Ecological site R025XY041NV
SHALLOW CALCAREOUS SLOPE 14+ P.Z.

Last updated: 4/25/2024
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General information

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

MLRA notes

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

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

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

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

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

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

Water:
The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow in the mountains. Surface water from mountain runoff is generally of excellent quality and suitable for all uses. The basin fill sediments in the narrow alluvial valleys between the mountain ranges provide some ground water for irrigation. The alluvial deposits along the large streams have the most ground water. Based on measurements of water quality in similar deposits in adjacent areas, the basin fill deposits probably contain moderately hard water. The water is suitable for almost all uses. The carbonate rocks in this area are considered aquifers, but they are little used. Springs are common along the edges of the limestone outcrops.

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

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

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

Ecological site concept

This site occurs on moderately steep to steep, linear to convex, mountain sideslopes. Although this site may occur on all aspects, northerly exposures are most common. The characteristic landscape positions for this site discourage snow accumulation. Slopes range from 4 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations are about 6500 to 7500 feet.

The soils associated with this site are derived from sedimentary parent materials that have are high in carbonates. The soils are shallow with depth to bedrock ranging from 14 to 20 inches. These soils normally have from 30 to over 75 percent gravel and cobbles (by volume) distributed throughout their profile. Soil reaction increases with depth and carbonates are common in the subsoil.

The reference plant community is dominated by black sagebrush and Idaho fescue. Cusick's bluegrass, Utah serviceberry, and mountain snowberry are species that are commonly associated with this plant community.

Potential vegetative composition is about 50 percent grasses, 10 percent forbs and 40 percent shrubs. Approximate ground cover (basal and crown) is 20 to 35 percent.

Associated sites

R025XY002NV	**ASPEN THICKET**
R025XY004NV	**LOAMY SLOPE 16+ P.Z.**
R025XY009NV	**SOUTH SLOPE 12-14 P.Z.**
R025XY024NV	**MOUNTAIN RIDGE**
R025XY046NV	**FRACTURED STONY LOAM 14+ P.Z.**

Similar sites

R025XY026NV	**CHANNERY HILL** ACHY codominant grass; less productive site
R025XY024NV	**MOUNTAIN RIDGE** ARAR8-ARNO4 codominant shrubs; less productive site
R025XY055NV	**SHALLOW CLAY SLOPE 10-14 P.Z.** PSSPS dominant grass; less productive site
R025XY057NV	**SHALLOW CLAY LOAM 10-14 P.Z.** PSSPS dominant grass

Table 1. Dominant plant species

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

Physiographic features

This site occurs on moderately steep to steep, linear to convex, mountain sideslopes. Although this site may occur on all aspects, northerly exposures are most common. The characteristic landscape positions for this site discourage snow accumulation. Slopes range from 4 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations are about 6500 to 7500 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,981–2,286 m
Slope	4–75%
Water table depth	152 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.
The average annual precipitation ranges from 10 to 12 inches. Mean annual air temperature is typically <45 degrees F.

Mean annual precipitation across the range in which this ES occurs is 18.58".

Monthly mean precipitation: January 1.65”; February 1.68”; March 1.98”; April 2.43”; May 2.41”; June 1.62”; July 0.61”; August 0.63”; September 0.84”; October 1.41”; November 1.51”; December 1.79”.

*The above data is averaged from the Jarbridge 4N and Lamoille PH WRCC climate stations.
Frost free days (>32): 83.5
Freeze free days (>28): 114

Table 3. Representative climatic features

Frost-free period (characteristic range)	53-55 days
Freeze-free period (characteristic range)	90-93 days
Precipitation total (characteristic range)	356-406 mm
Frost-free period (actual range)	52-56 days
Freeze-free period (actual range)	89-94 days
Precipitation total (actual range)	356-432 mm
Frost-free period (average)	54 days
Freeze-free period (average)	92 days
Precipitation total (average)	381 mm

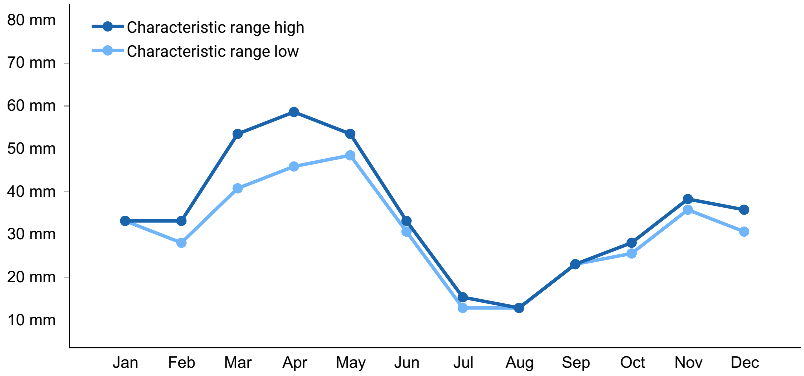


Figure 1. Monthly precipitation range

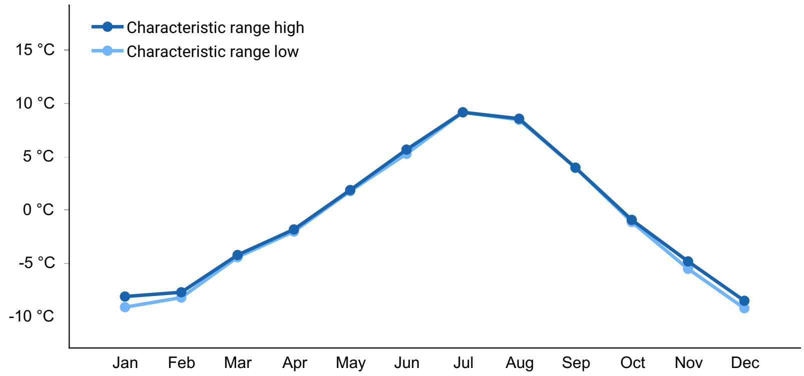


Figure 2. Monthly minimum temperature range

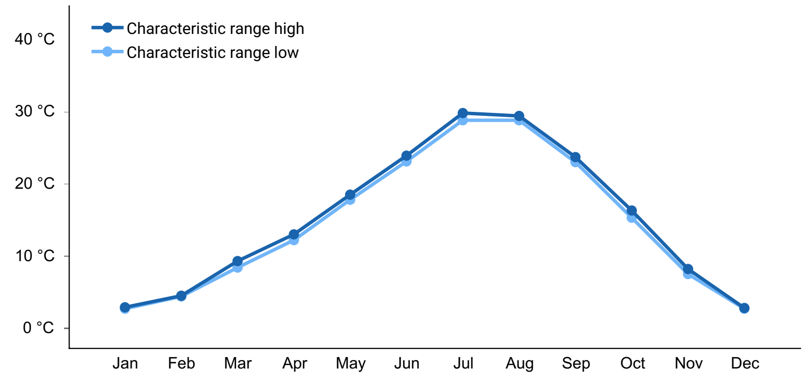


Figure 3. Monthly maximum temperature range

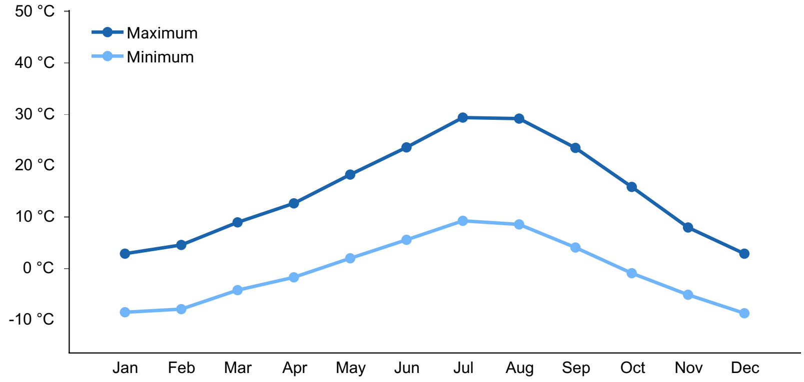


Figure 4. Monthly average minimum and maximum temperature

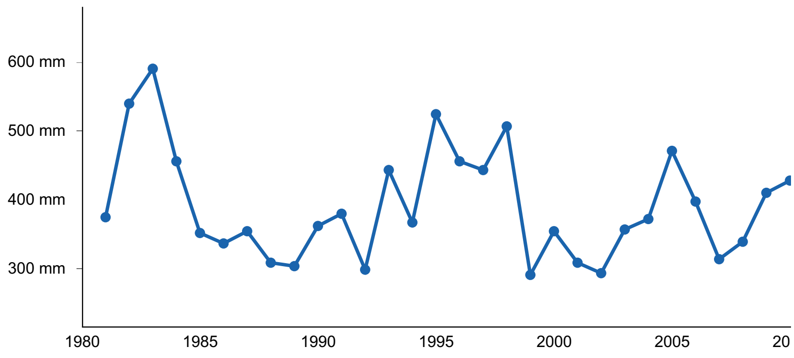


Figure 5. Annual precipitation pattern

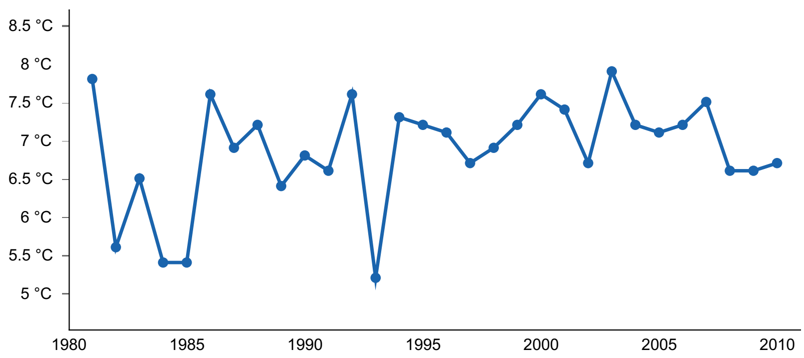


Figure 6. Annual average temperature pattern

Climate stations used

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

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are derived from sedimentary parent materials that are high in carbonates. The soils are shallow with depth to bedrock ranging from 14 to 20 inches. These soils normally have from 30 to over 75 percent gravel and cobbles (by volume) distributed throughout their profile. Soil reaction increases with depth and carbonates are common in the subsoil. The available water holding capacity is low. These soils typically have high amounts of gravels on the surface. The soils have a mollic epipedon and an argillic horizon. The temperature regime is frigid.

Soil series correlated to this site is: Wereld

Table 4. Representative soil features

Parent material	(1) Colluvium (2) Residuum
Surface texture	(1) Very gravelly silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Slow to moderate
Depth to restrictive layer	102–152 cm
Soil depth	102–152 cm
Surface fragment cover <=3"	30–40%
Surface fragment cover >3"	5–7%
Available water capacity (0-101.6cm)	7.11–11.18 cm
Calcium carbonate equivalent (0-101.6cm)	5–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–10
Soil reaction (1:1 water) (0-101.6cm)	7–9
Subsurface fragment volume <=3" (Depth not specified)	35–40%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

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

This ecological site is dominated by deep-rooted cool season perennial bunchgrasses and long-lived shrubs (50+

years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 meters (Dobrowolski et al. 1990). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). However, community types containing black sagebrush as the dominant shrub were found to have soil depths and thus available rooting depths of 77 to 81 centimeters in a study in northeast Nevada (Jensen 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

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

Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks, especially with regard to sagebrush defoliator Aroga moth (Aroga websteri). Aroga moth infestations have occurred throughout the Great Basin in the 1960s, early 1970s, and has been ongoing in Nevada since 2004 (Bentz et al. 2008). Thousands of acres of big sagebrush have been impacted, with partial to complete die-off observed (Gates 1964, Hall 1965); the research is inconclusive regarding the damage sustained by black sagebrush populations.

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

The perennial bunchgrasses that are dominant include Idaho fescue and Cusick's bluegrass. These species generally have shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m of the soil profile. General differences in root depth distributions between grasses and shrubs results 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 invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition. It can also increase resource pools via the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

As ecological condition declines, perennial grasses and forbs decline as black sagebrush and rabbitbrush increase.

This ecological site has low to moderate resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Four possible stable states have been identified for the Shallow Calcareous Slope 14+" P.Z ecological site.

Fire Ecology:
Black sagebrush communities generally lack enough fine fuels to carry a fire. In addition to low fine fuel loading, wide shrub spacing makes fire infrequent or difficult to prescribe in black sagebrush types. Black sagebrush is highly susceptible to fire-caused mortality; plants are readily killed by all fire intensities. Following burning, reestablishment occurs through off-site sources. Aboveground parts of Utah serviceberry may be killed or consumed under fire conditions with sufficient flame lengths. Utah serviceberry may be slightly harmed by fire, depending on moisture conditions, but is generally considered to be fire tolerant. Utah serviceberry sprouts from the root crown following fire. Soil moisture is important to aid sprouting. Fires top-kill mountain snowberry. Although plant survival may be variable, mountain snowberry root crowns usually survive even severe fires. Mountain snowberry sprouts from basal buds at the root crown following fire. Idaho fescue grows in a dense, fine-leaved tuft. Fires tend to burn within the accumulated fine leaves at the base of the plant and may produce temperatures sufficient to kill some of the root crown. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons. Cusick's bluegrass is unharmed to slightly harmed by light-severity fall fires. Cusick's bluegrass regenerates after fire from

seed and by tillering. Sandberg bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur. Burning bluebunch wheatgrass may remove most of the aboveground biomass but does not usually result in plant mortality. Bluebunch wheatgrass is generally favored by burning. Burning stimulates flowering and seed production. However, season of burning affects mortality.

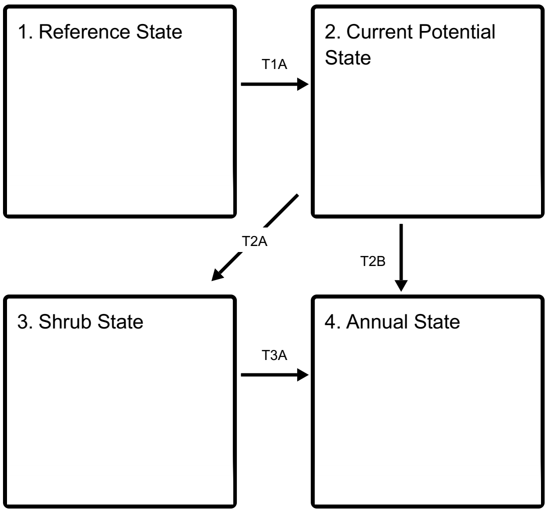
Fire return intervals have recently been estimated at 100 to 200 years (Kitchen and McArthur 2007); however, fires were probably patchy and very infrequent due to the low productivity of these sites. Black sagebrush plants have no morphological adaptations for surviving fire and must reestablish from seed (Wright et al. 1979). The ability of black sagebrush to establish after fire is mostly dependent upon the amount of seed deposited in the seed bank the preceeding year. Seeds typically do not persist in the soil for more than one growing season (Beetle 1960). A few seeds may remain viable in soil for 2 years (Meyer 2008); however, even in dry storage, black sagebrush seed viability has been found to drop rapidly over time, from 81% to 1% viability after 2 and 10 years of storage respectively (Stevens et al. 1981). Thus, repeated frequent fires can eliminate black sagebrush from a site, though black sagebrush in zones receiving 12 to 16 inches of annual precipitation have been found to have greater fire survival (Boltz 1994). In lower precipitation zones, rabbitbrush may become the dominant shrub species following fire, often with an understory of Sandberg bluegrass and/or cheatgrass and other weedy species.
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.

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

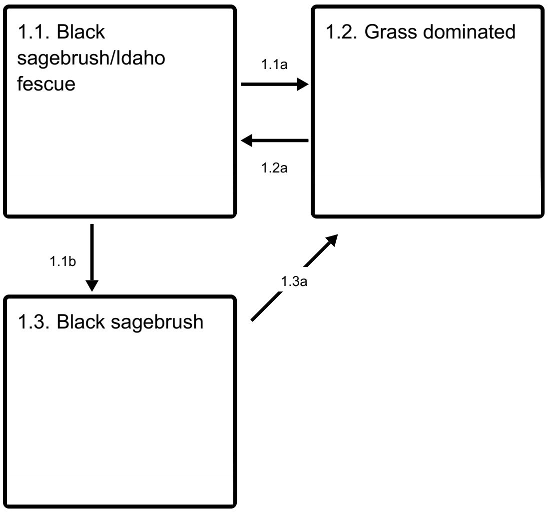
Sandberg bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper rooted bunchgrass. Repeated frequent fire in this community will eliminate black sagebrush, Thurber's needlegrass and other perennial bunchgrasses from these sites and facilitate the establishment of an annual weed community with varying amounts of Sandberg bluegrass, spiny hopsage and rabbitbrush.

State and transition model

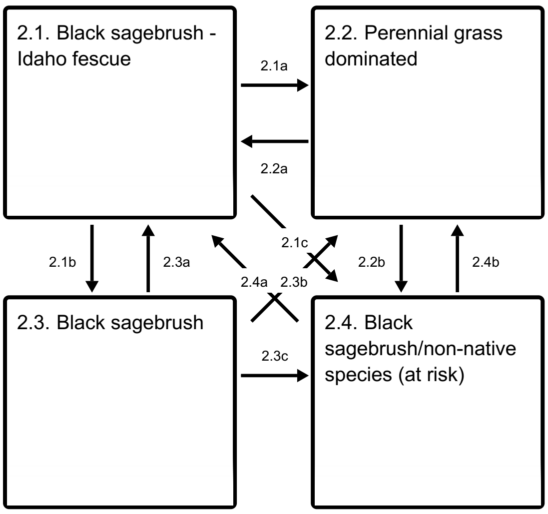
Ecosystem states



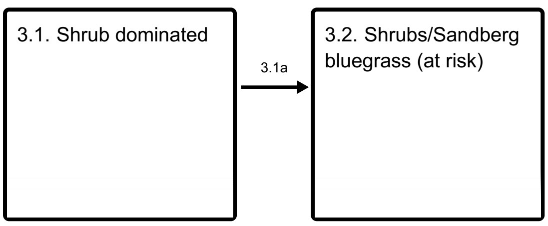
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Annual grasses and forbs

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, and a shrub dominant phase and a grass 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. Utah juniper may be present on the site, but will only occur as scattered trees and will not dominate the site.

Community 1.1
Black sagebrush/Idaho fescue

The reference plant community is dominated by black sagebrush and Idaho fescue. Cusick’s bluegrass, Utah serviceberry, and mountain snowberry are species that are commonly associated with this plant community. Potential vegetative composition is about 50 percent grasses, 10 percent forbs and 40 percent shrubs. Approximate ground cover (basal and crown) is 20 to 35 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	168	280	392
Shrub/Vine	135	224	314
Forb	34	56	78
Total	**337**	**560**	**784**

Community 1.2
Grass dominated

This community phase is characteristic of a post-disturbance, early or mid-seral community. Idaho fescue and other perennial grasses dominate. Depending on fire severity, patches of intact sagebrush may remain. Forbs may increase post-fire but will likely return to pre-burn levels within a few years. Sandberg bluegrass is stable within the community.

Community 1.3
Black sagebrush

Black sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory. Sandberg bluegrass will likely increase in the understory and may be the dominant grass on the site. Scattered Utah juniper may be present on the site.

Pathway 1.1a
Community 1.1 to 1.2

A low severity fire would decrease the overstory of sagebrush and allow for the understory perennial grasses and forbs to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring facilitating an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts.

Pathway 1.1b
Community 1.1 to 1.3

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

Pathway 1.2a
Community 1.2 to 1.1

Time and lack of disturbance will allow black sagebrush to increase.

Pathway 1.3a
Community 1.3 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be high intensity due to the dominance of sagebrush in this community phase, resulting in removal of the overstory shrub community.

State 2
Current Potential State

This state is similar to the Reference State however with the addition of a fourth community phase. Ecological function of community phases 2.1, 2.2 and 2.3 has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant in this state. These non-native species can be highly flammable, and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks reduce ecosystem resilience and stability of the state. These include the non-natives high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Black sagebrush - Idaho fescue

This community phase is compositionally similar to the Reference State Community Phase 1.1, with the addition of non-native species in trace amounts. Black sagebrush and Idaho fescue are dominant. Cusick's bluegrass is a sub-dominant species in the community. Forbs such as balsamroot are also common.

Community 2.2
Perennial grass dominated

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Idaho fescue, Cusick's bluegrass and other perennial grasses dominate. Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several years. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush may be sprouting. Forbs may increase post-fire and be a significant component for a number of years. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Community 2.3
Black sagebrush

Black sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Sandberg bluegrass may increase and become co-dominant with deep rooted bunchgrasses. Utah juniper and/or singleleaf pinyon may be present and without management will likely increase. Annual non-natives species may be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from inappropriate grazing management, drought, and fire. This community is at risk of crossing a threshold to either State 3.0 (grazing or fire) or State 4.0 (fire).

Community 2.4
Black sagebrush/non-native species (at risk)

This community is at risk of crossing into an annual state. Native bunchgrasses dominate; however, annual non-native species such as cheatgrass may be sub-dominant in the understory. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Seeded species may be present. Grazing management targeted at shrubs can decrease black sagebrush and increase perennial forbs. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway 2.1a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses and forbs to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. Annual non-native species are likely to increase after fire.

Pathway 2.1b
Community 2.1 to 2.3

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

Pathway 2.1c
Community 2.1 to 2.4

Grazing management targeted at shrubs (i.e. sheep) reduces black sagebrush canopy. Inappropriate sheep grazing management allows unpalatable forbs to increase. Higher than normal spring precipitation favors annual non-native species such as cheatgrass and can increase overall production on the site.

Pathway 2.2a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of black sagebrush may take many years.

Pathway 2.2b
Community 2.2 to 2.4

Higher than normal spring precipitation favors annual non-native species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway 2.3a
Community 2.3 to 2.1

Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase.

Heavy late-fall/winter grazing may cause mechanical damage to sagebrush thus promoting the perennial bunchgrass understory. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. Annual non-native species are present and may increase in the community. A low severity fire would decrease the overstory of sagebrush and allow for the understory perennial grasses to increase. Due to low fuel loads in this State, fires will likely be small creating a mosaic pattern.

Pathway 2.3b
Community 2.3 to 2.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be high intensity due to the dominance of sagebrush resulting in removal of the overstory shrub community. Annual non-native species respond well to fire and may increase post-burn. Brush treatment would reduce black sagebrush overstory and allow for perennial bunchgrasses to increase.

Pathway 2.3c
Community 2.3 to 2.4

Grazing management targeted at shrubs (i.e. sheep) reduces black sagebrush canopy. Inappropriate sheep grazing management allows unpalatable forbs to increase. Higher than normal spring precipitation favors annual non-native species such as cheatgrass and can increase overall production on the site.

Pathway 2.4a
Community 2.4 to 2.1

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production. Grazing management may allow for black sagebrush to increase.

Pathway 2.4b
Community 2.4 to 2.2

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

State 3
Shrub State

This state has two community phases. Sagebrush cover exceeds site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and Sandberg bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed. Bare ground and soil redistribution may be increasing.

Community 3.1
Shrub dominated

Decadent sagebrush dominates the overstory. Rabbitbrush and/or spiny hopsage may be significant components. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Sandberg bluegrass and annual non-native species increase. Bare ground and erosion are increasing.

Community 3.2
Shrubs/Sandberg bluegrass (at risk)

Sandberg bluegrass dominates the site. Rabbitbrush and spiny hopsage may be sprouting. Annual non-native species may be increasing and bare ground is significant. This site is at risk for significant soil erosion and for an increase in invasive annual weeds.

Pathway 3.1a
Community 3.1 to 3.2

Fire reduces black sagebrush to trace amounts and allows for sprouting shrubs such as rabbitbrush to dominate. Shadscale may also establish post-fire and become dominant. Inappropriate or excessive sheep grazing could also reduce cover of sagebrush and allow for shadscale or sprouting shrubs to dominate the community. Brush treatments with minimal soil disturbance would facilitate sprouting shrubs and/or Sandberg's bluegrass.

State 4
Annual State

The Annual State is characterized by the dominance of annual non-native species such as cheatgrass, mustards, and/or bur buttercup in the understory. The dominance of cheatgrass in the understory has shortened the fire return interval, which now drives site dynamics.

Community 4.1
Annual grasses and forbs

Non-native species such as cheatgrass, mustards, bur buttercup and other annuals dominate the site. Sprouting shrubs may be present. Soil erosion may be significant.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass and mustards. Slow variables: Over time the annual non-native species will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition T2A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate cattle/horse grazing will decrease or eliminate deep rooted perennial bunchgrasses, increase Sandberg bluegrass and favor shrub growth and establishment. To Community Phase 3.2: Severe fire will remove sagebrush overstory, decrease perennial bunchgrasses and enhance Sandberg bluegrass. Soil disturbing brush treatments and/or inappropriate sheep grazing will reduce sagebrush and potentially increase sprouting shrubs and Sandberg bluegrass and/or galleta grass. Slow variables: Long term decrease in deep-rooted perennial grass density and/or black sagebrush. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black sagebrush changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

Transition T2B
State 2 to 4

Trigger: Catastrophic fire or soil surface disturbance. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Transition T3A
State 3 to 4

Trigger: Severe fire. Slow variables: Increased production and cover of non-native annual species. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			219–454	
	Idaho fescue	FEID	*Festuca idahoensis*	168–280	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	28–84	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–45	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	11–45	–
2	**Secondary Perennial Grasses**			11–45	
	lupine	LUPIN	*Lupinus*	11–28	–
	woolly groundsel	PACA15	*Packera cana*	3–17	–
	phlox	PHLOX	*Phlox*	3–17	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	3–17	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	3–17	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	0–17	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	3–17	–
	squirreltail	ELEL5	*Elymus elymoides*	3–11	–
	muttongrass	POFE	*Poa fendleriana*	3–11	–
Forb					
3	**Perennial**			22–101	
	black sagebrush	ARNO4	*Artemisia nova*	112–168	–
	lupine	LUPIN	*Lupinus*	11–28	–
	phlox	PHLOX	*Phlox*	3–17	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	3–17	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	3–17	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	0–17	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	3–17	–
	little sagebrush	ARAR8	*Artemisia arbuscula*	3–17	–
Shrub/Vine					
4	**Primary Shrubs**			135–241	
	black sagebrush	ARNO4	*Artemisia nova*	112–168	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	11–45	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	11–28	–
5	**Secondary Shrubs**			11–45	
	little sagebrush	ARAR8	*Artemisia arbuscula*	3–17	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	3–17	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	3–17	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Considerations for grazing management include timing, intensity and duration of grazing. Grazing management should be keyed to Idaho fescue and perennial grass production. Idaho fescue provides important forge for many types of domestic livestock. The foliage cures well and is preferred by livestock in late fall and winter. In winter, at lower elevations, black sagebrush is heavily utilized by domestic sheep. Cusick's bluegrass makes up only a small proportion of the biomass of the sagebrush communities in which it lives, but it is often taken preferentially by cattle, especially early in the season. Sandberg bluegrass is a widespread forage grass. It is one of the earliest grasses in the spring and is sought by domestic livestock and several wildlife species. Sandberg 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. 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. In winter, at lower elevations, black sagebrush is heavily utilized by domestic sheep. Utah serviceberry provides good browse for domestic sheep and domestic goats. In the spring, Utah serviceberry provides fair forage for cattle and good to excellent browse for domestic sheep and goats. Utah serviceberry provides good forage late in winter and in early spring, because it leafs out and blooms earlier than associated 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.

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

Utah serviceberry fruits were used by Native Americans and early European explorers in North America for food and medicine.

Other information

Black sagebrush is an excellent species to establish on sites where management objectives include restoration or improvement of domestic sheep, pronghorn, or mule deer winter range. 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.

Inventory data references

NV-ECS-1 - 2 records

Soils and Physiographic features were gathered from NASIS database.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T34S R60E S20
General legal description	About 2 miles southwest of Sharp Ranch, west side of Secret Valley, Humboldt-Toiyabe National Forest, Elko County, Nevada.

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Approval

Kendra Moseley, 4/25/2024

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/19/2024
Approved by	Kendra Moseley
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

    Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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

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17. **Perennial plant reproductive capability:**
