Ecological site R030XD008CA
Hyperthermic Sandhill

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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): 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 notes

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).

Classification relationships

This ecological site is found within the Pleuraphis rigida Herbaceous Alliance (Sawyer et al. 2009), and includes the Pleuraphis rigida/Larrea tridentata Association.

Ecological site concept

This ecological site is found on stabilized dunes and steep sandsheets at elevations ranging from 950 to 2620 feet, and slopes of 8 to 30 percent. Soils are very deep fine sands that formed from eolian deposits and exhibit no soil development. The reference community is dominated by big galleta (Pleuraphis rigida), and creosote bush (Larrea tidentata), dyebush (Psorothamnus emoryi), and burrobush (Ambrosia dumosa) are common secondary species. Production reference value (RV) is 562 pounds per acre, and depending on precipitation and resulting annual forb production, ranges from 250 to 905 pounds per acre. Annual forbs are abundant during years of average to above average precipitation. Semi-stabilized, deep fine sands are optimum habitat for big galleta, which colonizes and stabilizes these eolian habitats with rhizomatous growth. Data in the following sections is based on all components (major and minor) that are correlated with this ecological site.

Associated sites

R030XA006CA	**Granitic Loam 5-7" p.z.** R030XD006CA is found on adjacent fan aprons. Creosote bush (Larrea tridentata) is dominant.

R030XA025CA	**Saline Bottom** R030XD025CA is found on adjacent sandsheets. Creosote bush (Larrea tridentata) is dominant and big galleta (Pleuraphis rigida) and Emory's dyebush (Psorothamnus emoryi) are important species.
R030XD001CA	**Hyperthermic Dry Hills** R030XD001CA is found on adjacent hill and mountain slopes. Creosote bush (Larrea tridentata) and burrobush (Ambrosia dumosa) are dominant.
R030XD003CA	**Hyperthermic Steep South Slopes** R030XD003CA is found on adjacent hill and mountain slopes. Brittlebush (Encelia farinosa) and creosote bush (Larrea tridentata) are dominant.
R030XD004CA	**Low-Production Hyperthermic Hills** R030XD004CA is found on adjacent hillslopes. Creosote bush (Larrea tridentata) is dominant.
R030XD014CA	**Hyperthermic Sandy Plains** R030XD014CA is found on adjacent sandsheets. Big galleta (Pleuraphis rigida) is dominant.
R030XY023CA	**Hyperthermic Dissected Shallow Pediment** R030XD023CA is found on adjacent pediments. Mojave indigobush (Psorothamnus arborescens) and desertsenna (Senna armata) are dominant.
R030XD042CA	**Hyperthermic Shallow To Moderately Deep Fan Remnants** R030XD042 is found on adjacent fan remnants. Vegetation is sparse and dominated by creosote bush (Larrea tridentata).

Similar sites

R030XD025CA	**Hyperthermic Sandsheets** R030XD025CA is found on less steep sandsheets (slopes < 8 percent). Creosote bush (Larrea tridentata) dominates and big galleta (Pleuraphis rigida) and Emory's dyebush (Psorothamnus emoryi) are important species.
R030XD014CA	**Hyperthermic Sandy Plains** R030XD014CA is found on less steep and less stable sandsheets. Production is higher and big galleta (Pleuraphis rigida) is dominant.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Larrea tridentata* (2) *Ambrosia dumosa*
Herbaceous	(1) *Pleuraphis rigida*

Physiographic features

This ecological site is found on stabilized dunes and steep sandsheets. Elevations range from 950 to 2620 feet, and slopes are 8 to 30 percent. Runoff class is low.

Table 2. Representative physiographic features

Landforms	(1) Dune (2) Sand sheet
Flooding frequency	None
Ponding frequency	None
Elevation	290 – 800 m
Slope	10 – 30 %
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 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; numbers in square brackets represent relative weights):

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)	

Precipitation total (average)	130 mm

Influencing water features

Soil features

The soils associated with this ecological site are very deep sands that formed from eolian deposits derived from mixed sources, granitoid or igneous parent material. Surface textures are fine sand with fine sand subsurface textures. Gravel sized (3 inch diameter) surface rock fragments range from 0 to 60 percent, with larger fragments typically absent. Subsurface gravel sized fragments by volume range from 0 to 5 percent, with no larger fragments present (for a depth of 0 to 59 inches). These soils are somewhat excessively drained with rapid permeability. The associated soil series that are 15 percent or greater of any one map unit are: Dalelake (mixed, hyperthermic Typic Torripsamments).

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

2716;Dalelake complex, 4 to 30 percent slopes;Dalelake;;75
2717;Dalelake-Rock outcrop-Buzzardsprings association, 4 to 30 percent slopes;Dalelake;;40
1230;Jadestorm-Rock outcrop complex, 30 to 75 percent slopes;Dalelake;;1
2715;Dalelake-Sheephole-Pintobasin complex, 2 to 8 percent slopes;Dalelake;;6

Table 4. Representative soil features

Parent material	(1) Eolian deposits – granite
Surface texture	(1) Fine sand
Family particle size	(1) Sandy
Drainage class	Somewhat excessively drained
Permeability class	Rapid
Soil depth	150 cm
Surface fragment cover <=3"	0 – 60 %
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	5.08 – 7.87 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified

Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	6.6 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	0 – 10 %
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

Abiotic Factors

The abiotic factors driving this site are a stable eolian environment with hyperthermic soil temperatures.
This ecological site occurs on stable sand dunes and steep sandsheets on soils with a hyperthermic soil temperature regime. Stable or dormant dunes and sandsheets are those where perennial vegetation cover is well-developed, and current rates of sand movement and deposition are low, but may become active as a result of minor climate change or disturbance (Lancaster 1994). The semi-active nature of these landforms means that factors such as burial or abrasion by blowing sand does not restrict vegetation to psammophiles (plants restricted to active eolian environments), but does restrict establishment of most species.

The plant community is strongly dominated by big galleta, a highly drought-tolerant C4 grass that occurs on a range of soil types, but is dominant only on sandy soils where soil moisture is most readily available (McAuliffe 1994, Austin et al. 2004). Big galleta colonizes and stabilizes semi-stabilized eolian habitats with rhizomatous growth (Matthews 2000), and dominance by big galleta on these habitats is an indicator of eolian stability. Big galleta exhibits rapid growth and high productivity in response to temporal high moisture availability in these deep sands (Austin et al. 2004). In arid regions, sandy soils have greater water availability because water quickly infiltrates through sand to depths where it is not lost to evaporation, and because sandy surfaces form a physical crust that further reduces evaporation (Noy-Meir 1973, Hamerlynk et al. 2002). Thus, in desert regions, where the availability of soil water is the critical resource shaping plant communities in arid environments, productivity is higher on sandy soils (Noy-Meir 1973, McAuliffe 1994, Martre et al. 2002, Hamerlynk and McAuliffe 2002, Austin et al. 2004).

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, and once established in this ecological site, individuals are large and productive. Creosote remains a secondary species in this site however, because of soil moisture restrictions and seedling sand abrasion during the establishment phase. Creosote bush establishes in response to warm season moisture; given limited warm season rain in this ecological site, the rapid infiltration of water and rapidly drying soil surfaces during the warm season, and increased erosion and abrasion during the summer, opportunities for successful establishment of creosote seedlings are rare. Burrobush is a drought-deciduous, shallow-rooted shrub commonly co-occurring with creosote bush. It is typically more abundant on soils where the development of restrictive soil horizons (such as an argillic or petrocalcic horizons) increases the temporal availability of water available at shallow soil depths (Hamerlynk et al. 2002, Hamerlynk and McAuliffe 2008). The stabilized dunes that this site occurs on are capable of retaining soil water longer than adjacent sandsheets (Barrows et al. 2009), which enhances habitat for burrobush. Dyebush is a small, drought-deciduous shrub that reaches highest abundance on sandsheets, dunes and washes, and has a largely Sonoran Desert distribution. Leaves and stems are densely tomentose, which is an adaptation to the extreme heat of open sandy soil surfaces. This ecological site is at the arid extent of the range of dyebush; consequently, it has relatively low density and low production in this site.

Annual species are an important component of the vegetation community of this ecological site, comprising up to 40 percent of biomass production during years of average to above average precipitation. Annual species, which can complete their life cycle during brief and intermittent periods of high moisture availability, then remain dormant until the next favorable period, are well-adapted to eolian environments.

Disturbance dynamics

Drought, invasion by nonnative species, and fluctuations in sand erosion and deposition are the primary disturbance affecting this ecological site.

Drought is an important shaping force in desert plant communities (Webb et al. 2003, Bowers 2005, Hereford et al. 2006, Miriti et al. 2007, Hamerlynk and McAuliffe 2008). The effects of drought may be particularly severe in deep sandy soils with little horizon development. High availability of soil moisture during normal to high precipitation conditions can lead to high growth rates and large individuals whose size cannot be sustained when water is no longer available (Hamerlynk and McAuliffe 2008). Short-lived shrubs and perennial grasses demonstrate the highest rates of drought-induced 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, 1974, 1976). Long-lived species are more likely to exhibit branch-pruning with limited recruitment during drought (Hereford et al. 2006, Miriti et al. 2007).

Severe drought, especially if coupled with additional disturbance such as off-road vehicle use, increases the susceptibility of soils to wind erosion due to loss of stabilizing plant cover, and increased erodibility of dry soils (Cooke et al. 1993, Lancaster 1994). This may trigger a transition to an altered state where stabilized sand surface become active. Wind strength, precipitation, vegetation cover, and disturbance (off-road vehicle use, fire, grazing, farming) influence the degree to which sand depositional surfaces are active or stable (Cooke et al. 1993, Lancaster 1994). Semi-stabilized sand surfaces may alternatively become more stable with changes environmental changes resulting in increased vegetation cover, changes in wind environment or decreased deposition. Increases in vegetation cover and decreases in deposition are generally due to a wetter climate (Cooke et al. 1993, Lancaster 1994).

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 throughout the Mojave Desert over the past century (Rickard and Beatley 1965, D'Antonio and Vitousek 1992, Brooks 1999, Reid et al. 2006, Norton et al. 2007). 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). Asian mustard and Russian thistle (Salsola tragus) are significant threats in eolian habitats, with Russian thistle potentially abundant on disturbed areas or more active sand. Asian mustard may become dominant on stabilized sandsheets during years of above average precipitation, during which time is has detrimental affects on the abundance and fecundity of native annuals (Barrows et al. 2009). Asian mustard is less dominant on semi-stabilized dunes (Barrows et al. 2009); probably because of increased seed burial depths in these habitats from which seedlings cannot emerge (Abella et al. 2011).

State and transition model

Figure 3. R030XD008CA

Additional community tables

Table 5. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			28-118	
	creosote bush	LATR2	*Larrea tridentata*	28-84	4-8
	burrobush	AMDU2	*Ambrosia dumosa*	0-56	0-4
	California croton	CRCA5	*Croton californicus*	0-28	0-2
	dyebush	PSEM	*Psorothamnus emoryi*	0-28	0-2
	Wiggins' cholla	CYEC3	*Cylindropuntia echinocarpa*	0-22	0-1
	white ratany	KRGR	*Krameria grayi*	0-11	0-1
Grass/Grasslike					
2	**Perennial grasses**			252-504	
	big galleta	PLRI3	*Pleuraphis rigida*	252-504	10-20
5	**Non-native annual grasses**			0-112	
	common Mediterranean grass	SCBA	*Schismus barbatus*	0-112	0-10
Forb					

3	**Native forbs**			0-318	
	pincushion flower	CHFR	*Chaenactis fremontii*	0-168	0-15
	cryptantha	CRYPT	*Cryptantha*	0-112	0-10
	small wirelettuce	STEX	*Stephanomeria exigua*	0-22	0-2
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0-11	0-1
	birdcage evening primrose	OEDE2	*Oenothera deltoides*	0-1	0-2
	desert palafox	PAAR8	*Palafoxia arida*	0-1	0-1
	suncup	CAMIS	*Camissonia*	0-1	0-1
	soft prairie clover	DAMO2	*Dalea mollissima*	0-1	0-1
4	**Non-native annual forbs**			0-56	
	Asian mustard	BRTO	*Brassica tournefortii*	0-56	0-3

Table 6. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

This ecological site is preferred habitat for the threatened desert tortoise (Gopherus agassizii agassizii). 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). A diverse assemblage of reptiles and mammals are likely to be found in this site. These may include (based on habitat preferences): Lizards: Mojave Desert tortoise (Gopherus agassizii agassizii) Desert banded Gecko (Coleonyx variegatus variegatus) Northern desert iguana (Dipsosaurus dorsalis dorsalis) Long-nosed leapard lizard (Gambelia wislizenii wislizenii) Western chuckwalla (Sauromalus ater obesus) Mojave zebra-tailed lizard (Callisaurus draconoides rhodostictus) Southern desert horned lizard (Phrynosoma platyrhinos calidiarum) Western brush lizard (Urosaurus graciosus graciosus) Desert side-blotched lizard (Uta stansburiana stejnegeri) Great basin whiptail (Aspidoscelis tigris tigris) Snakes: Desert glossy snake (Arizona occidentalis eburnata) Mojave shovel-nosed snake (Chionactis occipitalis occipitalis) California kingsnake (Lampropeltis getula californae) Red coachwhip (Masticophis flagellum piceus) Western leaf-nosed snake (Phyllorynchus decurtatus perkinsi) Sonoran gopher snake (Pituophis catenifer affinis) Western long-nosed snake (Rhinocheilus lecontei lecontei) Desert patch-nosed snake (Salvadora hexalepis hexalepis) Smith's black-headed snake (Tantilla hobartsmithi) Western diamondback snake (Crotalus atrox) Mojave Desert sidewinder (Crotalus cerastes cerastes) Colorado Desert sidewinder (Crotalus cerastes laterorepens) The following mammals are likely to occur in this ecological site: American badger (Taxidea taxus berlandieri) California desert bat (Myotis californicus stephensi) Western pipistrelle (Pipistrellus hesperus hesperus) Desert big brown bat (Eptesicus fuscus pallidus) Pallid bat (Antrozous pallidus minor) Desert coyote (Canis macrotis arsipus) Desert kit fox (Vulpes macrotis arsipus) Southern Desert cottontail (Sylvilagus audobonii arizonae) Desert blacktail jackrabbit (Lepus californicus deserticola) Whitetail antelope squirrel (Ammospermphilus leucurus leucurus) Mojave roundtail ground squirrel (Spermophilus tereticaudus tereticaudus) Mojave pocket gopher (Thomomys bottae mojavensis) Coachella pocket gopher (Thomomys bottae rupestris) Eastern spiny pocket mouse (Peroganthus spinatus spinatus) Pallid (San Diego) pocket mouse (Chaetodipus fallax pallidus) Mojave little pocket mouse (Perognathus longimembris longimembris) Merriam's kangaroo rat (Dipodomys merriami merriami) Desert kangaroo rat (Dipodomys deserti) Desert wood rat (Neotoma fuscipes simplex) Sonoran deer mouse (Peromyscus maniculatus sonoriensis) Desert grasshopper mouse (Onychomys torridus pulcher) Desert shrew (Notiosorex crawfordi crawfordi

Recreational uses

This site may be used for hiking, wildflower viewing, 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 bowl complaints, 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. Dyebush branches are steeped in water to make a yellow-brown dye for coloring deerskins.

Other information

Dyebush is host to the unusual stem parasite Thurber's stemsucker (Pilostyles thurberi).

Inventory data references

Community phase 2.1: 11CA795128 (Type location) D1-E Y-13 225-7-6

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3870616
UTM easting	612730
General legal description	The type location is in the Devil's Playground area of the Mojave National Preserve, approximately 6.5 miles west of the intersection of Kelbaker and Kelso-Cima Road.

Other references

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Contributors

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Approval

Kendra Moseley, 10/21/2024

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	08/31/2026
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:**