Ecological site R030XD002CA
Desert Pavement

Last updated: 2/08/2019
Accessed: 05/17/2024

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.

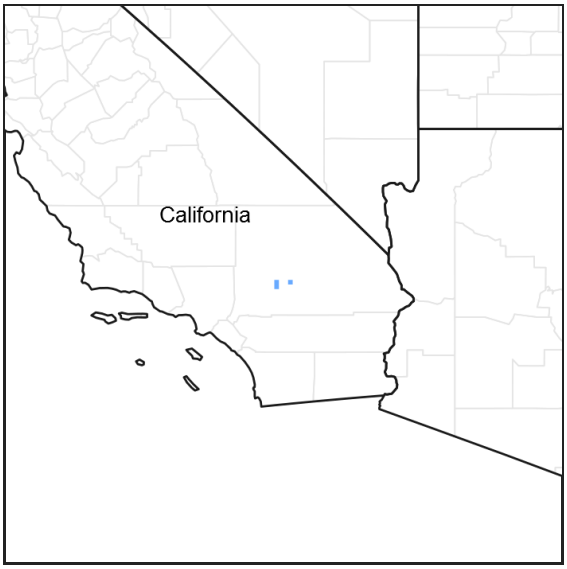

Figure 1. Mapped extent

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): 030X–Mojave Basin and Range

The Mojave Desert Major Land Resource Area (MLRA 30) is found in southern California, southern Nevada, the extreme southwest corner of Utah and northwestern Arizona within the Basin and Range Province of the Intermontane Plateaus. The Mojave Desert is a transitional area between hot deserts and cold deserts where close proximity of these desert types exert enough influence on each other to distinguish these desert types from the hot and cold deserts beyond the Mojave. Kottek et. al 2006 defines hot deserts as areas where mean annual air temperatures are above 64 F (18 C) and cold deserts as areas where mean annual air temperatures are below 64 F (18 C). Steep elevation gradients within the Mojave create islands of low elevation hot desert areas surrounded by islands of high elevation cold desert areas.

The Mojave Desert receives less than 10 inches of mean annual precipitation. Mojave Desert low elevation areas are often hyper-arid while high elevation cold deserts are often semi-arid with the majority of the Mojave being an arid climate. Hyper-arid areas receive less than 4 inches of mean annual precipitation and semi-arid areas receive more than 8 inches of precipitation (Salem 1989). The western Mojave receives very little precipitation during the summer months while the eastern Mojave experiences some summer monsoonal activity.

In summary, the Mojave is a land of extremes. Elevation gradients contribute to extremely hot and dry summers and cold moist winters where temperature highs and lows can fluctuate greatly between day and night, from day to day

and from winter to summer. Precipitation falls more consistently at higher elevations while lower elevations can experience long intervals without any precipitation. Lower elevations also experience a low frequency of precipitation events so that the majority of annual precipitation may come in only a couple precipitation events during the whole year. Hot desert areas influence cold desert areas by increasing the extreme highs and shortening the length of below freezing events. Cold desert areas influence hot desert areas by increasing the extreme lows and increasing the length of below freezing events. Average precipitation and temperature values contribute little understanding to the extremes which govern wildland plant communities across the Mojave.

Hyper-Arid Mojave Land Resource Unit (XD)

LRU notes

The Mojave Desert is currently divided into 4 Land Resource Units (LRUs). This ecological site is within the Hyper-Arid Mojave LRU, extremely hot and dry low elevation troughs within the Mojave Desert. The Hyper-Arid Mojave LRU is designated by the 'XD' symbol within the ecological site ID. This LRU is found within the Death Valley/Mojave Central Trough, as well as portions of the Mojave exposed to the Salton Sea Trough and the Colorado River Valley. This LRU is essentially equivalent to the Death Valley/Mojave Central Trough, Arid Valleys and Canyonlands, and associated Mojave Sand Dunes and Mojave Playas of EPA Level IV Ecoregions.

Elevations are predominantly below 1650 feet with precipitation is less than 4 inches per year. Mountain slopes within the watersheds of these low elevation troughs may extend up to approximately 2460 feet (750 m). This LRU is distinguished by its extremely aridity where a nearly barren landscape is occupied by widely spaced shrubs. Vegetation includes creosote bush, burrobush, big galleta grass with many annual species able to take advantage of infrequent precipitation events which occur in this LRU. Playa species such as Mojave seablite and saltbush species are also common in this LRU.

Ecological site concept

This ecological site occurs on fan remnants, ballenas and fan aprons. This site is defined by the presence of desert pavement surfaces, with an underlying eolian-deposited horizon dominated by vesicular pores. A range of soil development is present under the desert pavement surfaces. Soils typically have a hyperthermic soil temperature regime, and the surface is covered by interlocking rock fragments (desert pavement). The pavement surface limits water infiltration, which limits production and diversity. Desert pavement rocks are often covered with desert patina, a thin varnish of clay, manganese and iron oxides. Vegetation is dominated by very sparse creosote bush (Larrea tridentata), which is confined to breaks in the pavement surface.

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 or greater).

Associated sites

R030XY001CA	**Occasionally Flooded, Hyperthermic, Diffuse Ephemeral Stream** This ecological site occurs on first and second order drainageways, where flow loses velocity or becomes divergent across inset fans and fan aprons. Creosote bush, Schott’s dalea and burrobush are dominant.
R030XD003CA	**Hyperthermic Steep South Slopes** This ecological site is found on steep south facing hills and sideslopes of fan remnants. Brittlebush and creosote bush are present.
R030XD004CA	**Low-Production Hyperthermic Hills** This ecological site is found on side slopes of fan remnants, and has sparse cover of creosote bush.
R030XD006CA	**Abandoned Fan** This ecological site is found on fan aprons and alluvial fans, with very deep soil, and little surface run-on. Sparse creosote bush is present.
R030XD015CA	**Hyper-Arid Fans** This ecological site occurs on fan aprons, fan remnants, and alluvial fans, with rare sheet flood events. Creosote and burrobush are present, with a few other shrubs and forbs.

R030XD025CA	**Hyperthermic Sandsheets** This ecological site occurs on stabilized sandsheets, with creosote bush, dyebush, big galleta and burrobush.
R030XD039CA	**Coarse Gravelly Fans** This ecological site occurs on fan aprons, alluvial fans, and fan remnants. It has rare sheet flooding with creosote bush and brittlebush dominant.

Similar sites

R030XY092NV	**DESERT PATINA** This desert pavement ecological site has higher production, is more often on thermic soils, and generally has very deep soils with calcic horizons.
R030XD042CA	**Hyperthermic Shallow To Moderately Deep Fan Remnants** This ecological site has similar soils and species, but does not have desert pavement surfaces, and production is slightly higher.
R030XB019NV	**Eroded Fan Remnant Pavette 4-6 P.Z.** This site has a small patchwork of desert pavement areas which allows more vegetation to grow than areas with uniform and well developed pavement.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Larrea tridentata*
Herbaceous	Not specified

Physiographic features

This site occurs on fan remnants, ballenas, and fan aprons with desert pavement surfaces. Elevations range from 520 to 2950 feet, and slopes are typically 0 to 4 percent, but may range from 0 to 15 percent.

Table 2. Representative physiographic features

Landforms	(1) Fan remnant (2) Ballena (3) Fan apron
Flooding frequency	None
Ponding frequency	None
Elevation	158–899 m
Slope	0–15%
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 65 percent falling in winter between November and March. The mean annual air temp is 68 to 77 degrees, and the mean annual precipitation is 3 to 5 inches. The frost free period is 300 to 340 days, and freeze free period is estimated to range from 320 to 360 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):

42598, Eagle Mountain, CA (Period of record = 1933 to 2011) [1]

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

049099, Twentynine Palms, California (Period of record = 1935 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)	340 days
Freeze-free period (average)	360 days
Precipitation total (average)	127 mm

Influencing water features

Soil features

The soils associated with this ecological site are shallow to very deep, well drained to excessively drained, and formed in eolian deposits over alluvium or alluvium from various igneous and/or metamorphic parent materials. This site is defined by a desert pavement surface, composed of tightly interlocked rock fragments darkened by desert patina (desert varnish) and a thin A horizon characterized by vesicular pores. A range of soil development is present under the desert pavement surfaces, indicating either different time scales of development or different processes of development. Soils associated with this site generally have a hyperthermic temperature regime, argillic horizon development, and loamy-skeletal, coarse-loamy, or loamy textures in the particle control section (exceptions are described below). Several soils have a duripan at depths of 11 to 19 inches. Surface textures are dominantly gravel due to the high rock fragment cover at the surface, but very gravelly fine sand, very gravelly loamy sand, fine sandy loam, and channers are also possible. Subsurface textures (from 1 inch to depth of duripan or 59 inches) range from non gravelly to very gravelly sand, sandy loam, loam, and silt loam. Surface rock fragments less than 3 inches range from 42 to 90 percent cover, and fragments greater than 3 inches range from 3 to 30 percent cover. Subsurface percent by volume of rock fragments less than 3 inches ranges from 10 to 75, and greater that 3 inch fragments range from 0 to 15 percent.

The Aquapeak, Buzzardsprings, Carpentflat, Carrizo, Descent, Goldenbell, Oldale, Rubylee, adn Russiroks soils are major soils (15 percent or greater of a mapunit) associated with this ecological site.
The Aquapeak, Carpetflat, and Goldenbell soils are shallow over a duripan (11 to 19 inches), with gravel surface textures. These soils often have alkaline pH near the surface, with representative values (RV) 8.2 to 9.1. The Aquapeak soils are loamy, mixed, superactive, hyperthermic, shallow Argidic Argidurids; Carpetflat soils are loamy-skeletal, mixed, superactive, hyperthermic, shallow Typic Haplodurids; and the Goldenbell soils are loamy-skeletal, mixed, superactive, hyperthermic, shallow Argidic Argidurids.

The Olddale and Rubylee soils are very deep and have argillic horizons. The Oldale soils are loamy-skeletal, mixed, superactive, hyperthermic Typic Haplargids and Rubylee soils are coarse-loamy, mixed, superactive, hyperthermic Typic Haplargids.
The Buzzardsprings soils are very deep with calcic horizons. The Buzzardsprings soils are sandy, mixed, hyperthermic Typic Haplocalcids. Russiroks soils are loamy-skeletal, mixed, superactive, hyperthermic Typic Calciargids. These soils have both an argillic horizon and a calcic horizon..

The least developed soils are Carrizo and Descent. The Carrizo and Descent soils are sandy-skeletal, mixed, hyperthermic Typic Torriorthents. The Descent soils contain pedogenic silica and calcium carbonates, but the carbonates do not increase with depth, so these soils do not classify as calcic soils.

Other soils associated as minor components only are: Blackmagic, Gocougs, Perurose, Silvermine, Werewolf, and Pintobasin. The Blackmagic, Gocougs, and Silvermine soils have a thermic soil temperature regime, and often occur without desert pavement surfaces, but when correlated to this site they do have desert pavement surfaces. The Blackmagic soils are fine-loamy, mixed, superactive, thermic Typic Calciargids; Gocougs are fine-loamy, mixed, superactive, thermic Argic Petrocalcids; and the Silvermine soils are sandy, mixed, thermic, shallow Cambidic

Haplodurids. The Perurose soils are sandy, mixed, hyperthermic Cambidic Haplodurids, and are moderately deep to a duripan. The Pintobasin soils are mixed, hyperthermic Typic Torripsamments, and have little to no soil development.

This ecological site has been correlated with the following mapunits and major soil components (15 percent or greater) within the Joshua Tree National Park Soil Survey Area (CA794):

Mapunit ID; Mapunit name; Component; phase; percent
1513; Carrizo-Rubylee complex, 1 to 4 percent slopes; Rubylee;; 15
1514; Carrizo-Pintobasin-Rubylee complex, 0 to 4 percent slopes; Rubylee;; 15
1523; Pintobasin-Aquapeak association, 2 to 4 percent slopes; Aquapeak;;25
1540; Carrizo-Russiroks complex, 2 to 8 percent slopes;Carrizo;stable; 25 and Russiroks;; 20
1541; Carrizo-Cambidic Haplodurids association, 4 to 15 percent slopes; Carrizo; stable; 50
1550; Buzzardsprings-Coxpin-Dalelake complex, 2 to 8 percent slopes; Buzzardsprings; stable; 35
2065; Dalelake-Aquapeak-Coxpin association, 2 to 8 percent slopes; Aquapeak ; ; 25
2068; Aquapeak-Carpetflat-Pintobasin complex, 0 to 4 percent slopes;Aquapeak; ; 45
2070; Missionsweet-Carpetflat association, 2 to 30 percent slopes;Carpetflat; ; 25
2075; Oldale-Missionsweet association, 0 to 15 percent slopes; Oldale; ; 50
2076; Oldale-Carrizo complex, 2 to 8 percent slopes; Oldale;; 40
2077; Oldale-Carrizo association, 2 to 8 percent slopes; Oldale;; 50
2085; Rainbowsend-Goldenbell complex, 4 to 50 percent slopes; Goldenbell; ; 35
2110; Descent association, 4 to 50 percent slopes; Descent; stable; 15
2130; Goldenbell-Descent association, 2 to 15 percent slopes; Goldenbell; ; 55

This ecological site is correlated with an additional 17 minor components, including the soil components above and these additional soil components; Blackmagic, Goucougs stable, Perurose gravelly surface, Silvermine stable, Werewolf stable, and Pintobasin stable.

Table 4. Representative soil features

Surface texture	(1) Very gravelly fine sand (2) Very gravelly loamy sand
Family particle size	(1) Loamy
Drainage class	Very poorly drained to excessively drained
Permeability class	Slow to rapid
Soil depth	13 cm
Surface fragment cover <=3"	42–90%
Surface fragment cover >3"	3–30%
Available water capacity (0-101.6cm)	1.27–9.14 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–4
Soil reaction (1:1 water) (0-101.6cm)	6–9.4
Subsurface fragment volume <=3" (Depth not specified)	10–75%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

This ecological site occurs on fan remnants, ballenas and fan aprons. This site is defined by a desert pavement surface, composed of tightly interlocked gravels darkened by desert patina (desert varnish) and an underlying eolian-deposited horizon dominated by vesicular pores. A range of soil development is present under the desert pavement surfaces, indicating either different time scales of development or different processes of development. The more developed soils have a calcium carbonate- cemented duripan at depths of 11 to 19 inches, while the least developed soils have little to no horizon development and are composed of very deep sands.

Desert pavement has near surface soil features that reduce the rate of infiltration, and reduce germination and establishment of vegetation. Creosote bush is the dominant shrub on desert pavement, and it tends to establish in small breaks in the flat pavement surface where runoff accumulates or gravel cover is lower. Annuals may be present in the breaks, or in pockets of eolian sands and silt deposits that overlie the desert pavement. Small drainages dominated by creosote bush, burrobush (*Ambrosia dumosa*), and brittlebush (*Encelia farinosa*) dissect the desert pavement surfaces. These drainageways are composed of very deep sands, which allow for quick and deep infiltration of water (See ESD R030XY021CA for more information).

Recent theories on the development of desert pavement suggest that eolian dust from nearby dry lake beds have been deposited on the soil surface for thousands of years, and accumulated (through a variety of processes) under the surface gravels (McFadden et al. 1987, McFadden 1998, Meadows et al. 2008). The vesicular layer is composed of eolian clays, silts, and salts, which form vesicle-shaped air pockets due to cycles of wetting and drying (McFadden 1998, Turk et al. 2010). Within the vesicular horizon, a process of shrink and swell activity in the accumulated clays pushes a layer of gravels to the surface creating a nearly level surface of interlocking gravels. The surface gravels weather to smaller pieces by physical and chemical weathering processes, including heat and salt fracturing. Older desert pavement surfaces may have higher cover of interlocking gravels, and more developed vesicular horizons. It has been proposed that infiltration through the vesicular horizon decreases with age, increasing runoff, and eventually erosion of the pavement surfaces. However, recent studies indicate that infiltration in older vesicular horizons (>10,000 years) may occur though preferential pathways along the vertical ped faces, rather than through the ped matrix as in the younger soils, so older and younger soils may have similar infiltration rates but use different infiltration processes (Meadows et al. 2008).

The desert patina, or rock varnish, that coats the rock fragments, harbors an incredibly diverse microbial community, which has been little explored by science (Kuhlman et al. 2006). Desert patina takes thousands of years to develop, and may be used as a record of past climatic and disturbance events such drought and increased wind erosion, and fire. Ancient intaglios have been formed by removing the dark patina covered rock fragments, revealing the lighter colored soils beneath. There are large intaglios made in desert pavement surfaces in Blythe, CA and the famous Nasca Lines in Peru.

The limited infiltration of water through desert pavement surfaces has created pools of nitrate accumulation under the desert pavement (Graham et al. 2008). Nitrates are deposited along with the eolian dust and other salts, and have accumulated over time to a limited depth where water can infiltrate. Nitrates levels are significantly lower in nearby soils without desert pavement surfaces. If the desert pavement surface is disrupted, and water is able to infiltrate deep into the soils, high levels of nitrates could potentially be leached into the ground water. If dust is mobilized, high levels of nitrogen may be spread to distant areas such as alpine lakes or the snow pack of the Sierra Nevada (Graham et al. 2008). Soils with high nitrogen levels and a disrupted pavement surface are also more susceptible to invasion by non-native species such as red brome (*Bromus rubens*), Mediterranean grass (Shismus sp.), and Asian mustard (*Brassica tournefortii*).

This ecological site does not develop vegetation that would carry fire. The non-native Mediterranean grass is present in low amounts.

State and transition model

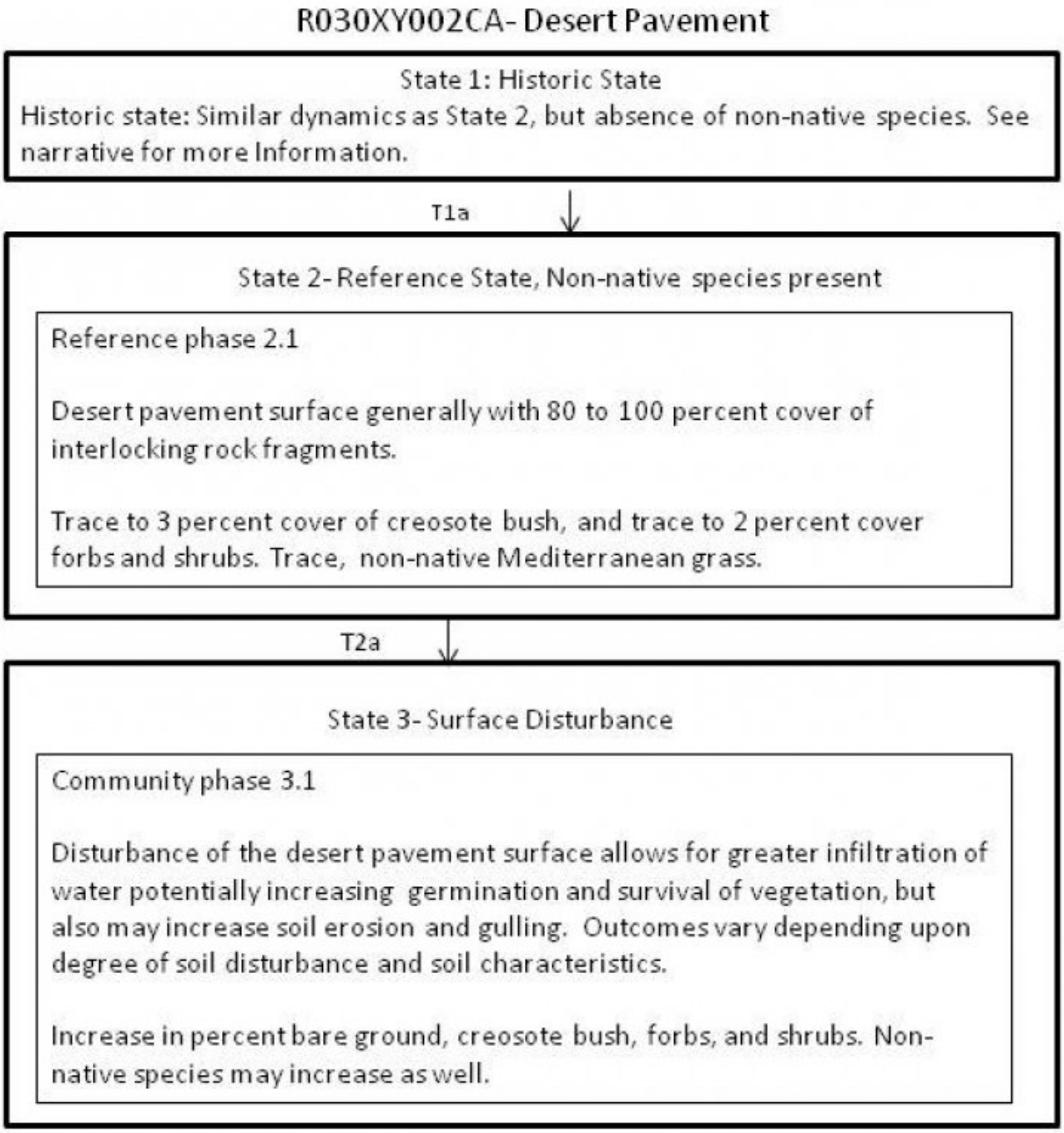

Figure 4. R030XY002CA Model

State 1
Historic State

State 1 represents the historic-natural condition for this ecological site. It is similar to State 2, but has only native species. If we were to include dynamics for this state it would be the same as displayed in State 2. The presence of non-native species is minimal in State 2, and has not altered the hydrology or fire frequency.

State 2
Reference State

This state represents the most common and most ecologically intact condition for this ecological site at the present time.

Community 2.1

Reference Community

Figure 5. Community Phase 2.1 Desert Pavement

The tightly interwoven rock fragments, in combination with the underlying eolian-deposited horizon create a soil surface that is generally inhospitable to seed germination. Lack of suitable germination sites, creates a barren site with the exception of annual forbs with very shallow root depth requirements and widely scattered creosote bush shrubs. Creosote bush is able to persist due to an ability to establish deep taproots to extract water from deep into the soil profile (sometimes up to 5 m deep), and once established, a positive feedback is developed where infiltration rates are greater directly beneath the shrub. Burrobush and desertholly (*Atriplex hymenelytra*) are occasionally present. Forb cover is low, but may increase in areas with shallow sand or dust deposits over the desert pavement surface. Common forbs are desert marigold (*Baileya multiradiata*), pincushion flower (*Chaenactis fremontii*), cryptantha (Cryptantha sp.), hairy desertsunflower (*Geraea canescens*), smooth desertdandelion (*Malacothrix glabrata*), and desert Indianwheat (*Plantago ovata*). The small native perennial grass, low woollygrass (*Dasyochloa pulchella*), is present in trace amounts. The non-native annual, Mediterranean grass is present with low cover.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	11	56	73
Grass/Grasslike	–	2	17
Shrub/Vine	–	7	12
Total	**11**	**65**	**102**

State 3
Surface Disturbance

This state is characterized by significant disruption of the desert pavement surface. This state needs more investigation to determine disturbance pathways, due to a lack of data and variability in soil characteristics.

Community 3.1
Disturbed Surface

Disturbance of the desert pavement will increase the rate and depth of infiltration of direct precipitation and surface run-off into the soils. This will increase the ability of vegetation to establish, and over time creosote bush, burrobush, and brittlebush could develop more continuous cover across the disturbed fan remnants. Non-native grasses and forbs may become more abundant as well. Soils with silt loam (Oldale) and loam subsurface textures will be most vulnerable to erosion, because they are not clayey enough to be cohesive, and are composed of fine particles that are light enough to be eroded. They are also not as permeable as sandy soils, so the impact of rain will run off, and carry the newly exposed silts and fines with it. Deeper sandy soils will allow for quicker infiltration, and have heavier particles that take more force to erode. In addition, soils with a shallow duripan (Aquapeak, Carpetflat, and Goldenbell) risk losing a portion of an already limited soil thickness. Eroded desert pavement soils with a duripan

would develop a different plant community than on very deep soils. Deep sandy soils with little horizon development have a more favorable soil moisture characteristic than shallow soils with a root and water-limiting duripan, and are thus more susceptible to colonization by native and non-native species. Soil texture and permeability below the surface horizon(s) will also affect the rate of nitrate leaching to ground water and influence susceptibility to wind erosion. Soil alkalinity varies within this ecological site and within the soils series, but the lowest near surface pH (8.8 to 9.1) occurs on the Carpetflat and Aquapeak soils, which are older soils with a duripan. Since desert pavement requires thousands of years to develop, recovery times are longer than centuries, making natural recovery of the desert pavement virtually impossible in a lifetime.

Transition T2a
State 2 to 3

This transition occurs with large-scale displacement of the desert pavement surface. This could be from off-road vehicle use or road construction through the desert pavement. Displacement of large areas of pavement and disturbance of the fine-textured vesicular horizon will cause increased wind and water erosion. Larger scale disturbances can also mobilize nitrates that exist in high amounts near the soil surface, which can cause contamination of surface and groundwaters (Graham et al. 2008).

Additional community tables

Table 6. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Native shrubs**			0–16	
	creosote bush	LATR2	*Larrea tridentata*	0–16	0–1
	burrobush	AMDU2	*Ambrosia dumosa*	0–6	0
	desertholly	ATHY	*Atriplex hymenelytra*	0–6	0
Forb					
2	**Native annual forbs**			11–73	
	pincushion flower	CHFR	*Chaenactis fremontii*	0–58	0–7
	desert Indianwheat	PLOV	*Plantago ovata*	0–16	0–4
	cryptantha	CRYPT	*Cryptantha*	0–1	0
	hairy desertsunflower	GECA2	*Geraea canescens*	0–1	0
	smooth desertdandelion	MAGL3	*Malacothrix glabrata*	0–1	0
	desert marigold	BAMU	*Baileya multiradiata*	0–1	0
Grass/Grasslike					
3	**Non-native annual grasses**			0–16	
	Mediterranean grass	SCHIS	*Schismus*	0–16	–
4	**Native perennial grasses**			0–1	
	low woollygrass	DAPU7	*Dasyochloa pulchella*	0–1	0

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. Desert pavement is a unique and interesting feature of the

desert environment.

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

This site is equivalent to and was copied from R030XY002CA after is was decided by the Regional Ecological Site Specialist that the default "XY" LRU should not be used.

The following NRCS vegetation plots were used to describe this ecological site:

CAR810
EOVP-03
J5-L
J5-J
D1-X
PIMO-04, type location
PIWE-06

Older plots
217-116-1
LL-7
Y-24
Y-27
CC-7
KK-1
Y-23
DD-20
217-182-3
DD-23
BB-1
PIWE-06

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3750125
UTM easting	611923
General legal description	The type location is approximately 3 miles east-northeast of the Turkey Flat trailhead in the Pintobasin in Joshua Tree National Park.

Other references

Graham, R. C., D. R. Hirmas, Y. A. Wood, and C. Amrhein. 2008. Large near-surface nitrate pools in soils capped by desert pavement in the Mojave Desert, California. Geology 36:259-262.

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McFadden, L. D., McDonald, E.V., Wells, S.G., Anderson, K., Quade, J., Forman, S.L. 1998. The vesicular layer and carbonate collars of desert soils and pavements: formation, age and relation to climate change. Geomorphology 24:101-145.

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Meadows, D. G., M. H. Young, and E. V. McDonald. 2008. Influence of relative surface age on hydraulic properties and infiltration on soils associated with desert pavements. Catena 72:169-178.

Pavlik, B. M. 2008. The California Deserts: an ecological rediscovery. University of California Press, Ltd., Berkeley and Los Angeles, California.

Turk, J. K., C.-A. Houdeshell, and R. C. Graham. 2010. A proposed master V horizon for the designation of near surface horizons with vesicular porosity.

Contributors

Marchel Munnecke

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	Dustin Detweiler
Date	10/20/2014
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none. Rock fragments armor the soil surface.

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2. **Presence of water flow patterns:** None

3. **Number and height of erosional pedestals or terracettes:** None

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground typically < 10% but may be as high as 20% in less developed pavement areas; surface rock fragments typically between 80 and 98% but may be as low as 65%; shrub canopy is typically < 5% and may be slightly higher in areas with weak pavement development.

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 distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Much of the soil surface in this ESD is covered by gravel. In areas where the soil is present at the surface there can be as much as 5% incipient algal/fungal crust cover as well as trace amounts of cyanolichen crusts. Soil surface areas with biological crusts typically have a soil surface stability value of 5. Subsurface soil stability under the crust is usually 0 or single grained material. Shrubs in this ecological site tend to trap eolian material. Soil surface stability values under shrubs is often single grained material with a stability value of 0. Biological crusts may be present under shrubs but are more easily found in the intershrub spaces.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Desert pavement is composed of a gravel surface without much soil at the surface. Those areas of exposed soil at the surface may range in surface structure from single grain to strong very thick platy. The wide range of structure can be explained by eolian deposition forming the single grain structure while areas without a layer of eolian deposition can have a vesicular horizon which forms the strong very thick platy structure. Soil surface colors are very pale to light and typified. Organic matter of the surface 2 to 3 inches is less than 1 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Sparse shrub canopy and associated litter may contribute to some infiltration at this site but this ecological site is dominated by gravel pavement which in combination with vesicular horizons greatly reduces infiltration and increases runoff. Areas with disturbed, open or weakly developed pavement have less runoff and higher infiltration rates.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Subsoil argillic horizons should not be interpreted as compacted.

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: Long-lived evergreen shrubs (creosote bush) = annual forbs

    Sub-dominant: associated shrubs (burrobush) > annual grasses > perennial grass

    Other:

    Additional: Annual forbs and annual grasses respond to the timing and amount of precipitation events. In some cases for this ecological site, annual production and cover may be higher than creosote production which is why annual forbs are listed under the dominant category. Although there is very little creosote bush at this site, the plant is perennial and remains at the site regardless of precipitation events.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common. Burrobush and perennial grasses can be expected to show mortality during drought. A lack in the presence of annual species, live or standing dead may suggest extreme drought conditions exist where grazing is not present.

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14. **Average percent litter cover (%) and depth (in):** Percent litter in the interspaces between the very few plants is trace to 5%. Litter is usually very small pieces of plant debris.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season ± 60 lbs/ac. Favorable years ± 100 lbs/ac and unfavorable years ± 10 lbs/ac. Areas with broken up areas of desert pavement can have higher production than these listed here.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Potential invaders on this site include red brome, redstem filaree, and Mediterranean grass. Although a potential exists for these species to become invaders, the harsh conditions of this ecological site are likely to prevent dominance by any of these non-native species. Mediterranean grass does have the potential to exist as a co-dominant.

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17. **Perennial plant reproductive capability:** Droughty conditions, gravel pavement and vesicular horizons greatly limit seed crops at this site when compared to surrounding areas without pavement. Creosote bush may depend solely on clonal reproduction. Burrobush establishment may depend on favorable years and is found mainly at the edges of the pavement or in open areas within the pavement. There is also very little vegetation cover which in combination with very little seed production greatly limits the perennial plant reproductive capability of this site.
