USDA Natural Resources Conservation Service

Ecological site R028AY030NV
SILTY 8-10 P.Z.

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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.

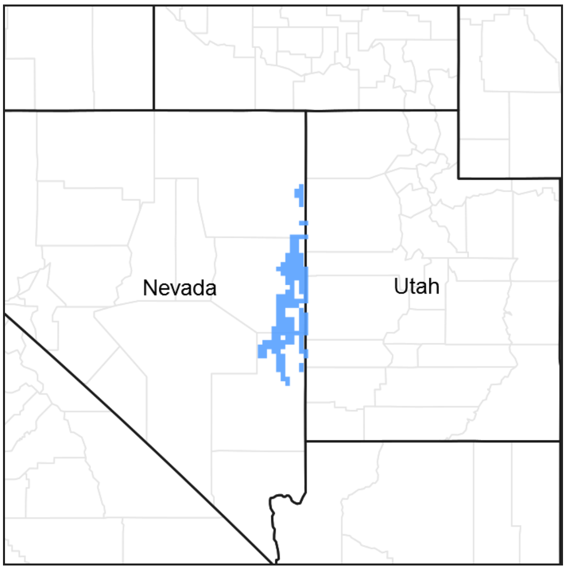

Figure 1. Mapped extent

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): 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 fan remnants, fan skirts, alluvial flats, basin floors, lake plains, inset fans and stream terraces. Slopes gradients of 2 to 8 percent are most typical. Elevations are 4400 to 6600 feet.

Average annual precipitation is 8 to 10(11) inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to 120 days.

The soils associated with the site are very deep and well to somewhat excessively drained. Permeability is moderate to moderately rapid with low to high available water holding capacity.

The reference state is dominated by winterfat and Indian ricegrass. Other commonly associated plants are fourwing saltbush, bud sagebrush, shadscale, squirreltail and galleta. Production ranges from 350 to 700 pounds per acre.

Associated sites

R028AY013NV	**SHALLOW CALCAREOUS LOAM 8-10 P.Z.**
R028AY015NV	**LOAMY 8-10 P.Z.**
R028AY031NV	**LOAMY FAN 8-10 P.Z.**
R028AY032NV	**DROUGHTY SODIC LOAM**
R028AY033NV	**SALINE TERRACE 8-10 P.Z.**

Similar sites

R028BY018NV	**SILTY 5-8 P.Z.** PLJA rare to absent and is not an "increaser" species
R028BY084NV	**COARSE SILTY 6-8 P.Z.** PLJA rare to absent and is not an "increaser" species
R028AY002NV	**COARSE SILTY 5-8 P.Z.** ACHY dominant plant
R028BY013NV	**SILTY 8-10 P.Z.** PLJA rare to absent and is not an "increaser" species

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Krascheninnikovia lanata*
Herbaceous	(1) *Achnatherum hymenoides*

Physiographic features

This site occurs on fan remnants, fan skirts, alluvial flats, basin floors, lake plains, inset fans and stream terraces. Slopes gradients of 2 to 8 percent are most typical. Elevations range from 4400 to 6600 feet.

Table 2. Representative physiographic features

Landforms	(1) Fan remnant (2) Lake plain (3) Stream terrace
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	Rare
Ponding frequency	None

Elevation	1,646–2,012 m
Slope	2–8%
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).

Average annual precipitation is 8 to 10(11) inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to 120 days.

Mean annual preciptiation at OASIS, NEVADA (265722) Climate station is 8.58 inches.

Monthly mean precipitation is:
January 0.65; February 0.58; March 0.69;
April 0.96; May 1.23; June 0.94; July 0.46;
August 0.62; September 0.47; October 0.76;
November 0.63; December 0.59.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	110 days
Precipitation total (average)	254 mm

Influencing water features

Additional moisture may be received on this site as overflow from adjacent ephemeral streams or as run-in from higher landscapes.

Soil features

The soils associated with the site are very deep and well to somewhat excessively drained. Permeability is moderate to moderately rapid with low to high available water holding capacity. Additional moisture may be received on this site as overflow from adjacent ephemeral streams or as run-in from higher landscapes. Potential for sheet and rill erosion is slight; however, this soil has a potential for formation of gullies, especially in areas near shallow drainage ways. The soil moisture regime is typic aridic and the soil temperature regime is mesic. Soil series associated with this site include: Bienfait, Linoyer, Penoyer, and Toano.

The representative soil series is Bienfait, classified as a Sandy, mixed, mesic Sodic Haplocambids. Diagnostic horizons include an ochric epipedon from the soil surface to 7 inches and a cambic horizon from 7 to 12 inches. Identifiable secondary carbonates occur from 12 to 60 inches. Clay content in the particle control section averages 2 to 7 percent. Rock fragments range from 5 to 25 percent, mainly gravel. Reaction is moderately alkaline or very strongly alkaline. Effervescence is violently effervescent. Lithology consists of quartz monzonite.

Table 4. Representative soil features

Parent material	(1) Alluvium–quartz-monzonite (2) Alluvium–limestone
Surface texture	(1) Coarse sandy loam (2) Gravelly sandy loam (3) Sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	183–213 cm
Surface fragment cover <=3"	2–30%
Surface fragment cover >3"	4–5%
Available water capacity (0-101.6cm)	9.91–20.07 cm
Calcium carbonate equivalent (0-101.6cm)	3–40%
Electrical conductivity (0-101.6cm)	0–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–60
Soil reaction (1:1 water) (0-101.6cm)	8.4–9.5
Subsurface fragment volume <=3" (Depth not specified)	2–20%
Subsurface fragment volume >3" (Depth not specified)	4–5%

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).
This ecological site is dominated by deep-rooted cool season, perennial bunchgrasses and drought tolerant shrubs with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which Fernandez and Caldwell (1975) reported as between 80 and 110 cm for shadscale and winterfat. Winterfat and shadscale initiate root growth in early April, a few days to a week prior to aerial plant parts.
Winterfat reproduces from seed and primarily pollinates via wind (Stevens et al. 1977). Seed production, especially in desert regions, is dependent on precipitation (West and Gasto 1978) with good seed years occurring when there

is appreciable summer precipitation and little browsing (Stevens et al. 1977). Winterfat has multiple dispersal mechanisms: diaspores are shed in the fall or winter, dispersed by wind, rodent-cached, or carried on animals (Majerus 2003). Diaspores take advantage of available moisture, tolerating freezing conditions as they progress from imbibed seeds to germinants to nonwoody seedlings (Booth 1989). Under some circumstances, the degree of reproduction may be dependent on mature plant density (Freeman and Emlen 1995).

Drought will initially cause a decline in bunchgrasses. Prolonged drought will cause a decline in shrubs, including shadscale and black greasewood, while annual weedy species and bare ground will increase. Shadscale is less adapted to drought than many of its common associates (Vest 1962, Holmgren and Hutchings 1972), showing high mortality during periods of prolonged drought (Schultz and Ostler 1995). Tolerance to drought is achieved through partial shedding of leaves; this reduces water loss during severe moisture stress (Lei 1999).
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. Historically, salt-desert shrub communities were free of exotic invaders; however, excessive grazing pressure during settlement and into the 20th century has increased the overall presence of cheatgrass, halogeton, Russian thistle and weedy mustard species (Peters and Bunting 1994). The presence of exotic annual plants within these ecosystems decreases ecosystem resilience and resistance to disturbance through competition for limited resources. Dobrowolski et al. (1990) cite multiple authors on the extent of the soil profile exploited by the competitive exotic annual cheatgrass: Specifically, the depth of rooting is dependent on the size the plant achieves and in competitive environments, cheatgrass roots were found to penetrate only 15 cm whereas isolated plants and pure stands were found to root at least 1 m in depth with some plants rooting as deep as 1.5 to 1.7 m.

Annual non-native species such as halogeton and cheatgrass invade these sites where competition from perennial species is decreased. Three possible stable states have been identified for this site, though a fourth Annual State has been noted in other MLRAs.

Fire Ecology:
Historically, salt-desert shrub 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 from the herbaceous component, increasing the fire hazard (West 1994, Paysen et al. 2000).
Winterfat tolerates environmental stress, extremes of temperature and precipitation, and competition from other perennials but not the disturbance of fire or overgrazing (Ogle et al. 2001). Fire is rare within these communities due to low fuel loads. There are conflicting reports in the literature about the response of winterfat to fire. In one of the first published descriptions, Dwyer and Pieper (1967) reported that winterfat sprouts vigorously after fire. This observation was frequently cited in subsequent literature, but recent observations have suggested that winterfat can be completely killed by fire (Pellant and Reichert 1984). The response is apparently dependent on fire severity. Winterfat is able to sprout from buds near the base of the plant. However, if these buds are destroyed, winterfat will not sprout. In addition, research has shown that winterfat seedling growth is depressed in growth by at least 90% when growing in the presence of cheatgrass (Hild et al. 2007). Repeated, frequent fires will increase the likelihood of conversion to a non-native, annual plant community with trace amounts of winterfat.
Bud sagebrush, a minor component of this ecological site, is a native, summer-deciduous shrub. It is a low growing, spinescent, aromatic shrub with a height of 4 to 10 inches and a spread of 8 to 12 inches (Chambers and Norton 1993). Bud sagebrush is fire intolerant and must reestablish from seed (Banner 1992, West 1994).
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 all factor into the individual species response. The growing points for most forbs and grasses 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). However, season and severity of the fire and post-fire soil moisture availability will influence plant response.
Indian ricegrass is a deep-rooted, cool season perennial bunchgrass that is adapted primarily to sandy soils and is dominant on this ecological site. It is fairly fire tolerant (Wright 1985), which is likely due to its low culm density and below ground plant crowns. Vallentine (1989) cites several studies in the sagebrush zone that classified Indian ricegrass as being slightly damaged from late summer burning. Indian ricegrass has also been found to reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983, West 1994); therefore, the presence of surviving, seed producing plants facilitates the reestablishment of Indian ricegrass. Grazing

management following fire to promote seed production and establishment of seedlings is important.
Galleta grass has been found to increase following fire likely due to its rhizomatous root structure and ability to resprout (Jameson 1962). This mat-forming grass species may retard reestablishment of deeper rooted bunchgrasses. Repeated frequent fire in this community will significantly reduce shadscale, bud sagebrush and winterfat while promoting establishment of an annual weed community with varying amounts of galleta, spiny hopsage, horsebrush, snakeweed and rabbitbrush.

Bottlebrush squirreltail, another cool-season, native perennial bunchgrass is common to this ecological site. Bottlebrush squirreltail is considered more fire tolerant than Indian ricegrass due to its small size, coarse stems, and sparse leafy material (Britton et al. 1990). Postfire regeneration occurs from surviving root crowns and from on- and off-site seed sources. Bottlebrush squirreltail has the ability to produce large numbers of highly germinable seeds, with relatively rapid germination (Young and Evans 1977) when exposed to the correct environmental cues. Early spring growth and ability to grow at low temperatures contribute to the persistence of bottlebrush squirreltail among cheatgrass dominated ranges (Hironaka and Tisdale 1973).
Sandberg bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may also hinder reestablishment of deeper rooted bunchgrasses.

State and transition model

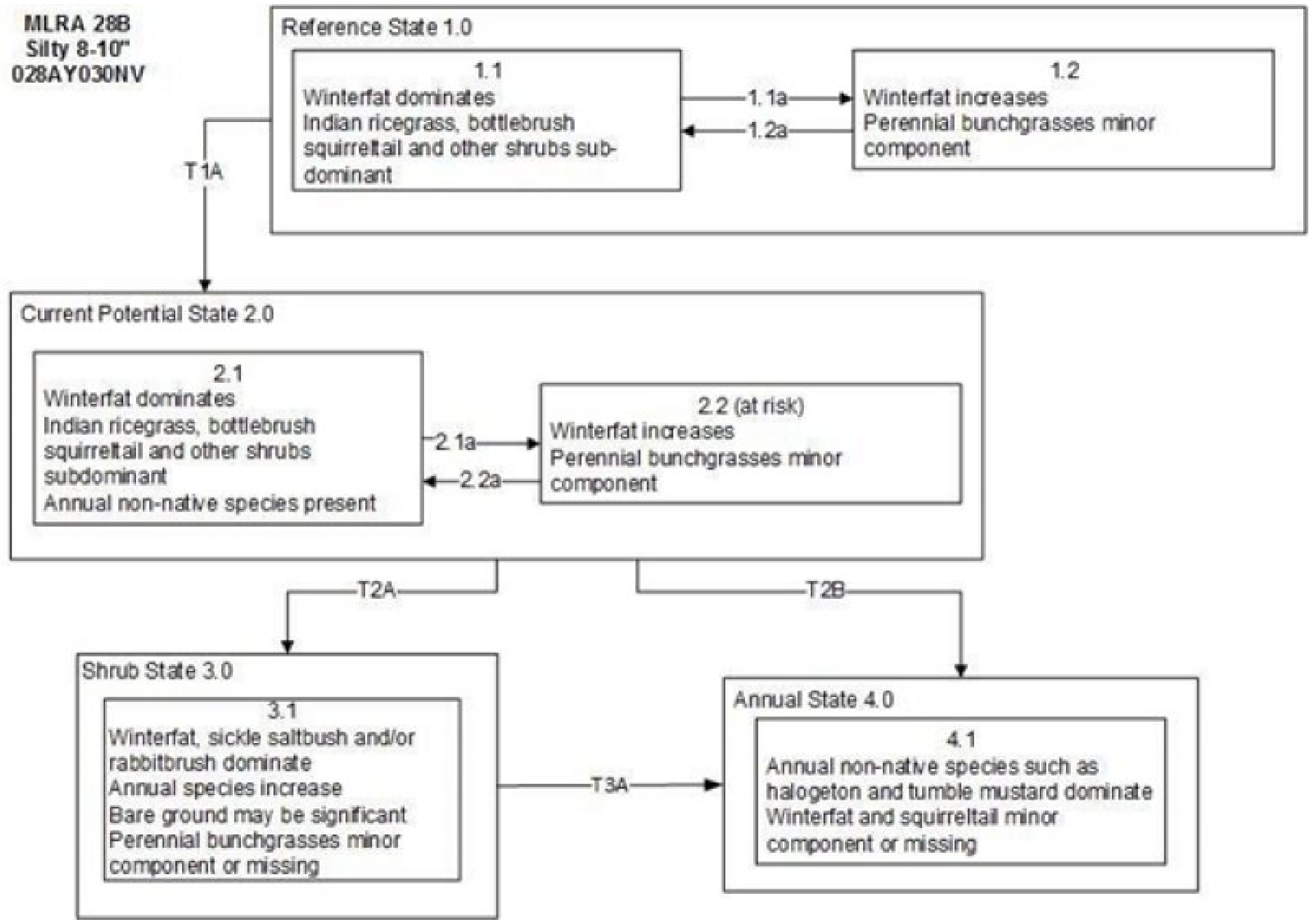

Figure 6. State and Transition Model

MLRA 28B
Silty 8-10"
028AY030NV

Reference State 1.0 Community Phase Pathways
1.1a: Long-term drought and/or excessive herbivory favors as decrease in perennial bunchgrasses. Fire was infrequent but would be patchy due to low fuel loads.
1.2a: Time and lack of disturbance and/or release from drought

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

Current Potential State 2.0 Community Phase Pathways
2.1a: Long-term drought and/or inappropriate grazing management
2.2a: Time and lack of disturbance and/or release from drought

Transition T2A: Inappropriate grazing management in the presence of non-native species (3.1)

Transition T2B: Catastrophic fire and/or multiple fires, inappropriate grazing management and/or soil disturbing treatments (4.1)

Transition T3A: Catastrophic fire and/or multiple fires, inappropriate grazing management and/or soil disturbing treatments (4.1)

Figure 7. Legend

State 1
Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. This state has two community phases, one co-dominated by shrubs and grass, and the other dominated by shrubs. 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. This site is very stable, with little variation in plant community composition. Plant community changes would be reflected in production in response to drought or wet years. Wet years will increase grass production, while drought years will reduce production. Shrub production will also increase during wet years; however, recruitment of winterfat is episodic.

Community 1.1
Community Phase

This plant community is dominated by winterfat and Indian ricegrass. Other commonly associated plants are fourwing saltbush, bud sagebrush and shadscale. Potential vegetative composition is about 30% grasses, 5% forbs and 65% shrubs. Approximate ground cover (basal and crown) is 15 to 25 percent.Community phase changes are primarily a function of chronic drought. Fire is infrequent and patchy due to low fuel loads.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	254	364	510
Grass/Grasslike	118	168	235
Forb	20	28	39
Total	**392**	**560**	**784**

Community 1.2
Community Phase

Drought will favor shrubs over perennial bunchgrasses. However, long-term drought will result in an overall decline in the plant community, regardless of functional group.

Pathway a
Community 1.1 to 1.2

Drought and/or herbivory. Fires would also decrease vegetation on these sites but would be infrequent and patchy due to low fuel loads.

Pathway a
Community 1.2 to 1.1

Time, lack of disturbance and recovery from drought would allow the vegetation to increase and bare ground would eventually decrease.

State 2
Current Potential State

This state is similar to the Reference State 1.0. This state has the same two general 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 is dominated by winterfat and Indian ricegrass. Bottlebrush squirreltail and fourwing saltbush are also important species on this site. Community phase changes are primarily a function of chronic drought. Fire is infrequent and patchy due to low fuel loads. Non-native annual species are present in trace amounts (<5%). Potential vegetative composition is approximately 25% grasses, 10% forbs and 65% shrubs.

Community 2.2
Community Phase (At Risk)

Drought will favor shrubs over perennial bunchgrasses. However, long-term drought will result in an overall decline in the plant community, regardless of functional group. Inappropriate grazing will favor unpalatable shrubs such as shadscale, and cause a decline in winterfat and budsage.

Pathway a
Community 2.1 to 2.2

Inappropriate grazing management and/or drought.

Pathway a
Community 2.2 to 2.1

Release from drought and/or growing season grazing pressure allows recovery of bunchgrasses, winterfat, and bud sagebrush.

State 3
Shrub State

This state consists of one community phase. This site has crossed a biotic threshold and site processes are being controlled by shrubs. Bare ground has increased.

Community 3.1
Community Phase

Figure 9. Silty 8-10" (R028AY030NV) T.Stringham April 2013

Perennial bunchgrasses, like Indian ricegrass are reduced and the site is dominated by winterfat. Rabbitbrush (Chrysothamnus spp.) and shadscale may be significant components or dominant shrubs. Annual non-native species increase. Bare ground has increased.

State 4
Annual State

This state consists of one community phase. This community is characterized by the dominance of annual non-native species such as halogeton and cheatgrass. Rabbitbrush and other sprouting shrubs may dominate the overstory.

Community 4.1
Community Phase

This community is dominated by annual non-native species. Trace amounts of winterfat and other shrubs may be present, but are not contributing to site function. Bare ground may be abundant, especially during low precipitation years. Wind erosion and extreme soil temperatures are driving factors in site function.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as halogeton and cheatgrass. 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: Inappropriate, long-term grazing of perennial bunchgrasses during the growing season and/or long term drought will favor shrubs and initiate a transition to Community phase 3.1. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter and soil moisture.

Transition B
State 2 to 4

Trigger: Severe fire/ multiple fires, long term inappropriate grazing management and/or soil disturbing treatments such as plowing. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Transition A
State 3 to 4

Trigger: Severe fire/ multiple fires, long term inappropriate grazing management, and/or soil disturbing treatments such as plowing. Slow variables: Increased production and cover of non-native annual species. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and shrubs truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			84–196	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	56–140	–
	squirreltail	ELEL5	*Elymus elymoides*	28–56	–
2	**Secondary Perennial Grasses**			10–50	
	western wheatgrass	PASM	*Pascopyrum smithii*	3–17	–
	James' galleta	PLJA	*Pleuraphis jamesii*	3–17	–
	Sandberg bluegrass	POSE	*Poa secunda*	3–17	–
Forb					
3	**Perennial**			3–28	
	globemallow	SPHAE	*Sphaeralcea*	3–28	–
Shrub/Vine					
4	**Primary Shrubs**			291–381	
	winterfat	KRLA2	*Krascheninnikovia lanata*	280–336	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–45	–
5	**Secondary Shrubs**			34–101	
	shadscale saltbush	ATCO	*Atriplex confertifolia*	6–17	–
	sickle saltbush	ATFA	*Atriplex falcata*	6–17	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	6–17	–
	spiny hopsage	GRSP	*Grayia spinosa*	6–17	–
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	6–17	–

Animal community

Livestock Interpretations:
This site is suitable for livestock grazing. Grazing management considerations include timing, duration, frequency, and intensity of grazing.
Productivity and grazing capacities are typically low for salt-desert shrub communities and these sites are typically used for winter range.
Winterfat is an important forage plant for livestock in salt-desert shrub rangeland and subalkaline flats, especially during winter when forage is scarce. Winterfat is a valuable forage species with an average of 10 percent crude

protein during winter when there are few nutritious options for livestock and wildlife (Welch 1989). However, excessive grazing throughout the west has negatively impacted survival of winterfat stands (Hilton 1941, Statler 1967, Stevens et al. 1977). Time of grazing is critical for winterfat with the active growing period being most critical (Romo 1995). Stevens et al. (1977) found that both vigor and reproduction of winterfat were reduced in Steptoe Valley, Nevada by improper season of use, and he recommended no more than 25% utilization during periods of active growth and up to 75% utilization during dormant season use. Rasmussen and Brotherson (1986) found significantly greater foliar cover and density of winterfat in areas ungrazed for 26 years versus winter grazed areas in Utah. In exclosures protected from grazing for between 5 and 16 years, Rice and Westoby (1978) found that winterfat increased in foliar cover but not in density where it was dominant, and in both foliar cover and density in shadscale-perennial grass communities where it was not dominant.

Fourwing saltbush is one of the most palatable shrubs in the West. Its protein, fat, and carbohydrate levels are comparable to alfalfa. Cattle readily eat the leaves, stems, fruits and flower and is a valuable forage on the winter range (Cook 1962, Booth et al. 2006).

Indian ricegrass is often heavily utilized in winter because it cures well (Booth et al. 2006). It is also readily utilized in early spring, being a source of green forage before most other perennial grasses have produced new growth (Quinones 1981).

Bottlebrush squirreltail is very palatable winter forage for domestic sheep of Intermountain ranges. Domestic sheep relish the green foliage. Overall, bottlebrush squirreltail is considered moderately palatable to livestock. Bottlebrush squirreltail has the ability to produce large numbers of highly germinable seeds, with relatively rapid germination (Young and Evans 1977) when exposed to the correct environmental cues. Early spring growth and ability to grow at low temperatures contribute to the persistence of bottlebrush squirreltail among cheatgrass dominated ranges (Hironaka and Tisdale 1973). Squirreltail generally increases in abundance when moderately grazed or protected (Hutchings and Stewart 1953). Heavy trampling was found to significantly reduce germination sites (Eckert et al. 1987). Squirreltail is more tolerant of grazing than Indian ricegrass but all bunchgrasses are sensitive to over utilization within the growing season.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. In summary, overgrazing causes a decrease in Indian ricegrass along with winterfat, bud sagebrush (a minor component of this site), while shadscale (also a minor component of this site) may initially increase. Spring grazing year after year can be detrimental to winterfat, bud sagebrush and bunchgrasses. Continued abusive grazing leads to increased bare ground and invasion by annual weeds (e.g., cheatgrass, halogeton, and annual mustards). Shadscale may become dominant with an annual understory. With further deterioration, shadscale declines, bare ground increases, soil redistribution accelerates and site productivity decreases. On some soils, erosion can result in increased surface salts and development of desert pavement. Reestablishment of perennials is limited in areas of extensive desert pavement. Fire is a very infrequent and patchy event in these salt desert shrub communities; however, where it has occurred the shrub community is greatly reduced and annual exotic weeds will increase if present. Repeated fire within a 10 to 20 year timeframe has the potential to convert this site to an annual weed dominated system. Knowledge of successful rehabilitation strategies in these droughty plant communities is limited grass was at least 10 times greater in undisturbed plots than in heavily grazed ones (Pearson 1965). Cook and Child (1971) found significant reduction in plant cover even after 7 years of rest from heavy (90%) and moderate (60%) spring use. The seed crop may be reduced where grazing is heavy (Bich et al. 1995). Tolerance to grazing increases after May, thus spring deferment may be necessary for stand enhancement (Pearson 1964, Cook and Child 1971); however, utilization of less than 60% is recommended. Adaptive management is required to manage this bunchgrass well.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine-tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:

This site provides valuable habitat for several wildlife species. Winterfat is important to wildlife for feed and cover in salt-desert shrub rangeland and sub-alkaline flats (Blaisdell and Holmgren 1984). In fact, during late winter months when other forage is scarce, winterfat is heavily grazed (Carey 1995). Winterfat seeds are eaten by rodents. Winterfat is a staple food for black-tailed jackrabbit (Lepus californicus). Winterfat and perennial grasses average 80% of jackrabbits' diet in southeastern Idaho, with shrubs being grazed in fall and winter particularly (Johnson and Anderson 1984). Mule deer (Odocoileus hemionus) and pronghorn antelope (Antilocapra americana) browse winterfat (Stevens et al. 1977, Ogle et al. 2001). Pronghorn and rabbits browse stems, leaves, and seed stalks of winterfat year round, especially during periods of active growth (Stevens et al. 1977). Winterfat is used for cover by rodents. It is potential nesting cover for upland game birds, especially when grasses grow up through its crown.

Management of wildlife browse is difficult and browse may be harmful to winterfat reestablishment as seed production and regrowth are curtailed if grazing occurs as the plant begins to grow (Eckert 1954).
Lagamorphs such as the Black-tailed jackrabbits will feed selectively on Winterfat, as previously mentioned, which comprises a majority of their diet. (Johnson and Anderson 1984). Similarly, although Nuttall's cottontail (Sylvilagus nuttallii) consumed mostly grasses and forbs, winterfat made up a large component of their diet as well (Johnson and Hansen 1979).
Rodents also utilize winterfat habitat. The diet of Townsend's ground squirrel (Urocitellus townsendii) consisted on average of 47% winterfat and three other native plant species (Yensen and Quinny 1992). Great Basin pocket mice can be found sporadically in winterfat communities (Dobkin and Sauder 2004). Piute ground squirrels (Urocitellus mollis), little pocket mice (Perognathus longimembris), dark kangaroo mice (Microdipodops megacephalus), chisel-toothed kangaroo rats (Dipodomys microps) and desert woodrats (Neotoma lepida) are found invariably in various shrubsteppe communities especially where winterfat occurs (Dobkin and Sauder 2004).
Ungulates that occur in Nevada feed on winterfat as well. Winterfat has been documented as a substantial forage item for bighorn sheep (Ovis canadensis nelsoni) occurring in Yellow Stone National Park, Arizona and North Dakota badlands throughout winter months (Keating et al. 1985, Fairaizl 1978, Morgart 1990). Winterfat has been identified as important forage for mule deer and makes up the majority of elk (Cervus canadensis) diet in winter (Hansen and Reed 1979, Hubbard and Hansen 1976, Nevada Wildlife Action Plan Team 2012).
Several passerine species occur in winterfat-dominated communities; these include horned lark (Eremophila alpestris), Brewer's sparrow (Spizella breweri), and sage thrasher (Oreoscoptes montanus) in east-central Nevada; however, they are not dependent on these species as their range extend well beyond the distribution of winterfat (Carey 1995, Bradford et al. 1996, Dobkin and Sauder 2004). Furthermore, the sandy soils found in winterfat communities can be important to burrowing owls (Athene cunicularia) and short-eared owls (Asio flammeus) (Nevada Wildlife Action Plan Team 2012).
Reptiles and amphibians have been documented to utilize habitat associated with winterfat. McArthur et al. (1994) suggested desert tortoises, a species of conservation priority in Nevada, eat winterfat. The use of winterfat by other reptiles and amphibians has not been well documented. However, several species of reptiles and amphibians are found where winterfat occurs (intermountain cold desert shrub habitat and semi-desert grasslands). It should be noted that habitats within the Great Basin, intermountain cold desert shrub communities are also the primary habitat of the long-nosed leopard lizard (Nevada Wildlife Action Plan 2012).
Fourwing saltbush provides valuable habitat and year-round browse for wildlife. Fourwing saltbush also provides browse and shelter for small mammals. Additionally, the browse provides a source of water for black-tailed jackrabbits in arid environments. Granivorous birds consume the fruits. Wild ungulates, rodent and lagomorphs readily consume all aboveground portions of the plant. Palatability is rated good for deer, elk, pronghorn and bighorn sheep.
Bottlebrush squirreltail is a dietary component of several wildlife species. Bottlebrush squirreltail may provide forage for mule deer and pronghorn.
Indian ricegrass is eaten by pronghorn in "moderate" amounts whenever available. 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.
Changes in plant community composition caused by human activity, invasive weeds, fire and frequency associated with this ecological site could affect the distribution and presence of wildlife species and it is important to maintain the community for optimal productivity and species diversity (Nevada Wildlife Action Plan 2012).

Hydrological functions

Runoff is low to medium and permeability is moderately high. Water flow patterns are rare to common dependent on site location relative to major inflow areas on basin floors and on steeper slopes after summer convection storms. Water flow patterns are typically short (<2m), meandering and not connected. This site is may experience brief flooding for short periods in the late winter or during summer convection storms. Deep-rooted bunchgrasses (i.e., Indian ricegrass) increase reduce runoff and increase infiltration. Shrubs provide opportunity for snow capture on this site.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition and the colorful flowering of wild flowers and shrubs during the spring and early summer. This site offers rewarding opportunities to photographers and for nature study. This site has potential for upland and big game hunting.

Other products

Fourwing saltbush is traditionally important to Native Americans. They ground the seeds for flour. The leaves, placed on coals, impart a salty flavor to corn and other roasted food. Top-growth produces a yellow dye. Young leaves and shoots were used to dye wool and other materials. The roots and flowers were ground to soothe insect bites. Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source.

Other information

Winterfat adapts well to most site conditions, and its extensive root system stabilizes soil. However, winterfat is intolerant of flooding, excess water, and acidic soils. Fourwing saltbush is widely used in rangeland and riparian improvement and reclamation projects, including burned area recovery. It is probably the most widely used shrub for restoration of winter ranges and mined land reclamation. Bottlebrush squirreltail is tolerant of disturbance and is a suitable species for revegetation.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T20N R68E S9
General legal description	Spring Valley, southeast of Red Hill Pass. This site occurs in Elko, Eureka, Lincoln, and White Pine Counties, 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.

Banner, R. E. 1992. Vegetation types of Utah. Rangelands 14:109-114.

Bich, B. S., J. L. Butler, and C. A. Schmidt. 1995. Effects of differential livestock use on key plant species and rodent populations within selected Oryzopsis hymenoides/Hilaria jamesii communities of Glen Canyon National Recreation Area. The Southwestern Naturalist 40:281-287.

Blaisdell, J. P. and R. C. Holmgren. 1984. Managing Intermountain Rangelands - Salt-desert Shrub Ranges. General Technical Report INT-163, USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Booth, D. T. 1989. Seedbed ecology of winterfat: cations in diaspore bracts and their effects on germination and early plant growth. Journal of Range Management 42:178-182.

Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. Western North American Naturalist 50:115-120.

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.

Cook, C. W. and R. D. Child. 1971. Recovery of desert plants in various states of Vvgor. Journal of Range Management 24:339-343.

Daubenmire, R. 1970. Steppe Vegetation of Washington.131 pp.

Daubenmire, R. 1975. Plant succession on abandoned fields, and fire influences in a steppe area in southeastern Washington. Northwest Science 49:36-48.

Dobkin, D. S., and J. D. Sauder. 2004. Shrubsteppe landscapes in jeopardy. Distributions, abundances, and the uncertain future of birds and small mammals in the Intermountain West. High Desert Ecological Research Institute, Bend, OR.

Dwyer, D. D. and R. D. Pieper. 1967. Fire effects on blue grama-pinyon-juniper rangeland in New Mexico. Journal of Range Management 20:359-362.

Eckert, R. E., Jr. 1954. A Study of Competition Between Whitesage and Halogeton in Nevada.223-225.

Eckert, R. E., Jr., F. F. Peterson, and F. L. Emmerich. 1987. A study of factors influencing secondary succession in the sagebrush [Artemisia spp. L.] type. Pages 149-168 in Proceedings: Seed and Seedbed Ecology of Rangeland plants. U. S. Department of Agriculture, Agricultureal Research Service, Tucson, A.Z.

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.

Freeman, D. C. and M. J. Emlen. 1995. Assessment of interspecifie interactions in plant communities: an illustration from the cold desert saltbrush grassland of North America. Journal of Arid Environments 31:179-198.

Hansen, R.M. and L.D. Reid. 1975. Diet overlap of deer, elk, and cattle in southern Colorado. Journal of Range Management 28: 43-47.

Hild, A. L., J. M. Muscha, and N. L. Shaw. 2007. Emergence and growth of four winterfat accessions in the presence of the exotic annual cheatgrass. Pages 147-152 in Proceedings: Shrubland Dynamics -- Fire and Water; RMRS-P-47. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Lubbock, TX.

Hilton, J. W. 1941. Effects of certain micro-ecological factors on the germinability and early development of Eurotia lanata. Northwest Science:86-92.

Hironaka, M. and E. Tisdale. 1973. Growth and development of Sitanion hystrix and Poa sandbergii. Research Memorandum RM 72-24. U.S. International Biological Program, Desert Biome.

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.

Hubbard, R.E. and R.M. Hansen. 1976. Diets of wild horses, cattle and mule deer in the Piceance Basin, Colorado. Journal of Range Management. 39:389-392.

Hutchings, S. S. and G. Stewart. 1953. Increasing forage yields and sheep production on intermountain winter ranges. Circular No. 925. U.S. Department of Agriculture, Washington, D.C.

Johnson, K. L. 1978. Wyoming shrublands: Proceedings, 7th Wyoming Shrub Ecology Eorkshop. University of Wyoming, Agricultural Extension Service, Rock Spring WY.

Johnson, R. D. and J. E. Anderson. 1984. Diets of black-tailed jack rabbits in relation to population density and vegetation. Journal of Range Management 37:79-83.

Johnson, M.K. and R.M. Hansen. 1979. Foods of cottontails and woodrats in south-central Idaho. Journal of Mammalogy. 60:213-215

Majerus, M. 2003. Winterfat seeds (Krascheninnikovia lanata). Native Plants:11 to 15.

Mozingo, H. N. 1987. Shrubs of the Great Basin: A Natural History. 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/

Ogle, D. G., L. John, and L. Holzworth. 2001. Plant guide management and use of winterfat. USDA-NRCS, Boise, I. D.

Pearson, L. 1964. Effect of harvest date on recovery of range grasses and shrubs. Agronomy Journal 56:80-82.

Pearson, L. C. 1965. Primary production in grazed and ungrazed desert communities of eastern Idaho. Ecology 46:278-285.

Pellant, M. and L. Reichert. 1984. Management and rehabilitation of a burned winterfat community in southwestern Idaho. Pp. 281-285 in McArthur, HC Stutz, and others (compilers), Proceedings of the Symposium on the Biology of Atriplex and Related Chenopods. United States Department of Agriculture, Forest Service General Technical Report INT-172.

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.

Rasmussen, L. L. and J. D. Brotherson. 1986. Response of winterfat (Ceratoides lanata) communities to release from grazing pressure. Great Basin Naturalist 46:148-156.

Rice, B. and M. Westoby. 1978. Vegetative responses of some Great Basin shrub communities protected against jackrabbits or domestic stock. Journal of Range Management 31:28-34.

Romo, J. T., Robert E. Redmann, Brendan L. Kowalenko and Andrew R. Nicholson. 1995. Growth of winterfat folloing defoliation in Northern Mixed Prairie of Saskatchewan. Journal of Range Management 48:240-245.

Statler, G. D. 1967. Technical Note: Eurotia lanata Establishment Trials. Journal of Range Management 20:253-255.

Stevens, R., B. C. Giunta, K. Jorgensen, and A. P. Plummer. 1977. Winterfat (Ceratoides lanata). Federal Aid Project W-82-R, Utah State Division of Wildlife Resources, Utah.

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.

Stubbendieck, J. L., S. L. Hatch, and C. H. Butterfield. 1992. North American Range Plants. University of Nebraska Press, Lincoln, NE.

Tisdale, E. W. and M. Hironaka. 1981. The sagebrush-grass region: A review of the ecological literature. University of Idaho, Forest, Wildlife and Range Experiment Station.

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

Welch, B. L. 1989. Nutritive value of shrubs. In McKell, C.M. (ed.). Academic Press, Inc. , San Diego, CA.

Welsh, S. L., N. D. Atwood, S. Goodrich, and L. C. Higgins. 1987. A Utah flora. The Great Basin Naturalist Memoir No. 9. Brigham Young University, Provo, Utah.

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.

West, N. E. and J. Gasto. 1978. Phenology of the aerial portions of shadscale and winterfat in Curlew Valley, Utah. Journal of Range Management 31:43-45.

Wildlife Action Plan Team. 2012. Nevada Wildlife Action Plan. Nevada Department of Wildlife, Reno, NV.

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.

Wood, B. W. and J. D. Brotherson. 1986. Ecological adaptation and grazing response of budsage (Artemisia spinescens) Pp. 75-92 in Proceedings-- Symposium on the Biology of Artemisia and Chrysothamnus. Gen. Tech. Rep. INT-200. U. S. Department of Agriculture, Forest Service, Intermountain Research Station, Provo, UT.

Yensen, E., D.L. Quinney, K. Johnson, K. Timmerman, and K. Steenhof. 1992. Fire, vegetation changes, and population fluctuations of Townsend’s ground squirrels. American Midland Naturalist (128) 229-312.

Young, J. A. and R. A. Evans. 1977. Squirreltail seed germination. Journal of Range Management 30:33-36.

Young, R. P. 1983. Fire as a vegetation management tool in rangelands of the intermountain region. Pp. 18-31 in Managing Intermountain Rangelands - Improvement of Range and Wildlife Habitats. USDA, Forest Service.

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)	GK BRACKLEY / P NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist
Date	06/22/2006
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 and rills are not expected.

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2. **Presence of water flow patterns:** Water flow patterns are rare to common dependent on site location relative to major inflow areas on basin floors and on steeper slopes after summer convection storms. Water flow patterns are typically short (<2m), meandering and not connected.

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3. **Number and height of erosional pedestals or terracettes:** None

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 50-60%; surface rock fragments less than 15%; shrub canopy to 15%; basal area for perennial herbaceous plants <5%.

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None to rare. Some wind scouring may occur after a severe wildfire that removed all vegetation.

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage of grasses and annual & perennial forbs) expected to move distance of slope length during periods of intense summer convection storms or run in of early spring snow melt flows. Persistent litter (large woody material) will remain in place except during unusual flooding events.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values will range from 3 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure of soil surface will be thin or thick platy. Soil surface colors are grayish browns or light brownish grays and soils are typified by an ochric epipedon. Surface textures are sandy loams. Organic matter is typically around 1 percent (OM values taken from lab characterization data).

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This site is may experience brief flooding for short periods in the late winter or during summer convection storms. Deep-rooted bunchgrasses (i.e., Indian ricegrass) increase reduce runoff and increase infiltration. Shrubs provide opportunity for snow capture on this site.

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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 subsurface layers are normal for this site and are not to be interpreted as compaction.

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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: Short-stature salt-desert shrub (winterfat)

    Sub-dominant: deep-rooted, cool season, perennial bunchgrasses (Indian ricegrass) = shallow-rooted/rhizomatous grasses = associated shrubs > = cool season, rhizomatous grasses > deep-rooted, cool season, perennial forbs =

fibrous, shallow-rooted, cool season, perennial and annual forbs.

Other: Microbiotic crusts

Additional:

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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

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (10-20%) and depth (< ¼ in.)

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (Thru May) ± 500 lbs/ac; Favorable years ±700 lbs/ac and unfavorable years ±350 lbs/ac.

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

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