

Ecological site R025XY027NV LOAMY 12-14 P.Z.

Last updated: 4/25/2024
Accessed: 05/05/2024

General information

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

MLRA notes

Major Land Resource Area (MLRA): 025X—Owyhee High Plateau

MLRA Notes 25—Owyhee High Plateau

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

Physiography:

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

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

Geology:

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

Climate:

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

Water:

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

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

Soils:

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

Biological Resources:

This MLRA supports shrub-grass vegetation. Lower elevations are characterized by Wyoming big sagebrush associated with bluebunch wheatgrass, western wheatgrass, and Thurber's needlegrass. Other important plants include bluegrass, squirreltail, penstemon, phlox, milkvetch, lupine, Indian paintbrush, aster, and rabbitbrush. Black sagebrush occurs but is less extensive. Singleleaf pinyon and Utah juniper occur in limited areas. With increasing elevation and precipitation, vast areas characterized by mountain big sagebrush or low sagebrush/early sagebrush in association with Idaho fescue, bluebunch wheatgrass, needlegrasses, and bluegrass become common. Snowberry, curl-leaf mountain mahogany, ceanothus, and juniper also occur. Mountains at the highest elevations support whitebark pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, aspen, and curl-leaf mountain mahogany.

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

Ecological site concept

This site occurs on rolling hills on all exposures. Slopes range from 2 to 30 percent, but slope gradients of 2 to 15 percent are most typical. Elevations range from 5,300 to 6,500 feet.

The soils in this site are typically moderately deep to deep and well drained. Surface soils are moderately fine to medium textured and more than 10 inches thick to the subsoil or underlying material. The available water capacity is moderate to high.

This state includes the plant communities that were best adapted to the unique combination of biotic, abiotic, and climatic factors associated with the ecological site, prior to European settlement. The representative plant community is dominated by Idaho fescue and basin big sagebrush.

Associated sites

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

Similar sites

R025XY012NV	LOAMY SLOPE 12-16 P.Z. ARTRV dominant shrub; PSSPS-FEID codominant grasses; PUTR2 important shrub
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R025XY029NV	DEEP LOAMY 14+ P.Z. LECI4-FEID codominant grasses; more productive site
R025XY056NV	LOAMY 14-16 P.Z. More productive site; ARTRV dominant shrub
R025XY010NV	STEEP NORTH SLOPE ARTRV dominant shrub; occurs on very steep north slopes

Table 1. Dominant plant species

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

Physiographic features

This site occurs on rolling hills on all exposures. Slopes range from 2 to 30 percent, but slope gradients of 2 to 15 percent are most typical. Elevations are 5300 to 6500 feet.

Table 2. Representative physiographic features

Landforms	(1) Hill
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	5,300–6,500 ft
Slope	2–30%
Water table depth	78 in
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 (average)	47 days
Freeze-free period (average)	68 days
Precipitation total (average)	14 in

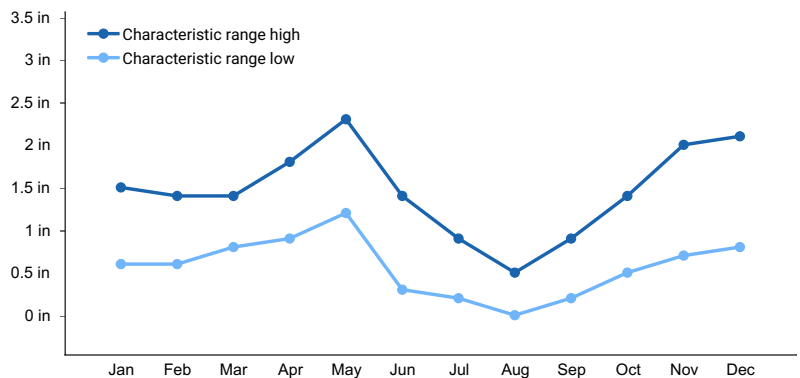


Figure 1. Monthly precipitation range

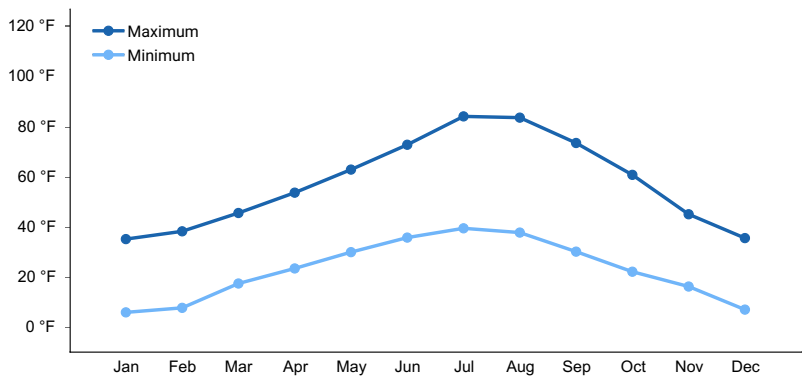


Figure 2. Monthly average minimum and maximum temperature

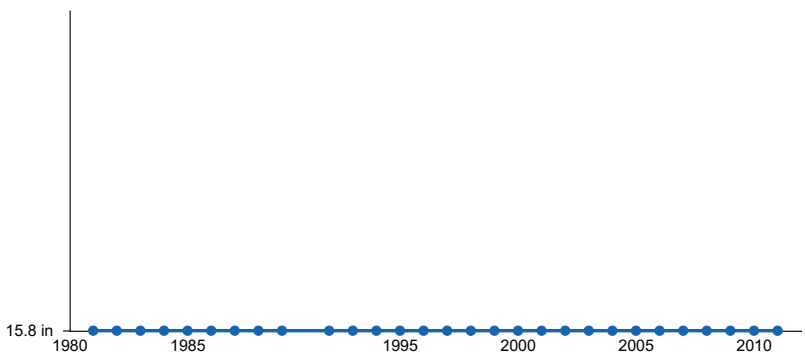


Figure 3. Annual precipitation pattern

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 in this site are typically moderately deep to deep and well drained. Surface soils are moderately fine to medium textured and more than 10 inches thick to the subsoil or underlying material. The available water capacity is moderate to high. Runoff is slow to medium. Potential for sheet and rill erosion is slight to moderate depending on slope. Soil stability values should be 3 to 6 on most soil textures found on this site.

The soil series associated with this site are: Alyan, Arvan, Blackleg, Chayson, Dutchjohn, Eboda, Forvic, Gochea, Golsum, Hart Camp, Hatpeak, Heechee, Lerrow, Reluctan, Rugar, Shivlum, Simon, Soonaker, Upsteer and Vitale.

A representative soil series associated with this site is Lerrow, classified as a fine, smectitic, frigid Vitritorrandic Argixeroll. This soil is moderately deep and well drained. It was formed in residuum and colluvium derived mainly from volcanic rocks. Reaction is neutral or slightly alkaline, increasing with depth. Diagnostic horizons include a mollic epipedon that occurs from the soil surface to 15 inches and an argillic horizon that occurs from 5 to 32 inches. Clay content in the particle-size control section is 35 to 50 percent. Rock fragments range from 15 to 35 percent, mainly cobbles and gravel. Lithology of fragments is volcanic rocks such as andesite.

Table 4. Representative soil features

Parent material	(1) Colluvium–welded tuff (2) Residuum
Surface texture	(1) Loam (2) Gravelly loam (3) Gravelly clay loam
Family particle size	(1) Fine-loamy (2) Fine (3) Loamy-skeletal (4) Clayey-skeletal
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	40–72 in
Soil depth	40–72 in
Surface fragment cover ≤3"	0–10%
Surface fragment cover >3"	0–2%
Available water capacity (0–40in)	3–8 in
Calcium carbonate equivalent (0–40in)	0–2%
Electrical conductivity (0–40in)	0–4 mmhos/cm
Sodium adsorption ratio (0–40in)	0–12
Soil reaction (1:1 water) (0–40in)	7–7.2
Subsurface fragment volume ≤3" (Depth not specified)	5–10%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

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

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

roots of antelope bitterbrush have been documented from 4.5 to 5.4 meters in length (McConnell 1961). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

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

Mountain big sagebrush and antelope bitterbrush are generally long-lived; therefore it is unnecessary for new individuals to recruit every year for perpetuation of the stand. Simultaneous low, continuous recruitment and infrequent large recruitment events are the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent upon adequate moisture conditions.

Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks especially with regard to Aroga moth (*Aroga websteri*), a sagebrush defoliator. Aroga moth infestations have occurred in the Great Basin in the 1960s, early 1970s, and have been ongoing in Nevada since 2004 (Bentz et al 2008). Thousands of acres of big sagebrush have been impacted, with partial to complete die-off observed in both individual plants and entire stands (Furniss and Barr 1975).

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

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

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

Where management results in abusive livestock use, big sagebrush and rabbitbrush become dominant with increases of bottlebrush squirreltail and Nevada bluegrass in the understory. The potential invasive/noxious weeds are cheatgrass, rabbitbrush, snakeweed, Russian thistle and annual mustards.

This ecological site has low to high resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Six possible stable states have been identified for the Loamy Slope 12-14" ecological site.

Fire Ecology:

In many basin big sagebrush communities, changes in fire frequency occur with fire suppression, livestock grazing and off-highway vehicle (OHV) use. Few, if any, fire history studies have been conducted on basin big sagebrush; however, Sapsis and Kauffman (1991) suggest that fire return intervals in basin big sagebrush are intermediate between mountain big sagebrush (15 to 25 years) and Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) (50 to 100 years). Fire severity in big sagebrush communities is described as "variable" depending on weather, fuels, and topography. However, fire in basin big sagebrush communities are typically stand-replacing

(Sapsis and Kauffman 1991). Basin big sagebrush does not sprout after fire; due to the length of 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). Regeneration of basin big sagebrush after stand replacing fires is therefore both 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 cheatgrass, an invasive species (Clements and Young 2002).

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

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

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

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

Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. (2013) reported increased total shoot and reproductive shoot

densities in the first year following fire; by year two, however, there was little difference between burned and control treatments.

State and transition model

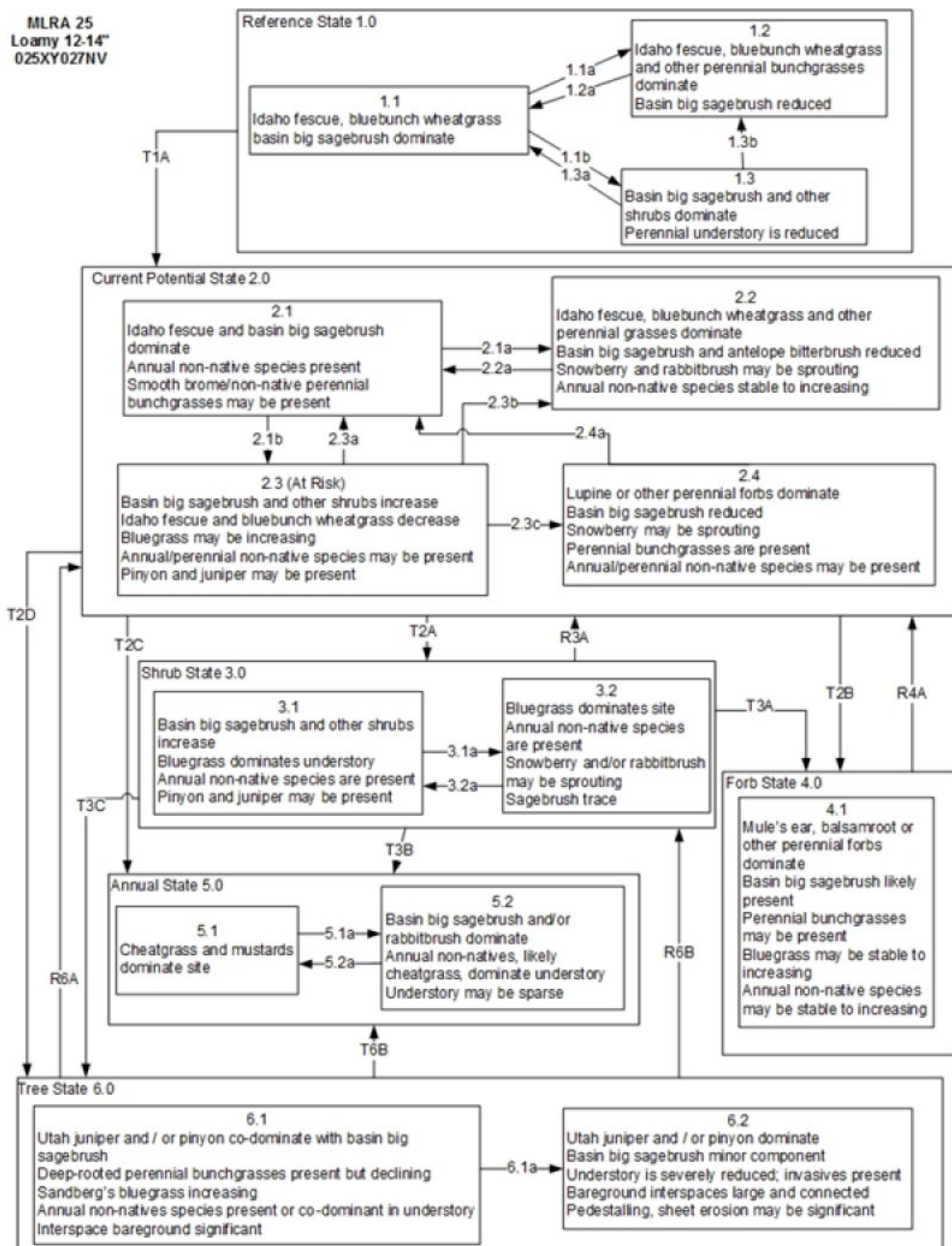


Figure 5. T. Stringham July 2015

MLRA 25
Loamy Slope 12-16"
025XY027NV

Reference State 1.0 Community Pathways

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

Transition T1A: Introduction of non-native annual species.

Current Potential State 2.0 Community Pathways

- 2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
- 2.1b: Time and lack of disturbance such as fire or drought. Inappropriate grazing management may also reduce perennial understory.
- 2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
- 2.3a: Low severity fire and/or grazing management creates sagebrush/grass mosaic.
- 2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community.
- 2.3c: Inappropriate grazing management coupled with fire
- 2.4a: Time and lack of disturbance and a change in grazing management to facilitate perennial bunchgrass production.

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

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

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

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

Shrub State 3.0 Community Pathways

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

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

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

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

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

Forb State 4.0 Community Pathways

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

Annual State 5.0 Community Pathways

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

Tree State 6.0 Community Pathways

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

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

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

Transition T6B: Catastrophic fire (5.1).

Figure 6. T. Stringham July 2015

State 1

Reference State

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

Community 1.1

Perennial bunchgrasses/basin big sagebrush

This state includes the plant communities that were best adapted to the unique combination of biotic, abiotic, and climatic factors associated with the ecological site, prior to European settlement. The representative plant community is dominated by Idaho fescue and basin big sagebrush. Potential vegetative composition is approximately 70 percent grasses, 10 percent forbs and 20 percent shrubs. Approximate ground cover (basal and crown) is 40 to 50 percent. Bare ground is approximately 35 percent. Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 25 percent of total woody canopy; some of the mature bunchgrasses (<20 percent) have dead centers. Litter cover (approximately 35 percent) occurs within plant interspaces at a depth of about 1/2 inch.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	350	630	910
Shrub/Vine	100	180	260
Forb	50	90	130
Total	500	900	1300

Community 1.2

Perennial bunchgrasses

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

Community 1.3

Basin big sagebrush

Basin 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 1.3b

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 basin 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 1.0 and has four community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable, and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate and adaptations for seed dispersal.

Community 2.1

Perennial bunchgrasses-basin big sagebrush/annual non-native species

Similar to community phase 1.1 with the addition of annual non-native species present in the community.

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

Shrubs/bluegrass/annual non-native species (at risk)

Basin 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.

Community 2.4

Forbs/annual non-native species present

Lupine and other perennial forbs dominate the site. Basin big sagebrush may be present in trace amounts. Perennial bunchgrasses are present. Smooth brome and/or other perennial non-native bunchgrasses may be present. This community phase can be maintained for several years with spring grazing and poor distribution of

grazing animals. With a change in grazing management mountain big sagebrush will increase and perennial forb community will eventually decrease.

Pathway 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.

Pathway 2.3c

Community 2.3 to 2.4

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

Pathway 2.4a

Community 2.4 to 2.1

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

State 3

Shrub State

This state has two community phases: a 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 on this site. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants.

Community 3.1

Basin big sagebrush/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

Shrubs/annual non-native species

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

Forb State

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

Community 4.1

Forbs/basin big sagebrush/bluegrass

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

State 5

Annual State

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

Community 5.1

Annual non-native species

One or more of the weeds that are on the State noxious or invasive weed lists, or a new invasive weed, dominates the herbaceous vegetation, competitively excluding the native perennial herbaceous dominants. Such weeds may burn readily and typically exclude sagebrush and/or pinyon and juniper trees. Their competitive advantage in an environment without disease, insects, etc. from their ancestral home allows them to displace most other plants to form virtual monocultures. Initial weeds may facilitate the establishment of even more competitive invasive weeds.

Community 5.2

Shrubs/annual non-native species

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

Pathway 5.1a

Community 5.1 to 5.2

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

Pathway 5.2a

Community 5.2 to 5.1

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

State 6

Tree State

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

Community 6.1

Trees/basin big sagebrush/annual non-native species present

Utah juniper and singleleaf pinyon dominate the overstory. Basin 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/annual non-native species present

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

Pathway 6.1a

Community 6.1 to 6.2

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

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

Transition T2C

State 2 to 5

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

Transition T2D

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 with minimal soil disturbance/seeding of desired species.

Transition T3A

State 3 to 4

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

Transition T3B

State 3 to 5

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

Transition T3C

State 3 to 6

Trigger: Time and a lack of disturbance or management action allows for Utah juniper to dominate the site. This may be coupled with grazing management that favors tree establishment by reducing understory herbaceous competition for site resources. Slow variable: Over time the abundance and size of trees will increase resulting in reduced infiltration and increased runoff. Threshold: Trees dominate ecological processes and number of shrub skeletons exceed number of live shrubs.

Restoration pathway R4A

State 4 to 2

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

Restoration pathway R6A

State 6 to 2

This site could be restored with tree removal and seeding or recovery of herbaceous understory. Restoration efforts may result in smooth brome or intermediate wheatgrass after fire. This is most likely to succeed in community phase 6.1.

Transition T6B

State 6 to 3

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

Transition T6A

State 6 to 5

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

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	Primary Perennial Grasses			441–819	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	360–540	–
	bluebunch wheatgrass	PSSPS	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	45–135	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	18–72	–
2	Secondary Perennial Grasses			45–135	
	Nevada needlegrass	ACNE10	<i>Achnatherum nevadense</i>	5–27	–
	western needlegrass	ACOC3	<i>Achnatherum occidentale</i>	5–27	–
	Thurber's needlegrass	ACTH7	<i>Achnatherum thurberianum</i>	5–27	–
	Webber needlegrass	ACWE3	<i>Achnatherum webberi</i>	5–27	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	5–27	–
	Cusick's bluegrass	POCU3	<i>Poa cusickii</i>	5–27	–
Forb					
3	Perennial			18–90	
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	2–27	–
	tapertip hawksbeard	CRAC2	<i>Crepis acuminata</i>	2–27	–
	fleabane	ERIGE2	<i>Erigeron</i>	2–27	–
	pricklyphlox	LEPTO2	<i>Leptodactylon</i>	2–27	–
	western stoneseed	LIRU4	<i>Lithospermum ruderales</i>	2–27	–
	desertparsley	LOMAT	<i>Lomatium</i>	2–27	–
	lupine	LUPIN	<i>Lupinus</i>	2–27	–
	phlox	PHLOX	<i>Phlox</i>	2–27	–
	ragwort	SENEC	<i>Senecio</i>	2–27	–
Shrub/Vine					
4	Primary Shrubs			90–180	
	basin big sagebrush	ARTRT	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	90–180	–
5	Secondary Shrubs			18–72	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	5–27	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	5–27	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	5–27	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	5–27	–

Animal community

Livestock Interpretations:

This site is suited for livestock grazing. Grazing management should be keyed to Idaho fescue and other perennial grass production. Considerations for grazing management include timing, intensity and duration of grazing.

Overgrazing leads to an increase in sagebrush and a decline in understory plants like bluebunch wheatgrass and Idaho fescue. Squirrealtail 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 squirrealtail 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. Wildlife in sites with cheatgrass present could transition to cheatgrass-dominated communities, and without management, cheatgrass and annual forbs are likely

to dominate.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often dominates (Daubenmire 1970). Thus, depending on the season of use, the grazer and site conditions, either Sandberg bluegrass or cheatgrass may become the dominant understory with inappropriate grazing management.

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

Nevada bluegrass is very palatable and is preferred by both domestic livestock and wildlife during the spring and early summer, with reported crude protein levels of over 17% (Monson et al. 2004). In today's botanical climate, Nevada bluegrass and Sandberg bluegrass are no longer differentiated taxonomically, however the grasses typically grow in different ecological niches; Nevada bluegrass prefers locations with greater soil moisture during the growing season. Nevada bluegrass exhibits the characteristic of early spring growth, however in locations with sufficient soil moisture the growing season may be extended allowing the plant to increase in stature. Depending on soil moisture availability along with intensity, frequency and season of use, Nevada bluegrass may decrease under grazing pressure. Conversely, Sandberg bluegrass has been found to increase under grazing pressure due to its early dormancy and short stature (Tisdale and Hironaka 1981).

Antelope bitterbrush is an important shrub species to domestic livestock (Wood 1995). It is most commonly found on soils which provide minimal restriction to deep root penetration such as coarse textured soil, or finer textured soil with high stone content (Driscoll 1964, Clements and Young 2002). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953).

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

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

The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important for cattle and is readily grazed by both cattle and horses in the early spring and fall. Though coarse-textured during the winter, it may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses.

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:

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

Basin big sagebrush is the least palatable of all the subspecies of big sagebrush. Basin big sagebrush is browsed by mule deer from fall to early spring, but is not preferred.

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.

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, and because it remains green throughout early summer, it remains available for other small mammal forage for longer time than other grasses. It is intolerant of heavy, repeated, or spring grazing (Krall et al. 1971).

Hydrological functions

Rills are typically non-existent. Water flow patterns are typically non-existent. Water flow patterns may rarely be observed on steeper slopes in areas recently subjected to summer convection storms or rapid spring snowmelt, usually on steeper slopes. Pedestals are rare. Frost heaving of shallow rooted plants should not be considered a "normal" condition. Fine litter (foliage from grasses and annual and perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during catastrophic events. Perennial herbaceous plants (especially deep-rooted bunchgrasses) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

Recreational uses

Aesthetic value is derived from the colorful flowering of numerous forbs in the spring. Diverse floral and faunal populations offer rewarding opportunities for nature study and photography. This site has potential for deer and upland game hunting.

Wood products

None

Other products

Some Native American peoples used the bark of big sagebrush to make rope and baskets. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Basin big sagebrush shows high potential for range restoration and soil stabilization. Basin big sagebrush grows rapidly and spreads readily from seed. Basin wildrye is useful in mine reclamation, fire rehabilitation and stabilizing disturbed areas. Its usefulness in range seeding, however, may be limited by initially weak stand establishment.

Inventory data references

NRCS-RANGE-417 - 18 records

NV-ESC-1 - 6 records

NV-4400-13 (BLM) - 2 records

Soils and Physiographic features were gathered from NASIS.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T35N R54E S10
General legal description	Approximately 12 miles north of Elko, off the west site of Mountain City Highway (NvHwy 11), Elko County, Nevada. This site also occurs in Humboldt County, Nevada.

Other references

Akinsoji, A. 1988. Postfire vegetation dynamics in a sagebrush steppe in southeastern Idaho, USA. *Vegetatio* 78:151-155.

- Anderson, E. W. and R. J. Scherzinger. 1975. Improving quality of winter forage for elk by cattle grazing. *Journal of Range Management* 28:120-125.
- Barrington, M., S. Bunting, and G. Wright. 1988. A Fire Management Plan for Craters of the Moon National Monument. Cooperative Agreement CA-9000-8-0005. Moscow, ID: University of Idaho, Range Resources Department. 52 p. Draft.
- Bates, J. D., T. Svejcar, R. F. Miller, and R. A. Angell. 2006. The effects of precipitation timing on sagebrush steppe vegetation. *Journal of Arid Environments* 64: 670-697.
- Bentz, B., D. Alston, and T. Evans. 2008. Great Basin insect outbreaks. In: J. Chambers, N. Devoe, A. Evenden [eds]. Collaborative management and research in the Great Basin -- Examining the issues and developing a framework for action. Gen. Tech. Rep. RMRS-GTR-204. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO. p. 45-48.
- Blaisdell, J. P. 1953. Ecological effects of planned burning of sagebrush-grass range on the Upper Snake River Plains. US Dept. of Agriculture.
- Blaisdell, J. P. and W. F. Mueggler. 1956. Sprouting of bitterbrush (*Purshia tridentata*) following burning or top removal. *Ecology* 37: 365-370.
- Blaisdell, J. P., R. B. Murray, and E. D. McArthur. 1982. Managing intermountain rangelands - sagebrush-grass ranges. USDA Forest Serv. Intermountain Forest and Range Exp. Sta. Gen. Tech. Rep. INT-134.
- Blaisdell, J. P. and J. F. Pechanec. 1949. Effects of herbage removal at various dates on vigor of bluebunch wheatgrass and arrowleaf balsamroot. *Ecology* 30: 298-305.
- Bradley, A. F. 1984. Rhizome morphology, soil distribution, and the potential fire survival of eight woody understory species in western Montana. University of Montana.
- Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. *Great Basin Naturalist* 50:1 15-120.
- Bunting, S. C., B. M. Kilgore, and C. L. Bushey. 1987. Guidelines for prescribed burning sagebrush-grass rangelands in the northern Great Basin. US Department of Agriculture, Forest Service, Intermountain Research Station Ogden, UT, USA.
- Burkhardt, J. W. and E. Tisdale. 1969. Nature and successional status of western Juniper vegetation in Idaho. *Journal of Range Management*:264-270.
- Busse, D., A. Simon, and M. Riegel. 2000. Tree-growth and understory responses to low-severity prescribed burning in thinned *Pinus ponderosa* forests of central Oregon. *Forest Science* 46: 258-268.
- Caudle, D., J. DiBenedetto, M. Karl, H. Sanchez, and C. Talbot. 2013. Interagency Ecological Site Handbook for Rangelands. Available at: <http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf>. Accessed 4 October 2013.
- Chambers, J., B. Bradley, C. Brown, C. D'Antonio, M. Germino, J. Grace, S. Hardegree, R. Miller, and D. Pyke. 2013. Resilience to stress and disturbance, and resistance to *Bromus tectorum* L. invasion in cold desert shrublands of western North America. *Ecosystems* 17: 1-16.
- Chambers, J. C., B. A. Roundy, R. R. Blank, S. E. Meyer, and A. Whittaker. 2007. What makes Great Basin sagebrush ecosystems invisable by *Bromus tectorum*? *Ecological Monographs* 77:117-145.
- Clark, R. G., M. B. Carlton, and F. A. Sneva. 1982. Mortality of bitterbrush after burning and clipping in eastern Oregon. *Journal of Range Management* 35: 711-714.

Clements, C. D. and J. A. Young. 2002. Restoring antelope bitterbrush. *Rangelands* 24: 3-6.

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

Conrad, C. E. and C. E. Poulton. 1966. Effect of a wildfire on Idaho fescue and bluebunch wheatgrass. *Journal of Range Management* 19:138-141.

Cook, J. G., T. J. Hershey, and L. L. Irwin. 1994. Vegetative response to burning on Wyoming mountain-shrub big game ranges. *Journal of Range Management* 47: 296-302.

Daubenmire, R. 1970. *Steppe vegetation of Washington*. 131 pp.

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

Driscoll, R. S. 1964. A relict area in the central Oregon juniper zone. *Ecology* 45:345-353.

Dobrowolski, J. P., M. M. Caldwell, and J. H. Richards. 1990. Basin hydrology and plant root systems. In: C. B. Osmand, L. F. Pitelka, G. M. Hildy [eds]. *Plant biology of the basin and range*. *Ecological Studies*. 80: 243-292.

Eckert Jr, R. E. and J. S. Spencer. 1986. Vegetation response of allotments grazed under rest-rotation management. *Journal of Range Management*: 166-174.

Eckert, R. E., Jr. and J. S. Spencer. 1987. Growth and reproduction of grasses heavily grazed under rest-rotation management. *Journal of Range Management* 40:156-159.

Fire Effects Information System [Online]. <http://www.fs.fed.us/database/feis>.

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

Gaffney, W. S. 1941. The effects of winter elk browsing, South Fork of the Flathead River, Montana. *The Journal of Wildlife Management* 5:427-453.

Ganskopp, D., L. Aguilera, and M. Vavra. 2007. Livestock Forage Conditioning Among Six Northern Great Basin Grasses. *Rangeland Ecology & Management* 60: 71-78.

Garrison, G. A. 1953. Effects of clipping on some range shrubs. *Journal of Range Management* 6:309-317.

Houghton, J.G., C.M. Sakamoto, and R.O. Gifford. 1975. Nevada's weather and climate, special publication 2. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, NV.

Houston, D. B. 1973. Wildfires in northern Yellowstone National Park. *Ecology* 54:1111-1117.

Johnson, C. G., R. R. Clausnitzer, P. J. Mehringer, and C. Oilver. 1994. Biotic and abiotic processes of eastside ecosystems: The effects of management on plant and community ecology, and on stand and landscape vegetation dynamics. Forest Service General Technical Report. Forest Service, Portland, OR (United States). Pacific Northwest Research Station.

Kasworm, W. F., L. R. Irby, and H. B. I. Pac. 1984. Diets of ungulates using winter ranges in northcentral Montana. *Journal of Range Management* 37:67-71.

Kerns, B. K., W. G. Thies, and C. G. Niwa. 2006. Season and severity of prescribed burn in ponderosa pine forests: Implications for understory native and exotic plants. *Ecoscience* 13:44-55.

Krall, J. L., J. R. Stroh, C. S. Cooper, and S. R. Chapman. 1971. Effect of time and extent of harvesting basin

wildrye. Journal of Range Management 24: 414-418.

Kuntz, D. E. 1982. Plant response following spring burning Plant in an *Artemisia tridentata* subsp. vaseyana/Festuca Idahoensis habitat type. University of Idaho.

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

Leege, T. A. and W. O. Hickey. 1971. Sprouting of northern Idaho shrubs after prescribed burning. The Journal of Wildlife Management: 508-515.

Majerus, M. E. 1992. High-stature grasses for winter grazing. Journal of Soil and Water Conservation 47: 224-225.

McArthur, E. D., A. Blaner, A. P. Plummer, and R. Stevens. 1982. Characteristics and hybridization of important intermountain shrubs: 3. sunflower family. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. Research Paper INT-177 43.

McConnell, B. R. 1961. Notes on some rooting characteristics of antelope bitterbrush. PNW Old Series Research Note No. 204:1-5.

McConnell, B. R. and J. G. Smith. 1977. Influence of grazing on age-yield interactions in bitterbrush. Journal of Range Management 30: 91-93.

Merrill, E. H., H. Mayland, and J. Peek. 1982. Shrub responses after fire in an Idaho ponderosa pine community. The Journal of Wildlife Management 46: 496-502.

Miller, R. F. and E. K. Heyerdahl. 2008. Fine-scale variation of historical fire regimes in sagebrush-steppe and juniper woodland: An example from California, USA. International Journal of Wildland Fire 17:245-254.

Miller, R. F. R. J. T. 2000. The role of fire in juniper and pinyon woodlands: A descriptive analysis. Pages p. 15-30 in Proceedings of the Invasive Species Workshop: The Role of Fire in the Control and Spread of Invasive Species. Tallahassee, Florida.

Miller, R. F. C., Jeanne C.; Pyke, David A.; Pierson, Fred B.; Williams, C. Jason 2013. A review of fire effects on vegetation and soils in the Great Basin region: Response and ecological site characteristics. Gen. Tech. Rep. RMRS-GTR-308. Fort Collins CO: U.S. Department of Agriculture, United State Forest Service, Rocky Mountain Research Station. p. 126.

Mueggler, W. F. and J. P. Blaisdell. 1951. Replacing wyethia with desireable forage species. Journal of Range Management 4:143-150.

Murray, R. 1983. Response of antelope bitterbrush to burning and spraying in southeastern Idaho. Tiedemann, Arthur R.; Johnson, Kendall L., compilers. Research and management of bitterbrush and cliffrose in western North America. General Technical Report INT-152. Ogden, UT: US Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 142-152.

National Oceanic and Atmospheric Administration. 2004. The North American Monsoon. Reports to the Nation. Weather Service, Climate Prediction Center. Available online: <http://www.weather.gov/>

Neuenschwander, L. 1980. Broadcast burtning of sagebrush in the winter. Journal of Range Management: 233-236.

Noste, N. V. and C. L. Bushey. 1987. Fire response of shrubs of dry forest habitat types in Montana and Idaho. General technical report INT.

Noy-Meir, I. 1973. Desert ecosystems: Environment and producers. Annual Review of ecology and systematics. Vol. 4:25-51.

Personius, T.L., C. L. Wambolt, J. R. Stephens and R. G. Kelsey. 1987. Crude terpenoid influence on mule deer

preference for sagebrush. *Journal of Range Management*, 40:1 p. 84-88.

NRCS Plants Database. (<http://plants.usda.gov/>)

Richards, J. H. and M. M. Caldwell. 1987. Hydraulic lift: Substantial nocturnal water transport between soil layers by *Artemisia tridentata* roots. *Oecologia* 73: 486-489.

Robberecht, R. and G. Defossé. 1995. The relative sensitivity of two bunchgrass species to fire. *International Journal of Wildland Fire* 5:127-134.

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

Smith, J. K. and W. C. Fischer. 1997. Fire ecology of the forest habitat types of northern Idaho. US Department of Agriculture, Forest Service, Intermountain Research Station.

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

Uresk, D. W., J. F. Cline, and W. H. Rickard. 1976. Impact of wildfire on three perennial grasses in south-central Washington. *Journal of Range Management* 29: 309-310.

Whisenant, S. G. 1990. Changing fire frequencies on Idaho's Snake River Plains: Ecological and management implications. Pages 4-10 in Symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management. General Technical Report, Intermountain Research Station, USDA Forest Service.

Wood, M. K., Bruce A. Buchanan, & William Skeet. 1995. Shrub preference and utilization by big game on New Mexico reclaimed mine land. *Journal of Range Management* 48: 431-437.

Wright, H. A. 1971. Why squirreltail is more tolerant to burning than needle-and-thread. *Journal of Range Management* 24: 277-284.

Wright, H. A. 1985. Effects of fire on grasses and forbs in sagebrush-grass communities. Pages 12-21 in *Rangeland Fire Effects; A Symposium*: Boise, ID, USDI-BLM.

Wright, H.A., L.F. Neuenschwander, and C.M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: a state-of-the-art review. Gen. Tech. Rep. INT-58. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 48 p.

Young, R.P. 1983. Fire as a vegetation management tool in rangelands of the intermountain region. In: Monsen, S.B. and N. Shaw (eds). *Managing intermountain rangelands - improvement of range and wildlife habitats: Proceedings of symposia*; 1981 September 15-17; Twin Falls, ID; 1982 June 22-24; Elko, NV. Gen. Tech. Rep. INT-157. Ogden, UT. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. Pgs 18-31.

Ziegenhagen, L. L. 2003. Shrub reestablishment following fire in the mountain big sagebrush (*Artemisia tridentata* Nutt. ssp. *vaseyana* (Rydb.) Beetle) alliance. M.S. Oregon State University.

Ziegenhagen, L. L. and R. F. Miller. 2009. Postfire recovery of two shrubs in the interiors of large burns in the intermountain west, USA. *Western North American Naturalist* 69:195-205.

Zschaechner, G. A. 1985. Studying rangeland fire effects: A case study in Nevada. Pages 66-84 in *Rangeland Fire Effects, a Symposium*. Bureau of Land Management, Boise, Idaho.

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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)	GK BRACKLEY
Contact for lead author	State Rangeland Management Specialist
Date	06/22/2006
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are typically non-existent.

2. **Presence of water flow patterns:** Water flow patterns are typically non-existent. Water flow patterns may rarely be observed on steeper slopes in areas recently subjected to summer convection storms or rapid spring snowmelt, usually on steeper slopes

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 20-30% depending on amount of surface rock fragments

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

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

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

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. (To be field tested.)
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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically thin to thick platy. Soil surface colors are grayish browns and soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1.25 to 3 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.
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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Idaho fescue & bluebunch wheatgrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.
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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Subsoil argillic horizons are not to be interpreted as compacted.
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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**
- Dominant: Deep-rooted, cool season, perennial bunchgrasses>>tall shrubs (basin big sagebrush)
- Sub-dominant: deep-rooted, cool season, perennial forbs> associated shrubs>shallow-rooted, cool season, perennial grasses =fibrous, shallow-rooted, cool season, perennial and annual forbs
- Other:
- Additional:
-
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers
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14. **Average percent litter cover (%) and depth (in):** Reference Plant Community: Under and between plant interspaces (20-40%) and litter depth is < ½ inch
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through mid-June) ± 1000 lbs/ac; Spring moisture significantly affects total production
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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize**

degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is **NOT** expected in the reference state for the ecological site: Invaders include cheatgrass, snakeweed, Russian thistle and annual mustards

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years
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