

## **Ecological site F026XY061NV**

### **Very Shallow Steep Sandy Slopes 12-14 P.Z.**

Last updated: 4/10/2024  
Accessed: 05/05/2024

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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): 026X—Carson Basin and Mountains

MLRA 26 is in western Nevada and eastern California; approximately 69 percent is in Nevada, and 31 percent in California. The area is predominantly in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north-south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault-blocks with steep side slopes. The valleys are drained by three major rivers flowing east across MLRA 26; the Truckee, Carson and Walker rivers. A narrow strip along the western border of MLRA 26 is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault-block that has been uplifted with a dominant tilt to the west. The structure creates an impressive wall of mountains directly west of the area creating a rain shadow affect to MLRA 26. Parts of the eastern face; the foothills, mark the western boundary of the area. Elevations range from near 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

In MLRA 26, the valleys are composed dominantly of Quaternary alluvial deposits. Quaternary playa or alluvial flat deposits typically occupy the lowest valley bottoms in the internally drained valleys. Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks dominate the hills and mountains. Quaternary basalt flows are present in lesser amounts. Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Glacial till deposits, of limited extent are along the east flank of the Sierra Nevada Mountains; the result of alpine glaciation.

The average annual precipitation in MLRA 26 is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in MLRA 26 are Aridisols and Mollisols. The soils in the area typically have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. The soils are generally well drained, clayey or loamy and are commonly skeletal. The soils depths are typically very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush are on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, desert peach, and several forb species are also common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier sites that have a high concentration of salts.

Wildlife species in the area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove, amongst other species. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

## LRU notes

The Sierra Influenced Ranges LRU is characterized by wooded great basin mountains and climatic and biotic affinities to the Sierra Nevada Mountain range. The Sierra Influenced Ranges LRU receives greater precipitation than the mountain ranges of central Nevada.

Amount of precipitation varies in relation to the local strength of the Sierra Nevada rain shadow, characterized by pinyon and juniper trees. The White, Sweetwater, Pine Nut, Wassuk, and Virginia ranges of Nevada support varying amounts of Sierra Nevada flora, like ponderosa pine. Elevations range from 1610 to 2420 meters and slopes range from 5 to 49 percent, with a median value of 22 percent. Frost free days (FFD) ranges from 92 to 163.

## Classification relationships

PIMO WSG:0R0602

## Ecological site concept

The Very Shallow Steep Sandy Slopes 12-14 P.Z. occurs on mid- to lower mountain side slopes on all aspects except at the upper elevation range where it is on southerly aspects. Slopes range from 30 to 75. Elevations are 6000 to 8800 feet. The soils associated with this site are very shallow and somewhat excessively drained. The dominant plants are singleleaf pinyon (*Pinus monophylla*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and desert needlegrass (*Achnatherum speciosum*).

## Associated sites

F026XY044NV	<b>Shallow Sandy Slope 10-12 P.Z.</b>
F026XY062NV	<b>Shallow Sandy Loam Slope 10-14 P.Z</b>
R026XY005NV	<b>LOAMY 12-14 P.Z.</b>

## Similar sites

F026XY062NV	<b>Shallow Sandy Loam Slope 10-14 P.Z</b> Higher site index; ARTRW dominant understory shrub.
F026XY069NV	<b>Shallow Clayey Summit 11-14 P.Z. PIMO/ARTRV/POA-KOMA</b> Higher site index; POFE dominant understory grass.
F026XY044NV	<b>Shallow Sandy Slope 10-12 P.Z.</b> Higher site index; POFE and ACTH7 dominant understory grasses

Table 1. Dominant plant species

Tree	(1) <i>Pinus monophylla</i>
Shrub	(1) <i>Artemisia tridentata</i> var. <i>vaseyana</i>
Herbaceous	(1) <i>Achnatherum speciosum</i>

## Physiographic features

The Very Shallow Steep Sandy Slopes 12-14 P.Z. is on mid- to lower mountain side slopes on all aspects, except at the higher elevations where it is on southerly aspects. Slopes range from 30 to 75. Elevations are 6000 to 8800 feet.

**Table 2. Representative physiographic features**

Landforms	(1) Mountain slope
Runoff class	Low
Elevation	6,000–8,800 ft
Slope	30–75%
Aspect	Aspect is not a significant factor

## Climatic features

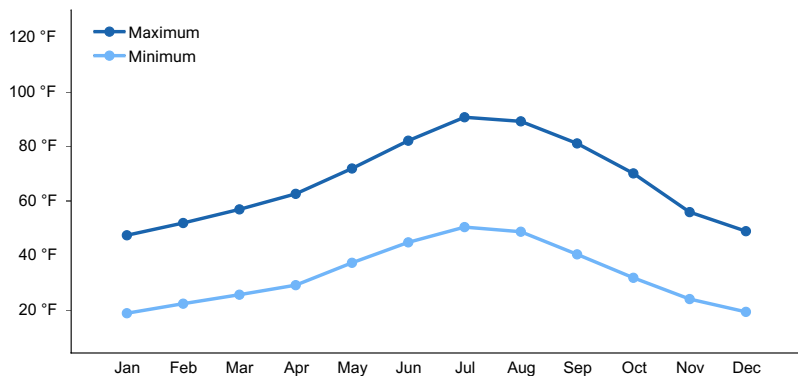
The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is about 12 to 14 (25 to 36 cm) inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 80 to 120 days.

Nevada's climate is predominantly arid, and has large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and significant location variations with elevation. Three basic geographical factors largely influence Nevada's climate: (1) continentality, (2) latitude, and (3) elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada is on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the Nevada. 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.

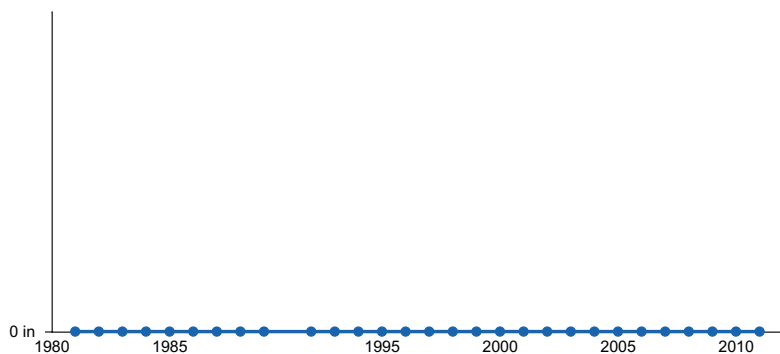
Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure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

**Table 3. Representative climatic features**

Frost-free period (average)	100 days
Freeze-free period (average)	
Precipitation total (average)	12 in



**Figure 1. Monthly average minimum and maximum temperature**



**Figure 2. Annual precipitation pattern**

## Influencing water features

No water features are influencing or are associated with this site.

## Soil features

The soils are very shallow to shallow and well drained to somewhat excessively drained. These soils have formed in residuum or colluvium from granitic rock or volcanic rock sources. The soils have 35 to over 50 percent gravels, cobbles, or stones, by volume, distributed throughout the soil profile. Available water capacity is very low, but trees and shrubs extend their roots into fractures in the bedrock allowing them to utilize deep moisture. Rock fragments on the soil surface provide a stabilizing effect on surface erosion conditions. Runoff is very low to very high and the potential for sheet and rill erosion is low to moderate depending on slope and amount of rock fragments on the soil surface. The soil series associated with this site include: Lazan, Toejom, and Ocul.

**Table 4. Representative soil features**

Parent material	(1) Colluvium–granite (2) Residuum–granite
Surface texture	(1) Gravelly coarse sand
Family particle size	(1) Sandy
Drainage class	Somewhat excessively drained
Permeability class	Moderately slow to very rapid
Soil depth	3–10 in
Surface fragment cover ≤3"	21–50%
Surface fragment cover >3"	0–4%
Available water capacity (0–40in)	0.1–0.2 in

Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–2
Soil reaction (1:1 water) (0-40in)	6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

## Ecological dynamics

Description of MLRA 26 DRG 19:

Disturbance Response Group (DRG) 19 consists of six ecological sites; F026XY060NV, F026XY044NV, F026XY061NV, F026XY069NV, F026XY104NV, F026XY071NOV (Stringham et al. 2021). This group receives 10 to 14 inches of precipitation each year. Elevations range from 5,000 to 9,000 while slopes range from 15 to 75 percent. The soils are typically shallow to moderately deep and well drained and the water holding capacity is low to moderate. The soils are generally skeletal with 35 to 50 percent gravels, cobbles, or stones, by volume, distributed throughout the soil profile. This group is dominated by singleleaf pinyon (*Pinus monophylla*) with mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) as the primary understory shrub. Utah juniper (*Juniperus osteosperma*) and curl-leaf mountain mahogany (*Cercocarpus ledifolius*) are minor components. Other subdominant shrubs in the group include Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and antelope bitterbrush (*Purshia tridentata*). The dominant understory grass is Thurber's needlegrass (*Achnatherum thurberianum*) or desert needlegrass (*Achnatherum speciosum*). Other grasses in the group include muttongrass (*Poa fendleriana*) and prairie junegrass (*Koeleria macrantha*). Under medium canopy cover (20-30%), understory production ranges from 200 to 450 pounds per acre in a normal year.

Potential Resilience Differences with other Ecological Sites:

Very Shallow Steep Sandy Slopes 12-14 P.Z. (F026XY061NV):

This site is very similar to the modal site but with desert needlegrass as the dominant grass. It is on hills mid- to lower mountain slopes as a slightly lower elevation of 5,000 to 7,500 feet. This site is less productive than the modal site with 200 pounds per acre of forage produced in a normal year under medium canopy (21 to 35 percent). This site is sometimes found with up to 15 percent Utah juniper canopy.

Major Successional Stages of Forest Development:

**HERBACEOUS:** Vegetation is dominated by grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as wildfire. Skeleton forest (dead trees) remaining after fire or other disturbances have little or no effect on the composition and production of the herbaceous vegetation.

**SHRUB-HERBACEOUS:** Herbaceous vegetation and woody shrubs dominate the site. Various amounts of tree seedlings (less than 20 inches in height) might be present up to the point where they are obviously a component of the vegetal structure.

**SAPLING:** In the absence of disturbance, the tree seedlings develop into saplings (20 inches to 4.5 feet in height) with a canopy cover generally of about 5 to 10 percent. Vegetation consists of grasses, forbs and shrubs in association with tree saplings.

**IMMATURE FOREST:** Singleleaf pinyon greater than 4.5 feet in height form a major constituent of the visual aspect and vegetal structure of the plant community. The upper crown of dominant and codominant trees is cone- or pyramidal-shaped. Seedlings and saplings of singleleaf pinyon are prevalent in the understory. Understory

vegetation is moderately influenced by a tree overstory canopy of about 10 to 20 percent.

**MATURE FOREST:** The visual aspect and vegetal structure are dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic, wildfire is a natural factor influencing the development and maintenance of these mature forestlands. This stage of forest development is assumed to be representative of this site in a pristine environment.

**OVER-MATURE FOREST:** In the absence of wildfire or other naturally occurring disturbances, the tree canopy on this site can become very dense. This stage is dominated by singleleaf pinyon that have reached maximal heights for the site. Dominant and codominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns of most trees are typically irregularly flat-topped or rounded. Understory vegetation is sparse to absent due to tree competition. Tree canopy cover is commonly greater than 40 percent.

The pinyon-juniper forest is generally a climax vegetation type throughout its range, reaching climax about 300 years after disturbance, with an ongoing trend toward increased tree density and canopy cover and a decline in understory species over time. Singleleaf pinyon seedling establishment is episodic. Population age structure is affected by drought, which differentially reduces seedling and sapling recruitment more than other age classes. The ecotones between singleleaf pinyon communities and adjacent shrublands and grasslands provide favorable microhabitats for singleleaf pinyon seedling establishment because they are active zones for seed dispersal, nurse plants are available, and singleleaf pinyon seedlings are only affected by competition from grass and other herbaceous vegetation for a couple of years.

Several natural and anthropogenic processes can lead to changes in the spatial distribution of pinyon-juniper forests over time. These

Include: (1) tree seedling establishment during favorable climatic periods, (2) tree mortality (especially seedlings and saplings) during periods of drought, (3) expansion of trees into adjacent grassland in response to overgrazing, fire suppression, or both, and (4) removal of trees by humans, fire, or other disturbance episodes. Specific successional pathways after disturbance in singleleaf pinyon stands are dependent on several variables such as plant species present at the time of disturbance and their individual responses to disturbance, past management, type and size of disturbance, available seed sources in the soil or adjacent areas, and site and climatic conditions throughout the successional process.

#### Fire Ecology:

On high-productivity sites where sufficient fine fuels existed, singleleaf pinyon communities burn every 15 to 20 years, and on less productive sites with patchy fuels, fire intervals might have been in the range of 50 to 100 years or longer. Thin bark and lack of self-pruning make singleleaf pinyon very susceptible to intense fire. Mature singleleaf pinyon can survive low-severity surface fires but is killed by more severe fires. Most tree seedlings are killed by fire, but cached seeds might survive. Mountain big sagebrush is highly susceptible to injury from fire. Plants are readily killed in all seasons, even light severity fires. Mountain big sagebrush plants top-killed by fire will not resprout. Wyoming big sagebrush establishes after fire from a seedbank; from seed produced by remnant plants that escaped fire; and from plants adjacent to the burn that seed in. Fires in Wyoming big sagebrush communities are usually not continuous, and remnant plants are the principal means of postfire reproduction. Antelope bitterbrush is very susceptible to fire kill. It is considered a weak sprouter and is often killed by summer or fall fire. Antelope bitterbrush in some areas might sprout after light-severity spring fire. Season of burning and environmental conditions impact antelope bitterbrush ability to survive fire and sprout. High fuel consumptions increase antelope bitterbrush mortality and therefore favors seedling establishment. Buckwheat is severely damaged by fire and has medium fire tolerance. Green ephedra generally sprouts vigorously from the roots or woody root crown after fire and rapidly produces aboveground biomass from surviving meristematic tissue. Desert needlegrass has persistent dead leaf bases, which make it susceptible to burning. Fire removes the accumulation; a rapid, cool fire will not burn deep into the root crown. Most perennial grasses have root crowns that can survive wildfire.

Muttongrass is unharmed to slightly harmed by light-severity fall fires. Muttongrass appears to be harmed by and is slow to recover from severe fire. Sandberg bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduce the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage because it is dormant when most fires occur.

## State and Transition Model Narrative for Group 19:

This is a text description of the states, phases, transitions, and community pathways possible in the State and Transition model for the MLRA 26 disturbance response group 19.

### Reference State 1.0:

The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree 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: (a) the presence of all structural and functional groups, (b) low fine fuel loads, and (c) retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic long-term drought, and/or insect or disease attack. Fires are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

### Community Phase 1.1:

This phase is characterized by widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns might be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*) and tapertip hawksbeard (*Crepis acuminata*) are minor components. Utah juniper might be present.

### Community Phase Pathway 1.1a, from Phase 1.1 to 1.2:

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

### Community Phase Pathway 1.1b, from Phase 1.1 to 1.4:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual infilling of singleleaf pinyon.

### Community Phase 1.2:

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrasses, and other perennial grasses dominate. Thurber's needlegrass can experience high mortality from fire and might be reduced in the community for several years. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Singleleaf pinyon seedlings up to 4 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation.

### Community Phase Pathway 1.2a, from Phase 1.2 to 1.3:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

### Community Phase 1.3

This community phase is characterized as an immature woodland with singleleaf pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and sagebrush.

### Community Phase Pathway 1.3a, from Phase 1.3 to 1.2:

This Community Phase Pathway is a result of fire which reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

### Community Phase Pathway 1.3b, from Phase 1.3 to 1.1:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce perennial grass understory.

#### Community Phase 1.4 (at-risk):

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes. Canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Utah juniper might be present. This community is at risk of crossing a threshold; without proper management this phase will transition to the infilled woodland state 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

#### Community Phase Pathway 1.4a, from Phase 1.4 to 1.1:

This Community Phase Pathway is a result of low intensity fire, insect infestation, or disease which kill individual trees within the stand, reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass communities increase in density and vigor.

#### Community Phase Pathway 1.4b, from Phase 1.4 to 1.2:

This Community Phase Pathway is a result of high-severity crown fire which will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

#### T1A: Transition from Reference State 1.0 to Current Potential State 2.0:

Trigger: Introduction of non-native annual species.

Slow variables: Over time the annual non-native plants will increase within the community.

Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

#### T1B: Transition from Reference State 1.0 to Infilled Tree State 3.0:

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance.

Slow variables: Over time the abundance and size of trees will increase.

Threshold: Singleleaf pinyon canopy cover is greater than 50 percent. Little understory vegetation remains due to competition with trees for site resources.

#### Current Potential State 2.0:

The Current Potential State 2.0 is similar to the Reference State 1.0, with four general community phases: (1) an old-growth woodland phase, (2) a shrub-herbaceous phase, (3) an immature tree phase, and (4) an infilled tree phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of non-native species. These non-natives, particularly cheatgrass, 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: (a) the presence of all structural and functional groups, (b) low fine fuel loads and (c) retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include: (a) the non-natives' high seed output, (b) persistent seed bank, (c) rapid growth rate, (d) ability to cross pollinate, and (e) adaptations for seed dispersal. Fires within this community with the small amount of non-native annual species present are likely still small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

#### Community Phase 2.1:

This phase is characterized by a widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah

juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns might be flat- or round-topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot and



tapertip hawksbeard are minor components. Utah juniper might be present.

Community Phase Pathway 2.1a, from Phase 2.1 to 2.2:

This Community Phase Pathway is when a high-severity crown fire eliminates or reduces the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

Community Phase Pathway 2.1b, from Phase 2.1 to 2.4:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual infilling of singleleaf pinyon.

Community Phase 2.2:

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrass, and other perennial grasses dominate. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Pinyon seedlings up to 4.5 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present, however, these have little or no effect on the understory vegetation. Annual non-native species generally respond well after fire and might be stable or increasing within the community.

Community Phase Pathway 2.2a, from Phase 2.2 to 2.3:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

Community Phase 2.3:

This community phase is characterized by an immature woodland, with singleleaf pinyon trees averaging over 4.5 feet in height. Tree canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and shrubs. Annual non-native species are present.

Community Phase Pathway 2.3a, from Phase 2.3 to 2.2:

This Community Phase Pathway is a result of fire which reduces or eliminates tree canopy where perennial grasses dominate the site.

Community Phase Pathway 2.3b, from Phase 2.3 to 2.1:

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce the perennial grass understory.

Community Phase 2.4 (at-risk):

This phase is dominated by singleleaf pinyon and Utah juniper might be present. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Annual non-native species are present primarily under tree canopies. Utah juniper might be present. This community is at risk of crossing a threshold. Without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

Community Phase Pathway 2.4a, from Phase 2.4 to 2.1:

This Community Phase Pathway is a result of low intensity fire, insect infestation, or a result of disease which kill individual trees within the stand, reducing canopy cover to less than 35 percent. Over time, young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor. Annual non-natives are present in trace amounts.

Community Phase Pathway 2.4b, from Phase 2.4 to 2.2:

This Community Phase Pathway is a result of high-severity crown fire which eliminates or reduces the singleleaf pinyon overstory and also reduces the shrub component which allows for the perennial bunchgrasses to dominate the site. Annual non-native grasses typically respond positively to fire and might increase in the post-fire community.

T2A: Transition from Current Potential State 2.0 to Infilled Tree State 3.0:

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance.

Slow variables: Over time the abundance and size of trees will increase.

Threshold: Pinyon canopy cover is greater than 30 percent. Little understory vegetation remains due to competition with trees for site resources.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0:

Trigger: Catastrophic crown fire facilitates the establishment of non-native, annual weeds.

Slow variables: (a) An increase in tree crown cover, (b) a loss of perennial understory and (c) an increase in annual non-native species.

Threshold: Cheatgrass or other non-native annuals dominate understory. Loss of deep-rooted perennial bunchgrasses changes: (a) spatial and temporal nutrient cycling, (b) nutrient redistribution, and (3) reduces soil organic matter. Increased canopy cover of trees allows severe stand-

replacing fire. The increased seed bank of non-native, annual species responds positively to post-fire conditions facilitating the transition to an Annual State.

Infilled Tree State 3.0:

This state has two community phases characterized by the dominance of singleleaf pinyon in the overstory. This state is identifiable by: (1) greater than 50 percent cover of singleleaf pinyon, and (2) a mixed age class. Older trees are at maximal height and upper crowns might be flat-topped or rounded. Younger trees are typically cone- or pyramidal-shaped. Understory vegetation is sparse due to increasing shade and competition from trees.

Community Phase 3.1:

Community Phase 3.1 is identifiable when singleleaf pinyon dominates the aspect. Understory vegetation is thinning. Perennial bunchgrasses are sparse, and mountain big sagebrush skeletons are as common as live shrubs due to tree competition for: (a) soil water, (b) overstory shading, and (c) duff accumulation. Tree canopy cover is greater than 50 percent. Utah juniper might be present. Annual non-native species are present or co-dominate in the understory. Bare ground areas are prevalent and soil redistribution is evident. This community phase is typically described as a Phase II woodland (Miller et al. 2008).

Community Phase Pathway 3.1a, from Phase 3.1 to 3.2:

This Community Phase Pathway is a result of time without disturbance such as: (a) fire, (b) long-term drought, or (3) disease which allows for the gradual maturation of singleleaf pinyon. Infilling by younger trees continues.

Community Phase 3.2:

Community Phase 3.2 is when Singleleaf pinyon dominates the aspect and Utah juniper might be present. Tree canopy cover exceeds 50 percent. Utah juniper might be present. Understory vegetation is sparse to absent. Perennial bunchgrasses, if present exist in the dripline or under the canopy of trees. Mountain sagebrush skeletons are common or the sagebrush has been extinct long enough that only scattered limbs remain. Mat-forming forbs or Sandberg's bluegrass might dominate interspaces. Annual non-native species are present and are typically found under the trees. Bare ground areas are large and interconnected. Soil redistribution might be extensive. This community phase is typically described as a Phase III woodland (Miller et al. 2008).

T3A Transition from Infilled Tree State 3.0 to Annual State 4.0:

Trigger: Catastrophic fire reduces the tree overstory and allows for the annual non-native species in the understory to dominate the site. Soil disturbing treatments such as slash and burn might reduce tree canopy and allow for non-native annual species to increase.

Slow variables: Over time, cover and production of annual non-native species increases.

Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size, and spatial variability of fires.

R3A Restoration from Infilled Tree State 3.0 to Current Potential State 2.0:

Manual or mechanical thinning of trees coupled with seeding. Probability of success is highest from community phase 3.1. Annual State 4.0:

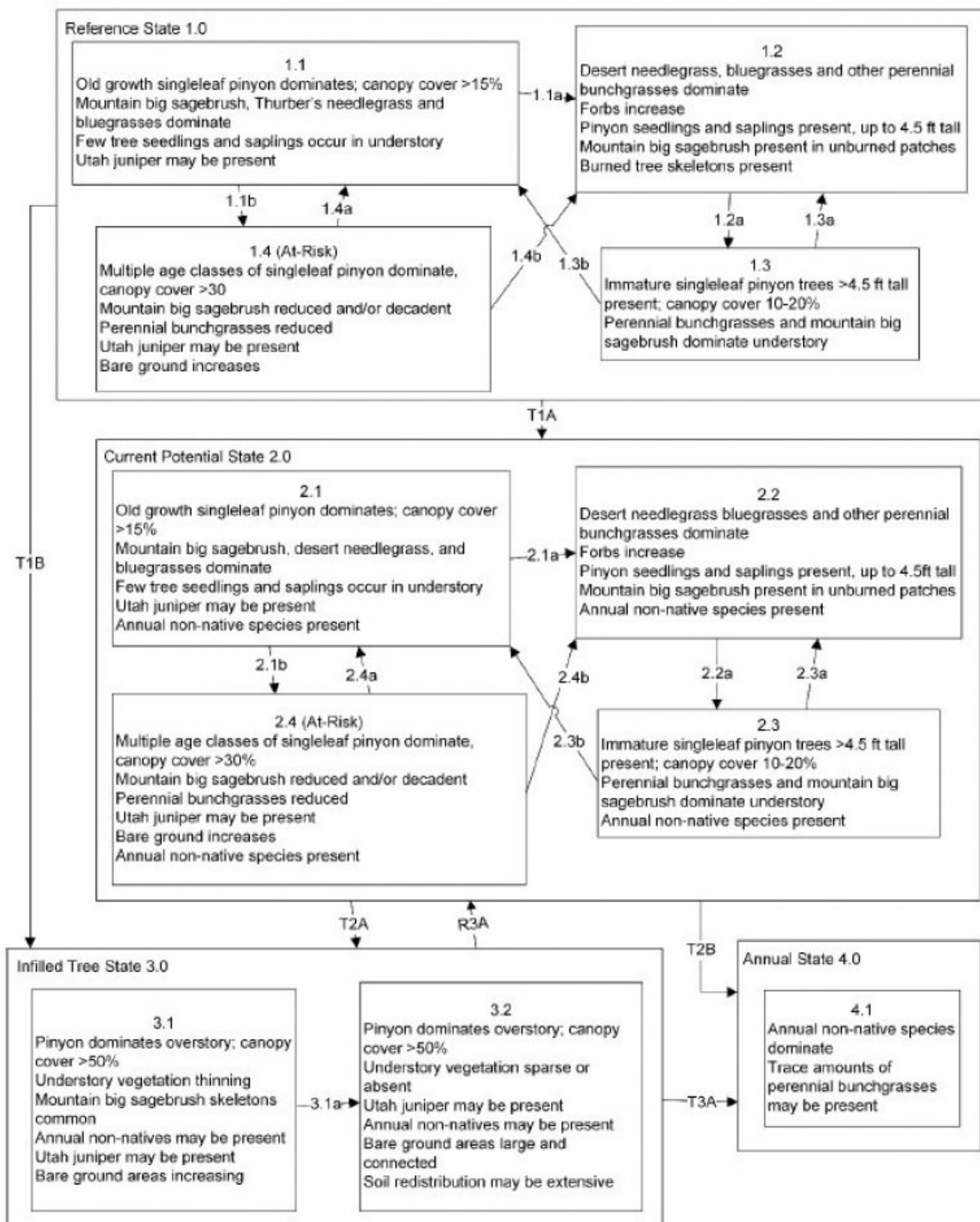
This community is characterized by the dominance of annual non-native species such as cheatgrass and tansy

mustard in the understory. Rabbitbrush or other sprouting shrubs might dominate the overstory. Annual non-native species dominate the understory. Ecological dynamics are significantly altered in this state. Annual non-native species create a highly combustible fuel bed that shortens the fire return interval. Nutrient cycling is spatially and temporally truncated as annual plants contribute significantly less to deep soil carbon. This state was not observed in MLRA 26 during field work for this project, however it is possible given increased fire activity in these sites and their proximity to known annual states of sagebrush ecological sites. We refer the reader to the report for Disturbance Response Group 21 for MLRA 28A and 28B.

#### Community Phase 4.1:

This community is characterized by dominance of cheatgrass, mustards and other non-native annual species. Trace amounts of perennial bunchgrasses might be present. Sprouting shrubs might increase. Burned tree skeletons are present

### **State and transition model**



Reference State 1.0 Community Pathways

- 1.1a: High severity crown fire reduces or eliminates tree cover.
- 1.1b: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.
- 1.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
- 1.3a: Fire.
- 1.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
- 1.4a: Low severity fire, insect infestation, or disease removes individual trees and reduces total tree cover.
- 1.4b: High severity crown fire reduces or eliminates tree cover.

Transition T1A: Introduction of non-native annual species.

Transition T1B: Time and a lack of disturbance allows for trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance.

Current Potential State 1.0 Community Pathways

- 2.1a: High severity crown fire reduces or eliminates tree cover.
- 2.1b: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.
- 2.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory or inappropriate grazing may also reduce perennial grass understory.
- 2.3a: Fire.
- 2.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory or inappropriate grazing may also reduce perennial grass understory.
- 2.4a: Low severity fire, insect infestation, or disease removes individual trees and reduces total tree cover.
- 2.4b: High severity crown fire reduces or eliminates tree cover.

Transition T2A: Time and a lack of disturbance allows for trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance.

Transition T2B: Catastrophic fire.

Infilled Tree State 3.0 Community Pathways

- 3.1a: Time and lack of disturbance such as fire, disease, or drought allows younger trees to infill.

Transition T3A: Catastrophic fire.

Restoration Pathway R3A: Thinning of trees coupled with seeding. Success unlikely from phase 3.2.

Annual State 4.0 Community Pathways

None.

## State 1

### Reference State

The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree 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: (a) the presence of all structural and functional groups, (b) low fine fuel loads, and (c) retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic long-term drought, and/or insect or disease attack. Fires are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

### Community 1.1

#### old growth singleleaf pinyon/mountain big sagebrush/perennial bunchgrasses

This phase is characterized by widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper might be present. Trees have reached maximal or near maximal heights for the site and many tree crowns may be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*) and tapertip hawksbeard (*Crepis acuminata*) are minor components. Utah juniper may be present.

**Forest overstory.** MATURE FOREST: The visual aspect and vegetal structure are dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic, wildfire is a natural factor influencing the development and maintenance of these mature forestlands. This stage of forest development is assumed to be representative of this site in a pristine environment.

**Forest understory.** Understory vegetative composition is about 40 percent grasses, 10 percent forbs, and 55 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 100 to 300 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4 1/2 feet of the ground surface.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	45	90	135
Grass/Grasslike	40	80	120
Tree	10	20	30
Forb	5	10	15
<b>Total</b>	<b>100</b>	<b>200</b>	<b>300</b>

## Community 1.2

### post-fire shrub and herbaceous community. Perennial grasses dominate.

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrasses, and other perennial grasses dominate. Thurber's needlegrass can experience high mortality from fire and might be reduced in the community for several years. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Singleleaf pinyon seedlings up to 4 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present; however, these have little or no effect on the understory vegetation.

## Community 1.3

### immature woodland of singleleaf pinyon/tree seedlings and saplings/Perennial bunchgrasses/sagebrush

This community phase is characterized as an immature woodland with singleleaf pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and sagebrush.

## Community 1.4

### (at risk) singleleaf pinyon of mixed age classes/decreased density of mountain big sagebrush/increased bareground/mat-forming forbs might increase

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes. Canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Utah juniper might be present. This community is at risk of crossing a threshold; without proper management this phase will transition to the infilled woodland state 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

## Pathway 1.1a

### Community 1.1 to 1.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component. This

allows for the perennial bunchgrasses to dominate the site.

### **Pathway 1.1b**

#### **Community 1.1 to 1.4**

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual infilling of singleleaf pinyon.

### **Pathway 1.2a**

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

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.

### **Pathway 1.3b**

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

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce perennial grass understory.

### **Pathway 1.3a**

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

This Community Phase Pathway is a result of fire which reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

### **Pathway 1.4a**

#### **Community 1.4 to 1.1**

This Community Phase Pathway is a result of low intensity fire, insect infestation, or disease which kill individual trees within the stand, reducing canopy cover to less than 35 percent. Over time young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass communities increase in density and vigor.

### **Pathway 1.4b**

#### **Community 1.4 to 1.2**

This Community Phase Pathway is a result of high-severity crown fire which will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

## **State 2**

### **Current Potential State 2.0**

The Current Potential State 2.0 is similar to the Reference State 1.0, with four general community phases: (1) an old-growth woodland phase, (2) a shrub-herbaceous phase, (3) an immature tree phase, and (4) an infilled tree phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of non-native species. These non-natives, particularly cheatgrass, 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: (a) the presence of all structural and functional groups, (b) low fine fuel loads and (c) retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include: (a) the non-natives' high seed output, (b) persistent seed bank, (c) rapid growth rate, (d) ability to cross pollinate, and (e) adaptations for seed dispersal. Fires within this community with the small amount of non-native annual species present are likely still small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all or most of the following community phases within this state.

## **Community 2.1**

### **singleleaf pinyon/mountain big sagebrush/perennial bunchgrasses**

This phase is characterized by a widely dispersed old-growth singleleaf pinyon trees with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by singleleaf pinyon with 15 percent or greater canopy cover (USDA 1997). Utah juniper may be present. Trees have reached maximal or near maximal heights for the site and many tree crowns may be flat- or round- topped. Thurber's needlegrass and bluegrasses are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot and tapertip hawksbeard are minor components. Utah juniper may be present.

## **Community 2.2**

### **perennial grasses dominate**

This community phase is characterized by a post-fire shrub and herbaceous community. Thurber's needlegrass, bluegrass, and other perennial grasses dominate. Forbs might increase post-fire but will likely return to pre-burn levels within a few years. Pinyon seedlings up to 4.5 feet in height might be present. Mountain big sagebrush might be present in unburned patches. Burned tree skeletons might be present, however, these have little or no effect on the understory vegetation. Annual non-native species generally respond well after fire and might be stable or increasing within the community.

## **Community 2.3**

### **singleleaf pinyon/perennial bunchgrasses/shrubs/annual non-native species are present**

This community phase is characterized by an immature woodland, with singleleaf pinyon trees averaging over 4.5 feet in height. Tree canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedling and saplings, as well as perennial bunchgrasses and shrubs. Annual non-native species are present.

## **Community 2.4**

### **(at-risk) singleleaf pinyon/Utah juniper/shrub/perennial bunchgrass**

This phase is dominated by singleleaf pinyon and Utah juniper might be present. The stand exhibits mixed age classes and canopy cover exceeds 30 percent. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs might increase. Annual non-native species are present primarily under tree canopies. Utah juniper might be present. This community is at risk of crossing a threshold. Without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

## **Pathway 2.1a**

### **Community 2.1 to 2.2**

This Community Phase Pathway is when a high-severity crown fire eliminates or reduces the singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

## **Pathway 2.1b**

### **Community 2.1 to 2.4**

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which will allow for the gradual infilling of singleleaf pinyon.

## **Pathway 2.2a**

### **Community 2.2 to 2.3**

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory might also reduce perennial grass understory.



### **Pathway 2.3b**

#### **Community 2.3 to 2.1**

This Community Phase Pathway is a result of time without disturbance such as fire, long-term drought, or disease which allows for the gradual maturation of singleleaf pinyon. Excessive herbivory might also reduce the perennial grass understory.

### **Pathway 2.3a**

#### **Community 2.3 to 2.2**

This Community Phase Pathway is a result of fire which reduces or eliminates tree canopy where perennial grasses dominate the site.

### **Pathway 2.4a**

#### **Community 2.4 to 2.1**

This Community Phase Pathway is a result of low intensity fire, insect infestation, or a result of disease which kill individual trees within the stand, reducing canopy cover to less than 35 percent. Over time, young trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor. Annual non-natives are present in trace amounts.

### **Pathway 2.4b**

#### **Community 2.4 to 2.2**

This Community Phase Pathway is a result of high-severity crown fire which eliminates or reduces the singleleaf pinyon overstory and also reduces the shrub component which allows for the perennial bunchgrasses to dominate the site. Annual non-native grasses typically respond positively to fire and may increase in the post-fire community.

## **State 3**

### **Infilled Tree State 3.0**

This state has two community phases characterized by the dominance of singleleaf pinyon in the overstory. This state is identifiable by: (1) greater than 50 percent cover of singleleaf pinyon, and (2) a mixed age class. Older trees are at maximal height and upper crowns may be flat-topped or rounded. Younger trees are typically cone- or pyramidal-shaped. Understory vegetation is sparse due to increasing shade and competition from trees.

### **Community 3.1**

#### **singleleaf pinyon/mountain big sagebrush/perennial bunchgrasses/annual non-native species**

Community Phase 3.1 is identifiable when singleleaf pinyon dominates the aspect. Understory vegetation is thinning. Perennial bunchgrasses are sparse, and mountain big sagebrush skeletons are as common as live shrubs due to tree competition for: (a) soil water, (b) overstory shading, and (c) duff accumulation. Tree canopy cover is greater than 50 percent. Utah juniper may be present. Annual non-native species are present or co-dominate in the understory. Bare ground areas are prevalent and soil redistribution is evident. This community phase is typically described as a Phase II woodland (Miller et al. 2008).

### **Community 3.2**

#### **singleleaf pinyon-Utah Juniper/mountain big sagebrush, Perennial bunchgrasses/annual non-native species are present**

Community Phase 3.2 is when Singleleaf pinyon dominates the aspect and Utah juniper might be present. Tree canopy cover exceeds 50 percent. Utah juniper might be present. Understory vegetation is sparse to absent. Perennial bunchgrasses, if present exist in the dripline or under the canopy of trees. Mountain sagebrush skeletons are common or the sagebrush has been extinct long enough that only scattered limbs remain. Mat-forming forbs or Sandberg's bluegrass might dominate interspaces. Annual non-native species are present and are typically found under the trees. Bare ground areas are large and interconnected. Soil redistribution might be extensive. This community phase is typically described as a Phase III woodland (Miller et al. 2008).

## **Pathway 3.1a**

### **Community 3.1 to 3.2**

This Community Phase Pathway is a result of time without disturbance such as: (a) fire, (b) long-term drought, or (3) disease which allows for the gradual maturation of singleleaf pinyon. Infilling by younger trees continues.

## **State 4**

### **Annual State 4.0**

This community is characterized by the dominance of annual non-native species such as cheatgrass and tansy mustard in the understory. Rabbitbrush or other sprouting shrubs might dominate the overstory. Annual non-native species dominate the understory. Ecological dynamics are significantly altered in this state. Annual non-native species create a highly combustible fuel bed that shortens the fire return interval. Nutrient cycling is spatially and temporally truncated as annual plants contribute significantly less to deep soil carbon. This state was not observed in MLRA 26 during field work for this project, however it is possible given increased fire activity in these sites and their proximity to known annual states of sagebrush ecological sites. We refer the reader to the report for Disturbance Response Group 21 for MLRA 28A and 28B.

## **Community 4.1**

### **annual non-native species**

This community is characterized by dominance of cheatgrass, mustards and other non-native annual species. Trace amounts of perennial bunchgrasses might be present. Sprouting shrubs might increase. Burned tree skeletons are present.

## **Transition T1A**

### **State 1 to 2**

T1A: Transition from Reference State 1.0 to Current Potential State 2.0 Trigger: Introduction of non-native annual species. Slow variables: Over time the annual non-native plants will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

## **Transition T1B**

### **State 1 to 3**

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Singleleaf pinyon canopy cover is greater than 50 percent. Little understory vegetation remains due to competition with trees for site resources.

## **Transition T2A**

### **State 2 to 3**

Trigger: Time and a lack of disturbance allow trees to dominate site resources; might be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Pinyon canopy cover is greater than 30 percent. Little understory vegetation remains due to competition with trees for site resources.

## **Transition T2B**

### **State 2 to 4**

Trigger: Catastrophic crown fire facilitates the establishment of non-native, annual weeds. Slow variables: (a) An increase in tree crown cover, (b) a loss of perennial understory and (c) an increase in annual non-native species. Threshold: Cheatgrass or other non-native annuals dominate understory. Loss of deep-rooted perennial

bunchgrasses changes: (a) spatial and temporal nutrient cycling, (b) nutrient redistribution, and (3) reduces soil organic matter. Increased canopy cover of trees allows severe stand-replacing fire. The increased seed bank of non-native, annual species responds positively to post-fire conditions facilitating the transition to an Annual State.

**Restoration pathway R3A**  
**State 3 to 2**

Manual or mechanical thinning of trees coupled with seeding. Probability of success is highest from community phase 3.1.

**Transition T3A**  
**State 3 to 4**

Trigger: Catastrophic fire reduces the tree overstory and allows for the annual non-native species in the understory to dominate the site. Soil disturbing treatments such as slash and burn might reduce tree canopy and allow for non-native annual species to increase. Slow variables: Over time, cover and production of annual non-native species increases. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size, and spatial variability of fires.

**Additional community tables**

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Primary Perennial Grasses</b>			40–84	
	desert needlegrass	ACSP12	<i>Achnatherum speciosum</i>	20–48	–
	muttongrass	POFE	<i>Poa fendleriana</i>	10–18	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	10–18	–
2	<b>Secondary Perennial Grasses</b>			8–40	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	2–10	–
	Thurber's needlegrass	ACTH7	<i>Achnatherum thurberianum</i>	2–10	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	2–10	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	2–10	–
5	<b>Secondary Shrubs</b>			10–50	
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	2–10	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	2–10	–
	hollywood	GUSA	<i>Guaiaacum sanctum</i>	2–10	–
	currant	RIBES	<i>Ribes</i>	2–10	–
	littleleaf horsebrush	TEGL	<i>Tetradymia glabrata</i>	2–10	–
<b>Forb</b>					
3	<b>Perennial</b>			4–20	
	rockcress	ARABI2	<i>Arabis</i>	2–10	–
	balsamroot	BALSA	<i>Balsamorhiza</i>	2–10	–
<b>Shrub/Vine</b>					
4	<b>Primary Shrubs</b>			50–90	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	10–18	–
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	10–18	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	10–18	–
	buckwheat	ERIOG	<i>Eriogonum</i>	10–18	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	10–18	–
<b>Tree</b>					
6	<b>Evergreen</b>			12–28	
	singleleaf pinyon	PIMO	<i>Pinus monophylla</i>	10–18	–
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	2–10	–

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
<b>Tree</b>							
singleleaf pinyon	PIMO	<i>Pinus monophylla</i>	Native	–	85–100	–	–
Utah juniper	JUOS	<i>Juniperus osteosperma</i>	Native	–	0–15	–	–

## Animal community

#### Livestock Interpretations:

This site is suited to cattle and sheep grazing where terrain permits. Grazing management should be keyed to muttongrass production. Muttongrass is highly nutritious and remains palatable through most of the grazing season. Thurber's and desert needlegrass provide palatable, nutritious feed during the spring and early summer. New plants of these grasses are established entirely from seed and grazing practices should allow for ample seed production and seedling establishment. Many areas are not used because of steep slopes or lack of adequate water.

Stocking rates vary over time depending upon: (a) season of use, (b) climate variations, (c) site, and (d) 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.

The forage value rating is not an ecological evaluation of the understory as is the range condition rating for rangeland. The forage value rating is a utilitarian rating of the existing understory plants for use by specific kinds of grazing animals.

The amount and nature of the understory vegetation in a forestland is highly responsive to the amount and duration of shade provided by the overstory canopy. Significant changes in kinds and abundance of plants occur as the canopy changes, often regardless of grazing use.

#### Wildlife Interpretations:

This site is used by mule deer in the summer and fall. The trees provide protection from winter storms. The pinyon jay is dependent on sites supporting pinyon pine trees. This site is also used by upland game species and various songbirds, rodents, reptiles, and associated predators natural to the area. Feral horses will use this site in the late spring, summer, and fall.

### Hydrological functions

Runoff is very low to very high and the potential for sheet and rill erosion is low to moderate depending on slope and the amount of rock fragments on the soil surface.

### Recreational uses

The trees on this site provide a welcome break in an otherwise open landscape. Steep slopes and stony surfaces inhibit many forms of recreation. It has potential for hiking, cross-country skiing, camping, and for big game as well as upland game hunting.

### Wood products

Singleleaf pinyon trees serve as a food source, and provide medicinal, cultural, and spiritual values for Native Americans. Pinyon wood is rather soft, brittle, heavy with pitch, and yellowish brown in color. Singleleaf pinyon has played an important role as a source of fuelwood and mine props. It has been a source of wood for charcoal used in ore smelting. It still has a promising potential for charcoal production. Other important uses for this tree are for Christmas trees and as a source of nuts for wildlife and human food. Thousands of pounds of nuts are gathered each year and sold throughout the United States. Diseases of singleleaf pinyon include infestations of dwarf mistletoe (a parasite), and blister rust. The mountain pine beetle attacks singleleaf pinyon.

Utah juniper wood is very durable. Its primary uses have been for posts and fuelwood. It probably has considerable potential in the charcoal industry and in wood fiber products.

### PRODUCTIVE CAPACITY

Very low-quality site for tree production.

Site index ranges from about 15 to 35 (Howell, 1940).

Productivity Class: 0.10 to 0.20

CMAI\*: greater than 1.30 to 2.70 cubic feet per acre per year (greater than 0.09 to 0.23 cubic meter per hectare per year)

\*CMAI: is the culmination of mean annual increment highest average growth rate of the stand in the units specified

Fuelwood Production: 2 to 4 cords per acre for stands averaging 5 inches in diameter at 1 foot height. There are near 289,000 gross British Thermal Units (BTUs) heat content per cubic foot of singleleaf pinyon wood. Firewood is commonly measured by cord, or a stacked unit equivalent to 128 cubic feet. Solid wood volume in a cord varies but assuming an average of 75 cubic feet of solid wood per cord, there are about 21 million BTUs of heat value in a cord of singleleaf pinyon wood.

Posts (7 foot): 15 to 30 per acre in stands of medium canopy.

Christmas trees: Five trees per acre in stands of medium canopy. Ten to fifteen trees per acre in stands at sapling stage. Pinyon Nuts: Annual production varies greatly, but mature forestland stage can yield over 150 pounds per acre.

## MANAGEMENT GUIDES AND INTERPRETATIONS

### 1. LIMITATIONS AND CONSIDERATIONS

- Potential for sheet and rill erosion is moderate to severe depending on slope.
- Severe equipment limitations due to steep slopes and on sites having extreme surface stoniness.
- Proper spacing is the key to a well- managed, multiple use and multi-product pinyon and juniper forestland.

### 2. ESSENTIAL REQUIREMENTS

- Adequately protect from wildfire.
- Protect soils from accelerated erosion.
- Apply proper grazing management.

### 3. SILVICULTURAL PRACTICES

Silvicultural treatments are not reasonably applied on this site due to poor site quality

## Other products

The pitch of singleleaf pinyon is used by Native Americans as an adhesive, caulking material, and a paint binder. It might also be used medicinally and chewed like gum. Pinyon seeds are a valuable food source for humans, and a valuable commercial crop. Native Americans use(d) big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark can be woven into mats, bags and clothing. Native Americans make tea from big sagebrush leaves. They use(d) the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal.

## Other information

Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish. Antelope bitterbrush has been used extensively in land reclamation. Antelope bitterbrush enhances succession by retaining soil and depositing organic material and in some habitats and with some ecotypes, by fixing nitrogen. Green ephedra is listed as a successful shrub for restoring western rangeland communities and can be used to rehabilitate disturbed lands. It also has value for reducing soil erosion on both clay and sandy soils. Green ephedra establishes readily through direct seeding, transplants, and stem cuttings.

Table 8. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
singleleaf pinyon	<i>PIMO</i>	15	35	1	3	—	—	—	
singleleaf pinyon	<i>PIMO</i>	15	35	1	3	—	—	—	

## Inventory data references

NASIS data for soil survey areas CA686, CA729, NV629, NV772, NV773, NV774, and NV799.

## Type locality

Location 1: Mineral County, NV	
Township/Range/Section	T7N R29E S14
UTM zone	N
UTM northing	350676
UTM easting	4258825
Latitude	38° 27' 54"
Longitude	118° 42' 41"
General legal description	About five miles west of Hawthorne, Powell Creek area, Wassuk Range, Mineral County, Nevada. This site occurs in Carson City, Douglas, Lyon, Storey and Washoe County, Nevada.

## References

Stringham, T.K., D. Snyder, P. Novak-Echenique, K. O'Neill, A. Lyons, and M. Johns. 2021. Great Basin Ecological Site Development Project: State-and-Transition Models for Major Land Resource Area 26, Nevada and Portions of California..

## Other references

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Howell, J. 1940. Pinyon and juniper: a preliminary study of volume, growth, and yield. Regional Bulletin 71. Albuquerque, NM.

Jordan, M. 1974. An inventory of two selected woodland sites in the Pine Nut Hills of Western Nevada. Master's Thesis, UNReno.

USDA-NRCS. 2000 National Forestry Manual - Part 537. Washington, D.C.

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## Approval

Kendra Moseley, 4/10/2024

## 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	05/05/2024
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

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

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

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

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

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

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

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

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

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

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

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

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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:

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):
- 

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

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

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

17. **Perennial plant reproductive capability:**
-