Ecological site R026XY028NV
MOUNTAIN RIDGE

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 026X–Carson Basin and Mountains

The area lies within western Nevada and eastern California, with about 69 percent being within Nevada, and 31 percent being within California. Almost all this area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north-south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys are drained by three major rivers flowing east across this MLRA. A narrow strip along the western border of the area is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault block that has been uplifted with a dominant tilt to the west. This structure leaves an impressive wall of mountains directly west of this area. This helps create a rain shadow affect to MLRA 26. Parts of this eastern face, but mostly just the foothills, mark the western boundary of this area. Elevations range from about 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

Valley areas are dominantly composed of Quaternary alluvial deposits with Quaternary playa or alluvial flat deposits often occupying the lowest valley bottoms in the internally drained valleys, and river deposited alluvium being dominant in externally drained valleys. Hills and mountains are dominantly Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks. Quaternary basalt flows are present in lesser amounts, and Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Also of limited extent are glacial till deposits along the east flank of the Sierra Nevada Mountains, the result of alpine glaciation.

The average annual precipitation in this area is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. They generally are well drained, are clayey or loamy and commonly skeletal, and are very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush occur on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, Anderson peachbrush, and several forb species also are common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier sites that have a high concentration of salts.

Some of the major wildlife species in this area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

LRU notes

The Sierra Influenced Ranges LRU is characterized by wooded great basin mountains with climatic and biotic affinities to the Sierra Nevada mountain range. The Sierra Influences Ranges LRU receives greater precipitation that the mountain ranges of central NV. Amount of precipitation varies in relation to the local strength of the Sierra NV rain shadow, characterized by pinyon and juniper trees. The White, Sweetwater, Pine Nut, Wassuk, and Virginia ranges of Nevada support varying amounts of Sierra Nevada flora, such as ponderosa pine. Elevations range from 1610 to 2420 meters and slopes range from 5 to 49 percent, with a median value of 22 percent. Frost free days (FFD) ranges from 92 to 163.

Ecological site concept

The Mountain Ridge site is found on mountains and mountain slopes. The annual precipitation for the Mountain Ridge site ranges from 14 to over 20 inches. Elevations range from 6,000 to 10,000 feet. Slopes range from 2 to over 50 percent, however, slopes of 4 to 30 percent are typical. Soils for these sites range from very shallow to moderately deep, and they typically exhibit a clay layer that can restrict root growth. The potential native plant community of these sites is dominated by low sagebrush (Artemisia arbuscula), pine needlegrass (*Achnatherum pinetorum*), and Letterman's needlegrass (*Achnatherum lettermanii*). Bluegrasses (Poa spp.) and prairie junegrass (Koeleria macrantha) are typically significant components of these sites. Production for a normal year ranges from 150 to 300 lbs/ac.

Associated sites

R026XY038NV	**LOAMY SLOPE 14+ P.Z.**
R026XY039NV	**CLAYPAN 14+ P.Z.**
R026XY052NV	**SHALLOW LOAM 16+ P.Z.**
R026XY056NV	**SOUTH SLOPE 16+ P.Z.**
R026XY058NV	**ALPINE RIDGE**

Similar sites

R026XY023NV	**CLAYPAN 10-12 P.Z.** ACTH7 dominant grass; more productive site
R026XY039NV	**CLAYPAN 14+ P.Z.** More productive site
R026XY058NV	**ALPINE RIDGE** Higher elevations; POA and KOMA dominant grasses; ARAR8 rare to absent
R026XY050NV	**GRAVELLY CLAY 10-12 P.Z.** ARARL3 dominant shrub
R026XY090NV	**SCABLAND 10-14 P.Z.** POSE dominant grass; lower elevations

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula*
Herbaceous	(1) *Achnatherum pinetorum*

Physiographic features

This site occurs on plateaus, summits, shoulders, and upper backslopes of mountains. Slopes range from 2 to 50 percent, but slope gradients of 4 to 30 percent are most typical. Elevations are 6,000 to over 11,000 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Mountain
Elevation	1,829–3,353 m
Slope	4–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is about 14 to over 20 inches. Mean annual air temperature is 39 to 46 degrees F. The average growing season is about 50 to 100 days. Climate data used to support this section were derived from PRISM and is not specifically tied to any dominant climate station.

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).

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	356-508 mm
Frost-free period (average)	75 days
Freeze-free period (average)	
Precipitation total (average)	432 mm

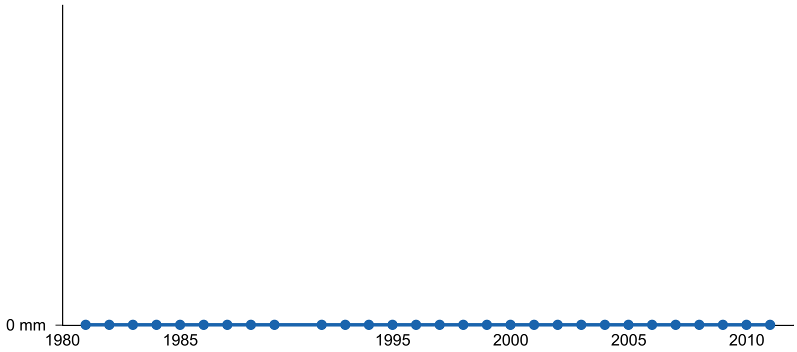


Figure 1. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are typically very shallow to shallow and formed in residuum or colluvium from extrusive igneous rocks. Many soils have a thin, clayey horizon just above bedrock. Lack of soil depth and high volumes of coarse fragments in the soil profile result in very low available water capacity. The soils commonly have over 70 percent gravels, cobbles and stones on the surface which provide a stabilizing affect on surface erosion conditions. Runoff is high to very high on this site. The soil moisture regime is xeric bordering on aridic and the soil temperature regime is frigid or cryic. Soil series associated with this site are Domehill, Gabica, Genoa, Granmount, Hiridge, Mopana, Rockabin, and Roughridge.

A representative soil series is Hiridge, a loamy-skeletal, mixed, superactive, shallow Xeric Argicryolls. A mollic epipedon occurs from the soil surface to 23 cm and an argillic horizon occurs from 10 to 46 cm.

Table 4. Representative soil features

Parent material	(1) Residuum–andesite
Surface texture	(1) Very cobbly sandy loam (2) Very gravelly sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderate
Soil depth	36–51 cm
Surface fragment cover <=3"	11–45%
Surface fragment cover >3"	0–20%
Available water capacity (0-101.6cm)	2.54–4.06 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.8

Subsurface fragment volume <=3" (Depth not specified)	10–48%
Subsurface fragment volume >3" (Depth not specified)	0–7%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al. 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The ecological sites in this DRG are dominated by shallow and deep-rooted cool season, perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 m (Dobrowolski et al. 1990). However, community types with low sagebrush as the dominant shrub were found to have soil depths and thus available rooting depths of 71 to 81 cm in a study in northeast Nevada (Jensen 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992). The ecological sites in this group have very shallow soil depths, resulting in low available water holding capacity and therefore low productivity. Additionally, these sites occur on harsh windswept ridgeline positions that favor low-stature vegetation.

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 with the soil profile (Bates et al. 2006). Low sagebrush is fairly drought tolerant but also tolerates periodic wetness during the early growing season. Low sagebrush is also susceptible to the sagebrush defoliator, Aroga moth. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975), but the research is inconclusive of the damage sustained by low sagebrush populations.

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 (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

At the time of publication of this document, no literature could be found about the ecological dynamics of pine needlegrass (*Achnatherum pinetorum*), but it likely responds similarly to Letterman's needlegrass (*Achnatherum lettermanii*), another densely tufted needlegrass which reproduces by seed and tillering.

The ecological sites in this DRG have moderate to high resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Three possible alternative stable states have been identified for this DRG.

Fire Ecology:
Fire is not a major ecological component of these community types (Winward 2001), and would be patchy and infrequent when they occur due to the low productivity of the sites. Fire return intervals have been estimated at 100 to 200 years (Kitchen and McArthur 2007). Low sagebrush is killed by fire and does not resprout (Tisdale and Hironaka 1981). Establishment after fire is from seed, generally blown in and not from the seed bank (Bradley et al. 1992). Fire risk is greatest following a wet, productive year when there is greater production of fine fuels (Beardall and Sylvester 1976). Fine fuel loads generally average 100 to 400 pounds per acre (110- 450 kg/ha) but are

occasionally as high as 600 pounds per acre (680 kg/ha) in low sagebrush habitat types (Bradley et al. 1992). Recovery time of low sagebrush following fire is variable (Young 1983). After fire, if regeneration conditions are favorable, low sagebrush recovers in 2 to 5 years, however, on harsh sites where cover is low to begin with and/or erosion occurs after fire, recovery may require more than 10 years (Young 1983). Slow regeneration may subsequently worsen erosion (Blaisdell et al. 1982).

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. Sandberg bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975) and may retard reestablishment of deeper-rooted bunchgrasses.
Prairie junegrass can be a significant component on these sites. It is a short-statured cool season perennial bunchgrass that is relatively shallow rooted (Albertson and Weaver 1944) but is found throughout the western United States and can vary morphologically. Prairie junegrass is moderately resistant to fire, likely due to its low stature and loosely tufted growth form (Young 1983). It is typically not a dominant grass in the Great Basin but is found in early-seral and climax communities and occurs on sites with coarse to medium textured soils (Friesen 2002). Prairie junegrass is widely documented as a drought tolerant species that is often used for reclamation but one study found that its drought tolerance significantly decreased in populations at higher elevations (Zhang et al. 2011).
Needlegrasses are slightly to moderately damaged by fire depending on season of burn. They tend to be more susceptible when burned during mid-summer (Wright and Klemmedson 1965).

Livestock/Wildlife Grazing Interpretations:
Domestic sheep and, to a much lesser degree, cattle consume low sagebrush, particularly during the spring, fall, and winter (Sheehy and Winward 1981). Heavy dormant season grazing by sheep will reduce sagebrush cover and increase grass production (Laycock 1967). Severe trampling damage to supersaturated soils could occur if sites are used in early spring when there is abundant snowmelt. Trampling damage, particularly from cattle or horses, in low sagebrush habitat types is greatest when high clay content soils are wet. In drier areas with more gravelly soils, no serious trampling damage occurs, even when the soils are wet (Hironaka et al. 1983). Bunchgrasses, in general, best tolerate light grazing after seed formation. Britton et al. (1990) observed the effects of clipping date on basal area of 5 bunchgrasses in eastern Oregon, and found grazing from August to October (after seed set) has the least impact. Heavy grazing during the growing season will reduce perennial bunchgrasses and increase sagebrush (Laycock 1967). Abusive grazing by cattle or horses will likely increase low sagebrush, rabbitbrush and some forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*). Annual non-native weedy species such as cheatgrass and mustards, and potentially medusahead (*Taeniatherum caput-medusae*), may invade.
Needlegrasses are widely distributed throughout the U.S. but are most common in the Great Basin and Southwest. They have a high forage value specifically in the western ranges. When mature the foliage can become coarse and reduce the palatability of these grasses, however, they remain green longer than other grasses and mature well, making them valuable forage for late fall and winter. The seeds of these grasses are mechanically injurious to grazing animals and can sometimes work into the tissues of the mouth, tongue, ears, and nose of livestock and game animals (USDA 1988).

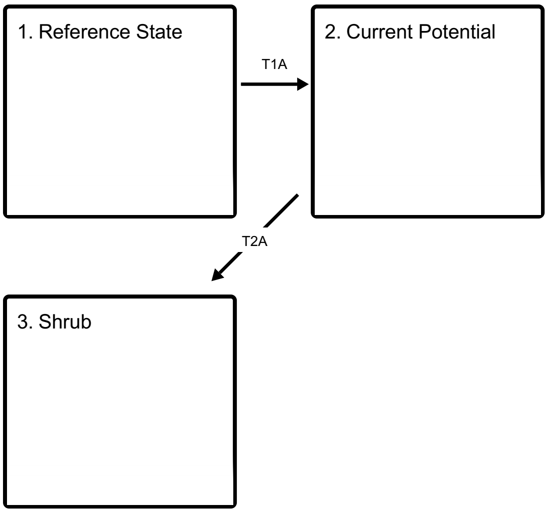
Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass or other weedy species.

Prairie junegrass is palatable to all livestock and many wildlife species including deer, antelope, elk, bighorn sheep, small mammals and upland birds. It is valuable forage in the early spring as it develops earlier than most species and flowers in April to June. Palatability decreases during seed development but then returns in the fall after curing. It is tolerant to grazing as long as adequate soil moisture is available (Fernandez-Gimenez and Allen-Diaz 2001).

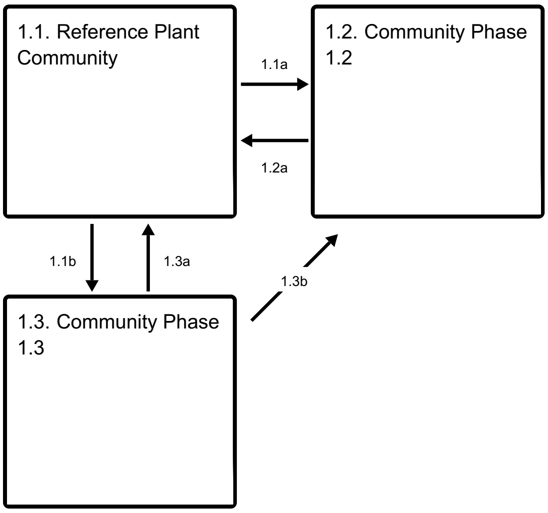
Low sagebrush sites are often used for strutting grounds for sage grouse (Centrocercus urophasianus) because the low cover allows for high visibility of strutting males (McAdoo and Back 2001). Sage grouse also use these high wind-swept sites during the winter where sagebrush provides food and cover (Braun, Connelly and Schroeder 2005).

State and transition model

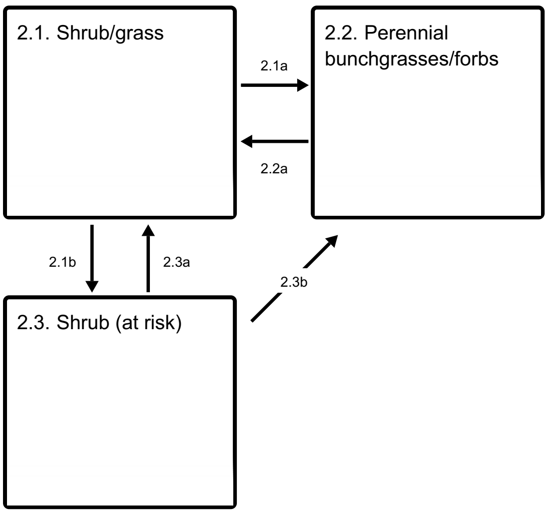
Ecosystem states



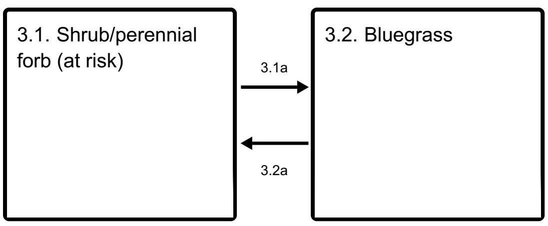
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

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

Community 1.1
Reference Plant Community

The reference plant community is dominated by low sagebrush and pine needlegrass. Prairie junegrass and bluegrasses are other important plants associated with this site. Potential vegetative composition is about 40% grasses, 5% forbs and 55% shrubs. Approximate ground cover (basal and crown) is about 5 to 15 percent. Bare ground is approximately 20%, surface rock fragments are variable but typically more than 70%, shrub canopy is 5 to 15% and foliar cover for perennial herbaceous plants is approximately 20%. Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 15% of total woody canopy. Some of the mature bunchgrasses (less than 10%) have dead centers. Within plant interspaces litter is approximately 10% cover and the depth of litter is approximately one-fourth inch.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	46	93	185
Grass/Grasslike	34	67	135
Forb	4	8	17
Total	**84**	**168**	**337**

Community 1.2
Community Phase 1.2

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 and/or from herbivory.

Community 1.3
Community Phase 1.3

This community is at risk of crossing a threshold to another state. 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. Bluegrasses may increase and become dominant. Annual non-native species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway 1.1a
Community 1.1 to 1.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. 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.

Pathway 1.1b

Community 1.1 to 1.3

Long-term drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels leading to a reduced fire frequency and allowing sagebrush to dominate the site.

Pathway 1.2a
Community 1.2 to 1.1

Release from drought allows the perennial bunchgrasses to increase.

Pathway 1.3a
Community 1.3 to 1.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Low sagebrush are palatable shrub species and can decrease with increased grazing pressure. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. 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.

Pathway 1.3b
Community 1.3 to 1.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

State 2
Current Potential

This state is similar to the Reference State 1.0. Ecological function has not changed, however, the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. 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 feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Shrub/grass

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. Sagebrush, pine needlegrass and prairie junegrass dominate the site. A diversity of forbs and other shrubs and grasses make up smaller components of this site.

Community 2.2
Perennial bunchgrasses/forbs

This community phase is characteristic of a post-disturbance, early to mid-seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses and forbs dominate the site. Depending on fire severity, patches of intact sagebrush may remain. Rabbitbrush may be sprouting or dominant in the community. Perennial forbs may be a significant component for a number of years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3

Shrub (at risk)

This community is at risk of crossing a threshold to another state. 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. Bluegrasses may increase and become dominant. Annual non-native species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway 2.1a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses and perennial forbs to dominate the site. 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.

Pathway 2.1b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Long-term drought reduces fine fuels and leads to a reduced fire frequency, allowing sagebrush to dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely bluegrasses may increase in the understory depending on grazing management.

Pathway 2.2a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

Pathway 2.3a
Community 2.3 to 2.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Low sagebrush are palatable shrub species and can decrease with increased grazing pressure. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. 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. Annual non-native species are present and may increase in the community.

Pathway 2.3b
Community 2.3 to 2.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

State 3
Shrub

This state has 2 community phases, a shrub dominated phase and a bluegrass/annual grass dominated phase. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Bluegrasses will increase with a reduction in deep-rooted perennial bunchgrass competition and become the dominant grass. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 3.1
Shrub/perennial forb (at risk)

Decadent sagebrush dominates the overstory with perennial forbs dominant in the understory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Bluegrasses and annual non-native species increase. Bare ground is significant.

Community 3.2
Bluegrass

Bluegrass dominates the site; annual non-native species may be present but are not dominant. Trace amounts of sagebrush or rabbitbrush may be present.

Pathway 3.1a
Community 3.1 to 3.2

Fire, heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, will greatly reduce the overstory shrubs to trace amounts and allow for bluegrasses to dominate the site.

Pathway 3.2a
Community 3.2 to 3.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate grazing will decrease or eliminate deep-rooted perennial bunchgrasses, increase bluegrasses and favor shrub growth and establishment. To Community Phase 3.2: Severe fire in Community Phase 2.3 will remove sagebrush overstory, decrease perennial bunchgrasses and enhance bluegrasses. Annual non-native species will increase. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			61–101	
	pine needlegrass	ACPI2	*Achnatherum pinetorum*	43–67	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	9–17	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	3–6	–
	muttongrass	POFE	*Poa fendleriana*	3–6	–
	Sandberg bluegrass	POSE	*Poa secunda*	3–6	–
2	**Secondary Perennial Grasses**			3–13	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	1–6	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	1–6	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	1–6	–
	needle and thread	HECO26	*Hesperostipa comata*	1–6	–
Forb					
3	**Perennial**			9–26	
	aster	ASTER	*Aster*	1–6	–
	bitter root	LERE7	*Lewisia rediviva*	1–6	–
	phlox	PHLOX	*Phlox*	1–6	–
	goldenweed	PYRRO	*Pyrrocoma*	1–6	–
Shrub/Vine					
4	**Primary Shrubs**			43–59	
	little sagebrush	ARAR8	*Artemisia arbuscula*	43–59	–
5	**Secondary Shrubs**			9–26	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	2–6	–
	buckwheat	ERIOG	*Eriogonum*	2–6	–
	rockspirea	HODU	*Holodiscus dumosus*	2–6	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	2–6	–

Animal community

Livestock Interpretations:
This site has limited potential for domestic livestock grazing due to low forage production. Low sagebrush is considered a valuable browse plant for livestock during the spring, fall, and winter months. Needlegrass, prairie Junegrass and bluegrass provide valuable forage for domestic livestock.

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

Wildlife Interpretations:
Mule deer utilize and sometimes prefer low sagebrush, particularly in winter and early spring. Needlegrass provides valuable forage for many species of wildlife. Thurber's needlegrass provides some cover for small birds and mammals.

Hydrological functions

Rills and water flow patterns are none to rare on this site. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid snowmelt. Pedestals are rare with occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a normal condition.

Fine litter (foliage from grasses and annual and perennial forbs) are expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. High winds over ridge top landscapes limit accumulation of litter. Persistent litter (large woody material) will remain in place except during catastrophic events. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e. needlegrass, muttongrass, Cusick bluegrass] slow runoff and increase infiltration. Low stature and sparseness of shrub canopy coupled with high velocity ridge-top winds, limit snow catch and accumulation on this site.

Recreational uses

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

Other information

Low sagebrush can be successfully transplanted or seeded in restoration.

Type locality

Location 1: Mineral County, NV	
Township/Range/Section	T8N R28E S12
General legal description	West face of Mount Grant, Wassuk Range, Mineral County, Nevada. This site also occurs in Douglas, Lyon and Washoe counties, Nevada.

Other references

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

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

References

Albertson, F.W. and J.E. Weaver. 1944. Nature and Degree of Recovery of Grassland from the Great Drought of 1933 to 1940. Ecological Monographs 14: 393-479.

Bates, J. D., T. Svejcar, R. F. Miller, and R. A. Angell. 2006. The effects of precipitation timing on sagebrush steppe vegetation. Journal of Arid Environments 64(4):670-697.

Beardall, L. E. and V. E. Sylvester. 1976. Spring burning of removal of sagebrush competition in Nevada. In: Proceedings, Tall Timbers fire ecology conference and fire and land management symposium. 1974, October 8-10. Missoula MT. Tallahassee, FL: Tall Timbers Research Station. Pages 539-547.

Blaisdell, James P.; Murray, Robert B.; McArthur, E. D. 1982. Managing intermountain rangelands-sagebrush-grass ranges. Gen. Tech. Rep. INT-134. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 41 p.

Bradley, Anne F.; Noste, Nonan V.; Fischer, William C. 1992. Fire ecology of forests and woodlands in Utah. Gen. Tech. Rep. INT-GTR-287. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 128 p.

Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. The Great Basin Naturalist 50(2):115-120.

Caudle, D., J. DiBenedetto, M. Karl, H. Sanchez, and C. Talbot. 2013. Interagency ecological site handbook for rangelands. Available at: http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf. Accessed 4 October 2013.

Chambers, J., B. Bradley, C. Brown, C. D'Antonio, M. Germino, J. Grace, S. Hardegree, R. Miller, and D. Pyke. 2013. Resilience to Stress and Disturbance, and Resistance to *Bromus tectorum* L. Invasion in Cold Desert Shrublands of Western North America. Ecosystems 17:1-16.

Chambers, J. C., B. A. Roundy, R. R. Blank, S. E. Meyer, and A. Whittaker. 2007. What makes great basin sagebrush ecosystems invasible by *Bromus tectorum*? Ecological Monographs 77(1):117-145.

Comstock, J. P. and J. R. Ehleringer. 1992. Plant adaptation in the Great Basin and Colorado plateau. Western North American Naturalist 52:195-215.

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

Dobrowolski, J.P., Caldwell, M.M. and Richards, J.H. 1990. Basin hydrology and plant root systems. In: Plant Biology of the Basin and Range. Springer-Verlag Pub., New York, NY.

Fernandez-Gimenez, M. and B. Allen-Diaz. 2001. Vegetation Change Along Gradients from Water Sources in Three Grazed Mongolian Ecosystems. Plant Ecology 157: 101-118.

Friesen, G.M. 2002. Improving the Seedling Vigor and Seed Production of Blue Grama (Bouteloua gracilis) and Prairie Junegrass (Koeleria macrantha). Thesis. Masters. The University of Manitoba

Furniss, M. M. and Barr, W. F. 1975. Insects affecting important native shrubs of the northwestern United States. Gen. Tech. Rep. INT-19. Intermountain Forest and Range Experiment Station, U.S. Department of Agriculture, Forest Service. Ogden, UT. 68 p.

Hironaka, M., M. A. Fosberg, and A. H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Bulletin Number 35. University of Idaho, Forest, Wildlife and Range Experiment Station, Moscow, ID.

Jensen, M. E. 1990. Interpretation of Environmental Gradients Which Influence Sagebrush Community Distribution in Northeastern Nevada. Journal of Range Management 43:161-167.

Kitchen, S.G. and McArthur, E. D. 2007. Big and black sagebrush landscapes. Gen. Tech. Rep. RMRS-GTR-202. Rocky Mountain Research Station, U.S. Department of Agriculture, Forest Service. Fort Collins, CO. 82 p.

Laycock, W. A. 1967. How heavy grazing and protection affect sagebrush-grass ranges. Journal of Range Management 20(4):206-213.

Richards, J.H. and M.M. Caldwell. 1987. Hydralulic lift: Substantial nocturnal water transport between soil layers by Artemisia tridentate roots. Oecologia 73(4):486-489.

Sheehy, D. P. and A. H. Winward. 1981. Relative palatability of seven Artemisia taxa to mule deer and sheep. Journal of Range Management 34(5):397-399.

Tisdale, E. W. and M. Hironaka. 1981. The sagebrush-grass region: A review of the ecological literature. Bulletin 33. University of Idaho, Forest, Wildlife and Range Experiment Station. Moscow, ID. 40 p.

USDA Forest Service. 1988. Range Plant Handbook. New York, N. Y., Dover Publications, Inc.

Winward, A. H. 2001. Sagebrush taxonomy and ecology workshop.in Vegetation, wildlife and fish ecology and rare species management -- Wasatch-Cache National Forest. U.S. Department of Agriculture, Forest Service, Intermountain Region, Uinta-Wasatch-Cache National Forest, Logan, UT.

Young, R. P. 1983. Fire as a vegetation management tool in rangelands of the Intermountain region. In: Monsen, S.B. and N. Shaw (eds). Managing Intermountain rangelands—improvement of range and wildlife habitats: Proceedings. 1981, September 15-17; Twin Falls, ID; 1982, June 22-24; Elko, NV. Gen. Tech. Rep. INT-157. Ogden, UT. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Pages 18-31.

Zhang, H., L. E. DeWald, T. E. Kolb, and D. E. Koepke. 2011. Genetic variation in ecophysiological and survival responses to drought in two native grasses: Koeleria macrantha and Elymus elymoides. Western North American Naturalist 71:25-32.

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Approval

Kendra Moseley, 4/10/2024

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
Contact for lead author	State Rangeland Management Specialist
Date	06/20/2006
Approved by	Kendra Moseley
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 rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt.

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2. **Presence of water flow patterns:** Water flow patterns are none to rare but may be expected on steeper slopes in areas recently subjected to summer convection storms or rapid snowmelt.

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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. A few terracettes may occur on steeper slopes.

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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 5-10% depending on amount of surface rock fragments.

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

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

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

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

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, or subangular blocky. Soil surface colors are grayish browns and the soils are usually typified by a mollic epipedon. Organic carbon of the surface 2 to 4 inches is typically 1.25 to 2.5 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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 [needlegrasses, muttongrass, Cusick bluegrass)] slow runoff and increase infiltration. Low stature and sparseness of shrub canopy coupled with high velocity ridge-top winds, limit snow catch and accumulation on site.

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

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 Plant Community: Deep-rooted, cool season, perennial bunchgrasses = low shrubs (low sagebrush). (By above ground production)

    Sub-dominant: Deep-rooted, cool season, perennial forbs > associated shrubs = shallow-rooted, cool season, perennial bunchgrasses > fibrous, shallow-rooted, cool season, perennial and annual forbs. (By above ground production)

    Other:

    Additional:

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; standing dead shrub canopy material may be as much as 20% of total woody canopy; some of the mature bunchgrasses (<15%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (± 10%) and litter depth 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 (through mid-June) ± 150 lbs/ac; Spring moisture significantly affects total production. Favorable years ± 300 lbs/ac and unfavorable years ± 75 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 on this site include cheatgrass, Russian thistle and annual mustards.

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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 drought years.
