

## **Ecological site R025XY082NV STONY LOAM 12-14 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

The Stony Loam 12-14 P.Z. site occurs on linear to concave mountain plateaus, ridges and sideslopes on all aspects. Slopes range from 0 to 50 percent, but slope gradients of 5 to 15 percent are most typical. Elevations range from 4,300 to 8,000.

The soils associated with this site are moderately deep and well drained soils that formed in residuum and colluvium from volcanic rocks. Surface soils are medium textured and normally more than 6 inches thick. Subsoils range from moderately coarse to moderately fine textured. These soils have gravels, cobbles or stones throughout the profile.

The reference plant community is dominated by Idaho fescue, mountain brome and mountain big sagebrush. Slopes with a southerly exposure will normally express a higher percentage of bluebunch wheatgrass while north-facing slopes will support a higher component of Idaho fescue.

## Associated sites

R025XY005NV	<b>WET MEADOW</b>
R025XY006NV	<b>DRY MEADOW</b>
R025XY022NV	<b>COBBLY CLAYPAN 8-12 P.Z.</b>
R025XY084NV	<b>SCABLAND 10-14 P.Z.</b>

## Similar sites

R025XY056NV	<b>LOAMY 14-16 P.Z.</b> Occurs on sideslopes, PSSPS more prevalent. PUTR2 important shrub.
R025XY004NV	<b>LOAMY SLOPE 16+ P.Z.</b> More productive site; occurs on sideslopes.
R025XY032NV	<b>CLAYPAN 16+ P.Z.</b> More productive site; BRMA4 dominant grass.

**Table 1. Dominant plant species**

Tree	Not specified
Shrub	(1) <i>Artemisia tridentata subsp. vaseyana</i>
Herbaceous	(1) <i>Festuca idahoensis</i> (2) <i>Bromus marginatus</i>

## Physiographic features

The Stony Loam 12-14 P.Z. site occurs on linear to concave mountain plateaus, ridges and sideslopes on all aspects. Slopes range from 0 to 50 percent, but slope gradients of 5 to 15 percent are most typical. Elevations range from 4,300 to 8,000.

**Table 2. Representative physiographic features**

Landforms	(1) Plateau (2) Mountain slope (3) Ridge
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,311–2,438 m
Slope	0–50%
Water table depth	183 cm
Aspect	Aspect is not a significant factor

## Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. The average annual precipitation ranges from 10 to 12 inches. Mean annual air temperature is typically <45 degrees F.

Mean annual precipitation across the range in which this ES occurs is 13.13".

Monthly mean precipitation: January 1.45"; February 1.12"; March 1.20"; April 1.21"; May 1.62"; June 1.07"; July 0.55"; August 0.49"; September 0.62"; October 0.83"; November 1.41"; December 1.54".

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

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	1-2 days
Freeze-free period (characteristic range)	13-28 days
Precipitation total (characteristic range)	330-356 mm
Frost-free period (actual range)	1-2 days

Freeze-free period (actual range)	9-32 days
Precipitation total (actual range)	330-356 mm
Frost-free period (average)	2 days
Freeze-free period (average)	21 days
Precipitation total (average)	330 mm

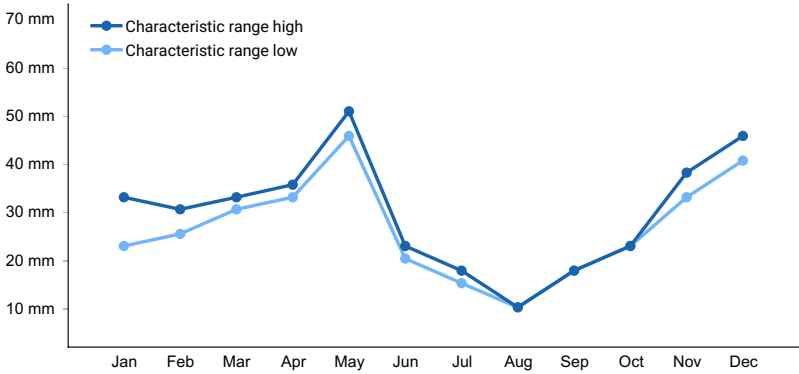


Figure 1. Monthly precipitation range

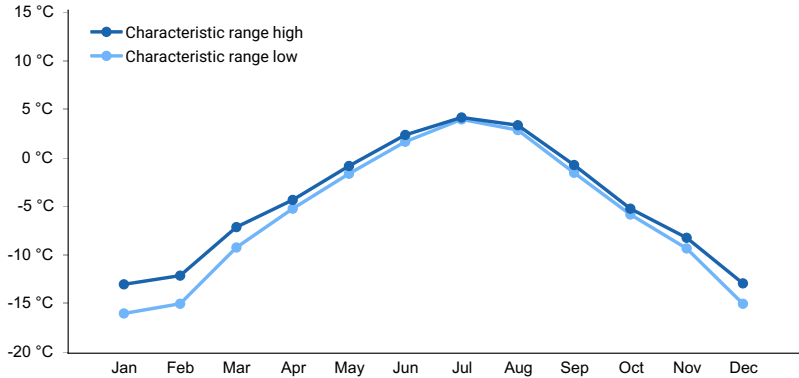


Figure 2. Monthly minimum temperature range

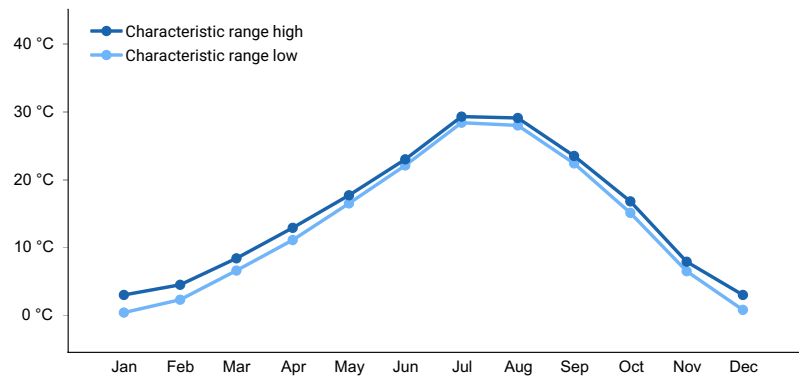
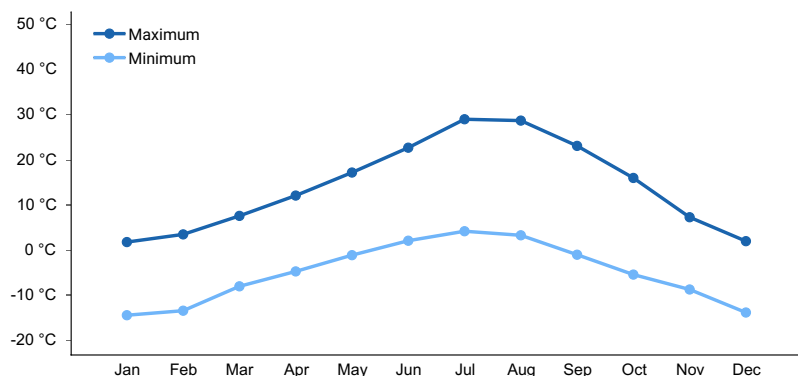
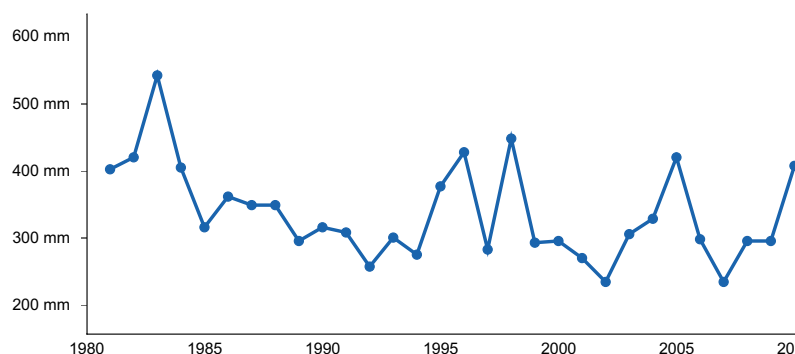


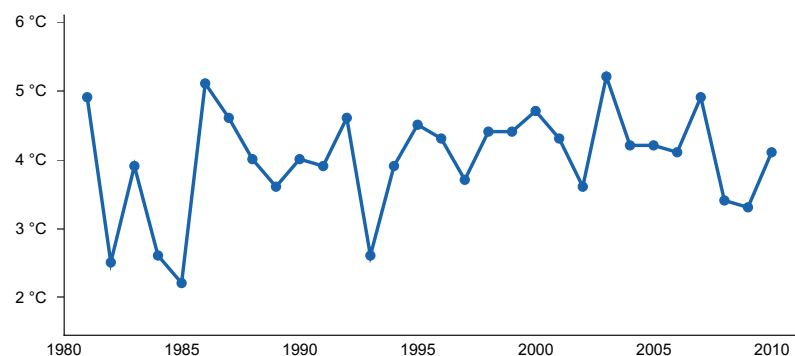
Figure 3. Monthly maximum temperature range



**Figure 4. Monthly average minimum and maximum temperature**



**Figure 5. Annual precipitation pattern**



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) 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 are moderately deep and well drained soils that formed in residuum and colluvium from volcanic rocks. Surface soils are medium textured and normally more than 6 inches thick. Subsoils range from moderately coarse to moderately fine textured. These soils have gravels, cobbles or stones throughout the profile. The available water capacity is moderate.

Soil series correlated to this site include: Reluctan.

**Table 4. Representative soil features**

Parent material	(1) Colluvium (2) Residuum
Surface texture	(1) Cobbly, very gravelly, gravelly loam
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow
Depth to restrictive layer	51–102 cm
Soil depth	51–102 cm
Surface fragment cover ≤3"	5–10%
Surface fragment cover >3"	0–10%
Available water capacity (0–101.6cm)	12.7–19.05 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)	7–7.6
Subsurface fragment volume ≤3" (Depth not specified)	5–35%
Subsurface fragment volume >3" (Depth not specified)	0–7%

## Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and 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, as well as 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 (Comstock and Ehleringer 1992). 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 (Dobrowolski et al. 1990).

In the Great Basin, the majority of annual precipitation is received during the winter and early spring. This continental semiarid climate regime favors growth and development of deep-rooted shrubs and herbaceous cool season plants using the C3 photosynthetic pathway (Comstock and Ehleringer 1992). Winter precipitation and slow melting of snow results in deeper percolation of moisture into the soil profile. Herbaceous plants, more shallow-rooted than shrubs, grow earlier in the growing season and thrive on spring rains, while deeper-rooted shrubs lag in phenological development because they draw from deeply infiltrating moisture in snowmelt from the previous winter.

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).

Variability in plant community composition and production depends on soil surface texture and depth. For example, Thurber's needlegrass will increase on gravelly soils, whereas Indian ricegrass will increase with sandy soil surfaces, and bottlebrush squirreltail will increase with silty soil surfaces. A weak argillic horizon will promote production of bluebunch wheatgrass. Production generally increases with soil depth. The amount of sagebrush in the plant community is dependent upon disturbances such as fire, Aroga moth infestations, and grazing. Sandberg bluegrass more easily dominates sites where surface soils are gravelly loams or when there is an increase in ash in the upper soil profile.

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 of plants or entire stands of big sagebrush observed (Furniss and Barr 1975).

Perennial bunchgrasses generally have shallower root systems than shrubs in these systems, 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 than shrubs. General differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

The Great Basin sagebrush communities have high spatial and temporal variability in precipitation, both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during winter. 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).

Where management results in abusive grazing use by livestock and/or horses, the composition of Idaho fescue and mountain brome decreases as bluegrass and bottlebrush squirreltail increase and become the dominant vegetation in the understory. Mountain big sagebrush, snowberry, and rabbitbrush increase in density and become the dominant vegetation in the overstory. Species likely to invade this site include cheatgrass.

The introduction of annual weedy species, such as cheatgrass, may cause an increase in fire frequency and eventually lead to an annual state. Conversely, as fire frequency decreases, sagebrush will increase and with inappropriate grazing management, perennial bunchgrasses and forbs may be reduced.

At the upper range of this site's precipitation range, there is potential for infilling by Utah juniper (*Juniperus osteosperma*) and/or singleleaf pinyon (*Pinus monophylla*). Infilling may also occur if the site is adjacent to woodland sites or other ecological sites with juniper present. Without disturbance in these areas, Utah juniper will eventually dominate the site and outcompete sagebrush for water and sunlight, severely reducing both the shrub and herbaceous understory (Miller and Tausch 2000, Lett and Knapp 2005). The potential for soil erosion increases as the woodland matures and the understory plant community cover declines (Pierson et al. 2010).

This ecological site has low resilience to disturbance and low resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability.

#### Fire Ecology:

Presettlement fire return intervals in mountain big sagebrush communities varied from 15 to 25 years. Mountain big sagebrush is highly susceptible to injury from fire. It is often top-killed by fire and will not resprout. Idaho fescue grows in a dense, fine-leaved tuft. Fires tend to burn within the accumulated fine leaves at the base of the plant and may produce temperatures sufficient to kill some of the root crown. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons. Mountain brome is likely to be top-killed by fire, although the

coarse stems and broad leaves may be more fire-resistant than fine-leaved bunchgrasses. Mountain brome is most susceptible to fire damage when it is actively growing in spring and early summer. Basin wildrye is top-killed by fire. Older basin wildrye plants with large proportions of dead material within the perennial crown can be expected to show higher mortality due to fire than younger plants having little debris. Basin wildrye is generally tolerant of fire but may be damaged by early season fire combined with dry soil conditions. The effects of fire on slender wheatgrass are dependent on its growth form. Tall, decadent plants with many leaves sustain the most fire damage, while those with short, sparse growth form, is the least likely to sustain damage to the root system during a fire. Cusick's bluegrass is unharmed to slightly harmed by light-severity fall fires. Cusick's bluegrass regenerates after fire from seed and by tillering. Sandberg bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur.

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 are factors in 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).

Burning has been found to decrease the vegetative and reproductive vigor of Thurber's needlegrass (Uresk et al. 1976). Fire can cause high mortality and a reduction in the basal area and yield of Thurber's needlegrass (Britton et al. 1990). The fine leaves and densely tufted growth form make this grass susceptible to subsurface charring of the crowns (Wright and Klemmedson 1965). Although timing of fire highly influences the response and mortality of Thurber's needlegrass, smaller bunch sizes are less likely to be damaged by fire (Wright and Klemmedson 1965). Thurber's needlegrass often survives fire and will continue growth or regenerate from tillers when conditions are favorable (Koniak 1985, Britton et al. 1990). Reestablishment on burned sites has been found to be relatively slow due to low germination and competitive ability (Koniak 1985). Cheatgrass has been found to be a highly successful competitor with seedlings of this needlegrass and may preclude reestablishment (Evans and Young 1978).

Fire will remove aboveground biomass from bluebunch wheatgrass but plant mortality is generally low (Robberecht and Defossé 1995) because the buds are underground (Conrad and Poulton 1966) or protected by foliage. 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). Plant response will vary depending on season, fire severity, fire intensity and post-fire soil moisture availability.

Sandberg bluegrass has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper-rooted bunchgrasses. 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.

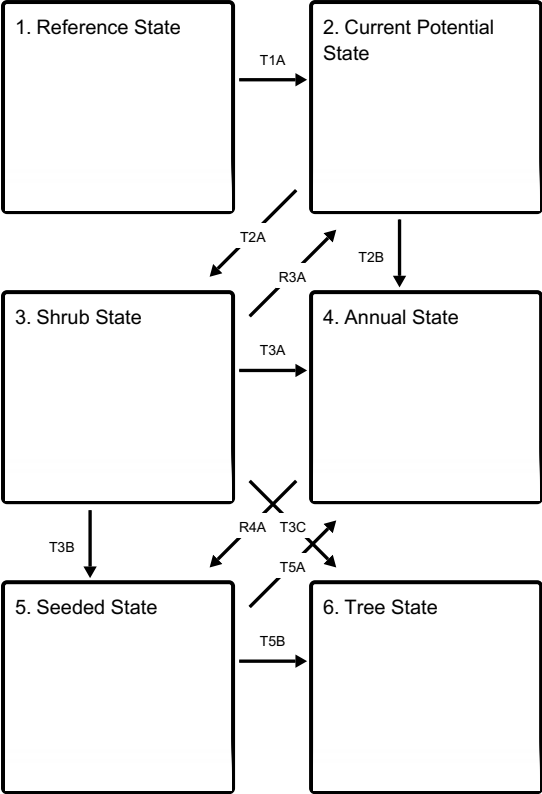
The range and density of Utah juniper and singleleaf pinyon has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion of trees into sagebrush ecosystems include wildfire suppression, historic livestock grazing, and climate change (Bunting 1994).

Depending on fire severity, rabbitbrush and horsebrush may increase after fire. Rubber rabbitbrush is top-killed by fire, but can resprout after fire and can also establish from seed (Young 1983). Yellow 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 shrubs such as rabbitbrush will not survive (Whisenant 1990).

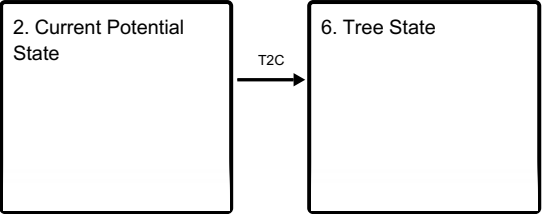
## **State and transition model**



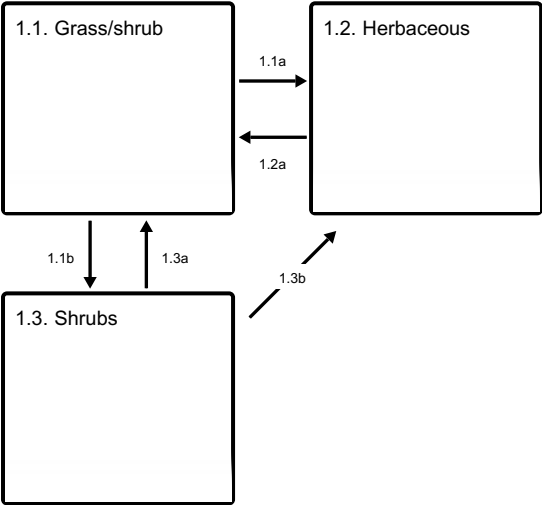
Ecosystem states



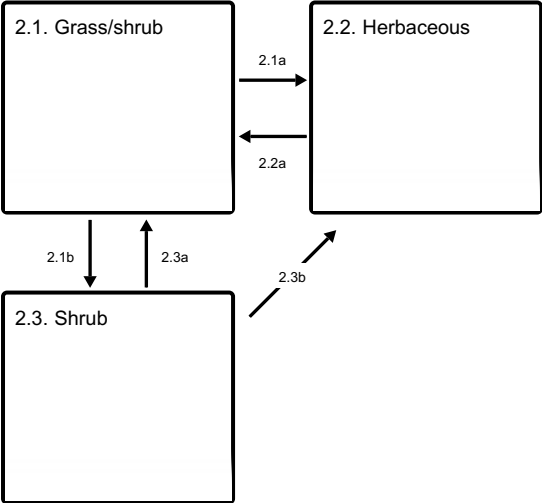
States 2 and 6 (additional transitions)



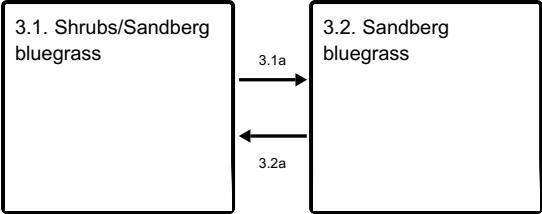
State 1 submodel, plant communities



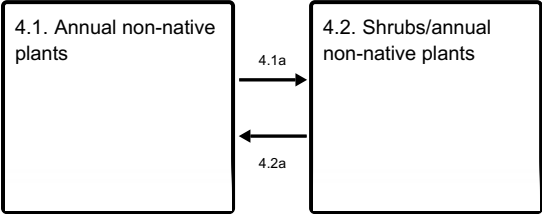
State 2 submodel, plant communities



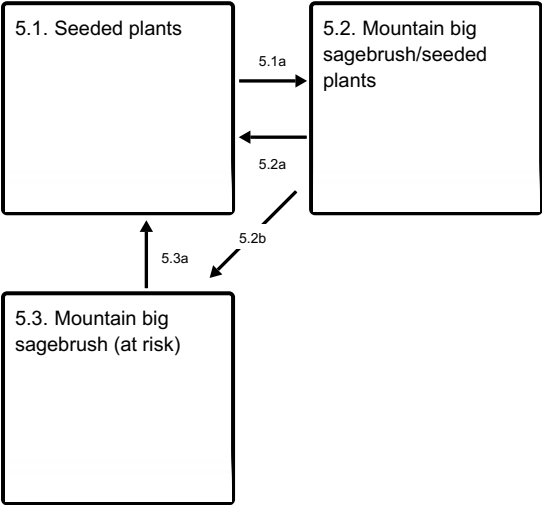
State 3 submodel, plant communities



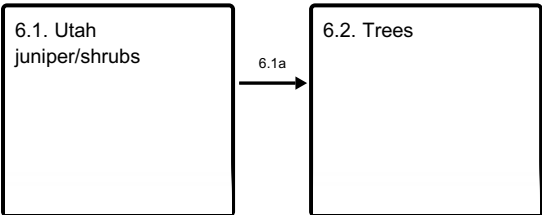
State 4 submodel, plant communities



State 5 submodel, plant communities



State 6 submodel, plant communities



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  
Grass/shrub



**Figure 7. Stony Loam 12-14" P.Z.**

The reference plant community is dominated by Idaho fescue, mountain brome and mountain big sagebrush. Slopes with a southerly exposure will normally express a higher percentage of bluebunch wheatgrass while north-facing slopes will support a higher component of Idaho fescue. Mountain big sagebrush is usually prevalent enough to dominate the aspect. Potential vegetative composition is about 60 percent grasses, 15 percent forbs and 25 percent shrubs. Approximate ground cover (basal and crown) is about 40 to 55 percent.

**Table 5. Annual production by plant type**

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	538	807	1076
Shrub/Vine	224	336	448
Forb	135	202	269
<b>Total</b>	<b>897</b>	<b>1345</b>	<b>1793</b>

**Community 1.2**  
**Herbaceous**

This community phase is characteristic of a post-disturbance, early to mid-seral community phase. Rabbitbrush, horsebrush, spiny hopsage and perennial grasses such as bluebunch wheatgrass, Indian ricegrass and squirreltail are common. Wyoming big sagebrush is killed by fire, therefore decreasing within the burned community. Sagebrush could still be present in unburned patches. Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several years.

**Community 1.3**  
**Shrubs**

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 1.1a**  
**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 1.1b**

### **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 1.2a**

### **Community 1.2 to 1.1**

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

## **Pathway 1.3a**

### **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 1.3b**

### **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. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. 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**

### **Grass/shrub**

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**

### **Herbaceous**

This community phase is characteristic of a post-disturbance, early seral community phase where non-native species are present. Idaho fescue, bluebunch wheatgrass and other perennial grasses dominate. Douglas rabbitbrush, mountain snowberry and Utah serviceberry may be resprouting. 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. Annual non-native species are stable or increasing within the community.

## **Community 2.3**

### **Shrub**

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. Juniper and pinyon may be present as a result of encroachment from neighboring sites, and lack of disturbance.

### **Pathway 2.1a**

#### **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 2.1b**

#### **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 2.2a**

#### **Community 2.2 to 2.1**

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

### **Pathway 2.3a**

#### **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 2.3b**

#### **Community 2.3 to 2.2**

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. 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.

## **State 3**

### **Shrub State**

The Shrub State has two community phases; a mountain big sagebrush dominated phase and a rabbitbrush dominated phase. This state 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. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush canopy cover is high and sagebrush may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and Sandberg 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**

### **Shrubs/Sandberg bluegrass**

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**

### **Sandberg bluegrass**

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 3.1a**

#### **Community 3.1 to 3.2**

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

### **Pathway 3.2a**

#### **Community 3.2 to 3.1**

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

## **State 4**

### **Annual State**

This state has two community phases; one dominated by annual non-native species and the other is a shrub dominated site. This state is characterized by the dominance of annual non-native species such as cheatgrass and tansy mustard in the understory. Sagebrush and/or rabbitbrush may dominate the overstory. Annual non-native species and squirreltail dominate the understory.

## **Community 4.1**

### **Annual non-native plants**

Annual non-native plants such as cheatgrass or tansy mustard dominate the site. This phase may have seeded species present if resulting from a failed seeding attempt.

## **Community 4.2**

### **Shrubs/annual non-native plants**

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

### **Pathway 4.1a**

#### **Community 4.1 to 4.2**

Time and lack of disturbance. Occurrence of this pathway is unlikely.

### **Pathway 4.2a**

#### **Community 4.2 to 4.1**

Fire allows for annual non-native species to dominate site.

## **State 5**

### **Seeded State**

The Seeded 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 and other desired seeded species including mountain big sagebrush, native and non-native forbs may be present.

#### **Community 5.1**

##### **Seeded plants**

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

#### **Community 5.2**

##### **Mountain big sagebrush/seeded plants**

Mountain big sagebrush increases and may become the dominant overstory. Seeded wheatgrass species dominate understory. Annual non-native species may be present in trace amounts.

#### **Community 5.3**

##### **Mountain big sagebrush (at risk)**

Sagebrush becomes the dominant plant. Perennial bunchgrasses in the understory are reduced due to increased competition. Annual non-native species may be increasing. Utah juniper may be present.

#### **Pathway 5.1a**

##### **Community 5.1 to 5.2**

Time and lack of disturbance may be coupled with inappropriate grazing management.

#### **Pathway 5.2a**

##### **Community 5.2 to 5.1**

Fire, brush management and/or Aroga moth infestation reduces sagebrush overstory and allows for seeded wheatgrasses or other seeded grasses to increase.

#### **Pathway 5.2b**

##### **Community 5.2 to 5.3**

Continued inappropriate grazing management reduces bunchgrasses and increases density of sagebrush; usually a slow transition.

#### **Pathway 5.3a**

##### **Community 5.3 to 5.1**

Fire or brush management with minimal soil disturbance would reduce sagebrush to trace amounts and allow for the perennial understory to increase.

## **State 6**

### **Tree State**

This state has two community phases that are characterized by the dominance of Utah juniper and singleleaf pinyon in the overstory. Mountain 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 6.1**

### **Utah juniper/shrubs**

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**

### **Trees**

Utah juniper 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 skeletons will be more numerous than living sagebrush. Bunchgrasses may or may not be present. Sandberg bluegrass or mat forming forbs may be present in trace amounts. Bare ground interspaces are large and connected. Soil redistribution is evident.

## **Pathway 6.1a**

### **Community 6.1 to 6.2**

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

## **Transition T1A**

### **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 T2A**

### **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 T2B**

### **State 2 to 4**

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 4.1. 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 4.2. 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 T2C**

### **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 R3A**

### **State 3 to 2**

Brush management, herbicide or sub-soiling of Sandberg bluegrass and seeding of desired perennial bunchgrass.

## **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.

## **Restoration pathway T3B**

### **State 3 to 5**

Brush management, herbicide of Sandberg bluegrass and seeding of crested wheatgrass and/or other desired species.

## **Transition T3C**

### **State 3 to 6**

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 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 R4A**

### **State 4 to 5**

Application of herbicide and seeding of desired species. Success for this restoration pathway is unlikely; probability of success is best immediately following fire.

## **Transition T5A**

### **State 5 to 4**

Trigger: Fire. Slow variables: Increased production and cover of non-native annual species Threshold: Cheatgrass or other non-native annuals dominate understory.

## **Transition T5B**

### **State 5 to 6**

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 trees, reduced infiltration and increased runoff. 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.

**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			345–1054	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	135–404	–
	mountain brome	BRMA4	<i>Bromus marginatus</i>	135–404	–
	slender wheatgrass	ELTR7	<i>Elymus trachycaulus</i>	27–67	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	27–67	
	Cusick's bluegrass	POCU3	<i>Poa cusickii</i>	11–56	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–56	–
2	Secondary Perennial Grasses			39–202	
	Columbia needlegrass	ACNE9	<i>Achnatherum nelsonii</i>	7–40	–
	western needlegrass	ACOCO	<i>Achnatherum occidentale</i> ssp. <i>occidentale</i>	7–40	–
	Thurber's needlegrass	ACTH7	<i>Achnatherum thurberianum</i>	7–40	–
	sedge	CAREX	<i>Carex</i>	7–40	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	7–40	–
	melicgrass	MELIC	<i>Melica</i>	7–40	–
	bluebunch wheatgrass	PSSPS	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	7–40	–
Forb					
3	Perennial Forbs			135–269	
	basin wildrye	LECI4	<i>Leymus cinereus</i>	27–67	–
	agoseris	AGOSE	<i>Agoseris</i>	7–27	–
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	7–27	–
	Indian paintbrush	CASTI2	<i>Castilleja</i>	7–27	–
	tapertip hawksbeard	CRAC2	<i>Crepis acuminata</i>	7–27	–
	buckwheat	ERIOG	<i>Eriogonum</i>	7–27	–
	desertparsley	LOMAT	<i>Lomatium</i>	7–27	–
	lupine	LUPIN	<i>Lupinus</i>	7–27	–
	beardtongue	PENST	<i>Penstemon</i>	7–27	–
	ragwort	SENEC	<i>Senecio</i>	7–27	–
	mule-ears	WYAM	<i>Wyethia amplexicaulis</i>	7–27	–
4	Annual Forbs			22–67	
Shrub/Vine					
5	Primary Shrubs			202–336	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	202–336	–
6	Secondary Shrubs			56–157	
	Utah serviceberry	AMUT	<i>Amelanchier utahensis</i>	13–40	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	13–40	–
	black chokecherry	PRVIM	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	13–40	–
	mountain snowberry	SYOR2	<i>Symphoricarpos oreophilus</i>	13–40	

## Animal community

### Livestock Interpretations:

This site is suitable for livestock grazing. Grazing management should be keyed to dominant perennial grass production. Idaho fescue provides important forage for many types of domestic livestock. The foliage cures well and is preferred by livestock in late fall and winter. Mountain brome is one of the most important forage grasses in the quaking aspen zone. Mountain brome is ranked as excellent forage for both cattle and horses and good for domestic sheep. Domestic sheep will graze mountain brome only when it is fairly succulent. The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important forage for cattle and 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. Slender wheatgrass is grazed by all classes of livestock. Cusick's bluegrass makes up only a small proportion of the biomass of the sagebrush communities in which it lives, but it is often taken preferentially by cattle, especially early in the season. Sandberg bluegrass is a palatable species, but its production is closely tied to weather conditions. It produces little forage in drought years, making it a less dependable food source than other perennial bunchgrasses. 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 provides important forage for several wildlife species. It is reported to be good forage for pronghorn, and deer in ranges of northern Nevada. Mountain brome seedheads and seeds provide food for many birds and small mammals. Pronghorn antelope will consume mountain brome primarily in the spring. The palatability of mountain brome is excellent for deer, particularly during the late spring and early summer. Basin wildrye provides winter forage for mule deer, though use is often low compared to other native grasses. Basin wildrye provides summer forage for black-tailed jackrabbits. Because basin wildrye remains green throughout early summer, it remains available for small mammal forage for longer time than other grasses. Slender wheatgrass is grazed by sage grouse, deer, elk, moose, and bighorn sheep, mountain goat, pronghorn, various rodents, and all classes of livestock. The seeds are eaten by various seed predators. Slender wheatgrass provides hiding and thermal cover for songbirds, upland game birds, waterfowl, and small mammals. Deer, elk, and mountain goat also use Cusick's bluegrass early in the season. The value of Cusick's bluegrass as cover for small animals has been rated as poor to fair. Sandberg bluegrass is desirable for pronghorn antelope and mule deer in the spring and preferable in the spring, summer, and fall for elk and desirable as part of their winter range. Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer and elk.

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.

Overgrazing leads to an increase in sagebrush and a decline in understory plants like bluebunch wheatgrass and Thurber's needlegrass. Squirreltail or 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 bluegrass and an increase in bare ground. A combination of overgrazing and prolonged drought leads to soil erosion, increased bare ground and a loss in plant production. 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. Although trees are not part of the site concept, Utah juniper and/or singleleaf pinyon can also invade and eventually dominate this site.

Thurber's needlegrass is an important forage source for livestock and wildlife in the arid regions of the west (Ganskopp 1988). Although the seeds are not injurious, grazing animals avoid them when they begin to mature. Sheep, however, have been observed to graze the leaves closely, leaving stems untouched (Eckert and Spencer 1987). Heavy grazing during the growing season has been shown to reduce the basal area of Thurber's needlegrass (Eckert and Spencer 1987), suggesting that both seasonality and utilization are important factors in management of this plant. A single defoliation, particularly during the boot stage, was found to reduce herbage production and root mass thus potentially lowering the competitive ability of Thurber's needlegrass (Ganskopp 1988).

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). 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, Britton et al. 1990). Tiller production and growth of bluebunch was greatly reduced when drought was coupled with clipping (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.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species such as saltlover (*Halogeton glomeratus*), bur buttercup (*Ceratocephala testiculata*) and annual mustards to occupy interspaces. 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 more moisture and may retain deep-rooted perennial grasses whereas convex areas are slightly less resilient and may have more Sandberg bluegrass present.

## Hydrological functions

Runoff is medium to high depending on slope. Permeability is moderately slow.

## Recreational uses

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

## 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. Berries from western serviceberry are eaten raw or cooked in jams or jellies. Various tribes made pemmican from serviceberry.

## Other information

In many areas where Idaho fescue is a late seral community dominant, grasslands are currently occupied by non-native species or have species compositions that deviate from historical communities and favor less desirable species. Seeding these sites with native species has had mixed results, with some non-native species establishing more rapidly and having better longevity than native species. Idaho fescue is slow to establish, but once established, has abundant growth that provide effective ground cover and dense roots that control erosion and improve soil structure.

Mountain brome and slender wheatgrass germinate and establish quickly when seeded. They are short-lived pioneer perennial species and when planted with slower developing native species, provide excellent cover crop attributes for the slower establishing species.

## Inventory data references

Soils and Physiographic features were gathered from NASIS.

## Type locality

Location 1: Malheur County, OR	
Township/Range/Section	T40S R44E S21
UTM zone	N

UTM northing	4659379
UTM easting	453474
Latitude	42° 5' 6"
Longitude	117° 33' 45"
General legal description	SE1/4 NW1/4 Malheur County, Oregon. This site also occurs in Humboldt County, Nevada.

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## Contributors

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Approval

Kendra Moseley, 4/25/2024

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)	
Contact for lead author	
Date	12/04/2024
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. Number and extent of rills:
- 
2. Presence of water flow patterns:
- 
3. Number and height of erosional pedestals or terracettes:
- 
4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):
- 
5. Number of gullies and erosion associated with gullies:
- 
6. Extent of wind scoured, blowouts and/or depositional areas:
- 
7. Amount of litter movement (describe size and distance expected to travel):
- 
8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):

- 
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**
- 
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**
- 
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**
- 
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:
- Sub-dominant:
- Other:
- Additional:
- 
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
- 
14. **Average percent litter cover (%) and depth ( in):**
- 
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-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:**
- 
17. **Perennial plant reproductive capability:**
-