Ecological site R026XY103NV
GRANITIC LOAM 10-12 P.Z.

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General information

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

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 Semiarid Fans and Basins LRU includes basins, alluvial fans and adjacent hill slopes immediately east of the Sierra Nevada mountain range and are affected by its climate or have its granitic substrate. Elevations range from 1355 to 1920 meters and slopes range from 0 to 30 percent, with a median value of 6 percent. Frost free days range from 121 to 170.

Ecological site concept

The Granitic Loam 10-12 P.Z. site is found on fan remnants at slopes less than 30 percent. The elevations are between 4,500 and 6,000 feet. The soil is deep with a sandy loam surface texture. The dominant vegetation is Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis) and desert needlegrass (Achnatherum speciosum).

Associated sites

R026XY008NV	**GRANITIC FAN 10-12 P.Z.**
R026XY010NV	**LOAMY 10-12 P.Z.**
R026XY018NV	**GRANITIC SOUTH SLOPE 10-12 P.Z.**
R026XY046NV	**GRANITIC SLOPE 12-14 P.Z.**
R026XY085NV	**GRANITIC FAN 12-14 P.Z.**

Similar sites

R026XY046NV	**GRANITIC SLOPE 12-14 P.Z.** ACOCO dominant grass
R026XY085NV	**GRANITIC FAN 12-14 P.Z.** ACOCO dominant grass; more productive site
R026XY008NV	**GRANITIC FAN 10-12 P.Z.** HECO26-ACHY codominant grasses
R026XY018NV	**GRANITIC SOUTH SLOPE 10-12 P.Z.** ACSP12 dominant grass; less productive site

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata var. wyomingensis*
Herbaceous	(1) *Achnatherum speciosum*

Physiographic features

This site occurs on fan remnants. Slopes range from 8 to 30 percent. Elevations are 4500 to 6000 feet.

Table 2. Representative physiographic features

Landforms	(1) Fan remnant
Elevation	1,372–1,829 m
Slope	8–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is arid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 10 to 12 inches. Mean annual air temperature is 46 to 53 degrees F. The average growing season is about 60 to 130 days.

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)	254-305 mm
Frost-free period (average)	104 days
Freeze-free period (average)	134 days
Precipitation total (average)	279 mm

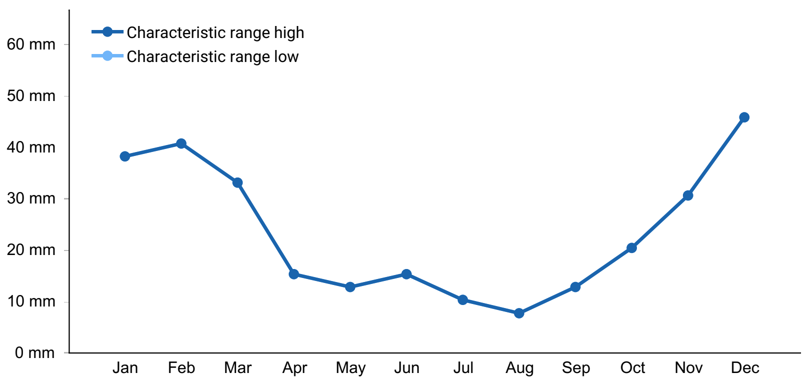

Figure 1. Monthly precipitation range

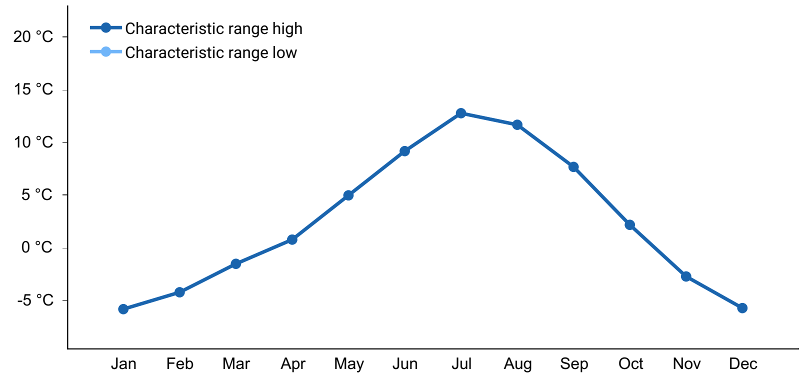

Figure 2. Monthly minimum temperature range

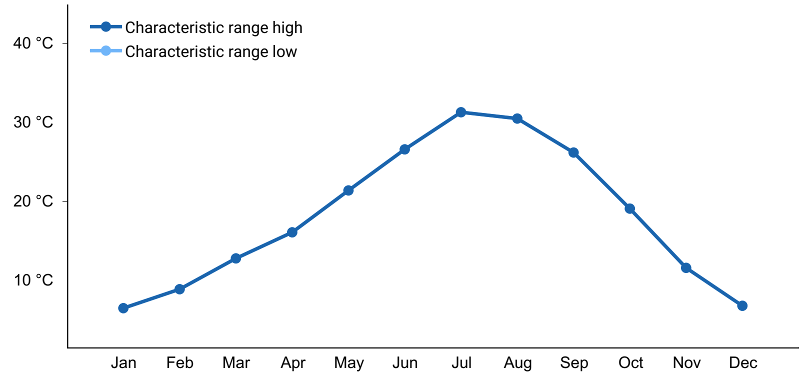

Figure 3. Monthly maximum temperature range

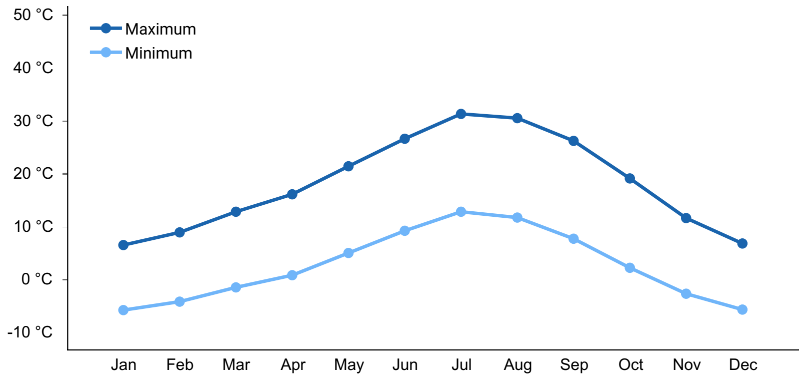

Figure 4. Monthly average minimum and maximum temperature

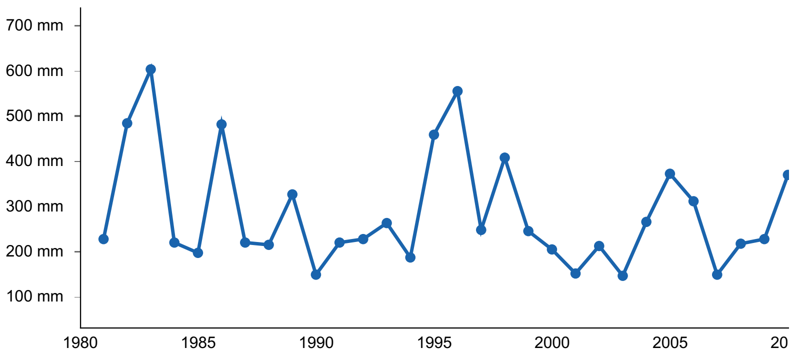

Figure 5. Annual precipitation pattern

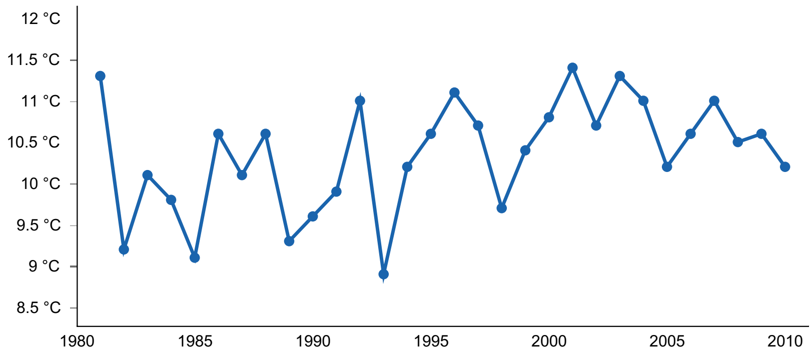

Figure 6. Annual average temperature pattern

Climate stations used

- (1) STEAD [USC00267820], Reno, NV

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils in this site are deep to very deep, well drained to somewhat excessively drained soils that formed in alluvium from mixed igneous rocks. The soil profile is modified with rock fragments. The soils are usually moist in the winter and spring, and dry in summer and fall. The moisture regime is aridic that borders on xeric. The soils have a mollic epipedon. Susceptibility to sheet and rill erosion is moderate. Soil series associated with this site include Galeppi and Linhart.

Table 4. Representative soil features

Surface texture	(1) Sandy loam (2) Very gravelly coarse sand
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to rapid
Soil depth	183–213 cm
Surface fragment cover <=3"	5–25%
Surface fragment cover >3"	2–4%
Available water capacity (0-101.6cm)	5.08–12.19 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	5–33%
Subsurface fragment volume >3" (Depth not specified)	2–17%

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 that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).
This ecological site is dominated by 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). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).
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). Wyoming big 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.
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 have been ongoing in Nevada since 2004 (Bentz et al 2008). Thousands of acres of big sagebrush have been impacted, with partial to complete die-off observed. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975).
The 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).
As ecological condition declines, the perennial grasses decrease and big sagebrush, Douglas' rabbitbrush and Anderson's peachbrush become more dominant. Species most likely to invade this site are cheatgrass and annual mustards.

Fire Ecology:
Fire is the principal means of renewal of decadent stands of Wyoming big sagebrush. Wyoming big sagebrush communities historically had low fuel loads, and patchy fires that burned in a mosaic pattern were common at 10 to 70 year return intervals (Young et al. 1979, West and Hassan 1985, Bunting et al. 1987). Davies et al. (2007) suggest fire return intervals in Wyoming big sagebrush communities were around 50 to 100 years. More recently, Baker (2011) estimates fire rotation to be 200-350 years in Wyoming big sagebrush communities. Wyoming big sagebrush is killed by fire and only regenerates from seed. Recovery time for Wyoming big sagebrush may require 50 to 120 or more years (Baker 2006). Post-fire hydrologic recovery and resilience is primarily influenced by pre-fire site conditions, fire severity, and post-fire weather and land use that relate to vegetation recovery. Sites with low abundances of native perennial grasses and forbs typically have reduced resiliency following disturbance and are less resistant to invasion or increases in cheatgrass (Miller et al 2013). However, the introduction and expansion of cheatgrass has dramatically altered the fire regime (Balch et al. 2013) and restoration potential of Wyoming big sagebrush communities.

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. For most forbs and grasses the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire.

Thus, fire mortality is more related to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Young 1983, Wright 1971).

Indian ricegrass is fairly fire tolerant (Wright 1985), which is likely due to its low culm density and below ground plant crowns. Vallentine (1989) cites several studies in the sagebrush zone that classified Indian ricegrass as being slightly damaged from late summer burning. Indian ricegrass has also been found to reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983, West 1994). Thus the presence of surviving, seed producing plants facilitates reestablishment of Indian ricegrass. Grazing management following fire to promote seed production and establishment of seedlings is important.

Desert needlegrass and needleandthread grass are top-killed by fire but will likely 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 needleandthread grass. Early spring season burning was seen to kill the plants while August burning had no effect. Thus under wildfire scenarios needle-and-thread is often present in the post-burn community. However, due to its lack of grazing tolerance, grazing after fire should be managed carefully.

Squirreltail is considered more fire tolerant than Indian ricegrass due to its small size, coarse stems, broad leaves and generally sparse leafy material (Wright 1971, Britton et al. 1990). Postfire regeneration occurs from surviving root crowns and from on-and off-site seed sources. Bottlebrush squirreltail has the ability to produce large numbers of highly germinable seeds, with relatively rapid germination (Young and Evans 1977) when exposed to the correct environmental cues. Early spring growth and ability to grow at low temperatures contribute to the persistence of bottle brush squirreltail among cheatgrass dominated ranges (Hironaka and Tisdale 1972).

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). Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often dominates (Daubenmire 1970). Thus, depending on the season of use, the grazer and site conditions, either Sandberg bluegrass or cheatgrass may become the dominant understory with inappropriate grazing management. Repeated frequent fire in this community will eliminate big sagebrush and severely decrease or eliminate the deep rooted perennial bunchgrasses from the site and facilitate the establishment of an annual weed community with varying amounts of Sandberg bluegrass and rabbitbrush.

Wildfire in sites with cheatgrass present could transition to cheatgrass dominated communities. Without management cheatgrass and annual forbs are likely to invade and dominate the site, especially after fire. Utah juniper and/or singleleaf pinyon may be present and with a lack in disturbances such as fire can eventually out-compete understory vegetation for site resources.

State and transition model

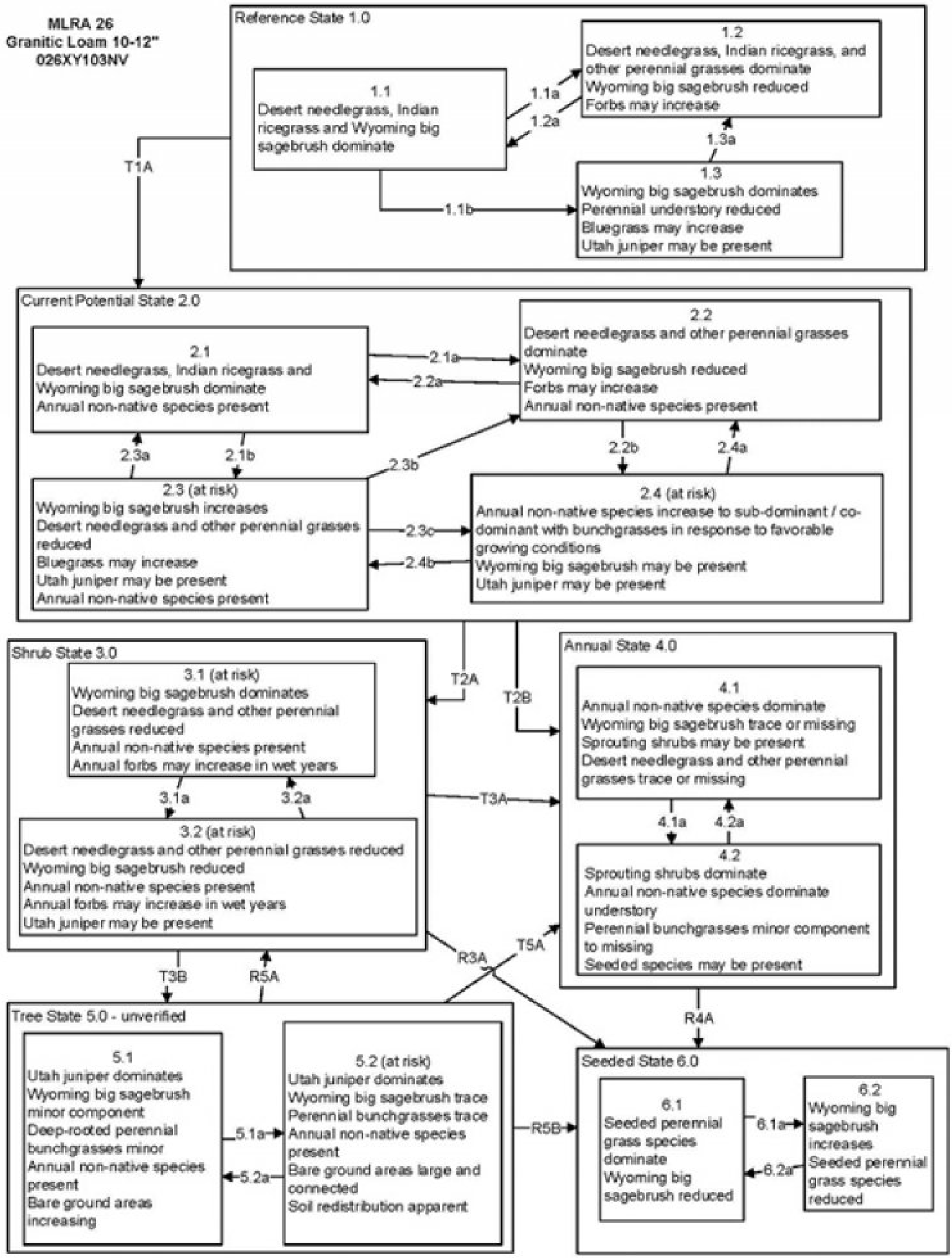

Figure 7. T. Stringham 4/2018 DRAFT

MLRA 26
Granitic Loam 10-12"
026XY103NV

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

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
2.1b: Time and lack of disturbance. Inappropriate grazing management and/or long-term drought may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.2b: Rainfall pattern favoring annual species production (higher than normal spring precipitation).
2.3a: Low severity fire creates sagebrush/grass mosaic, herbivory or combinations. Brush management with minimal soil disturbance reduces sagebrush.
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community. Brush management with minimal soil disturbance reduces sagebrush.
2.3c: Rainfall pattern favoring annual species production (higher than normal spring precipitation).
2.4a: Rainfall pattern favoring perennial bunchgrass production and reduced cheatgrass production.
2.4b: Rainfall pattern favoring perennial bunchgrass production and reduced cheatgrass production.

Transition T2A: Inappropriate grazing management (3.1), or high severity fire (3.2).
Transition T2B: Fire or brush management causing severe soil disturbance.

Shrub State 3.0 Community Phase Pathways
3.1a: Low severity fire, non-native annual species increase with higher than normal spring precipitation.
3.2a: Time and lack of disturbance.

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community.
Transition T3B: Time and lack of disturbance allows maturation of the tree community.

Restoration R3A: Brush management combined with seeding of desired species

Annual State 4.0
4.1a: Time and lack of disturbance. Big sagebrush is unlikely to reestablish and may take many years.
4.2a: Fire.

Restoration 4A: Application of herbicide and seeding of desired species (probability of success best immediately following fire).

Tree State 5.0
5.1a: Time and lack of disturbance allows for maturation of tree community.
5.2a: Tree thinning treatment (typically for fuels management).

Transition T5A: Catastrophic fire

Restoration R5A: Tree removal with no seeding (from Phase 5.1).
Restoration R5B: Tree management coupled with seeding of desired species.

Seeded State 6.0
6.1a: Time and lack of disturbance.
6.2a: Fire and/or brush management.

Figure 8. Legend

State 1
Reference State

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

Community 1.1
Reference Plant Community

The reference plant community is dominated by big sagebrush, and desert needlegrass. Potential vegetative composition is about 50 percent grasses, 10 percent forbs, and 40 percent shrubs. Approximate ground cover (basal and crown) is 30 to 40 percent. Bare ground is 35 to 40 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	332	437	542
Shrub/Vine	273	370	466
Forb	67	90	112
Total	**672**	**897**	**1120**

Community 1.2
Community Phase 1.2

This community phase is characteristic of a post-disturbance, early to mid-seral community. Bitterbrush, ephedra, and spiny hopsage may be sprouting and may become the dominant shrubs in this phase. Big sagebrush is killed by fire and is reduced within the burned community but may be present in unburned patches. Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several years. With low fire severity, Thurber’s needlegrass may dominate the site post-fire.

Community 1.3
Community Phase 1.3

Big sagebrush increases in the absence of disturbance. Thurber’s needlegrass and other perennial grasses reduced. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Bluegrass (Poa) species will likely increase in the understory and may be the dominant grass on the site. Pinyon and/or juniper may be present but constitute less than 2 percent of production on the site.

Pathway 1.1a
Community 1.1 to 1.2

Low severity fire creates a sagebrush/grass mosaic. High severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs. In reference condition, fires would typically be small and patchy due to low fuel loads. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Pathway 1.1b
Community 1.1 to 1.3

Time and lack of disturbance such as fire or drought allows shrubs to become dominant and may reduce grass production. Excessive herbivory and/or long-term drought may also reduce the perennial understory.

Pathway 1.2a

Community 1.2 to 1.1

Time and lack of disturbance allows for shrubs to reestablish.

Pathway 1.3a
Community 1.3 to 1.2

Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

State 2
Current Potential State

This state is similar to the Reference State 1.0. with similar community phases plus the 2.4 at-risk community phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. 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. Additionally, the presence of highly flammable, non-native species reduces state resilience because these species can promote fire where historically fire has been infrequent leading to positive feedbacks that further the degradation of the system.

Community 2.1
Community Phase 2.1

Thurber’s needlegrass is codominant with big sagebrush. Sagebrush may be a mix of Wyoming big sagebrush, basin big sagebrush, and mountain big sagebrush. Pinyon and/or juniper may be present. Non-native annual species are present in minor amounts.

Community 2.2
Community Phase 2.2

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. Sprouting shrubs such as Anderson's peachbrush, ephedra and rabbitbrush are common in the overstory. Perennial forbs may be a significant component for several years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase 2.3

Figure 10. T. Stringham, NV 628, MU 1143, Mottsville series,

This community is at risk of crossing a threshold to another state. Sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced from competition with shrubs, inappropriate grazing, or both. Rabbitbrush may be a significant component. Sandberg bluegrass may increase and become co-dominate with deep rooted bunchgrasses. Utah juniper and singleleaf pinyon may be present and without management will likely increase. Annual non-natives 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.

Community 2.4
Community Phase 2.4

This community is at risk of crossing into an annual state. Native bunchgrasses dominate; however, annual non-native species such as cheatgrass may be sub or co-dominant in the understory. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Seeded species may be present. Sagebrush may be present if coming from phase 2.3. This site is susceptible to further degradation from grazing, drought, and fire. Pinyon and/or juniper may be present.

Pathway 2.1a
Community 2.1 to 2.2

Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Pathway 2.1b
Community 2.1 to 2.3

Time, long-term drought, grazing management that favors shrubs or combinations of these would allow the sagebrush overstory to increase and dominate the site, causing a reduction in the perennial bunchgrasses. However, Sandberg bluegrass and/or squirreltail may increase in the understory depending on the grazing management. Heavy spring grazing will favor an increase in sagebrush. Annual non-native species may be stable or increasing within the understory.

Pathway 2.2a
Community 2.2 to 2.1

Absence of disturbance over time allows for the sagebrush to recover may be combined with grazing management that favors shrubs.

Pathway 2.2b
Community 2.2 to 2.4

Higher than normal spring precipitation favors annual non-native species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway 2.3b
Community 2.3 to 2.1

Low severity fire or Aroga moth infestation creates sagebrush/grass mosaic. Other disturbances/practices include brush management with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.

Pathway 2.3a
Community 2.3 to 2.2

Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Pathway 2.3c
Community 2.3 to 2.4

Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Higher than normal spring precipitation creates high annual production of annual grasses (Bradley et al. 2016). Non-native annual species increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway 2.4b
Community 2.4 to 2.2

Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Depending on temperatures and precipitation in winter and spring, annual grass production may be reduced in favor of perennial bunchgrasses.

Pathway 2.4a
Community 2.4 to 2.3

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

State 3
Shrub State

This state has two community phases and is the product of many years of heavy grazing during time periods harmful to deep-rooted perennial bunchgrasses. With a reduction in deep-rooted perennial bunchgrass competition, bluegrasses and squirreltail will increase and become the dominant grass. Sagebrush dominates the overstory. Bitterbrush and/or rabbitbrush may be significant components. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. Bare ground is also increasing. 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
Community Phase 3.1

Figure 11. P NovakEchenique, NV 628, MU 1210, Torripsammentic

This site is at risk of transitioning to another state. Wyoming big sagebrush, possibly decadent, dominates overstory and rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Utah juniper may be present or increasing. Annual non-native species are present to increasing. Understory may be sparse, with bare ground increasing. Utah juniper or singleleaf pinyon may be present as a result of encroachment from neighboring sites and lack of disturbance.

Community 3.2
Community Phase 3.2

After wildfire, rabbitbrush and sprouting shrubs dominate. Annual non-natives 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 3.1a
Community 3.1 to 3.2

Fire would decrease or eliminate the overstory of sagebrush. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to bluegrasses, forbs and sprouting shrubs. Heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, would greatly reduce the overstory shrubs and allow for bluegrasses to dominate the site.

Pathway 3.2a
Community 3.2 to 3.1

Absence of disturbance over time would allow for sagebrush and other shrubs to recover.

State 4
Annual State

This state has two community phases. One phase is characterized by the dominance of annual non-native species such as cheatgrass and tansy mustard. The second phase has either Wyoming big sagebrush and/or rabbitbrush dominating the overstory with an understory of annual non-natives.

Community 4.1
Annual phase

Annual non-native plants such as annual mustards and cheatgrass dominate this phase. Perennial plants are a minor component or missing from the site. This phase may have seeded species present if resulting from a failed seeding attempt.

Community 4.2

Shrub/Annual phase

Figure 12. T. Stringham, NV 628, MU 1210, Xeric Torrifluvent,

Sprouting shrubs dominate the overstory. Annual non-native plants such as annual mustards and cheatgrass dominate the understory. Trace amounts of desirable bunchgrasses may be present. This phase may have seeded species present if resulting from a failed seeding attempt.

Pathway 4.1a
Community 4.1 to 4.2

Time and lack of disturbance allows for shrubs to reestablish. Sprouting shrubs such as ephedra, desert peach and rabbitbrush will be the first to reappear after fire. Probability of sagebrush establishment is extremely low.

Pathway 4.2a
Community 4.2 to 4.1

Fire kills shrubs and allows for annual non-native species to dominate the site.

State 5
Tree State

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

Community 5.1
Community Phase 5.1

Utah juniper and/or singleleaf pinyon dominate overstory. Big sagebrush is subdominant and may be decadent. Thurber’s needlegrass and other perennial grasses are reduced. Annual non-native may be present. Bare ground areas are large and connected.

Community 5.2
Community Phase 5.2

Utah juniper and/or singleleaf pinyon dominates the site and tree leader growth is minimal; annual non-native species may be the dominant understory species and will typically be found under the tree canopies. Trace amounts of sagebrush may be present, however dead shrub skeletons will be more numerous than living sagebrush. Bunchgrasses may or may not be present. Bottlebrush squirreltail or mat forming forbs may be present in trace amounts. Bare ground interspaces are large and connected. Soil redistribution is evident.

Pathway 5.1a

Community 5.1 to 5.2

Absence of disturbance over time allows for tree cover and density to further increase and out-compete the herbaceous understory species.

Pathway 5.2a
Community 5.2 to 5.1

Manual or mechanical thinning of trees allows understory regrowth due to less competition for resources. This treatment is typically done for fuel management.

State 6
Seeded State

This state has three community phases; a grass-dominated phase, and grass-shrub dominated phase, and a shrub dominated phase. This state is characterized by the dominance of seeded introduced wheatgrass species in the understory. Forage kochia (*Bassia prostrata*) and other desired seeded species including Wyoming big sagebrush, native and non-native forbs may be present.

Community 6.1
Seeded species

Seeded wheatgrass and/or other seeded species dominate the community. Non-native annual species are present. Trace amounts of big sagebrush may be present, especially if seeded.

Community 6.2
Seeded species-Big sagebrush

Big sagebrush increases and may be codominant with seeded wheatgrass species. Annual non-native species may be present in trace amounts.

Pathway 6.1a
Community 6.1 to 6.2

Time and lack of disturbance allow shrubs to increase. Pathway may be coupled with inappropriate grazing management.

Pathway 6.2a
Community 6.2 to 6.1

Fire and/or brush management allows seeded grasses to return to dominance.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual weeds, such as cheatgrass, mustards and Russian thistle (*Salsola tragus*). Slow variables: Over time the annual non-native plants will increase within the community decreasing organic matter inputs from deep-rooted perennial bunchgrasses resulting in reductions in soil water availability for perennial bunchgrasses. 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

Transition from Current Potential State 2.0 to Shrub State 3.0: Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during growing season would favor shrubs and initiate transition to Community Phase 3.1. Fire would cause a transition to Community Phase 3.2.Slow variables: Long term decrease in deep-rooted perennial grass density resulting in a decrease in organic matter inputs and subsequent soil water decline. Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and redistribution and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger: Fire or a failed range seeding leads to plant community phase 4.1. Inappropriate grazing management that favors shrubs in the presence of non-native annual species leads to community phase 4.2. Slow variables: Increased production and cover of non-native annual species. Threshold: Cheatgrass or other non-native annuals dominate understory.

Transition T3A
State 3 to 4

Trigger: Fire or inappropriate grazing management can eliminate the Sandberg bluegrass understory and transition to community phase 4.1 or 4.2. Slow variable: 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.

Transition T3B
State 3 to 5

Trigger: Lack of fire allows for trees to dominate site; may be coupled with inappropriate grazing management that reduces fine fuels. Slow variables: Increased establishment and cover of juniper/pinyon trees, reduction in organic matter inputs. Threshold: Trees overtop Wyoming big sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

Restoration pathway R3A
State 3 to 6

Brush management, herbicide, and seeding of crested wheatgrass (*Agropyron cristatum*) and/or other desired species.

Restoration pathway R4A
State 4 to 6

Application of herbicide and seeding of desired species. Probability of success is best immediately following fire.

Restoration pathway R5A
State 5 to 3

Tree removal with no seeding. Treatments done in phase 5.1 will be more successful. Tree removal practices that minimize soil disturbance are recommended. Probability of success declines with increased presence of nonnative annual species.

Transition T5A
State 5 to 4

Trigger: Catastrophic crown fire would reduce or eliminate trees to transition the site to 4.1. Tree removal when annual non-natives such as cheatgrass are present would also transition the site to state 4.0. Slow variable: 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 R5B
State 5 to 6

Tree removal and seeding of desired species. Tree removal practices that minimize soil disturbance are recommended. Probability of success declines with increased presence of nonnative annual species.

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**			332–565	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	269–359	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	45–135	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	18–72	–
2	**Secondary Perennial Grasses**			18–72	
		ACBL	*Achnatherum ×bloomeri*	4–18	–
	squirreltail	ELEL5	*Elymus elymoides*	4–18	–
	needle and thread	HECO26	*Hesperostipa comata*	4–18	–
	Sandberg bluegrass	POSE	*Poa secunda*	4–18	–
3	**Annual Grasses**			1–18	
	sixweeks fescue	VUOC	*Vulpia octoflora*	1–18	–
Forb					
4	**Perennial**			18–90	
	Hooker's balsamroot	BAHO	*Balsamorhiza hookeri*	4–18	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	4–18	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	4–18	–
	buckwheat	ERIOG	*Eriogonum*	4–18	–
	desertparsley	LOMAT	*Lomatium*	4–18	–
	lupine	LUPIN	*Lupinus*	4–18	–
	phlox	PHLOX	*Phlox*	4–18	–
5	**Annual**			1–18	
Shrub/Vine					
6	**Primary Shrubs**			224–314	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	224–314	–
7	**Secondary Shrubs**			13–67	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	9–27	–
	mormon tea	EPVI	*Ephedra viridis*	9–27	–
	pricklypear	OPUNT	*Opuntia*	9–27	–
	desert peach	PRAN2	*Prunus andersonii*	9–27	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	9–27	–
	desert gooseberry	RIVE	*Ribes velutinum*	9–27	–
	horsebrush	TETRA3	*Tetradymia*	9–27	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management should be keyed to desert needlegrass and Indian ricegrass production. Livestock browse Wyoming big sagebrush, but may use it only lightly when palatable herbaceous species are available. Desert needlegrass produces considerable basal foliage and is good forage while young. Young desert needlegrass is palatable to all classes of livestock. Mature herbage is moderately grazed by horses and cattle but rarely grazed by sheep. Indian ricegrass has good forage value for domestic sheep, cattle and horses. It can be important cattle forage in winter, particularly in salt desert communities. Indian ricegrass is often used most heavily in the late winter, when succulent and nutritious new green leaves are produced. It supplies a source of green feed before most other native grasses have produced much new growth.

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:
Many wildlife species are dependent on the sagebrush ecosystem including the greater sage grouse, sage sparrow, pygmy rabbit and the sagebrush vole. Dobkin and Sauder (2004) identified 61 animal species, including 24 mammals and 37 birds, associated with the shrub-steppe habitats of the Intermountain West.

Overgrazing leads to an increase in big sagebrush and a decline in understory plants like Indian ricegrass and needleandthread grass. Squirreltail and Sandberg bluegrass will increase temporarily with further degradation. Invasion of annual weedy forbs and cheatgrass could occur with further grazing degradation, leading to a decline in squirreltail and an increase in bare ground. A combination of overgrazing and prolonged drought may lead to soil redistribution, increased bare ground and a loss in plant production.

Wyoming big sagebrush communities are important winter ranges for big game (Allen et al 1984, Tweit and Houston 1980). The literature is unclear as to the palatability of Wyoming big sagebrush. Generally, Wyoming sagebrush is the least palatable of the big sagebrush taxa (Bray et al 1991, Sheehy and Winward 1981) however it may receive light or moderate use depending upon the amount of understory herbaceous cover (Tweit and Houston 1980). Personius et al (1987) found Wyoming big sagebrush and basin big sagebrush to be intermediately palatable to mule deer when compared to mountain big sagebrush (most palatable) and black sagebrush (least palatable).

Indian ricegrass is a deep-rooted, cool season perennial bunchgrass that is adapted primarily to well-drained 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) also notes 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. The seed crop may be reduced where grazing is heavy (Bich et al. 1995). Additionally, heavy early spring grazing was found to reduce 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). Yet, Cook and Child (1971) found significant reduction in plant cover after 7 years of rest from heavy (90%) and moderate (60%) spring use. 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, the co-dominant grass on this site, is most commonly found on warm/dry soils and is widely distributed over the western states and Great Plains (USDA 1988)). This plant is a deep-rooted bunchgrass which depends upon seed for reproduction therefore on drier sites where seed production is variable it is easily removed by overgrazing (USDA 1988). Therefore it is considered not grazing tolerant in the arid west 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).

Bottlebrush squirreltail, a minor component of this ecological site is a short lived perennial bunchgrass that is generally an early seral species (Jones 1998). It is thought to be grazing tolerant but will decrease in basal area with heavy grazing (Eckert and Spencer 1987). Its grazing tolerance is likely due to its morphology and early dormancy during the summer months (Wright 1967). Squirreltail is considered to be fair forage for livestock and wildlife until the heads develop (Dayton 1937). Squirreltail also exhibits traits that allow it to be a good competitor with cheatgrass (*Bromus tectorum*) and make it a viable option when rehabilitating invaded rangelands (Rowe and Leger 2010).

The majority of research concerning rabbitbrush has been conducted on green rabbitbrush. Green rabbitbrush has a large taproot and is known to be shorter-lived and less competitive than sagebrush. Seedling density, flower production, and shoot growth decline as competition from other species increases (McKell and Chilcote 1957, Miller et al. 2013, Young and Evans 1974). Wyoming big sagebrush is preferred browse for wild ungulates. Pronghorn usually browse Wyoming big sagebrush heavily. Wyoming big sagebrush communities are critical habitat for the birds. Desert needlegrass, Indian ricegrass and Thurber's needlegrass are other important forage species for several wildlife species.

Hydrological functions

Runoff is very low to very high and permeability is moderately slow to rapid. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Water flow patterns are rare but can be expected on steeper slopes recently subjected to summer convection storms or rapid snowmelt. Pedestals are rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition. There are no gullies. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., desert needlegrass]) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on 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 has potential for off-road vehicle use and hiking and has potential for upland and big game hunting.

Other products

Native Americans made tea from big sagebrush leaves. They used the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal.
Indian ricegrass was traditionally eaten by some Native American peoples. The Paiutes used seed as a reserve food source.

Other information

Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish.
Indian ricegrass is well-suited for surface erosion control and desert revegetation although it is not highly effective in controlling sand movement.
Desert needlegrass seeds are easily germinated and have potential for commercial use. Desert needlegrass may be used for groundcover in areas of light disturbance, but it is susceptible to excessive trampling.

Type locality

Location 1: Washoe County, NV	
Township/Range/Section	T22N R20E S21
Latitude	39° 44′ 9″
Longitude	119° 46′ 42″
General legal description	Hungry Ridge, north of Reno, NV

Other references

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

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

Contributors

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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)	G. Brackley/P. Novak-Echenique
Contact for lead author	State Rangeland Management Specialist
Date	04/25/2007
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. These are typically short (<1m) and begin to heal during the following growing season.

2. **Presence of water flow patterns:** Water flow patterns are rare but can be expected in areas recently subjected to summer convection storms or rapid snowmelt, usually on steeper slopes. They are typically short (< 1 m), meandering, and not connected.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 35 to 40%; surface rock fragments 5 to 25%; shrub canopy 20 to 25%; foliar cover of perennial herbaceous plants 30 to 40%.

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

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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 heavy 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 4 to 6 on most soil textures found on this site. (To be field tested.)

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically moderate to fine subangular blocky or single-grained and is soft and friable. Soil surface colors are dark-grayish browns and soils are typified by a mollic epipedon. Organic carbon of the surface 2 to 4 inches is typically 1 to 3 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., desert needlegrass]) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

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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 not expected. Platy or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted.

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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 Plant Community: Deep-rooted, cool season, perennial bunchgrasses >> tall shrubs (Wyoming big 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: Microbiotic crusts

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 15% of total woody canopy; some of the mature bunchgrasses (<15%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (±20-305%) and litter depth is less than 0.25 inches.

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) ± 800 lbs/ac; Spring moisture significantly affects total production.

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, red-stem filaree, Russian thistle, annual mustards and Utah juniper.

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