USDA Natural Resources Conservation Service

Ecological site R030XB164CA
Steep South Slopes

Last updated: 10/21/2024
Accessed: 05/12/2025

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.

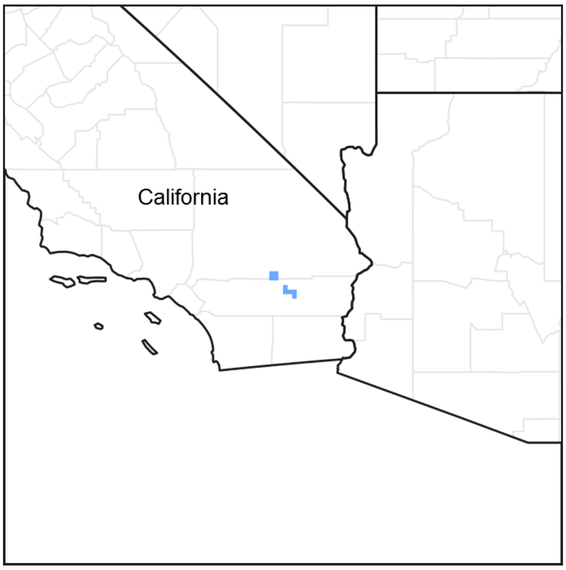

Figure 1. Mapped extent

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 LRU (designated by 'XB') is found across the eastern half of California, much of the mid-elevations of Nevada, the southernmost portions of western Utah, and the mid-elevations of northwestern Arizona. Elevations range from 1800 to 5000 feet and precipitation ranges from 4 to 9 inches per year, but is generally between 5-6 inches. This LRU is characterized primarily by the summer precipitation it receives, ranging from 18 – 35% but averages 25%. Summer precipitation falls between July and September in the form of rain, and winter precipitation falls starting in November and ends between February and March, also mostly in the form of rain; however it does receive between

0 and 3 inches of snow, with an average of 1 inch. The soil temperature regime is thermic and the soil moisture regime is typic-aridic. Vegetation includes creosote bush, burrobush, Nevada jointfir, ratany, Mojave yucca, Joshua tree, chollas, cactus, big galleta grass and several other warm season grasses. At the upper portions of the LRU, plant production and diversity are greater and blackbrush is a common dominant shrub.

Classification relationships

The Encelia farinosa Association of the Encelia farinosa shrubland alliance (Sawyer et al. 2009) is found within this ecological site.

Ecological site concept

This ecological site occurs on steep south-facing slopes at elevations of approximately 2100 to 3950 feet. Soils have a warm thermic temperature regime, and are shallow gravelly sands over bedrock.

Annual production reference value (RV) is 273 pounds per acre, and ranges from 145 to 370 pounds per acre, depending on precipitation. The site is strongly dominated by brittlebush (Encelia farinosa). Arid topographic positions and shallow soils favor dominance by this drought-tolerant and cold-intolerant shrub.

Data ranges in the physiographic data, climate data, water features, and soil data sections of this Ecological Site Description are based on all components (major and minor) correlated with this ecological site.

This is a group concept and provisional STM that also covers R030XB077NV.

Associated sites

R030XB139CA	**Shallow Dry Hill 4-6 P.Z.** R030XB139CA is found on adjacent extremely gravelly slopes. Creosote bush (Larrea tridentata) is the dominant species.
R030XB171CA	**Dissected Pediment** R030XB171CA Dissected Pediment, Warm 3-5
R030XB170CA	**Bouldery Very Shallow To Shallow Gravelly Slopes** R030XB170CA occurs on cool thermic slopes at higher elevations. The site has a high percentage of rock outcrops. Blackbrush (Coleogyne ramosissima), single-leaf pinyon pine (Pinus monophylla), California juniper (Juniperus californica), and Muller's oak (Quercus cornelius-mulleri) are dominant species.
R030XB193CA	**Very Shallow To Moderately Deep Gravelly Slopes** R030XB193CA is found on adjacent slopes with moderately deep soils and an argillic horizon. Burrobush (Ambrosia dumosa), Parish's goldeneye (Viguiera parishi), jojoba (Simmondsia chinensis) and waterjacket (Lycium andersonii) are important species.
R030XE196CA	**Sandy Xeric-Intergrade Slopes** R030XE196CA is found on adjacent slopes with a xeric soil moisture regime. Single-leaf pinyon pine (Pinus monophylla) and Muller's oak (Quercus cornelius-mulleri) dominate over a diverse shrub understory.

Similar sites

R030XD003CA	**Hyperthermic Steep South Slopes** R030XD003CA occurs on hyperthermic soils. The dominant species are brittlebush (Encelia farinosa) and creosote bush (Larrea tridentata). Site diversity and productivity is generally lower than in this site, and Schott's dahlia (Psorothamnus schottii) is often present.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Encelia farinosa* (2) *Larrea tridentata*
Herbaceous	Not specified

Physiographic features

This ecological site occurs on south-facing hill and mountain slopes at elevations of 2100 to 4900 feet. Slopes are typically 30 to 60 percent, but may range from 8 to 60 percent. The site experiences no flooding or ponding, and runoff class is high to very high.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain
Flooding frequency	None
Ponding frequency	None
Elevation	640–1,201 m
Slope	8–60%
Aspect	S

Climatic features

The climate of this ecological site is characterized by hot temperatures, aridity, and a bimodal precipitation pattern. Precipitation predominately falls as rain, with 32 to 50 percent falling in summer between July and October, and 50 to 64 percent falling in winter between November and March. The mean annual precipitation is 3 to 7 inches and mean annual air temperature is 63 to 68 degrees F. The frost free period is 270 to 320 days.

Table 3. Representative climatic features

Frost-free period (average)	320 days
Freeze-free period (average)	
Precipitation total (average)	178 mm

Influencing water features

Soil features

The dominant soils associated with this ecological site are very shallow to shallow, and formed from alluvium derived from granitoid and/or residuum weathered from granitoid. Surface textures are gravelly sand or very gravelly loamy sand with gravelly loamy sand subsurface textures over paralithic or lithic bedrock. For rock fragments less than 3 inches in diameter, the percent surface cover is 30 to 70 percent, and subsurface volume is 15 to 50 percent (subsurface fragments by volume for a depth of 0 to 7 inches). For rock fragments greater than 3 inches in diameter, the percent surface cover is 5 to 25 percent, with 5 to 25 percent large fragments in subsurface horizons. Bedrock is encountered at depths of 2 to 14 inches. Typically bedrock is slightly weathered with very fine roots common in fractures. Clay films are present in fractures and on rock fragments, and calcium carbonate threads are present on rock fragments. These soils are somewhat excessively drained with rapid permeability.

The only associated soil greater than 15 percent of any one map unit is the Ironped soils which are mixed, thermic, shallow Typic Torripsamments. This site is also associated with a 3 percent or component of the Lostpalms series – sandy-skeletal, mixed, thermic Lithic Torriorthents. The Ironped soils have gravelly surface textures and a paralithic contact. The Lostpalms soils have very gravelly surface textures with a lithic contact.

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

3325;Ironped-Rock outcrop-Hexie complex, 30 to 60 percent slopes;Ironped;warm;30; Ironped;warm;2
4900;Rock outcrop-Aguilareal-Lostpalms complex, 15 to 60 percent slopes;Lostpalms;warm;3

Table 4. Representative soil features

Parent material	(1) Colluvium–granite
Surface texture	(1) Gravelly sand (2) Very gravelly loamy sand
Family particle size	(1) Sandy
Drainage class	Somewhat excessively drained
Permeability class	Rapid
Soil depth	5–36 cm
Surface fragment cover <=3"	30–70%
Surface fragment cover >3"	5–25%
Available water capacity (0-101.6cm)	0.76–1.52 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–4
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	15–50%
Subsurface fragment volume >3" (Depth not specified)	5–25%

Ecological dynamics

Abiotic Factors

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

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

While leaf and shoot-adaptations allow brittlebush to withstand hot temperatures and extreme aridity, freezing temperatures restrict brittlebush. Frosts cause branch die-back and mortality in adult brittlebush (Sandquist and Ehleringer 1996), and reduce seedling establishment (Bowers 1994). Brittlebush seedlings emerge over multiple pulses in response to cool season rains, with emergence triggered by a minimum of 19 mm of precipitation, and seedlings are killed if freezing temperatures occur within nine days of the trigger event (Bowers 1994). Warm, south-facing slopes experience fewer and less severe frosts, allowing brittlebush populations to persist without damage. Further, optimal soil temperatures for root growth of established brittlebush occur over winter, and conditions are more favorable on warm, south-facing slopes (Martre et al. 2002).

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

Disturbance Dynamics

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

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

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

State and transition model

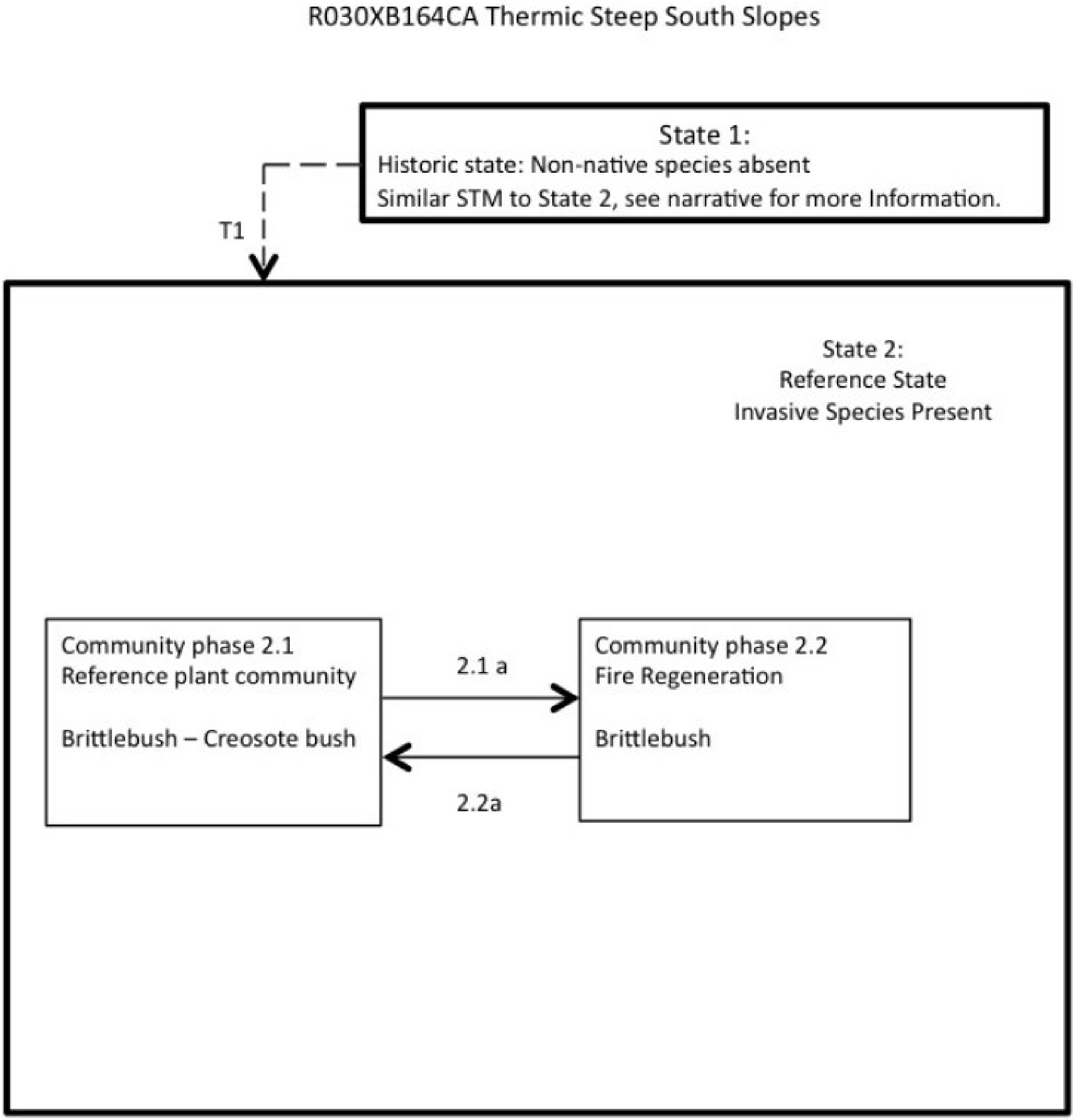

Figure 4. R030XB164CA

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 Desert. Drought and very rare fire were the natural disturbances influencing this ecological site. Data for this State does not exist, but it would have been similar to State 2, except with only native species present. See State 2 narrative for more detailed information.

State 2
Reference State

State 2 represents the current range of variability for this site. Non-native annuals, including red brome (*Bromus rubens*) and red-stem stork's bill (*Erodium cicutarium*) are naturalized in this plant community. Their abundance varies with precipitation, but they are at least sparsely present (as current year's growth or present in the soil seedbank).

Community 2.1
Current potential plant community

Figure 5. Community Phase 2.1

This community phase is dominated by brittlebush and creosote bush. Secondary shrubs are present at low levels, and include burrobush (*Ambrosia dumosa*), waterjacket (*Lycium andersonii*), jojoba (*Simmondsia chinensis*), Parish's goldeneye (*Viguiera parishii*), Mojave yucca (*Yucca schidigera*), white ratany (*Krameria grayi*i), and California barrel cactus (*Ferocactus cylindraceus*). The perennial bunchgrass big galleta (*Pleuraphis rigida*) may be sparsely present. Native subshrubs and perennial forbs include brownplume wirelettuce (*Stephanomeria pauciflora*), Mojave aster (*Xylorhiza tortifolia*), desert globemallow (*Sphaeralcea ambigua*) and desert trumpet (*Eriogonum inflatum*). Annuals species, though present, have relatively low abundance in this ecological site. High surface fragment cover limits the microsites available for annuals, and the canopy of the short-lived brittlebush does not provide suitable habitat for annuals (Muller 1953). Though not abundant, winter annuals are seasonally present, and commonly include desert poppy (*Eschscholzia glyptosperma*), brittle spineflower (*Chorizanthe brevicornu*), pincushion flower (*Chaenactis fremontii*), lacy phacelia (Phacelia tenacetifolia), sand fringepod (*Thysanocarpus curvipes*), and whispering bells (Emmenanthe pendulifera). The non-native annual forb red-stem stork's bill is typically present, but non-native annual grasses are infrequent in this site. Declines in cover and production occur in response to prolonged or severe periods of drought in this community phase, but remain within the natural range of variation. Bowers (2005) measured no effect of drought on mortality rates of brittlebush during modest drought in the 1950s, but approximately 26% increased mortality during severe drought in the early 2000s. Creosote bush exhibits branch-pruning, but low mortality in response to drought in the Mojave Desert (Webb et al. 2003, 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). These rates remain within the natural range of variability for the ecological site. This ecological site may also experience declines in cover and production due to freezing events. Brittlebush may die, or exhibit branch die-back in response to freezing (Sandquist and Ehleringer 1996).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	146	213	291
Forb	17	90	118
Grass/Grasslike	–	3	6
Total	**163**	**306**	**415**

Community 2.2
Fire regeneration community

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

Pathway 2.1a
Community 2.1 to 2.2

This community pathway occurs with moderate to severe fire.

Pathway 2.2a
Community 2.2 to 2.1

This community pathway occurs with time without fire.

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 Mojave 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 (%)
Shrub/Vine					
1	**Native shrubs**			146–291	
	brittlebush	ENFA	*Encelia farinosa*	73–191	10–35
	creosote bush	LATR2	*Larrea tridentata*	28–84	3–10
	Mojave yucca	YUSC2	*Yucca schidigera*	0–34	0–4
	burrobush	AMDU2	*Ambrosia dumosa*	6–22	0–3
	water jacket	LYAN	*Lycium andersonii*	1–3	0–1
	jojoba	SICH	*Simmondsia chinensis*	1–3	0–1
	Parish's goldeneye	VIPA14	*Viguiera parishii*	1–3	0–1
	California barrel cactus	FECY	*Ferocactus cylindraceus*	0–1	0–1
	white ratany	KRGR	*Krameria grayi*	0–1	0–1
Grass/Grasslike					
2	**Native perennial grasses**			0–6	
	big galleta	PLRI3	*Pleuraphis rigida*	0–6	0–2
Forb					
3	**Native forbs**			17–118	
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–28	0–1
	pincushion flower	CHFR	*Chaenactis fremontii*	0–22	0–1
	whisperingbells	EMPE	*Emmenanthe penduliflora*	0–11	0–1
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–11	0–1
	desert poppy	ESGL	*Eschscholzia glyptosperma*	0–11	0–1
	lacy phacelia	PHTA	*Phacelia tanacetifolia*	0–11	0–1
	sand fringepod	THCU	*Thysanocarpus curvipes*	0–11	0–1
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–6	0–1
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–1	0–1
	Mojave woodyaster	XYTO2	*Xylorhiza tortifolia*	0–1	0–1
4	**Non-native annual forbs**			0–11	
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–11	0–1

Animal community

This ecological site provides habitat for many reptiles and mammals. Brittlebush is used as forage by desert bighorn sheep and mule deer. The species most likely to be encountered in this ecological site (based on preferred habitat characteristics) are listed below.

Lizards:
Desert banded Gecko (Coleonyx variegatus variegatus)
Long-nosed leopard lizard (Gambelia wislizenii wislizenii)
Mojave collared lizard (Crotaphytus bicinctores)
Western chuckwalla (Sauromalus aster obesus)
San Diego horned lizard (Phrynosoma coronatum blainvillii)
Yellow-backed spiny lizard (Sceloporus magister uniformus)
Great Basin fence lizard (Sceloporus biseriatus longipes)
Western brush lizard (Urosaurus graciosus graciosus)
Desert side-blotched lizard (Uta stansburiana stejnegeri)
Desert night lizard (Xantusia vigilis vigilis)
Great Basin Whiptail (Aspidoscelis tigris tigris)

Snakes:
Mojave glossy snake (Arizona occidentalis candida) California kingsnake (Lampropeltis getula californae)
Red coachwhip (Masticophis flagellum piceus)
Desert night snake (Hypsiglena torquata deserticola)
California kingsnake (Lampropeltis getula californae)
Western leaf-nosed snake (Phyllorynchus decurtatus perkinsi)
Great Basin gopher snake (Pituophis catenifer deserticola)
California lyre snake (Trimorphodon biscutatus vandenburghi)
Mojave Desert sidewinder (Crotalus cerastes cerastes)
Southwestern speckled rattlesnake (Crotalus mitchelli Pyrrhus)
Red diamond rattlesnake (Crotalus ruber ruber)
The following mammals are likely to occur in this ecological site:
Long-tailed weasel (Mustela frenata latirosta)

Mammals:
Long-tailed weasel (Mustela latirosta)
California desert bat (Myotis californicus stephensi)
Western pipistrelle (Pipistrellus hesperus hesperus)
Desert big brown bat (Eptesicus fuscus pallidus)
Hoary bat (Lasiurus cinereus cinereus)
Pallid bat (Antrozous pallidus minor)
Desert coyote (Canis macrotis arsipus)
Common gray fox (Urocyon cinereoargenteus scottii)
Desert bobcat (Lynx rufus baileyi)
California ringtail (Bassariscus astutus ocatvus)
Southern mule deer (Odoceileus hemionus fuliginatus)
Desert bighorn sheep (Ovis canadensis nelson)
Southern Desert cottontail (Sylvilagus audobonii arizonae)
Desert blacktail jackrabbit (Lepus californicus deserticola)
Whitetail antelope squirrel (Ammospermphilus leucurus leucurus)
Western Mojave ground squirrel (Spermophilus beecheyi parvulus)
Pallid (San Diego) pocket mouse (Chaetodipus fallax pallidus)
Mojave little pocket mouse (Perognathus longimembris longimembris)
Long-tailed pocket mouse (Chaetodipus mojavensis)
Merriam's kangaroo rat (Dipodomys deserti)
Desert wood rat (Neotoma fuscipes simplex)
White-throated wood rat (Neotoma albigula venusta)
Desert canyon mouse (Peromyscus crinitus stephensi)
Cactus mouse (Peromyscus eremicus eremicus)
Southern brush mouse (Peromyscus boylii rowleyi)
Sonoran deer mouse (Peromyscus maniculatus sonoriensis)
Desert grasshopper mouse (Onychomys torridus pulcher)
Desert shrew (Notiosorex crawfordi crawfordi

Recreational uses

This ecological site may be used for cross-country hiking and aesthetic enjoyment. When brittlebush is in flower, is lights up entire hillslopes with its yellow blooms, hence the common name 'goldenhills'.

Other products

Brittlebush has medicinal uses for Native Americans, including as a poultice for pain and for toothaches. Brittlebush resin is used as chewing gum, to fasten arrow points to twigs, to waterproof water bottles, and is melted to make a varnish. Brittlebush twigs were used as kindling for quick fires. http://herb.umd.umich.edu/herb/search.pl?searchstring=Encelia+farinosa.

Brittlebush resin is burned as incense in churches in Mexico (Tesky 1993).

Inventory data references

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

2.1:

12497-140-08 (Type location)
1249706103
Y-4
4605AM4

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	579506
UTM easting	3772119
General legal description	The type locality is approximately 0.12 miles east of the Rattlesnake canyon trailhead in Joshua Tree National Park.

Other references

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

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

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

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

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

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

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

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

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

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

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

6:751-759.

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

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

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

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

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

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

Tesky, Julie L. 1993. Encelia farinosa. In: Fire Effects Information System, [Online].
U.S. Department of Agriculture, Forest Service,
Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
Available: http://www.fs.fed.us/database/feis/.

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

Contributors

Alice Lee Miller
Allison Tokunaga

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

Indicators

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

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

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 15-25%; surface cover of rock fragments to 70%; shrub canopy to 5%; foliar cover of perennial herbaceous plants ± 1%.

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 catastrophic events.

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

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

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

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

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

    Dominant: Mojave Desert shrubs

    Sub-dominant: deep-rooted, warm-season, bunchgrasses > perennial forbs > annual forbs > deep-rooted, cool-season, bunchgrasses

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers.

---

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

---

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

---

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

---

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