Ecological site R025XY014NV
LOAMY 10-12 P.Z.

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General information

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

MLRA notes

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

The Owyhee High Plateau, MLRA 25, lies within the Intermontane Plateaus physiographic province. The southern half is found in the Great Basin while the northern half is located in the Columbia Plateaus. The southern section of the Owyhee High Plateau is characterized by isolated, uplifted fault-block mountain ranges separated by narrow, aggraded desert plains. This geologically older terrain has been dissected by numerous streams draining to the Humboldt River. The northern section forms the southern boundary of the extensive Columbia Plateau basalt flows. Deep, narrow canyons drain to the Snake River across the broad volcanic plain.

This MLRA is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. Elevation ranges from 3,000 to 7,550 feet on rolling plateaus and in gently sloping basins. It is more than 9,840 feet on some steep mountains. The average annual precipitation in most of this area is typically 11 to 22 inches. It increases to as much as 49 inches at the higher elevations. Precipitation occurs mainly as snow in winter. The supply of water from precipitation and streamflow is small and unreliable, except along major rivers. Streamflow depends largely on accumulated snow in the mountains.

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic or frigid temperature regime and an aridic, arid bordering on xeric, or xeric moisture regime. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam, and have ashy texture modifiers in some cases. Argillic horizons occur on the more stable landforms.

Ecological site concept

This ecological site is on upper fan remnants on all aspects. Soils associated with this site are moderately deep to a duripan, well drained, and formed in eolian influenced alluvium derived from volcanic rocks. Slopes are typically less than 30 percent. Important abiotic factors contributing to the presence of this ecological site include a subsurface horizon characterized by clay accumulation (argillic horizon) and gentle slopes contributing to increased soil moisture allowing basin big sagebrush to dominate a landscape position that does not receive run-in moisture. Under reference conditions the plant community is dominated by basin big sagebrush, bluebunch wheatgrass, and Thurber's needlegrass.

Associated sites

R025XY012NV	**LOAMY SLOPE 12-16 P.Z.** Loamy Slope 12-16
R025XY015NV	**SOUTH SLOPE 8-12 P.Z.** South Slope 8-10
R025XY019NV	**LOAMY 8-10 P.Z.** Loamy 8-10

R025XY018NV	**CLAYPAN 10-12 P.Z.** Claypan 10-12

Similar sites

R025XY066NV	**ASHY LOAM 10-12 P.Z.** ARTRW8 dominant shrub, ACHY-ELMA7-HECO26 important species. Soils have a high concentration of volcanic ash and an ochric epipedon.
R025XY019NV	**LOAMY 8-10 P.Z.** ARTRW8 dominant shrub, Less productive site. Soils characterized by an ochric epipedon and argillic horizon.
R025XY013NV	**CHURNING CLAY 8-12 P.Z.** LECI4 dominant grass. Found in concave pockets with soils characterized by greater than 35% clay in the soil profile.
R025XY021NV	**SHALLOW LOAM 8-12 P.Z.** Much less productive site. Soils depth less than 50cm to root restrictive layer (duripan).
R025XY015NV	**SOUTH SLOPE 8-12 P.Z.** PSSPS dominant grass; occurs on south facing, fan remnant side slopes with slopes greater than 15 percent.
R025XY012NV	**LOAMY SLOPE 12-16 P.Z.** ARTRV dominant shrub, occurs on mountain side-slopes, soils formed in residuum.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Achnatherum thurberianum*

Physiographic features

This ecological site is associated with piedmont slope landscapes on side slopes of upper fan remnant. Slopes range from 4 to 30 percent, but are typically less than 15 percent. Elevations are between 5,500-6,500 feet (1,676-1,981meters). This site has high to very high runoff potential.

Table 2. Representative physiographic features

Landforms	(1) Piedmont slope > Fan remnant
Runoff class	High to very high
Flooding frequency	None
Elevation	5,500–6,500 ft
Slope	4–30%
Water table depth	150 in
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is defined by hot dry summers and cold snowy winters. Typical estimate for frost free-days is 70 and 80 freeze-free days. Mean annual precipitation is 12 inches (30.5cm), with the highest rainfall occurring in May 1.6 in (4cm) and the lowest in August 0.4 in (1cm). Effective precipitation is between 10-12 inches (25- 31cm). Averages snowfall is around 35 inches (89cm) per year. Air temperatures average 11 degrees F in January (coldest) and 85 degrees F in July (warmest).

* The following data is averaged from the MTN CITY RS and JACKPOT climate stations, NASIS, and Western

Regional Climate Center.

Table 3. Representative climatic features

Frost-free period (characteristic range)	50-90 days
Freeze-free period (characteristic range)	60-120 days
Precipitation total (characteristic range)	11-13 in
Frost-free period (actual range)	50-90 days
Freeze-free period (actual range)	60-120 days
Precipitation total (actual range)	9-16 in
Frost-free period (average)	70 days
Freeze-free period (average)	80 days
Precipitation total (average)	12 in

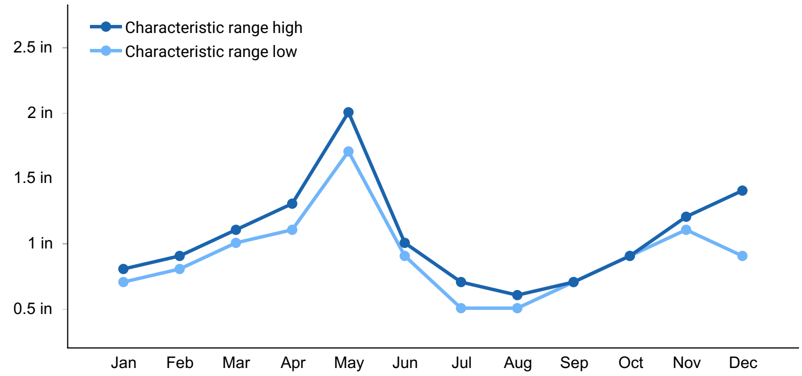


Figure 1. Monthly precipitation range

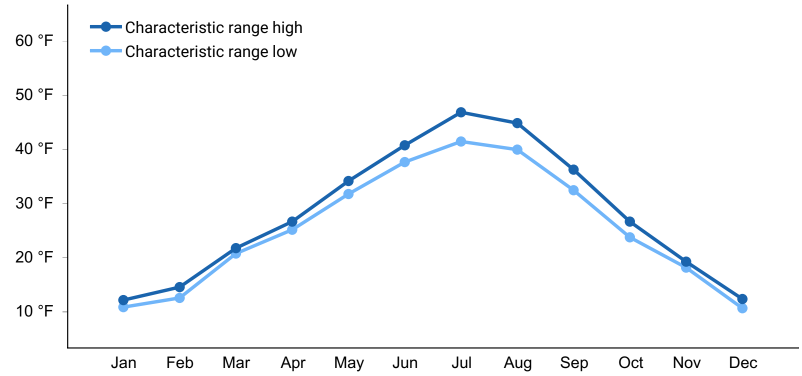


Figure 2. Monthly minimum temperature range

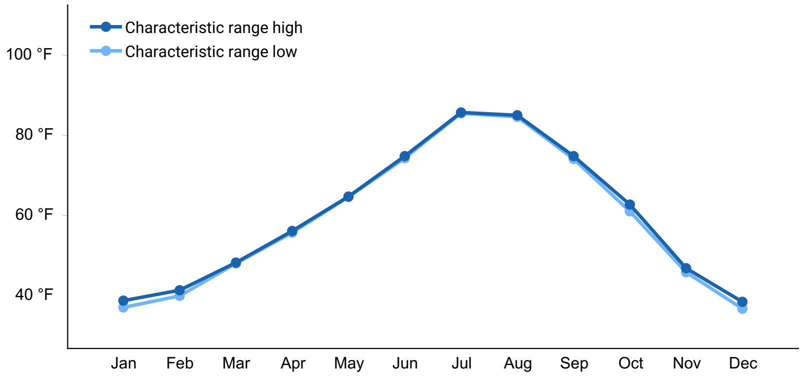


Figure 3. Monthly maximum temperature range

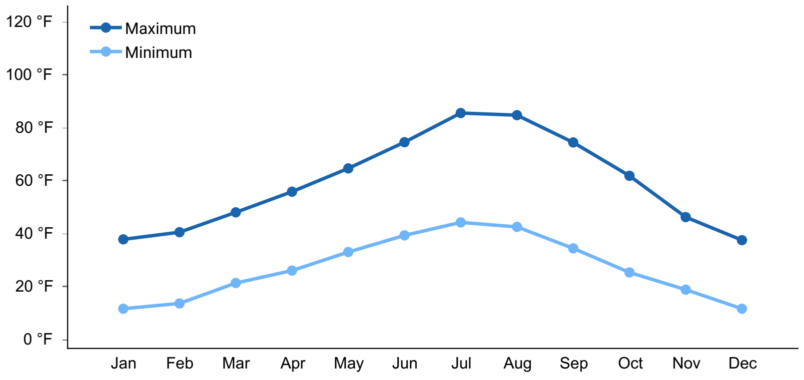


Figure 4. Monthly average minimum and maximum temperature

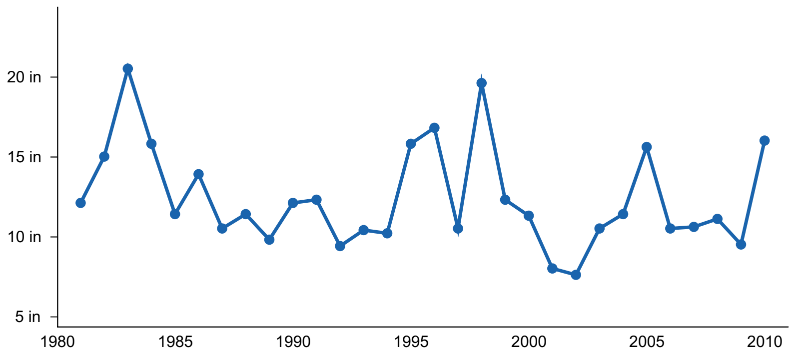


Figure 5. Annual precipitation pattern

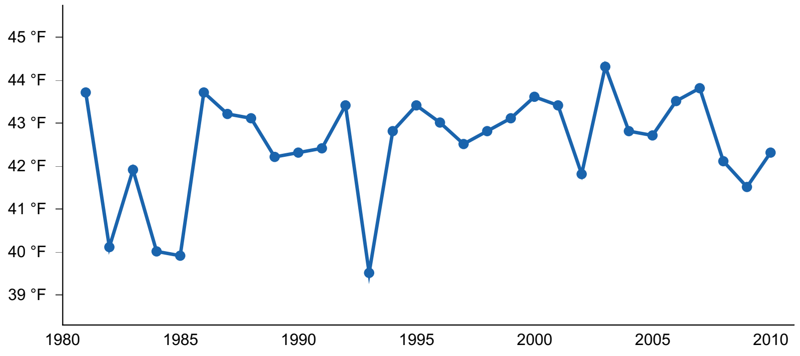


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MTN CITY RS [USC00265392], Mountain City, NV
- (2) JACKPOT [USC00264016], Jackpot, NV

Influencing water features

Ecological site is not influenced by adjacent wetlands, streams or run-on. No water table is present.

Wetland description

N/A

Soil features

The soils associated with site formed in eolian material and alluvium derived from volcanic rocks. These soils are moderately deep and well drained with a gravely loam surface. The soil profile is characterized by a horizon of clay accumulation (argillic) between 12 and 24 inches (30 and 60cm), less than 35 percent rock fragments throughout, and a subsurface horizon cemented by silica (duripan) greater than 20 inches (50cm) from surface.

Representative soil components associated with this ecological site include the Stampede, Gochea, Carstump, Kleckner, Quarz, Ramires, Susie Creek, Alyan, Roca, and Handy.

Table 4. Representative soil features

Parent material	(1) Alluvium–volcanic rock (2) Eolian deposits
Surface texture	(1) Very gravelly loam (2) Gravelly loam (3) Loam (4) Silt loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	24–40 in
Soil depth	24–40 in
Surface fragment cover <=3"	12–28%
Surface fragment cover >3"	3–10%
Available water capacity (0-40in)	3–6 in
Soil reaction (1:1 water) (0-40in)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	10–25%
Subsurface fragment volume >3" (Depth not specified)	5–10%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	14–60 in
Soil depth	14–60 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

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

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

In the Great Basin, the majority of annual precipitation is received during winter and early spring. This continental semiarid climate regime favors growth and development of deep-rooted shrubs and herbaceous cool season plants using the C3 photosynthetic pathway (Comstock and Ehleringer 1992). Winter precipitation and slow melting of snow results in deeper percolation of moisture into the soil profile. Herbaceous plants, more shallow-rooted than shrubs, grow earlier in the growing season and thrive on spring rains, while the deeper rooted shrubs lag in phenological development because they draw from deeply infiltrating moisture from snowmelt the previous winter. Periodic drought regularly influences sagebrush ecosystems and drought duration and severity has increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability within the soil profile (Bates et al 2006).

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

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

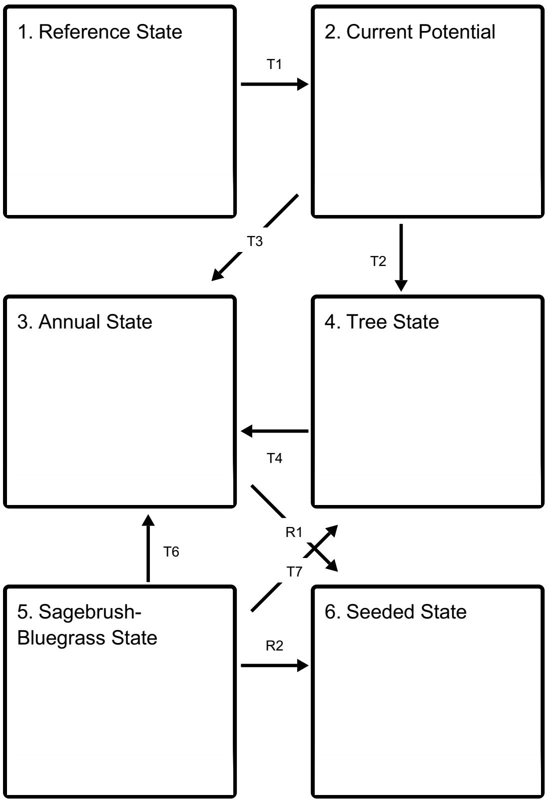
In addition, the range and density of Utah juniper and singleleaf pinyon has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion of trees into sagebrush ecosystems include wildfire suppression, historic livestock grazing, and climate change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

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

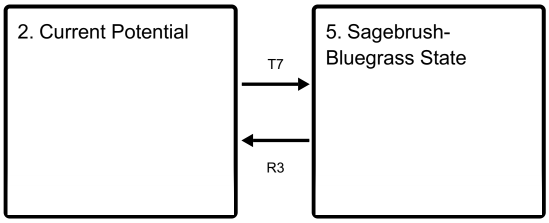
This ecological site has low to moderate resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Five possible alternative stable states have been identified for this ecological site.

State and transition model

Ecosystem states



States 2 and 5 (additional transitions)



T1 - Introduction of annual non-native species.

T3 - Repeated, widespread and severe fire.

T2 - Absence of wildfire

T7 - Loss of deep-rooted perennial bunchgrasses

R1 - Rangeland seeding

T4 - Catastrophic fire or a failed restoration attempt

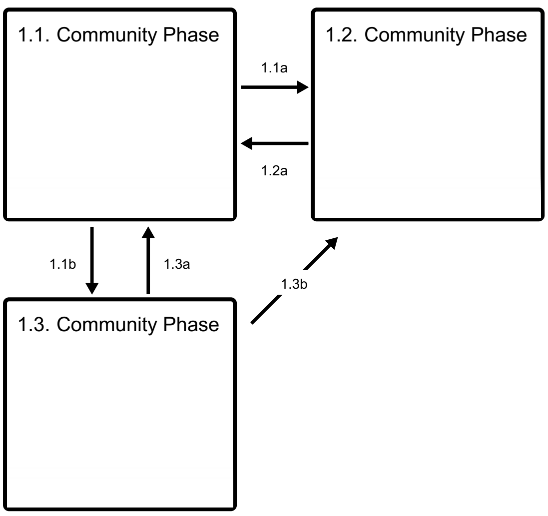
R3 - Brush management and seeding with native species

T6 - Wildfire

T7 - Decreasing grass species

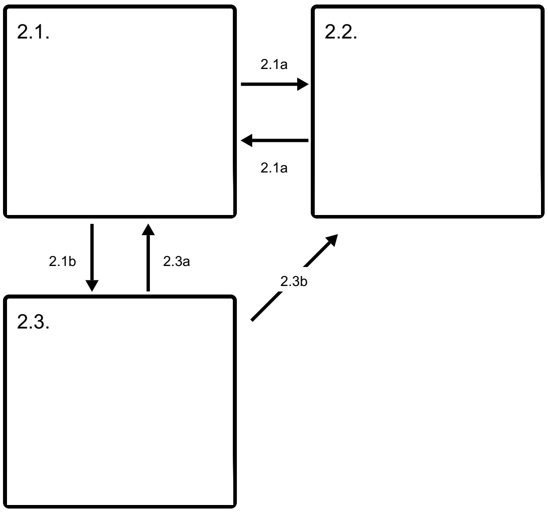
R2 - Rangeland seeding

State 1 submodel, plant communities

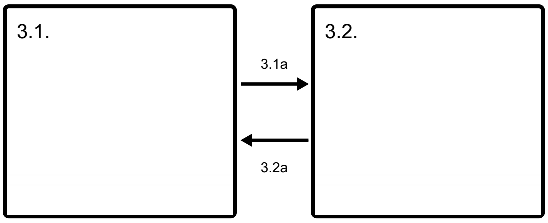


1.1a - Wildfire

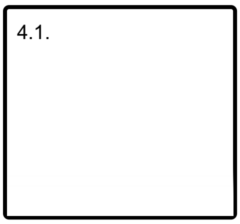
State 2 submodel, plant communities



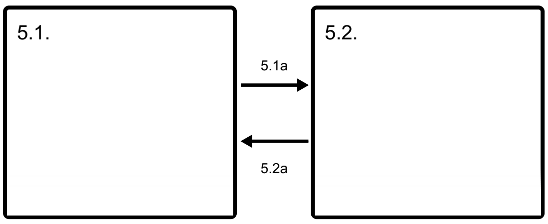
State 3 submodel, plant communities



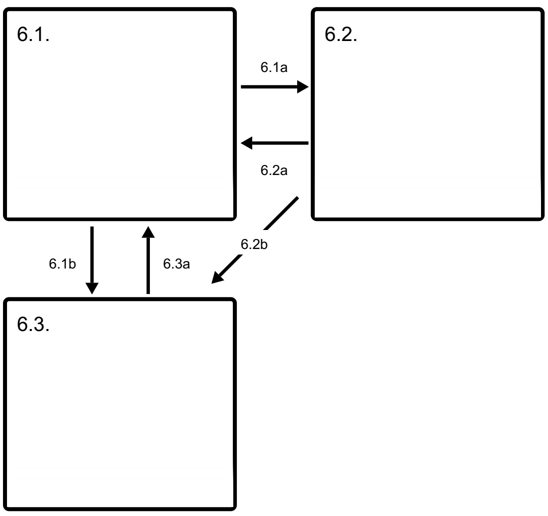
State 4 submodel, plant communities



State 5 submodel, plant communities



State 6 submodel, plant communities



State 1
Reference State

The Reference State is a representative of the natural range of variability under pristine conditions. 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.

Dominant plant species

- big sagebrush (*Artemisia tridentata*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Thurber's needlegrass (*Achnatherum thurberianum*), grass

Community 1.1
Community Phase

This community phase is characteristic of a mid-seral plant community and is dominated by big sagebrush and bluebunch wheatgrass. Thurber's needlegrass, antelope bitterbrush and rabbitbrush are also common on this site. Potential vegetative composition by weight is about 65 percent grasses, 10 percent forbs and 25 percent shrubs. Total vegetative cover averages 30 to 40 percent.

Resilience management. Thurber’s needlegrass often survives fire and will continue growth or regenerate from tillers when conditions are favorable (Koniak 1985, Britton et al. 1990). Reestablishment on burned sites has been found to be relatively slow due to low germination and competitive ability (Koniak 1985).

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	390	520	650
Shrub/Vine	150	200	250
Forb	60	80	100
Total	**600**	**800**	**1000**

Community 1.2
Community Phase

This community phase is characterized by a post-disturbance, early seral, plant community. Sagebrush and other shrubs are reduced, or patchy. Perennial bunchgrasses and forbs dominate the visual aspect of the plant community. Disturbance tolerant shrubs such as rabbitbrush and antelope bitterbrush will sprout from the root-crown following low and medium intensity wildfire and may begin to dominate the plant community 2 to 5 years post-disturbance.

Resilience management. Basin big sagebrush does not sprout after fire. Because of the time needed to produce seed, it is eliminated by frequent fires (Bunting et al. 1987). Basin big sagebrush establishes on a site primarily by off-site seed or seed from plants that survive in unburned patches. Approximately 90% of big sagebrush seed is dispersed within 30 feet (9 m) of the parent shrub (Goodrich et al. 1985) with maximum seed dispersal at approximately 108 feet (33 m) from the parent shrub (Shumar and Anderson 1986). Therefore, regeneration of basin big sagebrush after stand replacing fires is difficult and dependent upon proximity of residual mature plants and favorable moisture conditions (Johnson and Payne 1968, Humphrey 1984). The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. For most forbs and grasses the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983).

Community 1.3
Community Phase

Natural regeneration and absence of disturbance over time allows sagebrush to mature and dominate the plant community. Perennial bunchgrasses and forbs are reduced in both vigor and productivity due to competition for light, moisture and nutrient resources. Juniper may also be increasing in cover and number of individual trees due to lack of wildfire.

Pathway 1.1a
Community 1.1 to 1.2

Low severity fire creates sagebrush/grass mosaic; higher intensity fires significantly reduce sagebrush cover and lead to early seral community dominated by grasses and forbs. Frequency and intensity of wildfire is primarily driven by cover and amount of herbaceous vegetation. Under pre-Eurosettlement conditions fire return interval is estimated to be between 20 and 50 years.

Pathway 1.1b
Community 1.1 to 1.3

Time, absence of disturbance and natural regeneration over time allows sagebrush to dominate site resources. This community phase pathway may be coupled with drought and/or herbivory further reducing herbaceous understory.

Pathway 1.2a
Community 1.2 to 1.1

Time, absence of disturbance and natural regeneration over time allows sagebrush to recover. Recovery of sagebrush depends on the availability of a local seed source (patches of mature shrubs) as well as precipitation patterns favorable for germination and seedling recruitment. Sagebrush seedlings are susceptible to less than favorable conditions for several years. Completion of this community phase pathways may take decades.

Pathway 1.3a
Community 1.3 to 1.1

Low intensity, patchy wildfire or insect infestation would reduce sagebrush overstory creating a mosaic on the landscape. Perennial bunchgrasses and forbs dominate disturbed patches due to an increase in light, moisture and nutrient resources.

Pathway 1.3b
Community 1.3 to 1.2

Wide spread wildfire removes sagebrush and allows perennial bunchgrasses and forbs to dominate.

State 2
Current Potential

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-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. Management would be to maintain high diversity of desired species to promote organic matter inputs and prevent the dispersal and seed production of the non-native invasive species.

Dominant plant species

- big sagebrush (*Artemisia tridentata*), shrub
- cheatgrass (*Bromus tectorum*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

Community 2.1

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts.

Resilience management. The presence of non-native annuals has reduced site resilience. Management actions should focus on maintaining the presence of all functional and structural groups and minimizing wildfire and soil disturbing practices.

Community 2.2

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Perennial bunchgrasses and forbs recover rapidly following wildfire. Annual non-native species are stable or increasing within the community. Disturbance tolerant shrubs typically recover 2 to 5 years post fire and may dominate the sites for many years.

Resilience management. Depending on fire severity, rabbitbrush and horsebrush may increase after fire. Rubber rabbitbrush is top-killed by fire, but can resprout after fire and can also establish from seed (Young 1983). Yellow rabbitbrush is top-killed by fire, but sprouts vigorously after fire (Kuntz 1982, Akinsoji 1988). Cheatgrass has been found to be a highly successful competitor with seedlings of Thurber's needlegrass and may preclude reestablishment (Evans and Young 1978).

Community 2.3

This community phase is characterized by decadent sagebrush, reduced perennial bunchgrass and increasing bare ground. Annual non-natives species are stable or increasing due to lack of competition from perennial bunchgrasses. Juniper may also be increasing in cover and number of individual trees. Additional field work is need to determine the extent of juniper on this ecological site and determine if correlation to a more appropriate site is warranted.

Pathway 2.1a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fire may be patchy resulting in a mosaic pattern with patches of mature sagebrush remaining. 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. Mature sagebrush is controlling the spatial and temporal distribution of moisture, nutrient and light resources. Native perennial bunchgrasses are reduced due to competition for these resources. Non-native annuals are stable to increasing.

Pathway 2.1a
Community 2.2 to 2.1

Time, lack of disturbance and natural regeneration of sagebrush. The establishment of little sagebrush depends on presence of seed source and favorable weather patterns. It may take decades for sagebrush to recover to pre-disturbance levels.

Pathway 2.3a
Community 2.3 to 2.1

Low intensity wildfire, insect infestation, or brush management with minimal soil disturbance reduces sagebrush overstory and releases herbaceous understory.

Pathway 2.3b
Community 2.3 to 2.2

Fire reduces or eliminates the overstory of sagebrush and allows for the understory perennial grasses and forbs to increase. Annual non-native species respond well to fire and may increase post-burn.

State 3
Annual State

Annual non-natives dominated site productivity and site resources. The dominance of non-native annuals control the spatial and temporal distribution of soil moisture, soil nutrients and energy resources. Remaining patches of sagebrush and/or perennial bunchgrass suffer from increased competition and narrowed fire return intervals.

Characteristics and indicators. This state experiences frequent fire due to increased cover and continuity of fine fuels. Fire is frequent enough to prevent the recovery of long-lived native perennials like big sagebrush. Disturbance tolerant shrubs may be present or increasing depending on time since disturbance. As cheatgrass increases, fire frequencies also increase to frequencies between 0.23 and 0.43 times a year; then even sprouting shrubs such as rabbitbrush will not survive (Whisenant 1990).

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- tansymustard (*Descurainia*), grass
- medusahead (*Taeniatherum*), grass
- fescue (*Vulpia*), grass
- bulbous bluegrass (*Poa bulbosa*), grass

Community 3.1

This community phase in dominated by annual non-native plants such as medusahead or cheatgrass and shallow-rooted perennial grasses like Sandberg bluegrass. Sprouting shrubs such as rabbitbrush may also common. Patches of mature sagebrush may or may not be present.

Community 3.2

This community phase is characteristic of a post-wildfire community where annual non-natives are controlling site resources. Depending on season and/or intensity of fire the visually aspect of the site in dominated annual non-natives and bare ground. Site may be experiencing soil loss.

Resilience management. This community phases is high susceptible to frequent and repeated wildfire. Best management practices prevent sites from reaching this community phase. Management options are extremely limited.

Pathway 3.1a
Community 3.1 to 3.2

Fire reduces or eliminates the overstory shrubs and shallow-rooted perennials and allows for annual non-natives to increase

Pathway 3.2a
Community 3.2 to 3.1

Time and lack of fire allows for sagebrush/rabbitbrush to establish. Probability of sagebrush establishment is very unlikely and dependent on a near-by seed source from unburned patches of sagebrush.

State 4
Tree State

This state is characterized by a dominance of Utah juniper. Sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients and soil organic matter distribution and nutrient cycling have been spatially and temporally altered. This state is relatively stable due to rapid growth rate and long life span of juniper.

Dominant plant species

- Utah juniper (*Juniperus osteosperma*), tree

Community 4.1

Juniper dominates overstory and site resources. Trees are actively growing and seedlings may be present. The shrub and grass understory is reduced. Sagebrush is stressed and dying. Trace amounts Sandberg bluegrass and forbs may be found in the interspaces. Annual non-native species are present under tree canopies. Bare ground areas are large and connected.

State 5
Sagebrush-Bluegrass State

This state is characterized by the dominance of shallow rooted perennial bunchgrass, which have replaced the deep-rooted perennial bunch grass typical of the site. Big sagebrush and rabbitbrush dominate the overstory. Bluegrass species dominate understory with non-native species present.

Characteristics and indicators. Sandberg bluegrass has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper rooted bunchgrass. Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces.

Community 5.1

This community phase is characteristic of a mid-seral plant community and is dominated by Wyoming big sagebrush/ rabbitbrush with a bluegrass understory. Juniper may be present along with annual non-native species. Understory may be sparse with bare patches of ground.

Community 5.2

This community phase is characteristics of a early seral, post-disturbance plant community. Bluegrass recovers rapidly following disturbance and dominates site resources. Annual non-native species are present and may be increasing. Remnant patches of sagebrush or rabbitbrush may be present.

Pathway 5.1a
Community 5.1 to 5.2

Fire reduces the shrub overstory and allows for shallow-rooted perennial bunchgrasses to dominate the site. Fire may be patchy resulting in a mosaic pattern with patches of mature sagebrush remaining. Annual non-native species are likely to increase after fire. Severe aroga moth infestation may also also reduce sagebrush overstory releasing herbaceous understory.

Pathway 5.2a
Community 5.2 to 5.1

Time

State 6
Seeded State

This state is characterized by the dominance of non-native perennial wheatgrass species, like crested wheatgrass (*Agropyron cristatum*) or desert wheatgrass (*Agropyron desertorum*). Non-native perennial wheatgrass are frequently seeded following disturbance for erosion control and forage. Seeded perennials are long-lived and persistent and are capable of outcompeting native perennials and prohibit the return of pre-disturbance plant diversity. Soil nutrients , soil moisture, and organic matter distribution and cycling are primarily driven by introduced bunchgrasses. Native species, grass and forbs, may still be present in small amounts.

Community 6.1

This community phase is characteristic of a successful restoration attempt. Seeded perennials like crested wheatgrass, forage kochia, or other introduced forage species dominate. Trace amounts of big sagebrush may be present. Annual non-natives present and may be increasing, but do not dominante.

Community 6.2

This community phase is characterized by the recovery of big sagebrush. Crested wheatgrass is persistent and dominates understory. Annual non-native species are present but do not dominate.

Community 6.3

This community phase is characteristic of a late-seral community phase. Wyoming big sagebrush and annual non-native species increase with a decrease in crested wheatgrass.

Pathway 6.1a
Community 6.1 to 6.2

Time, absence of disturbance and natural regeneration over time allows sagebrush to increase.

Pathway 6.1b
Community 6.1 to 6.3

Wildfire removes sagebrush canopy. Seeded species may increase following disturbance, Non-native annuals may also increase following disturbance.

Pathway 6.2a
Community 6.2 to 6.1

Insect infestation, brush management or other shrub removing disturbance that does not disturb the soil surface. Soil disturbing practices have the potential to significantly increase annual non-natives.

Pathway 6.2b
Community 6.2 to 6.3

Wildfire removes sagebrush canopy. Seeded species may increase following disturbance, Non-native annuals may also increase.

Pathway 6.3a
Community 6.3 to 6.1

Time, absence of disturbance and natural regeneration over time allows sagebrush to increase.

Transition T1
State 1 to 2

Trigger: Introduction of annual non-native species Slow variable: Over time the annual non-native plants 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 T3
State 2 to 3

Trigger: Repeated, widespread and severe fire. Slow variables: Increased production and cover of non-native annual species over time. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community.

Transition T2
State 2 to 4

Trigger: Presence of juniper Slow variables: Encroachment of juniper is primarily driven by lack of fire. This may also be coupled with prolonged drought and poor grazing management. Threshold: Juniper is now controlling energy, moisture and nutrient resources Dominance of juniper results in decreased infiltration and increased runoff, reducing soil moisture and nutrient cycling. Sagebrush and perennial bunchgrass are reduced both vigor and reproductive capacity.

Transition T7
State 2 to 5

Trigger: inappropriate grazing management, prolonged drought or a combination. Slow variable: Reduction of deep-rooted perennial bunchgrass through inappropriate grazing management, prolonged drought or a combination. Threshold: Changes in the spatial and temporal patterns of infiltration and runoff effects soil moisture. Shallow-rooted perennial grasses are highly competitive for moisture and nutrient resources in the surface soil horizon.

Restoration pathway R1
State 3 to 6

Seeding drought tolerant species combined with grazing management/prescribed grazing. Minimize soil disturbance and maximize non-native annual plant biomass removal during early spring. Continue to protect site from wildfire. Probability of success is low.

Transition T4
State 4 to 3

Trigger: Catastrophic fire causing a stand replacing event. Or a failed restoration attempt including inappropriate tree removal or rangeland seeding using soil disturbing practices. Slow variables: Increased production and cover of non-native annual species under tree canopy. Threshold: Closed tree canopy with non-native annual species in the understory changes the intensity, size and spatial variability of wildfires. Changes in community composition are driven by temporal changes in energy capture, soil moisture and nutrient cycling and result in the loss of perennial bunchgrasses and sagebrush.

Restoration pathway R3
State 5 to 2

Brush management treatments, physical or chemical. May be combined with seeding of native species using non-soil disturbing practices.

Transition T6

State 5 to 3

Trigger: Repeated, widespread and severe fire. Slow variables: Increased production and cover of non-native annual species over time. Threshold: Loss of shallow-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community.

Transition T7
State 5 to 4

Trigger: Presence of juniper Slow variables: Encroachment of juniper is primarily driven by lack of fire. This may also be coupled with prolonged drought and poor grazing management. Threshold: Juniper is now controlling energy, moisture and nutrient resources Dominance of juniper results in decreased infiltration and increased runoff, reducing soil moisture and nutrient cycling. Sagebrush and perennial bunchgrass are reduced both vigor and reproductive capacity.

Restoration pathway R2
State 5 to 6

Seeding with drought tolerant, non-native, species. May be combined with brush management or herbicide application.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1				390–650	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	160–280	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	80–160	–
	bluegrass	POA	*Poa*	16–80	–
	basin wildrye	LECI4	*Leymus cinereus*	16–64	–
	squirreltail	ELEL5	*Elymus elymoides*	1–5	–
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	1–5	–
	Sandberg bluegrass	POSE	*Poa secunda*	1–5	–
	Idaho fescue	FEID	*Festuca idahoensis*	1–5	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	1–5	–
Forb					
2				60–100	
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	–	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	–	–
	lupine	LUPIN	*Lupinus*	–	–
	buckwheat	ERIOG	*Eriogonum*	–	–
Shrub/Vine					
3				150–250	
	big sagebrush	ARTR2	*Artemisia tridentata*	80–160	–
	rabbitbrush	CHRYS9	*Chrysothamnus*	40–80	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	16–64	–

Animal community

Livestock Interpretations:
This site is suited to cattle and sheep grazing during the spring, early summer, and fall. Attentive grazing management is required on steep slopes due to erosive surface conditions. 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 Thurber's needlegrass. Squirreltail or Sandberg bluegrass will increase temporarily with further degradation. Invasion of annual weedy forbs and cheatgrass could occur with further grazing degradation, leading to a decline in squirreltail and bluegrass and an increase in bare ground. A combination of overgrazing and prolonged drought leads to soil erosion, increased bare ground and a loss in plant production. Wildfire in sites with cheatgrass present could transition to cheatgrass-dominated communities. Without management, cheatgrass and annual forbs are likely to invade and dominate the site, especially after fire. Although trees are not part of the site concept, Utah juniper and/or singleleaf pinyon can also invade and eventually dominate this site.

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). 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.

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

Thurber's needlegrass is an important forage source for livestock and wildlife in the arid regions of the west (Ganskopp 1988). Thurber's needlegrass begins growth early in the year and remains green throughout a relatively long growing season. This pattern of development enables animals to use Thurber's needlegrass when many other grasses are unavailable. Cattle prefer Thurber's needlegrass in early spring before fruits have developed as it becomes less palatable when mature. Thurber's needlegrasses are grazed in the fall only if the fruits are softened by rain. Although the seeds are not injurious, grazing animals avoid them when they begin to mature. Sheep, however, have been observed to graze the leaves closely, leaving stems untouched (Eckert and Spencer 1987). Heavy grazing during the growing season has been shown to reduce the basal area of Thurber's needlegrass (Eckert and Spencer 1987), suggesting that both seasonality and utilization are important factors in management of this plant. A single defoliation, particularly during the boot stage, was found to reduce herbage production and root mass thus potentially lowering the competitive ability of this needlegrass (Ganskopp 1988).

Bluebunch wheatgrass is moderately grazing-tolerant and is very sensitive to defoliation during the active growth period (Blaisdell and Pechanec 1949, Laycock 1967, Anderson and Scherzinger 1975, 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.

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

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine-tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Reliance on the big sagebrush ecosystem by many wild animals for both food and cover has been documented and reviewed extensively. Sage grouse use this site for nesting and for brood rearing while the forbs remain succulent. Mountain big sagebrush is a highly preferred winter forage for mule deer. In a study by Personius et al. (1987), mountain big sagebrush was the most preferred sagebrush species. Fecal samples from ungulates in Montana showed that bighorn sheep, mule deer, and elk all consumed mountain big sagebrush in small amounts in winter, while cattle showed no sign of sagebrush use.

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.

Wyoming big sagebrush is preferred browse for wild ungulates. Pronghorn usually browse Wyoming big sagebrush heavily. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities.

Hydrological functions

Runoff is low to medium and the potential for sheet and rill erosion varies with slope gradient. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Water flow patterns are rare but can be expected in areas recently subjected to summer convection storms or rapid snowmelt, usually on steeper slopes. 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. 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 large rainfall 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

Aesthetic value is derived from the colorful flowering and numerous forbs backgrounded by the verdure of native grasses and shrubs in the spring and early summer. The diverse floral and faunal populations offer rewarding opportunities to photographers and for nature study. This site has potential for deer, antelope and upland game hunting.

Other products

Native peoples used big sagebrush leaves and branches for medicinal teas as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks., and the leaves as a fumigant. Big sagebrush seeds were eaten raw or made into meal. Bark was woven into mats, bags and clothing. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Bluebunch wheatgrass seeds are not easily harvested and can be expensive, which, along with some of its botanical characteristics, makes the plant a less desirable choice for reclamation projects. 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. Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish. Basin big sagebrush shows high potential for range restoration and soil stabilization. Basin big sagebrush grows rapidly and spreads readily from seed.

Inventory data references

Old SS Manuscripts, Range Site Descriptions, etc.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T29N R56E S35
General legal description	Approximately ¾ mile northwest of Zaga Ranch House, Jiggs, Elko County, Nevada. This site also occurs in Humboldt County, Nevada

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Contributors

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Approval

Kendra Moseley, 4/24/2024

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few rills can be expected on steeper slopes in areas subjected to summer convection storms or after wildfires.

2. **Presence of water flow patterns:** Water flow patterns are rare and short. Flow is disrupted by perennial grasses.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are rare. Occurrence is usually limited to areas of water flow patterns

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 40-60% 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 weak medium platy or moderate medium subangular blocky. Soil surface colors are grayish browns and soils are typified by an ochric or mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1 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., 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):** None. Soil profiles with duripans or 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

    Sub-dominant: >> tall shrubs (big sagebrush) > perennial forbs > associated shrubs.

    Other: annual forbs

    Additional:

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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):** Between plant interspaces (20-30%) 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) ± 800 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:** Potential invaders on this site include cheatgrass, annual mustards and Utah juniper.

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