USDA Natural Resources Conservation Service

Ecological site R010XA027OR
Juniper Pumice Flat 8-10 PZ

Last updated: 1/28/2025
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General information

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

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 010X–Central Rocky and Blue Mountain Foothills

This MLRA is characterized by gently rolling to steep hills, plateaus, and low mountains at the foothills of the Blue Mountains in Oregon and the Central Rocky Mountains in Idaho. The geology of this area is highly varied and ranges from Holocene volcanics to Cretaceous sedimentary rocks. Mollisols are the dominant soil order and the soil climate is typified by mesic or frigid soil temperature regimes, and xeric or aridic soil moisture regimes. Elevation ranges from 1,300 to 6,600 feet (395 to 2,010 meters), increasing from west to east. The climate is characterized by dry summers and snow dominated winters with precipitation averaging8 to 16 inches (205 to 405 millimeters) and increasing from west to east. These factors support plant communities with shrub-grass associations with considerable acreage of sagebrush grassland. Big sagebrush, bluebunch wheatgrass, and Idaho fescue are the dominant species. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are often dominant on sites with shallow restrictive layers. Western juniper is one of the few common tree species and since European settlement has greatly expanded its extent in Oregon. Nearly half of the MLRA is federally owned and managed by the Bureau of Land Management. Most of the area is used for livestock grazing with areas accessible by irrigation often used for irrigated agriculture.

Ecological site concept

This ecological site occurs on nearly level basalt lava plains overlain by eolian pumice sands. Elevations range from

2,300 to 4,300 feet (700 to 1,300 meters) and slopes range from 0 to 10 percent but is typically less 3 percent. The soils associated with this site are moderately deep to deep to bedrock. The soil climate is mesic (soil temperature regime) and aridic (soil moisture regime). The reference plant community is characterized by an open stand of old growth western juniper, which are over 150 years old and express unique morphological characteristics. In the understory, Idaho fescue dominates under tree canopies. Interspaces between trees are dominated by mountain and basin big sagebrush and needle and thread grass, with minor components of Indian ricegrass, western needlegrass and Thurber's needlegrass.

Associated sites

R010XA022OR	**Juniper Lava Blisters 8-10 PZ** Occurs in complex with this site on pressure ridges of lava flows. Pumice sand mantle is shallow to bedrock and commonly mixed with rock outcrop.

Similar sites

R010XA009OR	**Juniper Shrubby Pumice Flat 10-12 PZ** Higher precipitation and production. Understory dominated by mountain big sagebrush, bitterbrush, and Idaho fescue
R010XA021OR	**Juniper Shallow Pumice Hills 10-12 PZ** Higher precipitation and frigid soil temperature regime. Understory dominated by mountain big sagebrush and Idaho fescue.

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis*
Shrub	(1) *Artemisia tridentata ssp. tridentata* (2) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Hesperostipa comata* (2) *Festuca idahoensis*

Physiographic features

This site occurs on nearly level basalt lava plains. Slopes range from 0-10 percent, but are generally less than 3 percent. Elevations range from 2,300 to 4,300 feet.

Table 2. Representative physiographic features

Landforms	(1) Lava plain > Lava plateau
Flooding frequency	None
Ponding frequency	None
Elevation	2,300–4,300 ft
Slope	0–10%
Water table depth	60 in
Aspect	Aspect is not a significant factor

Climatic features

The annual precipitation ranges from 8 to 10 inches which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature is 48 degrees F. with extreme temperatures ranging from -10 to 105 degrees F. The frost free period is 40 to 90 days. The optimum period for plant growth is from late March through June.

Table 3. Representative climatic features

Frost-free period (characteristic range)	51 days
Freeze-free period (characteristic range)	106 days
Precipitation total (characteristic range)	9 in
Frost-free period (actual range)	51 days
Freeze-free period (actual range)	106 days
Precipitation total (actual range)	9 in
Frost-free period (average)	51 days
Freeze-free period (average)	106 days
Precipitation total (average)	9 in

Climate stations used

- (1) REDMOND ROBERTS FLD [USW00024230], Redmond, OR

Influencing water features

This site is not associated with riparian or wetland features.

Soil features

The soils of this site are moderately deep or deep to basalt bedrock. They are formed from eolian deposited pumice ash, primarily derived from Mt. Mazama. They are typically well drained and have an ashy sandy loam texture throughout the profile. Permeability is moderately rapid to rapid and the available water holding capacity is 3 to 7 inches for the profile. The potential for wind erosion is high. Soil temperature regime is mesic. Soil moisture regime is aridic.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Residuum–basalt
Surface texture	(1) Ashy sandy loam (2) Ashy loamy sand
Family particle size	(1) Coarse-loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	20–60 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	3–7 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–7.8

Subsurface fragment volume <=3" (0-60in)	0–10%
Subsurface fragment volume >3" (0-60in)	0–5%

Ecological dynamics

This site occurs on nearly level lava plains overlain by eolian pumice sands and supports a juniper woodland plant community. These woodlands are characterized by an open stand of old growth western juniper, which are over 150 years old and express unique morphological characteristics. In the understory, Idaho fescue dominates under tree canopies. Interspaces between trees are dominated by mountain and basin big sagebrush and needle and thread grass, with minor components of Indian ricegrass, western needlegrass and Thurber's needlegrass.

Woodland ecological sites existing on these eolian-volcanic sands collectively represent the most extensive old growth western juniper woodlands within the range of the species (Waichler et al. 2001). Trees in this region have been aged at over 1,600 years old. When compared to younger trees, old growth trees have a more rounded canopy shape with limited leader growth, deep vertical furrows in their bark, rot pockets, cavities, abundant arboreal lichen cover, and changing branch structure, including large basal branches. These woodlands have evolved over centuries and are relatively stable, resulting in the accumulation of dead wood in the form of snags, dead branches in live trees, logs, and weathered stumps (Miller et al., 2019, pg 57). It also predominately stays aloft throughout the decay process, deteriorating more through abiotic weathering than biotic decomposition; greatly limiting contributions to soil organic matter and nitrogen pools (Waichler et al. 2001).

Western juniper is highly susceptible to fire, so old growth juniper woodlands are often isolated in fire resistant locations such as "rock outcrops, knolls, ridges, and/or soils that are shallow, coarse, rocky, and often high in clay or sand" (Miller et al., 2019, pg 57). This site occurs on basalt lava plains overlain with moderately deep to deep pumice ash, primarily derived from Mt. Mazama. While soils on this site are deeper and have fewer coarse fragments than is typical of other old growth juniper sites, the soils on this site are geologically young; less than 7,000 years old, and primarily coarse pumice sands. Limited pedogenic development of these sandy soils in a low precipitation environment (8-10 inches annually) limits resources and results in a plant community that expresses large gaps between individual plants and limits overall understory production. Distance between trees and a discontinuous understory breaks up fine fuels and limits ladder fuels, typically containing fire events to one or several trees thereby creating the conditions for old growth woodlands to develop. This site is also in complex with shallow soils and rock outcrop. This close proximity to other fire resistant sites further limits fire spread. Stand replacement fires and mixed-severity fires were historically rare (return intervals measured in centuries) (Miller et al., 2005, pg 21; Miller et al., 2019, pg112); meaning climatic conditions, such as severe drought, are the primary influence on tree mortality and establishment and understory dynamics.

In addition to influencing fire behavior, soil characteristics on this site drive species composition and production in the understory. While soil textures are coarse, the soil particles themselves are porous and can hold water in addition to the capillary water of the profile. Some of this water is plant available, greatly increasing the available water capacity (AWC) of the soil compared to non-pumice soils with similar textures. (Anderson et al., 1998, pg 89). These pumice soils also have high albedo. The light color on the surface absorbs less sunlight and thus keeps the soil cooler than soils with darker A horizons. The porous nature of these soils also makes them very insulating, moderating subsurface temperatures, and keeping them cooler longer into the growing season. These unique characteristics result in a diverse species composition in the understory community that is typically more common on cooler, wetter, higher production sites. Spatial distribution of these understory species is further influenced by the size of the pumice sands. Redistribution of the pumice ash by wind resulted in varying surface textures across the site. The coarser sands favor the needelgrasses, while the finer sands favor other species like Idaho fescue and bluebunch wheatgrass.

Paleobotany and Climate:
Western juniper first arrived in its current geographical range in Central Oregon between 4,800 - 6,600 years ago, during the mid Holocene era. Cool and moist conditions 4,000 – 3,000 years ago favored tree growth, cone production and seedling establishment, resulting in rapid expansion; Western juniper reached its prehistoric maximum across most of its present-day range during this period. A subsequent warm period 2,500 – 3,000 years ago caused severe droughts, major fires, and regional declines in western juniper stands. With the onset of the Little

Ice Age conditions again became cooler and wetter and pollen records indicate juniper again began to gradually increase to its current range. (Miller et al., 2019, pg 102-103). Under a natural disturbance regime, climate is the primary driver of juniper distribution and persistence, particularly in juniper woodlands. It directly influences seed production, seedling establishment, and plant mortality while also influencing other disturbances such as fire, competition, insects, and disease. (Miller et al., 2019, pg 123)

Cool, moist conditions favor juniper expansion, while severe or extended drought and warmer conditions cause tree stress and mortality (Miller et al., 2019, pg 102). Some mortality is the direct result of drought stress, while some trees succumb to secondary disturbances due to reduced vigor. Old trees are susceptible to heart-rots, which target the heartwood of the trunk and large limbs. Heart-rots rarely kill the tree but can structurally weaken them. Stressed trees are also more susceptible to mistletoe infestations and insects. In spite of vulnerabilities, western juniper is very resistant to many pressures. Overall, tree mortality in old growth juniper woodlands is typically low (Miller et al., 2019, pg 42-48); estimated at less than one percent per century (Miller et al., 2019, pg 111).

Western Juniper Woodland Infill:
While old growth juniper woodlands are relatively stable, they are not static. They have historically experienced cycles of infill and mortality in response to climatic conditions. With the end of the Little Ice Age in the 1850s, evidence suggests these woodlands were slowly expanding and infilling. Rate of infill throughout the Great Basin greatly accelerated in the late 1800s, peaking in the early 1900s. Infill rates slowed with the onset of widespread severe droughts starting in the 1920s. This acceleration coincides with a significant rise in settlement throughout the Intermountain West and is attributed to a combination of factors including climate, grazing, altered fire regimes, and increased CO2 levels (Miller et al., 2019, pg 83, 104).

Woodland infill, precipitated by the end of the Little Ice Age, coincided with a time of rapid settlement and introduction of livestock grazing in the Great Basin, altering understory dynamics and fire behavior. Wetter periods, as were experienced during this timeframe, typically result in the accumulation of fine fuels (Miller et al., 2019, pg 83). In addition to effects increased understory vegetation has on fire cycles, paleobotany literature suggests competition with herbaceous vegetation may limit tree seedling establishment and/or result in thinning. This indicates a robust understory can provide some competition to juniper establishment, limiting infill (Miller et al., 2019, pg 112). Large numbers of domestic livestock grazing during this period prevented fine fuel accumulation and areas of heavy grazing would have resulted in understory plant stress. Without fire or competition, young juniper trees were able to rapidly establish.

Carbon dioxide (CO2) levels have also increased since the end of the Little Ice Age. Increased CO2 can increase water use efficiency in conifers relative to herbaceous species, resulting in faster tree growth and denser canopies (Miller et al., 2019, pg 119). As climate conditions became warmer and drier in the early 1900s, expansion and infill slowed but still exceeded historic rates under similar conditions. This suggests CO2 concentrations and reduced competition from perennial grasses could be playing a significant role in current woodland expansion (Miller et al., 2019, pg 121 & 123). These factors have resulted in altered stand structure in many persistent woodlands.

Infill trees compete with understory vegetation for water and other resources. Shrubs decline as trees increase in dominance, with sagebrush being highly sensitive to tree competition. Idaho fescue will persist longer as infill progresses, in part due to their superior shade tolerance relative to other species but will also eventually be removed from the site. (Miller et al., 2019, pg 52; Miller et al., 2000) Herbaceous species are more resistant to tree competition, but also decline with increased tree dominance. Microclimate conditions under old growth trees shelter Idaho fescue, so interspace species are the first to decline. Understory decline is accelerated when plants are stressed by other disturbances such as drought, heavy grazing, or recreational use (Miller et al., 2019, pg 48-55).

Non-Native Species:
With increased native plant understory stress and mortality, there is greater opportunity for establishment of non-native species and native increasers. This site is susceptible to cheatgrass (*Bromus tectorum*), an invasive annual grass, and introduced annual forbs like pale madwort (*Alyssum alyssoides*). Medusahead (*Taeniatherum caput-medusae*) and North Africa grass (*Ventenata dubia*) are not a concern on this site, as they typically do not establish in these coarse textured pumaceous soils. With repeated disturbance, sprouting shrubs (e.g. rabbitbrush species) and forbs (e.g. granite prickly phlox, *Linanthus pungens* and tansymustard, Descurainia sp.) also increase and fill open spaces in the understory.

Over time, this can create fuel continuity that is atypical of old growth woodlands, making this site more prone to

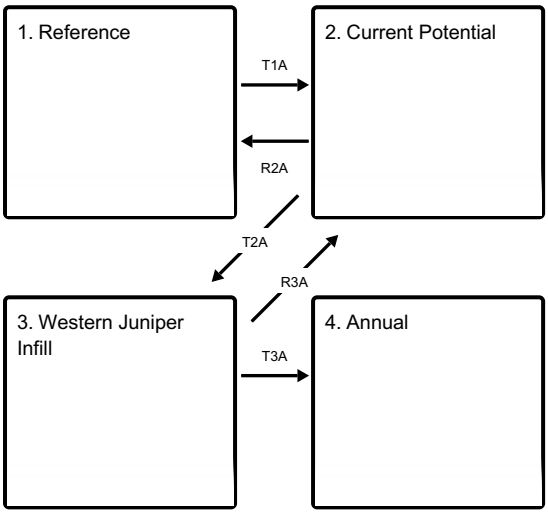
fire. Fires become more frequent and widespread. Higher tree densities from juniper infill also creates ladder fuels, making old trees more susceptible to fire, leading to more stand-replacing fires. (Miller et al., 2019, pg 115). Recurring fires favor re-establishment of annual and sprouting species over native perennial grasses and shrubs, thereby perpetuating the fire cycle.

Resilience Management:
Within the natural range of variability under a normal distribution regime this site is resistant to disturbance, but has low resilience when disturbance occurs. Physiographic characteristics including proximity to rock outcrops and adjacent shallow soils as well as low fine fuel loads and minimal ladder fuels make this site very fire resistant. The site is also capable of withstanding extended drought with limited plant mortality. Disturbances outside of shifts in climate are not common resulting in a very stable site.

When disturbance occurs outside the normal range of variability the plant community shifts quickly and is very susceptible to invasion by non-native annual species. This low resilience is a result of the site's limited resources (arid soil moisture regime and sandy soils) and warmer climate (mesic soil temperature regime).

State and transition model

Ecosystem states



T1A - Non-native species, fire, heavy grazing, and/or increased CO2 levels

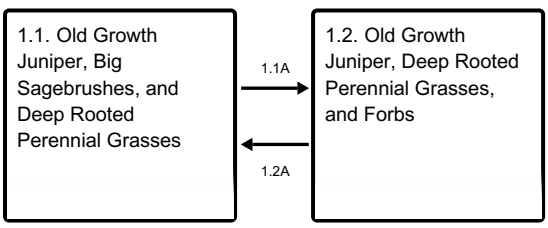
R2A - Mechanical treatment of infill trees (non-old growth juniper); non-native species are not present.

T2A - Time

R3A - Mechanical treatment of infill trees (non-old growth juniper).

T3A - Time or stand replacement fire

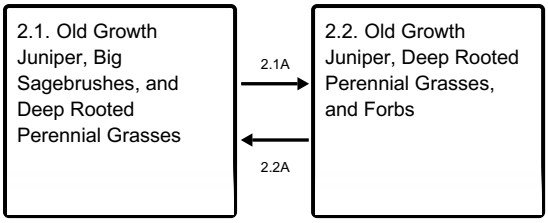
State 1 submodel, plant communities



1.1A - Insects , drought stress, and/or small isolated fire

1.2A - Time and favorable climatic conditions

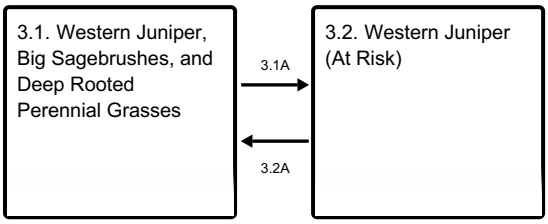
State 2 submodel, plant communities



2.1A - Insects, drought, and/or small isolated fire.

2.2A - Time and favorable climatic conditions.

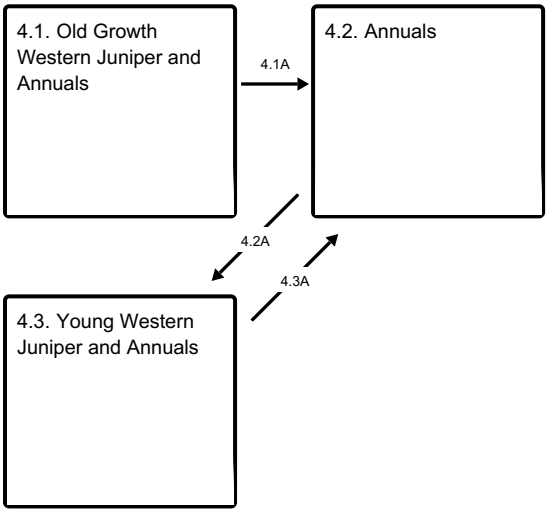
State 3 submodel, plant communities



3.1A - Time

3.2A - Disturbance removal and/or mechanical treatment of infill trees (non-old growth juniper).

State 4 submodel, plant communities



4.1A - Stand replacement fire.

4.2A - Time and lack of fire

4.3A - Fire

State 1
Reference

The Reference State is representative of the natural range of variability under pristine conditions. No introduced species occur in this state and disturbance has not fundamentally altered soil quality or plant community composition. This state represents a persistent old growth juniper woodland and has two general plant communities; a grass – shrub dominant community and a grass – forb dominated community. Both support an open stand of old growth juniper. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups and low fine fuel loads. Plant community phase changes are primarily driven by climate. Warm, dry cycles resulting in severe drought stresses plants and increases susceptibility to insects and disease. Cooler, wetter cycles that are conducive to tree establishment may result in woodland infill, and fine fuel accumulations may result in single tree or small area fires. Fire return interval

is centuries.

Characteristics and indicators. • Lack of introduced plant species • Presence of all functional and structural groups • High plant vigor and reproductive capacity in most years

Resilience management. Management should focus on preservation of old growth juniper and prevention of non-native species establishment. Removal of infill trees to maintain pre-European infill rates can prevent transition to State 2.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Old Growth Juniper, Big Sagebrushes, and Deep Rooted Perennial Grasses

This community is characterized by an open stand of old growth juniper. Occasional younger trees of varying ages are present in the understory or as a limited part of the overstory. The understory is composed of two distinct communities in complex with each other. Under the trees and within influence of the crown is an Idaho fescue dominated ground layer. The interspaces between the trees (openings) are dominated by mountain and basin big sagebrush, needle and thread, and several other minor species such as Indian ricegrass, western needlegrass, and Thurber's needlegrass. This community is very stable and the most common community in this state.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	450	600	750
Shrub/Vine	70	90	110
Tree	50	70	90
Forb	30	40	50
Total	**600**	**800**	**1000**

Figure 9. Plant community growth curve (percent production by month). OR4011, B10A Mesic, Mid Elev., N/A, Good Condition. RPC Growth Curve (Pumice Flats).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	10	58	28	2	0	0	0	0	0

Community 1.2
Old Growth Juniper, Deep Rooted Perennial Grasses, and Forbs

Juniper overstory has experienced isolated mortality as the result of small, single tree or small area fire; or drought and disease. This community is limited to the extent of the disturbance (usually a small, isolated area). Site is still characterized by an open stand of old growth juniper. Young trees (<150 years old) and/or shrubs are reduced or

removed from the site. Perennial forbs and grasses expand.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Pathway 1.1A
Community 1.1 to 1.2

Insects (e.g. aroga moth), drought stress, and/or small isolated fire reduces sagebrush and young juniper trees. Disturbance from drought and disease may be more widespread than fire.

Pathway 1.2A
Community 1.2 to 1.1

Time and favorable climatic conditions (cooler/wetter climatic cycles) facilitate increase in shrub overstory.

State 2
Current Potential

This state is similar to the reference state yet some amount of introduced species occur and/or infill rates are exceeding pre-European settlement rates. Ecological function is largely intact, however the resiliency of the state has been reduced. This state represents a persistent old growth juniper woodland and has two general plant communities; a grass – shrub dominant community and a grass – forb dominated community. Both support an open stand of old growth juniper. Non-natives may increase in abundance but will not become dominant within this State. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups and low fine fuel loads. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid

growth rate, residual dry matter accumulation, and adaptations for seed dispersal. Plant community phase changes are primarily driven by climate. Warm, dry cycles resulting in severe drought stresses plants and increases susceptibility to insects and disease. Cooler, wetter cycles that are conducive to tree establishment may result in woodland infill, and fine fuel accumulations may result in single tree or small area fires. Fire return interval is centuries.

Characteristics and indicators. • Presence of all functional and structural groups • High plant vigor and reproductive capacity in most years

Resilience management. Management should focus on preservation of old growth juniper and prevention of non-native species expansion. Removal of infill trees to maintain pre-European infill rates can prevent transition to State 3; or restore to Reference (State 1) if non-native species are not present.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 2.1
Old Growth Juniper, Big Sagebrushes, and Deep Rooted Perennial Grasses

This community is characterized by an open stand of old growth juniper. Occasional younger trees of varying ages are present in the understory or as a limited part of the overstory. The understory is composed of two distinct communities in complex with each other. Under the trees and within influence of the crown is an Idaho fescue dominated ground layer. The interspaces between the trees (openings) are dominated by mountain and basin big sagebrush, needle and thread, and several other minor species such as Indian ricegrass, western needlegrass, and Thurber's needlegrass. Annual non-native species may be present but not dominant. This community is very stable and the most common community in this state.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 2.2
Old Growth Juniper, Deep Rooted Perennial Grasses, and Forbs

Juniper overstory has experienced isolated mortality as the result of small, single tree or small area fire; or drought and disease. This community is limited to the extent of the disturbance (usually a small, isolated area). Site is still characterized by an open stand of old growth juniper. Young trees (<150 years old) and/or shrubs are reduced or removed from the site. Perennial forbs and grasses expand. If annual non-native species are present, they may increase with disturbance but will not become dominant.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Pathway 2.1A
Community 2.1 to 2.2

Insects (e.g. aroga moth), drought stress, and/or small isolated fire reduces sagebrush. Disturbance from drought

and disease may be more widespread than fire.

Pathway 2.2A
Community 2.2 to 2.1

Time and favorable climatic conditions (cooler/wetter climatic cycles) facilitate increase in shrub overstory.

State 3
Western Juniper Infill

In this state western juniper dominates the overstory and site resources. Young juniper (<100 years old) is co-dominant with old growth juniper and increasing. Big sagebrush, bitterbrush, and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients and soil organic matter distribution and cycling have been spatially and temporally altered. Increased pace of tree recruitment results in a multi-age class overstory. As tree density increases, shrub mortality increases, and deep-rooted perennial grasses are reduced. Bare ground interspaces are large and connected, allowing for establishment and expansion of cheatgrass, annual forbs, mustards, and granite prickly phlox.

Characteristics and indicators. • Western juniper infill trees are co-dominant with old growth trees or dominant in the overstory • Presence of all functional and structural groups, though diversity may be reduced • Bare ground patches are large and connected

Resilience management. Management should focus on preservation of old growth juniper and promoting native understory vigor and expansion. Removal of infill trees to release resources and reduce competition for native understory vegetation can help maintain State 3; or restore to Current Potential (State 2) if all functional groups and understory species are present.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 3.1
Western Juniper, Big Sagebrushes, and Deep Rooted Perennial Grasses

Western juniper dominates the overstory and site resources. Young trees are actively growing with noticeable leader growth. Shrubs and bunchgrasses are still present in the understory, but production has been reduced. Gaps between perennial plants have increased. Annual non-native species and perennial increasers are present, particularly in the interspaces.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Idaho fescue (*Festuca idahoensis*), grass

Community 3.2
Western Juniper (At Risk)

Western juniper dominates the site. Trace amounts of sagebrush may be present however dead skeletons will be more numerous than living brush. Deep-rooted bunchgrasses may or may not be present in the interspaces. Idaho fescue may still be present under the canopy of large trees. Bare ground interspaces are large and connected. Soil redistribution may be increasing, especially by wind . Annual non-native species and perennial increasers are present and increasing, particularly in the interspaces .

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- Idaho fescue (*Festuca idahoensis*), grass
- cheatgrass (*Bromus tectorum*), grass

Pathway 3.1A
Community 3.1 to 3.2

Time allows for maturation of the tree community. Additional disturbances such as recreational vehicle use, repeated heavy grazing, and pressure from the urban interface that stress understory species accelerate this pathway.

Pathway 3.2A
Community 3.2 to 3.1

Removal of disturbances such as recreational vehicle use, repeated heavy grazing, and pressure from the urban interface may allow understory species to increase vigor and expand in the understory if infill trees are not utilizing all site resources. Mechanical treatment of infill trees (non-old growth juniper) can also facilitate this pathway.

State 4
Annual

In this state, perennial bunchgrasses and non-sprouting shrubs are greatly reduced or missing on the site. The understory has been replaced by non-native annual grasses and forbs, sprouting shrubs, and native increasers. Competition with the tree overstory and/or repeated disturbances such as fire, heavy grazing, and recreational use has allowed non-sprouting shrubs and perennial grasses to be replaced by cheatgrass, an invasive annual grass, and introduced annual forbs like pale madwort (*Alyssum alyssoides*). Forbs (e.g. granite prickly phlox , *Linanthus pungens* and tansymustard, Descurainia sp.) and sprouting shrubs (e.g. rabbitbrush species) also increase and fill open spaces in the understory. This state may still support a western juniper overstory. If the site has not had a stand replacement fire, it will be a mix of old growth and young juniper. Following a stand replacement fire, the tree overstory will be temporarily lost. Time without disturbance will allow trees to reestablish. However, fuel continuity typical of annual dominated systems causes fires to become more frequent and widespread making replacement of old growth trees unlikely. Reestablishment of old growth trees would take centuries without disturbance (primarily fire), and feasibility of this pathway is currently unknown.

Characteristics and indicators. • Understory is dominated by cheatgrass and introduced annual forbs • Perennial grasses are greatly reduced or missing

Community 4.1
Old Growth Western Juniper and Annuals

Annual non-native plants, native increaser forbs, and sprouting shrubs dominate this site. This community has a western juniper overstory that still supports old growth trees. Young trees (<100 years old) are co-dominant or dominant. Non-sprouting shrubs may be present in trace amounts.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- yellow rabbitbrush (*Chrysothamnus viscidiflorus*), shrub
- cheatgrass (*Bromus tectorum*), grass

Community 4.2
Annuals

This community occurs after stand replacement fire. Annual non-native plants, native increaser forbs, and sprouting shrubs dominate this site. Scattered juniper or patches of juniper may persist, but the western juniper overstory has been removed.

Dominant plant species

- yellow rabbitbrush (*Chrysothamnus viscidiflorus*), shrub
- cheatgrass (*Bromus tectorum*), grass

Community 4.3
Young Western Juniper and Annuals

Annual non-native plants, native increaser forbs, and sprouting shrubs dominate this site. Western juniper has re-established in the overstory following a stand replacing fire.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- yellow rabbitbrush (*Chrysothamnus viscidiflorus*), shrub
- cheatgrass (*Bromus tectorum*), grass

Pathway 4.1A
Community 4.1 to 4.2

Stand replacement fire.

Pathway 4.2A
Community 4.2 to 4.3

Time and lack of fire allows for sprouting shrubs such as rabbitbrush to increase, and potentially sagebrush to establish. The probability of sagebrush establishment is extremely low. Young juniper reestablishes.

Pathway 4.3A
Community 4.3 to 4.2

Fire

Transition T1A
State 1 to 2

Introduction of non-native species, altered fire regimes, repeated heavy grazing by domestic livestock, and/or increased CO2 levels.

Context dependence. The combination of multiple triggers increases likelihood of this transition.

Restoration pathway R2A
State 2 to 1

Mechanical treatment of infill trees (non-old growth juniper); non-native species are not present.

Context dependence. Non-native species are not present.

Transition T2A
State 2 to 3

Time and favorable conditions for tree expansion allow trees to become dominant.

Restoration pathway R3A
State 3 to 2

Mechanical treatment of infill trees (non-old growth juniper).

Context dependence. Depleted understories may be slow to recover. Understory recovery may not be possible if anthropogenic disturbances are still stressing understory species. Restoration to State 2 is possible from Community 3.1 when all functional groups are still present, and site has maintained understory species diversity. Restoration from Community 3.2 is unlikely due to depleted understory.

Transition T3A
State 3 to 4

Time allows for maturation of the tree community and loss of understory species; or stand replacement fire .

Context dependence. Additional disturbances such as recreational vehicle use, repeated heavy grazing, and pressure from the urban interface that stress understory species accelerate this transition.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses and Grasslikes**			450–750	
	needle and thread	HECO26	*Hesperostipa comata*	240–340	–
	Idaho fescue	FEID	*Festuca idahoensis*	85–150	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	20–50	–
	western needlegrass	ACOC3	*Achnatherum occidentale*	20–50	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	20–50	–
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	15–30	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	15–25	–
	Ross' sedge	CARO5	*Carex rossii*	15–25	–
	squirreltail	ELEL5	*Elymus elymoides*	10–15	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	10–15	–
Forb					
2	**Perennial Forbs**			30–50	
	common yarrow	ACMI2	*Achillea millefolium*	0–10	–
	pussytoes	ANTEN	*Antennaria*	0–10	–
	larkspur	DELPH	*Delphinium*	0–10	–
	fleabane	ERIGE2	*Erigeron*	0–10	–
	buckwheat	ERIOG	*Eriogonum*	0–10	–
	common starlily	LEMO4	*Leucocrinum montanum*	0–10	–
	lupine	LUPIN	*Lupinus*	0–10	–
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–10	–
	phacelia	PHACE	*Phacelia*	0–10	–
	spiny phlox	PHHO	*Phlox hoodii*	0–10	–
Shrub/Vine					
3	**Dominant Shrubs**			55–85	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	10–75	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	10–75	–
4	**Other Shrubs**			15–25	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–10	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–10	–
	spiny hopsage	GRSP	*Grayia spinosa*	0–10	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–10	–
	desert gooseberry	RIVE	*Ribes velutinum*	0–10	–
Tree					
5	**Evergreen Tree**			50–90	
	western juniper	JUOC	*Juniperus occidentalis*	50–90	–

Animal community

The unique morphological structure of old growth western juniper trees including hollows and cavities provide habitat for cavity nesting birds. A study in Central Oregon found cavity nesting birds were 2.7 times more abundant

in old growth juniper woodlands than post settlement stands (Waichler et al. 2001).

Hydrological functions

The soils of this site have high infiltration rates and low runoff potential.

Wood products

Firewood and fence posts.

Inventory data references

Prineville District BLM Ecological Site Inventory
NASIS component and pedon data
Range Site Descriptions
Field knowledge of range-trained personnel

Other references

Anderson, E. J., M. M. Borman, and W. C. Krueger. 1998. The Ecological Provinces of Oregon: a Treatise on the Basic Ecological Geography of the State., Oregon Agricultural Experiment Station. Special Report 990. (Oregon State University: Corvallis.)

Miller, R.F.; Bates, J.D.; Svejcar, T.J.; [et al.] E. Eddleman. 2005. Biology, ecology, and management of western juniper (Juniperus occidentalis). Tech. Bul. 152. Corvallis, OR: Oregon State University Agricultural Experiment Station. 82 p.

Miller, Richard F.; Chambers, Jeanne C.; Evers, Louisa; Williams, C. Jason; Snyder, Keirith A.; Roundy, Bruce A.; Pierson, Fred B. 2019. The ecology, history, ecohydrology, and management of pinyon and juniper woodlands in the Great Basin and Northern Colorado Plateau of the western United States. Gen. Tech. Rep. RMRS-GTR-403. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 284 p.

Waichler, W.S.; Miller, R.F.; Doescher, P.S. 2001. Community characteristics of old-growth western juniper woodlands. Journal of Range Management. 54(5): 518-527.

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Approval

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Rangeland health reference sheet

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

Author(s)/participant(s)	Jeff Repp and Bruce Franssen.
Contact for lead author	State Rangeland Management Specialist for NRCS - Oregon
Date	04/24/2003
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

2. **Presence of water flow patterns:** None

3. **Number and height of erosional pedestals or terracettes:** None

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20-30%

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Slightly to moderately resistant to erosion: aggregate stability = 2-5

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** single grain to moderate very fine granular structure, dry color value 4-5, 7-12 inches thick; low organic matter content (1-2%).

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Significant ground cover (60-70%) and moderate slopes (0-10%) effectively limit rainfall impact and overland flow

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

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: Perennial, deep-rooted bunch-grasses

    Sub-dominant: Evergreen shrubs

    Other: Evergreen trees = perennial forbs > other shrubs

    Additional:

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

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):** Favorable: 1000, Normal: 800, Unfavorable: 600 lbs/acre/year at high RSI

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:** Cheatgrass and Medusahead invade sites that have lost deep rooted perennial grass functional groups

17. **Perennial plant reproductive capability:** All species should be capable of reproducing annually