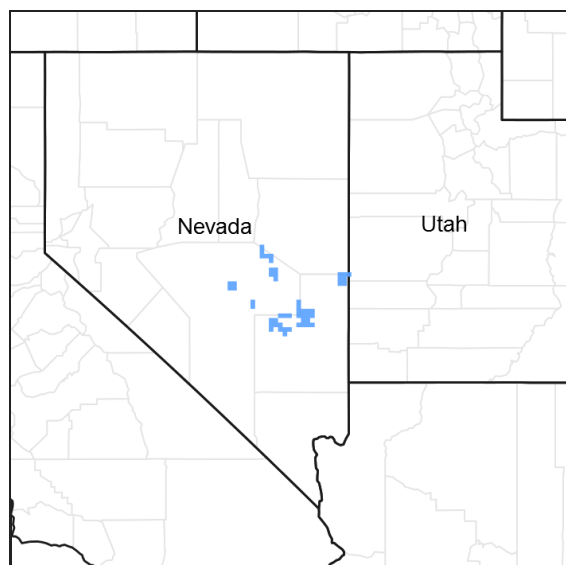


## **Ecological site R028AY024NV SODIC TERRACE 5-8 P.Z.**

Accessed: 05/13/2025

### **General information**

**Provisional.** A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.



**Figure 1. Mapped extent**

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

### **MLRA notes**

Major Land Resource Area (MLRA): 028A—Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

## Ecological site concept

This site occurs on alluvial flats and lake plain terraces. Slopes range from 0 to 4 percent. Elevations range from 5,600 to 6,000 feet.

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation ranges from 5 to 8 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 100 to 120 days.

The soils associated with this site are very deep, well drained, and have formed over lacustrine sediments. Soil textures are silt loams, loams and sandy loams. Soils are calcareous throughout and strongly saline. Runoff is very low to low, permeability is slow to moderately rapid and the available water holding capacity is low to moderate. The reference state is dominated by alkali sacaton and black greasewood. Shadscale, Indian ricegrass, and inland saltgrass are important species associated with this site. Production ranges from 300 to 700 pounds per acre.

## Associated sites

R028BY100NV	<b>DRY MEADOW 6-10 P.Z.</b>
-------------	-----------------------------

## Similar sites

R028AY103NV	<b>SHALLOW SODIC TERRACE 5-8 P.Z.</b> Less productive site; SAVE4 severely stunted, nearly prostrate in growth form
R028AY008NV	<b>SODIC TERRACE 8-10 P. Z.</b> ARTR2 codominant shrub
R028BY031NV	<b>WET CLAY TERRACE</b> SPAI-MURI codominant grasses; more productive site
R028BY074NV	<b>SODIC TERRACE 5-8 P.Z.</b> SAVE4-ATCO codominant shrubs; SPAI minor species, if present

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Sarcobatus vermiculatus</i>
Herbaceous	(1) <i>Sporobolus airoides</i>

## Physiographic features

This site occurs on alluvial flats and lake plain terraces. Slopes range from 0 to 4 percent. Elevations are 5600 to 6000 feet.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Alluvial flat
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	1,707–1,829 m
Slope	0–4%
Aspect	Aspect is not a significant factor

Climatic features

Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating. Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 5 to 8 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 100 to 120 days.

Mean annual precipitation at LAGES, NEVADA Station is 8.13 inches.

Monthly mean precipitaion is:  
January 0.59; February 0.6; March 0.76; April 0.92;  
May 0.92; June 0.65; July 0.71; August 0.46;  
September 0.63; October 0.94; November 0.5;  
December 0.46.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	110 days
Precipitation total (average)	178 mm

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are very deep, well drained, and have formed over lacustrine sediments. Soil textures are silt loams, loams and sandy loams. Soils are calcareous throughout and strongly saline. Runoff is very low to low, permeability is slow to moderately rapid and the available water holding capacity is low to moderate. Soil series associated with this site include: Cirac and Slaw.

The representative soil component is Slaw, silt loam (NV784, MU 1080), classified as a Fine-silty, mixed,

superactive, calcareous, mesic Typic Torrifluvents. Diagnostic horizons include an ochric epipedon from the soil surface to 7 inches. Clay content in the particle control section averages 18 to 35 percent. Reaction is strongly or very strongly alkaline. Effervescence is slightly to violently effervescent. Lithology consists of mixed rocks.

**Table 4. Representative soil features**

Surface texture	(1) Sandy loam (2) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to slow
Soil depth	152–213 cm
Surface fragment cover <=3"	0%
Available water capacity (0-101.6cm)	11.68–18.54 cm
Calcium carbonate equivalent (0-101.6cm)	1–4%
Electrical conductivity (0-101.6cm)	16–32 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	13–45
Soil reaction (1:1 water) (0-101.6cm)	8.5–9.6
Subsurface fragment volume <=3" (Depth not specified)	0–15%

## Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The Great Basin shrub communities have high spatial and temporal variability in precipitation, both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance.

Black greasewood is classified as a phreatophyte (Eddleman 2002), and its distribution is well correlated with the distribution of groundwater (Mozingo 1987). Meinzer (1927) discovered that the taproots of black greasewood could penetrate from 20 to 57 feet below the surface. Romo (1984) found water tables ranging from 3.5 to 15 m under black greasewood dominated communities in Oregon. Black greasewood stands develop best where moisture is readily available, either from surface or subsurface runoff (Brown 1965). It is commonly found on floodplains that are either subject to periodic flooding, have a high water table at least part of the year, or have a water table less than 34 feet deep (Harr and Price 1972, Blauer et al. 1976, Branson et al. 1976, Blaisdell and Holmgren 1984, Eddleman 2002). Ganskopp (1986) reported that water tables within 9.8 to 11.8 inches of the surface had no effect on black greasewood in Oregon. However, a study, conducted in California, found that black greasewood did not survive six months of continuous flooding (Groeneveld and Crowley 1988, Groeneveld 1990). Black greasewood is

usually a deep rooted shrub but has some shallow roots near the soil surface; the maximum rooting depth can be determined by the depth to a saturated zone (Harr and Price 1972).

Drought will initially cause a decline in bunchgrasses, but prolonged drought will eventually cause a decline in shrubs, including black greasewood. As site condition deteriorates, these sites may become a pure stand of black greasewood or a pure stand with an annual understory. Marcum and Kopec (1997) found inland saltgrass more tolerant of increased levels of salinity than alkali sacaton; thus, dewatering and/or long term drought that causes increased levels of salinity would create environmental conditions more favorable to inland saltgrass over alkali sacaton. Alkali sacaton is considered a facultative wet species in this region; it is not drought tolerant. A lowering of the water table can occur with ground water pumping in these sites and has been identified in other MLRAs. This may contribute to the loss of deep rooted species such as greasewood and basin wildrye, and an increase in rabbitbrush, shadscale and other species with the absence of drought.

Vegetation on these sites is normally restricted to coppice mound areas that are surrounded by playa-like depressions or nearly level, usually barren interspaces. These communities often exhibit the formation of microbiotic crusts within the interspaces. These crusts influence the soils on these sites and their ability to reduce erosion and increase infiltration. They may also alter the soil structure and possibly increase soil fertility (Fletcher and Martin 1948, Williams 1993). Finer textured soils, such as silts, tend to support more microbiotic cover than coarse-textured soils (Anderson et al. 1982). Disturbance such as hoof action from inappropriate grazing and cheatgrass invasion can reduce biotic crust integrity (Anderson et al. 1982, Ponzetti et al. 2007) and increase erosion. Annual non-native species such as Russian thistle, halogeton and cheatgrass invade these sites where competition from perennial species is decreased.

This ecological site has moderate resilience to disturbance and resistance to invasion. A primary disturbance on this site is extended drought or other disturbance leading to lowering of the seasonal water table. This facilitates an increase in shrubs and a decrease in basin wildrye. The introduction of annual weedy species, like cheatgrass, may cause an increase in fire frequency and eventually lead to an annual state or a state dominated by black greasewood and rabbitbrush. Three possible stable states have been identified for this site, though a fourth Annual State has been noted in other MLRAs.

#### Fire Ecology:

Fire is a rare disturbance in these salt-desert shrub communities, and likely occurs in years with above average production. Natural fire return intervals are estimated to vary between less than 35 years up to 100 years in salt-desert shrub ecosystems (Paysen et al. 2000). Historically, black greasewood-saltbush communities had sparse understories and bare soil in intershrub spaces, making these communities somewhat resistant to fire (Young 1983, Paysen et al. 2000). They may burn only during high fire hazard conditions; for example, years with high precipitation can result in almost continuous fine fuels, increasing fire hazard (West 1994, Paysen et al. 2000).

Black greasewood may be killed by severe fires, but can resprout after low to moderate severity fires (Robertson 1983, West 1994). Sheeter (1969) reported that following a Nevada wildfire, black greasewood sprouts reached approximately 2.5 feet within 3 years. Grazing and other disturbances may result in increased biomass production due to sprouting and increased seed production, which also leads to greater fuel loads (Sanderson and Stutz 1994). Higher production sites will experience fire more frequently than lower production sites.

Shadscale is intolerant of fire and can only regenerate through seed (Zielinski 1994). Increases in the fire return interval leads to increases in the shrub component of the plant community, potentially facilitating increases in bare ground, inland salt grass and invasive weeds. Lack of fire combined with excessive herbivory decreases or eliminates the herbaceous understory, favoring black greasewood and annual species. Therefore, fire can be detrimental to these communities, especially in the presence of fire tolerant, annual non-native species.

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire factor into individual species' responses. For most forbs and grasses, the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire; thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983). Season and severity of the fire will influence plant response, however. Plant response will vary depending on post-fire soil moisture availability.

Alkali sacaton, the dominant grass on this site, is a native, long-lived, warm season densely tufted perennial bunchgrass ranging from 20 to 40 inches in height. It usually grows on saline soils but is not restricted to saline soils and can be found on nonsaline soils, rocky sites, open plains, valleys and bottom lands (Dayton 1931). Alkali sacaton can tolerate fire but is not resistant to it. The recovery time of alkali sacaton after fire has been reported to be between two to four years (Bock and Bock 1978).

Indian ricegrass is fairly fire tolerant (Wright 1985), which is likely due to its low culm density and below-ground plant crowns. It is a minor component of this community. Indian ricegrass has been found to reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983, West 1994); thus, the presence of surviving, seed-producing plants is necessary for reestablishment of Indian ricegrass. Grazing management following fire to promote seed production and establishment of seedlings is important.

Basin wildrye, also a minor component on this site, is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. 2013 reports fall and spring burning increased total shoot and reproductive shoot densities in the first year, although live basal areas were similar between burn and unburned plants. By year two there was little difference between burned and control treatments.

## **State and transition model**

MLRA 28A  
Sodic Terrace 5-8"  
028AY024NV

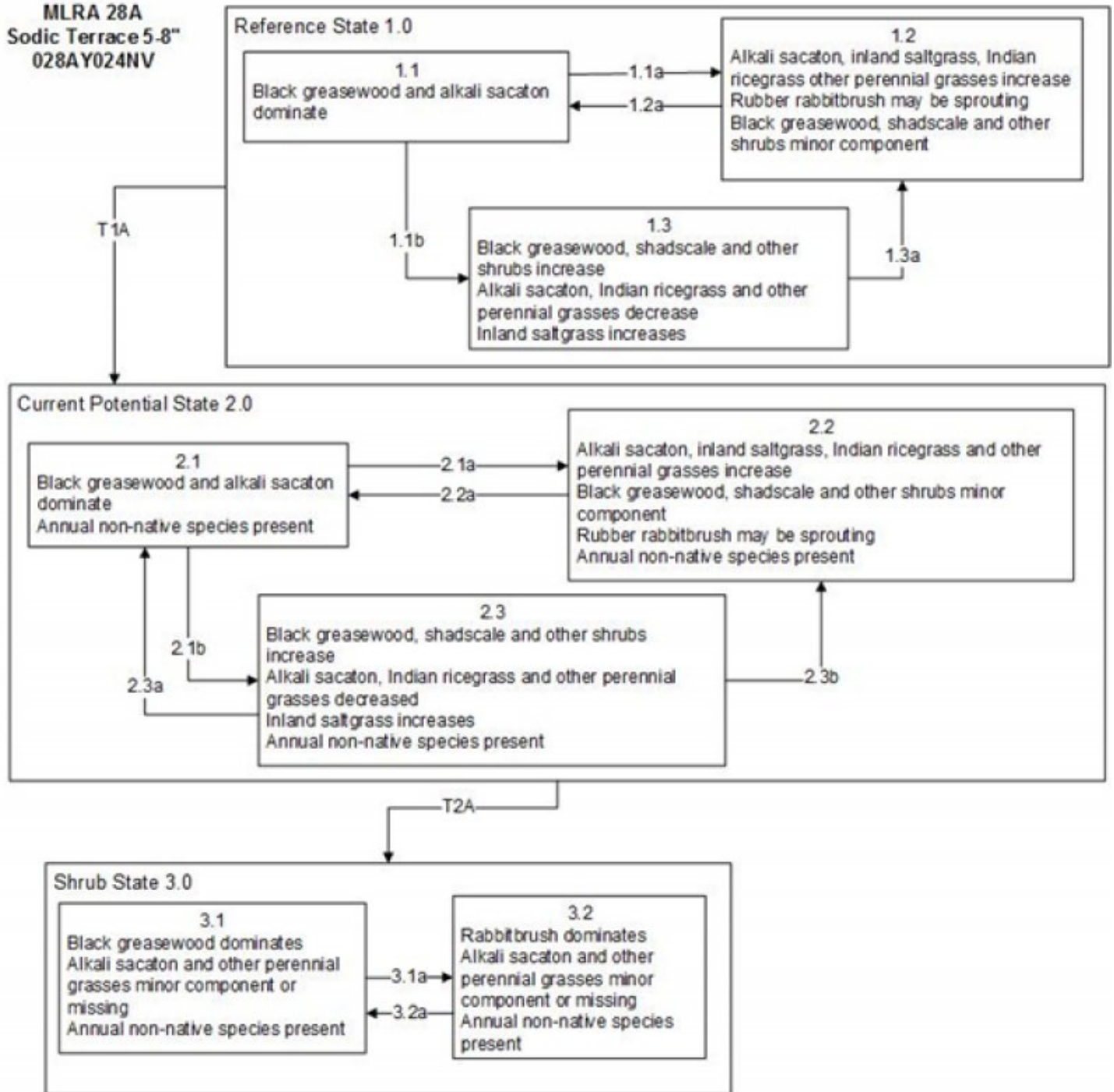


Figure 6. State and Transition Model

#### Reference State 1.0 Community Phase Pathways

- 1.1a: Low severity fire creates grass/shrub mosaic.
- 1.1b: Time and lack of disturbance, long-term drought, herbivory or combinations.
- 1.2a: Time and lack of disturbance allows for shrub regeneration.
- 1.3a: Fire significantly reduces shrub cover and leads to early/mid-seral community.

Transition T1A: Introduction of non-native species such as cheatgrass and halogeton.

#### Current Potential State 2.0 Community Phase Pathways

- 2.1a: Fire or brush treatments (i.e. mowing) with minimal soil disturbance.
- 2.1b: Time and lack of disturbance, long-term drought, inappropriate grazing management or combinations.
- 2.2a: Time and lack of disturbance allows for shrub regeneration, may be coupled with grazing management to increase shrubs.
- 2.3a: Heavy late fall/winter grazing, brush treatments and/or fire.

Transition T2A: Inappropriate grazing management would reduce the perennial understory(3.1). Severe fire, lowering of water table from groundwater pumping and/or soil disturbing brush treatments (3.2)

#### Shrub State 3.0 Community Phase Pathways

- 3.1a: Long-term drought and/or lowering of the water table due to groundwater pumping and/or severe fire.
- 3.2a: Release of drought and/or grazing pressure may allow for black greasewood and perennial bunchgrasses to increase

Figure 7. Legend

## State 1 Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. The Reference State has three general community phases; a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

## Community 1.1 Community Phase

This community is dominated by black greasewood. Shadscale is also common. The herbaceous understory is dominated by alkali sacaton. Inland saltgrass, basin wildrye and other perennial grasses and shrubs make up minor components. Potential vegetative composition is about 55% grasses, 5% forbs and 40% shrubs. Approximate ground cover (basal and crown) is 10 to 20 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	185	308	432
Shrub/Vine	135	224	314
Forb	17	28	39
<b>Total</b>	<b>337</b>	<b>560</b>	<b>785</b>



## **Community 1.2**

### **Community Phase**

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and alkali sacaton dominate the community. Black greasewood will decrease but will likely sprout and return to pre-burn levels within a few years. Early colonizers such as rabbitbrush and shadscale may increase.

## **Community 1.3**

### **Community Phase**

Black greasewood and shadscale increase in the absence of disturbance. Decadent shrubs dominate the overstory and deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs, herbivory, drought or combinations of these.

## **Pathway a**

### **Community 1.1 to 1.2**

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring facilitating an increase in fine fuels may be more severe and reduce black greasewood cover to trace amounts.

## **Pathway b**

### **Community 1.1 to 1.3**

Absence of disturbance over time, significant herbivory, chronic drought or combinations of these would allow the black greasewood overstory to increase and dominate the site. This will generally cause a reduction in perennial bunchgrasses; however inland saltgrass may increase in the understory depending on the timing and intensity of herbivory. Heavy spring utilization will favor an increase in black greasewood.

## **Pathway a**

### **Community 1.2 to 1.1**

Time and lack of disturbance will allow shrubs to increase

## **Pathway a**

### **Community 1.3 to 1.2**

Fire will decrease the overstory of black greasewood and allow for the perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads.

## **State 2**

### **Current Potential State**

This state is similar to the Reference State 1.0 with three similar community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

## **Community 2.1**

### **Community Phase**

This community phase is similar to the Reference State Community Phase 1.1. This community is dominated by

black greasewood. Shadscale and rubber rabbitbrush are also common. The herbaceous understory is dominated by alkali sacaton, inland saltgrass, basin wildrye and other perennial grasses are also common. Non-native annual species such as halogeton, Russian thistle and cheatgrass are present in minor amounts. Potential vegetative composition is approximately 50% grasses, 10% forbs and 40% shrubs.

## **Community 2.2**

### **Community Phase**

This community phase is characteristic of a post-disturbance, early-seral community where annual non-native species are present. Perennial bunchgrasses such as alkali sacaton, inland saltgrass and basin wildrye dominate the site. Depending on fire severity patches of intact shrubs may remain. Black greasewood and rabbitbrush may be sprouting. Annual non-native species are stable to increasing in the community.

## **Community 2.3**

### **Community Phase**

Black greasewood dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Annual non-native species are stable or increasing. This community is at risk of crossing a threshold to State 3.0 (grazing or fire).

## **Pathway a**

### **Community 2.1 to 2.2**

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce black greasewood cover to trace amounts. Brush treatments with minimal soil disturbance may also reduce black greasewood and allow for perennial bunchgrasses to increase. Annual non-native species are likely to increase after fire.

## **Pathway b**

### **Community 2.1 to 2.3**

Absence of disturbance over time, chronic drought, inappropriate grazing management or combinations of these would allow the black greasewood overstory to increase and dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely inland saltgrass may increase in the understory.

## **Pathway a**

### **Community 2.2 to 2.1**

Absence of disturbance over time and/or grazing management that favors the establishment and growth of black greasewood allows the shrub component to recover.

## **Pathway a**

### **Community 2.3 to 2.1**

Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing may cause mechanical damage to black greasewood promoting the perennial bunchgrass understory. Brush treatments with minimal soil disturbance will also decrease black greasewood and release the perennial understory. Annual non-native species are present and may increase in the community. A low severity fire would decrease the overstory of black greasewood (it said sagebrush) and allow for the understory perennial grasses to increase.

## **Pathway b**

### **Community 2.3 to 2.2**

Fire would reduce shrubs in the overstory and allow for the perennial bunchgrasses in the understory to increase.

### **State 3**

#### **Shrub State**

This state has two community phases, one that is characterized by a dominance of a black greasewood overstory and the other with a rabbitbrush overstory. This site has crossed a biotic and abiotic threshold and site processes are being controlled by shrubs. Bare ground has increased.

#### **Community 3.1**

##### **Community Phase**

Black greasewood dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses such as alkali sacaton have significantly declined. Annual non-native species increase. Bare ground is significant.

#### **Community 3.2**

##### **Community Phase**

Rabbitbrush dominates the site. Perennial bunchgrasses may be present but will be a minor component. Annual non-native species are present and may be increasing in the understory.

#### **Pathway a**

##### **Community 3.1 to 3.2**

Drought and/or lowering of water table by groundwater pumping would reduce black greasewood and alkali sacaton and allow for rabbitbrush and other shrubs on the site to dominate. Severe fire would also reduce black greasewood overstory and allow for an increase rabbitbrush.

#### **Pathway a**

##### **Community 3.2 to 3.1**

Release from drought and/or grazing pressure may allow for black greasewood, alkali sacaton and other perennial bunchgrasses to increase.

### **Transition A**

#### **State 1 to 2**

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, halogeton, and Russian thistle. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

### **Transition A**

#### **State 2 to 3**

Trigger: To Community Phase 3.1: Inappropriate grazing management will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. To Community Phase 3.2: Severe fire will reduce and/or eliminate black greasewood overstory and decrease perennial bunchgrasses. Soil disturbing brush treatments will reduce black greasewood and possibly increase non-native annual species. Lowering of the water table due to groundwater pumping will also decrease black greasewood and allow for rabbitbrush and other shrubs to increase. Slow variables: Long term decrease in deep-rooted perennial bunchgrasses density and/or black greasewood. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black greasewood changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

## Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Primary Perennial Grasses</b>			247–415	
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	224–280	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	11–45	–
	saltgrass	DISP	<i>Distichlis spicata</i>	11–45	–
2	<b>Secondary Perennial Grasses</b>			11–56	
	squirreltail	ELEL5	<i>Elymus elymoides</i>	3–17	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	3–17	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	3–17	–
<b>Forb</b>					
3	<b>Perennial</b>			11–45	
	globemallow	SPHAE	<i>Sphaeralcea</i>	3–11	–
	thelypody	THELY	<i>Thelypodium</i>	3–11	–
<b>Shrub/Vine</b>					
4	<b>Primary Shrubs</b>			123–241	
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	112–196	–
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	11–45	–
5	<b>Secondary Shrubs</b>			28–84	
	sickle saltbush	ATFA	<i>Atriplex falcata</i>	6–17	–
	Nevada jointfir	EPNE	<i>Ephedra nevadensis</i>	6–17	–
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i> var. <i>nauseosa</i>	6–17	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6–17	–
	bud sagebrush	PIDE4	<i>Picrothamnus desertorum</i>	6–17	–
	seepweed	SUAED	<i>Suaeda</i>	6–17	–

## Animal community

Livestock Interpretations:

This site is suitable for livestock grazing. Grazing considerations include timing, intensity, frequency, and duration of grazing.

Black greasewood is an important browse species for wildlife and livestock. In a study by Smith et al. (1992), utilization of new growth on greasewood shrubs by cattle was 77 percent in summer, and greasewood was found to have the highest amounts of crude protein when compared to perennial and annual grasses. Black greasewood plants have been found to contain high amounts of sodium and potassium oxalates which are toxic to livestock and caution should be taken when grazing these communities. These shrubs can be used lightly in the spring as long as there is a substantial amount of other preferable forage available (Benson et al. 2011). Shadscale is a valuable browse species for a wide variety of wildlife and livestock (Blaisdell and Holmgren 1984). The spinescent growth habit of shadscale lends to its browsing tolerance with no more than 15 to 20% utilization by sheep being reported (Blaisdell and Holmgren 1984) and significantly less utilization by cattle. Increased presence of shadscale within grazed versus ungrazed areas is generally a result of the decreased competition from more heavily browsed associates (Cibils et al. 1998). Reduced competition from more palatable species in heavily grazed areas may increase shadscale germination and establishment. Chambers and Norton (1993) found shadscale establishment

higher under spring than winter browsing as well as heavy compared to light browsing ( $p < 0.01$ ). During years of below average precipitation, shadscale has been found very susceptible to grazing pressure regardless of season (Chambers and Norton 1993).

Shadscale is a valuable browse species for a wide variety of wildlife and livestock (Blaisdell and Holmgren 1984). The spinescent growth habit of shadscale lends to its browsing tolerance with no more than 15 to 20% utilization by sheep being reported (Blaisdell and Holmgren 1984) and significantly less utilization by cattle. Increased presence of shadscale within grazed versus ungrazed areas is generally a result of the decreased competition from more heavily browsed associates (Cibils et al. 1998). Reduced competition from more palatable species in heavily grazed areas may increase shadscale germination and establishment. Chambers and Norton (1993) found shadscale establishment higher under spring than winter browsing as well as heavy compared to light browsing ( $p < 0.01$ ). During years of below average precipitation, shadscale has been found very susceptible to grazing pressure regardless of season (Chambers and Norton 1993).

Alkali sacaton has been found to be sensitive to early growing season defoliation whereas late growing season and/or dormant season use allowed recovery of depleted stands (Hickey and Springfield 1966). Shadscale, squirreltail, and saltgrass will eventually decline with continued inappropriate grazing. Thus, inadequate rest and recovery from defoliation can cause a decrease in basin wildrye and an increase in rabbitbrush and black greasewood, along with inland saltgrass and non-native weeds (Young et al. 1976, Roundy 1985).

Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Basin wildrye is valuable forage for livestock (Ganskopp et al. 2007) and wildlife, but is intolerant of heavy, repeated, or spring grazing (Krall et al. 1971). Basin wildrye is used often as a winter feed for livestock and wildlife; not only providing roughage above the snow but also cover in the early spring months (Majerus 1992).

#### Wildlife Interpretations:

Salt-desert shrub communities provide valuable habitat for a number of species. Black greasewood dominates the salt desert shrub-type habitat, generally bordering areas that are dominated by sagebrush species. Black greasewood is an important winter cover and browse plant for wildlife. (Nevada Wildlife Action Plan 2012, Dayton 1931, Austin and Hash 1988, Johnson 1979).

Ungulates, such as pronghorns (*Antilocapra americana*), browse black greasewood. Trace amounts of black greasewood were identified in the feces of pronghorn (seasonal preference was not determined) in a microhistology study by Johnson (1979). Furthermore, pronghorn and mule deer that occurred in greasewood habitat, utilized greasewood for cover, although the study did not determine if black greasewood was a desirable forage (Hanley and Hanley 1982). Other studies indicated that although mule deer (*Odocoileus hemionus*) and pronghorn do not prefer black greasewood as forage, the ungulates use black greasewood habitat as cover (Oedekoven and Lindzey 1987). Further, mule deer find fawning cover and travel corridors in black greasewood communities (USDA, Ecological Site Interpretation).

Small mammals will also utilize black greasewood. For example, trace amounts of black greasewood were identified in the feces of black-tailed jack rabbits (*Lepus californicus*), seasonal preference was not determined (Johnson 1979). A study in the Great Basin by Feldhamer (1979) found that pocket mice (*Perognathus parvus*) and chipmunk (*Tamias* spp.) populations were restricted to plant communities dominated by black greasewood. Furthermore, black greasewood habitat is documented as used in minor amounts by other small mammals including voles, chipmunks, porcupines (*Erethizon dorsatum*), and raccoons (*Procyon lotor*) (Anderson 2004). Soils of this habitat tend to be loose and either sandy or gravelly and are often easy to dig making them attractive to species such as the pale kangaroo mouse (*Microdipodops pallidus*) (Nevada Wildlife Action Plan 2012). This habitat is also an important feeding ground for pallid bats (*Antrozous pallidus*), which eat scorpions and other large invertebrates off its exposed desert flats (Nevada Wildlife Action Plan 2012).

Black greasewood provides cover and nest sites for several species of birds. Bird species, such as the sage sparrow (*Amphispiza belli*) and lark buntings (*Calamospiza melanocorys*), are known to utilize black greasewood habitat (Wiens and Rotenberry 1981). The loggerhead shrike (*Lanius ludovicianus*) will use black greasewood for nesting and cover. Burrowing owls (*Athene cunicularia*) will use the loose soils for burrowing. Bald eagles (*Haliaeetus leucocephalus*) and prairie falcons (*Falco mexicanus*) winter in the valley bottoms where black greasewood occurs, preying on jack rabbits, and other rodents (Nevada Wildlife Action Plan 2012).

Reptiles and amphibians also occur in black greasewood habitats. Western rattlesnakes (*Crotalus viridis*) and gopher snakes (*Pituophis catenifer*) were recorded in greasewood habitat in a study by Diller and Johnson (1988). Reptile species including: eastern racers (*Coluber constrictor*), ringneck snakes (*Diadophis punctatus*), night snakes (*Hypsiglena torquata*), Sonoran mountain kingsnakes (*Lampropeltis pyromelana*), striped whipsnakes

(*Masticophis taeniatus*), long-nosed snakes (*Rhinocheilus lecontei*), wandering gartersnakes (*Thamnophis elegans vagrans*), sidewinders (*Crotalus cerastes*), Great Basin rattlesnakes (*Crotalus oreganus*), Great Basin collared lizard (*Crotaphytus bicinctores*), long-nosed leopard lizard (*Gambelia wislizenii*), short-horned lizard (*Phrynosoma hernandesi*), desert-horned lizard (*Phrynosoma platyrhinos*), western fence lizards (*Sceloporus occidentalis*), northern side-blotched lizards (*Uta stansburiana nevadensis*), banded gecko (*Coleonyx variegatus*), desert iguana (*Dipsosaurus dorsalis*), chuckwalla (*Sauromalus ater*), zebra-tailed lizard (*Callisaurus draconoides*), pigmy horned-lizard (*Phrynosoma douglasii*), desert night lizard (*Xantusia vigilis*), whip-tailed lizard (*Aspidoscelis uniparens*) and western skinks (*Plestiodon skiltonianus*) occur in areas where black greasewood habitat is prominent. Similarly, amphibians such as: western toads, (*Anaxyrus boreas*) Woodhouse's toads (*Anaxyrus woodhousii*), northern leopard frogs (*Lithobates pipiens*), Columbia spotted frogs (*Rana luteiventris*), bullfrogs (*Lithobates catesbeianus*), and Great Basin spadefoots (*Spea intermontana*), California toads (*Anaxyrus boreas halophilus*), Amargosa toads (*Anaxyrus nelsoni*), great plains toads (*Anaxyrus cognatus*), Sonoran toads (*Anaxyrus alvarius*), red-spotted toads (*Anaxyrus punctatus*) and mountain toad (*Anaxyrus cavifrons*), also occur throughout the Great Basin in areas black greasewood species are dominant (Hamilton 2004).

Basin wildrye provides winter forage for mule deer, though use is often low compared to other native grasses. Basin wildrye provides summer forage for black-tailed jackrabbits. Because basin wildrye remains green throughout early summer, it remains available for small mammal forage for longer time than other grasses.

Indian ricegrass is eaten by pronghorn in "moderate" amounts whenever available. In Nevada it is consumed by desert bighorns. A number of heteromyid rodents inhabiting desert rangelands show preference for seed of Indian ricegrass. Indian ricegrass is an important component of jackrabbit diets in spring and summer. In Nevada, Indian ricegrass may even dominate jackrabbit diets during the spring through early summer months. Indian ricegrass seed provides food for many species of birds. Doves, for example, eat large amounts of shattered Indian ricegrass seed lying on the ground.

Saltgrass provides cover for a variety of bird species, small mammals, and arthropods and is on occasion used as forage for several big game wildlife species.

Bottlebrush squirreltail is a dietary component of several wildlife species including mule deer and pronghorn.

## Hydrological functions

Runoff is very slow. Permeability is moderately slow. Water flow paths are relatively short and meandering. Deep-rooted bunchgrasses reduce runoff and aid in infiltration. Shrub canopies aid in snow capture.

## Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition. This site offers rewarding opportunities to photographers and for nature study. This site is used for hiking and has potential for upland and big game hunting.

## Other products

The leaves, seeds and stems of black greasewood are edible. Seeds of shadscale were used by Native Americans of Arizona, Utah and Nevada for bread and mush. Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source.

## Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates processed oil shale and is commonly found on eroded areas and sites too saline for most plant species. Alkali sacaton is one of the most commonly used species for seeding and stabilizing disturbed lands. Due to alkali sacaton's salt tolerance, is recommended for native grass seeding on subirrigated saline sites. Given its extensive system of rhizomes and roots which form a dense sod, saltgrass is considered a suitable species for controlling wind and water erosion.

## Type locality

Location 1: Elko County, NV	
Township/Range/Section	T34N R63E S11
General legal description	SW¼SW¼ Section 11, T34N. R63E. MDBM. Approximately 4 miles southeast of Tobar and about 1½ miles west of Ventosa, Independence Valley/Clover Valley area, Elko County, Nevada.

## Other references

- Anderson, D. C., K. T. Harper, and S. R. Rushforth. 1982. Recovery of Cryptogamic Soil Crusts from Grazing on Utah Winter Ranges. *Journal of Range Management* 35:355-359.
- Benson, B., D. Tilley, D. Ogle, L. St. John, S. Green, J. Briggs. 2011. Plant Guide: Black Greasewood. In: Plants database. U. S. Department of Agriculture, Natural Resources Conservation Service, Boise, ID.
- Blaisdell, J. P. and R. C. Holmgren. 1984. Managing Intermountain rangelands -- salt-desert shrub ranges. Gen. Tech. Rep. INT-163. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Blauer, A. C., A. P. Plummer, E. D. McArthur, R. Stevens, and B. C. Giunta. 1976. Characteristics and hybridization of important Intermountain shrubs. II. Chenopod family. USDA For Serv Res Pap INT US Dep Agric Intermt For Range Exp Stn.
- Branson, F. A., R. F. Miller, and I. S. McQueen. 1976. Moisture Relationships in Twelve Northern Desert Shrub Communities Near Grand Junction, Colorado. *Ecology* 57:1104-1124.
- Brown, R. W. 1965. The distribution of plant communities in the Badlands of southeastern Montana. Dissertation. Montana State University, Bozeman, Montana.
- Bock, C. E. and J. H. Bock. 1978. Response of birds, small mammals, and vegetation to burning sacaton grasslands in southeastern Arizona. *Journal of Range Management Archives* 31:296-300.
- Caudle, D., J. DiBenedetto, M. Karl, H. Sanchez, and C. Talbot. 2013. Interagency ecological site handbook for rangelands. Available at: <http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf>. Accessed 4 October 2013.
- Chambers, J., B. Bradley, C. Brown, C. D'Antonio, M. Germino, J. Grace, S. Hardegree, R. Miller, and D. Pyke. 2013. Resilience to Stress and Disturbance, and Resistance to *Bromus tectorum* L. Invasion in Cold Desert Shrublands of Western North America. *Ecosystems*:1-16.
- Chambers, J. C. and B. E. Norton. 1993. Effects of grazing and drought on population dynamics of salt desert species on the Desert Experimental Range, Utah. *Journal of Arid Environments*:261-275.
- Cibils, A. F., S. M. David, and D. E. McArthur. 1998. Plant-Herbivore Interactions in Atriplex: Current State of Knowledge. General Technical Report RMRS-GTR-14, USDA: FS, Rocky Mountain Research Station, Ogden, UT.
- Dayton, W. A. 1937. Important western browse plants. United States Department of Agriculture.
- Eckert, R. E., Jr., A. D. Bruner, and G. J. Klomp. 1973. Productivity of Tall Wheatgrass and Great Basin Wildrye under Irrigation on a Greasewood-Rabbitbrush Range Site. *Journal of Range Management* 26:286-288.
- Eddleman, L. E. 2002. *Sarcobatus vermiculatus* (Hook.) Torr.: Black greasewood. .in F. T. Bonner, editor. Woody plant seed manual. Department of Agriculture, Forest Service, Washington, DC.
- Fire Effects Information System (Online; <http://www.fs.fed.us/database/feis/plants/>).
- Fletcher, J. E. and W. P. Martin. 1948. Some Effects of Algae and Molds in the Rain-Crust of Desert Soils. *Ecology* 29:95-100.
- Ganskopp, D., L. Aguilera, and M. Vavra. 2007. Livestock forage conditioning among six northern Great Basin grasses. *Rangeland Ecology & Management* 60:71-78.

Ganskopp, D. C. 1986. Tolerances of Sagebrush, Rabbitbrush, and Greasewood to Elevated Water Tables. *Journal of Range Management* 39:334-337.

Groeneveld, D. P. 1990. Shrub rooting and water acquisition to threatened shallow groundwater habitats in the Owens Valley, California. Pages 221-237 in *Proceedings -- symposium on cheatgrass incursion, shrub die-off, and other aspects of shrub biology and management* Gen. Tech. Rep. INT-276. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Las Vegas, NV.

Groeneveld, D. P. and D. E. Crowley. 1988. Root System Response to Flooding in Three Desert Shrub Species. *Functional Ecology* 2:491-497.

Harr, R. D. and K. R. Price. 1972. Evapotranspiration from a Greasewood-Cheatgrass community. *Water Resources Research* 8:1199-1203.

Hickey, W. C., Jr. and H. W. Springfield. 1966. Alkali sacaton: Its merits for forage and cover. *Journal of Range Management* 19:71-74.

Holmgren, R. C. and S. S. Hutchings. 1972. Salt desert shrub response to grazing use. Pages 153-165 in *Wildland shrubs- their biology and utilization*. Gen. Tech. Rep. INT-1. U.S. Department of Agriculture, Intermountain Forest and Range Experiment Station.

Houghton, J.G., C.M. Sakamoto, and R.O. Gifford. 1975. Nevada's Weather and Climate, Special Publication 2. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, NV.

Krall, J. L., J. R. Stroh, C. S. Cooper, and S. R. Chapman. 1971. Effect of time and extent of harvesting basin wildrye. *Journal of Range Management*:414-418.

Lei, S. A. 1999. Effects of severe drought on biodiversity and productivity in a creosote bush-blackbrush ecotone of southern Nevada. Pages 217-221 in *Proceedings: shrubland ecotones*. RMRS-P-11. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ephraim, UT.

Majerus, M. E. 1992. High-stature grasses for winter grazing. *Journal of soil and water conservation* 47:224-225.

Marcum, K. B. and D. M. Kopec. 1997. Salinity tolerance of turfgrasses and alternative species in the subfamily Chloridoideae (Poaceae). *International Turfgrass Society Research Journal* 8:735-742.

Meinzer, C.E. 1927. Plants as indicators of ground water. USGS Water Supply Paper 577.

Mozingo, H. N. 1987. Shrubs of the Great Basin: A natural history. Pages 67-72 in H. N. Mozingo, editor. *Shrubs of the Great Basin*. University of Nevada Press, Reno NV.

National Oceanic and Atmospheric Administration. 2004. The North American Monsoon. Reports to the Nation. National Weather Service, Climate Prediction Center. Available online: <http://www.weather.gov/>

Paysen, T. E., R. J. Ansley, J. K. Brown, G. J. Gottfried, S. M. Haase, M. G. Harrington, M. G. Narog, S. S. Sackett, and R. C. Wilson. 2000. Fire in western shrubland, woodland, and grassland ecosystems. Pages 121-159 in *Wildland fire in ecosystems: Effects of fire on flora*. Gen. Tech. Rep. RMRS-GTR-42-volume 2. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.

Ponzetti, J. M., B. McCune, and D. A. Pyke. 2007. Biotic Soil Crusts in Relation to Topography, Cheatgrass and Fire in the Columbia Basin, Washington. *The Bryologist* 110:706-722.

Robberecht, R. and G. Defossé. 1995. The relative sensitivity of two bunchgrass species to fire. *International Journal of Wildland Fire* 5:127-134.

Robertson, J. 1983. Greasewood (*Sarcobatus vermiculatus* (Hook.) Torr.). *Phytologia* 54:309-324.

Romo, J. T. 1984. Water relations in *Artemisia tridentata* subsp. *wyomingensis*, *Sarcobatus vermiculatus*, and



*Kochia prostrata*. Oregon State University, Corvallis, OR.

Roundy, B. A. 1985. Emergence and Establishment of Basin Wildrye and Tall Wheatgrass in Relation to Moisture and Salinity. *Journal of Range Management* 38:126-131.

Sanderson, S. C. and H. C. Stutz. 1994. Woody chenopods useful for rangeland reclamation in western North America. Pages 374-378 in *Proceedings-- ecology and management of annual rangelands*. Gen. Tech. Rep. INT-GTR-313. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Boise, ID.

Schultz, B. W. and K. W. Ostler. 1995. Effects of prolonged drought on vegetation associations in the northern Mojave Desert. Pages 228-235 in *Proceedings: wildland shrub and arid land restoration symposium*. Gen. Tech. Rep. INT-GTR-315. U. S. Department of Agriculture, Forest Service, Intermountain Research Station, Las Vegas, NV.

Sheeter, G.R. 1968. Secondary succession and range improvements after wildfire in northeastern Nevada. Reno, NV: University of Nevada. 203 p. Thesis.

Smith, M. A., J. D. Rodgers, J. L. Dodd, and Q. D. Skinner. 1992. Habitat Selection by Cattle along an Ephemeral Channel. *Journal of Range Management* 45:385-390.

Stringham, T.K., P. Novak-Echenique, P. Blackburn, C. Coombs, D. Snyder and A. Wartgow. 2015. Final Report for USDA Ecological Site Description State-and-Transition Models, Major Land Resource Area 28A and 28B Nevada. University of Nevada Reno, Nevada Agricultural Experiment Station Research Report 2015-01. p. 1524.

Stuart, D. M., G. E. Schuman, and A. S. Dylla. 1971. Chemical Characteristics of the Coppice Dune Soils in Paradise Valley, Nevada<sup>1</sup>. *Soil Sci. Soc. Am. J.* 35:607-611.

USDA-NRCS Plants Database (Online; <http://www.plants.usda.gov>).

Vest, E. D. 1962. Biotic communities in the Great Salt Lake desert. University of Utah, Institute of Environmental Biological Research.

West, N. E. 1994. Effects of fire on salt-desert shrub rangelands. in *Proceedings--Ecology and Management of Annual Rangelands*, General Technical Report INT-313. USDA Forest Service, Intermountain Research Station, Boise, ID.

Williams, J. D. 1993. Influence of microphytic crusts on selected soil physical and hydrologic properties in the Hartnet Draw, Capital Reef National Park Utah. Utah State University.

Wright, H. A. 1971. Why Squirreltail Is More Tolerant to Burning than Needle-and-Thread. *Journal of Range Management* 24:277-284.

Wright, H. A. 1985. Effects of fire on grasses and forbs in sagebrush-grass communities. In: K.E. Sanders [ed.] *Rangeland Fire Effects; A Symposium: proceedings of a symposium sponsored by Bureau of Land Management and University of Idaho at Boise Idaho*. Boise, ID, USDI-BLM. P. 12-21.

Young, J. A. and R. A. Evans. 1981. Germination of Great Basin Wildrye Seeds Collected from Native Stands. *Agron. J.* 73:917-920.

Young, J. A., R. A. Evans, and P. T. Tueller. 1976. Great Basin plant communities-pristine and grazed. Holocene environmental change in the Great Basin. Nevada Archeological Survey Research Paper 6:186-215.

Young, R. P. 1983. Fire as a vegetation management tool in rangelands of the intermountain region. Pages 18-31 in *Managing intermountain rangelands - improvement of range and wildlife habitats*. USDA, Forest Service.

Zielinski, M. J. 1994. Controlling erosion on lands administered by the Bureau of Land Management, Winnemucca District, Nevada. Pages 143-146 in *Proceedings - ecology and management of annual rangelands* Gen. Tech. Rep. INT-GTR-313. USDA, Forest Service, Intermountain Research Station, Boise ID.

Zschaechner, G. A. 1985. Studying rangeland fire effects: a case study in Nevada. Pages 66-84 in Rangeland fire effects, a symposium. Bureau of Land Management, Boise, Idaho.

## Contributors

RK  
T Stringham  
P NovakEchenique

## Rangeland health reference sheet

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

Author(s)/participant(s)	P. Novak-Echenique
Contact for lead author	State Rangeland Management Specialist
Date	10/28/2013
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

- 1. Number and extent of rills:** This site is nearly flat, thus rills are non-existent.

---
- 2. Presence of water flow patterns:** Water flow patterns are common in areas subjected to summer convection storms. Flow patterns not extensive, short (<3m), meandering and stable.

---
- 3. Number and height of erosional pedestals or terracettes:** Pedestals are none to rare with occurrence typically limited to areas within water flow patterns.

---
- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground  $\pm$  60 to 80%

---
- 5. Number of gullies and erosion associated with gullies:** None

---
- 6. Extent of wind scoured, blowouts and/or depositional areas:** Typically none - wind scouring may occur during severe wind events prior to summer convection storms or winter storms.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.
- 
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. Areas of this site occurring on soils that have a physical crust will probably have stability values less than 3.
- 
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically fine platy. Soil surface colors are light yellowish browns and soils are typified by an ochric epipedon. Surface textures are loams and silt loams. Organic matter of the surface 2 to 3 inches is less than 1 percent.
- 
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Shrub canopy and associated litter break raindrop impact and provide for snow capture on this site. Deep-rooted, perennial grasses (alkali sacaton) enhance infiltration and reduce runoff.
- 
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Platy or massive sub-surface horizons are not to be interpreted as compacted layers.
- 
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: Reference State: Deep-rooted, warm season perennial bunchgrass (alkali sacaton)
- Sub-dominant: tall shrubs (black greasewood) > associated shrubs > deep-rooted, cool season perennial bunchgrasses > warm-season, rhizomatous grasses = perennial forbs.
- Other: Cool season rhizomatous grasses and annual forbs. Microbiotic crusts
- Additional:
- 
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 35% of total woody canopy; mature bunchgrasses commonly ( $\pm 25\%$ ) have dead centers.
- 
14. **Average percent litter cover (%) and depth ( in):** Between plant interspaces (10-20%) and depth ( $< \frac{1}{4}$  in.)
- 
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (thru June)  $\pm 500$  lbs/ac; Favorable years  $\pm 700$  lbs/ac and unfavorable years  $\pm 300$  lbs/ac.

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

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average and above average growing season years. Reduced growth and reproduction occurs during extended or extreme drought periods.
-