Ecological site R025XY066OR SHRUBBY LOAM 11-13 PZ

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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

The Owyhee High Plateau, MLRA 25, lies within the Intermontane Plateaus physiographic province. The southern half is found in the Great Basin while the northern half is located in the Columbia Plateaus. The southern section of the Owyhee High Plateau 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 section forms the southern boundary of the extensive Columbia Plateau basalt flows. Deep, narrow canyons drain to the Snake River across the broad volcanic plain.

This MLRA is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. 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 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. Precipitation occurs mainly as snow in winter. The supply of water from precipitation and streamflow is small and unreliable, except along major rivers. Streamflow depends largely on accumulated snow in the mountains.

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, arid bordering on xeric, or xeric moisture regime. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam, and have ashy texture modifiers in some cases. Argillic horizons occur on the more stable landforms.

Ecological site concept

This ecological site is on plateaus and broad tablelands associated with volcanic plateau landscapes. Elevations range from 4,200 to 5,500 feet and slopes range from 2 to 12 percent. The soils associated with this site are moderately deep or deep to lithic or paralithic bedrock. The soil climate is frigid (soil temperature regime) and aridic bordering xeric (soil moisture regime). The reference plant community is characterized by bitterbrush and basin big sagebrush in the overstory and bluebunch wheatgrass is dominant in the understory, Idaho fescue is also common in the understory.

Associated sites

R025XY012OR	**LOAMY 11-13 PZ**
R025XY016OR	**SHALLOW CLAYPAN 11-13 PZ**
R025XY064OR	**SHRUBBY SHALLOW CLAYPAN 13-16 PZ**

Similar sites

R025XY010OR	**LOAMY 8-11 PZ** Warmer and drier (mesic, aridic); lower production; species composition is dominated by Wyoming sagebrush and bluebunch wheatgrass.
R025XY012OR	**LOAMY 11-13 PZ** Bedrock is less fractured; possibly different geologies. More likely to occur on lithic than paralithic soils.
R025XY065OR	**SHRUBBY LOAM 13-16 PZ** Cooler and wetter (frigid, xeric); higher production; species composition is dominated by bitterbrush and mountain big sagebrush with a mix of Idaho fescue and bluebunch wheatgrass in the understory.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Purshia tridentata* (2) *Artemisia tridentata subsp. tridentata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Festuca idahoensis*

Physiographic features

This site is on tablelands and plateaus. Slopes range from 2 to 12%. Elevation varies from 4,200 to 5,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Mountain (2) Tableland > Plateau (3) Mountains > Plateau
Runoff class	High to very high
Elevation	1,280–1,676 m
Slope	2–12%
Water table depth	254 cm
Aspect	Aspect is not a significant factor

Climatic features

The annual precipitation ranges from 11 to 13 inches, most of which occurs in the form of snow during the months of December through March. Localized convection storms occasionally occur during the summer. The soil temperature regime is frigid with a mean annual air temperature of 45 degrees F. Temperature extremes range from -30 to 100 degrees F. The frost free period ranges from less than 30 to 90 days. The optimum growth period for native plants is from April through June.

Table 3. Representative climatic features

Frost-free period (characteristic range)	30-100 days
Freeze-free period (characteristic range)	110-130 days
Precipitation total (characteristic range)	279-330 mm
Frost-free period (average)	80 days
Freeze-free period (average)	120 days
Precipitation total (average)	330 mm

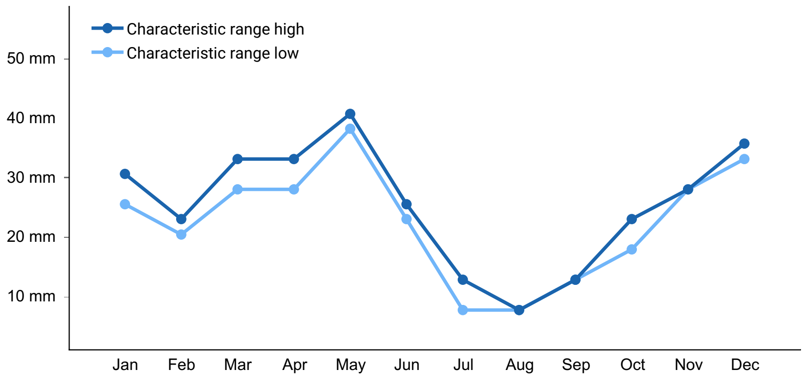


Figure 1. Monthly precipitation range

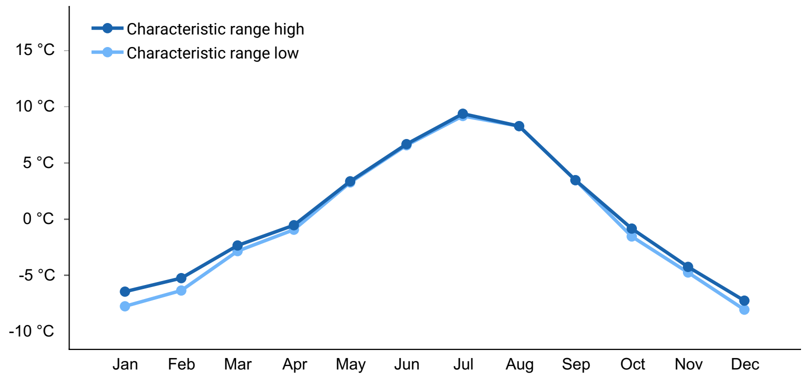


Figure 2. Monthly minimum temperature range

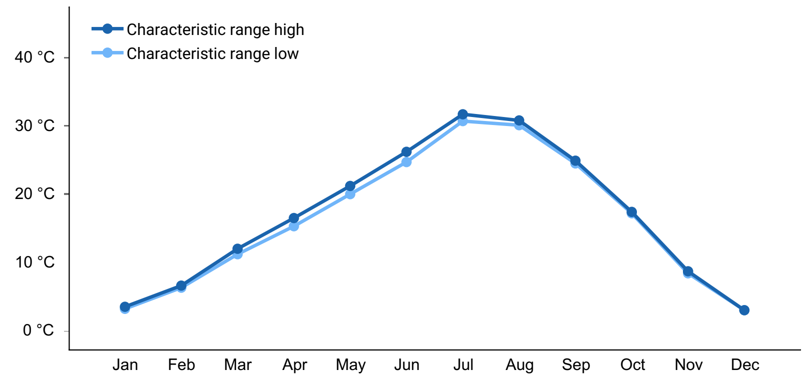


Figure 3. Monthly maximum temperature range

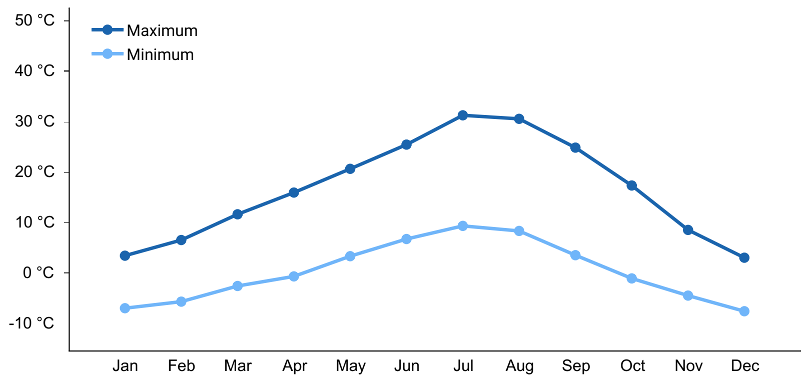


Figure 4. Monthly average minimum and maximum temperature

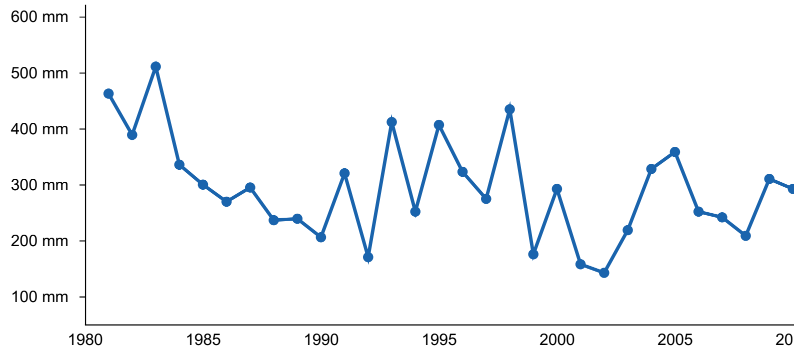


Figure 5. Annual precipitation pattern

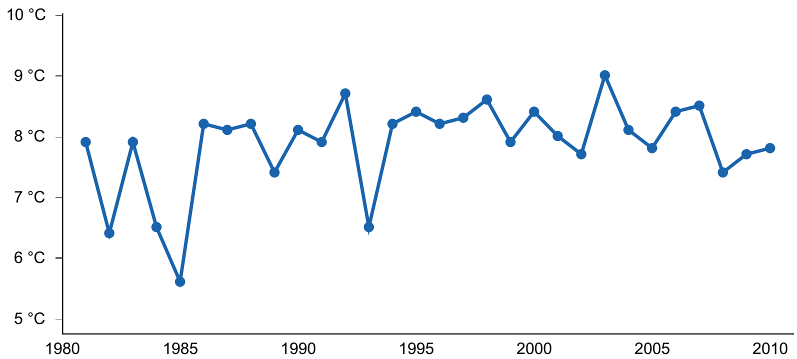


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DANNER [USC00352135], Jordan Valley, OR
- (2) ROCKVILLE 5 N [USC00357277], Adrian, OR

Influencing water features

Site is not influenced by water features.
Site is not connected to a water table.

Soil features

The soils associated with this site are moderately deep or deep over paralithic or lithic bedrock and are well drained. The surface layer is ashy loam to loam. The subsoil is a silty loam to silty clay loam. Depth to weathered bedrock is about 20 to 60 inches. Permeability is moderate. The available water holding capacity is about 4 to 7 inches for the profile.

The soil series correlated with this site is Littlegrass.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Loess (3) Residuum–volcanic rock
Surface texture	(1) Ashy loam (2) Loam
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	51–152 cm

Soil depth	51–152 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	10.16–17.78 cm
Soil reaction (1:1 water) (0-101.6cm)	7–8
Subsurface fragment volume <=3" (0-101.6cm)	0–10%
Subsurface fragment volume >3" (0-101.6cm)	0–10%

Ecological dynamics

The reference plant community is dominated by bitterbrush and basin big sagebrush with an understory of bluebunch wheatagrass. Idaho fescue is also common in the understory. The site has low resilience to disturbance and to moderately low resistance to invasion. Resilience is a system's capacity to regain its structure, processes, and function following stressors or disturbance (e.g. drought or fire). Resistance is the capacity of the system to retain its structure, processes, and function despite stressors or disturbances (including pressure from invasive species) (Chambers 2014). Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability (Stringham et al. 2015); where greater resource availability and more favorable environmental conditions exist for plant growth and reproduction (Chambers 2014).

This ecological site's lower effective precipitation (aridic bordering xeric soil moisture regime) limits site productivity resulting in more open space for establishment of invasive annual grasses. Timing of precipitation also favors invasive annual grasses that are particularly well adapted to cool wet winters and warm dry summers; beginning growth and utilizing resources prior to native species breaking dormancy. The site's cooler soil temperature regime (frigid) does provide some resistance compared to warmer sites but is not cold enough to inhibit invasive annual grasses (Chambers 2014).

This ecological site is dominated by deep-rooted cool season, perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 m (Dobrowolski et al. 1990). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

Periodic drought regularly influences sagebrush ecosystems and drought duration and severity has increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability with the soil profile (Bates et al. 2006).

In the Great Basin, the majority of annual precipitation is received during 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 the deeper rooted shrubs lag in phenological development because they draw from deeply infiltrating moisture from snowmelt 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).

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. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975).

The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

The introduction of annual weedy species, like 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 the perennial bunchgrasses and forbs may be reduced.

Fire Ecology:
Basin big sagebrush does not sprout after fire. Because of the time needed to produce seed, it is eliminated by frequent fires (Bunting et al. 1987). Basin big sagebrush reinvades a site primarily by off-site seed or seed from plants that survive in unburned patches. Approximately 90% of big sagebrush seed is dispersed within 30 feet (9 m) of the parent shrub (Goodrich et al. 1985) with maximum seed dispersal at approximately 108 feet (33 m) from the parent shrub (Shumar and Anderson 1986). Therefore, regeneration of basin big sagebrush after stand replacing fires is difficult and dependent upon proximity of residual mature plants and favorable moisture conditions (Johnson and Payne 1968, Humphrey 1984).

Antelope bitterbrush is moderately fire tolerant (McConnell and Smith 1977). It regenerates by seed and resprouting (Blaisdell and Mueggler 1956, McArthur et al. 1982), however 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 the invasive species cheatgrass (Clements and Young 2002).

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

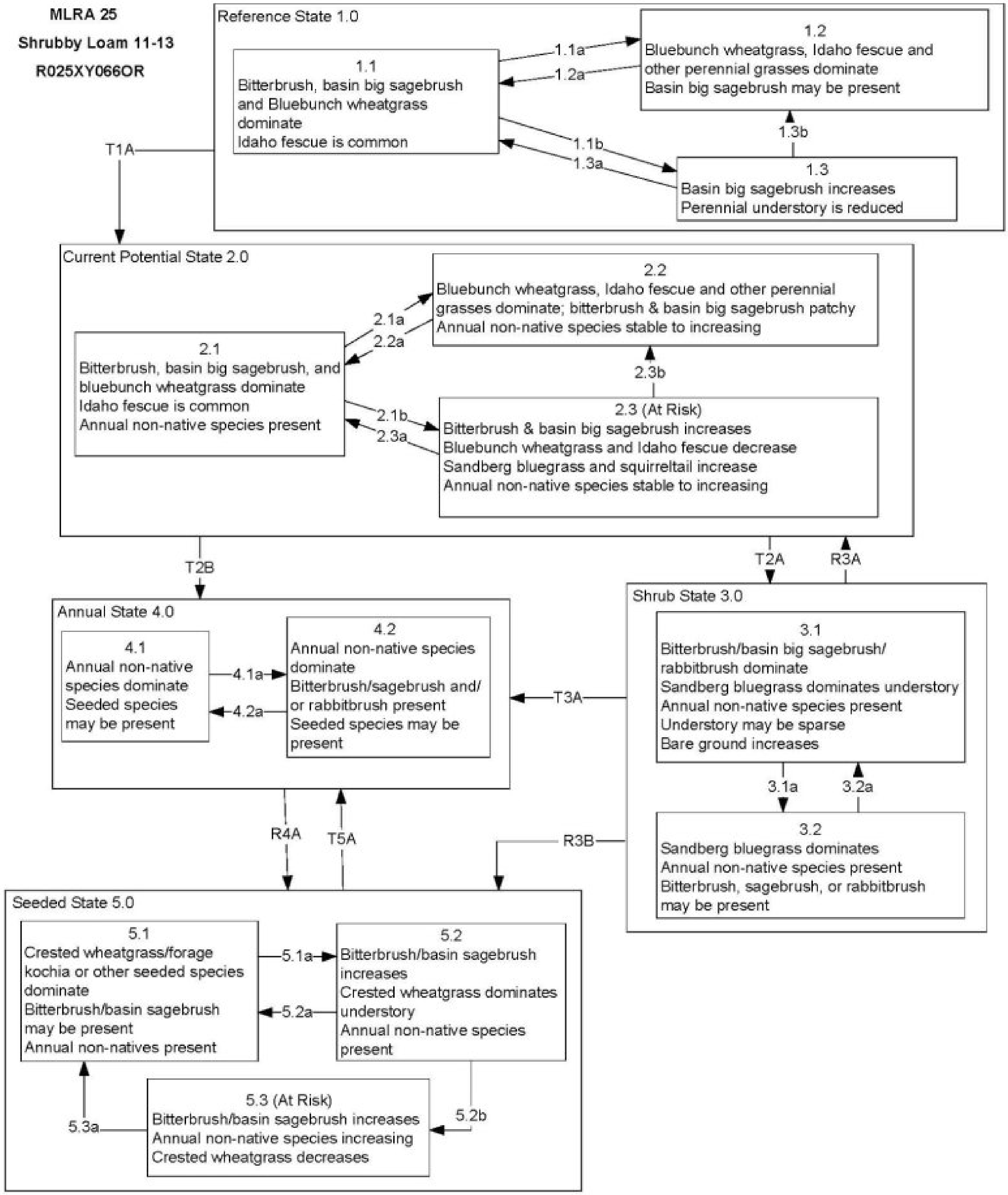
Fire will remove aboveground biomass from bluebunch wheatgrass but plant mortality is generally low (Robberecht and Defossé 1995) because the buds are underground (Conrad and Poulton 1966) or protected by foliage. Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch 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, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper rooted bunchgrass. 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.

Depending on fire severity, rabbitbrush 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 frequencies between 0.23 and 0.43 times a year; then even sprouting shrubs such as rabbitbrush will not survive (Whisenant 1990).

Adapted from: Stringham, T.K., P. Novak-Echenique, P. Blackburn, D. Snyder, and A. Wartgow. 2015. Final Report for USDA Ecological Site Description State-and-Transition Models by Disturbance Response Groups, Major Land Resource Area 25 Nevada. University of Nevada Reno, Nevada Agricultural Experiment Station Research Report 2015-02. p. 569

State and transition model



(Adapted from Stringham, T.K. et all., 2015)

MLRA 25

Shrubby Loam 11-13

R025XY066OR

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates grass/sagebrush 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 decrease perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Low severity fire or Aroga moth infestation resulting in a mosaic pattern.
1.3b: High severity fire or Aroga moth significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native species.

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates grass/sagebrush 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 or Aroga moth infestation creates sagebrush/grass mosaic. Brush treatment with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.
2.3b: High severity fire or Aroga moth significantly reduces sagebrush cover leading to a early/mid-seral community.

Transition T2A: Inappropriate grazing management favoring shrub dominance and reducing perennial bunchgrasses will lead to phase 3.1. Soil disturbing treatments will lead to phase 3.2.
Transition T2B: Catastrophic fire (to 4.1); inappropriate cattle/horse grazing management that removes bunchgrasses, favors shrubs and promotes the presence of non-native annual species (to 4.2)

Shrub State 3.0 Community Phase Pathways
3.1a: Low severity fire or Aroga moth infestation creates sagebrush/grass mosaic. Brush treatment with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.
3.2a: Time and lack of disturbance.

Restoration R3A: Brush management and seeding of native deep rooted bunchgrasses (probability of success is low).

Transition T3A: Fire and/or soil disturbing treatments.

Annual State 4.0 Community Phase Pathways
4.1a: Time and lack of disturbance. Big sagebrush is unlikely to reestablish and may take many years.
4.2a: High-severity fire.

Restoration R4A: Application of herbicide and seeding of desired species (probability of success best immediately following fire).

Seeded State 5.0 Community Phase Pathways
5.1a: Time without disturbance.
5.2a: Fire, brush management, or Aroga moth infestation reduces shrub component.
5.2b: Inappropriate grazing management decreases perennial bunchgrass understory.
5.3a: Fire, brush management, Aroga moth infestation.

Transition T5A: Catastrophic fire (coming from 5.3).

(Adapted from Stringham, T.K. et all., 2015)

State 1
Reference State 1.0

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

Community 1.1
Community 1.1

Bitterbrush, basin big sagebrush and bluebunch wheatgrass dominate the site. Idaho Fescue, other perennial grasses, and perennial forbs are also common on this site.

Dominant plant species

- antelope bitterbrush (*Purshia tridentata*), shrub
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata ssp. spicata*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	717	897	1166
Shrub/Vine	135	168	219
Forb	45	56	73
Total	**897**	**1121**	**1458**

Community 1.2
Community 1.2

This community phase is characteristic of a post-disturbance, early to mid-seral community phase. Rabbitbrush and perennial grasses such as bluebunch wheatgrass, Idaho fescue, and squirreltail are common. Basin big sagebrush is killed by fire, therefore decreasing within the burned community. Bitterbrush and sagebrush could still be present in unburned patches. Perennial forbs may increase or dominate after fire for several years.

Community 1.3
Community 1.3

Bitterbrush and basin big sagebrush increase in the absence of disturbance. Decadent shrubs dominate the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Sandberg bluegrass will likely increase in the understory and may be the dominant grass on the site.

Pathway P1.1a
Community 1.1 to 1.2

Fire would decrease or eliminate the shrub overstory and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce shrub 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 P1.1b
Community 1.1 to 1.3

Long-term drought, time and/or herbivory favor an increase in shrubs over deep-rooted perennial bunchgrasses. Combinations of these would allow the shrub overstory to increase and dominate the site, causing a reduction in the perennial bunchgrasses. Sandberg bluegrass may increase in density depending on the grazing management.

Pathway P1.2a
Community 1.2 to 1.1

Time and lack of disturbance allows for shrubs to reestablish.

Pathway P1.3a

Community 1.3 to 1.1

Aroga moth infestation and/or release from growing season herbivory may reduce shrub dominance and allow recovery of the perennial bunchgrass understory.

Pathway P1.3b
Community 1.3 to 1.2

Fire would decrease or eliminate the overstory of shrubs and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce shrub 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 2.0

This state is similar to the Reference State 1.0. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate and adaptations for seed dispersal. Additionally, the presence of highly flammable, non-native species reduces State resilience because these species can promote fire where historically fire has been infrequent leading to positive feedbacks that further the degradation of the system.

Community 2.1
Community 2.1

Bitterbrush, basin big sagebrush, and bluebunch wheatgrass dominate the site. Idaho Fescue, other perennial grasses, and perennial forbs are also common on this site. Non-native annual species are present in minor amounts.

Community 2.2
Community 2.2

This community phase is characteristic of a post-disturbance, early seral community phase. Rabbitbrush and perennial grasses such as bluebunch wheatgrass, Idaho fescue, and squirreltail are common. Basin big sagebrush is killed by fire, therefore decreasing within the burned community. Bitterbrush and sagebrush could still be present in unburned patches. Perennial forbs may increase or dominate after fire for several years. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Community 2.3
Community 2.3 (At Risk)

Bitterbrush and basin big sagebrush increases, and the perennial understory is reduced. Decadent shrubs dominate the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from inappropriate grazing management. Sandberg bluegrass will likely increase in the understory and may be the dominant grass on the site. Annual non-native species present.

Pathway P2.1a
Community 2.1 to 2.2

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

Pathway P2.1b
Community 2.1 to 2.3

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

Pathway P2.2a
Community 2.2 to 2.1

Absence of disturbance over time allows for the shrubs to recover, or grazing management that favors shrubs.

Pathway P2.3a
Community 2.3 to 2.1

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

Pathway P2.3b
Community 2.3 to 2.2

: Fire would decrease or eliminate the overstory of shrubs and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce shrub 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 3
Shrub State 3.0

This state has two community phases; a bitterbrush/basin 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. Bitterbrush/sagebrush dominates the overstory and rabbitbrush may be a significant component. Shrub canopy cover is high and shrubs 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
Community 3.1

Bitterbrush/basin big sagebrush dominates overstory and rabbitbrush may be a significant component. Sandberg bluegrass dominates the understory and squirreltail may also be a significant component of the plant community. Annual nonnative species are present to increasing. Understory may be sparse, with bare ground increasing.

Community 3.2
Community 3.2

Sandberg bluegrass dominates the understory; annual non-natives are present but are not dominant. Trace amounts of bitterbrush/sagebrush may be present. Rabbitbrush may dominate for a number of years following fire.

Pathway P3.1a
Community 3.1 to 3.2

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

Pathway P3.2a
Community 3.2 to 3.1

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

State 4
Annual State 4.0

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. Bitterbrush/sagebrush and/or rabbitbrush may dominate the overstory. Annual non-native species and Sandberg bluegrass dominate the understory.

Community 4.1
Community 4.1

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
Community 4.2

Bitterbrush/basin big sagebrush remains in the overstory with annual non-native species, likely cheatgrass, dominating the understory. Trace amounts of desirable bunchgrasses may be present.

Pathway P4.1a
Community 4.1 to 4.2

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

Pathway P4.2a
Community 4.2 to 4.1

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

State 5
Seeded State 5.0

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

Community 5.1
Community 5.1

Seeded wheatgrass and/or other seeded species dominate the community. Non-native annual species are present.

Trace amounts of bitterbrush/big sagebrush may be present, especially if seeded.

Community 5.2
Community 5.2

Bitterbrush/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
Community 5.3 (at risk)

Bitterbrush/sagebrush becomes the dominant functional structural group. Perennial bunchgrasses in the understory are reduced due to increased competition. Annual non-native species may be increasing.

Pathway P5.1a
Community 5.1 to 5.2

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

Pathway P5.2a
Community 5.2 to 5.1

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

Pathway P5.2b
Community 5.2 to 5.3

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

Pathway P5.3a
Community 5.3 to 5.1

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

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual weeds, such as cheatgrass and mustard. Slow variables: Over time the annual non-native plants will increase within the community decreasing organic matter inputs from deep-rooted perennial bunchgrasses resulting in reductions in soil water availability for perennial bunchgrasses. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

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

Transition T2B
State 2 to 4

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

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 R3B
State 3 to 5

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

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

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	**Dominant, perennial, deep rooted grasses**			616–1009	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	448–673	–
	Idaho fescue	FEID	*Festuca idahoensis*	168–336	–
2	**Sub-dominant, perennial, shallow rooted grasses**			22–56	
	Sandberg bluegrass	POSE	*Poa secunda*	22–56	–
3	**All other perennial grasses**			34–90	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	0–22	–
	basin wildrye	LECI4	*Leymus cinereus*	11–22	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	11–22	–
	squirreltail	ELEL5	*Elymus elymoides*	6–11	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	6–11	–
Forb					
4	**Dominant, perennial forbs**			39–84	
	lupine	LUPIN	*Lupinus*	11–22	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	11–22	–
	fleabane	ERIGE2	*Erigeron*	6–17	–
	phlox	PHLOX	*Phlox*	6–11	–
	pussytoes	ANTEN	*Antennaria*	6–11	–
5	**All other perennial forbs**			16–61	
	prairie Junegrass	KOMA	*Koeleria macrantha*	12–36	–
	basin wildrye	LECI4	*Leymus cinereus*	12–36	–
	squirreltail	ELEL5	*Elymus elymoides*	6–11	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	2–9	–
	buckwheat	ERIOG	*Eriogonum*	2–9	–
	desertparsley	LOMAT	*Lomatium*	2–9	–
	tansyaster	MACHA	*Machaeranthera*	0–6	–
	stoneseed	LITHO3	*Lithospermum*	2–6	–
	common yarrow	ACMI2	*Achillea millefolium*	2–6	–
	onion	ALLIU	*Allium*	2–6	–
	milkvetch	ASTRA	*Astragalus*	2–6	–
Shrub/Vine					
6	**Dominant, perennial, shrubs**			168–280	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	112–168	–
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	56–112	–
7	**All other perennial shrubs**			11–67	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	6–22	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–17	–
	horsebrush	TETRA3	*Tetradymia*	6–17	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–

Animal community

Livestock Grazing:
This site is suitable for grazing. Grazing management considerations include timing, duration and intensity of grazing.

Overgrazing leads to an increase in sagebrush and a decline in antelope bitterbrush and understory plants like bluebunch wheatgrass and Idaho fescue. 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 bluegrasss 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.

Antelope bitterbrush is an important shrub species to a variety of animals, such as domestic livestock, antelope, deer, and elk. Bitterbrush is critical browse for mule deer, as well as domestic livestock, antelope, and elk (Wood 1995). 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).

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 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.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species such as halogeton (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.

(Adapted from Stringham, T.K. et al., 2015)

Wildlife
Antelope bitterbrush is a critical browse species for mule deer, antelope and elk and is often utilized heavily by domestic livestock (Wood 1995). Grazing tolerance is dependent on site conditions (Garrison 1953) and the shrub can be severely hedged during the dormant season for grasses and forbs.

(Adapted from Stringham, T.K. et al., 2015)

Inventory data references

Vale District BLM Ecological Site Inventory
NASIS component and pedon data
Range Site Descriptions
Field knowledge of range-trained personnel

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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	07/17/2024
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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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:**