

## Ecological site R028AY057NV LOAMY 16+ 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.

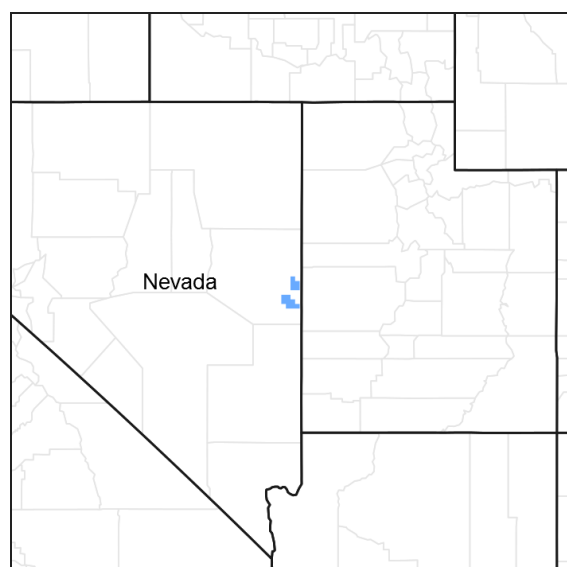


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

### MLRA notes

Major Land Resource Area (MLRA): 028A—Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

## Ecological site concept

This site occurs on footslopes of mountains and mountain valley fans on all aspects. Slope gradients of 15 to 50 percent are typical. Elevations are 7700 to 10500 feet.

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. Average annual precipitation is 16 to 20 inches. Mean annual air temperature is 37 to 43 degrees F. The average growing season is about 30 to 60 days.

Soils associated with this site are very deep and well drained. The surface layer is medium textured and is 10 inches or more in thickness to the subsoil or underlying material. This site provides a cool, moist environment for plant growth because of the elevations where it occurs. Soil temperatures and evaporation potentials are limited during the growing season due to reduced insolation. Snow accumulation persists on this site late into spring when the soil is not frozen. Snowmelt, at this time, is added to the soil moisture supply and is available during most of the active growth period. Runoff from this site is high and the potential for sheet and rill erosion is low to moderate depending on slope.

The reference state is dominated by mountain brome, slender wheatgrass, Columbia and western needlegrasses and mountain big sagebrush. Production ranges from 1000 to 2300 pounds per acre.

## Associated sites

|             |                                   |
|-------------|-----------------------------------|
| F028AY056NV | <b>POTR5-ABCOC/ROWO/POA-CAREX</b> |
| F028AY078NV | <b>POTR5-PIEN WSG:1R1907</b>      |
| R028AY065NV | <b>SHALLOW LOAM 14+ P.Z.</b>      |
| R028AY068NV | <b>LOAMY SLOPE 16+ P.Z.</b>       |

## Similar sites

|             |  |
|-------------|--|
| R028AY067NV | <b>CALCAREOUS LOAM 14+ P.Z.</b><br>Less productive site; PSSPS dominant plant                        |
| R028AY092NV | <b>LOAMY 12-14 P.Z.</b><br>Less productive site; PSSPS-ACHNA codominant grasses                      |
| R028AY065NV | <b>SHALLOW LOAM 14+ P.Z.</b><br>PSSPS dominant grass; less productive site                           |
| R028AY068NV | <b>LOAMY SLOPE 16+ P.Z.</b><br>Less productive site; PSSPS important grass; occurs on steeper slopes |

Table 1. Dominant plant species

|            |  |
|------------|--|
| Tree       | Not specified  |
| Shrub      | (1) <i>Artemisia tridentata</i> ssp. <i>vaseyana</i>           |
| Herbaceous | (1) <i>Bromus marginatus</i><br>(2) <i>Elymus trachycaulus</i> |

## Physiographic features

This site occurs on footslopes of mountains and mountain valley fans on all aspects. Slope gradients of 15 to 50 percent are typical. Elevations range from 7700 to 10,500 feet.

Table 2. Representative physiographic features

|           |   |
|-----------|---|
| Landforms | (1) Mountain valley<br>(2) Mountain slope |
| Elevation | 2,347–3,200 m                             |
| Slope     | 15–50%                                    |

|        |                                    |
|--------|------------------------------------|
| Aspect | Aspect is not a significant factor |
|--------|------------------------------------|

### Climatic features

Nevada’s climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada’s climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.

Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. Average annual precipitation is 16 to 20 inches. Mean annual air temperature is 37 to 43 degrees F. The average growing season is about 30 to 60 days.

The Mean annual precipitation at the Great Basin Natinal Park Climate Station (263340) is 13.33 inches.

Monthly mean precipitation is:  
January 1.05; February 1.18; March 1.37; April 1.21; May 1.24; June .87; July .97; August 1.18; September 1.08; October .96; December .96

Table 3. Representative climatic features

|                               |         |
|-------------------------------|---------|
| Frost-free period (average)   | 0 days  |
| Freeze-free period (average)  | 45 days |
| Precipitation total (average) | 457 mm  |

### Influencing water features

Snow accumulation persists on this site late into spring when the soil is not frozen. Snowmelt, at this time, is added to the soil moisture supply and is available during most of the active growth period.

### Soil features

Soils associated with this site are very deep and well drained. The soils are formed in residuum and colluvium derived from quartzie with a minor influence from limestone and dolomite. The surface layer is medium textured and is 10 inches or more in thickness to the subsoil or underlying material. A mollic epipedon extends from the surface to bedrock. This site provides a cool, moist environment for plant growth because of the elevations where it occurs. The soil temperature regime is cryic and the soil moisture regime is xeric. Soil temperatures and evaporation potentials are limited during the growing season due to reduced insolation. Snow accumulation persists on this site late into spring when the soil is not frozen. Snowmelt, at this time, is added to the soil moisture supply and is available during most of the active growth period. Runoff from this site is medium to very high and the potential for

sheet and rill erosion is low to moderate depending on slope. The soil series associated with this site include: Badhap and Successloop.

The representative soil series is Badhap, a Loamy-skeletal, mixed, superactive Pachic Haplocryolls. Diagnostic horizons include a mollic epipedon from the soil surface to 44 inches. Clay content in the particle control section averages 18 to 27 percent. Rock fragments range from 35 to 60 percent; Some pedons contain sub-horizons that range up to 70 percent. Reaction is slightly acid or neutral. Effervescence is none. Lithology consists of quartzite with a component of loess.

**Table 4. Representative soil features**

|  |   |
|--|---|
| Parent material  | (1) Colluvium–quartzite<br>(2) Residuum–quartzite |
| Surface texture  | (1) Very gravelly loam                            |
| Family particle size                                     | (1) Loamy   |
| Drainage class   | Well drained                                      |
| Permeability class                                       | Moderate to moderately rapid                      |
| Soil depth   | 152–213 cm  |
| Surface fragment cover <=3"                              | 30–35%  |
| Surface fragment cover >3"                               | 0–5%  |
| Available water capacity<br>(0-101.6cm)                  | 8.64–8.89 cm                                      |
| Calcium carbonate equivalent<br>(0-101.6cm)              | 0%  |
| Electrical conductivity<br>(0-101.6cm)                   | 0 mmhos/cm  |
| Sodium adsorption ratio<br>(0-101.6cm)                   | 0   |
| Soil reaction (1:1 water)<br>(0-101.6cm)                 | 6.2–7.4   |
| Subsurface fragment volume <=3"<br>(Depth not specified) | 35–60%  |
| Subsurface fragment volume >3"<br>(Depth not specified)  | 0–45%   |

## Ecological dynamics

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

The 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. (Comstock and Ehleringer 1992). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992). The perennial bunchgrasses generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. General differences in root depth distributions between grasses and shrubs

results in resource partitioning in these shrub/grass systems.

Mountain big sagebrush, mountain snowberry and Utah serviceberry are generally long-lived; therefore it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent large recruitment events and simultaneous low, continuous recruitment is the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent on adequate moisture conditions. Aroga moth can partially or entirely kill individual big sagebrush plants (Furniss and Barr 1975), however it is unlikely that entire stands of sagebrush will be severely affected in sites at high elevation such as this.

The perennial bunchgrasses that are co-dominant with the shrubs include bromes, slender wheatgrass, needlegrasses, sedges and bluegrasses. These species generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. Differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource uptake by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al 2007). Dobrowolski et al. (1990) cite multiple authors on the extent of the soil profile exploited by the competitive exotic annual cheatgrass. Specifically, the depth of rooting is dependent on the size the plant achieves and in competitive environments cheatgrass roots were found to penetrate only 15 cm whereas isolated plants and pure stands were found to root at least 1 m in depth with some plants rooting as deep as 1.5 to 1.7 m.

The ecological site has moderate to high resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, precipitation, and nutrient availability. Long-term disturbance response may be influenced by small differences in landscape topography. Concave areas receive run-in from adjacent landscapes and consequently retain more moisture to support the growth of deep-rooted perennial grasses (i.e. bluebunch wheatgrass) whereas convex areas where runoff occurs are slightly less resilient and may have more shallow-rooted perennial grasses (i.e. muttongrass). North slopes are also more resilient than south slopes because lower soil surface temperatures operate to keep moisture content higher on northern exposures. Two possible alternative stable states have been identified for this site.

#### Fire Ecology:

Fire is believed to be the dominant disturbance force in natural big sagebrush communities. Several authors suggest pre-settlement fire return intervals in mountain big sagebrush communities varied from 15 to 25 years (Burkhardt and Tisdale 1969, Houston 1973, and Miller et al. 2000). Kitchen and McArthur (2007) suggest a mean fire return interval of 40 to 80 years for mountain big sagebrush communities. The range from 15 to 80 years is probably more accurate and reflects the differences in elevation and precipitation where mountain big sagebrush communities occur. On a landscape scale, multiple seral stages were represented in a mosaic reflecting periodic reoccurrence of fire and other disturbances (Crawford et al 2004). Post-fire hydrologic recovery and resilience is primarily influenced by pre-fire site conditions, fire severity, and post-fire weather and land use that relate to vegetation recovery. Fire adaptation by herbaceous species is generally superior to the dominant shrubs, which are typically killed by fire. Sites with low abundances of native perennial grasses and forbs typically have reduced resiliency following disturbance and are less resistant to invasion or increases in cheatgrass (Miller et al 2013).

Mountain big sagebrush is killed by fire (Neuenschwander 1980, Blaisdell et al. 1982) and does not resprout (Blaisdell 1953). Post fire regeneration occurs from seed and will vary depending on site characteristics, seed source, and fire characteristics. Mountain big sagebrush seedlings can grow rapidly and may reach reproductive maturity within 3 to 5 years (Bunting et al. 1987). Mountain big sagebrush may return to pre-burn density and cover within 15-20 years following fire, but establishment after severe fires may proceed more slowly (Bunting et al. 1987).

Depending on fire severity, rabbitbrush, mountain snowberry, Utah serviceberry and creeping barberry may increase after fire. Douglas' rabbitbrush is top-killed by fire, but sprouts vigorously after fire (Kuntz 1982, Akinsoji 1988). Snowberry and creeping barberry are also top-killed by fire, but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Snowberry has been noted to regenerate well and exceed pre-burn

biomass in the third season after a fire (Merrill et al. 1982). If balsamroot or mules ear is common before fire, they will increase after fire or with heavy grazing (Wright 1985). Utah serviceberry resprouts from the root crown.

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).

## State and transition model

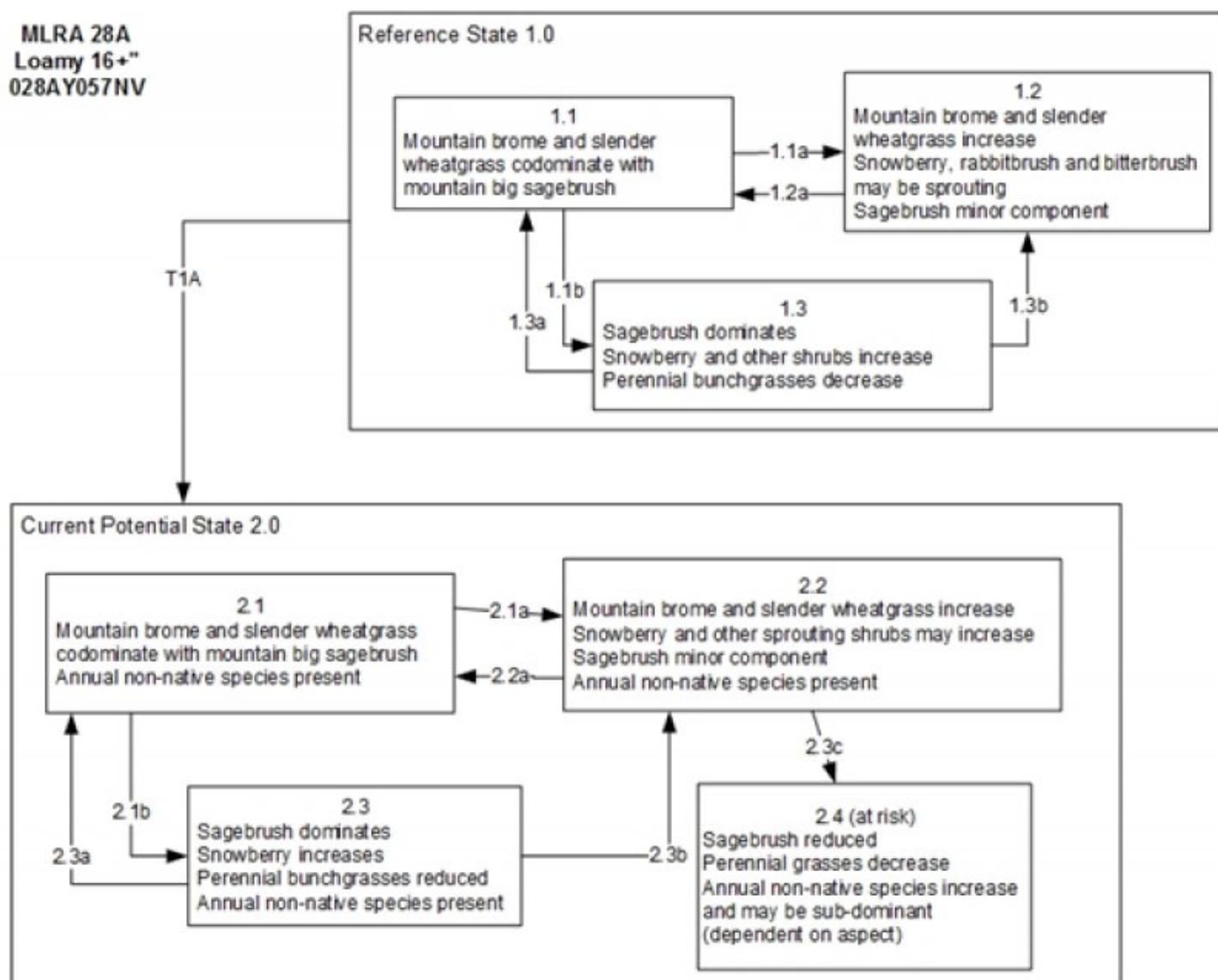


Figure 6. State and Transition Model

#### 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 long-term drought. Excessive herbivory may also decrease perennial understory.  
1.2a: Time and lack of disturbance allows for regeneration of sagebrush.  
1.3a: Low severity fire resulting in a mosaic pattern.  
1.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non native species.

#### Current Potential State 2.0 Community Phase Pathways

- 2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs.  
2.1b: Time and lack of disturbance such as fire or long-term drought; inappropriate grazing management may also decrease perennial understory.  
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.  
2.2b: Fire in the presence of annual grass species coupled with heavy spring precipitation.  
2.3a: Low severity fire creates sagebrush/grass mosaic. Brush management with minimal soil disturbance; late-fall/winter grazing causing mechanical damage to sagebrush.  
2.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Figure 7. Legend

## State 1 Reference State

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

## Community 1.1 Community Phase

This community phase is dominated by mountain brome, slender wheatgrass and Columbia and western needlegrass. Mountain big sagebrush is the major overstory shrub in this plant community. Potential vegetative compositions is about 60% grasses and grass-likes, 10% forbs and 30% shrubs. Approximate ground cover (basal and canopy) is 25 to 45 percent.

Table 5. Annual production by plant type

| Plant Type      | Low<br>(Kg/Hectare) | Representative Value<br>(Kg/Hectare) | High<br>(Kg/Hectare) |
|-----------------|---------------------|--------------------------------------|----------------------|
| Grass/Grasslike | 673                 | 1009                                 | 1547                 |
| Shrub/Vine      | 336                 | 504                                  | 773                  |
| Forb            | 112                 | 168                                  | 258                  |
| <b>Total</b>    | <b>1121</b>         | <b>1681</b>                          | <b>2578</b>          |

## Community 1.2 Community Phase

Mountain big sagebrush is reduced and the perennial bunchgrasses in the understory increase. Mountain

snowberry, rabbitbrush, Utah serviceberry, creeping barberry, chokecherry and elderberry may be sprouting.

### **Community 1.3**

#### **Community Phase**

Mountain big sagebrush increases in the absence of disturbance or with grazing management that favors shrubs. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from grazing management.

#### **Pathway a**

#### **Community 1.1 to 1.2**

Low severity fire creates sagebrush/grass mosaic; higher intensity fires significantly reduce sagebrush cover and lead to early/mid seral community dominated by grasses and forbs.

#### **Pathway b**

#### **Community 1.1 to 1.3**

Absence of fire over time allows for sagebrush to increase; inappropriate grazing may also reduce fine fuels and lead to reduced fire frequency and increased shrub cover.

#### **Pathway a**

#### **Community 1.2 to 1.1**

Absence of fire over time allows mountain big sagebrush to increase. Grazing management that favors shrubs may accelerate this transition.

#### **Pathway a**

#### **Community 1.3 to 1.1**

Aroga moth infestation would reduce the mountain big sagebrush overstory and allow the perennial bunchgrasses to recover.

#### **Pathway b**

#### **Community 1.3 to 1.2**

Fire would reduce the mountain big sagebrush and allow the perennial bunchgrasses to dominate the site.

### **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-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.

### **Community 2.1**

#### **Community Phase**

The plant community consists of mountain big sagebrush as the major overstory shrub, with snowberry also common on this site. Bluebunch wheatgrass is the dominant understory species. Annual non-native species are now present in this community. Cheatgrass is the species most likely to invade.



## **Community 2.2**

### **Community Phase**

Mountain big sagebrush is reduced. Mountain snowberry, rabbitbrush, Utah serviceberry, creeping barberry, chokecherry and elderberry may be sprouting or may dominate the overstory. Perennial bunchgrasses in the understory increase and dominate. Annual non-native species are stable to increasing.

## **Community 2.3**

### **Community Phase**

Mountain big sagebrush increases and the perennial understory is reduced. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from grazing management. Perennial forbs such as mules-ear may increase with inappropriate grazing management. Annual non-natives are present.

## **Community 2.4**

### **Community Phase (at risk)**

This phase is characterized by an increase of annual non-native species such as cheatgrass. Mountain big sagebrush and perennial bunchgrasses such as bluebunch wheatgrass still dominate. This site is unlikely to go to an annual phase due to the amount of precipitation and high elevation, but this phase is very at risk of another fire. Years with heavy spring precipitation will cause an increase in the amount of cheatgrass in the understory. Targeted grazing could be used to reduce seed production and density of non-natives.

## **Pathway a**

### **Community 2.1 to 2.2**

Low severity fire creates sagebrush/grass mosaic; high intensity fires significantly reduce sagebrush cover and lead to early/mid seral community dominated by grasses and forbs.

## **Pathway b**

### **Community 2.1 to 2.3**

Absence of fire over time allows for sagebrush to increase. Inappropriate grazing may also reduce fine fuels and lead to reduced fire frequency and increased shrub cover.

## **Pathway a**

### **Community 2.2 to 2.1**

Time without disturbance allows for mountain big sagebrush to recover as well as other perennial bunchgrasses.

## **Pathway b**

### **Community 2.2 to 2.4**

A disturbance such as fire or brush treatment, when applied in the presence of non-native annual grasses like cheatgrass allows these non-natives to increase in abundance. This pathway occurs in years with heavy spring precipitation.

## **Pathway a**

### **Community 2.3 to 2.1**

An aroga moth infestation that reduces shrub cover or a change in management that encourages growth of bunchgrasses allows for perennial bunchgrasses to increase. Release from drought conditions may also cause an increase in the amount of grasses.

**Pathway b**  
**Community 2.3 to 2.2**

Fire reduces mountain big sagebrush overstory and allows for perennial bunchgrasses to increase.

**Transition A**  
**State 1 to 2**

Trigger: Introduction of annual non-native species Slow variable: Over time the annual non-native plants will increase within the community. 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.

**Additional community tables**

Table 6. Community 1.1 plant community composition

| Group                  | Common Name                        | Symbol | Scientific Name  | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|------------------------|------------------------------------|--------|--|--------------------------------|------------------|
| <b>Grass/Grasslike</b> |                                    |        |  |                                |                  |
| 1                      | <b>Primary Perennial Grasses</b>   |        |  | 656–1261                       |                  |
|                        | slender wheatgrass                 | ELTR7  | <i>Elymus trachycaulus</i>                             | 252–420                        | –                |
|                        | nodding brome                      | BRAN   | <i>Bromus anomalus</i>                                 | 126–211                        | –                |
|                        | mountain brome                     | BRMA4  | <i>Bromus marginatus</i>                               | 127–210                        | –                |
|                        | sedge                              | CAREX  | <i>Carex</i>   | 34–84                          | –                |
|                        | Lettermann's needlegrass           | ACLE9  | <i>Achnatherum lettermanii</i>                         | 28–84                          | –                |
|                        | Dore's needlegrass                 | ACNED  | <i>Achnatherum nelsonii</i> ssp. <i>dorei</i>          | 28–84                          | –                |
|                        | western needlegrass                | ACOCO  | <i>Achnatherum occidentale</i> ssp. <i>occidentale</i> | 28–84                          | –                |
| 2                      | <b>Secondary Perennial Grasses</b> |        |  | 84–252                         |                  |
|                        | blue grama                         | BOGR2  | <i>Bouteloua gracilis</i>                              | 9–50                           | –                |
|                        | basin wildrye                      | LECI4  | <i>Leymus cinereus</i>                                 | 9–50                           | –                |
|                        | melicgrass                         | MELIC  | <i>Melica</i>  | 9–50                           | –                |
|                        | bluebunch wheatgrass               | PSSPS  | <i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>     | 9–50                           | –                |
| <b>Forb</b>            |                                    |        |  |                                |                  |
| 3                      | <b>Perennial</b>                   |        |  | 84–252                         |                  |
|                        | aster                              | ASTER  | <i>Aster</i>   | 9–84                           | –                |
|                        | geranium                           | GERAN  | <i>Geranium</i>  | 9–84                           | –                |
|                        | western stone seed                 | LIRU4  | <i>Lithospermum ruderales</i>                          | 9–84                           | –                |
|                        | lupine                             | LUPIN  | <i>Lupinus</i>   | 9–84                           | –                |
|                        | ragwort                            | SENEC  | <i>Senecio</i>   | 9–84                           | –                |
|                        | clover                             | TRIFO  | <i>Trifolium</i>                                       | 9–84                           | –                |
|                        | vetch                              | VICIA  | <i>Vicia</i>   | 9–84                           | –                |
|                        | mule-ears                          | WYAM   | <i>Wyethia amplexicaulis</i>                           | 9–84                           | –                |
| <b>Shrub/Vine</b>      |                                    |        |  |                                |                  |
| 4                      | <b>Primary Shrubs</b>              |        |  | 202–471                        |                  |
|                        | mountain big sagebrush             | ARTRV  | <i>Artemisia tridentata</i> ssp. <i>vaseyana</i>       | 168–336                        | –                |
|                        | mountain snowberry                 | SYOR2  | <i>Symphoricarpos oreophilus</i>                       | 34–135                         | –                |
| 5                      | <b>Secondary Shrubs</b>            |        |  | 34–168                         |                  |
|                        | Utah serviceberry                  | AMUT   | <i>Amelanchier utahensis</i>                           | 17–50                          | –                |
|                        | yellow rabbitbrush                 | CHVI8  | <i>Chrysothamnus viscidiflorus</i>                     | 17–50                          | –                |
|                        | slender buckwheat                  | ERMI4  | <i>Eriogonum microthecum</i>                           | 17–50                          | –                |
|                        | rubber rabbitbrush                 | ERNA10 | <i>Ericameria nauseosa</i>                             | 17–50                          | –                |
|                        | black chokecherry                  | PRVIM  | <i>Prunus virginiana</i> var. <i>melanocarpa</i>       | 17–50                          | –                |
|                        | elderberry                         | SAMBU  | <i>Sambucus</i>  | 17–50                          | –                |

## Animal community

Livestock Interpretations:

This site is suitable for livestock grazing. Considerations for grazing management including timing, intensity and duration of grazing. Targeted grazing could be used to decrease the density of non-natives.

Mountain brome is one of the most important forage grasses on this site. Mountain brome is ranked as excellent forage for both cattle and horses and good for domestic sheep. Domestic sheep will graze mountain brome only when it is fairly succulent. Palatability for nodding brome is high for grazers and medium for browsers. Slender wheatgrass is grazed by all classes of livestock. Columbia needlegrass provides valuable forage for all classes of livestock. Overall production is generally low in the upper sagebrush and mountain brush zones and at the limits of its range where Columbia needlegrass grows only in scattered patches. It is especially valuable to cattle and horses on summer ranges and to domestic sheep on lambing grounds. It is more often cropped closely by cattle and horses than by sheep. Western needlegrass has a spreading and deeply penetrating root system, which makes it resistant to trampling. Letterman's needlegrass begins growth early in the year and remains green throughout the relatively long growing season, thus, making it valuable forage for livestock. Nevada bluegrass is a palatable species, but its production is closely tied to weather conditions. It produces little forage in drought years, making it a less dependable food source than other perennial bunchgrasses. Mountain big sagebrush is eaten by domestic livestock but has long been considered to be of low palatability, and a competitor to more desirable species. Mountain snowberry is readily eaten by all classes of livestock, particularly domestic sheep. Inappropriate grazing management leads to a decline in understory plants like bluebunch wheatgrass and an increase in big sagebrush. Muttongrass may increase temporarily with further degradation. Invasion of annual weedy forbs and cheatgrass could occur with further grazing degradation, leading to an increase in bare ground. A combination of overgrazing and prolonged drought may lead to soil redistribution, increased bare ground and a loss in plant production. 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:

Many wildlife species are dependent on the sagebrush ecosystem including the greater sage grouse, sage sparrow, pygmy rabbit and the sagebrush vole. Dobkin and Sauder (2004) identified 61 species, including 24 mammals and 37 birds, associated with the shrub-steppe habitats of the Intermountain West. Mountain big sagebrush is important to wildlife for both food and cover. Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer, elk and pronghorn. Elk (*Alces alces*) and pronghorn antelope (*Antilocapra americana*) prefer mountain big sagebrush over basin and Wyoming sagebrush (Beale and Smith 1970, Wambolt 1996). A study by Brown (1977) determined that desert bighorn sheep (*Ovis canadensis nelsoni*) preferred big sagebrush over other shrub types; however, the variety was not noted. Welch and Wagstaff (1992) noted in a study near Provo, Utah, mountain big sagebrush was highly preferred winter forage of mule deer (*Odocoileus hemionus*) over other available forage. Other studies have determined, in the same study area, that mountain big sagebrush is preferred by both wintering domestic sheep as well as mule deer (Welch et al. 1986).

Furthermore, wildlife use a variety of associated understory plants and soils that occur in basin big sagebrush habitat. For example: sage grouse (*Centrocercus urophasianus*), sagebrush vole (*Lemmiscus curtatus*), Merriam's shrew (*Sorex merriami*) and Preble's shrew (*Sorex preblei*) use the grasses that occur with mountain big sagebrush for nesting, cover and forage. Mountain big sagebrush sandy soil sites provide burrowing opportunities and protection from predators for burrowing owls (*Athene cunicularia*), dark and pale kangaroo mice (*Microdipodops megacephalus* and *Microdipodops pallidus*, respectively). Mountain big sagebrush that occur on woodland and rock ecotones provides nesting and foraging habitat for the ferruginous hawk (*Buteo regalis*) (Nevada Wildlife Action Plan 2012). Deer and elk make heavy use of muttongrass, especially in early spring when other green forage is scarce. Depending upon availability of other nutritious forage, deer may use mutton grass in all seasons. Muttongrass cures well and is an important fall and winter deer food in some areas.

Several reptiles and amphibians are distributed throughout the sagebrush steppe in the west in Nevada. (Bernard and Brown 1977). Reptile species including: eastern racers (*Coluber constrictor*), ringneck snakes (*Diadophis punctatus*), night snakes (*Hypsiglena torquata*), Sonoran mountain kingsnakes (*Lampropeltis pyromelana*), striped whipsnakes (*Masticophis taeniatus*), gopher snakes (*Pituophis catenifer*), long-nosed snakes (*Rhinocheilus lecontei*), wandering garter snakes (*Thamnophis elegans vagrans*), Great Basin rattlesnakes (*Crotalus oreganus lutosus*), Great Basin collared lizard (*Crotaphytus bicinctores*), long-nosed leopard lizard (*Gambelia wislizenii*), short-horned lizard (*Phrynosoma douglassi*), desert-horned lizard (*Phrynosoma platyrhinos*), sagebrush lizards (*Sceloporus graciosus*), western fence lizards (*Sceloporus occidentalis*), northern side-blotched lizards (*Uta stansburiana*), western skinks (*Plestiodon skiltonianus*), and Great Basin whiptails (*Aspidoscelis tigris*) occur in areas where sagebrush is dominant. Similarly, amphibians such as: western toads (*Anaxyrus boreas*), Woodhouse's toads (*Anaxyrus woodhousii*), northern leopard frogs (*Lithobates pipiens*), Columbia spotted frogs (*Rana luteiventris*), bullfrogs (*Lithobates catesbeianus*), and Great Basin spadefoots (*Spea intermontana*) also occur throughout the Great Basin in areas sagebrush species are dominant (Hamilton 2004). Studies have not determined if reptiles and amphibians prefer certain species of sagebrush; however, researchers agree that

maintaining habitat where big sagebrush and reptiles and amphibians occur is important. In fact, wildlife biologists have noticed declines in reptiles where sagebrush steppe habitat has been seeded with introduced grasses (West 1999 and ref. therein).

Sagebrush communities are important for maintaining lagomorph and rodent populations. Pygmy rabbits, sagebrush obligates, use sites with big sagebrush at a higher intensity than low sagebrush sites (Heady and Laundre 2005). A study by Larrison and Johnson (1973) captured more deer mice in big sagebrush communities than in any other plant community. Although specific varieties of big sagebrush are not mentioned in these studies, thus, suggests that deer mice prefer big sagebrush plant communities where mountain big sagebrush are present, for cover over other plant communities.

It should be noted that sagebrush-grassland communities provide critical sage-grouse (*Centrocercus urophasianus*) 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.

Mountain snowberry is considered important browse for many types of wildlife. Bighorn sheep use mountain snowberry regularly during the summer. Forage value to elk is fair. Mountain snowberry is important as both cover and food for bird and small mammal populations. These include sharp-tailed, ruffed, and blue grouse, wild turkey and, several non-game species of bird including the kingbird, western flycatcher, and western bluebird. Among small mammals that rely on mountain snowberry are fox squirrels, desert cottontails, and pocket gopher. Bluebunch wheatgrass is considered one of the most important forage grass species on western rangelands for wildlife. Bluebunch wheatgrass does not generally provide sufficient cover for ungulates, however, mule deer are frequently found in bluebunch-dominated grasslands. Slender wheatgrass is grazed by sage grouse, deer, elk, moose, bighorn sheep, mountain goat, pronghorn, and various rodents. The seeds are eaten by various seed predators.

**Hydrological functions**

Permeability is moderately slow. Runoff is high. Hydrologic soil group is B.

**Recreational uses**

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

**Other products**

Native Americans used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing.

**Other information**

Mountain snowberry is useful for establishing cover on bare sites and has done well when planted onto roadbanks. Mountain brome is an excellent native bunchgrass for seeding alone or in mixtures in disturbed areas, including depleted rangelands, burned areas, roadways, mined lands, and degraded riparian zones. Slender wheatgrass is widely used for revegetating disturbed lands. Slender wheatgrass is a short-lived perennial with good seedling vigor. It germinates and establishes quickly when seeded making it a good choice for quick cover on disturbed sites. It persists long enough for other, slower developing species to establish. It is especially valuable for use in saline soils. It has been used for rehabilitating mine spoils, livestock ranges, and wildlife habitat and watershed areas. Letterman’s needlegrass has been used successfully in revegetating mine spoils. This species also has good potential for erosion control.

**Type locality**

|                                   |               |
|-----------------------------------|---------------|
| Location 1: White Pine County, NV |               |
| Township/Range/Section            | T14N R68E S26 |
| Latitude                          | 39° 2’ 56”    |

|                           |  |
|---------------------------|--|
| Longitude                 | 114° 18' 33"   |
| General legal description | Upper Strawberry Creek east of Windy Canyon, Great Basin National Park, Snake Range, White Pine County, Nevada |

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## Contributors

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## 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)                    | P. NOVAK-ECHENIQUE                    |
| Contact for lead author                     | STATE RANGELAND MANAGEMENT SPECIALIST |
| Date  | 03/23/2015                            |
| Approved by                                 |                                       |
| Approval date                               |                                       |
| Composition (Indicators 10 and 12) based on | Annual Production                     |

## Indicators

1. **Number and extent of rills:** None to rare. A few may occur on steeper slopes after summer convection storms. These will be short and stable. They will begin to heal during the next growing season.
-



2. **Presence of water flow patterns:** Water flow patterns are typically none to rare. Water flow patterns may rarely be observed on steeper slopes in areas recently subjected to summer convection storms or rapid spring snowmelt. These will be short (<2m) meandering and stable.
- 
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 should not be considered a "normal" condition.
- 
4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 5-20% 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 (<5 m) during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.
- 
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 4 to 6 on most soil textures found on this site.
- 
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically medium fine granular. Soil surface colors are browns or dark grayish browns and soils are typified by a mollic epipedon. Surface textures are very gravelly loams. Organic matter of the surface 2 to 4 inches is typically 2 to 4 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.
- 
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., needlegrasses] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.
- 
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. Platy or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted.
- 
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 State: Deep-rooted, cool season, perennial bunchgrasses > .

Sub-dominant: tall shrubs (mountain big sagebrush) > associated shrubs > deep-rooted, cool season, perennial forbs > shallow-rooted, cool season, perennial grasses = fibrous, shallow-rooted, cool season, perennial and annual forbs

Other:

Additional: With an extended fire return interval, the shrub component will increase at the expense of the herbaceous component.

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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.
- 

14. **Average percent litter cover (%) and depth ( in):** Between plant interspaces ( $\pm 35\%$ ) 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 June)  $\pm 1500$  lbs/ac; Favorable years  $\pm 2300$  lbs/ac and unfavorable years  $\pm 1000$  lbs/ac.
- 

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 include cheatgrass and Kentucky bluegrass.
- 

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Reduced growth and reproduction occur during extreme drought or extended drought conditions.
-