10
	pincushion flower	CHFR	*Chaenactis fremontii*	0–45	0–8
	desert Indianwheat	PLOV	*Plantago ovata*	0–28	0–13
	Abrams' sandmat	CHAB2	*Chamaesyce abramsiana*	0–22	0–1
	Western Mojave buckwheat	ERMO3	*Eriogonum mohavense*	0–10	0–1
	ghost flower	MOCO	*Mohavea confertiflora*	0–1	0–1
	devil's spineflower	CHRI	*Chorizanthe rigida*	0–1	0–1
	chia	SACO6	*Salvia columbariae*	0–1	0–1
Grass/Grasslike					
4	**Native grasses**			0–22	
	purple threeawn	ARPU9	*Aristida purpurea*	0–22	0–2
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–1	0–1
5	**Non-native annual grasses**			0–1	
	Mediterranean grass	SCHIS	*Schismus*	0–1	0–1

Animal community

Creosote bush shrublands provides a home for an abundance of specialist insect species, for example, creosote bush flowers provide nutrition for over twenty species of bees, and the creosote bush grasshopper (Bootettix argentatus) feeds solely on creosote leaves (Pavlik 2008). The sparse vegetation of this ecological site does not provide good cover or food for animals.

Recreational uses

This site may be used for hiking and aesthetic enjoyment.

Other products

Creosote bush is an important medicinal plant for Native Americans. It has a very wide range of uses from treatment for consumption, bowl complaints, and menstrual cramps, to induce vomiting, relief for arthritis, rheumatism, aching bones and sprains, congestion and cold, as an antiseptic and disinfectant, dandruff, antispasmodic, to induce urination, gonorrhea, and to cancer treatment. (This list is not exhaustive). http://herb.umd.umich.edu/herb/search.pl?searchstring=Larrea+tridentata.

Creosote bush stems are used to make weapons, digging tools, and basket handles, and creosote gum is used for knife and awl handles. Creosote bush branches are used as thatch in dwelling construction. http://herb.umd.umich.edu/herb/search.pl?searchstring=Larrea+tridentata.

Inventory data references

Community Phase 2.1:

WP024 (Type location)
H3-E
VIPA-01
VIPA-07
WP001
WP028

Type locality

Location 1: Riverside County, CA	
UTM zone	N
UTM northing	3738834
UTM easting	641682
General legal description	The type location is approximately two tenths of a mile north of the MWD Aqueduct Road, and 1 mile west of the intersection of Eagle Mountain Road and the MWD Aqueduct Road in Joshua Tree National Park.

Other references

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**