USDA Natural Resources
Conservation Service

Ecological site R028BY011NV
SHALLOW CALCAREOUS LOAM 8-10 P.Z.

Accessed: 05/11/2025

General information

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

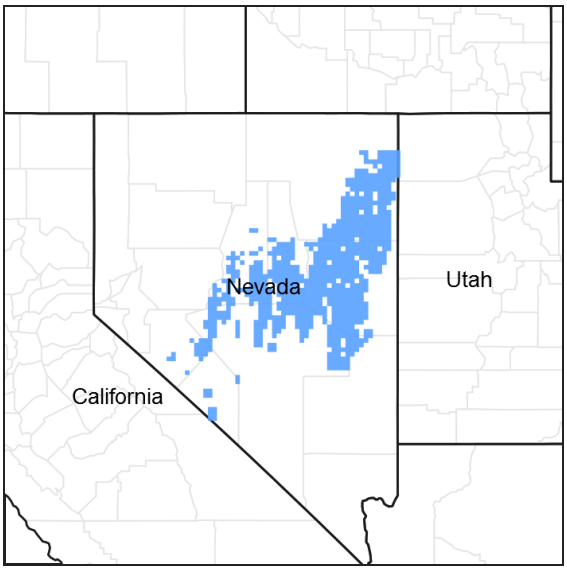


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 028B–Central Nevada Basin and Range

MLRA 28B occurs entirely in Nevada and comprises about 23,555 square miles (61,035 square kilometers). More than nine-tenths of this MLRA is federally owned. This area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep sideslopes. Many of the valleys are closed basins containing sinks or playas. Elevation ranges from 4,900 to 6,550 feet (1,495 to 1,995 meters) in the valleys and basins and from 6,550 to 11,900 feet (1,995 to 3,630 meters) in the mountains.
The mountains in the southern half are dominated by andesite and basalt rocks that were formed in the Miocene and Oligocene. Paleozoic and older carbonate rocks are prominent in the mountains to the north. Scattered outcrops of older Tertiary intrusives and very young tuffaceous sediments are throughout this area. The valleys consist mostly of alluvial fill, but lake deposits are at the lowest elevations in the closed basins. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Sands, silts, and clays are on the distal ends of the fans.
The average annual precipitation ranges from 4 to 12 inches (100 to 305 millimeters) in most areas on the valley floors. Average annual precipitation in the mountains ranges from 8 to 36 inches (205 to 915 millimeters) depending on elevation. The driest period is from midsummer to midautumn. The average annual temperature is 34 to 52 degrees F (1 to 11 degrees C). The freeze-free period averages 125 days and ranges from 80 to 170 days, decreasing in length with elevation.

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

Ecological site concept

This site occurs on fan remnants on all exposures. Slopes gradients of 2 to 10 are typical. Elevations are 5000 to 7000 feet.
The soils associated with this site formed in alluvium derived from limestone. They are well drained and have carbonatic minerology. They have an ochric epipedon and a calcic horizon within 50cm of the surface.
The reference state is dominated by black sagebrush, Indian ricegrass, and needleandthread. Production ranges from 250 to 600 pounds per acre.

Associated sites

R028BY007NV	**LOAMY 10-12 P.Z.**
R028BY010NV	**LOAMY 8-10 P.Z.**
R028BY052NV	**DROUGHTY LOAM 8-10 P.Z.**
R028BY080NV	**SHALLOW LOAM 8-10 P.Z.**
R028BY094NV	**CALCAREOUS LOAM 10-14 P.Z.**

Similar sites

R028BY059NV	**SHALLOW CALCAREOUS HILL 8-12 P.Z.** Less productive site; JUOS dominates visual aspect.
R028BY089NV	**SHALLOW CLAY LOAM 10-12 P.Z.** ACHY-ACTH7 codominant grasses; soils derived from volcanic parent materials.
R028BY090NV	**SHALLOW CALCAREOUS HILL 14+ P.Z.** PSSP dominant grass; less productive site; PIMO dominates visual aspect.
R028BY008NV	**SHALLOW CALCAREOUS SLOPE 10-12 P.Z.** PSSP-ACHY codominant grasses; less HECO26.
R028BY027NV	**SHALLOW CALCAREOUS SLOPE 14+ P.Z.** PSSP dominant grass; higher elevations on mountain slopes.

R028BY048NV	**CALCAREOUS MOUNTAIN RIDGE** PSSP dominant grass; higher elevations; less productive site.
R028BY006NV	**SHALLOW CALCAREOUS LOAM 10-12 P.Z.** PSSP-ACHY codominant grasses; more productive site.
R028BY093NV	**SHALLOW CLAY LOAM 12-14 P.Z.** PSSP-ACTH7 codominant grasses; soils derived from volcanic parent materials.
R028BY016NV	**SHALLOW CALCAREOUS SLOPE 8-10 P.Z.** Less productive site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia nova*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Hesperostipa comata*

Physiographic features

This site occurs on fan remnants on all exposures. Slopes range from 2 to 50 percent, but slope gradients of 2 to 10 percent are typical. Elevations are 5000 to 7000 feet, but can range from 4000 to 7600 feet in some places.

Table 2. Representative physiographic features

Landforms	(1) Fan remnant (2) Fan piedmont (3) Pediment
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Ponding frequency	None
Elevation	5,000–7,000 ft
Slope	2–10%
Ponding depth	0 in
Water table depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

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

The average annual precipitation ranges from 8 to 12 inches. Mean annual air temperature is about 45 to 50 degrees F. The average growing season is 100 to 120 days.

Mean annual precipitation across the range in which this ES occurs is 9.01". Monthly mean precipitation:
January 0.69; February 0.65; March 0.87; April 0.88; May 1.14; June 0.73; July 0.65; August 0.77; September 0.66; October 0.79; November 0.62; December 0.60.
*The above data is averaged from the Diamond Valley- Eureka and McGill WRCC climate stations.

Table 3. Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	9 in

Climate stations used

- (1) MCGILL [USC00264950], Ely, NV
- (2) DIAMOND VALLEY - EUREKA 14NNW [USC00262296], Eureka, NV

Influencing water features

Influencing water features are not associated with this site.

Soil features

The soils associated with this site can range from shallow to deep and have a calcic horizon within 50cm of the surface. These soils are well drained, have an ochric epipedon and are derived from alluvium from limestone. 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, Eastwell, Lien, Molion, Nuc, Palinor, Peeko, Pibler, Tosser, Umil, Unius, Wiffo, Wrango, 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 18cm, a calcic horizon from 25 to 46cm, and a duripan from 46 to 76cm. 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 greater than 40 percent in the particle control section. Reaction is moderately alkaline or strongly alkaline. Effervescence is strongly effervescent or violently effervescent. Lithology consists of limestone and dolomite.

Where this ecological site is correlated to Haplargids or Argidurids (Novacan, Zaidy and Grassval)consideration should be given to the future re-correlation to 028BY089NV Shallow Clay Loam 10-12" P.Z.

Where this ecological site correlated to soils found on hills derived from residuum/colluvium, such as Izar, Biken, Hundraw, Tarnach, and Zombob, consideration should be given to the future recorrelation to 028BY016NV Shallow Calcareous Slope 8-10" P.Z., especially where slopes exceed 20 percent.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone (2) Alluvium–dolomite
Surface texture	(1) Very gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately rapid
Soil depth	10–30 in
Surface fragment cover <=3"	30–40%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	0.8–3.7 in
Calcium carbonate equivalent (0-40in)	40–60%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–12
Soil reaction (1:1 water) (0-40in)	8.2–8.8

Subsurface fragment volume <=3" (Depth not specified)	45–70%
Subsurface fragment volume >3" (Depth not specified)	0–5%

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).

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. Needleandthread, 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 singleleaf pinyon and Utah juniper has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion of trees 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 disturbance of these community types (Winward 2001), and would be infrequent. Historic 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. Needleandthread 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).

State and transition model

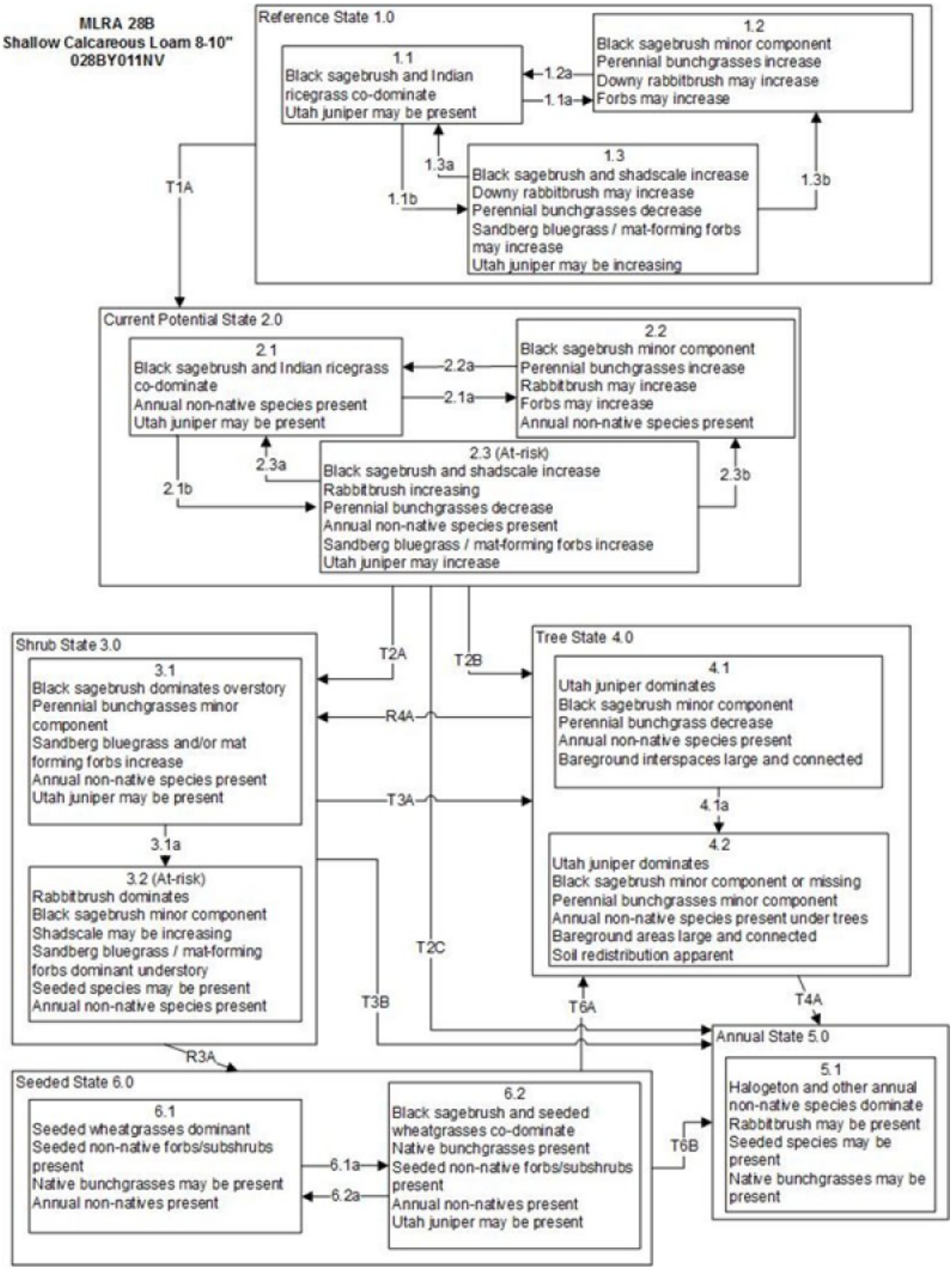


Figure 6. State and Transition Model

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.

Figure 7. 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 1.1
Community Phase

Figure 8. P.Novak-Echenique 7/2014

Figure 9. P.Novak-Echenique 7/2014

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.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	125	225	300
Shrub/Vine	110	197	261
Forb	13	23	30
Tree	2	5	9
Total	**250**	**450**	**600**

Community 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 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.

Pathway a
Community 1.1 to 1.2

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.

Pathway b
Community 1.1 to 1.3

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.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance will allow sagebrush to establish.

Pathway a
Community 1.3 to 1.1

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

Pathway b
Community 1.3 to 1.2

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.

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 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 2.2
Community Phase

Figure 11. 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 2.3
Community Phase (At Risk)

Figure 12. 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).

Pathway a
Community 2.1 to 2.2

A low severity fire (or brush management) 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.

Conservation practices

Brush Management

Pathway b
Community 2.1 to 2.3

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

Pathway a
Community 2.2 to 2.1

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

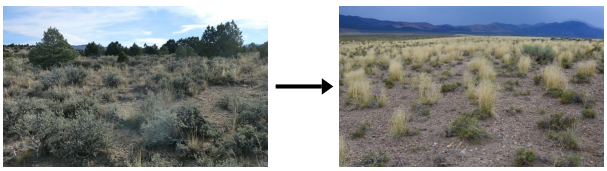
Pathway a
Community 2.3 to 2.1

Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing may cause mechanical damage to 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.

Conservation practices

Brush Management

Pathway b
Community 2.3 to 2.2



Community Phase (At Risk) **Community Phase**

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.

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 3.1
Community Phase

Figure 13. P.Novak-Echenique 9/2012

Figure 14. 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

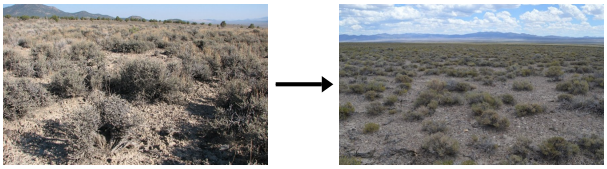
Community 3.2
Community Phase (At Risk)

Figure 15. T.K. Stringham_7/2014

Figure 16. 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.

Pathway a
Community 3.1 to 3.2



Community Phase **Community Phase (At Risk)**

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.

Conservation practices

Brush Management

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 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 4.2
Community Phase

Figure 17. 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.

Pathway a
Community 4.1 to 4.2

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.

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 5.1
Community Phase

Figure 18. 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 6.1
Community Phase

Figure 19. P.Novak-Echenique 9/2013

Figure 20. T.K. Stringham_9/2013

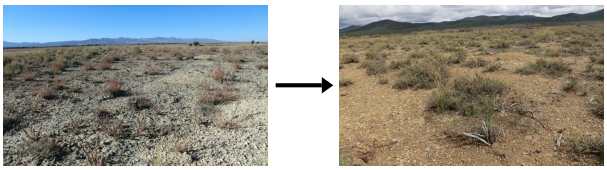
Introduced wheatgrass species and other non-native species such as forage kochia dominate the community. Native and non-native seeded forbs may be present. Trace amounts of black sagebrush may be present. Native bunchgrasses may be present in trace amounts. Annual non-native species present.

Community 6.2
Community Phase

Figure 21. 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.

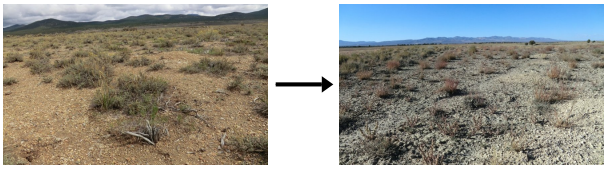
Pathway a
Community 6.1 to 6.2



Community Phase **Community Phase**

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

Pathway a
Community 6.2 to 6.1



Community Phase **Community Phase**

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.

Conservation practices

Brush Management

Transition A
State 1 to 2

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.

Transition A
State 2 to 3

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
State 2 to 4

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
State 2 to 5

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.

Transition A
State 3 to 4

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
State 3 to 5

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
State 3 to 6

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

Conservation practices

Range Planting

Restoration pathway A
State 4 to 3

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

Conservation practices

Brush Management
Range Planting

Transition A
State 4 to 5

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.

Transition A
State 6 to 4

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
State 6 to 5

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.

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**			131–285	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	90–158	–
	needle and thread	HECO26	*Hesperostipa comata*	23–68	–
	Sandberg bluegrass	POSE	*Poa secunda*	9–36	–
	squirreltail	ELEL5	*Elymus elymoides*	9–23	–
2	**Secondary Perennial Grasses**			9–36	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	2–14	–
Forb					
3	**Perennial**			23–45	
	black sagebrush	ARNO4	*Artemisia nova*	113–158	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	2–14	–
	milkvetch	ASTRA	*Astragalus*	2–9	–
	beardtongue	PENST	*Penstemon*	2–9	–
	phlox	PHLOX	*Phlox*	2–9	–
	globemallow	SPHAE	*Sphaeralcea*	2–9	–
	princesplume	STANL	*Stanleya*	2–9	–
Shrub/Vine					
4	**Primary Shrubs**			131–204	
	black sagebrush	ARNO4	*Artemisia nova*	113–158	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	9–23	–
	yellow rabbitbrush	CHVIP4	*Chrysothamnus viscidiflorus ssp. puberulus*	9–23	–
5	**Secondary Shrubs**			21–57	
	Nevada jointfir	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					
6	**Evergreen**			2–9	
	Utah juniper	JUOS	*Juniperus osteosperma*	2–9	–

Animal community

Livestock Interpretations:
This site is suitable for livestock grazing. Considerations for grazing management including timing, intensity and duration of grazing. Targeted grazing could be used to decrease the density of non-natives.
Black sagebrush palatability has been rated as moderate to high depending on the ungulate and the season of use (Horton 1989, Wambolt 1996). The palatability of black sagebrush increases the potential negative impacts on remaining black sagebrush plants from grazing or browsing pressure following fire (Wambolt 1996). Pronghorn utilize black sagebrush heavily (Beale and Smith 1970). On the Desert Experiment Range, black sagebrush was found to comprise 68% of pronghorn diet even though it was only the third most common plant. Fawns were found to prefer black sagebrush utilizing it more than all other forage species combined (Beale and Smith 1970).
Domestic livestock will also utilize black sagebrush. The domestic sheep industry that emerged in the Great Basin in the early 1900s was largely based on wintering domestic sheep in black sagebrush communities (Mozingo 1987).

Domestic sheep will browse black sagebrush during all seasons of the year depending on the availability of other forage species, with greater amounts being consumed in fall and winter. Black sagebrush is generally less palatable to cattle than to domestic sheep and wild ungulates (McArthur et al. 1979); however, cattle use of black sagebrush has also been shown to be greatest in fall and winter (Schultz and McAdoo 2002), with only trace amounts being consumed in summer (Van Vuren 1984).

Inappropriate grazing management during the growing season will cause a decline in understory plants such as needleandthread and Indian ricegrass. Growing season grazing by cattle may initially cause a decrease in the bunchgrass component and give a competitive advantage to shrub species including black sagebrush (Eckert et al. 1972).

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 et al. 1985). In eastern Idaho, productivity of Indian ricegrass was at least 10 times greater in undisturbed plots than in heavily grazed ones (Pearson 1976). Cook and Child (1971) found significant reduction in plant cover after 7 years of rest from heavy (90%) and moderate (60%) spring use. The seed crop may be reduced where grazing is heavy (Bich et al. 1995). Tolerance to grazing increases after May, thus spring deferment may be necessary for stand enhancement (Pearson 1964, Cook and Child 1971); however, utilization of less than 60% is recommended. Needleandthread grass is not grazing tolerant and will be one of the first grasses to decrease under heavy grazing pressure (Smoliak et al. 1972, Tueller and Blackburn 1974). Heavy grazing is likely to reduce basal area of these plants (Smoliak et al. 1972). With the reduction in competition from deep rooted perennial bunchgrasses, shallower rooted grasses such as Sandberg bluegrass and forbs may increase (Smoliak et al. 1972). Further degradation of the grass community can lead to an invasion by exotic annual species such as halogeton and cheatgrass.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg's bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg's bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. Depending on the season of use, the type of grazing animal, and site conditions, either Sandberg's bluegrass or cheatgrass may become the dominant understory with inappropriate grazing management.

Halogeton is a non-competitive plant that tends to invade areas that are susceptible to repeated disturbance such as; livestock trails, roadsides, trampled areas near watering holes or corrals and rangeland areas stripped of the natural vegetation by excessive grazing or other soil disturbing activities (Young 2002). It was first introduced into the western U.S. during the 20th century with the first collection being made near Wells, Nevada in 1934. Halogeton is highly toxic to sheep and has been responsible for thousands of sheep deaths throughout the western U.S., which triggered a massive effort to eradicate the introduced species (Young 2002).

Halogeton has two distinct seed forms; black form which consists of the achene only and brown form which consists of the achene and attached sepals (Tisdale and Zappetini 1953, Robocker et al. 1969). The black form of halogeton seed germinate readily under a wide range of pH and salt concentrations within the first year. The brown form of seed was found to be 100 percent viable at the end of 2 years and 15 percent viable at the end of 10 years, proving that halogeton seed may remain viable in the soil for up to 10 years (Robocker et al. 1969). Eradication of this species is problematic therefore appropriate range management practices focused on soil and rangeland integrity may keep the plant in check.

Wildlife Interpretations:

Black sagebrush are desirable forage plants and also act as good cover for wildlife (Blaisdell et al. 1982). Pronghorn do best where shrub cover is moderate to low, therefore, low sagebrush varieties may be preferred in some areas over big sagebrush varieties (Blaisdell et al. 1982). Furthermore, a review identified black sagebrush as the most important source of winter browse for pronghorn in Utah (Allen et al. 1984). In winter, it was reported by Clary and Beale (1983) that pronghorn preferred black sagebrush habitat.

In a study by Behan and Welch (1985) black sagebrush accessions were preferred over six other big sagebrush accessions for winter habitat by mule deer. Black sagebrush (and other sagebrush communities) are less attractive

to elk and moose. In southwestern Wyoming comparing winter habitat use by wild ungulates, elk and moose used Wyoming big sagebrush and black sagebrush community less than expected, while mule deer used it almost exclusively (Oedekoven et al. 1987).
Bird species use black sagebrush habitat. Sage thrashers and most passerines prefer areas with black sagebrush and other dwarf shrubs over areas with taller shrubs (Medin et al. 2000). Gunnison sage-grouse, Columbian sharp-tailed grouse, Brewer's sparrow, sage sparrow, sage thrasher, also use black sagebrush communities for cover and feed (Paige and Ritter 1999). Greater Sage grouse are known obligates in black sagebrush and other sagebrush habitats and will use black sagebrush sites as winter grounds (Connelly et al. 2000). For example: sage-grouse on the Snake River Plains of Idaho use black sagebrush-big sagebrush communities as winter range, and in Nevada, sage-grouse select wind-swept ridges with short, scattered black sagebrush plants as winter feeding areas (Clements and Young 1997). In fact, throughout the west, greater sage grouse use mixed sagebrush habitats of big sagebrush and black sagebrush stands.

Black sagebrush, is often a component of low sagebrush communities and is an important shrub for pygmy rabbits and other sagebrush obligate species (Oregon Conservation Strategy, 2006).
Rodents also use black sagebrush habitats. A study in northeastern Nevada showed deer mice, Great Basin pocket mice, and Ord's kangaroo rats used gray low sagebrush-black sagebrush communities on dry ridge tops in late spring and summer (McAdoo et al. 2006). Rodents on cold-desert warm-desert ecotones within the Nevada Test Site preferred cold-desert communities over transition and warm-desert communities in which black sagebrush communities were more abundant (Hansen et al. 1999). Black sagebrush communities also support predators. According to study by MacLaren et al. (1988) greater sage-grouse are the primary avian prey of golden eagles in a mixed big sagebrush-black sagebrush shrubland in southeastern Wyoming.
Threats and Management
Changes in plant community composition caused by fire frequency, and other threats associated with this ecological site could affect the distribution and presence of wildlife species.

Hydrological functions

Runoff is medium to very high with well to somewhat excessive drainage. Rills and water flow patterns are none to rare. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Indian ricegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact.

Recreational uses

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

Other products

Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source. The large-seeded panicle is often used in dry floral arrangements.

Other information

Black sagebrush is an excellent species to establish on sites where management objectives include restoration or improvement of domestic sheep, pronghorn, or mule deer winter range. Indian ricegrass is well-suited for surface erosion control and revegetation although it is not highly effective in controlling sand movement. Certain native ecotypes exhibit desirable characteristics such as drought and salinity tolerance, low seed dormancy, and good nutritional qualities. However, Indian ricegrass can be difficult to establish. Indian ricegrass can be useful in the reclamation of many arid and semiarid areas in the western United States. Typical sites include those in which vegetation has been removed due to surface mining, construction activity, brush control, heavy grazing, or fire. Indian ricegrass can be used for revegetating degraded rangelands in areas of low precipitation and has naturally revegetated overgrazed ranges.
Needleandthreadgrass is useful for stabilizing eroded or degraded sites. The presence of the long and tough seed

awn on needleandthreadgrass reduces is usefulness as a commercial seed, but needleandthreadgrass hay has been used successfully in revegetation projects.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T16 N R57 E S7
General legal description	East side of main road to Green Springs; approximately 1/2 mile north of northern-most turnoff to Monte Cristo, west side of White Pine Range, south end of Newark Valley, White Pine County, 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	06/20/2006
Approved by	P.Novak-Echenique
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Rills will begin to heal during the following growing season.

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2. **Presence of water flow patterns:** Water flow patterns are none to few (short, <1 m and disconnected) and can be expected in areas subjected to summer convection storms or rapid snowmelt. Flow patterns are meandering and interrupted by plants and exposed rocks.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition.

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

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None - rock fragments protect the surface.

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

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

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically thin to thick platy. Soil surface color is brown or pale brown and the soils are typified by an ochric epipedon. Organic carbon of the surface 2 to 3 inches is typically 1 to 1.5 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Indian ricegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact.

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

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

    Dominant: Reference State: Deep-rooted, cool season, perennial bunchgrasses = low shrubs (black sagebrush

    Sub-dominant: Associated shrubs > shallow-rooted, cool season, bunchgrasses > deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, perennial forbs = annual forbs.

    Other: Succulents, evergreen trees

    Additional: With an extended fire return interval, the shrub component will increase at the expense of the herbaceous component. Utah juniper and singleleaf pinyon may increase and eventually dominate this site.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers.

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

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (end of May) ± 450 lbs/ac; Spring moisture significantly affects total production. Favorable years ± 600 lbs/ac and unfavorable years ± 250 lbs/ac.

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

singleleaf pinyon. Utah juniper and singleleaf pinyon may increase and eventually dominate this site.

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