United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site name: **SHALLOW CALCAREOUS LOAM 8-10 P.Z.**
/ *Artemisia nova* / *Achnatherum hymenoides* - Hesperostipa comata
(/ black sagebrush / Indian ricegrass - needleandthread)
Site type: Rangeland
Site ID: R028BY011NV
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. They are not well dissected because of the low amount of rainfall in the area. 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 is 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. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. 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 loamy-skeletal, and shallow to very deep.

Ecological Site Concept

This site occurs on summits and sideslopes of lower piedmont slopes and low hills on all exposures. Slopes range from 0 to 50 percent, but slope gradients of 2 to 10 percent are most typical. Elevations are 4000 to 7600 feet.
The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. The 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 shallow to a duripan and well drained to somewhat excessively drained. Most of these soils are high in calcium carbonates, especially in the subsoil.
The reference state is dominated by black sagebrush, Indian ricegrass, and needleandthread. Production ranges from 250 to 600 pounds per acre.

Physiographic Features

This site occurs on summits and sideslopes of lower piedmont slopes, fan remnants, ballenas and low hills on all exposures. Slopes range from 0 to 50 percent, but slope gradients of 2 to 10 percent are most typical. Elevations range from 4000 to 7600 feet.

Landform: (1) Fan piedmont
(2) Hill
(3) Fan remnant

	Minimum	Maximum

Elevation (feet):	4000	7600
Slope (percent):	0	50
Water table depth (inches):	0	0
Flooding		
Frequency:	None	Rare
Duration:	None	Very brief
Ponding		
Depth (inches):	0	0
Frequency:	None	None
Runoff class:	Medium	Very high
Aspect:	No Influence on this site	

Climatic Features

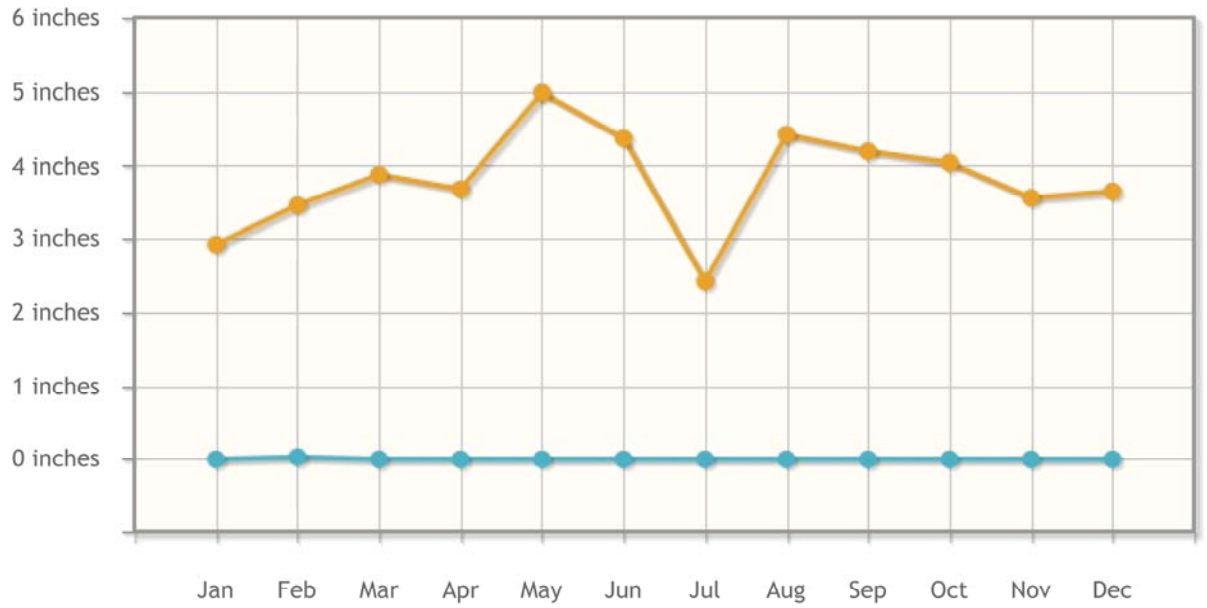
Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. 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. The average annual precipitation is 8 to 12 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to 120 days. Mean annual precipitaion at the LAGES,NEVADA climate station (264341) is 8.13 inches. monthly mean precipitation is: January 0.59; February 0.60; March 0.76; April

0.92; May 0.92; June 0.65; July 0.71; August 0.46; September 0.63; October 0.94; November 0.50; December 0.46.

	Averaged
Frost-free period (days):	110
Freeze-free period (days):	110
Mean annual precipitation (inches):	9.00

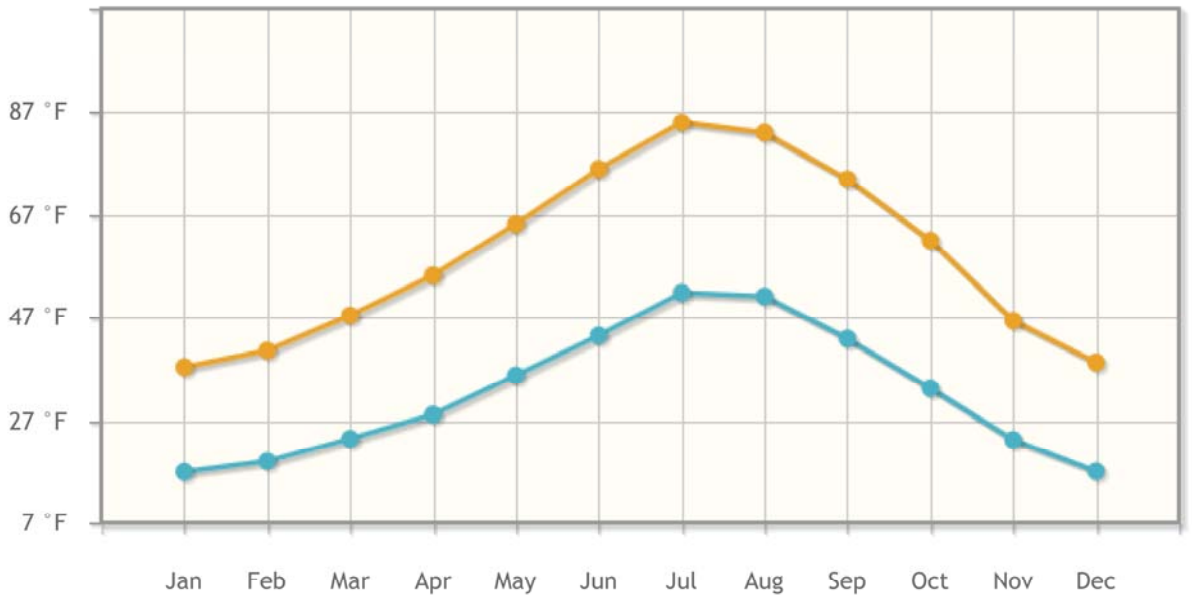
Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	2.92	3.46	3.88	3.68	4.99	4.37	2.41	4.42	4.19	4.04	3.56	3.65
Low	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Monthly Temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	38.1	41.3	48.1	55.9	65.9	76.7	85.7	83.7	74.7	62.7	47.1	39.0
Low	17.7	19.8	24.2	28.9	36.5	44.2	52.5	51.8	43.6	34.0	24.0	17.8



Climate stations: (1) 262708, Eureka, NV. Period of record 1952-2005

Influencing Water Features

There are no influencing water features associated with this site.

Representative Soil Features

The soils associated with this site are very shallow to a duripan and well drained to somewhat excessively drained. The soils are high in calcium carbonates, especially in the subsoil. Soil textures are generally loams to gravelly loams. The available water holding capacity is very low to low, water intake rates are slow to moderately rapid and runoff is medium to very high. The soil moisture regime is aridic bordering on xeric and the soil temperature regime is mesic. The soil series associated with this site include: Automal, Barrier, Biken, Eastwell, Grassval, Hundraw, Izar, Lien, Molion, Novacan, Nuc, Palinor, Peeko, Pibler, Tarnach, Tosser, Umil, Unius, Wiffo, Wrango, Zaidy, and Zapa.

The representative soil series is Palinor, a Loamy-skeletal, carbonatic, mesic, shallow Xeric Haplodurids. Diagnostic horizons include an ochric epipedon from the soil surface to 7 inches, and a calcic horizon from 10 to 18 inches. Clay content in the particle

control section averages 10 to 18 percent. Rock fragments range from 45 to 75 percent gravel and 0 to 5 percent cobbles. The calcium carbonate equivalent is 15 to 40 percent in the particle control seciton. Reaction is moderately alkaline or strongly alkaline. Effervescence is strongly effervescent or violently effervescent. Lithology consists of limestone and dolomite.

Parent materials

Kind: Alluvium, Alluvium

Origin: Limestone, Dolomite

Surface texture: (1)Very gravelly Loam

Subsurface texture group: Loamy

	Minimum	Maximum
Surface fragments <=3" (% cover):	30	40
Surface fragments >3" (% cover):	0	0
Subsurface fragments <=3" (% volume):	45	70
Subsurface fragments >3" (% volume):	0	5

Drainage class: Well drained to somewhat excessively drained

Permeability class: Slow to moderately rapid

	Minimum	Maximum
Depth (inches):	10	30
Available water capacity (inches):	0.80	3.70
Electrical conductivity (mmhos/cm):	0	8
Sodium adsorption ratio:	0	12
Calcium carbonate equivalent (percent):	40	60
Soil reaction (1:1 water):	8.2	8.8

Plant Communities

107 °F

Ecological Dynamics of the Site

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 that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

Periodic drought regularly influences sagebrush 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).

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 is ongoing in Nevada since 2004 (Bentz et al. 2008). Thousands of acres of sagebrush have been impacted, with partial to complete die-off observed (Gates 1964, Hall 1965), but the research is inconclusive of the damage sustained by black sagebrush populations.

Black sagebrush 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.

The perennial bunchgrasses that are co-dominant with the shrubs include bluebunch wheatgrass and Indian ricegrass. Needle and thread, Sandberg’s bluegrass, and squirreltail are other important grass species. These species generally have somewhat shallower root systems than the shrubs, but root densities are often as high or higher than those of shrubs in the upper 0.5 m of the soil profile. General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.

The Great Basin sagebrush 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 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. The invasion of sagebrush communities by cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

The range and density of Utah juniper has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion of Utah juniper into sagebrush ecosystems include wildfire suppression, historic livestock grazing, and climate change (Bunting 1994). Mean fire return intervals prior to European settlement in black sagebrush ecosystems were greater than 100 years, however frequent enough to inhibit the encroachment of Utah juniper into these low productive sagebrush cover types (Kitchen and McArthur 2007). Thus, trees were isolated to fire-safe areas such as rocky outcroppings and areas with low-productivity. An increase in crown density causes a decrease in understory perennial vegetation and an increase in bare ground. This allows for the invasion of non-native annual species such as cheatgrass. With annual species in

the understory wildfire can become more frequent and increase in intensity. With frequent wildfires these plant communities can convert to annual species with a sprouting shrub and juvenile tree overstory.

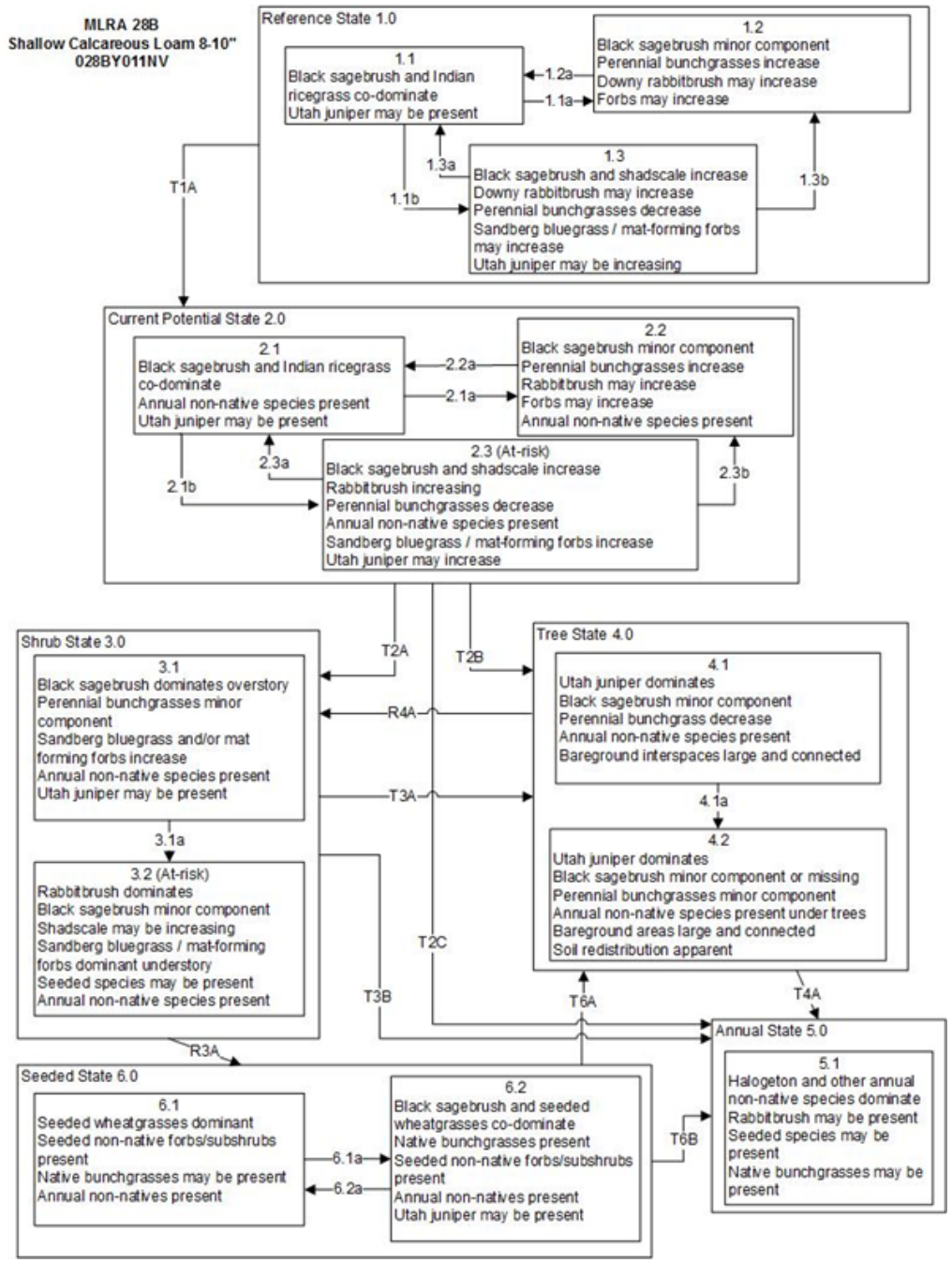
This ecological site has low to moderate resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Six possible stable states have been identified.

Fire Ecology:
Fire is not a major ecological component of these community types (Winward 2001), and would be infrequent. Fire return intervals have been estimated at 100 to 200 years (Kitchen and McArthur 2007); however, fires were probably patchy and very infrequent due to the low productivity of these sites. Black sagebrush plants have no morphological adaptations for surviving fire and must reestablish from seed following fire (Wright et al. 1979). The ability of black sagebrush to establish after fire is mostly dependent on the amount of seed deposited in the seed bank the year before the fire. Seeds typically do not persist in the soil for more than 1 growing season (Beetle 1960). A few seeds may remain viable in soil for 2 years (Meyer 2008); however, even in dry storage, black sagebrush seed viability has been found to drop rapidly over time, from 81% to 1% viability after 2 and 10 years of storage, respectively (Stevens et al. 1981). Thus, repeated frequent fires can eliminate black sagebrush from a site, however black sagebrush in zones receiving 12 to 16 inches of annual precipitation have been found to have greater fire survival (Boltz 1994). In lower precipitation zones, spiny hopsage and/or shadscale may become the dominant shrub species following fire. Douglas' rabbitbrush and ephedra can also sprout after fire and become a dominant shrub on this site often with an understory of Sandberg's bluegrass and/or cheatgrass and other weedy 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. The two dominant grasses on this site, Indian ricegrass and needle and thread, have different responses to fire. Needle and thread is top-killed by fire but is likely to resprout if fire does not consume above ground stems (Akinsoji 1988, Bradley, Noste and Fischer 1992). In a study by Wright and Klemmedson (1965), season of burn rather than fire intensity seemed to be the crucial factor in mortality for needle and thread grass. Early spring season burning was seen to kill the plants while August burning had no effect. Indian ricegrass is fairly fire tolerant (Wright 1985), which is likely due to its low culm density and below ground plant crowns. Indian ricegrass has been found to reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983, West 1994). Thus the presence of surviving, seed producing plants is necessary for reestablishment of Indian ricegrass. Grazing management following fire to promote seed production and establishment of seedlings is important.
Sandberg's bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg's bluegrass may retard reestablishment of deeper rooted bunchgrass. Repeated frequent fire in this community will eliminate both black sagebrush and Indian ricegrass from the site and facilitate the establishment of an annual weed community with varying amounts of Sandberg's bluegrass, spiny hopsage and rabbitbrush.

Utah juniper and singleleaf pinyon are usually killed by fire, and are most vulnerable to fire when it is under four feet tall (Bradley et al. 1992). Larger trees, because they have foliage farther from the ground and thicker bark, can survive low severity fires but mortality does occur when 60% or more of the crown is scorched (Bradley et al. 1992). With the low production of the understory vegetation, high severity fires within this plant community were not likely and rarely became crown fires (Bradley et al. 1992, Miller and Tausch 2000). Tree density on this site increases with grazing management that favors the removal of fine fuels and management focused on fire suppression. With an increase of cheatgrass in the understory, fire severity is likely to increase. Utah juniper reestablishes by seed from nearby seed source or surviving seeds. Utah juniper begins to produce seed at about 30 years old (Bradley et al. 1992). Seeds establish best through the use of a nurse plant such as sagebrush and rabbitbrush (Everett and Ward 1984, Tausch and West 1988, Bradley et al. 1992). Utah juniper woodlands reach mature stage between 85 to 150 years after fire (Barney and Frischknecht 1974, Tausch and West 1988).

State-and-Transition Diagram



State and Transition Model

Legend

KEY
MLRA 28
Shallow Calcareous Loam 8-10"
028BY011NV

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush and leads to early/mid-seral community, dominated by grasses.
1.1b: Time and lack of disturbance such as fire. Excessive herbivory and/ or long-term drought may also reduce perennial understory.
1.2a: Time and lack of disturbance allows for shrub reestablishment
1.3a: Low severity fire, herbivory or combinations will reduce sagebrush and create a sagebrush/grass mosaic.
1.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native annual species

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush and leads to early/mid-seral community, dominated by grasses and forbs: non-native annual species present
2.1b: Time and lack of disturbance such as fire; long-term drought, inappropriate grazing management or combinations of these would allow the sagebrush overstory to increase and dominate the site.
2.2a: Time and lack of disturbance and/or grazing management that favors shrub establishment.
2.3a: Low severity fire, late fall/winter grazing or brush treatment with minimal soil disturbance creates sagebrush/ grass mosaic.
2.3b: High severity fire significantly reduces sagebrush and leads to early/mid-seral community.

Transition T2A: Inappropriate cattle/horse grazing management favoring shrub dominance and reducing perennial bunchgrasses will lead to phase 3.1. Soil disturbing treatments and/or inappropriate sheep grazing management will lead to phase 3.2.
Transition T2B: Time and lack of disturbance allows for maturation of the tree community.
Transition T2C: Catastrophic fire or soil disturbing treatments.

Shrub State 3.0 Community Pathways
3.1a: Fire and/or sheep grazing. Brush treatments (i.e. mowing) with minimal soil disturbance.

Transition T3A: Time and lack of disturbance allows for maturation of the tree community. Inappropriate grazing will expedite this transition.
Transition T3B: Fire and/or soil disturbing treatments.

Restoration Pathway R3A: Drill or aerial seeding of native and non-native grasses, forbs, and other species.

Tree State 4.0 Community Pathways
4.1a: Time and lack of disturbance allows for maturation of the tree community.

Transition T4A: Catastrophic fire that significantly reduces or eliminates tree and any remaining shrub overstory. Inappropriate tree removal practices may also contribute to this transition.
Restoration Pathway R4A: Removal of trees and seeding of desired species.

Seeded State 6.0 Community Pathways
6.1a: Inappropriate grazing management during the growing season facilitates shrub establishment and dominance.
6.2a: Fire or brush treatments with minimal soil disturbance.

Transition T6A:Time without disturbance allows trees to establish and dominate the site; may be coupled with grazing management that favors reduced perennial grass density and increased tree establishment.
Transition T6B: High severity fire and/or inappropriate grazing management. Soil disturbing brush treatments may also lead to the annual state.

Legend

State 1: Reference State

The Reference State 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, and a shrub dominant phase and a grass dominate 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. Due to the nature and extent of disturbance in this site, all three plant community phases would

likely occur in a mosaic across the landscape. Utah juniper may be present on the site, but will only occur as scattered trees and will not dominate the site.

Community Phase 1.1: Community Phase

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This plant community is dominated by black sagebrush in the overstory with Indian ricegrass and needleandthread grass dominant in the understory. Utah juniper may be present. Potential vegetative composition is about 50% grasses, 5% forbs, and 45% shrubs. Approximate ground cover (basal and crown) is 15 to 20 percent.

Community Phase Pathway a
A low severity fire would decrease the overstory of sagebrush 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 sagebrush cover to trace amounts.

Community Phase Pathway b
Absence of disturbance over time, significant herbivory, chronic drought or combinations of these would allow the sagebrush overstory to increase and dominate the site. This will generally cause a reduction in perennial bunch grasses; however Sandberg's bluegrass may increase in the understory depending on the timing and intensity of herbivory. Heavy spring utilization will favor an increase in sagebrush.

Community Phase Plant Species Composition

Grass/Grasslike

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	Annual Production (pounds per acre) High	Foliar cover (percent) Low	Foliar cover (percent) High
1 -Primary Perennial Grasses					131	285		
		Indian ricegrass	ACHY	*Achnatherum hymenoides*	90	158		
		bottlebrush squirreltail	ELEL5	*Elymus elymoides*	9	23		
		needleandthread	HECO26	*Hesperostipa comata*	23	68		
		Sandberg's bluegrass	POSE	*Poa secunda*	9	36		
2 -Secondary Perennial Grasses					9	36		
		bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	2	14		

Forb

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	Annual Production (pounds per acre) High	Foliar cover (percent) Low	Foliar cover (percent) High
3 -Perennial					23	45		
		milkvetch	ASTRA	*Astragalus*	2	9		
		penstemon	PENST	*Penstemon*	2	9		
		phlox	PHLOX	*Phlox*	2	9		
		globemallow	SPHAE	*Sphaeralcea*	2	9		
		prince'splume	STANL	*Stanleya*	2	9		

Shrub/Vine

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	Annual Production (pounds per acre) High	Foliar cover (percent) Low	Foliar cover (percent) High
4 -Primary Shrubs					131	204		
		black sagebrush	ARNO4	*Artemisia nova*	113	158		
		shadscale	ATCO	*Atriplex confertifolia*	9	23		
		downy rabbitbrush	CHVIP4	*Chrysothamnus viscidiflorus ssp. puberulus*	9	23		

5 -Secondary Shrubs				21	57
	Nevada ephedra	EPNE	*Ephedra nevadensis*	2	14
	spiny hopsage	GRSP	*Grayia spinosa*	2	14
	winterfat	KRLA2	*Krascheninnikovia lanata*	2	14
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	2	14

Tree Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre) Low	Annual Production (pounds per acre) High	Foliar cover (percent) Low	Foliar cover (percent) High
6 -Evergreen					2	9		
		Utah juniper	JUOS	*Juniperus osteosperma*	2	9		

Annual Production by Plant Type

Plant type	Annual Production (lbs/ac) Low	Representative value	High
Grass/Grasslike	125	225	300
Forb	13	23	30
Shrub/Vine	110	197	261
Tree	2	5	9
Total	250	450	600

Community Phase 1.2: Community Phase

This community phase is characteristic of a post-disturbance, early seral community phase. Indian ricegrass and needleandthread will increase and dominate the community. Sprouting shrubs such as Douglas' rabbitbrush, spiny hopsage, and shadscale may increase. Black sagebrush could still be present in unburned patches. Forbs may increase post-fire but will likely return to pre-burn levels within a few years.

Community Phase Pathway a
Time and lack of disturbance will allow sagebrush to establish.

Community Phase 1.3: Community Phase

Black sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory

are reduced, either from competition with shrubs or from herbivory. Sandberg's bluegrass will likely increase in the understory and may be the dominant grass on the site. Scattered Utah juniper trees may be present on the site.

Community Phase Pathway a
A low severity fire, herbivory or combinations will reduce the sagebrush overstory and create a sagebrush/grass mosaic.

Community Phase Pathway b
Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be high intensity due to the dominance of sagebrush resulting in removal of the overstory shrub community.

Transition A

Trigger: Introduction of non-native annual plants.
Slow variables: Over time the annual non-native plants 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.

State 2: Current Potential State

This state is similar to the Reference State 1.0 and has three similar community phases. Ecological function has not changed in this state, but the resiliency of the state has been reduced by the presence of invasive weeds. These non-native species can be highly flammable, and promote fire where historically fire had been infrequent. 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. 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 Phase 2.1: Community Phase

This community phase is compositionally similar to the Reference State Community Phase 1.1 with the presence non-native species in trace amounts. This community is dominated by black sagebrush in the overstory with Indian ricegrass and needleandthread grass dominant in the understory. Utah juniper may be present.

Community Phase Pathway a
A low severity fire would decrease the overstory of sagebrush and allow for the

understory perennial grasses to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. Annual non-native species are likely to increase after fire.

Community Phase Pathway b
Absence of disturbance over time, chronic drought, inappropriate grazing management or combinations of these would allow the sagebrush overstory to increase and dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory.

Community Phase 2.2: Community Phase

T.K. Stringham_8/2014

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush or other sprouting shrubs may be increasing. Shadscale may increase. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Community Phase Pathway a
Absence of disturbance over time and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of black sagebrush can take many years.

Community Phase 2.3: Community Phase (At Risk)

P.Novak-Echenique 10/2014

Black sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Sandberg's bluegrass will likely increase in the understory and may be co-dominant with the deep rooted bunchgrasses. Utah juniper may be present and without management will likely increase. Annual non-native species are stable or increasing. This community is at risk of crossing a threshold to either State 3.0 (grazing or fire) or State 4.0 (fire).

Community Phase Pathway a
Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing may cause mechanical damage to sagebrush promoting the perennial bunchgrass understory. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. Annual non-native species are present and may increase in the community. A low severity fire would decrease the overstory of sagebrush and allow for the understory perennial grasses to increase. Due to low fuel loads in this State, fires will likely be small creating a mosaic pattern.

Community Phase Pathway b
Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be high intensity due to the dominance of sagebrush resulting in removal of the overstory shrub community. Annual non-native species respond well to fire and may increase post-burn.

Transition A

Trigger: To Community Phase 3.1: Inappropriate cattle/horse grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and favor shrub growth and establishment. To Community Phase 3.2: Severe fire will remove sagebrush overstory, decrease perennial bunchgrasses and enhance Sandberg's

bluegrass. Soil disturbing brush treatments and/or inappropriate sheep grazing will reduce sagebrush and potentially increase sprouting shrubs and Sandberg's bluegrass.
Slow variables: Long term decrease in deep-rooted perennial grass density and/or black sagebrush.
Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black sagebrush changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

Transition B

Trigger: Absence of disturbance over time allows for Utah juniper dominance.
Feedbacks and ecological processes: Trees increasingly dominate use of soil water resulting in decreasing herbaceous and shrub production and decreasing organic matter inputs, contributing to reductions in soil water availability to grasses and shrubs and increased soil erodibility.
Slow variables: Long term increase in juniper density.
Threshold: Trees overtop black sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs in number. There is minimal recruitment of new shrub cohorts. Litter builds up underneath trees while bare ground increases in interspaces; this changes nutrient cycling and levels of organic matter in the soil. Redistribution of soil, organic matter and nutrients may occur with water and wind erosion.

Transition C

Trigger: Catastrophic fire or soil surface disturbance.
Slow variables: Increased production and cover of non-native annual species.
Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes energy and nutrient capture and cycling both temporally and spatially within the community. Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires.

State 3: Shrub State

This state has one community phase is characterized by black sagebrush or a sprouting shrub overstory with a Sandberg's bluegrass understory. The 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 Phase 3.1: Community Phase

P.Novak-Echenique 9/2012

T.K. Stringham_7/2014

Black sagebrush dominates overstory while Sandberg's bluegrass dominates the understory. Deep-rooted perennial bunchgrasses have significantly declined. Annual non-native species may be present. Bare ground and soil redistribution may be increasing. If present on the site, Utah juniper is increasing. The community phase may be at risk of transitioning into a Tree State or Annual State

Community Phase Pathway a
Fire reduces black sagebrush to trace amounts and allows for sprouting shrubs such as rabbitbrush to dominate. Shadscale may also establish post-fire and become dominate. Inappropriate or excessive sheep grazing could also reduce cover of sagebrush and allow for shadscale or sprouting shrubs to dominate the community. Brush treatments with minimal soil disturbance would facilitate sprouting shrubs and Sandberg's bluegrass.

Community Phase 3.2: Community Phase (At Risk)

T.K. Stringham_7/2014

T.K. Stringham_6/2012

Shadscale or rabbitbrush dominate the overstory. Broom snakeweed may be present to increasing. Annual non-native species may be increasing and bare ground is significant. This site is at risk for an increase in invasive annual weeds.

Transition A

Trigger: Absence of disturbance over time allows for Utah juniper/singleleaf pinyon dominance.
Feedbacks and ecological processes: Trees increasingly dominate use of soil water resulting in decreasing herbaceous and shrub production and decreasing organic matter inputs, contributing to reductions in soil water availability to grasses and shrubs and increased soil erodibility.
Slow variables: Long term increase in tree density.
Threshold: Trees overtop black sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs in number. There is minimal recruitment of new shrub cohorts. Litter builds up underneath trees while bare ground increases in interspaces; this changes nutrient cycling and levels of organic matter in the soil.

Transition B

Trigger: Fire or treatments that disturb the soil and existing plant community (ex: failed restoration attempts).
Slow variables: Increased seed production and cover of annual non-native 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 and impact the nutrient cycling and distribution.

Restoration Pathway A

Seeding of deep-rooted introduced bunchgrasses and other desired species; may be coupled with brush management and/or herbicide. Probability of success is low.

State 4: Tree State

This state has two community phases that are characterized by a dominance of Utah juniper and/or singleleaf pinyon in the overstory. Black sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients and soil organic matter distribution and cycling have been spatially and temporally altered.

Community Phase 4.1: Community Phase

Utah juniper and/or singleleaf pinyon trees dominate the overstory, sagebrush is decadent and dying, deep rooted perennial bunchgrasses are decreasing. Recruitment of sagebrush cohorts is minimal. Annual non-natives may be present or increasing. Bare ground in interspaces are large and connected.

Community Phase Pathway a
Time and lack of disturbance or management action allows for tree cover and density to further increase and trees to out-compete the herbaceous understory species for sunlight and water.

Community Phase 4.2: Community Phase

Elko County, 2013

Utah juniper and/or singleleaf pinyon trees dominate the overstory. Black sagebrush is decadent and dying with numerous skeletons present. Bunchgrasses present in trace amounts and annual non-native species may dominate understory. Herbaceous species may be located primarily under the canopy or near the drip line of trees. Bare ground interspaces are large and connected. Soil redistribution may be apparent.

Transition A

Trigger: Catastrophic fire causing a stand replacement event. Inappropriate tree removal practices with soil disturbance will also cause a transition to Annual State 5.
Slow variables: Increased production and cover of non-native annual species under tree canopies.
Threshold: Closed tree canopy with non-native annual species dominant in the understory changes the 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 and impacts nutrient cycling and distribution.

Restoration Pathway A

Removal of trees in community phase 4.1. If restoration efforts fail, this site could transition to annual state 5.0.

State 5: Annual State

This state has one community phase. In this state, a biotic threshold has been crossed and state dynamics are driven by the dominance and persistence of the annual grass community which is perpetuated by a shortened fire return interval fire. The herbaceous understory is dominated by annual non-native species such as cheatgrass, halogeton, and mustards. Resiliency has declined and further degradation from fire facilitates a cheatgrass and/or halogeton and sprouting shrub plant community. Fire return interval

has shortened due to the dominance of cheatgrass in the understory and is a driver in site dynamics.

Community Phase 5.1: Community Phase

T.K. Stringham_9/2013

Cheatgrass, mustards, halogeton and other annuals dominate the site. Halogeton more readily invades this site. Sprouting shrubs may be present. Erosion may be significant.

State 6: Seeded State

This state has two community phases and is characterized by the dominance of seeded introduced wheatgrass species. Forage kochia and other desired seeded species including black sagebrush and native and non-native forbs may be present.

Community Phase 6.1: Community Phase

P.Novak-Echenique 9/2013

T.K. Stringham_9/2013

Introduced wheatgrass species and other non-native species such as forage kochia dominate the community. Native and non-native seeded forbs may be present. Trace amounts of black sagebrush may be present. Native bunchgrasses may be present in trace amounts. Annual non-native species present.

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

Community Phase 6.2: Community Phase

Community Phase 6.2, P.Novak-Echenique, 9/2013

Black sagebrush and seeded wheatgrass species co-dominate. Native bunchgrasses may be present in trace amounts. Annual non-native species stable to increasing.

Community Phase Pathway a
Low severity fire or brush management with minimal soil disturbance will reduce the sagebrush overstory and may allow seeded wheatgrass species to become dominant. Native bunchgrasses may be present in trace amounts.

Transition A

Trigger: Absence of disturbance over time and/or inappropriate grazing management facilitates the establishment and eventual dominance of Utah juniper/singleleaf pinyon.
Slow variables: Long term increase in Utah juniper/singleleaf pinyon density.
Threshold: Trees out-compete understory species for water and sunlight. There is minimal recruitment of new shrub cohorts. Litter builds up underneath trees while bare ground increases in interspaces; this changes nutrient cycling and levels of organic matter in the soil. Redistribution of soil, organic matter and nutrients may occur with water and wind erosion.

Transition B

Trigger: Fire, inappropriate grazing management or treatments that disturb the soil and existing plant community (ex: failed restoration attempts).
Slow variables: Increased seed production and cover of annual non-native 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 and impact the nutrient cycling and distribution.