Ecological site R030XB218CA
Moderately Deep To Very Deep Loamy Fan Remnants

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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.

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.

Ecological Site Concept –

This ecological site occurs on thermic fan aprons or fan aprons over fan remnants at elevations of 2230 to 4000 feet, with slopes of 2 to 8 percent. The soils associated with this ecological site are moderately deep to deep to a pan, and/or have a thick argillic (clay-enriched) horizon, or are deep sands that receive additional moisture from very rare sheet flooding.

Production Reference Value (RV) is 400 pounds per acre and ranges from 270 to 720 pounds per acre. The site is dominated by burrobush (Ambrosia dumosa), Hall's shrubby spurge (Tetracoccus hallii) and creosote bush (Larrea tridentata). Increased moisture availability at shallow depths increases the competitive ability of burrobush. This ecological site occurs at the southern edge of the Mojave Desert (the Mojave Desert-Sonoran Desert or MLRA30-31 boundary). Thus, it represents a transition from a warm desert where winter precipitation is dominant, to a hot desert where summer precipitation is much more significant. Ancient pediment landforms surround the site, and soils with considerable horizon development, and a thick argillic horizon, petrocalic pan (calcium carbonate) and/or duripan (silicate) are typical. The area is likely a relictual stronghold of a formerly more continuous distribution of Hall's shrubby spurge, when rainfall was more abundant.

Data ranges in the physiographic data, climate data, water features, and soil data sections of this Ecological Site Description are based on major components only (15 percent of map unit or greater).

Classification relationships

Larrea tridentata Shrubland Alliance (Sawyer et al. 2009).

Associated sites

R030XB005NV	**Arid Active Alluvial Fans** R030XB005NV is found on adjacent fan aprons. Burrobush (Ambrosia dumosa) and creosote bush (Larrea tridentata) dominate.
R030XB220CA	**Very Shallow Duripan Fan Remnants** R030XB220CA occurs on adjacent fan remnants. Burrobush (Ambrosia dumosa) and lotebush (Ziziphus obtusifolia) are dominant species.
R030XB221CA	**Loamy Fan Remnants And Pediments** R030XB221CA is found on adjacent moderately deep fan remnants. Blackbrush (Coleogyne ramosissima), burrobush (Ambrosia dumosa) and Hall's shrubby spurge (Tetracoccus hallii) are dominant species.
R030XB225CA	**Warm Sloping Pediments** R030XB225 is found on pediments adjacent to this site. Burrobush (Ambrosia dumosa) and Hall's shrubby spurge (Tetracoccus hallii) are dominant species.
R030XY188CA	**Slightly Alkaline, Rarely To Occasionally Flooded Ephemeral Stream** R030XY188CA is found on adjacent rarely flooded drainageways and inset fans. Hall's shrubby spurge (Tetracoccus hallii) and creosote bush (Larrea tridentata) dominate.

Similar sites

R030XB225CA	**Warm Sloping Pediments** R030XB225CA is found on pediments with very shallow to shallow soils. Burrobush (Ambrosia dumosa) and Hall's shrubby spurge (Tetracoccus hallii) dominate, and creosote bush (Larrea tridentata) is a minor species. Production is lower and plant diversity is higher.
R030XB221CA	**Loamy Fan Remnants And Pediments** R030XB221CA occurs on fan remnants with moderately deep soils to a duripan. Blackbrush (Coleogyne ramosissima) is a co-dominant species with burrobush (Ambrosia dumosa) and Hall's shrubby spurge (Tetracoccus hallii).

R030XY188CA	**Slightly Alkaline, Rarely To Occasionally Flooded Ephemeral Stream** R030XY188CA occurs on rarely flooded landforms associated with ephemeral drainageways. Hall's shrubby spurge (Tetracoccus hallii) and creosote bush (Larrea tridentata) dominate the site.
R030XB005NV	**Arid Active Alluvial Fans** R030XB005NV is found on similar landforms and soils, but Hall's shrubby spurge (Tetracoccus hallii) is absent.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Ambrosia dumosa* (2) *Tetracoccus hallii*
Herbaceous	Not specified

Physiographic features

This ecological site is found on fan aprons and fan aprons over fan remnants at elevations of 2230 to 4000 feet. Slopes are 2 to 8 percent. Sheet flooding is none to very rare, and of very brief duration. Runoff class is very low to low.

Table 2. Representative physiographic features

Landforms	(1) Fan apron
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to very rare
Ponding frequency	None
Elevation	680–1,219 m
Slope	2–8%
Aspect	Aspect is not a significant factor

Climatic features

The climate on this site is characterized by cool, somewhat moist winters and hot, somewhat moist summers, with approximately 60 percent of precipitation falling as rain between November and March, and approximately 30 percent falling as rain between July and October. Summer precipitation falls as heavy monsoonal events, while winter precipitation is spread out over a longer time period. The average annual precipitation ranges from 4 to 7 inches. Mean annual air temperature is 63 to 68 degrees F, and the frost free period ranges from 270 to 320 days per year.

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:

44405 Joshua Tree, California (Period of record = 1959 to 2011) [1]

LTHC1 Lost Horse, Joshua Tree National Park (Period of record = 1991 to 2011) [1]

49099, Twentynine Palms, California (Period of record = 1935 – 2011) [1]

The data from multiple weather were combined to most accurately reflect the climatic conditions of this ecological site. The Lost Horse and Joshua Tree weather stations have colder temperatures and less summer precipitation than this ecological site. The Twentynine Palms weather station has hotter temperatures and less total precipitation than this ecological site.

Table 3. Representative climatic features

Frost-free period (average)	320 days
Freeze-free period (average)	0 days
Precipitation total (average)	178 mm

Influencing water features

Soil features

The soils associated with this ecological site are moderately deep to very deep, and well to somewhat excessively drained. These soils formed in alluvium derived from granitoid rocks. Surface textures are loamy coarse sand, gravelly loamy sand, and sand, with sand and loam subsurface textures. For rock fragments less than 3 inches in diameter, the percent surface cover ranges from 20 to 75 percent, and subsurface volume ranges from 5 to 40 percent (subsurface fragments by volume are ranges for the soil profile for a depth of 0 to 65 inches). For rock fragments greater than 3 inches in diameter, the percent surface cover ranges from 0 to 2 percent, and larger subsurface fragments are negligible.

This ecological site is associated with the following soil series: Gocougs (fine-loamy, mixed, superactive, thermic Argic Petrocalcids), Cajon (mixed, thermic Typic Torripsamments), Corbilt (coarse-loamy, mixed, superactive, thermic Duric Haplocalcids), Friedliver (coarse-loamy, mixed, superactive, thermic Typic Haplargids), Helendale (coarse-loamy, mixed, superactive, thermic Typic Haplargids), and a minor component of Popups (coarse-loamy, mixed, superactive, thermic Argidic Argidurids).

The Gocougs soils are moderately deep to a cemented, massive petrocalcic horizon that occurs at depths of 20 to 40 inches, and is 4 to 32 inches thick. These soils have an argillic horizon at depths of 1 to 22 inches, with a combined thickness of 12 to 36 inches (Bt, Btk1 and Btk2 horizons). Surface textures are loamy coarse sands with sand, gravelly loam, cemented gravelly sandy loam and gravelly coarse sand beneath. The Cajon soils are very deep sands. Surface textures are sandy with loamy sand, gravelly loamy coarse sand and gravelly coarse sand beneath. When associated with this ecological site, these soils are very rarely flooded. The Corbilt soils are deep to a weakly cemented duripan (encountered at depths of 40 to 60 inches). These soils also have a calcic horizon at depths of 13 to 24 inches. Surface textures are sand, with sand, loamy sand and cemented loamy sand beneath. When associated with this ecological site, these soils are very rarely flooded. Friedliver soils are very deep. An argillic horizon occurs at depths of 10 to 20 inches. Surface textures are very gravelly loamy sand with very gravelly loamy sand, and gravelly sandy loam beneath. The Helendale soils are also very deep. An argillic horizon occurs at depths of 1 to 10 inches, and is up to 48 inches thick (Bt-Bt5 horizons). The Popups soils are moderately deep to a weakly cemented duripan (encountered at depths of 20 to 40 inches). An argillic horizon occurs at depths of 4 to 12 inches. Surface textures are loamy sand, with sandy loam beneath. When associated with this ecological site, these soils are very rarely flooded.

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

3695;Gocougs loamy coarse sand, 2 to 8 percent slopes;Gocougs;;80; Popups;very rarely flooded;10
3509;Cajon-Friedliver complex, 2 to 8 percent slopes, moist;Cajon;very rarely flooded;60; Friedliver;;20
4260;Minhoyt-Corbilt association, 2 to 8 percent slopes;Corbilt;rarely flooded;40
4064;Gravesumit-Helendale complex, 2 to 4 percent slopes;Gocougs;;3
4280;Mekkadale-Edalph association, 4 to 30 percent slopes;Gocougs;;2
3242;Langwell-Rock outcrop-Typic Helendale complex, 4 to 30 percent slopes;Helendale;cool;20

Table 4. Representative soil features

Parent material	(1) Alluvium–granite

Surface texture	(1) Loamy coarse sand (2) Sand (3) Very gravelly loamy sand
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	51 cm
Surface fragment cover <=3"	20–75%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	4.32–13.46 cm
Calcium carbonate equivalent (0-101.6cm)	0–14%
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)	5–40%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Abiotic factors

This ecological site occurs on fan aprons or fan aprons over fan remnants at elevations of approximately 2200 to 3600 feet, with slopes of 2 to 8 percent. Burrobush, creosote bush, and Hall's shrubby spurge dominate the site, with a high diversity of secondary shrubs and cacti. This ecological site occurs at the southern edge of the Mojave Desert (the Mojave Desert – Sonoran Desert or MLRA30 – 31 boundary). Thus, it represents a transition from a warm desert where winter precipitation is dominant, to a hot desert where summer precipitation is much more significant. Burrobush and creosote bush are widespread species in both deserts, while Hall's shrubby spurge has a limited distribution at the southern boundary of the Mojave Desert and the northern Sonoran Desert (Baldwin et al. 2002). This ecological site also occurs in an area where relictual soils, landforms and plant communities are significant. Ancient pediment landforms surround the site, and soils with considerable horizon development, and a thick argillic horizon, petrocalic pan (calcium carbonate) and/or duripan (silicate) is typical. The area is likely a relictual stronghold of a formerly more continuous distribution of Hall's shrubby spurge, when rainfall was more abundant (Dressler 1954).

The soils associated with this ecological site are moderately deep to deep to a pan, and/or have a thick argillic (clay-enriched) horizon, or are deep sands that receive additional moisture from very rare sheet flooding. All of these factors increase the competitive ability of burrobush on this site by increasing the availability of water at shallow depths. Burrobush is a short-lived, shallow-rooted, drought-deciduous shrub that co-exists with creosote bush over vast areas of North American Deserts. Burrobush becomes more dominant on older soils with greater horizon development, because well-developed argillic, petrocalcic or silicate duripans impede water permeability, and increase the temporal availability of water at shallower depths. In the Mojave and Sonoran Deserts, creosote bush reaches maximum dominance and growth on young, coarse textured, weakly developed soils where water permeability is rapid, deep water storage is large, and root growth is unimpeded (McAuliffe 1994, Hamerlynk et al. 2002, Hamerlynk and McAuliffe 2003, 2008). The very rare flooding regime on associated soils without significant horizon development also allows burrobush to maintain high densities on this site. The additional moisture supports growth of burrobush, while the regular low-level soil disturbance increases establishment opportunities. There is almost no ecological information available on Hall's shrubby spurge. It is a long-lived semi-deciduous shrub found on a range of landforms and soils in the greater area that this ecological site occurs in. It achieves maximum production in washes receiving additional run-on.

Disturbance Dynamics

The primary disturbances influencing this ecological site are drought, invasion by non-native annual plants, and fire, all of which interact. Drought is an important shaping force in Mojave Desert plant communities (Webb et al. 2003, Bowers 2005, Hereford et al. 2006, Miriti et al. 2007). Short-lived perennial shrubs and perennial grasses 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.

Non-native annual grasses (red brome [*Bromus rubens*], cheatgrass [*Bromus tectorum*] and Mediterranean grass [Schismus species]) 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). Annual grass cover and production is directly related to winter precipitation (Beatley 1969, Brooks and Berry 2006, Hereford et al. 2006), and several years of drought may reduce the abundance of non-native annuals in the soil sandbank (Minnich 2003). Non-native annual cover and biomass is highest on sandy soils (Rao et al. 2010), because of the higher availability of water in these soils (Noy-Meir 1973, Austin et al. 2004). This ecological site is susceptible to high densities and production of invasive annuals.

Invasion by non-native annual grasses has increased the flammability of Mojave Desert vegetation communities by providing a continuous fine fuel layer between widely spaced shrubs (Brown and Minnich 1986, Brooks 1999, Brooks et al. 2004, Rao and Allen 2010, Rao et al. 2010). After fire, these communities appear to be more susceptible to invasion by exotic grasses, leading to a grass-fire cycle (D'Antonio and Vitousek 1992).

State and transition model

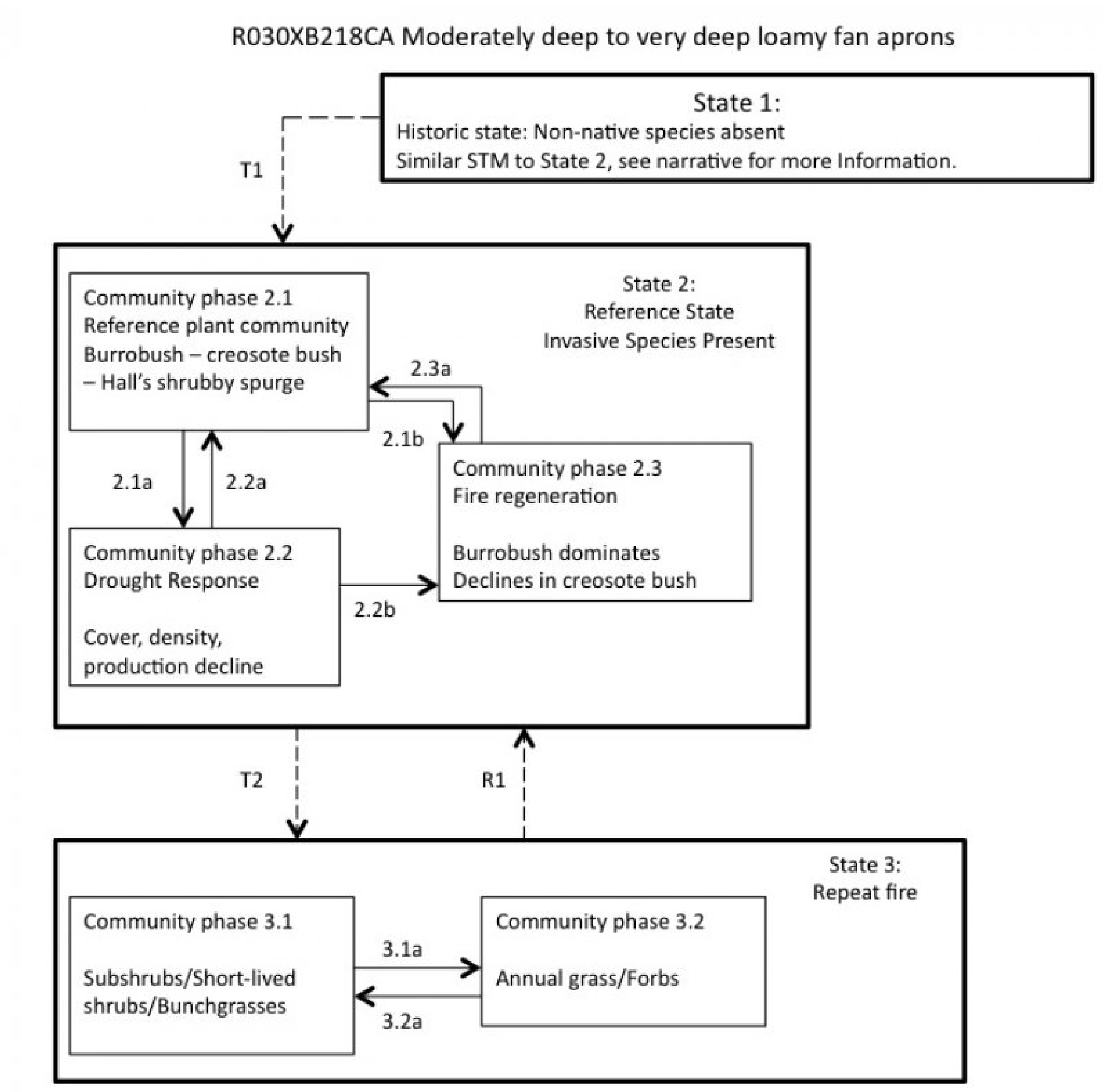

Figure 4. R030XB218CA

State 1
Historic

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. Periodic drought and rare fire were the natural disturbances influencing this ecological site. Fire would have been a very rare occurrence due to the lack of a continuous fine fuel layer between shrubs (Brown and Minnich 1986, Brooks et al. 2007). Data for this State does not exist, but dynamics and composition would have been similar to State 2, except with only native species present. See State 2 narrative for more detailed information.

State 2
Non-native species present

State 2 represents the current range of variability for this site. Non-native annuals, including Mediterranean grass, red brome 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 years growth or present in the soil seedbank).

Community 2.1
Reference Plant Community

Figure 5. Community Phase 2.1

The reference plant community is maintained by periods of average climatic conditions and the absence of fire. It is co-dominated by burrobrush, creosote bush, and Hall's shrubby spurge. Secondary shrubs include Mojave yucca (*Yucca schidigera*), jojoba (*Simmondsia chinensis*), white ratany (*Krameria grayi*), branched pencil cholla (*Cylindropuntia ramosissima*) and Nevada jointfir (*Ephedra nevadensis*). A range of other minor shrub species may also be present. The perennial bunchgrass big galleta (*Pleuraphis rigida*) is often sparsely present. Annual forbs are abundant with winter precipitation, common species include bristly fiddleneck (*Amsinckia tessellata*), chia (*Salvia columbariae*), brittle spineflower (*Chorizanthe brevicornu*), miniature woollystar (*Eriastrum diffusum*), and smooth desert dandelion (*Malacothrix glabrata*). The non-native annuals red-stem stork's bill, red brome, and Mediterranean grass are typically present.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	135	291	448
Forb	4	123	336
Grass/Grasslike	–	22	247
Total	**139**	**436**	**1031**

Community 2.2
Drought Response

This community phase is characterized by an overall decline in cover due to mortality of burrobush and Hall's shrubby spurge, branch-pruning and lack of recruitment of longer-lived species including creosote bush, and lack of emergence of annual forbs and grasses. A long-term monitoring study in the reference plant community found long-periods of stability under average conditions and moderate drought, but high rates of mortality resulting from one year of extreme drought. Following severe drought in 2002, burrobush suffered 68% mortality, Hall's shrubby spurge 58%, short-lived shrubs and subshrubs up to 100% mortality, but virtually no mortality in creosote bush (Miriti et al. 2007).

Community 2.3
Fire regeneration Community

This community phase is characterized by severe declines in creosote bush and dominance by burrobush and other short-live shrubs and perennials. The effects of fire on Hall's shrubby spurge are unknown, but high mortality is assumed. Creosote bush is generally killed by fire, and is slow to re-colonize burned areas due to specific recruitment requirements (Brown and Minnich 1986, Brooks et al. 2007, Steers and Allen 2011). Burrobush colonizes burned areas from seed relatively quickly, and provides cover under which creosote bush can re-establish. There is no information in the literature on the fire tolerance of Hall's shrubby spurge. Since it is a slow-growing long-lived shrub that occurs in an ecosystem that very rarely experiences fire, it is presumed that fire tolerance is low, but data is needed to confirm this. Creosote bush communities in the Mojave desert may resemble the natural range of variation found in pre-fire conditions in terms of species composition in as little as nineteen years (Engel and Abella 2011), but creosote communities in the Colorado Desert may show little recovery after 30 years (Steers and Allen 2011). The timing and severity of fire, as well as post-fire climate conditions determines trajectories of recovery (Brown and Minnich 1986, Steers and Allen 2011). Initially, the post-burn community is dominated by non-native grasses (red brome, Mediterranean grass), native annuals and native subshrubs. Native annuals likely to be present include smooth desert dandelion, bristly fiddleneck, chia, and brittle spineflower, but many different species could be present at a particular site. Subshrubs that often become dominant after fire include desert globemallow (*Sphaeralcea ambigua*), desert trumpet (*Eriogonum inflatum*), and brownplume wirelettuce (*Stephanomeria pauciflora*). With time, shrub cover increases with the recovery of species capable of resprouting including Mojave yucca, white ratany, Nevada jointfir, water jacket, and jojoba. Colonization from off-site seed occurs for short-lived shrubs such as burrobush, eastern Mojave buckwheat (*Eriogonum fasciculatum*), and rayless goldenhead (*Acamptopappus sphaerocephalus*). As shrub cover increases, safe sites for creosote bush and Hall's shrubby spurge recruitment increases. With a long period of time without fire, creosote bush and Hall's shrubby spurge regain co-dominance as shorter-lived species die out. This community is an at-risk phase, as the increased cover and biomass of non-native annual grasses increases the likelihood of repeat burning (D'Antonio and Vitousek 1992, Brooks et al. 2004). If the fire return interval is less than 20 years, this community is very likely to transition to State 3.

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with prolonged or severe drought.

Pathway 2.1b
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 a return to average or above average precipitation. Burrobush is a rapid colonizer, and with adequate soil moisture, will return to pre-drought densities relatively quickly. The colonizing abilities and growth rates of Hall's shrubby spurge are unknown. Presumably they are slower than burrobush, and reductions in density of Hall's shrubby spurge could take significantly longer.

Pathway 2.2b
Community 2.2 to 2.3

This pathway occurs with moderate to severe fire, and takes place within three years of a very wet period when annual grass thatch is still present. At longer than three years of drought, the community is at low risk of burning.

Pathway 2.3a
Community 2.3 to 2.1

This pathway occurs with time without fire.

State 3
Repeated Fire

This state develops when the fire return interval is less than 20 years. This state has been significantly altered from the natural range of variability found in States 1 and 2. Creosote bush and Hall's shrubby spurge are lost and non-native annual grasses, native sub-shrubs, and short-lived shrubs dominate the community. Annual grasses and forbs are abundant immediately post-fire, with dominance subshrubs and short-lived perennials several years post-fire.

Community 3.1
Subshrubs/Short-lived shrubs

This community phase develops with time without fire (5-20 years), and is dominated by subshrubs (desert globemallow, desert trumpet, and brownplume wirelettuce) and short-lived shrubs (burrobush, rayless goldenhead, eastern Mojave buckwheat). Longer-lived shrubs that have resprouted may be patchily present. There is high cover of non-native and native annuals during wet years. This community is at high risk of repeat burning due to high cover of fine fuels.

Community 3.2
Annual grass/forbs

This community phase occurs one to five years post-fire. The community is dominated by non-native annual species including red brome, Mediterranean grass and red-stem stork's bill, and native forbs, including desert dandelion, bristly fiddleneck, chia and brittle spineflower, (many other native forbs could also be present). Native subshrubs including globemallow, desert trumpet, and brownplume wirelettuce may be abundant. There may be very sparse cover of resprouting shrubs including Mojave yucca, white ratany, water jacket, jojoba and Nevada ephedra. Seedlings of short-lived shrubs may be present, and may include burrobush, rayless goldenhead, and eastern Mojave buckwheat. This community is at high-risk of repeat burning due to high fine fuel cover. This community is also susceptible to wind and water erosion, due to the loss of stabilizing shrub cover (Bull 1997). This can lead to arroyo development near ephemeral drainage channels.

Pathway 3.1a
Community 3.1 to 3.2

This pathway occurs with fire.

Pathway 3.2a
Community 3.2 to 3.1

This pathway occurs with time without fire (> 5 years).

Transition 1
State 1 to 2

This transition occurred with the introduction and naturalization of non-native species, including red brome (*Bromus rubens*), Mediterranean grass (Schismus spp), and red-stem stork's bill (*Erodium cicutarium*). This transition is irreversible.

Transition 2
State 2 to 3

This transition occurs when the fire return interval is less than 20 years.

Restoration pathway 1
State 3 to 2

Restoration of arid desert communities severely altered by repeat fire at the landscape scale is very difficult (Allen 1993). Reducing invasion of non-native grasses that increase after fire may help promote native plant recovery, and reduce the probability of repeat burning (Fuhrmann et al. 2009, Matchett et al. 2009, Steers and Allen 2010); however, accomplishing this at a landscape scale, for a time period long enough to be effective, has not yet been accomplished. In small-scale trials, Fusilade, a grass-specific herbicide, was successful in reducing invasive grasses in burned creosote bush communities in the Colorado Desert in the initial three years after fire (Steers and Allen 2010). The long-term efficacy of such treatments on a landscape scale, and non-target effects have not yet been determined. The pre-emergent herbicide Plateau was applied in conjunction with aerial seeding of natives after fire in Zion National Park (Fuhrmann et al. 2009, Matchett et al. 2009). Initial results indicate that autumn application of Plateau after fire is most effective for reducing cheatgrass (*Bromus tectorum*), but longer-term monitoring is needed to evaluate long-term and non-target effects. In addition to controlling invasive species, active recovery of native vegetation may be attempted. Methods may include seeding of early native colonizers such as desert globemallow, burrobrush, threeawns (Aristida spp.), and desert marigold (e.g. Abella et al. 2009, Abella et al. 2012). Increased native cover may help to reduce non-native plant invasion, helps to stabilize soils, provides a source of food and cover for wildlife, including desert tortoise (Gopherus agassizii), and provides microsites that facilitate creosote bush establishment. However, the amount of seed required for success is often prohibitive. Large-scale planting of both early colonizers and community dominants tends to be more successful in terms of plant survival, especially if outplants receive supplemental watering during the first two years (Allen 1993). Creosote bush and burrobush can be successfully propagated and outplanted (Joshua Tree National Park).

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**			135–448	
	creosote bush	LATR2	*Larrea tridentata*	7–252	3–8
	burrobush	AMDU2	*Ambrosia dumosa*	17–135	1–10
	Mojave yucca	YUSC2	*Yucca schidigera*	7–67	1–2
	white ratany	KRGR	*Krameria grayi*	6–45	1–3
	jojoba	SICH	*Simmondsia chinensis*	11–39	1–2
	Hall's shrubby-spurge	TEHA	*Tetracoccus hallii*	9–28	2–5
	Nevada jointfir	EPNE	*Ephedra nevadensis*	0–25	0–1
	branched pencil cholla	CYRA9	*Cylindropuntia ramosissima*	4–17	0–1
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–7	0–1
	water jacket	LYAN	*Lycium andersonii*	0–6	0–1
	Wiggins' cholla	CYEC3	*Cylindropuntia echinocarpa*	0–4	0–1
Grass/Grasslike					
2	**Native perennial grasses**			0–18	
	big galleta	PLRI3	*Pleuraphis rigida*	0–18	0–1
5	**Non-native annual grasses**			0–224	
	red brome	BRRU2	*Bromus rubens*	0–224	0–3
	Mediterranean grass	SCHIS	*Schismus*	0–1	0–1
Forb					
3	**Native forbs**			4–336	
	bristly fiddleneck	AMTET	*Amsinckia tessellata var. tessellata*	0–224	0–2
	chia	SACO6	*Salvia columbariae*	0–112	0–2
	pincushion flower	CHFR	*Chaenactis fremontii*	0–11	0–2
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–11	0–1
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	0–11	0–1
	smooth desertdandelion	MAGL3	*Malacothrix glabrata*	0–11	0–1
	cryptantha	CRYPT	*Cryptantha*	0–4	0–1
	buckwheat	ERIOG	*Eriogonum*	0–1	0–1
	desert calico	LOMA10	*Loeseliastrum matthewsii*	0–1	0–1
	grape soda lupine	LUEX	*Lupinus excubitus*	0–1	0–1
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–1	0–1
	wishbone-bush	MILAV	*Mirabilis laevis var. villosa*	0–1	0–1
	purplemat	NADE	*Nama demissum*	0–1	0–1
	curvenut combseed	PERE	*Pectocarya recurvata*	0–1	0–1
	Fremont's phacelia	PHFR2	*Phacelia fremontii*	0–1	0–1
	New Mexico plumeseed	RANE	*Rafinesquia neomexicana*	0–1	0–1
4	**Non-native annual forbs**			0–34	
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–34	0–3

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 information

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

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

Community Phase 2.1:
CCOSP01
POWA15
POWA55
POWA57
POWA58
POWA61
POWA64 (Type Location)
POWA70

Type locality

Location 1: Riverside County, CA	
UTM zone	N
UTM northing	3736574
UTM easting	610033
General legal description	The type location is approximately 3 miles north- northeast of the Cottonwood Visitors Center in Joshua Tree National Park.

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Rangeland health reference sheet

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

Author(s)/participant(s)	

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

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
