USDA Natural Resources Conservation Service

Ecological site R030XB168CA
Cool Deep Sandy Fans

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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 typically occurs on cool thermic fans with very deep sandy soils that are located adjacent to mountains. This ecological site may be found on some minor components with moderately deep soils over bedrock.

Cooler temperatures exclude creosote bush (*Larrea tridentata*) from this site while allowing blackbrush (Coleogyne ramosissima) and California juniper (Juniperus californica) to dominate. Runon from adjacent mountains makes the site moister than similar sites not adjacent to the mountains, which further enhances habitat for California juniper in this arid environment.

Data ranges in the physiographic data, climate data and soil data are based on major components only (15 percent or greater). Information for associated minor components may be included in the narrative section.

Associated sites

R030XB166CA	**Dissected Pediment, Cool** Pediments. Very shallow to shallow soils over bedrock limit the productivity of this site and distinguish it from R030XB168CA. R030XB166CA is dominated by California juniper (Juniperus californica) and blackbrush (Coleogyne ramosissima). Joshua tree (Yucca brevifolia var. breviolia) is not present in R030XB166CA.
R030XB170CA	**Bouldery Very Shallow To Shallow Gravelly Slopes** Cool hills and mountains; very shallow to shallow soils over bedrock. Blackbrush (Coleogyne ramosissima), singleleaf pinyon (Pinus monophylla) and Muller oak (Quercus cornelius-mulleri) are the dominant species at this site. The presence of singleleaf pinyon suggests this site is a cooler and moister than R030XB168CA.
R030XB183CA	**Loamy Very Deep Fan Remnants** Fan remnants, fan aprons on fan remnants and fan aprons on pediment. Deep to very deep soils. This site has creosote bush (Larrea tridentata) and no California juniper (Juniperus californica) suggesting it is warmer and drier than R030XB168CA.
R030XB188CA	**Cool Shallow to Moderately Deep Fans** Flat summit of pediment, fan aprons on pediments; very shallow to shallow soils over bedrock. Creosote bush (Larrea tridentata) and blackbrush (Coleogyne ramosissima) are dominant plant species at this site. The presence of creosote bush suggests this site is warmer than R030XB168CA.
R030XB189CA	**Shallow Cool Hills** Hills, hillslope, mountains, mountain slopes, ridges; very shallow to deep soils over bedrock. Blackbrush (Coleogyne ramosissima) and California juniper (Juniperus californica) are dominant, and Joshua tree (Yucca brevifolia var. brevifolia) is not present.
R030XY202CA	**Very Rarely To Rarely Flooded Thermic Ephemeral Stream** Smaller ephemeral stream with very rare to rare flash flood events on. Diverse shrubs include Nevada jointfir (Ephedra nevadensis), water jacket (Lycium andersonii) and desert almond (Prunus fasciculata).

Similar sites

R030XB166CA	**Dissected Pediment, Cool** Fan remnants on pediments, fan aprons of pediment, hill and mountains (mostly fan remnants on pediments, fan aprons of pediment). Very shallow to shallow soils over bedrock limit the productivity of this site and distinguish it from R030XB168CA. R030XB166CA is dominated by California juniper and blackbrush. Joshua tree is not present at R030XB166CA.
R030XB183CA	**Loamy Very Deep Fan Remnants** Fan remnants, fan aprons on fan remnants and fan aprons on pediment. Deep to very deep soils. This site has creosote bush and no California juniper suggesting it is warmer and drier than R030XB168CA.

R030XB188CA	**Cool Shallow to Moderately Deep Fans** Flat summit of pediment, fan aprons on pediments; very shallow to shallow soils over bedrock. Creosote bush and blackbrush are dominant plant species at this site. The presence of creosote suggests this site is warmer than R030XB168CA.
R030XB173CA	**Coarse Loamy Very Deep Fan Remnants** Fan remnant and upper fan aprons. Very deep soils, very shallow and shallow to argillic. The presence of creosote and blackbrush along with the absence of California juniper suggests this site is a bit warmer and drier than R030XB168CA.
R030XB174CA	**Sandy Fan Aprons** Fan aprons, fan aprons over fan remnants, fan aprons over pediments, inset fans, stream terraces, and channels. Deep to very deep soils. Creosote bush, big galleta and Joshua Tree dominate this site suggest this site is much warmer and drier than R030XB168CA.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Coleogyne ramosissima* (2) *Juniperus californica*
Herbaceous	Not specified

Physiographic features

This ecological site typically occurs on fan aprons and fan remnants, and may occur on low hills and pediment overlain with a thick layer of alluvium. It occurs at elevations of 3280 to 5200 feet. Slope ranges from 2 to 15 percent. Flooding and ponding does not occur on this ecological site, and runoff class is very low to medium.

Table 2. Representative physiographic features

Landforms	(1) Fan apron (2) Fan remnant
Flooding frequency	None
Ponding frequency	None
Elevation	1,000–1,585 m
Slope	2–15%
Aspect	Aspect is not a significant factor

Climatic features

The climate at this site is arid, and characterized by cool, somewhat moist winters and hot, dry summers. The average annual precipitation ranges from 4 to 7 inches with most precipitation falling as rain from November to March. Mean annual air temperature ranges from 55 to 63 degrees Fahrenheit. June, July and August can experience average maximum temperatures of 100 degrees Fahrenheit while December and January can have average minimum temperatures near 20 degrees Fahrenheit.

Maximum and minimum monthly climate data for this ESD were generated by the Climate Summarizer (http://www.nm.nrcs.usda.gov/technical/handbooks/nrph/Climate_Summarizer.xls) using data
from the following climate stations (results are weighted averages; numbers in square brackets represent relative weights):

LTHC1 Lost Horse, Joshua Tree National Park (Period of record = 1991 to 2011) [2]

44405 JOSHUA TREE, CA (Period of record = 1959 to 2011) [1]

44467 Kee Ranch, CA (Period of record = 1948 to 1979) [1]

45112 Yucca Valley, CA (Period of record = 1990 to 2011) [1]

The combination of these stations were used because of sparse climate data. The Lost Horse weather station is closest to this ecological site but is limited by the number of years data was collected. The Joshua Tree weather station is also nearby this ecological site but is located at approximately 2750 feet in elevation while the ecological site has an elevational range of 3200 to 5200 feet. This weather station is lacking precipitation data for the years between 1975 and 2008 and there is very little temperature data. Kee Ranch weather station contains precipitation data for all years of the period of record but has no temperature data. The Yucca Valley weather station contains temperature and precipitation data for the 20 year period of record.

Frost Free Period and Mean Annual Precipitation were determined using a variety of climate data and models. Freeze Free Period is a best guess based on available temperature data and the Frost Free Period. Due to sparse temperature data, the Frost Free Period determined using the Climate Summarizer does not agree with the models used to populate the National Soil Information System.

Table 3. Representative climatic features

Frost-free period (average)	270 days
Freeze-free period (average)	300 days
Precipitation total (average)	178 mm

Influencing water features

Soil features

This ecological site is found on alluvial soils derived from gneiss and/or granitoid. Soils are generally very deep, well drained to somewhat excessively drained, with sand or loamy sand surface textures.

The subsurface textures are mostly sand, loamy sand, sandy loam, gravelly sand, gravelly loamy sand and gravelly sandy loam with some coarse sandy loam, coarse sand and loamy coarse sand horizons. Rock fragments less than 3 inches in diameter compose 4 to 60 percent of the surface cover with typical ranges being between 4 to 20 percent. Rock fragments less than 3 inches compose up to 11 percent of the subsurface volume (for a depth of 0 to 79 inches). Rock fragments greater than 3 inches in diameter are a negligible component of the soil surface cover and subsurface volume.

This ecological site is associated with major components of the following soil series: Morongo (mixed, thermic Typic Torripsamments); Littlefargo (coarse-loamy, mixed, superactive, thermic Typic Haplargids); and Jumborox (coarse-loamy, mixed, superactive, thermic Typic Haplargids). One other soil on which this site is found is typically 10 percent or less of any map unit when associated with this site. This is the Bluecut series: fine-loamy, mixed, superactive, thermic Typic Paleargids.

The Morongo soils are composed of layers of loamy sand and sand with little to no soil development. The Jumborox, Littlefargo and Bluecut soils have an argillic horizon beginning at depths of 4 to 8 inches below the surface. The Littlefargo soils are moderately deep over weathered bedrock, and occur on low hills and pediments overlain with a thick layer of colluvium; these soils are not typical for this ecological site.

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

3679; Morongo-Jumborox complex, 2 to 8 percent slopes; Bluecut; cool; 8%; Jumborox; 20%; Jumborox, strongly sloping; 5%; Morongo; cool; 55%; Morongo; cool, strongly sloping; 7%
3682; Morongo-Jumborox-Urbanland complex, 4 to 8 percent slopes; Jumborox; 15%; Jumborox, strongly sloping; 7%; Morongo; cool; 50%; Morongo; cool, strongly sloping; 5%

3685; Morongo-Desertqueen complex, 8 to 30 percent slopes; Jumborox; 5%; Morongo; cool; 65%
4091; Littlefargo-Rock outcrop, 4 to 15 percent slopes; Littlefargo; 85%; Morongo; rarely flooded; 2%
4608; Pinecity-Rock outcrop association, 4 to 15 percent slopes, high elevation; Morongo; rarely flooded; 10%
4610; Jumborox-Desertqueen-Rock outcrop association, 2 to 8 percent slopes; Littlefargo; 3%
4615; Desertqueen-Jumborox-Rock outcrop association, 2 to 15 percent slopes; Jumborox; 25%

Table 4. Representative soil features

Parent material	(1) Alluvium–gneiss (2) Colluvium–granite
Surface texture	(1) Sand (2) Loamy sand
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid
Soil depth	51 cm
Surface fragment cover <=3"	4–60%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	4.06–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0–1%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	1–11%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Abiotic Factors

The abiotic drivers of this ecological site are very deep, cool thermic soils and upper piedmont positions that receive additional moisture from adjacent mountains and hills. The cool thermic climate supports dominance by blackbrush and California juniper. At lower elevations, warmer, drier climates support co-dominance by creosote bush (*Larrea tridentata*) and burrobush (*Ambrosia dumosa*), and exclude California juniper. At higher elevations, moister climates support pinyon-juniper woodlands.

The soils predominately associated with this ecological site are very deep sandy textures. In arid regions, the availability of moisture is the key resource driving the productivity and composition of vegetation (Noy-Meir 1973, McAuliffe 1994, Martre et al. 2002, Austin et al. 2004). Because water drains rapidly through coarser textured, sandy soils, with minimal loss due to run-off and evaporation, in arid regions, water availability is higher in coarser textured soils; consequently productivity is higher on these soils than on finer textured soils (Noy-Meir, 1973, Austin et al. 2004). Higher water availability in deep sandy soils, and received from runon from adjacent mountains increase the productivity of this site relative to adjacent landforms with shallower soil.

Blackbrush is a shallow-rooted, very long-lived, drought-tolerant shrub. It is typically dominant on shallow soils, but may also be abundant on deep soils. California juniper is a long-lived evergreen shrub or small tree that achieves maximum dominance at elevations slightly higher than this ecological site, where mean annual precipitation is above 9.5 inches (Rhode 2002). Runon from adjacent mountains makes the site moister than similar sites not adjacent to the mountains, which enhances habitat for California juniper.

Disturbance dynamics

The major disturbances affecting this ecological site are drought, invasion by non-native species, and fire.

Drought is an important shaping force in Mojave Desert plant communities (Webb et al. 2003, Hereford et al. 2006). 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 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). Increased soil nitrogen due to air pollution has been shown to increase the productivity of exotic annual grasses across the Mojave Desert (Brooks 1999). In Joshua Tree National Park, elevated soil N is decreasing the diversity and cover of native forb species in the park, and at the same time increasing the cover of exotic annual grasses (Rao and Allen 2010). The relatively high moisture availability of the soils of this ecological site, and the high rates of nitrogen deposition received by the area where this site occurs, make it particularly susceptible to heavy invasion of non-native annual grasses.

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). Wildfire historically would have been rare in this ecological site due to widely spaced shrubs and discontinuous fuels.

Blackbrush communities may be significantly altered by high intensity fires or other widespread disturbance. The ability of blackbrush to recolonize a disturbed site is severely limited by infrequent seedling establishment (Callison and Brotherson, 1985). Neither blackbrush nor California juniper resprouts following a fire.

Because blackbrush is highly competitive for resources, other plant species are able to take advantage of light, water, and nutrients made available after blackbrush is removed by disturbance. Annual invasive grasses such as cheatgrass (*Bromus tectorum*) and red brome (*Bromus rubens*) and shrubs such as Eastern Mojave buckwheat (*Eriogonum fasciculatum*) and Nevada jointfir (*Ephedra nevadensis*) are likely to fill in the areas where blackbrush has been removed. California juniper is also removed by fire but can return after several years without fire, creating areas where blackbrush is not present but California juniper has regained dominance (Schmidt and Larson 1989). Muller oak (*Quercus cornelius-mulleri*) is a dominant species on nearby ecological sites and is sometimes present on this site. Muller’s oak can tolerate fire and is sometimes a dominant on the site following high intensity fires.

State and transition model

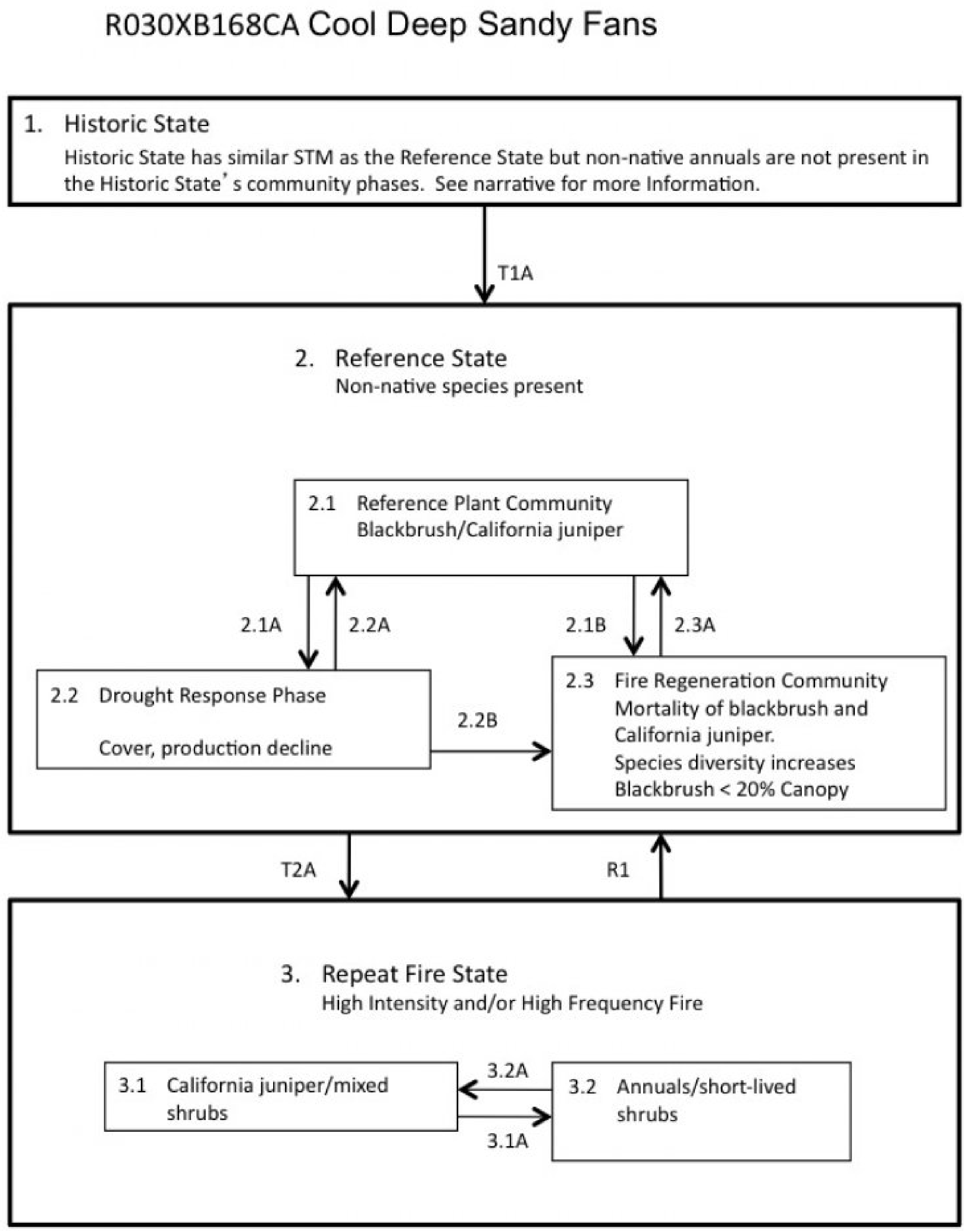

Figure 4. R030XB168CA

State 1
Historic State

This state is similar to State 2.0, but Historic State 1.0 contains only native species. If dynamics were included in this state, they would be similar to those displayed in State 2.0. The presence of non-native species in State 2.0 may increase fire frequency and intensity from that experienced in Historic State 1.0.

State 2
Reference State

There are three community phases maintained by the current natural conditions for this ecological site.

Community 2.1
Reference Plant Community

Figure 5. 2.1 Blackbrush and juniper community

The reference plant community is dominated by blackbrush and California juniper. Joshua tree (*Yucca brevifolia* var. brevifolia) is a characteristic secondary tree present at up to two percent cover. This site includes some very large, old-growth Joshua tree forests. Secondary shrubs may include Muller's oak, eastern Mojave buckwheat, Nevada jointfir, and Mexican bladdersage (*Salazaria mexicana*). The native perennial grasses big galleta (*Pleuraphis rigida*) and/or desert needlegrass (Acnatherum speciosum) are typically present. The invasive annual grasses red brome (*Bromus madritensis*) and cheatgrass (*Bromus tectorum*) are naturalized in this community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	404	471	633
Grass/Grasslike	11	123	258
Tree	11	50	90
Forb	–	22	50
Total	**426**	**666**	**1031**

Table 6. Ground cover

Tree foliar cover	2-8%
Shrub/vine/liana foliar cover	28-39%
Grass/grasslike foliar cover	4-16%
Forb foliar cover	1-12%
Non-vascular plants	0%
Biological crusts	0%
Litter	3-15%
Surface fragments >0.25" and <=3"	1-10%
Surface fragments >3"	0%
Bedrock	0%

Water	0%
Bare ground	24-41%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0%	0-1%	2-4%	1-2%
>0.15 <= 0.3	0-1%	0-1%	2-14%	1-10%
>0.3 <= 0.6	0-1%	10-20%	1-2%	1-2%
>0.6 <= 1.4	1-2%	10-20%	–	–
>1.4 <= 4	1-7%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.2
Drought Response

Figure 7. Low intensity fire

This community phase is characterized by a decline in cover and production due to branch-pruning of long-lived shrubs (including blackbrush, Nevada jointfir, and Mojave yucca), mortality of California juniper, and mortality of shorter-lived perennials (including Acton’s brittlebush, eastern Mojave buckwheat, and desert needlegrass), and lack of emergence of annual forbs and grasses.

Community 2.3
Fire Regeneration Community

This community is characterized by decreases in blackbrush, California juniper, and Joshua tree, and an increase in species diversity. Blackbrush survival and regeneration following fire is rare and its documentation is limited to only a few cases of blackbrush re-sprouting (Bates 1984), seedling establishment (Ellison 1950; Lei 1999), autogenic succession following fire (Thatcher 1975) and fire islands (Minnich 2003). Joshua tree is capable of sprouting after fire, but this is not a guarantee of survival (Minnich 2003, DeFalco et al. 2010). If drought follows fire, individuals that initially survived are subject to increased herbivory, which often causes mortality (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). Vigorous sprouting of shrubs including Nevada jointfir, Mexican bladdersage, Muller's oak, water jacket (*Lycium andersonii*), and desert bitterbrush (*Purshia glandulosa*), and the perennial grasses big galleta and desert needlegrass occurs following fire, and the canopy cover of these plant species will increase in the post-fire community. Species capable of quickly colonizing after fire from off-site seed dispersal also increase, including eastern Mojave buckwheat, desert globemallow, narrowleaf goldenbush (*Ericameria linearifolia*), threadleaf snakeweek (*Gutierrezia microcephala*), and wishbone bush (Mirabalis laevisvar. villosa). Annual grasses and forbs are also ikely to increase at this site following fire (Humphrey 1953; Wallace and Romney 1972; Baldwin 1979; Callison et al. 1985; West and Hassan 1985; Conrad 1987; Minnich 1995; Loik et al. 2000; Brooks and Matchett 2003; Abella et al. 2009). This community is considered an at-risk community phase. A community is at risk when annual plant cover creates a continuous fuel load between shrubs. Islands of vegetation may exist that were not burned by fire may provide seed sources for colonization. These unburned islands are especially important for blackbrush re-colonization.

Pathway 2.1A
Community 2.1 to 2.2

Reference Plant Community

Drought Response

This pathway occurs with prolonged or severe drought.

Pathway 2.1B
Community 2.1 to 2.3

This pathway occurs with fire. Low intensity fire may be patchy, leaving islands of blackbrush and California juniper from which regeneration is enhanced.

Pathway 2.2A
Community 2.2 to 2.1

Drought Response

Reference Plant Community

This pathway occurs with a return to average climatic conditions. Growth of long-lived shrubs and colonization by shorter-lived shrubs increases cover.

Pathway 2.2B
Community 2.2 to 2.3

This pathway occurs with moderate to severe fire. Although live annuals are largely absent from Community Phase 2.2, standing annual biomass in drought years immediately following a period of heavy precipitation poses a severe risk for fire. Cured native annual cover may pose a risk during the first year of drought, and non-native annual grasses pose a risk for three or more years (Minnich 2003, Brooks et al. 2007, Rao et al. 2010).

Pathway 2.3A
Community 2.3 to 2.1

With time and the absence of additional disturbance community phase 2.3 will develop into community phase 2.1. Shrub dominance will return within 20 years but may not resemble the pre-burn composition (Callison et al. 1985). Blackbrush requires more time than California juniper to achieve pre-burn cover and production, because establishment from seed is rare (Webb et al. 1987). California juniper may repopulate an area as early as fifteen years after fire, especially when islands of juniper have survived a burn (Wright 1972; Schmidt and Larson 1989).

State 3
Repeat Fire

There are two community phases maintained by an increase in fire intensity and fire frequency due to the abundance of annual species, especially invasive grasses.

Community 3.1
California juniper/mixed shrubs

Figure 9. Annuals and short lived shrubs

California juniper can reestablish itself by seed after several years without fire. California juniper does not sprout from live root tissue following fire (Hanes 1971). Juniper may be able to repopulate an area in as little as 15 years if islands of unburned juniper exist. Areas where juniper has been completely removed may require up to fifty years for juniper establishment (Wright 1972; Schmidt and Larson 1989). Years with above average precipitation will produce an abundance of annual grasses, contributing to the conversion of this community phase to community phase 3.1.

Community 3.2
Annuals/short lived shrubs

High intensity fire has removed blackbrush and California juniper from the site. It has been 15 years since the site described here has burned. Annual grasses, forbs and short lived shrubs dominate the site. Post burn species composition in this ecological site is variable (Bowns and West 1976; Vamstad 2009). Non-native invaders have the potential to permanently increase the fire frequency regime at these sites, maintaining this community phase (D’Antonio and Vitousek 1992; Whisenant 1990).

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, >15 years, when California juniper may repopulate the site via seed sources.

Transition T1A
State 1 to 2

Non-native forbs and grasses are introduced to the Historic State. There may be only a trace amount of non-native species present. Non-native species are well adapted to the desert climate. Attempts to eradicate this species may be futile as seed sources are widespread throughout the state of California and the Southwest.

Transition T2A
State 2 to 3

This transition occurs with repeat or high intensity fire that permanently removes blackbrush from the plant community.This transition is most likely to occur when the interstitial spaces between shrubs are filled with dried annual species, especially non-native grasses.

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 blackbrush 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). Blackbrush is difficult to cultivate for outplanting due to susceptibility to fungal pathogens in the greenhouse environment, and California juniper is difficult to germinate.

Additional community tables

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
1	**Tree/Shrub**			11–90	
	blackbrush	CORA	*Coleogyne ramosissima*	392–448	20–40
	California juniper	JUCA7	*Juniperus californica*	22–78	1–5
	desert bitterbrush	PUGL2	*Purshia glandulosa*	0–50	0–5
	Eastern Mojave buckwheat	ERFA2	*Eriogonum fasciculatum*	0–34	0–1
	Joshua tree	YUBR	*Yucca brevifolia*	0–18	1–2
	Nevada jointfir	EPNE	*Ephedra nevadensis*	3–17	0–3
	Mexican bladdersage	SAME	*Salazaria mexicana*	0–11	0–1
	burrobrush	HYSA	*Hymenoclea salsola*	0–6	0–1
	Wiggins' cholla	CYEC3	*Cylindropuntia echinocarpa*	0–4	0–1
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–3	0–1
Shrub/Vine					
2	**Native Shrubs**			404–633	
	blackbrush	CORA	*Coleogyne ramosissima*	392–504	25–40
	California juniper	JUCA7	*Juniperus californica*	11–90	1–5
	Muller oak	QUCO7	*Quercus cornelius-mulleri*	0–45	0–4
	Eastern Mojave buckwheat	ERFA2	*Eriogonum fasciculatum*	0–34	0–1
	Joshua tree	YUBR	*Yucca brevifolia*	0–18	0–3
	Nevada jointfir	EPNE	*Ephedra nevadensis*	6–17	0–1
	Mexican bladdersage	SAME	*Salazaria mexicana*	0–6	0–1
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–3	0–1
Grass/Grasslike					
3	**Native grasses**			0–17	
	big galleta	PLRI3	*Pleuraphis rigida*	0–17	0–2
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–4	0–1
4	**Non-native grasses**			0–241	
	red brome	BRRU2	*Bromus rubens*	0–235	0–10
	pincushion flower	CHFR	*Chaenactis fremontii*	0–22	0–1
	chia	SACO6	*Salvia columbariae*	0–22	0–1
	cheatgrass	BRTE	*Bromus tectorum*	0–17	0–5
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–11	0–1
Forb					
5	**Native forbs**			0–50	
	red brome	BRRU2	*Bromus rubens*	11–179	1–10
	cheatgrass	BRTE	*Bromus tectorum*	0–22	0–3
	pincushion flower	CHFR	*Chaenactis fremontii*	0–22	0–3
	chia	SACO6	*Salvia columbariae*	0–22	0–2
	Forb, annual	2FA	*Forb, annual*	0–11	0–7
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–11	0–1

Table 9. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
1	**Trees**			0–28	
	Joshua tree	YUBR	*Yucca brevifolia*	0–15	0–1
	California juniper	JUCA7	*Juniperus californica*	0–11	0–3
Shrub/Vine					
2	**Native Shrubs**			325–415	
	blackbrush	CORA	*Coleogyne ramosissima*	112–224	3–5
	Muller oak	QUCO7	*Quercus cornelius-mulleri*	0–179	0–4
	Eastern Mojave buckwheat	ERFA2	*Eriogonum fasciculatum*	34–90	2–5
	desert bitterbrush	PUGL2	*Purshia glandulosa*	4–58	0–1
	Mexican bladdersage	SAME	*Salazaria mexicana*	0–22	0–8
	threadleaf snakeweed	GUMI	*Gutierrezia microcephala*	0–7	0–1
	Nevada jointfir	EPNE	*Ephedra nevadensis*	3–6	2–4
	Wiggins' cholla	CYEC3	*Cylindropuntia echinocarpa*	0–6	0–1
	water jacket	LYAN	*Lycium andersonii*	0–6	0–1
	narrowleaf goldenbush	ERLI6	*Ericameria linearifolia*	0–1	0–1
Grass/Grasslike					
3	**Native grasses**			0–28	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–1	0–25
	Sandberg bluegrass	POSE	*Poa secunda*	–	0–1
4	**Non-native grasses**			78–269	
	cheatgrass	BRTE	*Bromus tectorum*	0–247	0–14
	red brome	BRRU2	*Bromus rubens*	0–78	0–8
Forb					
5	**Native forbs**			6–45	
	pincushion flower	CHFR	*Chaenactis fremontii*	0–34	0–5
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–11	0–2

Table 10. Community 2.3 plant community composition

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

Table 11. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Native Shrubs**			–	
	goldenbush	ERICA2	*Ericameria*	–	7–9
	wishbone-bush	MILAV	*Mirabilis laevis var. villosa*	–	0–2
	beavertail pricklypear	OPBA2	*Opuntia basilaris*	–	0–1
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	–	0–1
	peach thorn	LYCO2	*Lycium cooperi*	–	0–1
	Eastern Mojave buckwheat	ERFA2	*Eriogonum fasciculatum*	–	0–1
Tree					
2	**Tree/Shrub**			–	
	Muller oak	QUCO7	*Quercus cornelius-mulleri*	–	0–4
	Joshua tree	YUBR	*Yucca brevifolia*	–	0–1
Grass/Grasslike					
3	**Native grasses**			–	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	–	0–4
4	**Non-native grasses**			–	
	cheatgrass	BRTE	*Bromus tectorum*	–	4–6
	barley	HORDE	*Hordeum*	–	0–2
	red brome	BRRU2	*Bromus rubens*	–	0–1
Forb					
5	**Native forbs**			–	
	onion	ALLIU	*Allium*	–	0–1
	woolly easterbonnets	ANWA	*Antheropeas wallacei*	–	0–1
	desert larkspur	DEPA	*Delphinium parishii*	–	0–1
	bluedicks	DICA14	*Dichelostemma capitatum*	–	0–1
	golden linanthus	LEAUA3	*Leptosiphon aureus ssp. aureus*	–	0–1

Table 12. Community 3.2 plant community composition

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

Animal community

Bighorn sheep and mule deer may tend to use this site in the winter to feed on blackbrush, juniper, desert needlegrass and big galleta (Sampson and Jesperson 1963; Bradley 1965; Stark 1966; Bowns and West 1976; West 1983; Mozingo 1987; Loope et. al 1988; Urness and Austin 1989; Seegmiller et. al 1990; Krausman et. al 1997). Small mammals, such as kangaroo rats, and birds will cache and eat blackbrush achenes and juniper berries (Barrett 1983; West 1983; Blake 1984; Mozingo 1987). A list of the many animals which may use the area is presented below (based on known habitat preferences [National Park Service 2012]). This list is not intended to be an exhaustive list of animals found in this ecological site. Many birds are likely to use this ecological site.

MAMMALS:

Badgers, Skunks, Weasels
Long-tailed Weasel (Mustela frenata latirosta)

Bats
Desert Long-legged Bat (Myotis volans interior)
Northern Fringed Bat (Myotis thysanodes thysanodes)
Western Pipistrelle (Pipistrellus hesperus hesperus)
Desert Big Brown Bat (Eptesicus fuscus pallidus)
Hoary Bat (Lasiurus cinereus cinereus)
Pallid Bat (Antrozous pallidus minor)

Bears
California Black Bear (Ursus Americanus californianus)

Canids
Desert Coyote (Canis latrans mearnsi)
Common Gray Fox (Urocyon cinereoargenteus scottii)

Cats
California Mountain Lion (Felis concolor californica)
Desert Bobcat (Lynx rufus baileyi)

Ringtails
California Ringtail (Bassariscus astutus ocatvus)

Deer & Sheep
Southern Mule Deer (Blacktail) (Odocoileus hemionus fuliginatus)
Desert Bighorn Sheep (Ovis canadensis nelsoni)

Rabbits & Hares
Southern Desert Cottontail (Sylvilagus audubonii arizonae)

Rodents
Dusky Chipmunk (Tamias obscurus davisi)
Whitetail Antelope Squirrel (Ammospermophilus leucurus leucurus)
Western Mojave Ground Squirrel (Spermophilus beecheyi parvulus)
Long-tailed Pocket Mouse (Chaetodipus formosus mojavensis)
Western Chisel-toothed Kangaroo Rat (Dipodomys microps occidentalis)
Merriam’s Kangaroo Rat (Dipodomys merriami merriami)
Desert Wood Rat (Neotoma lepida lepida)
Eastern Dusky-footed Wood Rat (Neotoma fuscipes simplex)
White-throated Wood Rat (Neotoma albigula venusta)
Sonoran Deer Mouse (Peromyscus maniculatus sonoriensis)
Southern California Pinyon Mouse (Peromyscus truei chlorus)
Desert Grasshopper Mouse (Onychomys torridus pulcher)

Shrews
Desert Shrew (Gray) (Notiosorex crawfordi crawfordi)

REPTILES:

Lizards
Desert Banded Gecko (Coleonyx variegatus variegatus)
Mojave Collared Lizard (Crotaphytus bicinctores)
Western Chuckwalla (Sauromalus ater obesus)
Great Basin Fence Lizard (Sceloporus biseriatus longipes)
Western Brush Lizard (Urosaurus graciosus graciosus)
Great Basin Whiptai (Aspidoscelis tigris tigris)
Western Red-tailed Skink (Eumeces gilberti rubricaudatus)
San Diego Alligator Lizard (Elgaria multicarinata webbii)
Silvery Legless Lizard (Anniella pulchra pulchra)

Snakes
Southwestern Blind Snake (Leptotyphlops humilis humilis)
Desert Rosy Boa (Lichanura trivirgata gracia)
Mojave Glossy Snake (Arizona occidentalis candida)
Desert Night Snake (Hypsiglena torquata deserticola)
California Kingsnake (Lampropeltis getula californiae)
California Striped Racer (Masticophis lateralis lateralis)
Great Basin Gopher Snake (Pituophis catenifer deserticola)
Western Long-nosed Snake (Rhinocheilus lecontei lecontei)
Smith's Black-headed Snake (Tantilla hobartsmithi)
California Lyre Snake (Trimorphodon biscutatus vandenburghi)
Southwestern Speckled Rattlesnake (Crotalus mitchelli pyrrhus)
Red Diamond Rattlesnake (Crotalus ruber ruber)
Southern Pacifi c Rattlesnake (Crotalus helleri)

Recreational uses

This ecological site can be used for hiking and aesthetic enjoyment.

Wood products

California juniper is a poor source of lumber because of low volume and multi-stemmed growth form. However, early ranchers used juniper for fenceposts, and it is used for fuel and as Christmas trees (Cope 1992).

Other products

California juniper was used by Native Americans for a variety of medicinal purposes, including cold remedies, cough treatment, anticonvulsive, to induce sweating, for hangovers, for hypotension, fever and as a muscle relaxant for childbirth relief. Berries were eaten fresh, and were dried for later use, when they were ground to make porridge or to make bread. The Kawaiisu used the bark as a building cover, and used the wood to make arrows and cooking utensils. (http://herb.umd.umich.edu/herb/search.pl?searchstring=Juniperus+californica)

Blackbrush was used by the Kawaiisu for treating gonorrhea, and the Havasupai used blackbrush as source of fodder when grass was not available. (http://herb.umd.umich.edu/herb/search.pl?searchstring=Coleogyne+ramosissima).

Inventory data references

Cover data for this ecological site was described using line-point intercept transects. The complete protocol for this sampling method is found in Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume 1: Quick Start.

Production data for this ecological site was described using modified double-sampling transect. The protocol was modified by California State Rangeland Ecologist Kendra Moseley to use fewer plots and less destructive sampling. The complete protocol for this sampling method is found in Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume 2: Design, supplementary methods and interpretation.

Below are the User Pedon ID locations that were used to describe each community phase.

Community Phase 2.112497-203-34
12497-203-44 (Type location)
12497-203-47
12498-006-F

Community Phase 2.2

1249810213 (Type location)
12497-203-45

Community Phase 2.3
1249806946

Community Phase 3.1
1249800606

Community Phase 3.2
1249806905 (Type location)
1249806941

Type locality

Location 1: San Bernardino County, CA	
Township/Range/Section	T2S R7E S24
UTM zone	N
UTM northing	3760295
UTM easting	574035
General legal description	The site is approximately a half mile southeast of Stubbe-Randolph Road in Joshua Tree National Park in the in the SE 1/4 of section 24.

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Contributors

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Rangeland health reference sheet

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

Author(s)/participant(s)	Allison Tokunaga, Alice Miller, Dustin Detweiler and Marchel Munnecke.
Contact for lead author	
Date	03/01/2012
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be**

mistaken for compaction on this site):

---

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

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

---

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

---

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

---

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

---

17. **Perennial plant reproductive capability:**
