Ecological site R025XY024NV
MOUNTAIN RIDGE

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General information

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

MLRA notes

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

MLRA Notes 25—Owyhee High Plateau
This area is in Nevada (56 percent), Idaho (30 percent), Oregon (12 percent), and Utah (2 percent). It makes up about 27,443 square miles. MLRA 25 is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. The western boundary is marked by a gradual transition to the lower and warmer basins of MLRA 24. The boundary to the south-southeast, with MLRA 28B, is marked by gradual changes in geology marked by an increased dominance of singleleaf pinyon and Utah juniper and a reduced presence of Idaho fescue. The boundary to the north, with MLRA 11, is a rapid transition from the lava plateau topography to the lower elevation Snake River Plain.
Physiography:
All of this area lies within the Intermontane Plateaus. The southern half is in the Great Basin section of the Basin and Range province. This part of the MLRA is characterized by isolated, uplifted fault-block mountain ranges separated by narrow, aggraded desert plains. This geologically older terrain has been dissected by numerous streams draining to the Humboldt River.
The northern half of the area lies within the Columbia Plateaus province. This part of the MLRA forms the southern boundary of the extensive Columbia Plateau basalt flows. Most of the northern half is in the Payette section, but the northeast corner is in the Snake River Plain section. Deep, narrow canyons draining into the Snake River have been incised into this broad basalt plain. Elevation ranges from 3,000 to 7,550 feet on rolling plateaus and in gently sloping basins. It is more than 9,840 feet on some steep mountains. The Humboldt River crosses the southern half of this area
Geology:
The dominant rock types in this MLRA are volcanic. They include andesite, basalt, tuff, and rhyolite. In the north and west parts of the area, Cretaceous granitic rocks are exposed among Miocene volcanic rocks in mountains. A Mesozoic igneous and metamorphic rock complex dominates the south and east parts of the area. Upper and Lower Paleozoic calcareous sediments, including oceanic deposits, are exposed with limited extent in the mountains. Alluvial fan and basin fill sediments occur in the valleys.
Climate:
The average annual precipitation in most of this area is typically 11 to 22 inches. It increases to as much as 49 inches at the higher elevations. Rainfall occurs in spring and sporadically in summer. Precipitation occurs mainly as snow in winter. The precipitation is distributed fairly evenly throughout fall, winter, and spring. The amount of precipitation is lowest from midsummer to early autumn. The average annual temperature is 33 to 51 degrees F. The freeze-free period averages 130 days and ranges from 65 to 190 days, decreasing in length with elevation. It is typically less than 70 days in the mountains.
Water:
The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow in the mountains. Surface water from mountain runoff is generally of excellent quality and suitable for all uses. The basin fill sediments in the narrow alluvial valleys between the mountain ranges provide some ground water for irrigation. The alluvial deposits along the large streams have the most ground water. Based on measurements of water quality in similar deposits in

adjacent areas, the basin fill deposits probably contain moderately hard water. The water is suitable for almost all uses. The carbonate rocks in this area are considered aquifers, but they are little used. Springs are common along the edges of the limestone outcrops.
Soils:
The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic or frigid temperature regime and an aridic, aridic bordering on xeric, or xeric moisture regime. Soils with aquic moisture regimes are limited to drainage or spring areas, where moisture originates or runs on and through. These soils are of a very limited extent throughout the MLRA. They generally are well drained, clayey or loamy, and shallow or moderately deep. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam with ashy texture modifiers in some areas. Argillic horizons occur on the more stable landforms. They are exposed nearer the soil surface on convex landforms, where ash and loess deposits are more likely to erode. Soils that formed in carbonatic parent material in areas that receive less than 12 inches of precipitation are characterized by calcic horizons throughout the profile, while soils in areas that receive more than 12 inches of precipitation do not have calcic horizons in the upper part of the profile. Soils that formed on stable landforms at the lower elevations are dominated by ochric horizons. Soils that formed at the middle and upper elevations are characterized by mollic epipedons. Soils in drainage areas at all elevations that receive moisture running on or through them are characterized by thicker mollic epipedons.
Biological Resources:
This MLRA supports shrub-grass vegetation. Lower elevations are characterized by Wyoming big sagebrush associated with bluebunch wheatgrass, western wheatgrass, and Thurber’s needlegrass. Other important plants include bluegrass, squirreltail, penstemon, phlox, milkvetch, lupine, Indian paintbrush, aster, and rabbitbrush. Black sagebrush occurs but is less extensive. Singleleaf pinyon and Utah juniper occur in limited areas. With increasing elevation and precipitation, vast areas characterized by mountain big sagebrush or low sagebrush/early sagebrush in association with Idaho fescue, bluebunch wheatgrass, needlegrasses, and bluegrass become common. Snowberry, curl-leaf mountain mahogany, ceanothus, and juniper also occur. Mountains at the highest elevations support whitebark pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, aspen, and curl-leaf mountain mahogany.
Major wildlife species include mule deer, bighorn sheep, pronghorn, mountain lion, coyote, bobcat, badger, river otter, mink, weasel, golden eagle, red-tailed hawk, ferruginous hawk, Swainson’s hawk, northern harrier, prairie falcon, kestrel, great horned owl, short-eared owl, long-eared owl, burrowing owl, pheasant, sage grouse, chukar, gray partridge, and California quail. Reptiles and amphibians include western racer, gopher snake, western rattlesnake, side-blotched lizard, western toad, and spotted frog. Fish species include bull, red band, and rainbow trout.

Ecological site concept

This site is on summits, crests and shoulders of mountains. Slopes range from 4 to 75 percent, but slope gradients of 4 to 15 percent are most typical. Elevations are 7,000 to over 9,500 feet (2,134 to 2,896 meters).

The soils on this site have mostly shallow to very shallow effective rooting depths. Intense winds over this site inhibit snow accumulation and thus lower the effective precipitation. These soils have high percentages of gravels, cobbles, rock or stones on the surface which protect the soil from excessive erosion.

The representative state is dominated by Idaho fescue, low sagebrush and/or black sagebrush. Black sagebrush cover typically dominates the ridge tops while low sagebrush cover is typically more prominent on slopes off the ridges. In some instances, the dwarf species of sagebrush are intermingled with severely stunted big sagebrush. Potential vegetative composition is about 50 percent grasses, 15 percent forbs and 35 percent shrubs. Approximate ground cover (basal and crown) is 15 to 25 percent. Bare ground cover is approximately 20 percent. Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 15 percent of total woody canopy; some of the mature bunchgrasses (more than 10 percent) have dead centers. Litter cover (approximately 10 percent) is within plant interspaces at a depth of approximately 1/4 inch (0.64cm).

Associated sites

R025XY004NV	**LOAMY SLOPE 16+ P.Z.**
R025XY010NV	**STEEP NORTH SLOPE**
R025XY016NV	**SOUTH SLOPE 14-18 P.Z.**

R025XY017NV	**CLAYPAN 12-16 P.Z.**

Similar sites

R025XY051NV	**ERODED CLAYPAN 12-16 P.Z.** PSSPS-FEID codominant; ARAR8 dominant shrub
R025XY022NV	**COBBLY CLAYPAN 8-12 P.Z.** PSSPS-ACTH7 codominant grasses; ARNO4 absent; ARAR8 dominant shrub
R025XY055NV	**SHALLOW CLAY SLOPE 10-14 P.Z.** PSSPS dominant grass; more productive site
R025XY032NV	**CLAYPAN 16+ P.Z.** More productive site; FEID dominant grass; ARNO4 absent; ARAR8 dominant shrub
R025XY057NV	**SHALLOW CLAY LOAM 10-14 P.Z.** PSSPS-ACTH7 codominant grasses; ARNO4 dominant shrub; ARAR8 rarely occurs
R025XY017NV	**CLAYPAN 12-16 P.Z.** More productive site; ARAR8 dominant shrub; ARNO4 absent
R025XY018NV	**CLAYPAN 10-12 P.Z.**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula* (2) *Artemisia nova*
Herbaceous	(1) *Festuca idahoensis* (2) *Poa*

Physiographic features

This site is on summits, crests and shoulders of mountains. Slopes range from 4 to 75 percent, but slope gradients of 4 to 15 percent are most typical. Elevations are 7,000 to over 9,500 feet (2,134 to 2,896 meters).

Table 2. Representative physiographic features

Landforms	(1) Mountains > Ridge (2) Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,134–2,896 m
Slope	4–75%
Water table depth	183 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. Mean annual air temperature is typically more than 45 degrees F.

Mean annual precipitation across the range of this ecological site is 15 inches (38 cm).

Monthly mean precipitation in inches: January 1.65 (4.2 cm); February 1.68 (4.3 cm); March 1.98 (5.0 cm); April 2.43 (6.2 cm); May 2.41 (6.1 cm); June 1.62 (4.1 cm); July 0.61 (1.5 cm); August 0.63 (1.6 cm); September 0.84 (2.1 cm); October 1.41 (3.6 cm); November 1.51 (3.8 cm); December 1.79 (4.5 cm).

*The above data is averaged from the Jarbridge 4N and Lamoille PH WRCC climate stations, National Soil Information System (NASIS) and, Western Regional Climate Center.

Table 3. Representative climatic features

Frost-free period (characteristic range)	50-90 days
Freeze-free period (characteristic range)	60-93 days
Precipitation total (characteristic range)	356-406 mm
Frost-free period (actual range)	50-90 days
Freeze-free period (actual range)	60-94 days
Precipitation total (actual range)	279-584 mm
Frost-free period (average)	60 days
Freeze-free period (average)	70 days
Precipitation total (average)	381 mm

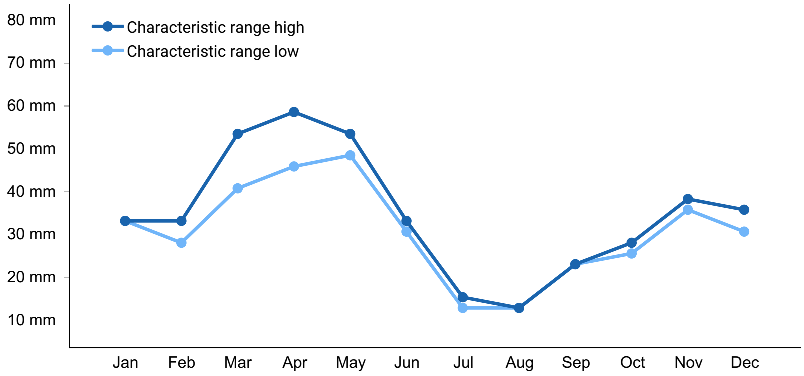

Figure 1. Monthly precipitation range

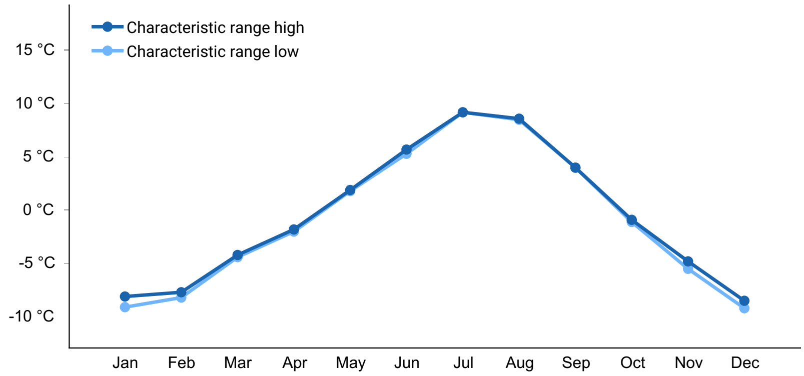

Figure 2. Monthly minimum temperature range

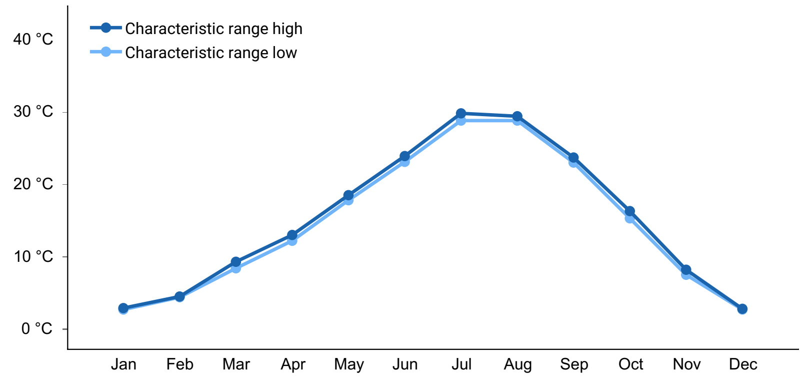

Figure 3. Monthly maximum temperature range

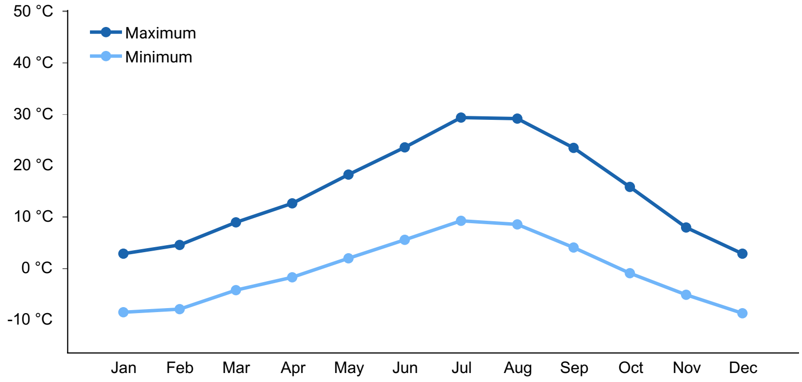

Figure 4. Monthly average minimum and maximum temperature

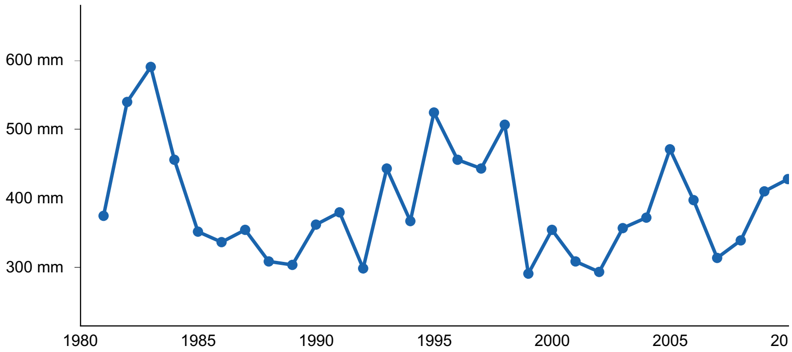

Figure 5. Annual precipitation pattern

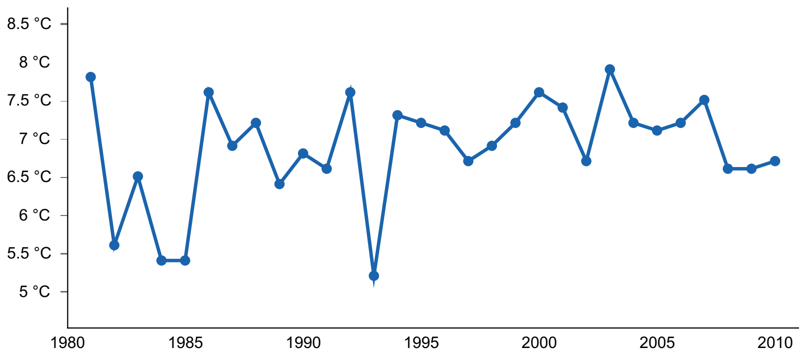

Figure 6. Annual average temperature pattern

Climate stations used

- (1) JARBIDGE 7 N [USC00264039], Jackpot, NV
- (2) LAMOILLE YOST [USC00264394], Spring Creek, NV

Influencing water features

No influencing water features are associated with this site.

Soil features

The soils on this site typically have shallow to very shallow effective rooting depths. Intense winds over this site inhibit snow accumulation and thus lower the effective precipitation. These soils have high percentages of gravels, cobbles, or stones on the surface which protect the soil from excessive erosion.
The available water capacity is low. The surface cover of rock fragments helps to reduce evaporation and conserve soil moisture. Runoff is medium to very high. Potential for sheet and rill erosion is moderate to high depending on the slope. Soil stability values are typically 3 to 6 on most soil textures found on this site.

The soil series associated with this site are Adobe, Bregar, Cleavage, Decram, Gando, Halacan, Highams Variant, Hiridge, Layview, Packer, Scalfar and Xica.

A representative soil series is Cleavage, classified as a loamy-skeletal, mixed, superactive, frigid Aridic Lithic Argixeroll. This soil is a shallow, well-drained soil that formed in residuum or colluvium derived from rhyolite, welded tuff, chert, shale, quartzite, sandstone or conglomerate and other igneous or sedimentary rocks. Reaction ranges from neutral through slightly alkaline. Diagnostic horizons include a mollic epipedon from the soil surface to 9 inches (23cm) (and an argillic horizon that occurs from 9 to 18 inches (23 to 46cm)). Clay content percentages in the particle-size control section are typically 20 to 35 percent. Rock fragments range from 50 to 80 percent, mostly gravel or cobbles.

Table 4. Representative soil features

Parent material	(1) Colluvium–welded tuff (2) Colluvium–sandstone (3) Residuum–welded tuff
Surface texture	(1) Very gravelly loam (2) Gravelly loam (3) Very gravelly sandy loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	13–46 cm
Soil depth	13–46 cm
Surface fragment cover <=3"	15–85%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	2.54–7.11 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	7–7.6
Subsurface fragment volume <=3" (Depth not specified)	5–40%
Subsurface fragment volume >3" (Depth not specified)	0–50%

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 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. Community types with low sagebrush as the dominant shrub, however, were found to have soil depths and thus available rooting depths of 71 to 81 centimeters in a study in northeast Nevada (Jensen 1990). 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).

Black sagebrush is generally long-lived therefore deeming it 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 on adequate moisture conditions.

Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks, especially with regard to sagebrush defoliator Aroga moth (Aroga websteri). Aroga moth infestations have occurred throughout the Great Basin in the 1960s, early 1970s, and has 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 (Gates 1964, Hall 1965); the research is inconclusive regarding the damage sustained by black sagebrush populations.

Low sagebrush is fairly drought tolerant but also tolerates periodic wetness during a portion of the growing season. Low sagebrush is also susceptible to Aroga moth, which can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975), though the research is inconclusive of the damage sustained by low sagebrush populations.

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

As ecological condition delines, the dwarf sagebrushes and small rabbitbrush become dominant with increases of Sandberg's bluegrass, phlox and other mat forming forbs in the understory. The potential invasive/noxious weeds are cheatgrass, rabbitbrush and snakeweed.

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

Fire Ecology:
Prior to 1897, mean fire return intervals for low sagebrush communities have been estimated to be from 35 to over 100 years. Fire most often occurs during wet years with high forage production. Fire return intervals have recently been estimated at 100-200 years in black sagebrush-dominated sites (Kitchen and McArthur 2007) and likely is similar in the low sagebrush ecosystem. Historically, however, fires were probably patchy due to the low productivity of these sites. Fine fuel loads generally average 100 to 400 pounds per acre (110- 450 kg/ha) but are occasionally as high as 600 pounds per acre (680 kg/ha) in low sagebrush habitat types (Bradley et al. 1992).

Black sagebrush is highly susceptible to fire-caused mortality as plants are readily killed by all fire intensities. Following burning, reestablishment occurs through off-site sources.

Low sagebrush is killed by fire and does not sprout (Tisdale and Hironaka 1984). Establishment after fire is from seed, generally blown in and not from the seed bank (Bradley et al. 1992). Fire risk is greatest following a wet, productive year when there is greater production of fine fuels (Beardall and Sylvester 1976). Recovery time of low sagebrush following fire is variable (Young 1983). After fire, if regeneration conditions are favorable, low sagebrush recovers in 2 to 5 years; on harsh sites where cover is low to begin with and/or erosion occurs after fire, recovery may require more than 10 years (Young 1983). Slow regeneration may subsequently worsen erosion (Blaisdell et al. 1982).

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. The growing points for most forbs and grasses 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). However, season and severity of the fire and post-fire soil moisture availability will influence plant response.

Idaho fescue grows in a dense, fine-leaved tuft. Fires tend to burn within the accumulated fine leaves at the base of the plant and may produce temperatures sufficient to kill some of the root crown. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons.

Bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur. Sandberg bluegrass has been found to increase following fire, likely due to its low stature and productivity (Daubenmire 1975) and may retard reestablishment of deeper rooted bunchgrasses.

Bluebunch wheatgrass, a minor component of this ecological site, has coarse stems with little leafy material, 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 it experiences slight damage to fire but is more susceptible in drought years (Young 1983).

Webber’s needlegrass, a minor component on this site, is damaged by burning due to dense plant material that can burn slowly and long, resulting in charring to the growing points. Late summer and early fall fires have been shown to be the least harmful to Webber’s needlegrass.

State and transition model

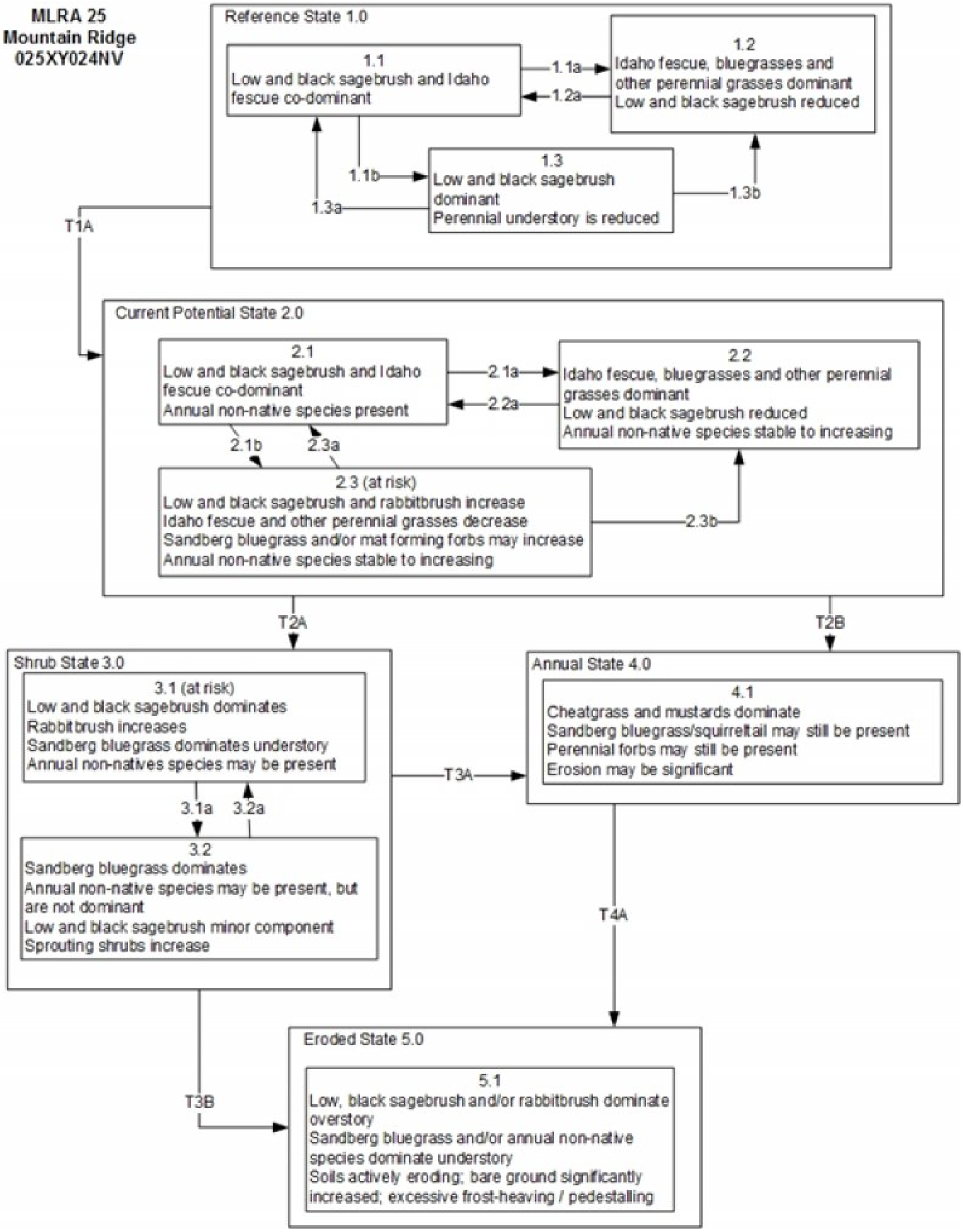

Figure 7. T. Stringham July 2015

MLRA 25
Mountain Ridge
025XY024NV

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community, dominated by grasses and forbs.
1.1b: Time and lack of disturbance such as fire or drought. Excessive herbivory and/or long-term drought may also reduce perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Low severity fire would create sagebrush/grass mosaic.
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 Phase Pathways
2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
2.1b: Time and lack of disturbance. Inappropriate grazing management and/or long-term drought may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.3a: Low severity fire creates sagebrush/grass mosaic, herbivory, or combinations. Brush management with minimal soil disturbance reduces sagebrush.
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community. Brush management with minimal soil disturbance reduces sagebrush.

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

Shrub State 3.0 Community Phase Pathways
3.1a: Low severity fire
3.2a: Time and lack of disturbance

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community
Transition T3B: Inappropriate grazing management following fire and/or multiple fires and/or prolonged drought. Additional soil disturbing treatments (ex: failed drill seeding) could also increase erosion.

Annual State 4.0

Transition T4A: Inappropriate grazing management following fire and/or multiple fires and/or long-term drought. Additional soil disturbing treatments (ex: seedings that fail) could also increase erosion.

Eroded State 5.0 Community Phase Pathways
5.1a: Inappropriate grazing management and/or impact of off road vehicles or other ground disturbing activity leads to further plant community reduction and increased bareground.

Figure 8. T. Stringham July 2015

State 1
Reference State

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

Community 1.1
Community Phase

Figure 9. Mountain Ridge (R025XY024NV) Phase 1.1 T. K. Stringham, August 2011

The representative plant community is dominated by Idaho fescue, low sagebrush and/or black sagebrush. Black sagebrush usually dominates the ridge tops while low sagebrush is normally more prominent on slopes off the ridges. In some instances, the dwarf sagebrushes are intermingled with severely stunted big sagebrush. Potential vegetative composition is about 50% grasses, 15% forbs and 35% shrubs. Approximate ground cover (basal and crown) is 15 to 25 percent. Bare ground is approximately 20 percent. Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 15% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers. Litter cover (approximately 10%) occurs within plant interspaces at a depth of approximately 1/4 inch.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	84	155	224
Shrub/Vine	59	108	157
Forb	26	46	67
Total	**169**	**309**	**448**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early/mid-seral community. Idaho fescue, bluegrasses and other perennial bunchgrasses dominate. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush and other sprouting shrubs may be sprouting. Perennial forbs may be a significant component for a number of years following fire.

Community 1.3
Community Phase

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.

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 may be more severe and reduce sagebrush cover to trace amounts.

Pathway 1.1b
Community 1.1 to 1.3

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

Pathway 1.2a
Community 1.2 to 1.1

Time and lack of disturbance will allow sagebrush to increase.

Pathway 1.3a
Community 1.3 to 1.1

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

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 may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community.

State 2
Current Potential State

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. These non-native species can be highly flammable, and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Community Phase

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. Low and black sagebrush and Idaho fescue dominate the site. Forbs and other shrubs and grasses make up smaller components of this site.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early to mid-seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush may be sprouting or dominant in the community. Perennial forbs may be a significant component for a number of years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase (at risk)

This community is at risk of crossing a threshold to another state. Sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Sandberg bluegrass may increase and become co-dominate with deep rooted bunchgrasses. Annual non-natives species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway 2.1a
Community 2.1 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. Annual non-native species are likely to increase after fire.

Pathway 2.1b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Long-term drought reduces fine fuels and leads to a reduced fire frequency, allowing big sagebrush to dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory depending on grazing management.

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 low sagebrush can take many years.

Pathway 2.3a
Community 2.3 to 2.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. A low severity fire would decrease the overstory of sagebrush and low for the understory perennial grasses to increase. Due to low fuel loads in this State, fires will likely be small creating a mosaic pattern. Annual non-native species are present and may increase in the community.

Pathway 2.3b
Community 2.3 to 2.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

State 3
Shrub State

This state has two community phases and is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sandberg bluegrass and muttongrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grasses. 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. The shrub overstory and bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 3.1
Community Phase (at risk)

Decadent sagebrush dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Sandberg bluegrass and annual non-native species increase. Bare ground is significant.

Community 3.2
Community Phase

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

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 low sagebrush can take many years.

State 4
Annual State

This state has one community phase. An abiotic threshold has been crossed and state dynamics are driven by fire and time. The herbaceous understory is dominated by annual non-native species such as cheatgrass and mustards. Resiliency has declined and further degradation from fire facilitates a cheatgrass and sprouting shrub plant community. Fire return interval has shortened due to the dominance of cheatgrass in the understory and is a driver in site dynamics.

Community 4.1
Community Phase

Annuals dominate; Sandberg bluegrass and perennial forbs may still be present in trace amounts. Surface erosion may increase with summer convection storms and would be verified through increased pedestalling of plants, rill formation or extensive water flow paths.

State 5
Eroded State

Community 5.1
Community Phase

This community phase is characterized by an increase in soil redistribution or loss of the A horizon. Low and/or black sagebrush and/or rabbitbrush dominate the overstory. Sandberg bluegrass and annual species dominate the understory. Plants are pedestalled. Dead sagebrush skeletons may be prominent. Regeneration of sagebrush and herbaceous species is not evident.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, and bur buttercup. Slow variables: Over time the annual non-native species will increase within the community. 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 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. Annual non-native species will increase. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger: Fire or soil disturbing treatment would transition to Community Phase 4.1. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size and spatial variability of fires.

Transition T3A
State 3 to 4

Trigger: Fire and/or treatments that disturb the soil and existing plant community. Slow variables: Increased seed production (following a wet spring) and cover of annual non-native species. Threshold: Increased, continuous fine fuels modify the fire regime by changing frequency, 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 temporal and spatial aspects of nutrient cycling and distribution.

Transition T3B
State 3 to 5

Trigger: Inappropriate grazing management causing a removal of perennial bunchgrasses and a disruption of the soil surface would increase soil erosion. Soil disturbing treatments such as a chaining or other mechanical tree removal treatment. Slow variable: Bare ground interspaces large and connected; water flow paths long and continuous, understory is sparse, pedestalling of plants significant. Threshold: Soil redistribution and erosion is significant and linked to vegetation mortality evidenced by pedestalling and burying of herbaceous species and / or lack of recruitment in the interspaces.

Transition T4A
State 4 to 5

Trigger: Inappropriate grazing management, multiple fires, cheatgrass dieoff, a prolonged drought, summer convection storms or combinations of disturbances that reduce ground cover .Soil disturbing treatments (ex: range seedings that fail) may promote further soil erosion. Slow variables: Overall reduction in the plant community coupled with increased bare ground and soil erosion. Threshold: Soil erosion is controlling site processes. Surface may be seal after rain events and infiltration rates are greatly reduced. Ponding may be evident. Large connected bare ground patches and evidence of long connected flow paths is common. In some landscape positions wind erosion may be more significant than water erosion.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			31–139	
	Idaho fescue	FEID	*Festuca idahoensis*	16–93	–
	bluegrass	POA	*Poa*	16–46	–
2	**Secondary Perennial Grasses**			16–46	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	1–16	–
	pine needlegrass	ACPI2	*Achnatherum pinetorum*	1–16	–
	Webber needlegrass	ACWE3	*Achnatherum webberi*	1–16	–
	needle and thread	HECO26	*Hesperostipa comata*	1–16	–
	spike fescue	LEKI2	*Leucopoa kingii*	1–16	–
	foxtail wheatgrass	PSSA2	×*Pseudelymus saxicola*	1–16	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	1–16	–
Forb					
3	**Perennial**			22–62	
	goldenweed	PYRRO	*Pyrrocoma*	7–16	–
	ragwort	SENEC	*Senecio*	1–9	–
	mock goldenweed	STENO7	*Stenotus*	1–9	–
	rosy pussytoes	ANROC	*Antennaria rosea ssp. confinis*	1–9	–
	aster	ASTER	*Aster*	1–9	–
	milkvetch	ASTRA	*Astragalus*	1–9	–
	Hooker's balsamroot	BAHO	*Balsamorhiza hookeri*	1–9	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	1–9	–
	fleabane	ERIGE2	*Erigeron*	1–9	–
	buckwheat	ERIOG	*Eriogonum*	1–9	–
	lupine	LUPIN	*Lupinus*	1–9	–
	beardtongue	PENST	*Penstemon*	1–9	–
	phlox	PHLOX	*Phlox*	1–9	–
Shrub/Vine					
4	**Primary Shrubs**			93–108	
	little sagebrush	ARAR8	*Artemisia arbuscula*	47–54	–
	black sagebrush	ARNO4	*Artemisia nova*	46–54	–
5	**Secondary Shrubs**			7–16	
	prairie sagewort	ARFR4	*Artemisia frigida*	1–9	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	1–9	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	1–9	–
	snowberry	SYMPH	*Symphoricarpos*	1–9	–

Animal community

Livestock Interpretations:
Due to the elevations at which this site occurs, livestock utilize it primarily during the summer and fall. This site generally receives limited use by cattle and sheep. It is a low-producing site and due to its normal topographic position is somewhat inaccessible and removed from adequate water. Rock outcrops, cliffs and escarpments may

be advantageously used in pasture fence design. Considerations for grazing management include timing, intensity and duration of grazing.

In general, bunchgrasses best tolerate light grazing after seed formation. Britton et al. (1990) observed the effects of clipping date on basal area of 5 bunchgrasses in eastern Oregon, and found that grazing from August to October (after seed set) has the least impact. Heavy grazing during the growing season will reduce perennial bunchgrasses and increase sagebrush (Laycock 1967). Abusive grazing by cattle or horses will likely increase low sagebrush, rabbitbrush and some forbs such as arrowleaf balsamroot. Annual non-native weedy species such as cheatgrass and mustards, and potentially medusahead, may invade.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces. Bluegrass is a widespread, palatable forage grass that is one of the earliest grasses in the spring and is sought by domestic livestock and several wildlife species. Its production is closely tied to weather conditions; little forage is produced in drought years, making it a less dependable food source than other perennial bunchgrasses. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass or other weedy species. 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.

Idaho fescue provides important forage for many types of domestic livestock. The foliage cures well and is preferred by livestock in late fall and winter. 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 also 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.

Domestic sheep and, to a much lesser degree, cattle consume low sagebrush, particularly during the spring, fall, and winter (Sheehy and Winward 1981). Heavy dormant season grazing by sheep will reduce sagebrush cover and increase grass production (Laycock 1967). Severe trampling damage to supersaturated soils may occur if sites are used in early spring when there is abundant snowmelt. Trampling damage, particularly from cattle or horses, in low sagebrush habitat types is greatest when high clay content soils are wet. In drier areas that contain more gravelly soils, no serious trampling damage occurs, even when the soils are wet (Hironaka et al. 1983).

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:
Pronghorn and deer utilize Idaho fescue in ranges of northern Nevada.

Low sagebrush is considered a valuable browse plant during the spring, fall and winter months. In some areas, it is of little value in winter due to heavy snow, though mule deer utilize and sometimes prefer low sagebrush in winter and early spring.

Black sagebrush is a significant browse species within the Intermountain region. It is especially important on low elevation winter ranges in the southern Great Basin, where extended snow free periods allow animals' access to plants throughout most of the winter. In these areas it is heavily utilized by pronghorn and mule deer. Black sagebrush palatability has been rated as moderate to high depending on the ungulate and the season of use (Horton 1989, Wambolt 1996). The palatability of black sagebrush increases the potential for negative impacts on remaining black sagebrush plants from grazing or browsing pressure following fire (Wambolt 1996). Pronghorn utilize black sagebrush heavily (Beale and Smith 1970). On the Desert Experiment Range, black sagebrush was found to comprise 68% of pronghorn diet even though it was only the third most common plant. Fawns were found to prefer black sagebrush, utilizing it more than all other forage species combined (Beale and Smith 1970).

Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Open Wyoming sagebrush communities are preferred nesting habitat. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Leks are often located on low sagebrush sites, grassy openings, dry meadows, ridgetops, and disturbed sites.

Hydrological functions

Rills are none to rare. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid snowmelt. Water flow patterns are rare but can be expected in areas subjected to summer convection storms or rapid snowmelt. Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants is common and should not be mistaken for pedestalling due to erosion. Gullies and erosion associated with gullies are non-existent. Fine litter (foliage from grasses and annual and perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. High winds over ridge top landscapes limit accumulation of fine litter. 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 this site.

Recreational uses

This site derives aesthetic value from its topographic position, affording an unobstructed view of the surrounding mountains and valleys. Normally it is an unspoiled site and is a place for peace and quiet to enjoy the scenic vistas. The site provides fair to good hunting for sage grouse, chukar and Hungarian partridge. The open vistas offer rewarding opportunities to photographers. Steep slopes may inhibit some forms of recreation.

Wood products

None

Other information

Low sagebrush can be successfully transplanted or seeded in restoration. Black sagebrush is an excellent species to establish on sites where management objectives include restoration or improvement of domestic sheep, pronghorn, or mule deer winter range.

Inventory data references

Physiographic and Soils features were gathered from NASIS.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T40N R63E S21
General legal description	Approximately 18 miles north of Wells, Summer Camp Ridge area, Snake Mountains, Elko County, Nevada. This site also occurs in Elko, Humboldt, Eureka and Lander Counties, Nevada.

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Contributors

RK/GKB

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 none to rare. Rock fragments armor the surface. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt.

2. **Presence of water flow patterns:** Water flow patterns are none to rare but may be expected on steeper slopes in areas recently subjected to summer convection storms or rapid snowmelt.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants is common and should not be mistaken for pedestalling due to erosion.

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

bare ground): Bare Ground ± 20%; surface cover of rock fragments variable but typically more than 70%; shrub canopy 5 to 15%; foliar cover of perennial herbaceous plants ± 25%.

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

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. High winds over ridge top landscapes limit accumulation of fine litter. 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 browns and the soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1.25 to 2.5 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)] slow runoff and increase infiltration. Low stature and sparseness of shrub canopy, coupled with high velocity ridge-top winds, limit 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 compaction.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses = low shrubs (low sagebrush). (By above ground production)

    Sub-dominant: Deep-rooted, cool season, perennial forbs > associated shrubs =shallow-rooted, cool season, perennial bunchgrasses > fibrous, shallow-rooted, cool season, perennial and annual forbs. (By above ground production)

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common; standing dead shrub canopy material may be as much as 15% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (± 25%) and litter depth is ± ¼ inch.

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) ± 275 lbs/ac; Spring moisture significantly affects total production.

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Potential invaders on this site include cheatgrass and medusahead.

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