

Ecological site R025XY007NV GRAVELLY LOAM 12-16 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): 025X—Owyhee High Plateau

MLRA Notes 25—Owyhee High Plateau

This area is in Nevada (56 percent), Idaho (30 percent), Oregon (12 percent), and Utah (2 percent). It makes up about 27,443 square miles. MLRA 25 is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. The western boundary is marked by a gradual transition to the lower and warmer basins of MLRA 24. The boundary to the south-southeast, with MLRA 28B, is marked by gradual changes in geology marked by an increased dominance of singleleaf pinyon and Utah juniper and a reduced presence of Idaho fescue. The boundary to the north, with MLRA 11, is a rapid transition from the lava plateau topography to the lower elevation Snake River Plain.

Physiography:

All of this area lies within the Intermontane Plateaus. The southern half is in the Great Basin section of the Basin and Range province. This part of the MLRA is characterized by isolated, uplifted fault-block mountain ranges separated by narrow, aggraded desert plains. This geologically older terrain has been dissected by numerous streams draining to the Humboldt River.

The northern half of the area lies within the Columbia Plateaus province. This part of the MLRA forms the southern boundary of the extensive Columbia Plateau basalt flows. Most of the northern half is in the Payette section, but the northeast corner is in the Snake River Plain section. Deep, narrow canyons draining into the Snake River have been incised into this broad basalt plain. Elevation ranges from 3,000 to 7,550 feet on rolling plateaus and in gently sloping basins. It is more than 9,840 feet on some steep mountains. The Humboldt River crosses the southern half of this area

Geology:

The dominant rock types in this MLRA are volcanic. They include andesite, basalt, tuff, and rhyolite. In the north and west parts of the area, Cretaceous granitic rocks are exposed among Miocene volcanic rocks in mountains. A Mesozoic igneous and metamorphic rock complex dominates the south and east parts of the area. Upper and Lower Paleozoic calcareous sediments, including oceanic deposits, are exposed with limited extent in the mountains. Alluvial fan and basin fill sediments occur in the valleys.

Climate:

The average annual precipitation in most of this area is typically 11 to 22 inches. It increases to as much as 49 inches at the higher elevations. Rainfall occurs in spring and sporadically in summer. Precipitation occurs mainly as snow in winter. The precipitation is distributed fairly evenly throughout fall, winter, and spring. The amount of precipitation is lowest from midsummer to early autumn. The average annual temperature is 33 to 51 degrees F. The freeze-free period averages 130 days and ranges from 65 to 190 days, decreasing in length with elevation. It is typically less than 70 days in the mountains.

Water:

The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow in the mountains. Surface water from mountain runoff is generally of excellent quality and suitable for all uses. The basin fill sediments in the narrow alluvial valleys between the mountain ranges provide some ground water for irrigation. The alluvial deposits along the large streams have the most ground water. Based on measurements of water quality in similar deposits in

adjacent areas, the basin fill deposits probably contain moderately hard water. The water is suitable for almost all uses. The carbonate rocks in this area are considered aquifers, but they are little used. Springs are common along the edges of the limestone outcrops.

Soils:

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic or frigid temperature regime and an aridic, aridic bordering on xeric, or xeric moisture regime. Soils with aquic moisture regimes are limited to drainage or spring areas, where moisture originates or runs on and through. These soils are of a very limited extent throughout the MLRA. They generally are well drained, clayey or loamy, and shallow or moderately deep. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam with ashy texture modifiers in some areas. Argillic horizons occur on the more stable landforms. They are exposed nearer the soil surface on convex landforms, where ash and loess deposits are more likely to erode. Soils that formed in carbonatic parent material in areas that receive less than 12 inches of precipitation are characterized by calcic horizons throughout the profile, while soils in areas that receive more than 12 inches of precipitation do not have calcic horizons in the upper part of the profile. Soils that formed on stable landforms at the lower elevations are dominated by ochric horizons. Soils that formed at the middle and upper elevations are characterized by mollic epipedons. Soils in drainage areas at all elevations that receive moisture running on or through them are characterized by thicker mollic epipedons.

Biological Resources:

This MLRA supports shrub-grass vegetation. Lower elevations are characterized by Wyoming big sagebrush associated with bluebunch wheatgrass, western wheatgrass, and Thurber's needlegrass. Other important plants include bluegrass, squirreltail, penstemon, phlox, milkvetch, lupine, Indian paintbrush, aster, and rabbitbrush. Black sagebrush occurs but is less extensive. Singleleaf pinyon and Utah juniper occur in limited areas. With increasing elevation and precipitation, vast areas characterized by mountain big sagebrush or low sagebrush/early sagebrush in association with Idaho fescue, bluebunch wheatgrass, needlegrasses, and bluegrass become common.

Snowberry, curl-leaf mountain mahogany, ceanothus, and juniper also occur. Mountains at the highest elevations support whitebark pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, aspen, and curl-leaf mountain mahogany.

Major wildlife species include mule deer, bighorn sheep, pronghorn, mountain lion, coyote, bobcat, badger, river otter, mink, weasel, golden eagle, red-tailed hawk, ferruginous hawk, Swainson's hawk, northern harrier, prairie falcon, kestrel, great horned owl, short-eared owl, long-eared owl, burrowing owl, pheasant, sage grouse, chukar, gray partridge, and California quail. Reptiles and amphibians include western racer, gopher snake, western rattlesnake, side-blotched lizard, western toad, and spotted frog. Fish species include bull, red band, and rainbow trout.

Ecological site concept

This site is on hill slopes, mountain slopes and fan remnants of all exposures. Slopes range from 2 to 50 percent, but slope gradients of 8 to 50 percent are most typical. Elevations are 5400 to 8400 feet (1645 to 2560 meters).

The soils of this site are typically shallow to moderately deep and well drained. Surface soils are medium textured and normally more than 10 inches (25 cm) thick. Subsoils are typically moderately fine textured. There are typically high amounts (30 to 45% ground cover) of gravel-size rock fragments on the soil surface. Some soils are modified by gravels, cobbles or stones through the profile. These soils typically have a mollic epipedon and an argillic horizon.

The Reference State is dominated by Idaho fescue, bluebunch wheatgrass, antelope bitterbrush, and mountain big sagebrush. Antelope bitterbrush dominates the aspect.

Associated sites

R025XY012NV	LOAMY SLOPE 12-16 P.Z.
R025XY014NV	LOAMY 10-12 P.Z.
R025XY017NV	CLAYPAN 12-16 P.Z.

Similar sites

R025XY012NV	LOAMY SLOPE 12-16 P.Z. ARTRV-PUTR2 codominant shrubs
R025XY009NV	SOUTH SLOPE 12-14 P.Z. PSSPS dominant grass; ARTRV usually dominant shrub-PUTR2 occasionally codominant
R025XY016NV	SOUTH SLOPE 14-18 P.Z. PSSPS-BRMA4 codominant grasses
R025XY023NV	GRAVELLY CLAYPAN 12-16 P.Z. ARAR8 dominant shrub

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Purshia tridentata</i>
Herbaceous	(1) <i>Festuca idahoensis</i> (2) <i>Pseudoroegneria spicata</i>

Physiographic features

This site is on hill slopes, mountain slopes and erosional fan remnants of all exposures. Slopes range from 2 to 50 percent, but slope gradients of 8 to 50 percent are most typical. Elevations are 5400 to 8400 feet (1645 to 2560 meters).

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain slope (3) Erosion remnant
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	5,400–8,400 ft
Slope	8–50%
Water table depth	72 in
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	2–50%
Water table depth	Not specified

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. The average annual precipitation ranges from 12 to 14 inches (30 to 35 cm). Mean annual air temperature is typically <45 degrees F.

Mean annual precipitation across the range in which this ES occurs is 13.13inches (33 cm).

Monthly mean precipitation in inches: January 1.45 (3 cm); February 1.12 (3 cm); March 1.20 (3 cm); April 1.21 (3 cm); May 1.62 (4 cm); June 1.07 (2 cm); July 0.55 (1 cm); August 0.49 (1 cm); September 0.62 (1 cm); October 0.83 (2 cm); November 1.41 (3 cm); December 1.54 (4 cm).

*The above data is averaged from the Mountain City RS and Wild horse RSVR WRCC climate stations.

Table 4. Representative climatic features

Frost-free period (characteristic range)	55-90 days
Freeze-free period (characteristic range)	75-110 days
Precipitation total (characteristic range)	12-14 in
Frost-free period (actual range)	50-100 days
Freeze-free period (actual range)	70-120 days
Precipitation total (actual range)	10-15 in
Frost-free period (average)	75 days
Freeze-free period (average)	90 days
Precipitation total (average)	13 in

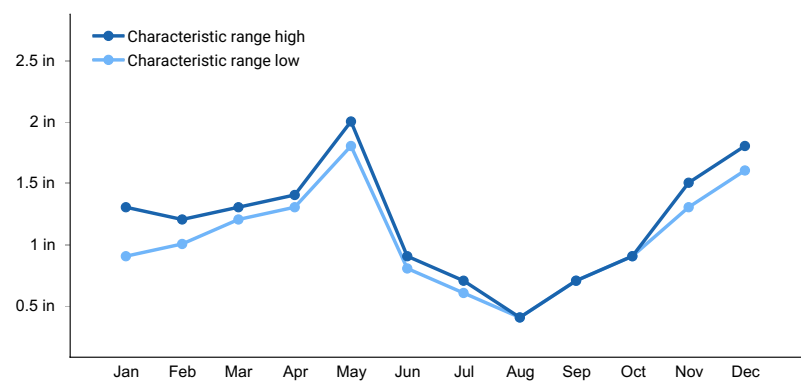


Figure 1. Monthly precipitation range

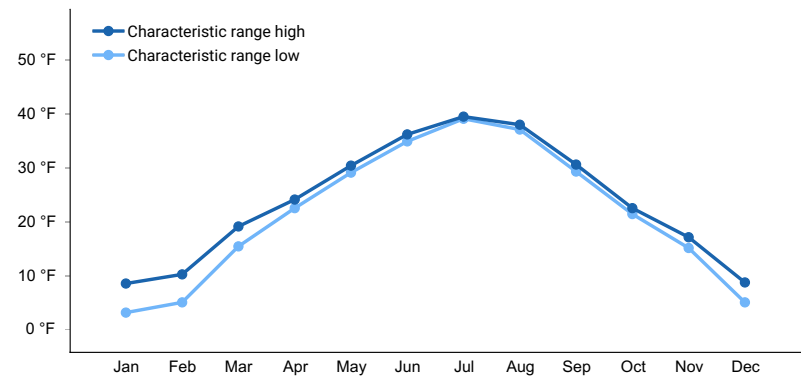


Figure 2. Monthly minimum temperature range

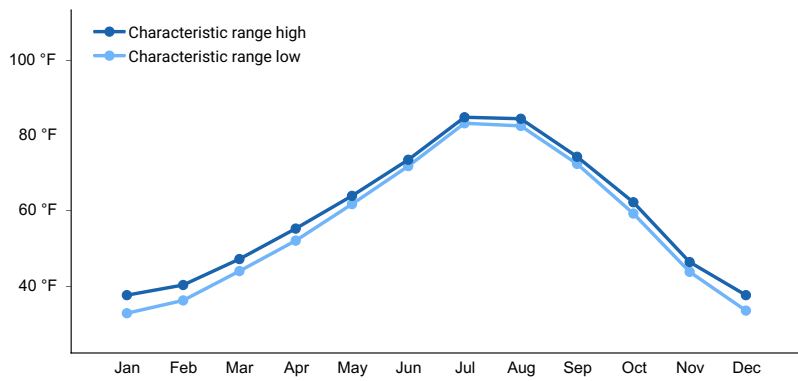


Figure 3. Monthly maximum temperature range

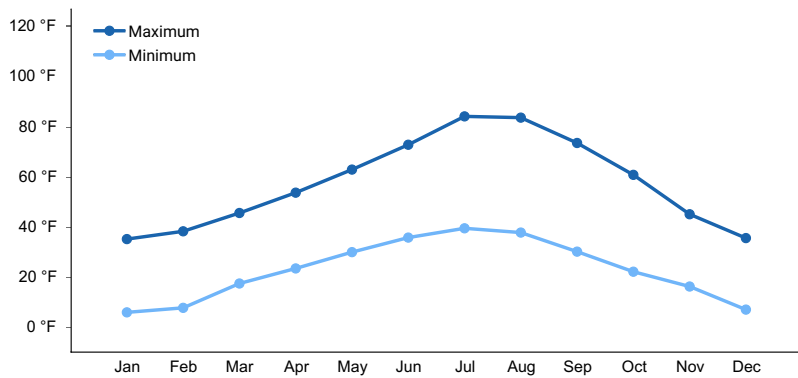


Figure 4. Monthly average minimum and maximum temperature

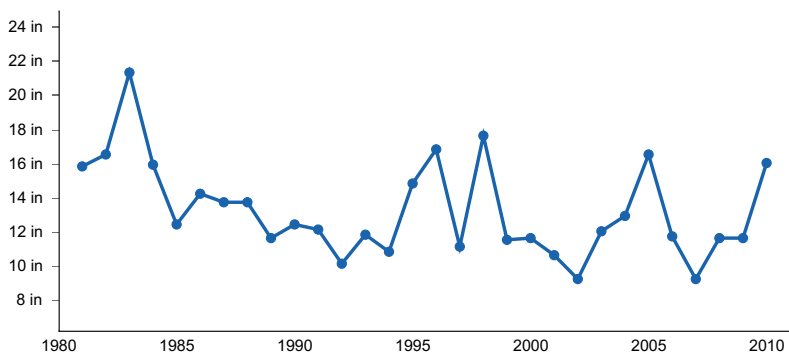


Figure 5. Annual precipitation pattern

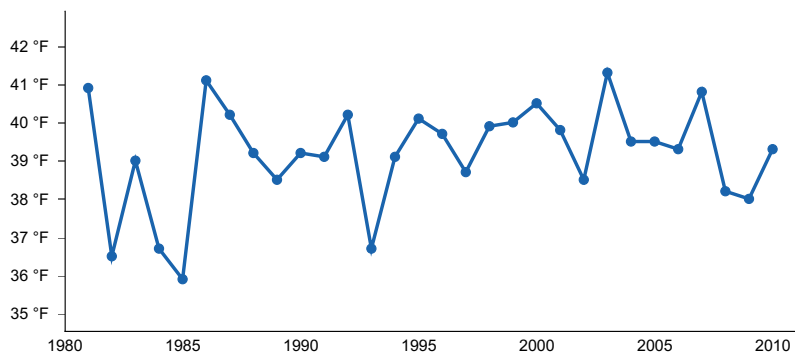


Figure 6. Annual average temperature pattern

Climate stations used

- (1) WILD HORSE RSVR [USC00269072], Deeth, NV
- (2) MTN CITY RS [USC00265392], Mountain City, NV

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils of this site are typically shallow to moderately deep and well drained. Surface soils are medium textured and normally more than 10 inches (25cm) thick. Subsoils are typically moderately fine textured. There are typically high amounts (30 to 45% ground cover) of gravel-size rock fragments on the soil surface. Some soils are modified by gravels, cobbles or stones through the profile. These soils typically have a mollic epipedon and an argillic horizon. The available water capacity is moderate and runoff is medium. The potential for sheet and rill erosion is moderate but will vary depending on slope and amount of surface rock fragments.

The soil series associated with this site are Agort, Booford, Graley, Heechee, Madeline and Tweener.

A representative soil series is Heechee, classified as a loamy-skeletal, mixed, superactive, frigid Typic Argixeroll. These soils are very deep, well drained and are formed in alluvium derived from mixed rocks. Reaction is slightly acid or neutral. Diagnostic horizons include a mollic epipedon that occurs from the soil surface to 18 inches (46cm) and an argillic horizon that occurs from 11 to 33 inches (20 to 84cm). Clay content in the particle-size control section ranges from 25 to 35 percent. Rock fragments are 35 to 60 percent; 20 to 45 percent gravel, 15 to 25 percent cobbles, and 0 to 10 percent stones.

Table 5. Representative soil features

Parent material	(1) Colluvium (2) Residuum (3) Alluvium
Surface texture	(1) Gravelly sandy loam (2) Stony loam (3) Very gravelly sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to moderately rapid
Depth to restrictive layer	20–60 in
Soil depth	7–30 in
Surface fragment cover ≤3"	5–35%
Surface fragment cover >3"	5–25%
Available water capacity (0-40in)	0.5–5.2 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.8
Subsurface fragment volume ≤3" (Depth not specified)	12–70%
Subsurface fragment volume >3" (Depth not specified)	2–38%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	4–40 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified
Calcium carbonate equivalent (0-40in)	Not specified
Electrical conductivity (0-40in)	Not specified
Sodium adsorption ratio (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation and temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration and runoff), 4) soils (depth, texture, structure, and organic matter), 5) plant communities (functional groups and 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).

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 meters (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). Tap roots of antelope bitterbrush have been documented from 4.5 to 5.4 meters in length (McConnell 1961). 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).

Mountain big sagebrush and antelope bitterbrush are generally long-lived; therefore it is unnecessary for new individuals to recruit every year for perpetuation of the stand. Simultaneous low, continuous recruitment and infrequent large recruitment events are the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent upon 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 with regard to Aroga moth (*Aroga websteri*), a sagebrush defoliator. 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 in both individual plants and entire stands (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. It can also increase resource pools via 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).

The perennial bunchgrasses that are dominant on this site includes Idaho fescue and bluebunch wheatgrass. These species generally have shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly. Differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

South-facing slopes will generally express a higher abundance of bluebunch wheatgrass, while north-facing slopes will contain more Idaho fescue. Production will be higher on sites with deeper soils. Overgrazing by livestock and horses will cause a decrease in deep-rooted perennial bunchgrasses, mainly Idaho fescue and bluebunch wheatgrass. As grass cover declines, the potential for invasion by annual non-native species (such as cheatgrass), singleleaf pinyon (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) will increase. Continued inappropriate grazing management may result in an increase in Sandberg bluegrass (*Poa secunda*), balsamroot, lupine, sagebrush, and rabbitbrush (*Chrysothamnus viscidiflorus*).

As ecological condition declines, mountain big sagebrush and rabbitbrush increase in the overstory. Snowberry, Sandberg's bluegrass, and bottlebrush squirreltail also increase as condition declines. Cheatgrass is the species likely to invade this site. The potential invasive/noxious weeds are cheatgrass, rabbitbrush, snakeweed, halogeton, Russian thistle, annual mustards, knapweeds and Utah juniper.

This ecological site has low to high resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Five alternative stable states have been identified for this site.

Fire Ecology:

Presettlement fire return intervals for antelope bitterbrush communities range from 15-25 years.

Antelope bitterbrush is moderately fire tolerant (McConnell and Smith 1977). It regenerates by seed and resprouting (Blaisdell and Mueggler 1956, McArthur et al. 1982), though sprouting ability is highly variable and has been attributed to genetics, plant age, phenology, soil moisture and texture, and fire severity (Blaisdell and Mueggler 1956, Blaisdell et al. 1982, Clark et al. 1982, Cook et al. 1994). Bitterbrush sprouts from a region on the stem approximately 1.5 inches above and below the soil surface; the plant rarely sprouts if the root crown is killed by fire (Blaisdell and Mueggler 1956). Low intensity fires may allow for bitterbrush to sprout; however, community response also depends on soil moisture levels at time of fire (Murray 1983). Lower soil moisture allows more charring of the stem below ground level (Blaisdell and Mueggler 1956), thus sprouting will usually be more successful after a spring fire than after a fire in summer or fall (Murray 1983, Busse et al. 2000, Kerns et al. 2006). If cheatgrass is present, bitterbrush seedling success is much lower. The factor that most limits establishment of bitterbrush seedlings is competition for water resources with cheatgrass, an invasive species (Clements and Young 2002).

Mountain big sagebrush is also an important component of this site. Mountain big sagebrush is killed by fire (Neuenschwander 1980, Blaisdell et al. 1982), and does not resprout (Blaisdell 1953). Post-fire regeneration occurs from seed and will vary depending on site characteristics, seed source, and fire characteristics. Mountain big sagebrush seedlings can grow rapidly and may reach reproductive maturity within 3 to 5 years (Bunting et al. 1987). Mountain big sagebrush may return to pre-burn density and cover within 15-20 years following fire, but establishment after severe fires may proceed more slowly and can take up to 50 years (Bunting et al. 1987, Ziegenhagen 2003, Miller and Heyerdahl 2008, Ziegenhagen and Miller 2009). The introduction of annual weedy species such as cheatgrass may cause an increase in fire frequency and eventually lead to an annual dominated community. Conversely, without fire, sagebrush will increase and the potential for encroachment by pinyon and

juniper also increases. Without fire or changes in management, pinyon and juniper will dominate the site and mountain big sagebrush will be severely reduced. The herbaceous understory will also be reduced; Idaho fescue may remain underneath trees on north facing slopes. The potential for soil erosion increases as the woodland matures and the understory plant community cover declines. Catastrophic wildfire in these tree-controlled sites may lead to an annual weed dominated site.

Depending on fire severity, rabbitbrush, Utah serviceberry (*Amelanchier utahensis*) and mountain snowberry (*Symphoricarpos orbiculatus*) may increase after fire. Mountain snowberry is also top-killed by fire, but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Snowberry has been noted to regenerate well and exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982). Utah serviceberry resprouts from the root crown. Douglas' rabbitbrush is top-killed by fire, but sprouts vigorously after fire (Kuntz 1982, Akinsoji 1988). As cheatgrass increases, fire frequencies also increase to between 0.23 and 0.43 times a year; at this rate, even sprouting rabbitbrush will not survive (Whisenant 1990).

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, coupled with seasonality and intensity of the fire factor into individual species' responses. For most forbs and grasses, the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983).

Idaho fescue's response to fire varies with condition and size of the plant, season and severity of fire, and ecological conditions. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons (Wright et al. 1979). Initial mortality may be high (in excess of 75%) on severe burns, but usually varies from 20 to 50% (Barrington et al 1988). Rapid burns have been found to leave little damage to root crowns, and new tillers are produced with onset of fall moisture (Johnson et al. 1994). However, Wright and others (1979) found the dense, fine leaves of Idaho fescue provided enough fuel to burn for hours after a fire had passed, thereby killing or seriously injuring the plant regardless of the intensity of the fire (Wright et al. 1979). Idaho fescue is commonly reported to be more sensitive to fire than the other prominent grass on this site, bluebunch wheatgrass (Conrad and Poulton 1966). Robberecht and Defosse (1995) suggested the latter was more sensitive, however. They observed culm and biomass reduction with moderate fire severity in bluebunch wheatgrass, whereas a high fire severity was required for this reduction in Idaho fescue. Given the same fire severity treatment, post-fire culm production was initiated earlier and more rapidly in Idaho fescue (Robberecht and Defosse 1995).

Bluebunch wheatgrass has coarse stems with little leafy material, therefore the aboveground biomass burns rapidly and little heat is transferred downward into the crowns (Young 1983). Bluebunch wheatgrass was described as fairly tolerant of burning, other than in May in eastern Oregon (Britton et al. 1990). Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass. Thus, bluebunch wheatgrass is considered to experience slight damage to fire but is more susceptible in drought years (Young 1983). Most authors classify the plant as undamaged by fire (Kuntz 1982).

Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. (2013) reported increased total shoot and reproductive shoot densities in the first year following fire; by year two, however, there was little difference between burned and control treatments.

State and transition model

MLRA 25
Gravelly Loam 12-16"
025XY007NV

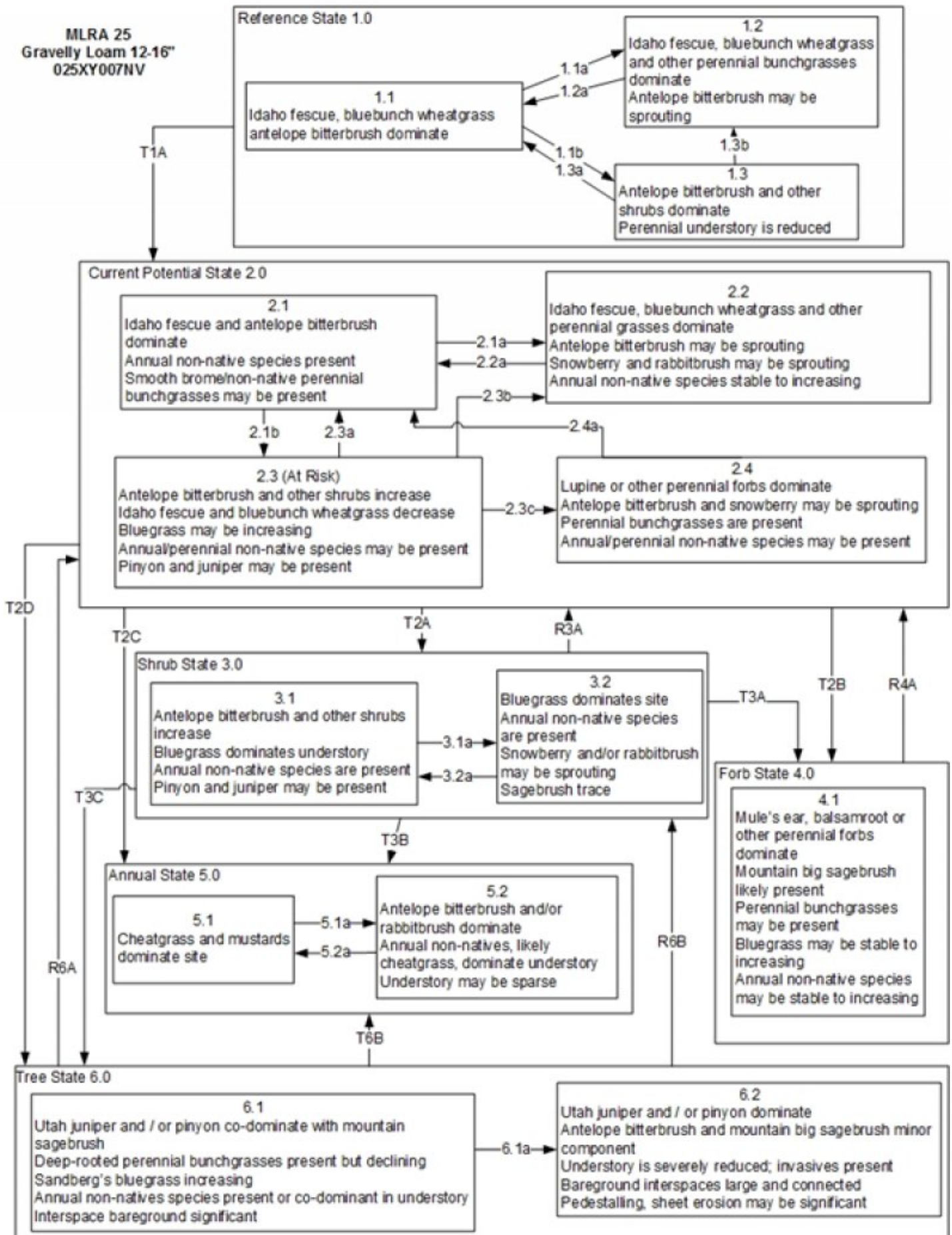


Figure 7. T. Stringham July 2015

MLRA 25
Gravelly Loam 12-16"
025XY007NV

Reference State 1.0 Community 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 may also reduce perennial understory.
- 1.2a: Time and lack of disturbance allows for shrub regeneration.
- 1.3a: Low severity fire, and/or herbivory, would create sagebrush/grass mosaic.
- 1.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community 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 such as fire or drought. Inappropriate grazing management may also reduce perennial understory.
- 2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
- 2.3a: Low severity fire and/or grazing management creates sagebrush/grass mosaic.
- 2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community.
- 2.3c: Inappropriate grazing management coupled with fire
- 2.4a: Time and lack of disturbance and a change in grazing management to facilitate perennial bunchgrass production.

Transition T2A: Inappropriate grazing management (3.1). High severity fire (3.2).

Transition T2B: Inappropriate grazing management that promotes dominance of forbs; this may be coupled with fire (4.1).

Transition T2C: Multiple fires and/or soil disturbing treatments (drill seeding, roller chopper, or Lawson aerator etc)(5.1), or inappropriate grazing management in the presence of annual non-native species (5.2).

Transition T2D: Time and lack of disturbance allows for trees to dominate site resources.

Shrub State 3.0 Community Pathways

- 3.1a: Fire and/or brush treatments with minimal soil disturbance (i.e. mowing).
- 3.2a: Time and lack of disturbance allows for sagebrush regeneration.

Restoration R3A: Brush management and/or seeding of desired species.

Transition T3A: Inappropriate grazing management promotes dominance of forbs; this may be coupled with fire (4.1)

Transition T3B: Multiple fires and/or soil disturbing treatments (5.1) and/or inappropriate grazing management eliminates bluegrass understory and leaves site open for non-native invasive species (5.2).

Transition T3C: Time and lack of disturbance allows for trees to dominate site resources.

Forb State 4.0 Community Pathways

Restoration R4A: Herbicide treatment may be coupled with seeding of desired species.

Annual State 5.0 Community Pathways

- 5.1a: Time and lack of disturbance (unlikely to occur).
- 5.2a: Fire

Tree State 6.0 Community Pathways

- 6.1a: Time and lack of disturbance allows for maturation of tree community.

Restoration R6A: Tree removal and seeding of desired species or recovery of herbaceous understory.

Restoration R6B: Tree removal when Sandberg bluegrass is dominant and remains in understory.

Transition T6B: Catastrophic fire (5.1).

Figure 8. T. Stringham July 2015

State 1

Reference State

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

Community 1.1

Community Phase

The representative plant community is dominated by Idaho fescue, bluebunch wheatgrass, antelope bitterbrush, and mountain big sagebrush. Antelope bitterbrush dominates the aspect. Potential vegetative composition is about 45% grasses, 10% forbs and 45% shrubs. Approximate ground cover (basal and crown) is 40 to 60 percent. Bare ground is approximately 30 percent. Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers. Litter cover (approximately 35%) occurs within plant interspaces at a depth of approximately 1/2 inch.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	405	630	1035
Shrub/Vine	405	630	1035
Forb	90	140	230
Total	900	1400	2300

Community 1.2

Community Phase

This community phase is characteristic of a post-disturbance, early seral community phase. Idaho fescue, bluebunch wheatgrass and other perennial grasses dominate. Douglas rabbitbrush, mountain snowberry and Utah serviceberry may be resprouting. Big sagebrush is killed by fire, therefore decreasing within the burned community. Depending on fire severity or intensity of Aroga moth infestations, patches of intact sagebrush may remain. Perennial forbs may increase post-fire but will likely return to pre-burn levels within a few years.

Community 1.3

Community Phase

Mountain big 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. Sandberg bluegrass and/or squirreltail will likely increase in the understory and may be the dominant grass on the site.

Pathway a

Community 1.1 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity resulting in a mosaic pattern 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 b

Community 1.1 to 1.3

Time and lack of disturbance such as fire allows for sagebrush to increase and become decadent. Long-term drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels leading to a reduced fire frequency allowing big sagebrush to dominate the site.

Pathway a

Community 1.2 to 1.1

Time and lack of disturbance will allow the mountain big sagebrush to recover/increase.

Pathway a

Community 1.3 to 1.1

A low severity fire, Aroga moth or combinations will reduce the sagebrush overstory and create a sagebrush/grass mosaic with sagebrush and perennial bunchgrasses codominant.

Pathway b

Community 1.3 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity due to low fine 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 and has four community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable, and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate and adaptations for seed dispersal.

Community 2.1

Community Phase

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. The plant community is dominated by Idaho fescue, bluebunch wheatgrass and basin wildrye. Mountain big sagebrush is the dominant shrub with antelope bitterbrush also common on this site. Smooth brome or other perennial non-native bunchgrasses may be present. Cheatgrass is the most likely species to invade.

Community 2.2

Community Phase



Figure 10. P NovakEchenique 7/2011 NV765, MU 744 Typic Argixeroll

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Big sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity or intensity of Aroga moth infestations, patches of intact sagebrush may remain. Rabbitbrush may be sprouting. Perennial forbs may be a significant component for a number of years. Annual non-

native species are stable or increasing within the community.

Community 2.3

Community Phase (at risk)



Figure 11. P NovakEchenique 7/2011 NV765 MU744 Typic Argixero

Mountain big sagebrush, rabbitbrush and bitterbrush increase, Idaho fescue and bluebunch wheatgrass decrease. Sandberg bluegrass may be increasing. Smooth brome and other non-native species are stable to increasing. Utah juniper and singleleaf pinyon may be present as a result of encroachment from neighboring sites, and lack of disturbance.

Community 2.4

Community Phase

Lupine and other perennial forbs dominate the site. Mountain big sagebrush may be present in trace amounts. Snowberry may be sprouting. Perennial bunchgrasses are present. Smooth brome and/or other perennial non-native bunchgrasses may be present. This community phase can be maintained for several years with spring grazing and poor distribution of grazing animals. With a change in grazing management mountain big sagebrush will increase and perennial forb community will eventually decrease.

Pathway a

Community 2.1 to 2.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will 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 b

Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Chronic drought will reduce fine fuels and lead to a reduced fire frequency allowing big sagebrush to dominate the site. Inappropriate grazing management will reduce the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory depending on grazing management. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often increases.

Pathway a

Community 2.2 to 2.1

Time and lack of disturbance such as fire and/or inappropriate grazing management that favors the establishment and growth of sagebrush will allow the shrub component to recover. The establishment of big sagebrush may take

many years.

Pathway a **Community 2.3 to 2.1**

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

Pathway b **Community 2.3 to 2.2**



Community Phase (at risk)

Community Phase

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. 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 are likely to increase after fire.

Pathway c **Community 2.3 to 2.4**

High severity fire following inappropriate grazing management (spring grazing suppresses perennial bunchgrass response) increases the forb community response.

Pathway a **Community 2.4 to 2.1**

Time and lack of disturbance combined with grazing management to facilitate perennial bunchgrass production such as fall season grazing.

State 3 **Shrub State**

This state has two community phases and is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sandberg bluegrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grass on this site. 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.

Community 3.1 **Community Phase**

This site has crossed a biotic threshold and site processes (soil hydrology, nutrient cycling, and energy capture) are being controlled by the shrub component of the plant community along with Sandberg bluegrass in the understory. Decadent big sagebrush and rabbitbrush dominate overstory. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Sandberg bluegrass and annual non-native species increase, and the amount of bare ground increases. Utah juniper may be present as a result of encroachment from neighboring sites and lack of natural fire. Singleleaf pinyon may be invading.

Community 3.2 **Community Phase**

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

Pathway a **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 Sandberg bluegrass to dominate the site.

Pathway a **Community 3.2 to 3.1**

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

State 4 **Forb State**

This state has one community phase that is dominated by deep-rooted perennial forbs. This state may be the result of many years of abusive grazing allowing the perennial forbs to increase. It may also be compounded by fire. This may occur as “pockets” or inclusions within other states of the same site, and can appear to be localized. The positive feedbacks in this state include the presence of a competitive functional group that possesses deep-rooted taproots and strong lateral roots, the sprouting ability of roots or root crown, high seed production and the ability to monopolize soil moisture.

Community 4.1 **Community Phase**

Mule’s ear (*Wyethia amplexicaulis*), and/or other perennial forbs dominate the site. Mountain big sagebrush is likely present. Sandberg bluegrass may be stable to increasing, and perennial bunchgrasses are a minor component.

State 5 **Annual State**

This state has two community phases and is characterized by the dominance of annual non-native species such as cheatgrass and tumble mustard in the understory. Sagebrush and/or rabbitbrush dominate the overstory.

Community 5.1 **Community Phase**

Annual non-native plants such as tumble mustard and cheatgrass dominate the site.

Community 5.2 **Community Phase**

Mountain big sagebrush and/or rabbitbrush dominate the overstory. Annual non-native species, likely cheatgrass, dominate the understory. Understory may be sparse.

Pathway a **Community 5.1 to 5.2**

Time and a lack of disturbance will allow for recovery of mountain big sagebrush and/or rabbitbrush. This community phase pathway is unlikely to occur.

Pathway a **Community 5.2 to 5.1**

Fire, brush management, or Aroga moth infestation will reduce or eliminate the sagebrush component on this site and allow for annual non-natives to dominate.

State 6

Tree State

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

Community 6.1

Community Phase

Utah juniper and singleleaf pinyon dominate the overstory. Mountain big sagebrush and rabbitbrush are minor components of the understory. Sandberg bluegrass is present. Deep rooted perennial bunchgrasses are present but declining. Annual non-native species are present or co-dominant in the understory. Pedestalling, sheet, and rill erosion are increasing.

Community 6.2

Community Phase

Utah juniper and pinyon pine dominate the overstory. The understory is sparse and bare ground may be significant. This community is not likely to change without human interference or a severe wildfire that will transition it to an Annual State 5.0.

Pathway a

Community 6.1 to 6.2

Absence of disturbance over time will eventually allow the pinyon and juniper trees to increase and mature severely affecting the understory.

Transition A

State 1 to 2

Trigger: Introduction of annual non-native species Slow variable: 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 A

State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and muttongrass 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 Sandberg bluegrass and muttongrass. Annual non-native species will increase. Slow variables: Long term decrease in deep-rooted perennial grass density resulting in decreased organic matter inputs and reduced soil water. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition B

State 2 to 4

Trigger: Inappropriate grazing management and/or fire promote mule ears and other perennial forbs to dominate the

site. Persistent spring grazing after a fire will suppress perennial grasses and promote forb production. Slow variable: Increasing density of perennial forbs and soil erosion. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes nutrient capture and cycling within the community and reduced organic matter inputs and soil water.

Transition C

State 2 to 5

Trigger: Multiple fires and/or soil disturbing treatments such as drill seeding, roller chopper or Lawson aerator will cause the site to transition to community phase 5.1. Inappropriate grazing management likely by cattle and/or horses can eliminate the native understory and will leave site open for non-native invasive species, which will transition to community phase 5.2. Slow variable: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires.

Transition D

State 2 to 6

Trigger: Absence of disturbance over time and lack of management action allows for trees to increase and transitions to community phase 6.1. Slow variables: Increased establishment and cover of juniper trees Threshold: Trees overtop big sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

Restoration pathway A

State 3 to 2

Brush management with minimal soil disturbance/seeding of desired species.

Conservation practices

Brush Management
Range Planting

Transition A

State 3 to 4

Trigger: Fire in combination with inappropriate grazing management can eliminate Sandberg bluegrass understory and transition to 4.1. Slow variable: Increasing density of perennial forbs and soil erosion. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes nutrient capture and cycling within the community and reduced organic matter inputs and reduced soil water.

Transition B

State 3 to 5

Trigger: Severe fire will transition to 5.1. Inappropriate grazing management in the presence of annual non-native species will transition to 5.2 Slow variables: Increased production and cover of non-native annual species. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact the nutrient cycling and distribution.

Transition C

State 3 to 6

Trigger: Time and a lack of disturbance or management action allows for Utah juniper to dominate the site. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources. Slow variable: Over time the abundance and size of trees will increase resulting in

reduced infiltration and increased runoff. Threshold: Trees dominate ecological processes and number of shrub skeletons exceed number of live shrubs.

Restoration pathway A
State 4 to 2

Herbicide treatment to reduce perennial forbs may be coupled with seeding of perennial bunchgrasses and other desirable species (Mueggler and Blaisdell 1951).

Conservation practices

Range Planting
Herbaceous Weed Control

Restoration pathway A
State 6 to 2

Tree removal and seeding or recovery of herbaceous understory. Restoration efforts may result in smooth brome or intermediate wheatgrass after fire.

Restoration pathway B
State 6 to 3

Tree removal or fire when Sandberg bluegrass is dominant in the understory will transition to community phase 3.2.

Conservation practices

Brush Management

Transition A
State 6 to 5

Trigger: Catastrophic crown fire will reduce or eliminate trees to transition the site to 5.1. Inappropriate tree removal practices such as chop and burn when annual non-natives such as cheatgrass are present will also transition the site to state 5.0. Slow variable: Increased seed production and cover of annual non-native species. Decreased infiltration and increased runoff result in reduction in soil water. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact the nutrient cycling and distribution.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	Primary Perennial Grasses			378–770	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	210–420	–
	bluebunch wheatgrass	PSSPS	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	140–280	–
	Thurber's needlegrass	ACTH7	<i>Achnatherum thurberianum</i>	28–70	–
2	Secondary Perennial Grasses			70–210	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	7–70	–
	western needlegrass	ACOC3	<i>Achnatherum occidentale</i>	7–70	–
	sedge	CAREX	<i>Carex</i>	7–70	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	7–70	–
	bluegrass	POA	<i>Poa</i>	7–70	–
Forb					
3	Perennial			70–210	
	sedge	CAREX	<i>Carex</i>	7–70	–
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	7–42	–
	tapertip hawksbeard	CRAC2	<i>Crepis acuminata</i>	7–42	–
	buckwheat	ERIOG	<i>Eriogonum</i>	7–42	–
	western stoneseed	LIRU4	<i>Lithospermum ruderales</i>	7–42	–
	lupine	LUPIN	<i>Lupinus</i>	7–42	–
	ragwort	SENEC	<i>Senecio</i>	7–42	–
Shrub/Vine					
4	Primary Perennial Shrubs			350–700	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	280–560	–
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	70–140	–
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	5–42	–
	tapertip hawksbeard	CRAC2	<i>Crepis acuminata</i>	5–42	–
	buckwheat	ERIOG	<i>Eriogonum</i>	5–42	–
	western stoneseed	LIRU4	<i>Lithospermum ruderales</i>	5–42	–
	lupine	LUPIN	<i>Lupinus</i>	5–42	–
	ragwort	SENEC	<i>Senecio</i>	5–42	–
5	Secondary Perennial Shrubs			70–210	
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	7–70	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	7–70	–
	currant	RIBES	<i>Ribes</i>	7–70	–
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	7–70	–

Animal community

Livestock Interpretations:

This site is suited to cattle and sheep grazing during the late spring, summer and fall. Livestock water is usually adequate as this site occurs in mountainous areas where flowing streams and springs are common. Sheep will make good use of the shrub component on this site. Considerations for grazing management include timing,

intensity and duration of grazing.

Overgrazing leads to an increase in big sagebrush and a decline in antelope bitterbrush as well as deep-rooted perennial bunchgrasses. Sandberg bluegrass will increase temporarily with further degradation. Invasion of annual weedy forbs and cheatgrass could also occur, 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.

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.

Long-term disturbance response may be influenced by small differences in landscape topography. Concave areas hold a little more moisture and may retain deep-rooted perennial grasses whereas convex areas are slightly less resilient and may have more Sandberg bluegrass present.

Antelope bitterbrush is an important shrub species to domestic livestock. Antelope bitterbrush is most commonly found on soils which provide minimal restriction to deep root penetration such as coarse textured soil, or finer textured soil with high stone content (Driscoll 1964, Clements and Young 2002). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953).

Idaho fescue provides important forage for many types of domestic livestock. The foliage cures well and is preferred by livestock in the late fall and winter. Idaho fescue tolerates light to moderate grazing (Ganskopp and Bedell 1980) and is moderately resistant to trampling (Cole 1987). Heavy grazing may lead to replacement of Idaho fescue with non-native species such as cheatgrass (Mueggler 1984).

Bluebunch wheatgrass is moderately grazing tolerant and is very sensitive to defoliation during the active growth period (Blaisdell and Pechanec 1949, Laycock 1967, Anderson and Scherzinger 1975, Britton et al. 1990). Herbage and flower stalk production was reduced with clipping at all times during the growing season; however, clipping was most harmful during the boot stage (Blaisdell and Pechanec 1949). Tiller production and growth of bluebunch was greatly reduced when clipping was coupled with drought (Busso and Richards 1995). Mueggler (1975) estimated that low vigor bluebunch wheatgrass may need up to 8 years rest to recover. Although an important forage species, it is not always the preferred species by livestock and wildlife.

During settlement, many of the cattle in the Great Basin were wintered on extensive basin wildrye stands; due to sensitivity to spring, use many stands were decimated by the early 20th century (Young et al. 1976). Less palatable species, such as big sagebrush and rabbitbrush (*Chrysothamnus* spp.), increased in dominance along with invasive non-native species such as Russian thistle, mustards, and cheatgrass (Roundy 1985). The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is readily grazed by cattle and horses in early spring and fall. Though coarse-textured during the winter, basin wildrye may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses. Basin wildrye is used often as a winter feed for livestock and wildlife by not only providing roughage above the snow but also cover in the early spring months (Majerus 1992). Inadequate rest and recovery from defoliation causes a decrease in basin wildrye and an increase in basin big sagebrush and rubber rabbitbrush (*Ericameria nauseosa*) (Young et al. 1976, Roundy 1985). Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Additionally, native basin wildrye seed viability has been found to be low and seedlings lack vigor (Young and Evans 1981). Roundy (1985) found that although basin wildrye is adapted to seasonally dry saline soils, high and frequent spring precipitation is necessary to establish it from seed. This suggests that establishment of native basin wildrye seedlings occurs only during years of unusually high precipitation; thus, reestablishment of a stand may be episodic.

Mountain big sagebrush is eaten by domestic livestock but has long been considered to be of low palatability, and a competitor to more desirable species.

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:

Idaho fescue is a valuable source of forage for pronghorn and deer in ranges of northern Nevada.

With a high percentage of shrubs such as antelope bitterbrush, snowberry and big sagebrush for browse and cover, this site provides valuable habitat for deer. Sage grouse use this site for nesting and brood rearing. Other upland game animals including rabbits, chukar and Hungarian partridge also use this site. It is used by various birds, rodents and reptiles and associated predators natural to the area.

Antelope bitterbrush is critical browse for mule deer, as well as antelope and elk (Wood 1995).

Mountain big sagebrush is a highly preferred winter forage for mule deer: In a study by Personius et al. (1987), mountain big sagebrush was the most preferred sagebrush species. Fecal samples from ungulates in Montana showed that bighorn sheep, mule deer, and elk all consumed mountain big sagebrush in small amounts in winter, while cattle showed no sign of sagebrush use. Reliance on the big sagebrush ecosystem by many wild animals for both food and cover has been documented and reviewed extensively. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities.

Hydrological functions

There are no rills. Water flow patterns are typically non-existent but can rarely occur in areas recently subjected to intense summer convection storms or rapid snowmelt, usually on steeper slopes. Pedestals are typically non-existent. Frost heaving of shallow rooted plants should not be considered a "normal" condition. Gullies are non-existent in areas of this site that occur on stable landforms. Fine litter (foliage from grasses and annual and 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 catastrophic events. Perennial herbaceous plants (especially deep-rooted bunchgrasses) 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 spring and summer wildflowers found on this site. This site is used for camping and hiking and has potential for deer and upland game hunting. Off-road vehicle use can destroy the fragile vegetation-soil complex causing severe erosion problems. The site offers rewarding opportunities to photographers and for nature study.

Wood products

None

Other products

Native Americans used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing.

Other information

Antelope bitterbrush has been used extensively in land reclamation. Antelope bitterbrush enhances succession by retaining soil and depositing organic material and in some habitats and with some ecotypes, by fixing nitrogen.

Inventory data references

Soils and Physiographic features were gathered from NASIS.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T42N R62E S28
General legal description	About 30 miles north of Wells, Elko County, Nevada.
Location 2: Elko County, NV	
Township/Range/Section	T40N R63E S21
General legal description	About 18 miles north of wells, Summer Ridge Area, Elko County, Nevada. This site also occurs in Humboldt County, Nevada.

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Approval

Kendra Moseley, 4/24/2024

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	06/22/2006
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Typically none - a few short rills (<1m) may occur on steeper slopes after summer convection storms or rapid snowmelt.

2. **Presence of water flow patterns:** Typically none - a few short water flow patterns (<1m) may occur on steeper slopes after summer convection storms or rapid snowmelt. These are meandering and not connected.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are typically non-existent but a few may occur along 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 5 to 25% depending on amount of surface rock fragments.
-
5. **Number of gullies and erosion associated with gullies:** None
-
6. **Extent of wind scoured, blowouts and/or depositional areas:** None
-
7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall 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.
-
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically angular blocky or fine granular. Soil surface colors are browns or dark grayish-browns and soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1.25 to 3 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 [i.e., bluebunch wheatgrass, Idaho fescue] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for 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. Platy or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted.
-
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: Deep-rooted, cool season, perennial bunchgrasses

Sub-dominant: tall shrubs (antelope bitterbrush & big sagebrush)>>associated shrubs>shallow-rooted, cool season, perennial grasses and grass-like plants=deep-rooted, cool season, perennial forbs>fibrous, shallow-rooted, cool season, perennial and annual forbs

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 common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers.
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14. **Average percent litter cover (%) and depth (in):** Under shrubs and between plant interspaces 35-50% and litter depth is $\pm\frac{1}{2}$ 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) \pm 1400 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 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
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