USDA Natural Resources
Conservation Service

Ecological site R030XD001CA
Hyperthermic Dry Hills

Accessed: 04/19/2024

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

MLRA Description

Major Land Resource Area (MLRA) 30, Mojave Desert, 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 climate of the area is hot (primarily hyperthermic and thermic; however at higher elevations, generally above 5000 feet, mesic, cryic and frigid) and dry (aridic). Elevations range from below sea level to over 12,000 feet in the higher mountain areas found within the MLRA. Due to the extreme elevational range found within this MLRA, Land Resource Units (LRUs) were designated to group the MLRA into similar land units.

LRU Description:

This Land Resource Unit (designated by 'XD') is found on the eastern side of California. Elevations range from 400 to 2200 feet on average, but may be found up to 3600 feet on southern exposures. Precipitation ranges from 1 to 6 inches per year, but averages between 2-4 inches. This LRU is characterized primarily by the extreme aridity, hot temperatures, hyperthermic soil temperatures and low stature of widely spaced vegetation. Temperatures can reach over 110 degrees Fahrenheit for several weeks in July and August. Summer precipitation falls between July and September, ranging from 20-33% in the form of rain, and winter precipitation falls starting in November and ends between February and March, ranging from 56-70%, also mostly in the form of rain. Vegetation is primarily small, widely-spaced, low-producing creosote bush (Larrea tridentata), burrobush (Ambrosia dumosa), and brittlebush (*Encelia farinosa*).

Ecological Site Concept -

This ecological site occurs on mountains, hills, steep sideslopes of fan remnants and basalt lava flows, on predominantly north-facing aspects at elevations of approximately 1000 to 2400 feet. At higher elevations this site may occur on all aspects. Soils are typically skeletal, with gravel surface textures, and range from very shallow to deep.

Production Reference Value (RV) is 255 pounds per acre and ranges from 70 to 431 pounds per acre depending on precipitation and annual forb production. This site is dominated by creosote bush (Larrea tridentata), and burrobush (Ambrosia dumosa) is an important secondary shrub. North-facing landscape positions on hyperthermic slopes favor dominance by creosote bush and burrobush.

The data in the following sections is from major (15% of mapunit or greater) components only.

Classification relationships

Mojave Creosote Bush (Holland 1986).
Larrea tridentata Shrubland Association (Sawyer et al. 2009).

Associated sites

R030XD003CA	**Hyperthermic Steep South Slopes** This ecological site occurs on adjacent south-facing slopes. Brittlebush (Encelia farinosa) is dominant.
R030XD004CA	**Low-Production Hyperthermic Hills** This ecological site occurs on adjacent drier, north-facing slopes. Creosote bush (Larrea tridentata) is dominant.
R030XD014CA	**Hyperthermic Sandy Plains** This ecological site occurs on adjacent sandsheets. Big galleta (Pleuraphis rigida) and creosote bush (Larrea tridentata) codominate.
R030XD152CA	**Hyperthermic Saline Hill** This ecological site occurs on adjacent strongly alkaline lava flows. Desert holly (Atriplex hymenelytra) is dominant.

Similar sites

R040XD001CA	**Limy Hill 4-6" p.z.** This ecological site occurs in MLRA31. Production is lower, especially of winter annuals.
R030XD004CA	**Low-Production Hyperthermic Hills** This ecological site is found on similar soils and landform positions, but occurs in drier environments. Production and cover are lower, creosote bush (Larrea tridentata) is dominant and burrobush (Ambrosia dumosa) is trace if present.
R030XD040CA	**Hyperthermic Steep North Slopes** This ecological site occurs on steep mountain slopes with a high percentage of rock outcrop and gullies. The site is co-dominated by burrobush (Ambrosia dumosa), creosote bush (Larrea tridentata) and brittlebush (Encelia farinosa), and shrub diversity and production are higher.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Larrea tridentata* (2) *Ambrosia dumosa*
Herbaceous	(1) *Pectocarya recurvata* (2) *Malacothrix glabrata*

Physiographic features

This site occurs predominately on north-facing mountain, hill and steep fan remnant slopes at elevations of 950 to 2390 feet. Slopes range from 15 to 75 percent. Runoff class ranges from low to very high.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Hill (3) Fan remnant
Flooding frequency	None
Ponding frequency	None
Elevation	980–2,390 ft
Slope	15–75%

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 precipitation is 3 to 5 inches and mean annual air temperature is 68 to 73 degrees F. The frost free period is 300 to 340 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 unweighted averages):

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)	0 days
Precipitation total (average)	5 in

Influencing water features

Soil features

The soils associated with this ecological site range from very shallow to very deep. Soils occur on mountains and hills, and formed from colluvium derived from granitoid, gneiss, or basalt over bedrock; or soils occur on steep sideslopes of fan remnants, and formed in sandy alluvium derived from granitoid. Soils that occur on mountain and hillslopes have minimal soil development, and are skeletal with gravel surface textures and fine sand or sandy loam subsurface textures. These soils are well to somewhat excessively drained with slow to rapid permeability.

The associated soil series that are 15 percent or greater of any one map unit are: Bolero (sandy-skeletal, mixed, hyperthermic Lithic Torriorthents); Jadestorm (loamy-skeletal, mixed, superactive, calcareous, hyperthermic, shallow Typic Torriorthents); Missionwell (loamy-skeletal, mixed, superactive, calcareous, hyperthermic Lithic Torriorthents); and Buzzardsprings (sandy, mixed, hyperthermic Typic Haplocalcids). Other soils on which this site is found are typically 5 percent or less of any map unit when associated with this site. They are: Rainbowsend (loamy-skeletal, mixed, superactive, hyperthermic, shallow Typic Haplodurids); Supplymine (loamy-skeletal, mixed, superactive, hyperthermic Typic Haplocalcids); Missionsweet (loamy-skeletal, mixed, superactive, hyperthermic, shallow Cambidic Haplodurids); and Typic Torriorthents.

The Bolero, Jadestorm, and Supplymine soils occur on hill and mountain slopes. The Buzzardsprings, Missionsweet, Rainbowsend, and Typic Torriorthents soils occur on fan remnants. The Missionwell soils occur on basalt hills and lava flows and are derived from colluvium derived from basalt over residuum weathered from basalt. The Bolero, Jadestorm and Missionwell soils are very shallow to shallow over bedrock. Bolero soils have loamy and very gravelly loamy fine sand subsurface textures over fractured gneissic bedrock. The Ck horizon, if present, has up to 90 percent gravels by volume. The Jadestorm and Missionwell soils have sandy loam subsurface textures with gravelly modifiers. The Buzzardsprings soils are very deep, have a sandy particle size control section, a calcic horizon and 1 to 30 percent gravel sized rock fragments by volume for a depth of 60 inches. The Rainbowsend soils are very shallow to shallow to a duripan, and have extremely gravelly fine sandy loam surface textures. The Supplymine soils are loamy-skeletal and moderately deep. The Typic Torriorthents are very deep with sandy loam and loamy sand subsurface textures and 2 to 25 percent gravel sized rock fragments by volume for a depth of 60 inches.

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

1415;Bolero-Rock outcrop complex, 30 to 75 percent slopes;Bolero;;60
2067;Aquapeak-Buzzard Springs-Dalelake complex, 2 to 30 percent slopes;Buzzardsprings;steep;15; Missionsweet;moist;5; Rainbowsend;dry;3;Typic Torriorthents;;2
1230;Jadestorm-Rock outcrop complex, 30 to 75 percent slopes;Jadestorm;cool;20
1410;Missionwell-Rock outcrop complex, 15 to 50 percent slopes;Missionwell;high elevation;15
1415;Bolero-Rock outcrop complex, 30 to 75 percent slopes;Supplymine;dry;3

Table 4. Representative soil features

Parent material	(1) Colluvium–granite
Surface texture	(1) Gravelly loamy sand
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	3 in
Surface fragment cover <=3"	20–80%
Surface fragment cover >3"	5–55%
Available water capacity (0-40in)	0.3–3.3 in
Calcium carbonate equivalent (0-40in)	0–10%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–8.6
Subsurface fragment volume <=3" (Depth not specified)	1–90%
Subsurface fragment volume >3" (Depth not specified)	0–55%

Ecological dynamics

Abiotic Factors

The most important abiotic factors driving this site are cooler soil temperatures than adjacent slopes, steep slopes, and skeletal soils. North-facing slope positions retain higher soil moisture availability during the winter and spring wet period, which allows the shallow-rooted burrobush to persist on the hyperthermic coarse soils of this ecological site. Cooler winter soil temperatures on these slopes restrict brittlebush (*Encelia farinosa*), which is dominant on adjacent south-facing slopes (Martre et al. 2002).

Steeper slopes experience greater degrees of water stress (Monson et al. 1992, Martre et al. 2002), and shallow skeletal soils have little water holding capacity. Creosote bush is a very long-lived, deep-rooted evergreen shrub that tends to be associated with coarse textured soils with little horizon development, and reaches greatest biomass and age on deep soils with large deep water reserves (McAuliffe 1994, Hamerlynk et al. 2002, Hamerlynk and McAuliffe 2008). On steep slopes, biomass and age are limited by erosional processes that cause shrub mortality, and by reduced deep soil water availability. Burrobush is a relatively short-lived, shallow-rooted, drought-deciduous shrub. It reaches greatest abundance on shallow soils, or soils with a high degree of horizon development that reduces water infiltration (Hamerlynk et al. 2002; Hamerlynk and McAuliffe 2008). The coarse soils of this ecological site do not retain water, but in the generally shallow soils of this ecological site, burrobush can access shallow water available at the soil – bedrock boundary during winter months. Although the Buzzardsprings soils are very deep, the calcic horizon increases water held at shallower depths.

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). Short-lived perennial shrubs demonstrate the highest rates of mortality (Webb et al. 2003, Bowers 2005, Hereford et al. 2006, Miriti et al. 2007), and annual species remain dormant in the soil seedbank (Beatley 1969, 1974, 1976). Long-lived shrubs and trees are more likely to exhibit branch-pruning, and or limited recruitment during drought (e.g. Hereford et al. 2006, Miriti et al. 2007), leading to reduced cover and biomass in drought-afflicted communities.

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), red brome (*Bromus rubens*), 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, during very wet years native annuals may reach high biomass, and since this site occurs on steep slopes over which fire may rapidly move, this site may burn during conditions of extreme fire behavior. In the rare event that this ecological site does burn, a burrobush dominated community recovers relatively rapidly, and although creosote bush communities may take decades to recover to pre-burn stature (Brown and Minnich 1986, Engel and Abella 2011), the vast expanse of the creosote seedbank on surrounding landforms means that this ecological site is not considered at risk of transitioning to a fire-altered State.

State and transition model

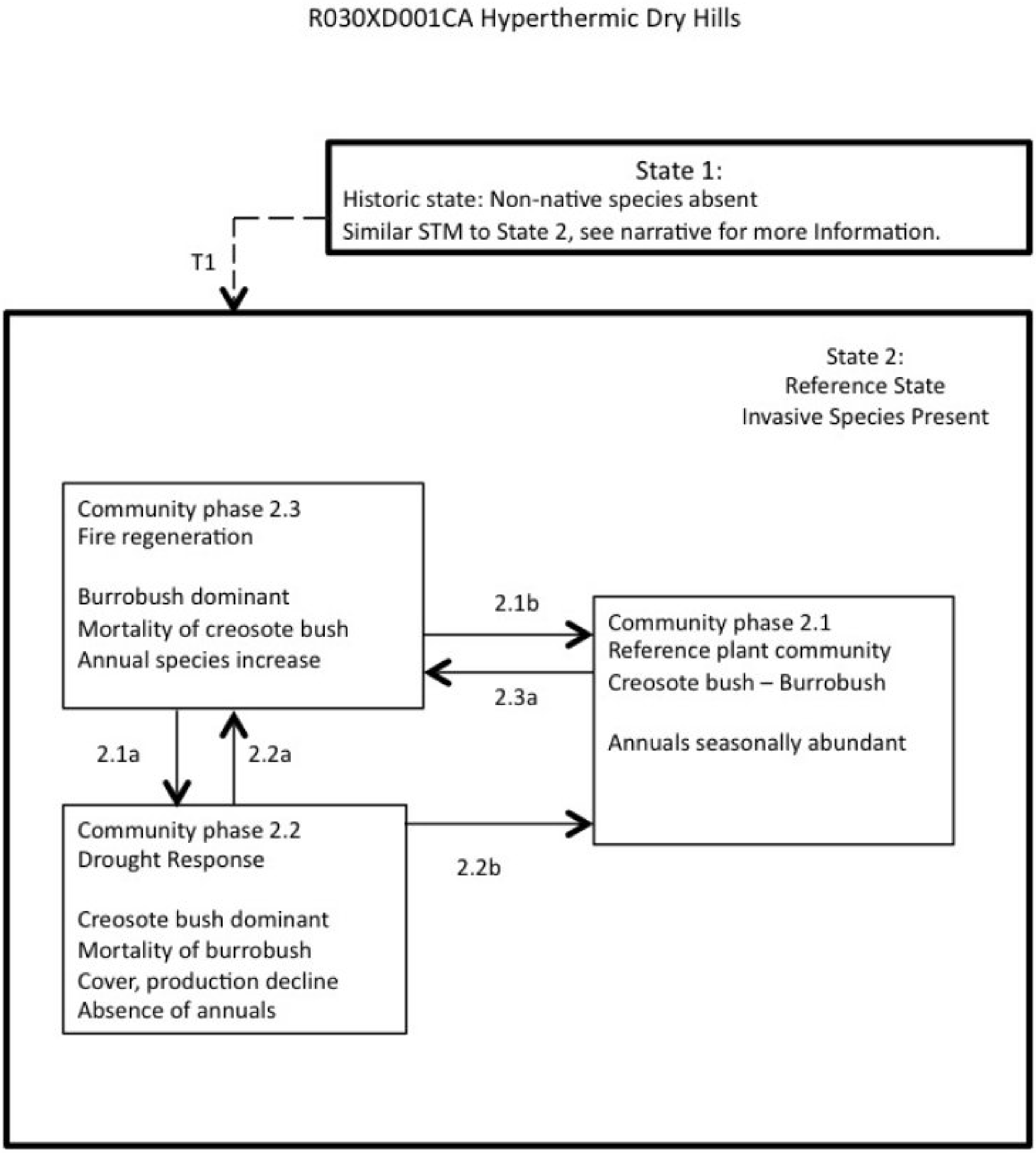

Figure 4. R030XD001CA

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 Mojave and Colorado Deserts. 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 plant community

Figure 5. Community Phase 2.1

This community phase is dominated by creosote bush at 4 to 8 percent cover, and burrobush is an important secondary species at 1 to 4 percent cover. Other shrubs are generally present at only trace levels, and may include waterjacket (*Lycium andersonii*), sweetbush (*Bebbia juncea*), brittlebush, and California barrel cactus (*Ferocactus cylindraceus*). Shrub diversity and waterjacket abundance is highest where very steep slopes and high large rock fragment surface cover contribute to higher run-on. Annuals forb species may contribute more than half of the production on this ecological site during wet years. Most of this biomass comes from curvenut combseed (*Pectocarya recurvata*). Smooth desertdandelion (*Malacothrix glabrata*) may also be abundant. Other common species include desert indianwheat (*Plantago ovata*), cryptantha (Cryptantha spp.), and bristly fiddleneck (*Amsinckia tessellata*). The non-native annual grass Mediterranean grass is sparsely present.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Forb	0	125	260
Shrub/Vine	70	130	170
Grass/Grasslike	0	0	1
Total	**70**	**255**	**431**

Community 2.2
Drought response

This community phase is characterized by an overall decline in cover due branch-pruning and lack of recruitment of creosote bush, mortality of burrobush, and lack of emergence of annual forbs.

Community 2.3
Fire regeneration

This community phase is characterized by the loss of creosote bush from the plant community, since creosote bush is typically killed by fire (Brown and Minnich 1986). Burrobush has limited sprouting ability following fire, but relatively rapidly colonizes disturbed areas from adjacent seed sources, and will dominate the fire regeneration community. Native annual forbs will also increase. By 19-20 years post-fire there is sparse cover of creosote bush and other secondary shrubs in burned communities (Engel and Abella 2011, Steers and Allen 2011).

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with prolonged or severe drought.

Pathway 2.2b
Community 2.1 to 2.3

This pathway occurs with moderate to severe fire.

Pathway 2.2a
Community 2.2 to 2.1

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

Pathway 2.2b
Community 2.2 to 2.3

This pathway occurs with moderate to severe fire, and takes place within one years of a very wet period when standing native forb biomass is still present.

Pathway 2.3a
Community 2.3 to 2.1

This community pathway occurs with time and an absence of additional disturbance.

Transition 1
State 1 to 2

Transition 1.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 (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Native shrubs**			70–170	
	creosote bush	LATR2	*Larrea tridentata*	60–130	4–8
	water jacket	LYAN	*Lycium andersonii*	0–30	0–2
	burrobush	AMDU2	*Ambrosia dumosa*	5–20	1–4
	sweetbush	BEJU	*Bebbia juncea*	0–3	0–1
	brittlebush	ENFA	*Encelia farinosa*	0–3	0–1
	California barrel cactus	FECY	*Ferocactus cylindraceus*	0–1	0–1
Forb					
2	**Native forbs**			0–260	
	curvenut combseed	PERE	*Pectocarya recurvata*	0–224	0–2
	smooth desertdandelion	MAGL3	*Malacothrix glabrata*	0–62	0–4
	desert Indianwheat	PLOV	*Plantago ovata*	0–24	0–3
	cryptantha	CRYPT	*Cryptantha*	0–12	0–1
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–1	0–1
Grass/Grasslike					
3	**Non-native annual grasses**			0–1	
	common Mediterranean grass	SCBA	*Schismus barbatus*	0–1	0–1

Animal community

This site is dominated by two shrubs highly valued by burrowing animals; creosote bush and burrobush. Desert tortoise (Gopherus agassizii), lizards, ground squirrels and other rodents all make burrows in the root-mounds of the creosote bush. The medium stature of creosote bush also allows for some perching by both birds and rodents. The partially shaded apron around the creosote bush is more nutrient rich than surrounding areas and gives rise to abundant annual plants when rainfall allows. This then provides a food source for the above-mentioned wildlife. Burrobush, although not as well suited as creosote bush, also provides good burrowing among its roots and provides good cover from predators.

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

Community Phase 2.1:

BB-5 (Type location)
CC-16
CLPA-01
CLPA-02

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3760760
UTM easting	622548

General legal description	The type location is approximately 1/2 mile northeast (60 degrees) from the intersection of Mecca Dale and Gold Crown 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)	Alice Miller Marchel Munnecke
Contact for lead author	
Date	04/19/2024
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:**