USDA Natural Resources Conservation Service

Ecological site R028BY085NV
CALCAREOUS LOAM 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.

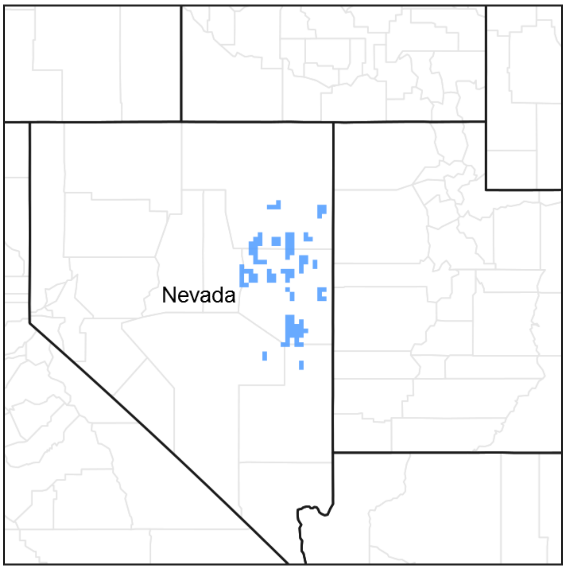

Figure 1. Mapped extent

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): 028B–Central Nevada Basin and Range

MLRA 28B occurs entirely in Nevada and comprises about 23,555 square miles (61,035 square kilometers). More than nine-tenths of this MLRA is federally owned. This area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep sideslopes. Many of the valleys are closed basins containing sinks or playas. Elevation ranges from 4,900 to 6,550 feet (1,495 to 1,995 meters) in the valleys and basins and from 6,550 to 11,900 feet (1,995 to 3,630 meters) in the mountains.
The mountains in the southern half are dominated by andesite and basalt rocks that were formed in the Miocene and Oligocene. Paleozoic and older carbonate rocks are prominent in the mountains to the north. Scattered outcrops of older Tertiary intrusives and very young tuffaceous sediments are throughout this area. The valleys consist mostly of alluvial fill, but lake deposits are at the lowest elevations in the closed basins. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Sands, silts, and clays are on the distal ends of the fans.
The average annual precipitation ranges from 4 to 12 inches (100 to 305 millimeters) in most areas on the valley floors. Average annual precipitation in the mountains ranges from 8 to 36 inches (205 to 915 millimeters) depending on elevation. The driest period is from midsummer to midautumn. The average annual temperature is 34 to 52 degrees F (1 to 11 degrees C). The freeze-free period averages 125 days and ranges from 80 to 170 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 soil temperature regime, an aridic or xeric soil moisture regime, and mixed or carbonatic mineralogy. They generally are well drained, loamy or loamyskeletal, and shallow to very deep.
Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms and heavy snowfall in the higher mountains. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. 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, as a result 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 midlatitude 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 occasional thundershowers. The eastern portion of the state receives noteworthy 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).

Ecological site concept

This site is found on mountains. Slopes gradients of 4 to 30 percent are typical and elevations range from 8000 to 10,000 feet.
The soils associated with this site are very deep to bedrock, well drained and formed in residuum and colluvium derived from limestone and dolomite. Soils are characterized by a mollic epipedon, carbonate minerology and greater than 35% rock fragments by volume. The available water holding capacity is moderate. Soil moisture regime is xeric and the temperature regime is cryic.

The reference state is dominated by bluebunch wheatgrass, Columbia needlegrass, Letterman's needlegrass and mountain big sagebrush. Production ranges from 900 to 1400 pounds per acre.

Important abiotic factors contributing to the presence of this site include high runoff, cold soil temperatures and a short growing season.

Associated sites

F028BY063NV	**ABCOC-PIFL2-PILO/ARTRV/LEKI2**
R028BY043NV	**CALCAREOUS MAHOGANY SAVANNA**
R028BY070NV	**MOUNTAIN LOAM 16+ P.Z.**
R028BY091NV	**GRAVELLY CALCAREOUS LOAM 14+ P.Z. burned phase**

Similar sites

R028BY087NV	**GRAVELLY CLAY 12-14 P.Z.** PSSP-ACTH7 codominant grasses
R028BY030NV	**LOAMY 12-16 P.Z.** ACTH7 codominant grass; BRMA4, ACNE9, & ACLE9 absent; less diversity of mountain browse species
R028BY070NV	**MOUNTAIN LOAM 16+ P.Z.** BRMA4 & ACNE9 rare to absent; shallow soils; less productive site

R028BY079NV	**SHALLOW LOAM 10-14 P.Z.** PSSP-ACHY codominant grasses; shallow soils; less productive site
R028BY088NV	**CALCAREOUS LOAM 14-16 P.Z.** PSSP dominant grass; BRMA4, ACNE9 & ACLE9 rare to absent, less productive, mollic (not pachic) epipedon, frigid soil temperature
R028BY094NV	**CALCAREOUS LOAM 10-14 P.Z.** BRMA4, ACNE9 & ACLE9 absent; less productive site
R028BY015NV	**LOAMY SLOPE 12-16 P.Z.** ACTH7 and/or ACOC3 major needlegrass spp.; BRMA4, ACNE9, & ACLE9 rare to absent

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. vaseyana*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Achnatherum*

Physiographic features

This site occurs on mountains, including sideslopes and footslopes. Slopes range from 8 to 75 percent, but slope gradients of 4 to 30 percent are typical. Elevations range from 8000 to 10,000 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Mountain slope
Elevation	8,000–10,000 ft
Slope	4–30%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.

Average annual precipitation ranges from 16 to over 22 inches. Mean annual air temperature is about 40 to 43 degrees F. The average growing season is about 50 to 70 days.

Weather stations with a long term data record are currently not available for this ecological site. Associated climate data will be updated when information becomes available.

Table 3. Representative climatic features

Frost-free period (average)	50 days
Freeze-free period (average)	70 days
Precipitation total (average)	19 in

Influencing water features

Influencing water features are not associated with this site.

Soil features

The soils associated with this site are very deep, well drained and formed in residuum and colluvium derived from limestone and dolomite. The soils have a mollic epipedon, carbonate minerology and greater than 35% rock fragments by volume. Organic carbon content of A horizons in the profile averages between 3 and 8 percent decreasing rapidly with depth. The bulk density of organic rich horizons averages less than 1.2 kPa. Soils are characterized by a xeric soil moisture regime and a cryic soil temperature regime. The soil surface is covered with approximately 40% rock fragments. Available water holding capacity is moderate and runoff is high. The soil series associated with this site is Lorgana (tentative).

Lorgana is a loamy-skeletal, carbonatic Pachic Haplocryoll. Diagnostic horizons include a pachic mollic epipedon from the soil surface to 66cm. Clay content in the particle size control section ranges from 20-27% and rock fragments are 45-70%, consisting mainly of gravels. Soils are slightly to strongly effervescent, increasing with depth. Parent material is limestone and dolomite.

Representative areas of this ecological site will be field checked to confirm the new soil series, Lorgana. This will help to define abiotic features contributing to the presence of this site

Table 4. Representative soil features

Parent material	(1) Residuum–dolomite (2) Colluvium–limestone
Surface texture	(1) Very gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	60–84 in
Surface fragment cover <=3"	15–25%
Surface fragment cover >3"	15–25%
Available water capacity (0-40in)	3–5 in
Calcium carbonate equivalent (0-40in)	1–25%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	30–75%
Subsurface fragment volume >3" (Depth not specified)	10–25%

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.
The perennial bunchgrasses that are co-dominant with the shrubs include bluebunch wheatgrass, needlegrasses, mountain brome and spike fescue. 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.

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, mountain snowberry, Utah serviceberry and green ephedra may increase after fire. Mountain snowberry is top-killed by fire, but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Snowberry has been noted to regenerate well and exceed pre-burn biomass in the third season after

a fire (Merrill et al. 1982). Utah serviceberry and green ephedra sprout from the root crown after fire.
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). Muttongrass, a minor component on this site, is top killed by fire but will resprout after low to moderate severity fires. A study by Vose and White (1991) in an open sawtimber site found minimal difference in overall effect of burning on mutton grass.
Fire will remove aboveground biomass from bluebunch wheatgrass but plant mortality is generally low (Robberecht and Defossé 1995) because the buds are underground (Conrad and Poulton 1966) or protected by foliage. Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass. Thus, bluebunch wheatgrass is considered to experience slight damage to fire but is more susceptible in drought years (Young 1983). Plant response will vary depending on season, fire severity, fire intensity and post-fire soil moisture availability.

State and transition model

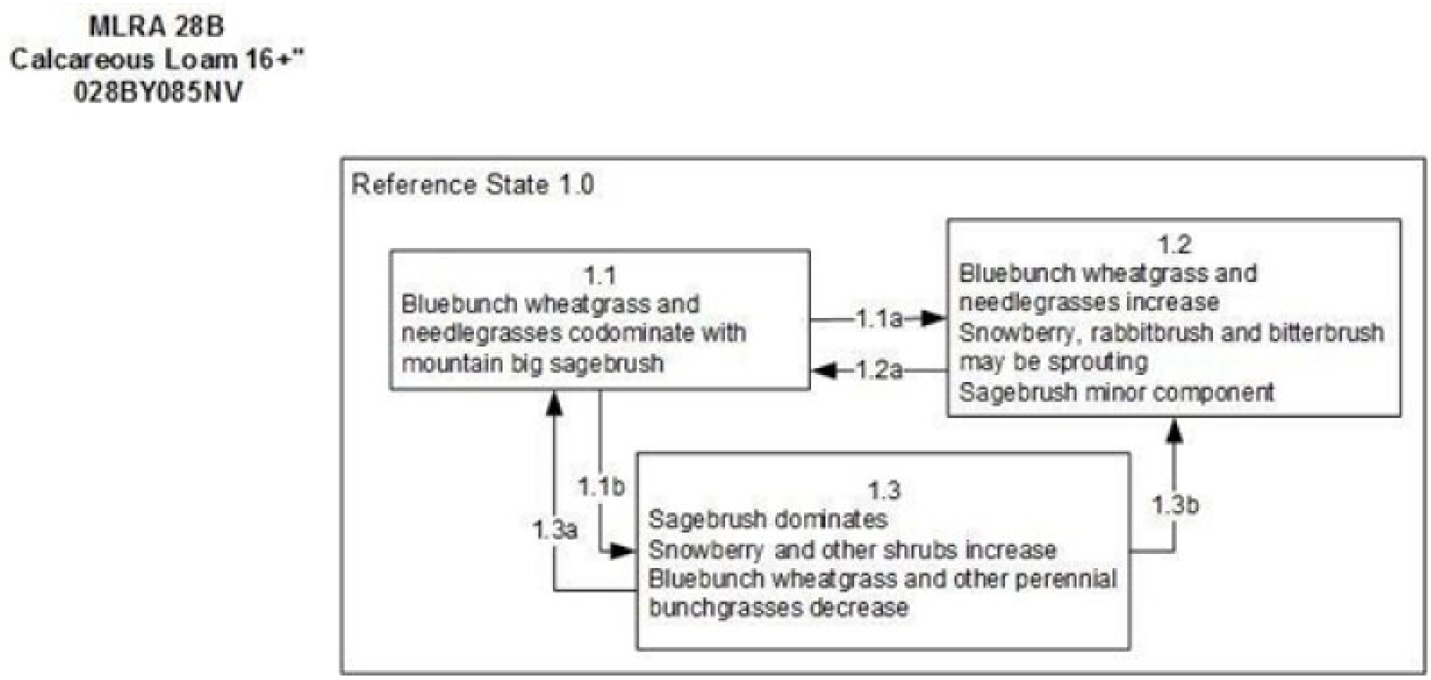

Figure 4. State and Transition Model


MLRA 28B
Calcareous Loam 16+"
028BY085NV

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.

Figure 5. 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

The plant community is dominated by bluebunch wheatgrass, Columbia needlegrass, Letterman's needlegrass and mountain big sagebrush. Potential vegetative composition is about 50% grasses, 10% forbs and 40% shrubs. Approximate ground cover (basal and crown) is 35 to 50 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	450	550	700
Shrub/Vine	360	440	560
Forb	90	110	140
Total	**900**	**1100**	**1400**

Community 1.2
Community Phase

Mountain big sagebrush is reduced and the perennial bunchgrasses in the understory increase. Mountain snowberry, Utah serviceberry and green ephedra may be sprouting.

Community 1.3
Community Phase

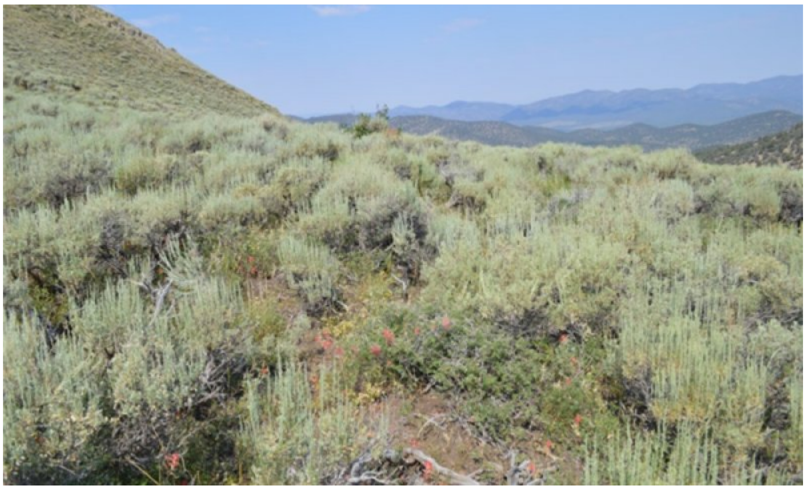

Figure 7. Calcareous Loam 16+" (R028BY085NV) T. Stringham July 2013

Figure 8. Calcareous Loam 16+" (R028BY085NV) T. Stringham July 2013

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.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			450–700	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	165–220	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	83–165	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	83–165	–
	mountain brome	BRMA4	*Bromus marginatus*	55–110	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	55–110	–
	spike fescue	LEKI2	*Leucopoa kingii*	55–110	–
2	**Secondary Perennial Grasses**			55–165	
	big squirreltail	ELMU3	*Elymus multisetus*	6–30	–
	basin wildrye	LECI4	*Leymus cinereus*	6–30	–
	bluegrass	POA	*Poa*	6–30	–
	muttongrass	POFE	*Poa fendleriana*	6–30	–
Forb					
3	**Perennial**			55–165	
	basin wildrye	LECI4	*Leymus cinereus*	6–33	–
	milkvetch	ASTRA	*Astragalus*	6–30	–
	hawksbeard	CREPI	*Crepis*	6–30	–
	buckwheat	ERIOG	*Eriogonum*	6–30	–
	lupine	LUPIN	*Lupinus*	6–30	–
	beardtongue	PENST	*Penstemon*	6–30	–
Shrub/Vine					
4	**Primary Shrubs**			187–418	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	165–275	–
	snowberry	SYMPH	*Symphoricarpos*	22–88	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	10–55	–
5	**Secondary Shrubs**			55–165	
	mormon tea	EPVI	*Ephedra viridis*	6–33	–
	chokecherry	PRVI	*Prunus virginiana*	6–33	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	6–33	–
	currant	RIBES	*Ribes*	6–33	–
	gooseberry currant	RIMO2	*Ribes montigenum*	6–33	–

Animal community

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. There is evidence that wild ungulates utlize mountain big sagebrush as winter browse. Fecal samples from ungulates in Montana showed that big horn sheep, mule deer, and elk all consumed mountain big sagebrush in small amounts in winter, while cattle had no sign of sagebrush use. This same study found that juniper (mostly juniperus horizontalis) constituted half of the diet of mule deer and approximately 1/6 of the late winter diets of elk and bighorn sheep (Kasworm et al. 1984). In studies by Personius et al (1987) and Sheehy and Winward (1981), mountain big sagebrush was one of the most preferred taxon by mule deer.

Inappropriate grazing management leads to a decline in understory plants like bluebunch wheatgrass and an increase in big sagebrush. Muttongrass many 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.

Antelope bitterbrush is an important shrub species to a variety of animals, such as domestic livestock, antelope, deer, and elk. Bitterbrush is critical browse for mule deer, as well as domestic livestock, antelope, and elk (Wood 1995). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953).

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

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management should be keyed to perennial grass production. Bluebunch wheatgrass is considered one of the most important forage grass species on western rangelands for livestock. Although bluebunch wheatgrass can be a crucial source of forage, it is not necessarily the most highly preferred species. 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. 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. Columbia needlegrass is palatable to livestock throughout its range. As with most needlegrasses, it is most palatable early in the season before the foliage becomes coarse and wiry. Palatability to cows and horses is increased because large amounts of fine leafage remain green throughout the gowing season. Palatability of Columbia needlegrass is described as "fair to good" for cattle and horses, becoming nearly unpalatable at maturity. Mountain brome is one of the most important forage grasses in the quaking aspen zone. 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. Domestic livestock commonly graze spike fescue on spring range. Spike fescue is a highly nutritious, productive, and palatable grass. It is fairly palatable for cattle and domestic sheep in the spring; however, as spike fescue matures in summer it becomes unpalatable and is grazed sparingly. Slender wheatgrass is grazed by all classes of livestock. 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. Snowberry is readily eaten by all classes of livestock, particularly domestic sheep.

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:
Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer and elk. 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. Snowberry is an important forage species for deer and elk on high elevation summer ranges. Snowberry is frequently one of the first species to leaf out, making it a highly sought after food in the early spring.
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 were frequently found in bluebunch-dominated grasslands. Columbia needlegrass provides valuable forage for many

species of wildlife. It is also consumed by mule deer and other wildlife species throughout the growing season. Needlegrasses are a significant component in the diet of pocket gophers. Columbia needlegrass is palatable to many species of wildlife throughout its range. As with most needlegrasses, it is most palatable early in the season before the foliage becomes coarse and wiry. Palatability of Columbia needlegrass is described as "fair" for wildlife overall, becoming nearly unpalatable at maturity. Letterman's needlegrass provides valuable forage for many species of wildlife. It is consumed by mule deer and is most palatable early in the season before the foliage becomes coarse and wiry. Mountain brome seedheads and seeds provide food for many birds and small mammals. Pronghorn antelope will consume mountain brome primarily in the spring. The palatability of mountain brome is excellent for deer, particularly during the late spring and early summer. Spike fescue is frequently browsed by mule deer and elk. Spike fescue provides some cover for smaller mammals and birds. Slender wheatgrass is grazed by sage grouse, deer, elk, moose, and bighorn sheep, mountain goat, pronghorn, various rodents, and all classes of livestock. The seeds are eaten by various seed predators. Slender wheatgrass provides hiding and thermal cover for songbirds, upland game birds, waterfowl, and small mammals.

Hydrological functions

Runoff is medium to high. Permeability is slow to moderate. Rills are none to rare. Rock fragments armor the soil surface. Water flow patterns are none to rare. 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. Gullies are none. Surface structure is subangular blocky or thick platy. Soil surface colors are dark and soils are typified by a mollic epipedon. Organic carbon of the surface 2 to 3 inches is typically 1 to 4 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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 camping and hiking and has potential for upland and big game hunting.

Other products

Native peoples used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing. Utah serviceberry fruits were used by Native Americans and early European explorers in North America for food and medicine.

Other information

Mountain snowberry is useful for establishing cover on bare sites and has done well when planted onto roadbanks. Utah serviceberry has been used to revegetate big game winter range and for surface stabilization. It grows slowly from seed and therefore transplanting may be more successful than seeding for revegetation projects. Letterman’s needlegrass has been used successfully in revegetating mine spoils. This species also has good potential for erosion control. 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.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T12N R62E S13
Latitude	38° 54′ 12″
Longitude	114° 57′ 25″

General legal description	About 6 miles east of Lund in the Egan Range near Sawmill Canyon, White Pine County, Nevada. This site also occurs in Elko County, Nevada.

Other references

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

Anderson, E. W. and R. J. Scherzinger. 1975. Improving quality of winter forage for elk by cattle grazing. Journal of Range Management:120-125.

Blaisdell, J. P. 1953. Ecological effects of planned burning of sagebrush-grass range on the upper Snake River Plains. US Dept. of Agriculture.

Blaisdell, J. P., R. B. Murray, and E. D. McArthur. 1982. Managing intermountain rangelands-sagebrush-grass ranges. USDA Forest Serv. Intermountain Forest and Range Exp. Sta. Gen. Tech. Rep. INT-134.

Blaisdell, J. P. and J. F. Pechanec. 1949. Effects of Herbage Removal at Various Dates on Vigor of Bluebunch Wheatgrass and Arrowleaf Balsamroot. Ecology 30:298-305.

Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. Great Basin Naturalist 50:115-120.

Bunting, S. C., B. M. Kilgore, and C. L. Bushey. 1987. Guidelines for prescribed burning sagebrush-grass rangelands in the northern Great Basin. US Department of Agriculture, Forest Service, Intermountain Research Station Ogden, UT, USA.

Burkhardt, J. W. and E. Tisdale. 1969. Nature and successional status of western juniper vegetation in Idaho. Journal of Range Management:264-270.

Busso, C. A. and J. H. Richards. 1995. Drought and clipping effects on tiller demography andgrowth of two tussock grasses in Utah. Journal of Arid Environments 29:239-251.

Chambers, J.C., B.A. Roundy, R.R. Blank, S.E. Meyer, and A. Whittaker. 2007. What makes Great Basin sagebrush ecosystems invasible by Bromus tectorum? Ecological Monographs 77:117-145.
Clements, C. D. and J. A. Young. 2002. Restoring Antelope Bitterbrush. Rangelands 24:3-6.

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

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

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, and C.S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. Journal of Range Management. 57: 2-19.

Dobrowolski, J.P., Caldwell, M.M. and Richards, J.H. 1990. Basin hydrology and plant root systems. In: Plant Biology of the Basin and Range. Springer-Verlag Pub., New York, NY.
Driscoll, R. S. 1964. A Relict Area in the Central Oregon Juniper Zone. Ecology 45:345-353.

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

Furniss, M. M. and W. F. Barr. 1975. Insects affecting important native shrubs of the northwestern United States. US Intermountain Forest And Range Experiment Station. USDA Forest Service General Technical Report INT INT-19.

Garrison, G. A. 1953. Effects of Clipping on Some Range Shrubs. Journal of Range Management 6:309-317.

Houghton, J.G., C.M. Sakamoto, and R.O. Gifford. 1975. Nevada's Weather and Climate, Special Publication 2. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, NV.

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

Kitchen, S. G. and E. D. McArthur. 2007. Big and black sagebrush landscapes. Pages 73-95 in Fire ecology and mangement of the major ecosystems of southern Utah. Gen. Teck. Rep. RMRMS-GTR-202. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Kasworm, W. F., L. R. Irby, and H. B. I. Pac. 1984. Diets of Ungulates Using Winter Ranges in Northcentral Montana. Journal of Range Management 37:67-71.

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

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

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

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

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

Miller, R. F., T. J. Svejcar, and J. A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management:574-585.

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

Mueggler, W. F. 1975. Rate and Pattern of Vigor Recovery in Idaho Fescue and Bluebunch Wheatgrass. Journal of Range Management 28:198-204.

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

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

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

Noy-Meir, I. 1973. Desert Ecosystems: Environment and Producers. Annual Review of Ecology and Systematics 4:25-51.

Personius, T.L., C. L. Wambolt, J. R. Stephens and R. G. Kelsey. (1987). Crude Terpenoid Influence on Mule Deer Preference for Sagebrush. Journal of Range Management, Vol. 40, No. 1 (Jan., 1987), pp. 84-88

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

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

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

Stringham, T.K., P. Novak-Echenique, P. Blackburn, C. Coombs, D. Snyder and A. Wartgow. 2015. Final Report for USDA Ecological Site Description State-and-Transition Models, Major Land Resource Area 28A and 28B Nevada. University of Nevada Reno, Nevada Agricultural Experiment Station Research Report 2015-01. p. 1524.

Taylor, Jennifer L. 2000. Achnatherum lettermanii. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/

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

USDA-NRCS Plants Database (Online; http://www.plants.usda.gov).

Vose, J. M. and A. S. White. 1991. Biomass response mechanisms of understory species the first year after prescribed burning in an Arizona ponderosa-pine community. Forest Ecology and Management 40:175-187.

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

Wright, H. A. 1971. Why Squirreltail Is More Tolerant to Burning than Needle-and-Thread. Journal of Range Management 24:277-284.

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

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

Young, R. P. 1983. Fire as a vegetation management tool in rangelands of the intermountain region. Pages 18-31 in Managing intermountain rangelands - improvement of range and wildlife habitats. USDA, Forest Service.

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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	11/18/2009
Approved by	PNovak-Echenique
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 may occur on steeper slopes after summer convection storms or rapid snowmelt. These are short and stable. They will begin to heal the next growing season.

2. **Presence of water flow patterns:** Water flow patterns are none to rare. A few may occur on steeper slopes after summer convection storms or rapid snowmelt. These are short (<2m), meandering and not connected.

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

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

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

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

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

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 subangular blocky, thin platy or medium granular. Soil surface colors are browns or dark grayish browns and soils are typified by a mollic epipedon. Surface textures are loams or silt loams. Organic matter of the surface 2 to 3 inches is typically 3 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 (i.e., bluebunch wheatgrass, 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. Subangular blocky or massive structure or subsoil

argillic horizons are not to be interpreted as compacted layers.

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

    Dominant: Reference State: Deep-rooted, cool season, perennial bunchgrasses > tall shrubs (i.e., mountain big sagebrush)

    Sub-dominant: Shallow-rooted, cool season, perennial bunchgrasses = associated shrubs > deep-rooted, cool season, perennial forbs = 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.

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14. **Average percent litter cover (%) and depth (in):** Within plant interspaces (25-35%) and depth of litter 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 (end of June) ~1100 lbs/ac; Spring moisture significantly affects total production. Favorable years ~1500 lbs/ac and unfavorable years ~700 lbs/ac.

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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 include annual mustards and cheatgrass.

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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 drought years.
