USDA Natural Resources Conservation Service

Ecological site R043CY804OR
Cool Mountain Bunchgrass (ARTRV/FEID)

Last updated: 9/08/2023
Accessed: 05/06/2024

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): 043C–Blue and Seven Devils Mountains

This MLRA covers the Blue and Seven Devils Mountains of Oregon, Washington and Idaho. The area is characterized by thrust and block-faulted mountains and deep canyons composed of sedimentary, metasedimentary, and volcanic rocks. Elevations range from 1,300 to 9,800 feet (395 to 2,990 meters). The climate is characterized by cold, wet winters and cool, dry summers. Annual precipitation, mostly in the form of snow, averages 12 to 43 inches (305 to 1,090 millimeters) yet ranges as high as 82 inches (2,085 millimeters) at upper elevations. Soil temperature regimes are predominately Frigid to Cryic and soil moisture regimes are predominately Xeric to Udic. Mollisols and Andisols are the dominant soil orders. Ecologically, forests dominate but shrub and grass communities may occur on south aspects and lower elevations as well as in alpine meadow environments. Forest composition follows moisture, temperature and elevational gradients and typically ranges from ponderosa pine and Douglas-fir plant associations at lower elevations, grand fir at middle elevations and subalpine fir and Engelman spruce at upper elevations. Historical fire regimes associated with these forest types range from frequent surface fires in ponderosa pine - Douglas Fir forest types to mixed and stand replacing fire regimes in grand fir and subalpine fir types. A large percentage of the MLRA is federally owned and managed by the U.S. Forest Service for multiple uses.

Classification relationships

Plant Assoc. of Blue and Ochoco Mountains (R6 E TP-036-92)
western juniper/Idaho fescue-bluebunch wheatgrass - CJG111
western juniper/mountain big sagebrush/Idaho fescue-bluebunch wheatgrass - CJS2
western juniper/bitterbrush/Idaho fescue-bluebunch wheatgrass - CJS321
mountain big sagebrush/Idaho fescue-bluebunch wheatgrass - SD2911
mountain big sagebrush/western needlegrass - SD2920
mountain big sagebrush/elk sedge - SS4911

USDA Forest Service Ecological Sub-region
M332 “Blue Mountains”

U.S. National Vegetation Classification Standard (NVCS)
Group: G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland
Alliance: A3207. Artemisia tridentata ssp. spiciformis - Artemisia tridentata ssp. vaseyana Steppe & Shrubland Alliance
Association: Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Grassland

Ecological site concept

This site occurs on mountain slopes, hillslopes, plateaus and ridges of the Blue and Ochoco Mountains. Soils are typically moderately deep but range from shallow to very deep. Typically, total available water (either due to soil

properties, or low precipitation) limits plant communities to drought resistant sagebrush and bunchgrass instead of large conifers. The reference state is characterized by a mix of mountain big sagebrush (Artemisia tridentata ssp. vaseyana), Idaho fescue (Festuca idahoensis) and perennial forbs. Minor amounts of western juniper (Juniperus occidentalis) and ponderosa pine (Pinus ponderosa) may be present. Typically, periodic low intensity fire removes woody species and favors deep rooted perennial bunchgrasses. Fire suppression favors invasion by western juniper and shrubs.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

R043CY808OR	**Claypan (ARAR8/FEID-PSSPS)** Adjacent soils with well developed claypan layers favoring low sagebrush

Similar sites

R043CY802OR	**Cool foothills and Mountains (FEID-KOMA-PSSPS)** Influenced by maritime climate patterns, ARTR uncommon
R043CY805OR	**Mountain Rockland (JUOC/CELE3/FEID)** Greater large coarse fragment content, shallower soils with higher cover of cobbles and stones on the surface and areas of rock outcrop

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Festuca idahoensis*

Physiographic features

This site occurs on all aspects of mountain slopes, hillslopes, plateaus and ridges of the Blue and Ochoco Mountains. Basalt of the Columbia River Group are most dominant, but sedimentary, metavolcanic, metamorphic, and other hard igneous extrusive geologies may also occur. Slopes are broad, ranging from 0 to 90% but average 15 to 35%. Elevation is typically from 5,350 to 6,300 feet (1,625 to 1,925 m) but ranges from 3,800 to 7,300 ft (1,150 to 2,225 m). With increased elevation, this site is more likely to occur on south slopes and conversely on north slopes with decreasing elevation. This site does not experience ponding or flooding and no water table is present within the upper two meters of soil.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Hillside or mountainside (2) Mountains > Plateau (3) Mountains > Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	5,350–6,300 ft
Slope	15–35%
Ponding depth	0 in
Water table depth	100 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	3,800–7,300 ft
Slope	0–90%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

Annual precipitation is 25 - 35 inches (635 - 890 mm), most of which occurs in the form of snow during the months of December through March. Localized convection storms occasionally occur during the summer but resulting precipitation does not generally have a significant effect on soil moisture. The soil temperature regime is frigid, and the soil moisture regime is xeric. The frost-free period ranges from less than 30 to 90 days. The optimum growth period for plant growth is late April through June. Climate graphs are populated from the closest available weather stations and are included to represent general trends rather than representative values.

Table 4. Representative climatic features

Frost-free period (characteristic range)	30-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	25-35 in
Frost-free period (average)	55 days
Freeze-free period (average)	
Precipitation total (average)	31 in

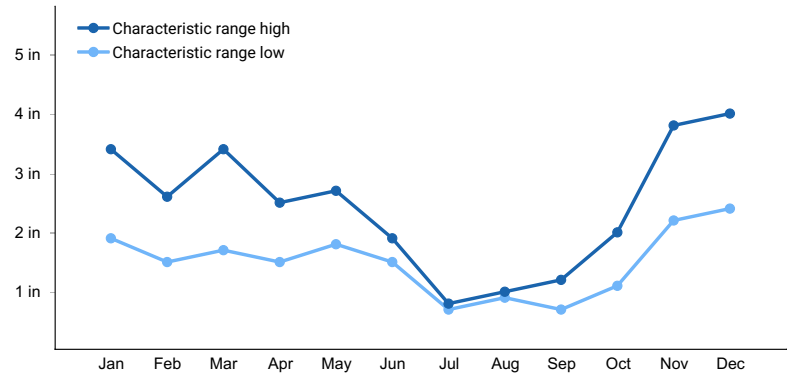


Figure 1. Monthly precipitation range

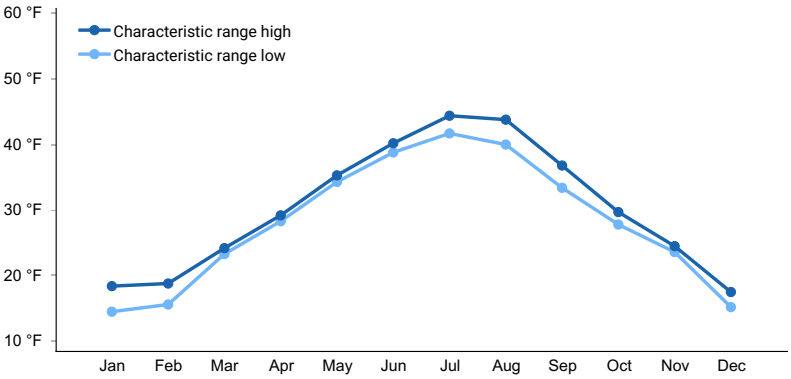


Figure 2. Monthly minimum temperature range

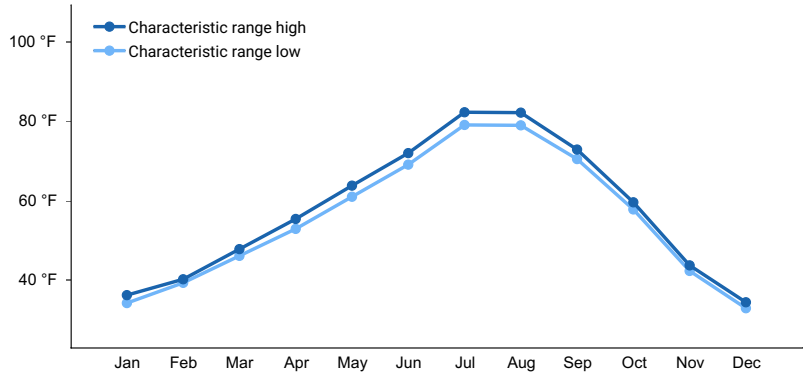


Figure 3. Monthly maximum temperature range

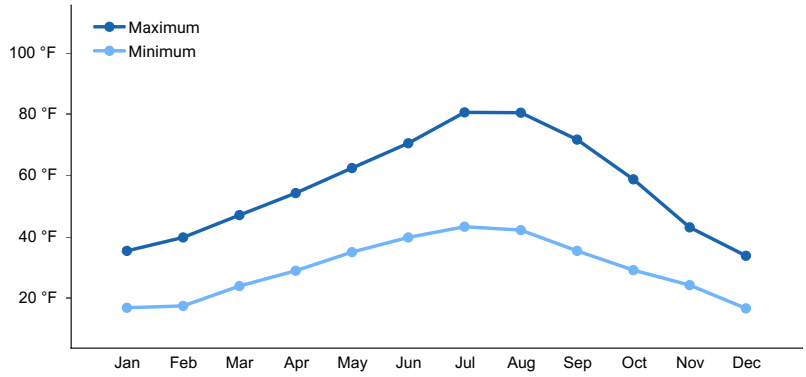


Figure 4. Monthly average minimum and maximum temperature

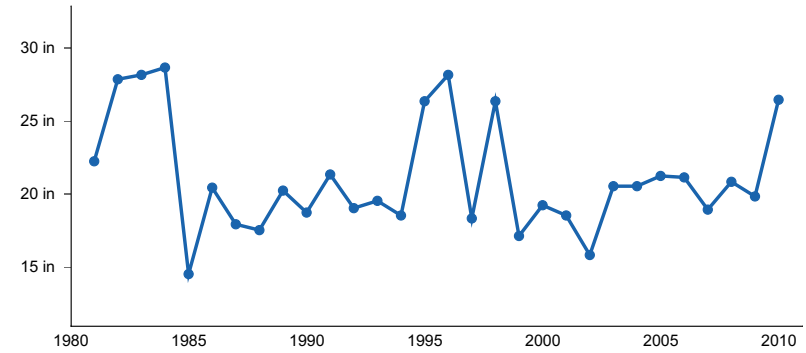


Figure 5. Annual precipitation pattern

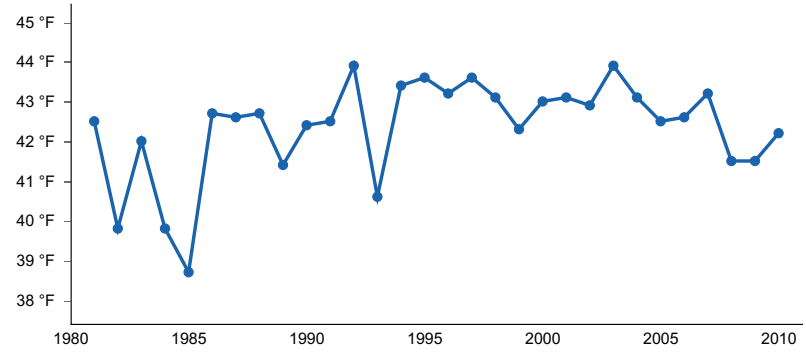


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MASON DAM [USC00355258], Baker City, OR
- (2) AUSTIN 3 S [USC00350356], Prairie City, OR
- (3) MEACHAM [USW00024152], Pendleton, OR

Influencing water features

This site is not influenced by water from a wetland or stream.

Soil features

The soils of this site are formed from residuum and colluvium derived from hard igneous extrusive geologies (basalt, andesite, rhyolite, tuff, etc.) with an influence of volcanic ash in the surface. Occasionally, sedimentary, metamorphic and metavolcanic geologies may be found associated with this site. These soils are typically moderately deep but range from shallow to very deep. The family particle size is typically loamy-skeletal but variable. Surface textures are variable. Subsurface textures range from loam to clay. The total volume of coarse fragments is variable depending on slope but is typically 15 to 40. See Ironside and Chochoco for modal series concepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–volcanic and metamorphic rock (2) Residuum–volcanic and metamorphic rock (3) Colluvium–volcanic and sedimentary rock (4) Colluvium–volcanic and sedimentary rock
Surface texture	(1) Ashy silt loam (2) Extremely cobbly loam (3) Very gravelly sandy loam (4) Very gravelly silt loam
Family particle size	(1) Ashy over loamy-skeletal (2) Fine-loamy (3) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to rapid
Depth to restrictive layer	20–40 in
Soil depth	20–40 in
Surface fragment cover <=3"	15–60%
Surface fragment cover >3"	5–20%
Available water capacity (0-40in)	0.5–5.34 in
Soil reaction (1:1 water) (0-40in)	5.4–7.3
Subsurface fragment volume <=3" (4-60in)	0–40%
Subsurface fragment volume >3" (4-60in)	0–65%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	10–80 in
Soil depth	10–80 in
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	Not specified

Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume <=3" (4-60in)	Not specified
Subsurface fragment volume >3" (4-60in)	Not specified

Ecological dynamics

The reference plant community is dominated by Idaho fescue in the understory and mountain big sagebrush in the overstory. Prairie junegrass (*Koeleria macrantha*), Sandberg bluegrass (*Poa secunda*) and a variety of forbs are also present.

Ecological Dynamics and Disturbance Response:
Ecological dynamics of this site are primarily driven by interactions between climatic patterns and disturbance regimes. Frequent low intensity fires were the historical disturbance that maintained the reference state and drove plant community shifts within the state. Intensity and frequency of these fires is strongly influence by drought cycles and/or insect or disease attacks on the plant community. Introduction of exotic annual grasses compromises the resistance and resiliency of the site, putting it at higher risk of crossing a threshold into another state.

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

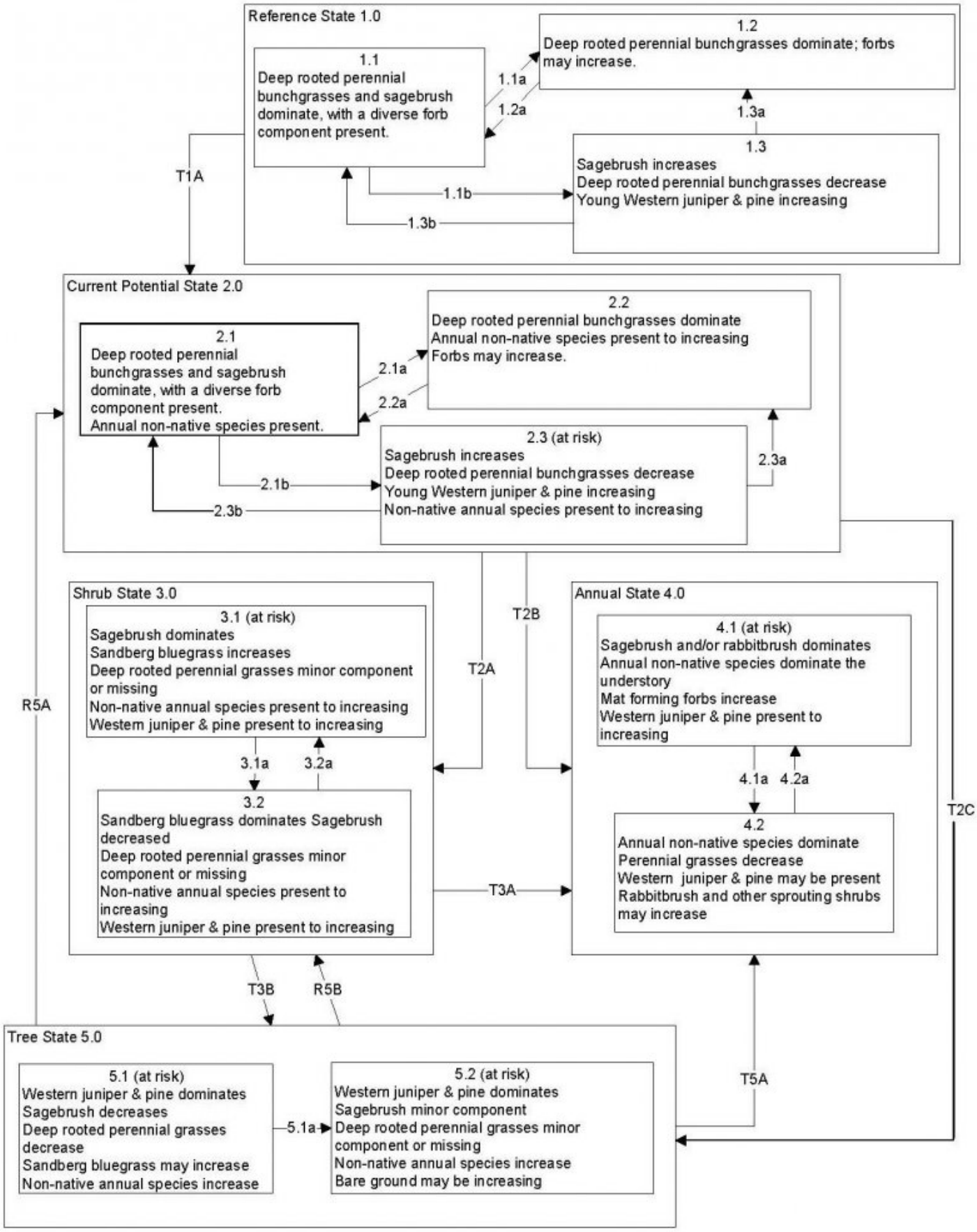
The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al. 2007).

This site is susceptible to western juniper encroachment; and to a lesser extent, ponderosa pine when the site is adjacent to mature conifers. The range and density of western juniper has increased since the middle of the nineteenth century (Tausch 1999, Miller and Tausch 2000). Causes for expansion of conifers into sagebrush ecosystems include wildfire suppression, historic livestock grazing, and climate change (Bunting 1994). Mean fire return intervals prior to European settlement in mountain big sagebrush ecosystems were 15 to 25 years (Burkhardt and Tisdale 1976, Young and Evans 1981), frequent enough to inhibit the encroachment of conifers into these big sagebrush cover types (Miller and Tausch 2000). With the increased suppression of wildfire and livestock grazing, which reduces ground fuels and understory competition, regeneration and establishment of conifers has expanded into suitable sites previously dominated by big sagebrush (Burns and Honkala 1990). An increase in crown density causes a decrease in understory perennial vegetation and an increase in bare ground. This allows for the invasion of non-native annual species such as cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*). With annual species in the understory wildfire can become more frequent and increase in intensity. With frequent wildfires, sagebrush will be reduced or eliminated and these plant communities can convert to annual species with a sprouting shrub and juvenile tree overstory.

Treatment Response:
North facing aspects respond positively to juniper removal if soil erosion is not significant. Seeding may be necessary if there is less than 1-2 bunchgrass plants per meter square in the understory. Sagebrush and forbs may also need to be seeded if adult plants are no longer present in the understory.

Adapted from: Stringham, et al. 2017

State and transition model


Reference State 1.0
1.1
Deep rooted perennial bunchgrasses and sagebrush dominate, with a diverse forb component present.
1.2
Deep rooted perennial bunchgrasses dominate; forbs may increase.
1.3
Sagebrush increases
Deep rooted perennial bunchgrasses decrease
Young Western juniper & pine increasing
1.1a
1.2a
1.3a
1.1b
1.3b
T1A
Current Potential State 2.0
2.1
Deep rooted perennial bunchgrasses and sagebrush dominate, with a diverse forb component present.
Annual non-native species present.
2.2
Deep rooted perennial bunchgrasses dominate
Annual non-native species present to increasing
Forbs may increase.
2.3 (at risk)
Sagebrush increases
Deep rooted perennial bunchgrasses decrease
Young Western juniper & pine increasing
Non-native annual species present to increasing
2.1a
2.2a
2.1b
2.3b
2.3a
R5A
T2A
T2B
T2C
Shrub State 3.0
3.1 (at risk)
Sagebrush dominates
Sandberg bluegrass increases
Deep rooted perennial grasses minor component or missing
Non-native annual species present to increasing
Western juniper & pine present to increasing
3.1a
3.2a
3.2
Sandberg bluegrass dominates Sagebrush decreased
Deep rooted perennial grasses minor component or missing
Non-native annual species present to increasing
Western juniper & pine present to increasing
T3A
T3B
R5B
Annual State 4.0
4.1 (at risk)
Sagebrush and/or rabbitbrush dominates
Annual non-native species dominate the understory
Mat forming forbs increase
Western juniper & pine present to increasing
4.1a
4.2a
4.2
Annual non-native species dominate
Perennial grasses decrease
Western juniper & pine may be present
Rabbitbrush and other sprouting shrubs may increase
T5A
Tree State 5.0
5.1 (at risk)
Western juniper & pine dominates
Sagebrush decreases
Deep rooted perennial grasses decrease
Sandberg bluegrass may increase
Non-native annual species increase
5.1a
5.2 (at risk)
Western juniper & pine dominates
Sagebrush minor component
Deep rooted perennial grasses minor component or missing
Non-native annual species increase
Bare ground may be increasing

Reference State 1.0 Community Pathways
1.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush cover and leads to a community dominated by grasses and forbs.
1.1b: Time and lack of disturbance such as fire facilitates an increase in the shrub overstory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: High severity fire significantly reduces sagebrush and conifer cover and leads to a community dominated by grasses and forbs. 1.3b: Low severity fire reduces sagebrush and conifer cover and creates sagebrush/grass mosaic.

Transition T1A: Introduction of non-native species

Current Potential State 2.0 Community Pathways
2.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush cover and leads to a community dominated by grasses and forbs. Brush treatments/tree thinning would also reduce the overstory allowing the perennial understory to increase.
2.1b: Time and lack of disturbance such as fire facilitates an increase in the shrub overstory; may be coupled with drought
2.2a: Time and lack of disturbance allows for shrub regeneration.
2.3a: Moderate to high severity fire reduces sagebrush and conifer cover and leads a community dominated by grasses and forbs. Brush treatments/tree thinning would also reduce the overstory allowing the perennial understory to increase.
2.3b: Low severity fire creates sagebrush/grass mosaic. Brush treatments/tree thinning would also reduce the overstory allowing the perennial understory to increase.

Transition T2A: Less frequent fire and/or extended drought reduces perennial bunchgrasses and allows for an increase in shrub/tree species (3.1).
Transition T2B: Catastrophic fire; often coupled with soil disturbing activities and/or extended drought.
Transition T2C: Time and lack of disturbance allows for maturation of the tree community (to 5.1).

Shrub State 3.0 Community Pathways
3.1a: Fire or brush treatments with minimal soil disturbance.
3.2a: Time and lack of disturbance allows for sagebrush to recover. Conifers may increase.

Transition T3A: Catastrophic fire, multiple fires, and/or soil disturbing treatments/activities.
Transition T3B: Time and lack of disturbance allows for maturation of the tree community.

Annual State 4.0 Community Pathways
4.1a: Fire
4.2a: Time and lack of disturbance allows for sagebrush and sprouting shrubs to increase. Conifers may be present.

Restoration R4A: Herbicide treatment may be coupled with seeding of desired species.

Tree State 5.0 Community Pathways
5.1a: Time and lack of disturbance allows for maturation of the tree community

Transition T5A: Catastrophic fire (4.2)
Restoration R5A: Mechanical treatment of trees coupled with seeding of desired species. (likely from 5.1)
Restoration R5B: Mechanical treatment of trees (likely from 5.1)

(Adapted from Stringham et al., 2017)

State 1
Reference State

The Reference State 1.0 is a representation of the natural range of variability under pristine conditions. The reference state has 3 general community phases; a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These are maintained by elements of ecosystem structure and function such as the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Sandberg bluegrass (*Poa secunda*), grass

State 2
Current Potential

This state is similar to the Reference State 1.0 with three similar community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These are maintained by elements of ecosystem structure and function such as the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. Processes and characteristics that contribute to positive feedbacks include the non-natives species' high seed output, persistent seed bank, rapid growth rate, residual dry matter accumulation, and adaptations for seed dispersal.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Sandberg bluegrass (*Poa secunda*), grass

State 3
Shrub State

This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses, changes in the historic fire regime or long-term drought favoring shrub establishment. Grazing tolerant Sandberg bluegrass will increase with a reduction in deep rooted perennial bunchgrass competition and become the dominant grass. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds the site concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and Sandberg bluegrass understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed (3.1). In both community phases, bare ground may be significant with soil redistribution occurring between interspace and shrub locations. Conifers increase and may begin to influence the understory vegetation.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- rabbitbrush (*Chrysothamnus*), shrub
- Sandberg bluegrass (*Poa secunda*), grass

State 4
Annual State

This community is characterized by the dominance of annual non-native species such as cheatgrass, medusahead, ventenata and tansy mustard (Descurainia spp.) in the understory. Sagebrush and/or rabbitbrush may dominate the overstory.

Dominant plant species

- rabbitbrush (*Chrysothamnus*), shrub
- cheatgrass (*Bromus tectorum*), grass
- medusahead (*Taeniatherum caput-medusae*), grass
- North Africa grass (*Ventenata dubia*), grass

State 5
Tree State

This state is characterized by a dominance of western juniper and/or ponderosa pine in the overstory. Sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soi nutrients and soil organic matter distribution and cycling have been spatially and temporally altered.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub

Transition T1A
State 1 to 2

Introduction of non-native species

Transition T2A
State 2 to 3

Less frequent fire and/or extended drought reduces perennial bunchgrasses and allows for an increase in shrub/tree species

Transition T2B
State 2 to 4

Catastrophic fire; often coupled with soil disturbing activities and/or extended drought

Transition T2C
State 2 to 5

Time and lack of disturbance allows for sagebrush to recover. Conifers may increase.

Transition T3A
State 3 to 4

Catastrophic fire, multiple fires, and/or soil disturbing treatments/activities

Transition T3B
State 3 to 5

Time and lack of disturbance allows for maturation of the tree community

Restoration pathway R5A
State 5 to 2

Mechanical treatment of trees coupled with seeding of desired species

Restoration pathway R5B
State 5 to 3

Mechanical treatment of trees

Transition T5A
State 5 to 4

Catastrophic fire

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Contributors

Jennifer Moffitt - Original concept developed for 2020 PES initiative
Andrew Neary - Further concept development for 2020 PES initiative

Approval

Kirt Walstad, 9/08/2023

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	05/06/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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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):**

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

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

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

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17. **Perennial plant reproductive capability:**
