USDA Natural Resources Conservation Service

Ecological site R028BY069NV
SODIC FLAT 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.

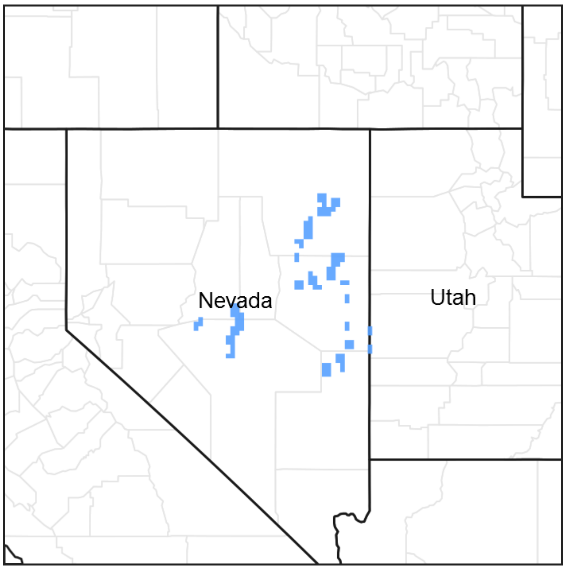

Figure 1. Mapped extent

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): 028B–Central Nevada Basin and Range

MLRA 28B occurs entirely in Nevada and comprises about 23,555 square miles (61,035 square kilometers). More than nine-tenths of this MLRA is federally owned. This area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep sideslopes. Many of the valleys are closed basins containing sinks or playas. Elevation ranges from 4,900 to 6,550 feet (1,495 to 1,995 meters) in the valleys and basins and from 6,550 to 11,900 feet (1,995 to 3,630 meters) in the mountains.
The mountains in the southern half are dominated by andesite and basalt rocks that were formed in the Miocene and Oligocene. Paleozoic and older carbonate rocks are prominent in the mountains to the north. Scattered outcrops of older Tertiary intrusives and very young tuffaceous sediments are throughout this area. The valleys consist mostly of alluvial fill, but lake deposits are at the lowest elevations in the closed basins. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Sands, silts, and clays are on the distal ends of the fans.
The average annual precipitation ranges from 4 to 12 inches (100 to 305 millimeters) in most areas on the valley floors. Average annual precipitation in the mountains ranges from 8 to 36 inches (205 to 915 millimeters) depending on elevation. The driest period is from midsummer to midautumn. The average annual temperature is 34 to 52 degrees F (1 to 11 degrees C). The freeze-free period averages 125 days and ranges from 80 to 170 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 soil temperature regime, an aridic or xeric soil moisture regime, and mixed or carbonatic mineralogy. They generally are well drained, loamy or loamyskeletal, and shallow to very deep.
Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms and heavy snowfall in the higher mountains. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. 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, as a result 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 midlatitude 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 occasional thundershowers. The eastern portion of the state receives noteworthy 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).

Ecological site concept

This site occurs on alluvial flats and lake plains. Slope gradients of 0 to 2 percent are typical. Elevations range from 4000 to 7000 feet. This site is characterized by a low annual precipitation and micro-topography that is slightly higher than the surrounding area allowing basin wildrye to dominate.

Soils are very deep, poorly drained, and formed in mixed alluvium and lacustrine deposits. They are saturated between 30-76cm (approximately 15-30") seasonally, strongly saline, alkaline and effervescent throughout and characterized by an ochric epipedon. High salt concentrations in the surface horizon and periods of ponding reduce seed viability and germination. Soil moisture regime is aquic and the soil temperature regime is mesic.

The reference state is dominated by black greasewood and basin wildrye. Potential vegetative composition is approximately 35% grasses, 5% forbs and 60% shrubs. Production ranges from 400 to 800 pounds per acre.

Associated sites

R028BY002NV	**SALINE MEADOW**
R028BY004NV	**SALINE BOTTOM**
R028BY020NV	**SODIC FLAT 5-8 P.Z.** 028BY020NV can be found adjacent to 028BY069NV, but on slightly lower positions and receive run-on moisture resulting in longer periods of ponding.
R028BY074NV	**SODIC TERRACE 5-8 P.Z.**

Similar sites

R028BY004NV	**SALINE BOTTOM** LECI4-SPAI codominant grasses; more productive site; ground cover (basal and crown) more than 15%
R028BY020NV	**SODIC FLAT 5-8 P.Z.** Less productive site- on slightly lower positions. Vegetation typically restricted to coppice mounds because the playa-like intermound areas experience prolonged ponding.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus*
Herbaceous	(1) *Leymus cinereus* (2) *Distichlis spicata*

Physiographic features

This site occurs on alluvial flats and lake plains. Slopes range from 0 to 4 percent, but gradients of 0 to 2 percent are typical. Elevations are 4000 to 7000 feet. Minor changes in micro-topography, being slightly higher than the surrounding area, allows for increased production of basin wildrye.

Table 2. Representative physiographic features

Landforms	(1) Alluvial flat (2) Lake plain
Flooding frequency	None
Ponding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Ponding frequency	Rare
Elevation	1,219–2,134 m
Slope	0–2%
Water table depth	30–76 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers.

Average annual precipitation ranges from 6 to 10 inches. Mean annual air temperature is about 45 to 55 degrees F. The average growing season is about 100 to 120 days.

Mean annual precipitation across the range in which this ES occurs is 7.83".

Monthly mean precipitation: January 0.685; February 0.61; March 0.70; April 0.845; May .97; June 0.68; July 0.50; August 0.395; September 0.50; October 0.745; November 0.60; December 0.60.

*The above data is averaged from the Beowawe and Lages WRCC climate stations.

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	160 days
Precipitation total (average)	203 mm

Climate stations used

- (1) BEOWAWE 49S U OF N RCH [USC00260800], Eureka, NV
- (2) LAGES [USC00264341], Ely, NV

Influencing water features

This site is associated with the presence of ground water. Seasonally high water table is within 76cm of the soil surface at some point during the year.

Soil features

Soils are very deep, poorly drained, and formed in mixed rocks and lacustrine sediments. High water table is within 76cm (approximately 30") of the soil surface sometime between January and June. The upper profile is strongly salt and sodium affected due to capillary movement of dissolved salts upward from the groundwater.

Soil chemistry of the surface horizon reduces seed viability and germination. Soil moisture regime is aquic and soil temperature regime is mesic. Soil series associated with this site include: Boofuss, Ewelac, Rosney, and Sheffit.

The representative soil component is Boofuss (NV780 MU1270), a clayey over loamy, smectitic over mixed, superactive, calcareous, mesic Typic Halaquepts. The profile is characterized by an ochric epipedon from the soil surface to 18 cm. Soils are strongly alkaline and effervescent throughout.

Table 4. Representative soil features

Surface texture	(1) Silty clay loam (2) Silt loam (3) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Poorly drained
Permeability class	Very slow
Soil depth	183–213 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	13.97–20.07 cm
Calcium carbonate equivalent (0-101.6cm)	25–35%
Electrical conductivity (0-101.6cm)	16–32 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	50–80
Soil reaction (1:1 water) (0-101.6cm)	9–9.6
Subsurface fragment volume <=3" (Depth not specified)	2–5%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it 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. Periodic drought regularly influences salt-desert shrub ecosystems and drought duration and severity has increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity.

Species composition and productivity can be altered by the timing of precipitation and water availability within the soil profile (Bates et al 2006).
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 3.5-15 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).

The perennial bunchgrasses generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. However, basin wildrye is weakly rhizomatous and has been found to root to depths of up to 2 meters and to exhibit greater lateral root spread than many other grass species (Abbott et al. 1991, Reynolds and Fraley 1989). Basin wildrye clumps may reach up to six feet in height (Ogle et al 2012a). Basin wildrye does not tolerate long periods of inundation; it prefers cycles of wet winters and dry summers and is most commonly found in deep soils with high water holding capacities or seasonally high water tables (Ogle et al 2012a, Perryman and Skinner 2007).

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 therefore dewatering and/or long term drought causing 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; therefore 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 MLRA's. 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 texture soils (Anderson et al. 1982). Disturbance such as hoof action from inappropriate grazing and cheatgrass (*Bromus tectorum*) 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 (Salsola L.), halogeton (*Halogeton glomeratus*) and cheatgrass invade these sites where competition from perennial species is decreased.

Annual non-native species such as halogeton, Russian thistle, and cheatgrass invade these sites where competition from perennial species is decreased. This ecological site has low to moderate resilience to disturbance and resistance to invasion. A primary disturbance on these ecological sites 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. Five possible stable states have been identified for this site.

Fire Ecology:

Fire is a rare disturbance in 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 to 100+ years in salt-desert ecosystems with basin wildrye (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 disturbance may result in increased biomass production due to sprouting and increased seed production, also leading to greater fuel loads (Sanderson and Stutz 1994). Higher production sites would have experienced 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 all factor into the individual species response. 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).

Basin wildrye, the dominant understory species 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. Alkali sacaton is a native, long-lived, warm season densely tufted perennial bunchgrass ranging from 20 to 40 inches in height. Alkali sacaton is tolerant of, but not resistant to fire. Recovery of alkali sacaton after fire has been reported as 2 to 4 years (Bock and Bock 1978).

State and transition model

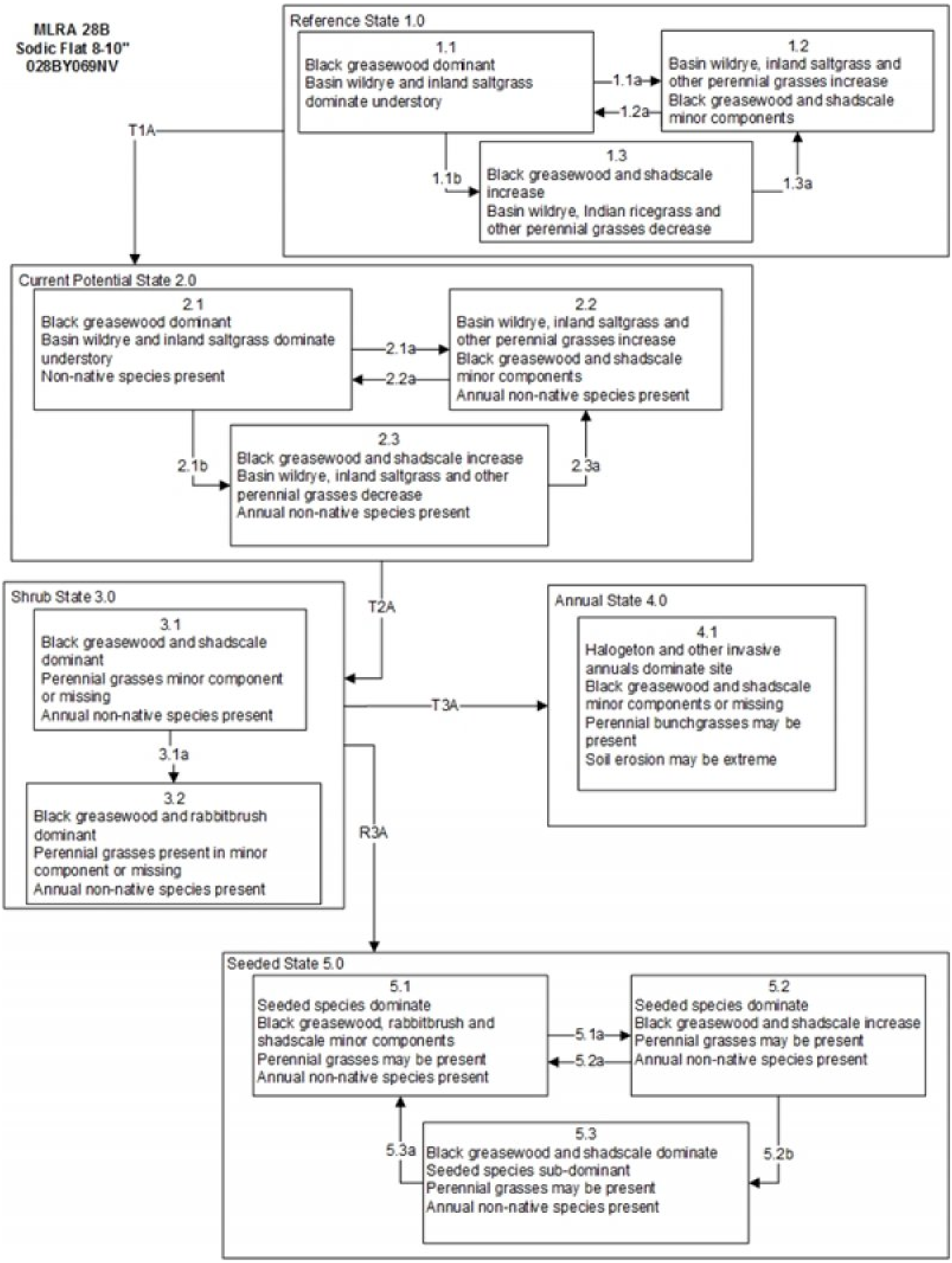

Figure 6. T. Stringham 2/2015

MLRA 28B
Sodic Flat 8-10"
028BY069NV

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 or 3.2). Fire and/or soil disturbing brush treatments (3.2)

Shrub State 3.0 Community Phase Pathways
3.1a: Fire

Transition T3A: Severe fire and/or multiple fires
Restoration Pathway R3A: Brush beating and seeding of desired perennial bunchgrass species (probability of success is low)

Seeded State 5.0 Community Phase Pathways
5.1a: Inappropriate grazing management.
5.2a: Low severity fire and/or brush management with minimal soil disturbance
5.2b: Time and lack of disturbance and/or inappropriate grazing management.
5.3a: Fire and/or brush management with minimal soil disturbance.

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

Figure 8. Sodic Flat 8-10", T.Stringham June 2013, NV780 MU1270

Figure 9. Sodic Flat 8-10" ,T.Stringham June 2013, NV780 MU 1130

This community is dominated by black greasewood. Basin wildrye and inland saltgrass are also common on these sites. Rabbitbrush, shadscale, and other perennial bunchgrasses and shrubs make up smaller components. Potential vegetative composition is about 35% grasses, 5% forbs and 60% shrubs. Approximate ground cover (basal and crown) is 15 to 25 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	269	404	538
Grass/Grasslike	157	235	314
Forb	22	34	45
Total	**448**	**673**	**897**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and inland saltgrass 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 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 will typically by high intensity in this phase due to the dominance of black greasewood resulting in removal of the overstory shrub community.

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 dominated by black greasewood. Basin wildrye and inland saltgrass are also common on these sites. Rabbitbrush, shadscale, bottlebrush squirreltail and other perennial bunchgrasses and shrubs make up smaller components. Non-native annual species such as halogeton and cheatgrass are present in minor amounts. Potential vegetative composition is approximately 30% grasses, 10% forbs and 60% shrubs. Approximate ground cover is 15 to 25 percent.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and inland saltgrass 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. Annual non-native species are stable to increasing in the community.

Community 2.3
Community Phase

Black greasewood 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 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 facilitating an increase in fine fuels may be more severe and reduce black greasewood cover to trace amounts.

Pathway b
Community 2.1 to 2.3

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 grasses; 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 2.2 to 2.1

Time and lack of disturbance will allow shrubs to increase.

Pathway a
Community 2.3 to 2.2

Fire will decrease the overstory of black greasewood and allow for the perennial bunchgrasses to dominate the site. Fires will typically by high intensity in this phase due to the dominance of black greasewood resulting in removal of the overstory shrub community.

State 3
Shrub State

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

Community 3.1
Community Phase

Black greasewood and shadscale dominate the site. Perennial bunchgrasses are present but a minor component. Annual non-native species may be present and may be increasing in the understory.

Community 3.2
Community Phase

Black greasewood dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Annual non-native species increase. Bare ground is significant.

Pathway a
Community 3.1 to 3.2

Fire would reduce the overstory. Some resprouting of black greasewood and rabbitbrush would occur. Soil disturbing treatments such as plowing and drill seeding would also allow for sprouting shrubs to dominate the site.

State 4
Annual State

This state is characterized by the dominance of annual non-native species such as halogeton, cheatgrass and Russian thistle in the understory. Rabbitbrush may dominate the overstory.

Community 4.1

Community Phase

Annual non-native plants such as halogeton and cheatgrass dominate this site. Black greasewood and rabbitbrush may be a minor component or missing from the community.

State 5
Seeded State

This state has three general community phases, and is characterized by the dominance of seeded introduced species. Black greasewood and other shrubs may be present. Native and non-native forbs may also be present.

Community 5.1
Community Phase

Introduced wheatgrass and basin wildrye species dominate the community. Native and non-native forbs may be present. Trace amounts of black greasewood and shadscale may be present, especially if seeded. Annual non-native species present.

Community 5.2
Community Phase

Black greasewood and seeded species co-dominate. Annual non-native species are stable to increasing within the community.

Community 5.3
Community Phase

Black greasewood and shadscale dominate. Rabbitbrush may be a significant component. Wheatgrass vigor and density is reduced. Annual non-native species are stable to increasing.

Pathway a
Community 5.1 to 5.2

Inappropriate grazing management particularly during the growing season reduces the perennial bunchgrass vigor and density and facilitates shrub establishment.

Pathway a
Community 5.2 to 5.1

Low severity fire and/or brush management would reduce shrub overstory and allow seeded wheatgrass species to become dominant.

Pathway b
Community 5.2 to 5.3

Absence of shrub removal disturbances over time coupled with inappropriate grazing management that promotes a reduction in perennial bunchgrasses and facilitates shrub dominance.

Pathway a
Community 5.3 to 5.1

Fire decreases the overstory and allows for the understory perennial grasses to increase. Fires would typically be low severity resulting in a mosaic pattern due to low fine fuel loads. A fire following an unusually wet spring or change in management favoring an increase in fine fuels, may be more severe and reduce the shrub component to trace amounts. Brush treatments with minimal soil disturbance would also decrease sagebrush and release the perennial understory. Annual non-native species respond well to fire and may increase post-burn.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, Russian thistle, and halogeton. 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 or 3.2: Inappropriate cattle/horse grazing will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. To Community Phase 3.2: Fire will decrease perennial bunchgrasses. Soil disturbing brush treatments could possibly increase non-native annual species. Slow variables: Long term decrease in deep-rooted perennial grass 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 and big sagebrush changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

Transition A
State 3 to 4

Trigger: Severe fire and/or multiple fires. 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 sagebrush truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Restoration pathway A
State 3 to 5

Brush management with minimal soil disturbance, coupled with seeding of desired species, usually wheatgrasses or basin wildrye. Probability of success is low.

Conservation practices

Brush Management
Range Planting

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**			94–235	
	basin wildrye	LECI4	*Leymus cinereus*	67–135	–
	saltgrass	DISP	*Distichlis spicata*	13–67	–
	squirreltail	ELEL5	*Elymus elymoides*	13–34	–
2	**Secondary Perennial Grasses**			13–34	
	western wheatgrass	PASM	*Pascopyrum smithii*	3–13	–
	alkali sacaton	SPAI	*Sporobolus airoides*	3–13	–
Forb					
3	**Perennial**			15–67	
	saltgrass	DISP	*Distichlis spicata*	13–67	–
	povertyweed	IVAX	*Iva axillaris*	3–13	–
	miterwort	MITEL	*Mitella*	3–13	–
	princesplume	STANL	*Stanleya*	3–13	–
	thelypody	THELY	*Thelypodium*	1–13	–
Shrub/Vine					
4	**Primary Shrubs**			336–404	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	336–404	–
	alkali sacaton	SPAI	*Sporobolus airoides*	3–13	–
5	**Secondary Shrubs**			13–67	
	western wheatgrass	PASM	*Pascopyrum smithii*	3–13	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	3–13	–
	rubber rabbitbrush	ERNAC2	*Ericameria nauseosa ssp. consimilis*	3–13	–

Animal community

Livestock Interpretations:
This site is suited to livestock grazing. Grazing management considerations include timing, frequency, intensity and duration of grazing.
During settlement, many of the cattle in the Great Basin were wintered on extensive basin wildrye stands however due to sensitivity to spring use many stands were decimated by early in the 20th century (Young et al. 1976). Basin wildrye is intolerant of heavy or repeated grazing, especially if grazed before reaching maturity. It is important forage for cattle and is readily grazed by cattle and horses in early spring and fall. Though coarse-textured during the winter, basin wildrye may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses. Less palatable species such as black greasewood, rabbitbrush and inland salt grass increased in dominance along with invasive non-native species such as povertyweed, Russian thistle, mustards and cheatgrass (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). 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). Additionally, natural basin wildrye seed viability has been found to be low and seedlings lack vigor (Young and Evans 1981). Roundy (1985) found that although basin wildrye is adapted to seasonally dry saline soils, high and frequent spring precipitation is necessary to establish it from seed suggesting that establishment of natural basin wildrye seedlings occurs only during years of unusually high precipitation. Therefore, reestablishment of a stand that has been decimated by grazing may be episodic. Black greasewood is an important winter browse plant for domestic sheep and cattle. Black greasewood may increase in response to grazing. Removal of competition can dramatically increase growth rates and total leader length of black greasewood. In a study by Smith et al. (1992), utilization of new growth on black greasewood shrubs by cattle was 77 percent in summer, and black 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).
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:
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). 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 (Tamius 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 grease wood 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 rattle snakes (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), 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 where black greasewood is 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. Bottlebrush squirreltail may provide forage for mule deer and pronghorn.

Hydrological functions

Permeability is very slow to moderately rapid. Runoff is low to very high. Water flow patterns are rare to common. Moderately fine to fine surface textures result in limited infiltration rates. Concentrations of surface salts and sodium result in chemical crusts which also impedes infiltration of precipitation. Water flow patterns are typically short, ending in depressional areas. Tall statured shrubs and associated litter break raindrop impact and provide some opportunity for snow capture.

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 is used for camping and hiking and has potential for upland and big game hunting.

Other products

The leaves, seeds and stems of black greasewood are edible. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates eroded areas and sites too saline for most plant species. Basin wildrye is useful in mine reclamation, fire rehabilitation and stabilizing disturbed areas. Its usefulness in range seeding, however, may be limited by initially weak stand establishment. 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. Bottlebrush squirreltail is tolerant of disturbance and is a suitable species for revegetation.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T23N R63E S3
Latitude	39° 53′ 34″
Longitude	114° 50′ 12″
General legal description	Approximately 2.5 miles east of Cherry Creek Station, west side of Duck Creek, Steptoe Valley, White Pine County, Nevada. This site also occurs in Elko County, Nevada.

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Contributors

RK/GKB
T Stringham
P NovakEchenique
E. Hourihan

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	02/21/2007

Approved by	P. Novak-Echenique
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** Water flow patterns are rare to common. Moderately fine to fine surface textures result in limited infiltration rates. Concentrations of surface salts and sodium result in chemical crusts which also impedes infiltration of precipitation. Water flow patterns are typically short and meandering (<3m) and end in depressional areas.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare and mainly occur in water flow paths.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 60-70%

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to rare. Wind scouring may occur during severe wind events preceding winter storms or summer convection storms.

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage of grasses and annual & perennial forbs) only expected to move during periods of flooding by adjacent streams. Persistent litter (large woody material) will remain in place except during major flooding 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 will range from 3 to 6. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure of soil surface will be subangular blocky or platy. Soil surface colors are light grays and soils are typified by an ochric epipedon. Surface textures are silt loams and silty clays. Organic carbon can range from about 1 percent to 2.5 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** "Playette" interspaces between vegetated hummucks have very low infiltration and are ponded for short periods with early spring snow melt (run-in). Tall statured shrubs and associated litter break raindrop impact and provide some opportunity for snow catch and moisture accumulation on the mounds or hummocks that support the majority of vegetation characteristic for this site.

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. Prismatic or massive subsurface structure is normal for this site and is 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: Tall salt-desert shrubs (black greasewood) >> tall-statured, deep-rooted, cool season, perennial bunchgrasses. (By above ground production)

    Sub-dominant: Rhizomatous grasses = associated perennial grasses = deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, perennial and annual forbs. (By above ground production)

    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 25% of total woody canopy.

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14. **Average percent litter cover (%) and depth (in):** Within plant interspaces 15-25% and depth of litter ±¼ inch.

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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 (through end of May) ± 600 lbs/ac; Winter moisture significantly affects total production. Favorable years ±800 lbs/ac and unfavorable years ±400 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, halogeton, Russian thistle, annual kochia, and cheatgrass.

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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 reproduction occurs during extreme or extended drought periods.
