USDA Natural Resources Conservation Service

Ecological site R028AY008NV
SODIC TERRACE 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.

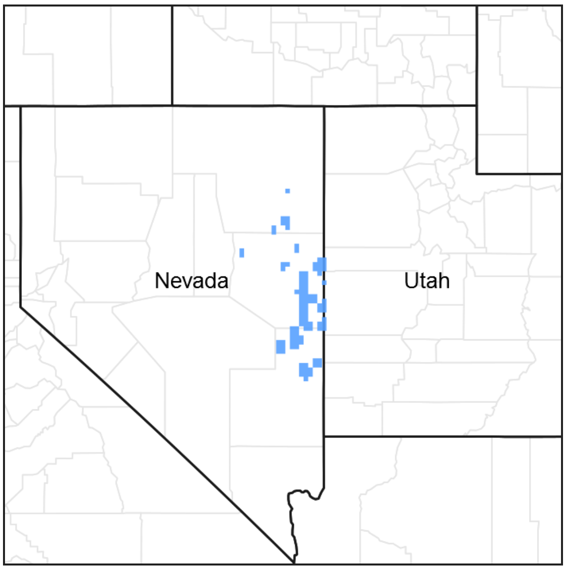

Figure 1. Mapped extent

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 skirts, alluvial plains, alluvial flats, lake plain terraces, beach terraces and fan piedmonts. Slopes range from 0 to 4 percent. Elevations are 5500 to 6200 feet.
The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to 120 days.
The soils associated with this site are very deep and are formed in mixed alluvium. Textures are variable, but tend to be medium to moderately coarse. Soils are moderately to strongly affected by salts, and are well drained. Sodium is the most common salt, but others may be present. A seasonally high water table may be present within 3 to 5 feet of the surface. Water intake rates are slow to moderately slow, available water holding capacity is very low to high, and runoff is low to medium.
The reference state is dominated by black greasewood, basin big sagebrush and basin wildrye. Production ranges from 400 to 800 pounds per acre.

Associated sites

R028AY001NV	**SILT FLAT**
R028AY024NV	**SODIC TERRACE 5-8 P.Z.**

Similar sites

R028BY028NV	**SODIC TERRACE 8-10 P.Z.** KOAM minor species, if present
R028AY025NV	**DRY FLOODPLAIN** More productive site; ARTR2 dominant shrub, SAVE4 minor shrub
R028AY015NV	**LOAMY 8-10 P.Z.** ACHY-HECO26 codominant grasses; more productive site
R028AY024NV	**SODIC TERRACE 5-8 P.Z.** Sodic Terrace 5-8" P.Z.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus* (2) *Artemisia tridentata*
Herbaceous	(1) *Leymus cinereus*

Physiographic features

This site occurs on fan skirts, alluvial plains, alluvial flats, lake plain terraces, beach terraces and fan piedmonts. Slopes range from 0 to 4 percent. Elevations are 5500 to 6200 feet.

Table 2. Representative physiographic features

Landforms	(1) Fan skirt (2) Lake plain (3) Alluvial flat
Elevation	5,500–6,200 ft
Slope	0–4%
Aspect	Aspect is not a significant factor

Climatic features

Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.
Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).
The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to 120 days.

Mean annual precipitation at ELY WBO, NEVADA
climate station (262631)is 9.72 inches.

Monthly mean precipitation is:
January 0.77; February 0.78; March 1.01;
April 1.03; May 1.1; June 0.65; July 0.64;
August 0.81; September 0.75; October 0.82;
November 0.68; December 0.68.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	110 days
Precipitation total (average)	9 in

Influencing water features

This site receives additional moisture as run-in from adjacent higher landscapes.

Soil features

The soils associated with this site are very deep and are formed in mixed alluvium. Textures are variable, but tend to be medium to fine textured. Soils are moderately to strongly affected by salts, and are well drained. Sodium is the most common salt, but others may be present. A seasonally high water table may be present within 3 to 5 feet of the surface. Water intake rates are slow to moderately slow, available water holding capacity is very low to high, and runoff is low to medium. The soil moisture regime is aridic bordering on xeric. Soil series associated with this site include: Bigspring, Chuffa, Zunzler, Ragnel, Teebone, and Yobe.

The representative soil series is Bigspring, classified as a Fine-loamy, mixed, superactive, mesic Aridic Calcixerolls. Diagnostic horizons include a mollic epipedon from the soil surface to 12 inches and a calcic horizon from 12 to 35 inches. Clay content in the particle control section averages 27 to 35 percent. Rock fragments range from 0 to 15 percent, consisting mainly of strongly cemented secondary calcium carbonate nodules. Reaction is slightly alkaline to strongly alkaline. Effervescence is slightly to strongly effervescent. Lithology consists of alluvium derived mainly from limestone and welded tuff over lacustrine deposits.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone (2) Alluvium–welded tuff
Surface texture	(1) Gravelly sandy loam (2) Silty clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to rapid
Soil depth	72–84 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2.4–7.9 in
Calcium carbonate equivalent (0-40in)	25–40%
Electrical conductivity (0-40in)	4–8 mmhos/cm
Sodium adsorption ratio (0-40in)	13–45
Soil reaction (1:1 water) (0-40in)	7.8–8.6
Subsurface fragment volume <=3" (Depth not specified)	0–15%
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. 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).
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).

Wyoming big sagebrush, the most drought tolerant of the big sagebrushes, is generally long-lived; therefore it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent large recruitment events and simultaneous low, continuous recruitment is the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent on adequate moisture conditions.
Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks especially a sagebrush defoliator, Aroga moth (Aroga websteri). Aroga moth infestations have occurred in the Great Basin in the 1960s, early 1970s, and are ongoing in Nevada since 2004 (Bentz et al. 2008). Thousands of acres of big sagebrush have been impacted, with partial to complete die-off observed. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975).
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).

These communities often exhibit the formation of microbiotic crusts within the interspaces between shrubs. These crusts influence the soils on these sites and their ability to reduce erosion and increase infiltration; they may also alter the soil structure and possibly increase soil fertility (Fletcher and Martin 1948, Williams 1993). Finer-textured soils such as silts tend to support more microbiotic cover than coarse-textured soils (Anderson 1982). Disturbance such as hoof action from inappropriate grazing and cheatgrass invasion can reduce biotic crust integrity (Anderson 1982, Ponzetti et al. 2007) and increase erosion.
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 resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Five possible stable states have been identified for this site.

Fire Ecology:
Fire is a rare disturbance in salt-desert shrub communities likely occurring in years with above-average production. Natural fire return intervals are estimated to vary between less than 35 years up to 100 years in salt desert 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.
Wyoming big sagebrush is easily killed by fire (Blaisdell 1953). Wyoming big sagebrush only regenerates from seed. Repeated fires may eliminate the onsite seed source; reinvasion into these areas may be extremely slow (Bunting et al. 1987). Reestablishment after fire may require 50-120 or more years (Baker 2006). Even then, up to 25 years after fire, Wyoming big sagebrush typically has less than 5% of pre-fire cover (Baker 2011). However, the

introduction and expansion of cheatgrass has dramatically altered the fire regime (Balch et al. 2013), therefore altering restoration potential of Wyoming big sagebrush communities (Evans and Young 1978). Sites with low abundances of native perennial grasses and forbs typically have reduced resiliency following disturbance and are less resistant to invasion or increases in cheatgrass (Miller et al 2013).
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.
Indian ricegrass 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). Thus 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.

State and transition model

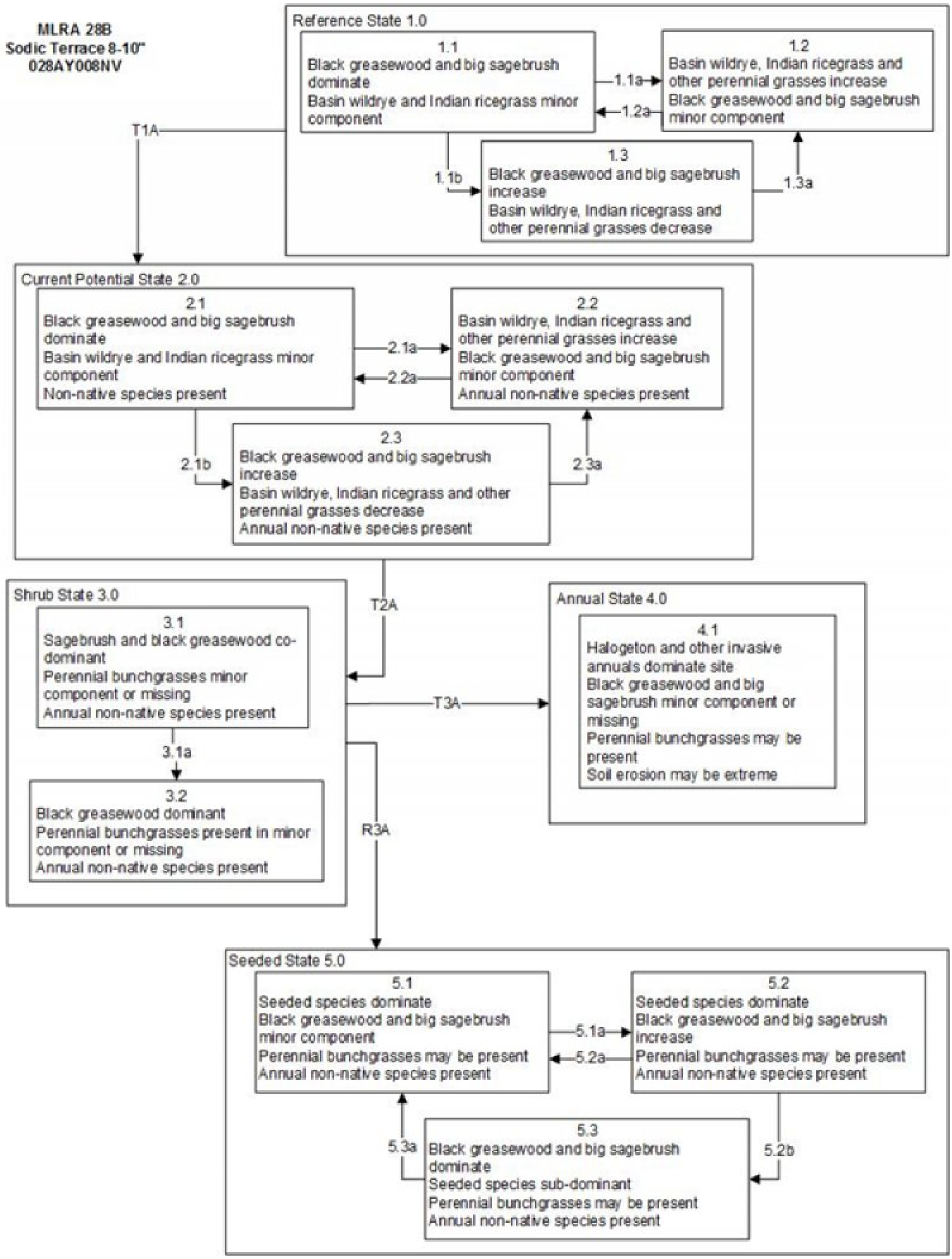

Figure 3. State and Transition Model

MLRA 28B
Sodic Terrace 8-10"
028AY008NV

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 4. Legend

State 1
Reference State

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

Community 1.1
Community Phase

This community phase is dominated by black greasewood and big sagebrush. Basin wildrye and Indian ricegrass are also common on these sites. Rabbitbrush, shadscale, bottlebrush squirreltail and other perennial bunchgrasses and shrubs make up smaller components. Potential vegetative composition is about 25% grasses, 5% forbs and 70% shrubs. Approximate ground cover (basal and crown) is 20 to 30 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	277	415	554
Grass/Grasslike	100	150	200
Forb	20	30	40
Tree	3	5	6
Total	**400**	**600**	**800**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and Indian ricegrass dominate the community. Black greasewood will decrease but will likely sprout and return to pre-burn levels within a few years. Big sagebrush is killed by fire and may be reduced in the community for several years. Early colonizers such as rabbitbrush and shadscale may increase.

Community 1.3
Community Phase

Black greasewood and big sagebrush 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. Management would be to maintain high diversity of desired species to promote organic matter inputs and prevent the dispersal and seed production of the non-native invasive species.

Community 2.1
Community Phase

This community is dominated by black greasewood and big sagebrush. Basin wildrye and Indian ricegrass 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 (<5%). Potential vegetative composition is approximately 25% grasses, 5% forbs and 70% shrubs. Approximate ground cover (basal and crown) is 20 to 30 percent.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and Indian ricegrass dominate the community. Black greasewood will decrease but will likely sprout and return to pre-burn levels within a few years. Big sagebrush is killed by fire and may be reduced in the community for several 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 and big sagebrush 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 bunch 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 big sagebrush and the other with a black greasewood 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

Figure 6. Sodic Terrace, T.Stringham, April 2013, NV779 MU3290

Decadent sagebrush and black greasewood 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

Figure 7. Sodic Terrace 8-10" ,T.Stringham, June 2013, NV779 MU 1304

After wildfire, sagebrush is reduced in the community and black greasewood dominates the overstory. Rabbitbrush may be a significant component due to resprouting. 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

Community Phase

Community Phase

Fire would reduce sagebrush overstory and allow for an increase in sprouting shrubs such as black greasewood and rabbitbrush. Soil disturbing treatments such as plowing and drill seeding would also decrease sagebrush and allow for sprouting shrubs to dominate 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. Sagebrush and/or 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 sagebrush 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. Wyoming big sagebrush, black greasewood and other shrubs may be present. Native and non-native forbs may also be present.

Community 5.1
Community Phase

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

Community 5.2
Community Phase

Big sagebrush, 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 big sagebrush 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 the sagebrush overstory and allow seeded wheatgrass species to become dominant.

Conservation practices

Brush Management

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 eliminates/decreases the overstory of sagebrush 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 grazing management will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. To Community Phase 3.2: Fire will reduce and/or eliminate big sagebrush overstory and decrease perennial bunchgrasses. Soil disturbing brush treatments will reduce big sagebrush and 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 reduced infiltration, 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 (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			102–180	
	basin wildrye	LECI4	*Leymus cinereus*	90–150	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	12–30	–
2	**Secondary Perennial Grasses**			12–48	
	saltgrass	DISP	*Distichlis spicata*	3–18	–
	squirreltail	ELEL5	*Elymus elymoides*	3–18	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	3–18	–
	western wheatgrass	PASM	*Pascopyrum smithii*	3–18	–
	Sandberg bluegrass	POSE	*Poa secunda*	3–18	–
Forb					
3	**Perennial**			12–48	
	globemallow	SPHAE	*Sphaeralcea*	3–12	–
	princesplume	STANL	*Stanleya*	3–12	–
	thelypody	THELY	*Thelypodium*	3–12	–
Shrub/Vine					
4	**Primary Shrubs**			330–510	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	180–240	–
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	60–90	–
5	**Secondary Shrubs**			29–84	
	shadscale saltbush	ATCO	*Atriplex confertifolia*	6–18	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	6–18	–
	spiny hopsage	GRSP	*Grayia spinosa*	6–18	–
Tree					
6	**Evergreen**			3–6	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	3–6	–

Animal community

Livestock Interpretations:
This site is suited to livestock grazing. Grazing management considerations include timing, intensity, frequency, 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. Indian ricegrass is a deep-rooted, cool season perennial bunchgrass that is adapted primarily to sandy soils. Indian ricegrass is a preferred forage species for livestock and wildlife (Cook 1962, Booth et al. 2006). This species 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 feed before most other perennial grasses have produced new growth (Quinones 1981). Booth et al. (2006) note that the plant does well when utilized in winter and spring. Cook and Child (1971) however, found that repeated heavy grazing reduced crown cover, which may reduce seed production, density, and basal area of these plants. Additionally, heavy early spring grazing reduces plant vigor and stand density (Stubbendieck 1985). In eastern Idaho, productivity of Indian ricegrass 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 after 7 years of rest from heavy (90%) and moderate (60%) spring use in the desert ranges of Utah. 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.

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).

Big sagebrush is eaten by domestic sheep and cattle, but has long been considered to be of low palatability to domestic livestock, a competitor with more desirable species, and a physical impediment to grazing.

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 greasewood habitat (Wiens and Rotenberry 1981). The loggerhead shrike (Lanius ludovicianus) will use black greasewood for nesting and cover. Burrowing owls (Athene cunicularia) will use the loose soils for burrowing. Bald eagles (Haliaeetus leucocephalus) and prairie falcons (Falco mexicanus) winter in the valley bottoms where black greasewood occurs, preying on jack rabbits, and other rodents Nevada Wildlife Action Plan 2012).

Reptiles and amphibians also occur in black greasewood habitats. Western 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), chuckwalla (Sauromalus ater), zebra-tailed lizard (Callisaurus draconoides), pigmy horned-lizard (Phrynosoma douglasii), desert night lizard (Xantusia vigilis), whip-tailed lizard (Aspidoscelis uniparens) and western skinks (Plestiodon skiltonianus) occur in areas where black greasewood habitat is prominent. Similarly, amphibians such as: western toads, (Anaxyrus boreas) Woodhouse’s toads (Anaxyrus woodhousii), northern leopard frogs (Lithobates pipiens), Columbia spotted frogs (Rana luteiventris), bullfrogs (Lithobates catesbeianus), and Great Basin spadefoots (Spea intermontana), California toads (Anaxyrus boreas halophilus), Amargosa toads (Anaxyrus nelsoni), great plains toads (Anaxyrus cognatus), Sonoran toads (Anaxyrus alvarius), red-spotted toads (Anaxyrus punctatus) and mountain toad (Anaxyrus cavifrons), also occur throughout the Great Basin in areas 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.

Hydrological functions

Runoff is low to medium. Permeability is slow to moderately slow. This site is nearly flat so rills are non-existent. Water flow patterns are rare to common in areas subjected to summer convection storms. Flow patterns after summer storms may be somewhat long (up to 15 ft), meandering and stable. Shrub canopy and associated litter provide some protection from raindrop impact. Ponding will occur after summer convention storms or rapid snowmelt.

Recreational uses

This site offers opportunities to photographers and for nature study. This site has potential for upland and big game hunting.

Other products

The leaves, seeds and stems of black greasewood are edible. Native Americans made tea from big sagebrush leaves. They used the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal. Native Americans used big sagebrush leaves as a fumigant. Bark was woven into mats, bags and clothing. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand. Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source.

Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish. 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.

Type locality

Location 1: Lincoln County, NV	
General legal description	This site occurs in White Pine and Lincoln Counties, Nevada.

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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 so rills are non-existent.

2. **Presence of water flow patterns:** Water flow patterns are rare to common in areas subjected to summer convection storms. Flow patterns after summer storms may be somewhat long (up to 15 ft), meandering and stable.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 30 to 50%

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None

7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall/ponding events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. This site typically has microbiotic crusts.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically fine to medium platy. Soil surface colors are pale browns and soils are typified by an ochric epipedon. Surface textures are sandy loams. Organic matter of the surface 2 to 3 inches is less than 1 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Shrub canopy and associated litter provide some protection from raindrop impact. Ponding will occur after summer convention storms or rapid snowmelt.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Platy or massive sub-surface horizons or subsoil calcic horizons are not to be interpreted as compacted layers.

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

    Dominant: Reference State: Tall shrubs (big sagebrush & black greasewood)

    Sub-dominant: deep-rooted, cool season, perennial bunchgrasses > associated shrubs > shallow-rooted/rhizomatous grasses = deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, annual and perennial forbs

    Other: Microbiotic crusts. Evergreen trees

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 35% of total woody canopy; mature bunchgrasses commonly (±25%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (15-25%) and depth (< ¼ in.)

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (thru June) ± 600 lbs/ac; Favorable years ±800 lbs/ac and unfavorable years ±400 lbs/ac.

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

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