Ecological site R030XC237CA
Shallow Limestone Slopes

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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 and dry with mostly hyperthermic and thermic soil temperature regimes. However, at higher elevations of this MLRA, generally above 5,000 feet, soil temperature regimes can be mesic, cryic and frigid. The most arid regimes of this MLRA can receive less than 4 inches (100 mm) Elevations range from below sea level to over 12,000 feet (3650 meters) 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:
The Bi-Modal Semi-Arid (XC) Land Resource Unit (LRU), represents a semi-arid zone as defined by the United Nations Food and Agriculture Organization and is a semi-arid region distinguished by other semi-arid regions of the Mojave by the amounts of summer precipitation it receives. Semi-arid regions in the western Mojave can experience hot and very dry summers whereas regions within the XC LRU can receive more than 2.5 inches (63.5 mm) of rain during the months of July, August and September. The Bi-Modal Semi-Arid LRU is found primarily in eastern Mojave such as in Nevada at the higher elevations, in California in the New York, Providence, Castle and Clark Mountain Ranges as well as the Cerbat and Virgin Mountains of Arizona. Elevations range from approximately 4000 to 12,000 feet (1500 to 3650 meters) and precipitation ranges 8 to 18 inches (200 – 450 mm) per year in the form of rain. Snow is not uncommon in this LRU with the chance of receiving 3 to 48 inches of snow per year.
Due to the relatively high volume of summer rainfall, soil moisture regimes may have been designated as ustic-aridic, however emerging soil moisture data suggests the xeric-aridic soil moisture regime may be more appropriate and is likely to dominate this LRU. Soils within this LRU also have a cool thermic or cooler soil temperature regime. The combination of cooler temperatures [mean annual air temperatures lower than 62 degrees F (17 degrees C)] with summer monsoonal rains help to create a unique climate within the Mojave Desert which may be more similar to the Southern Nevada Basin and Range (MLRA). Vegetation at the lower elevations of this LRU includes blackbrush, Joshua tree, juniper, pinyon pine, and mountain big sagebrush. At the higher elevations, vegetation includes oaks, Mojave sagebrush, Ponderosa pine, white fir, limber pine and the Great Basin bristlecone pine.

This site is part of group concept R030XC043NV.

Classification relationships

Juniperus osteosperma Woodland Alliance (Sawyer et al. 2009)

Ecological site concept

**This site will need to be updated with NASIS component data from 13LJ3, and possibly more mapunits. At the time of drafting, only MU4300 was in NASIS.

This ecological site occurs on ballenas (step, eroded alluvial fan remnants) and hillslopes at elevations between approximately 4500 to 5500 feet and slopes ranging from 8 to 30 percent. Mean annual precipitation ranges from 7 to 9 inches and the soil moisture regime is aridic bordering on ustic. Soils are shallow to bedrock or a petrocalcic horizon and formed in alluvium from limestone parent material or residuum and colluvium from mixed limestone and volcanic sources. Reference plants include Utah juniper (Juniper osteosperma), Jaeger's Joshua Tree (*Yucca brevifolia* var. jaegariana), and black grama (Bouteoloua eriopoda). Production reference value (RV) is 670 pounds per acre. This site occurs in the narrow elevation band in the eastern Mojave Desert where Utah juniper dominates over pinyon pine (Sawyer et al. 2009). Shallow droughty soils support relatively sparse, small-statured juniper. These droughty soils also support relatively abundant purple needlegrass (*Aristida purpurea*), which can increase in cover with disturbance on this site. High summer precipitation supports black grama. Dry, rocky calcic soils support calciphiles such as roughseed cryptantha (*Cryptantha flavoculata*) and slim tridens (Tridens muticus). Relatively steep slopes and a high cover of surface rock fragments increases run-on, and creates microsites for plant establishment, which supports a high diversity of shrubs and forbs. This site is in a transitional area between thermic to mesic soil temperature regimes, which also supports higher diversity, with a mixture of warm and cool desert species.

This site is part of group concept R030XC043NV.

Associated sites

R030XY219CA	**Ustic Ephemeral Drainageway Order 3** This site is found in 3rd order drainageways and associated landforms. A complex of vegetation communities is present that are associated with flooding frequency. Reference plants include desert willow (Chilopsis linearis), Mojave rabbitbrush (Ericameria paniculata) , woolly fruit bur ragweed (Ambrosia eriocentra), desert almond (Prunus fasciculata), black grama (Bouteloua eriopoda), and big galleta (Pleuraphis rigida).
R030XY220CA	**Ustic Ephemeral Drainageways Order 2** This site is found on adjacent 2nd ephemeral drainageways. A complex of vegetation communities is present that are associated with different flooding frequencies. Reference plants include purple sage (Salvia dorrii), woolly fruit bur ragweed (Ambrosia eriocentra), desert almond (Prunus fasciculata), black grama (Bouteloua eriopoda), and big galleta (Pleuraphis rigida).

Similar sites

R030XB015NV	**SHALLOW GRAVELLY SLOPE 7-9 P.Z.** This site occurs on hills and mountain slopes. inset fans at elevations of 3000 to 6000 ft. Slopes of 15 to 30% are typical. This site receives rare surface flooding. Soils range from very shallow to moderately deep. Reference plants include blackbrush, black grama, and big galleta, and disturbance plants include red brome, Cooper's goldenbush, and big galleta. Production range is 150-250-400.
R030XB014NV	**SHALLOW GRAVELLY LOAM 7-9 P.Z.** This site occurs on less steep fan remnants and fan piedmonts with deep soils. This site is dominated by blackbrush (Coleogyne ramosissima), and big galleta (Pleuraphis rigida) and black grama (Bouteloua eriopoda) are important species.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Juniperus osteosperma* (2) *Yucca brevifolia var. jaegeriana*
Herbaceous	(1) *Bouteloua eriopoda*

Physiographic features

This ecological site occurs on summits, shoulders and backslopes of steep ballenas, and backslopes of hills. It occurs at elevations of 4530 to 5300 feet on slopes of 8 to 30 percent. Runoff class is medium.

**Update with 13LJ3 NASIS data when available

Table 2. Representative physiographic features

Landforms	(1) Ballena (2) Hill
Flooding frequency	None
Elevation	1,381–1,676 m
Slope	8–30%
Aspect	Aspect is not a significant factor

Climatic features

Influencing water features

Soil features

The soils associated with this ecological site formed in alluvium derived from limestone or residuum and colluvium from mixed limestone and volcanic sources. Soils are shallow to a petrocalcic horizon or welded tuff. Soils have a thermic temperature regime and a typic aridic bordering on ustic soil moisture regime. Surface textures are gravelly and very gravelly sandy loams and subsurface textures are loamy or loamy-skeletal. Surface rock fragments less than 3 inches in diameter average 41 percent and larger fragments average 25 percent. Subsurface textures are gravelly sandy loam, cemented sand (Bkqm1) and very gravelly cemented sand (Bkqm2). The soil series that have been correlated with this site include Sagamore (Loamy, carbonatic, thermic, shallow Calcic Petrocalcids), and Ustic Torriorthents (Loamy-skeletal, mixed, superactive, calcic, thermic, shallow Ustic Torriorthents).

This ecological site has been correlated with the following mapunits and soil components in the Mojave National Preserve soil survey area (CA795):

4300 ; Sagamore-Stonekey complex, 4 to 30 percent slopes ; Sagamore ; 60
13LJ3 ; Shallow Ustic Torriorthents ; 50 (Draft MUD)

**Update with 13LJ3 NASIS data when available

Table 3. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Gravelly sandy loam (2) Very gravelly sandy loam
Family particle size	(1) Loamy
Drainage class	Somewhat excessively drained
Permeability class	Moderately rapid
Soil depth	25–36 cm
Surface fragment cover <=3"	41%
Surface fragment cover >3"	25%
Available water capacity (0-101.6cm)	2.54–3.3 cm
Calcium carbonate equivalent (0-101.6cm)	15–35%
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)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	1%
Subsurface fragment volume >3" (Depth not specified)	28%

Ecological dynamics

Abiotic factors
This ecological site occurs on ballenas (steep, eroded alluvial fan remnants) and hillslopes at elevations between approximately 4500 to 5500 feet and slopes ranging from 8 to 30 percent. Mean annual precipitation ranges from 7 to 9 inches and the soil moisture regime is aridic bordering on ustic. Soils are shallow to bedrock or a petrocalcic horizon and formed in alluvium from limestone parent material or residuum and colluvium from mixed limestone and volcanic sources. Reference plants include Utah juniper, Jaeger's Joshua tree, and black grama. Production reference value (RV) is 670 pounds per acre. This site occurs in the narrow elevation band in the eastern Mojave Desert where Utah juniper dominates over pinyon pine (Sawyer et al. 2009). Shallow droughty soils support relatively sparse, small-statured juniper trees. These soils also support relatively abundant purple needlegrass (*Aristida purpurea*), which can increase in cover with disturbance on this site. High summer precipitation supports black grama. Dry, rocky calcic soils support calciphiles such as roughseed cryptantha and slim tridens. Relatively steep slopes and a high cover of surface rock fragments increases run-on, and creates microsites for plant establishment, which supports a high diversity of shrubs and forbs. This site is in a transitional area between thermic to mesic soil temperature regimes, which also supports higher diversity, with a mixture of warm and cool desert species. At lower elevations north-facing aspects support higher densities of Utah juniper while south-facing aspects support higher densities of Jaeger's Joshua tree, while at higher elevations this site may only be found on south-facing aspects.

Disturbance factors
The primary disturbances influencing this ecological site are fire, invasion by non-native annual plants, livestock grazing, and drought. Land clearing associated with ranching has also influenced this site.

Pre-European settlement fire return intervals for Utah juniper woodland in California are estimated at 100-200 years (Sawyer et al. 2009). The rocky dry soils of this ecological site support a low cover plant community without sufficient fuels to carry frequent fire. Utah juniper is generally killed by even light fire, and mature woodlands of this very slow growing species can take 85 to 90 years to develop (Zlatnik 1999).
The naturalization of non-native annual species such as red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*) with European exploration and settlement from the 1860s through the 1900s (e.g. Brooks and Chambers 2011) caused a transition from the reference state with a long fire return interval and only native species, to a state that included non-natives and more frequent fire (State 2). Invasion by non-native annual grasses increases the flammability of these relatively sparse rocky habitats by providing a continuous fine fuel layer between trees and shrubs (e.g. Brown and Minnich 1986, Brooks et al. 2004, Brooks and Chambers 2011). After fire, these communities appear to be more susceptible to invasion by exotic grasses, which may lead to a grass-fire cycle (D'Antonio and Vitousek 1992). More frequent fires may be causing a reduction in the extent of Utah juniper woodlands in California (Sawyer et al. 2009). Although red brome is recorded in this site, the dry rocky soils of this ecological site do not appear to support high levels of non-native annual grasses.

Cattle grazing has influenced the community dynamics of this ecological site. Ranching was established in the eastern Mojave desert in approximately 1875 (Nystrom 2003). Grazing occurred unregulated in the area until the passage of the Taylor Grazing Act in 1934, which divided public land into allotments that were regulated by the Bureau of Land Management (BLM), and among other things, called for fenced ranges and multiple developed water sources (http://www.blm.gov/wy/st/en/field_offices/Casper/range/taylor.1.html). The Federal Land Policy and Management Policy Act of 1976 (FLPMA) brought further regulations, including 10-year grazing permits. In 1994 the

California Desert Protection Act created the Mojave National Preserve, and the National Park Service took over management of grazing allotments in much of the eastern Mojave. All of the area occupied by this ecological site within the Mojave National Preserve was retired from grazing in 2000 (Lanfair Valley Allotment) (Kim 2004).

Heavy cattle grazing in the arid west has been shown to have numerous negative effects on vegetative communities, including decrease cryptogram crust cover, decrease seedling survival, decrease total biomass, decrease perennial grass and shrub cover, and decrease litter cover (Jones 2000). In addition, soils and hydrology may be impacted, with reduced infiltration, increased runoff and erosion (e.g. Rauzi and Hanson 1966, Rauzi and Smith 1973, Jones 2000) due to soil compaction, which increases bulk density and decreases pore space (e.g. Rauzi and Hanson 1966, Abdel-Magid et al. 1987). Grazing in juniper dominated communities can increase juniper dominance due to reduced competition (Zlatnik 1999). Grazing may cause shifts in species composition from more palatable species such as black grama to less palatable species such as purple needlegrass, and to species more tolerant of mechanical disturbance, or with a shorter life-cycle.

All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in modal communities within the community phase. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), they do not represent the absolute range of characteristics or an exhaustive listing of all species that may occur in that phase over the geographic range of the ecological site.

State and transition model

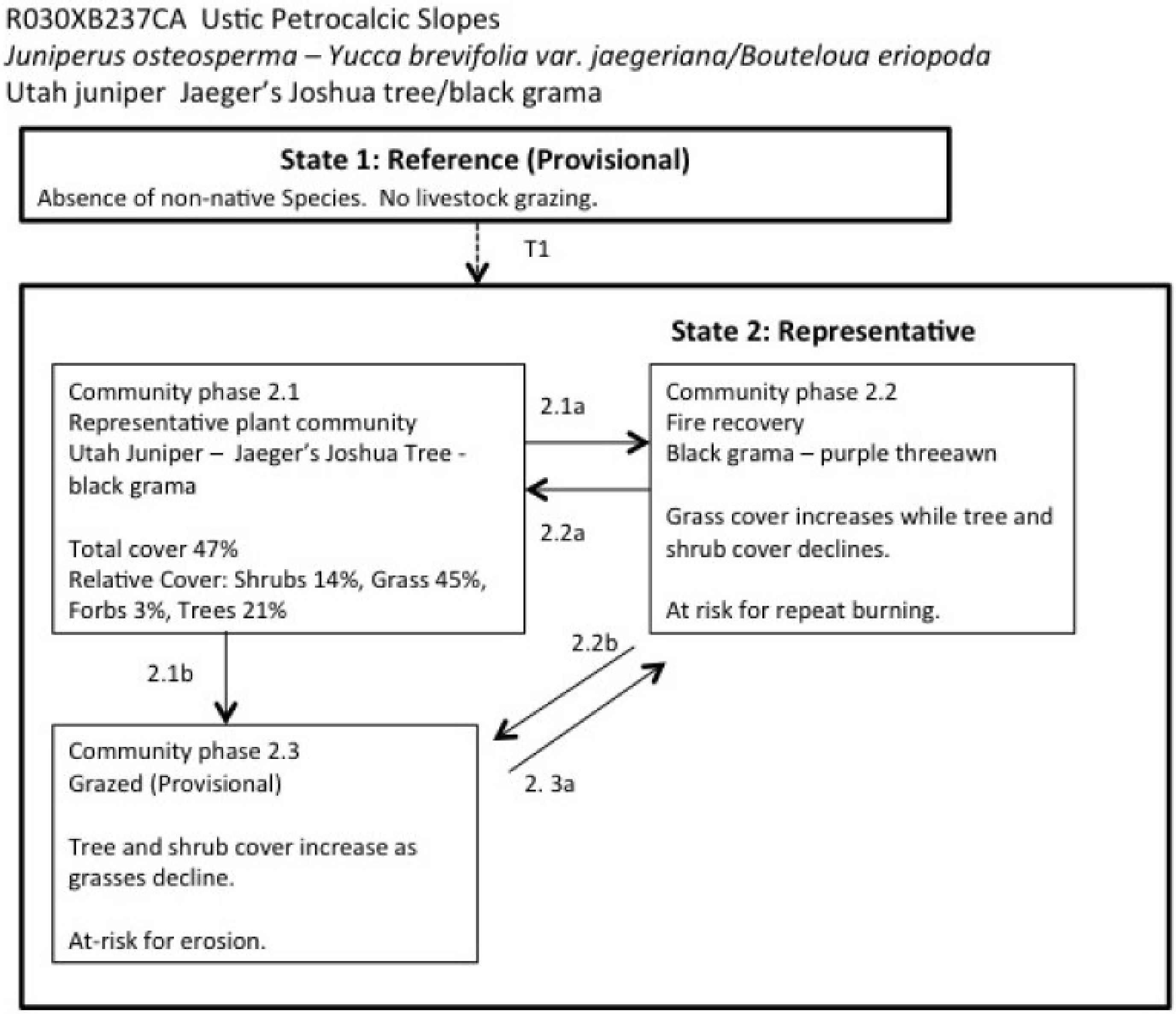

Figure 1. R030XB237CA

State 1
Reference

This state represents the natural range of variability for this ecological site, pre-European settlement. Data for this state does not currently exist, due to the naturalization of non-native species and intense land use of the geographic reference area of this site beginning the early 1800's, which included fire, mining, land clearing, hog farming, and cattle grazing (Snorf 1991). This state had infrequent fire, only native species, and no livestock grazing. Fluctuations in annual productivity would have occurred with climatic variability.

Community 1.1
Reference Community (Provisional)

The reference plant community was dominated by Utah juniper, Jaeger’s Joshua tree and black grama. Non-native species were not present.

State 2
Representative

This is the representative state for this ecological site. It is similar in composition to the reference plant community, but non-native species are present, Utah juniper cover may be lower than in the reference state due to widespread cutting of Utah juniper to support mining and settlements in the area (Snorf 1991), cover of black grama may have been higher and purple threeawn cover lower prior to the introduction of grazing (Canfield 1948).

Community 2.1
Representative

The representative plant community is dominated by Utah juniper, Jaeger's Joshua tree and black grama. A high diversity of shrubs and forbs is present, and the species composition reflects both lower elevation Mojave Desert shrublands and higher elevation desert mountains. Nevada jointfir (*Ephedra nevadensis*), littleleaf ratany (*Krameria erecta*) and banana yucca (*Yucca baccata*) are important secondary shrubs. Minor shrubs may include buck-horn cholla (*Cylindropuntia acanthocarpa*), Engelmann’s hedgehog cactus (Echinocerus engelmannii), slender buckwheat (*Eriogonum microthecum*), bastardsage (*Eriogonum wrightii*), threadleaf snakeweed (*Gutierrezia microcephala*), beavertail pricklypear (*Opuntia basilaris*), desert polygala (*Polygala acanthoclada*), and desert almond (*Prunus fasciculata*). Perennial forbs include roughseed cryptantha, purple birds-beak (*Cordylanthus parviflorus*), Mojave sandwort (*Arenaria macradenia*), desert trumpet (*Eriogonum inflatum*), cold-desert phlox (*Phlox stansburyi*), white sagebrush (*Artemisia ludoviciana*), desert globemallow (*Sphaeralcea ambigua*), whitestem paperflower (*Psilostrophe cooperi*), and brownplumed wirelettuce (Stephanomaria pauciflora). Annual forbs are a very minor component in the shallow, low moisture holding soils of this site. Squareseed spurge (*Euphorbia exstipulata*), which is rare in California but more common on dry rocky slopes elsewhere, was the only native annual recorded. Perennial bunchgrasses are an important component, with black grama dominant. Purple threeawn (*Aristida purpurea*), James’ galleta (*Pleuraphis jamesii*), and big galleta (*Pleuraphis rigida*) may be abundant. Purple threeawn and James’ galleta are increasers with grazing, and their current abundance on this site may reflect past grazing history. Minor grasses include the calciphile slim tridens, desert needlegrass (*Achnatherum speciosum*), Indian ricegrass (*Achnatherum hymenoides*), and bush muhly (*Muhlenbergia porteri*). The non-native annual grass red brome is typically present in low amounts. In addition to Utah juniper, desert polygala, purple birds-beak, cold-desert phlox, squareseed spurge, and James’ galleta are indicative of the more mesic desert mountain habitat, while other species are more typical of lower elevation fan piedmonts or are widespread in a range of habitats.

Table 4. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	157	560	729
Grass/Grasslike	202	286	370
Forb	1	17	22
Total	**360**	**863**	**1121**

Table 5. Ground cover

Tree foliar cover	5-15%
Shrub/vine/liana foliar cover	15-30%

Grass/grasslike foliar cover	15-25%
Forb foliar cover	0-3%
Non-vascular plants	0%
Biological crusts	0%
Litter	1-3%
Surface fragments >0.25" and <=3"	54-65%
Surface fragments >3"	7-20%
Bedrock	0%
Water	0%
Bare ground	3-5%

Table 6. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0-1%	0-5%	0-1%	0-1%
>0.15 <= 0.3	0-1%	3-5%	5-20%	0-1%
>0.3 <= 0.6	0-1%	6-8%	18-20%	0-3%
>0.6 <= 1.4	0-3%	5-7%	–	–
>1.4 <= 4	5-15%	0-3%	–	–
>4 <= 12	5-15%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.2
Fire Recovery

This community phase is characterized by increased grass cover and Utah juniper mortality. Initially after fire herbaceous species are strongly dominant. Black grama typically demonstrates rapid recovery after fire (Potter and Krenetsky 1967, Allred and Snyder 2008) although the rate of recovery will depend on the climatic conditions, with recovery slower if fire occurs during drought when perennial grasses are dormant, or if drought occurs after fire. Black grama had recovered to 51 percent of pre-fire patch size five years after fire, and was projected to fully recover within 12 years in a Chihuahuan Desert grassland (Parmenter 2008). Purple threeawn is killed by fire, and may decline for several years after fire unless there is above normal winter and spring precipitation after fire (Howard 1997). Purple threeawn has a seedbank that readily colonizes bare ground after fire, and will likely become abundant once it is re-established (Howard 1997). James galleta is generally only top-killed by fire, and will resprout from rhizomes, regaining pre-fire abundance within two years (Simonin 2000). With repeated burning, James' galleta may increase in abundance, suppressing shrub recovery (Sawyer et al. 2009). Big galleta may also increase in abundance post-fire. If burned when big galleta was green (which would typically be the case during the summer monsoon season), big galleta will quickly resprout and become abundant (Matthews 2000, Minnich 2003), though if big galleta is dormant when burned it may be killed by a hot fire (Matthews 2000). With time, perennial forbs and shrubs capable of re-sprouting after fire, or of quickly colonizing disturbed areas will increase. Species likely to resprout include banana yucca, Jaeger's Joshua tree, white sagebrush, Nevada jointfir, desert almond and Mexican bladdersage. Although Jaeger's Joshua tree may resprout from fire, if drought follows fire this species may suffer widespread mortality due to browse (DeFalco et al. 2010). Mortality rates are highest for younger Joshua trees that are exposed to higher fire temperatures or that have leaf ladders that allow flames to reach the canopy (DeFalco et al. 2010). Recruitment of Joshua tree is negatively impacted by fire (DeFalco et al. 2010), because of a loss of shrub cover that acts to facilitate seedling establishment (Brittingham and Walker 2000), and because of declines in rodent populations due to the loss of vegetation structure (Vamstad 2009). Thus, fire may shift Joshua tree communities towards a sparse cover of older, taller populations of Joshua tree with little recruitment or chance of survival beyond the Joshua tree lifespan (DeFalco et al. 2010). Species likely to re-establish from seed include desert globemallow, brownplumed wirelettuce, whitestem paperflower, and threadleaf snakeweed. Higher grass cover in this phase makes it susceptible to repeat burning, which would perpetuate this phase. Data is not available to indicate such frequent burning that a new grassland phase is triggered, but there is potential for this transition (e.g. Sawyer et al. 2009). The below table is ocular cover data for a burned and recovering community, at least 29 years after burning (the date that this site burned is unknown, and occurred pre-1985 when burn records for Mojave National Preserve are available. Numerous charred Utah juniper stumps indicate that the site was burned). Scientific name Common name Code Lifeform Cover *Baileya multiradiata* desert marigold BAMU Perennial forb 0.1 *Cryptantha flavoculata* roughseed cryptantha CRFL Perennial forb 0.1 Erigeron fleabane ERIGE2 Perennial forb 0.1 *Eriogonum inflatum* desert trumpet ERIN4 Perennial forb 0.1 *Psilostrophe cooperi* whitestem paperflower PSCO2 Perennial forb 0.1 *Chamaesyce revoluta* threadstem sandmat CHRE6 Annual forb 0.1 *Euphorbia exstipulata* squareseed spurge EUEX Annual forb 0.1 *Erodium cicutarium* red stem stork's bill ERCI6 Annual forb 0.1 *Aristida purpurea* purple threeawn ARPU9 Perennial grass 10 Triden muticus slim tridens TRMU Perennial grass 3 Bouteloua eriopdoa black grama BOER4 Perennial grass 13 *Achnatherum speciosum* desert needlegrass ACSP12 Perennial grass 1 *Dasyochloa pulchella* low woollygrass DAPU7 Perennial grass 0.1 *Muhlenbergia porteri* bush muhly MUPO2 Perennial grass 0.1 *Pleuraphis rigida* big galleta PLRI3 Perennial grass 5 *Krameria erecta* littleleaf ratany KRER Shrub 2 *Ephedra nevadensis* Nevada ephedra EPNE Shrub 2 *Cylindropuntia acanthocarpa* buck-horn cholla CYAC Shrub 0.1 *Gutierrezia microcephala* threadleaf snakeweed GUMI Shrub 0.1 *Yucca baccata* banana yucca YUBA Shrub 3 *Prunus fasciculata* desert almond PRFA Shrub 0.1 *Salazaria mexicana* Mexican bladdersage SAME Shrub 0.1 *Echinocereus engelmannii* Engelmann's hedgehog cactus ECEN Shrub 0.1 Opuntia phaecantha tulip pricklypear OPPH Shrub 0.1 *Opuntia chlorotica* dollarjoint pricklypear OPCH Shrub 0.1 *Yucca brevifolia* var.jaegariana Jaeger's Joshua tree YUBRJ Short tree 2 *Juniperus osteosperma* Utah juniper JUOS Short tree 2

Community 2.3
Grazed (Provisional)

This phase may develop with sustained grazing, especially at higher utilization levels. Black grama may decline with heavy grazing (e.g. Yao et al. 2006, Allred and Snyder 2008, Havstad and James 2010), and especially with grazing during drought or during the summer growing season. Black grama cover may increase rapidly with protection from grazing (Potter and Krenetsky 1967, Woodmansee and Potter 1971). Purple threeawn is an increaser with grazing (Canfield 1948, Howard 1997). Threeawns likely to be abundant in early years after grazing because they colonize disturbed soils quickly (Howard 1997). On a Texas mesa protected from grazing, black grama increased but purple threeawn was still abundant after five years. After 25 years and purple threeawn declined by 50 percent. After 5 years black grama increased, but threeawn still abundant. Declines in grass cover can lead to an increase in Utah juniper cover, and once trees are established their utilization of soil moisture can prevent grass establishment, causing a positive feedback that maintains higher Utah juniper cover (Zlatnik 1999). This phase is unlikely to return to the representative community with only the cessation of grazing. Manual thinning of Utah juniper or fire is necessary to reduce tree cover so that grasses can re-establish.

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with fire. Even light to moderate fire can kill Utah juniper and lead to a new community phase.

Pathway 2.1b
Community 2.1 to 2.3

May occur with grazing, especially at higher utilization levels.

Pathway 2.2a
Community 2.2 to 2.1

Occurs with time and a lack of further disturbance such as burning or grazing. Recovery may take 90 or more years (Sawyer et al. 2009).

Pathway 2.2b
Community 2.2 to 2.3

May occur with grazing. Grazing may promote tree recovery by reducing grass competition.

Pathway 2.3a
Community 2.3 to 2.2

This pathway occurs with fire. Even light to moderate fire can kill Utah juniper and lead to a new community phase.

Transition 1
State 1 to 2

This transition occurred with naturalization of non-native annual species such as red brome, cheatgrass, and redstem storks bill, and the introduction of livestock grazing with European exploration and settlement from the 1860s through the 1900s (e.g. Brooks and Chambers 2011). The ubiquitous presence of non-native annuals means that removing them entirely and returning to the reference state is not possible.

Additional community tables

Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Native shrubs**			157–729	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–560	3–9
	littleleaf ratany	KRER	*Krameria erecta*	11–112	3–5
	Nevada jointfir	EPNE	*Ephedra nevadensis*	39–112	2–4
	banana yucca	YUBA	*Yucca baccata*	11–45	1–6
	threadleaf snakeweed	GUMI	*Gutierrezia microcephala*	0–17	0–5
	bastardsage	ERWR	*Eriogonum wrightii*	0–11	0–1
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–4	0–1
	buck-horn cholla	CYAC8	*Cylindropuntia acanthocarpa*	0–4	0–1
	desert polygala	POAC2	*Polygala acanthoclada*	0–3	0–4
	slender buckwheat	ERMI4	*Eriogonum microthecum*	0–3	0–1
	beavertail pricklypear	OPBA2	*Opuntia basilaris*	0–2	0–1
	Mexican bladdersage	SAME	*Salazaria mexicana*	0–2	0–1
	Engelmann's hedgehog cactus	ECEN	*Echinocereus engelmannii*	0–2	0–1
	Jaeger's Joshua tree	YUBRJ	*Yucca brevifolia var. jaegeriana*	0–1	1–2
	desert almond	PRFA	*Prunus fasciculata*	0–1	0–1
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–1	0–1
Grass/Grasslike					
2	**Native perennial grasses**			202–370	
	black grama	BOER4	*Bouteloua eriopoda*	56–224	15–25
	purple threeawn	ARPU9	*Aristida purpurea*	11–224	2–20
	James' galleta	PLJA	*Pleuraphis jamesii*	11–90	1–3
	desert needlegrass	ACSP12	*Achnatherum speciosum*	1–28	0–1
	slim tridens	TRMU	*Tridens muticus*	0–22	0–3
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–4	0–1
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–2	0–1
3	**Non-native annual grasses**			0–6	
	red brome	BRRU2	*Bromus rubens*	0–6	0–4
Forb					
4	**Native forbs**			1–22	
	purple bird's-beak	COPA9	*Cordylanthus parviflorus*	0–17	0–1
	cold-desert phlox	PHST11	*Phlox stansburyi*	0–9	0–1
	whitestem paperflower	PSCO2	*Psilostrophe cooperi*	0–6	0–1
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–6	0–1
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–2	0–1
	squareseed spurge	EUEX4	*Euphorbia exstipulata*	0–1	0–1
	roughseed cryptantha	CRFL6	*Cryptantha flavoculata*	0–1	0–1

Animal community

Small mammals and birds eat juniper berries, and mule deer will browse juniper foliage if other food is not available (Zlatnik 1999).

Wood products

The decay resistant wood of Utah juniper is used for construction, fence posts, firewood, pencils, and Christmas trees (Zlatnik 1999).

Inventory data references

High intensity sampling (Caudle et al. 2013) was used to describe this ecological site. Site characteristics such as aspect, slope, elevation and UTMS were recorded for each plot, along with complete species inventory by ocular percent cover. The line-point intercept method was used to measure foliar cover, groundcover, and vegetation structure. At either 300 or 100 points along a 600- or 400-foot step transect, ground cover and intercepted plant species were recorded by height. The first hit method (Herrick et al. 2009) was used to generate the foliar cover values entered in the community phase composition tables. Annual production was estimated using the double-weight sampling method outlined in the National Range and Pasture Handbook and in Sampling Vegetation Attributes (NRCS 2003 and Interagency Technical Reference 1999 pgs. 102 - 115). For herbaceous vegetation, ten 9.6 square foot circular sub-plots were evenly distributed along a 200 foot transect. For woody and larger herbaceous species production was estimated in four 21'X21' square plots along the same transect. Weight units were collected for each species encountered in the production plots. The number of weight units for each species is then estimated for all plots.

Community phase 2.1:
11CA795246 (Type location)
11CA795251

Community phase 2.2:
2013CA7053078

Type locality

Location 1: San Bernardino County, CA	
UTM zone	N
UTM northing	3904693
UTM easting	660246
General legal description	The type location is in the Mojave National Preserve 0.2 miles at 223 degrees from Ivanpah Road, approximately 2 miles south from the Hart Mine Road - Ivanpah intersection.

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Approval

Sarah Quistberg, 2/25/2025

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	05/13/2025
Approved by	Sarah Quistberg
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:**