Ecological site group R008XG516WA
Shallow Stony, South Aspect, Columbia Hills

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Key Characteristics

None specified

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.

Physiography

Hierarchical Classification
Major Land Resource Area (MLRA): 8 – Columbia Plateau

LRU – Common Resource Areas (CRA):
8.5 - Moist Yakima Folds

Site Concept Narrative:

Note: for MLRA 8 there are two ecological sites with the name “Shallow Stony’:
1. One for the sagebrush steppe region
2. One for grasslands on south side of Columbia Hills

The Shallow Stony ESD below is for grasslands on the south side of Columbia Hills. In Klickitat Co.

Diagnostics:

Shallow stony, south aspect, Columbia Hills is a grassland steppe upland site on the south side of the Columbia Hills in Klickitat Co. It is a sparsely vegetated site occurring on soils that are both shallow (10-20” deep) AND stony to extremely stony. Soils have a stony or cobbly surface and rock fragments (35% or more) throughout the profile. Soil textures loam, silt loam and clay loam are most common. The soil surface is mostly bare soil, soil biotic crust or rock.

Note: due to historic farming and grazing the south side of the Columbia Hills has been heavily disturbed. Shallow Stony is quite stable but the disturbances may have altered some sites.

The south side of the Columbia Hills is a grassland steppe area and has not had sagebrush for more than 50 years and is not expected to have sagebrush. This area does not have sagebrush, nor bitterbrush, and no rabbitbrush except for one small area near the Columbia River.

Perennial bunchgrasses would dominate the reference state. Cool-season bunchgrasses form two distinct layers. Bluebunch wheatgrass is the dominant bunchgrass in the top grass layer, while Sandberg bluegrass is the major grass of the lower grass layer. Native forbs fill the interspaces.

Principle Vegetative Drivers:

The shallow soil depth and stones throughout the profile, and the south aspect drive the vegetative expression of this site. The soil depth limits deep-rooted species, plus the soil depth and stones limit the water holding capacity in the profile. Thus, plant production is quite limited for Shallow stony, south aspect, Columbia Hills sites.

Influencing Water Features:

A plant's ability to grow on a site and overall plant production is determined by soil-water-plant relationships
1. Whether rain and melting snow runs off-site or infiltrates into the soil
2. Whether soil condition remain aerobic or become saturated and become anaerobic
3. Water drainage and how quickly the soil reaches wilting point

With adequate cover of live plants and litter, there are no restrictions on this ecological site with water infiltrating into the soil. In some years Shallow stony, south aspect, Columbia Hills sites can become saturated due to the shallow soil depth, but with good drainage would remain anaerobic for only a short period of time. This site has an extremely restricted water holding capacity, so plant production is quite limited.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Shallow stony, south aspect, Columbia Hills sites occur on side-slopes of ridges and plateaus, ridges & benches, foot-slopes and hillslopes, and canyon walls of the Columbia Hills in Klickitat County.

Physiographic Division: Intermontane Plateau
Physiographic Province: Columbia Plateau
Physiographic Sections: Walla Walla Plateau Section

Landscapes: Hills, canyonlands and plateaus
Landform: Sideslopes, shoulders, ridges, summits

Elevation: Dominantly 800 to 4,000 feet
Central tendency: 1,000 to 3,000 feet
Slope: Total range: 0 to 65 percent
Central tendency: 10 to 50 percent
Aspect: Dominantly southern aspects, but can occur on all aspects

Geology:

This MLRA is almost entirely underlain by Miocene basalt flows. Columbia River basalt is covered in many areas with as much as 200 feet of loess and volcanic ash. Small areas of sandstones, siltstones, and conglomerates of the Upper Tertiary Ellensburg Formation are along the western edge of this area. Some Quaternary glacial drift covers the northern edge of the basalt flows, and some Miocene-Pliocene continental sedimentary deposits occur south of the Columbia River, in Oregon.

A wide expanse of scablands in the eastern portion of this MLRA, in Washington, was deeply dissected about 16,000 years ago, when an ice dam that formed ancient glacial Lake Missoula was breached several times, creating catastrophic floods. The geology of the northernmost part of this MLRA is distinctly different from that of the rest of the area. Alluvium, glacial outwash, and glacial drift fill the valley floor of the Okanogan River and the side valleys of tributary streams. The fault parallel with the valley separates pre-Tertiary metamorphic rocks on the west, in the Cascades, from older, pre-Cretaceous metamorphic rocks on the east, in the Northern Rocky Mountains. Mesozoic and Paleozoic sedimentary rocks cover the metamorphic rocks for most of the length of the valley on the west.

Climate

Grasslands do not have shrubs because they receive more spring precipitation especially in March (Daubenmire). The climate is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to

the rain shadow effect of the Cascades. Winter fog is variable and often quite localized, as the fog settles on some areas but not others. Compared to the rest of MLRA 8, the south side of the Columbia Hills is dry and hot. Taxonomic soil climate is xeric moisture regime with a mesic temperature regime.

Mean Annual Precipitation:
Range: 10 – 14 inches
Seventy to seventy-five percent of the precipitation comes late October through March as a mixture of rain and snow. June through early October is mostly dry.

Mean Annual Air Temperature:
Range: 46 to 54 F
Central Tendency: 48 – 52 F
Freezing temperatures generally occur from late-October through early-April. Temperature extremes are 0 degrees in winter and 110 degrees in summer.

Frost-free Period (days):
Total range: 110 to 160
Central tendency: 120 to 150
The growing season for Shallow stony, south aspect, Columbia Hills is March through April.

Soil features

Edaphic:

The Shallow stony, south aspect, Columbia Hills ecological site commonly occurs with Loamy, Very Shallow and Sands ecological sites.

Representative Soil Features:

This ecological site components are dominantly Lithic and Typic taxonomic subgroups of Argixerolls great group of the Mollisols taxonomic order. Soils are shallow to moderately deep. Average available water capacity of about 1.5 inches (3.8 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly loess mixed with colluvium and residuum.

The associated soils are Goodnoe, Horseflat and similar soils.

Dominate soil surface is silt loam.

Dominant particle-size class is loamy-skeletal.

Fragments on surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 5
Average: 0

Fragments within surface horizon > 3 inches (% Volume):
Minimum: 5
Maximum: 25
Average: 15

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 5
Maximum: 25
Average: 10

Subsurface fragments > 3 inches (% Volume)

Minimum: 10
Maximum: 40
Average: 20

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 5
Maximum: 40
Average: 25

Drainage Class: Dominantly well drained
Water table depth: Greater than 60 inches

Flooding:
Frequency: None

Ponding:
Frequency: None

Saturated Hydraulic Conductivity Class:
0 to 10 inches: Moderately high
10 to 40 inches: Moderately high

Depth to root-restricting feature (inches):
Minimum: 10
Maximum: 40

Electrical Conductivity (dS/m):
Minimum: 0
Maximum: 2

Sodium Absorption Ratio:
Minimum: 0
Maximum: 0

Calcium Carbonate Equivalent (percent):
Minimum: 0
Maximum: 5

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 5.6 to 8.4
10 - 40 inches: 5.6 to 8.4

Available Water Capacity (inches, 0 – 40 inches depth):
Minimum: 0.9
Maximum: 3.4
Average: 1.5

Vegetation dynamics

Ecological Dynamics:

Shallow stony, south aspect, Columbia Hills produces about 300-600 pounds/acre of biomass annually.

The line between sagebrush steppe and true grasslands has been discussed and debated for many years. Daubenmire states that the line has nothing to do with pre-settlement as native ungulates played no significant role in the evolution of ecotypes. He also says that there is no evidence that the distribution of vegetative types is related to fire. And he also says there is no useful correlation between soil classification and the line between grasslands and sagebrush steppe.

The ecotones between Daubenmire's vegetation types can be defined on the basis of consistent differences in climate and consistent differences in vegetation. Higher spring precipitation, especially in March, favors grasses over sagebrush. The south side of the Columbia Hills with the influence from the Columbia gorge receives enough spring precipitation that this area is a grassland. So, the grassland on the south side of the Columbia Hills is consistent with Daubenmire's findings.

Bluebunch wheatgrass is at the core of the Shallow stony, south aspect, Columbia Hills ecological site and warrants a degree of understanding. This perennial is a long-lived, mid-sized bunchgrass with an awned or awnless seed head arranged in a spike. Bluebunch provides a crucial and extensive network of roots to the upper portions (up to 48" deep in soils with no root-restrictive horizons) of the soil profile. These roots create a massive underground source to stabilize the soils, provide organic matter and nutrients inputs, and help maintain soil pore space for water infiltration and water retention in the soil profile. The extensive rooting system of mid-sized bunchgrasses leave very little soil niche space available for invasion by other species. This drought resistant root can compete with and suppress the spread of exotic weeds.

The stability and resiliency of the reference communities is directly linked to the health and vigor of bluebunch wheatgrass. Research has found that the community remains resistant to medusahead if the site maintains at least 0.8 mid-sized bunchgrass plant/sq. ft. (K. Davies, 2008). It is bluebunch that holds the system together. If we lose the bluebunch the ecosystem crashes or unravels.

Fire: The vegetative cover may be low, but the high winds from the Gorge push the fire across even sparse sites. For any plant, the fire is quick and then out, rarely burning into the crown of the plant.

Grazing: The south side of Columbia Hills are grazed in March when the bunchgrasses are vegetative and prior to the critical period. Deeper, more productive ecological sites are grazed much more intensely.

These sites do burn and are grazed, but Shallow stony, south aspect, Columbia Hills sites remain stable as burn severity and grazing pressure is light to moderate.

As grazing pressure increases the plant community unravels in stages:
1. Bluebunch wheatgrass declines while buckwheat species increase
2. As bluebunch wheatgrass continues to decline, invasive species such as cheatgrass and knapweed colonize the site.

For more grazing management information refer to Range Technical Notes found in Section I Reference Lists of NRCS Field Office Technical Guide for Washington State.

In Washington, bluebunch wheatgrass communities provide habitat for a variety of upland wildlife species.

Supporting Information:

Associated Sites:
Shallow Stony, south aspect, Columbia Hills is associated with other ecological sites in the grassland steppe area on the south side of the Columbia Hills including Loamy and Sands. Very Shallow may also be nearby.

Similar Sites:
Shallow Stony, south aspect, Columbia Hills is a sparsely vegetated bluebunch wheatgrass site. Sagebrush is nor present and other shrubs are nonexistent to only a trace.

The other sparsely vegetated Shallow Stony sites in MLRA 8 Columbia Plateau, MLRA 7 Columbia Basin and MLRA 6 East Slope of the Cascades all have sagebrush.

Inventory Data References (narrative):
Data to populate Reference Community came from several sources: (1) NRCS ecological sites from 2004, (2) Soil Conservation Service range sites from 1980s and 1990s, (3) Daubenmire's habitat types, and (4) ecological systems from Natural Heritage Program

Major Land Resource Area

MLRA 008X
Columbia Plateau

Subclasses

- R008XY516WA–Shallow Stony South Aspect Columbia Hills

Stage

Provisional

Contributors

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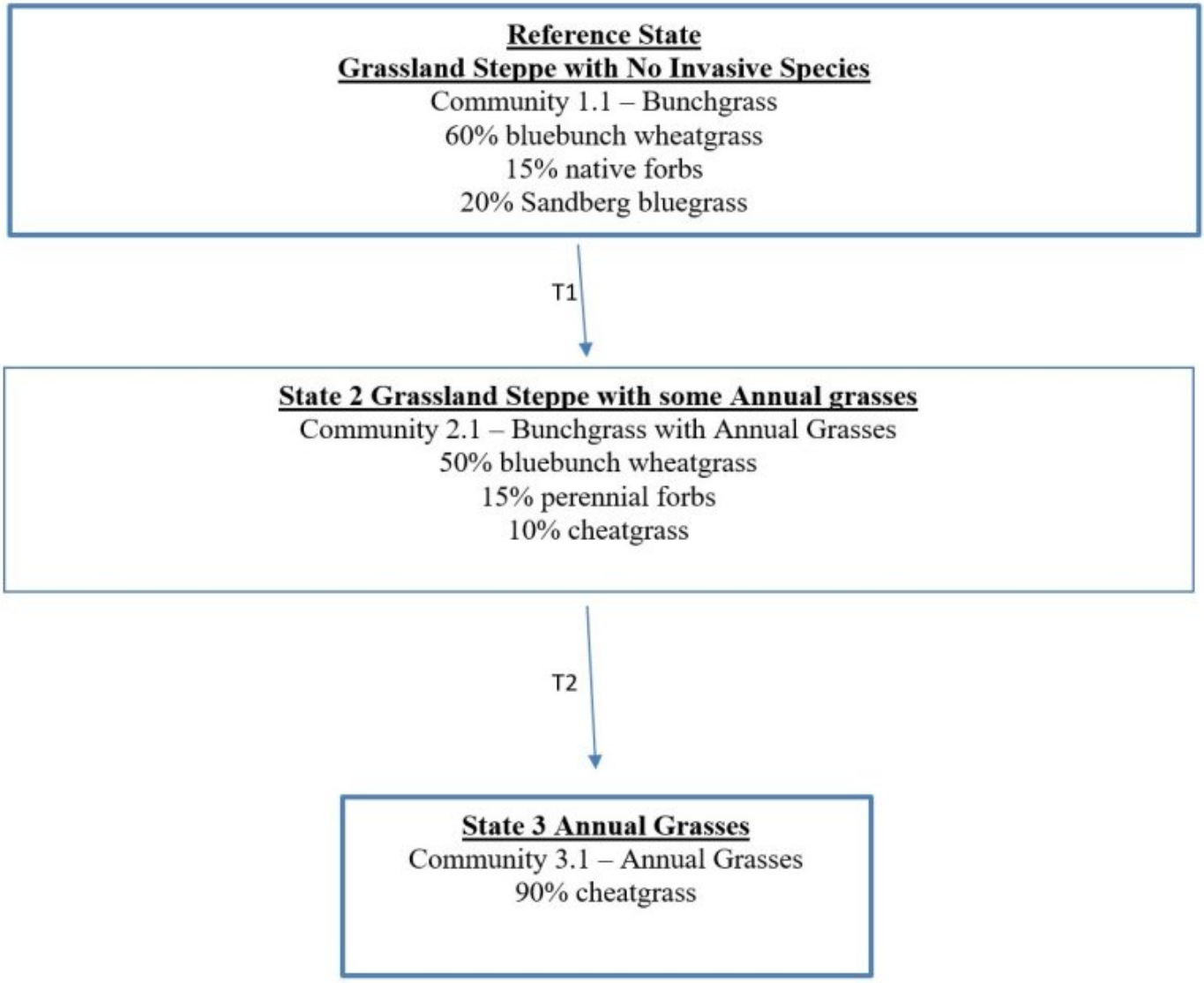
State and transition model

State and Transition Diagram for Shallow stony, south aspect, Columbia Hills in MLRA 8:

This state and transition model (STM) explains the general ecological dynamics for the Shallow stony, south aspect, Columbia Hills ecological site. The STM illustrates the common plant communities that can occur on the site. Boxes around each state represent the ecological threshold, which if crossed, is not reversible without human intervention. Arrows within a state represent the pathway between plant communities, while the arrows between states represent the transition or recovery between the states. Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions.

NOTES:

1. I have never seen SH Stony dominated by annuals
2. Seeding is not practical due so to rock and shallow depth, so, no seeded State 4



Reference Community 1.1 for Shallow stony, south aspect, Columbia Hills in MLRA 8

Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions. Pounds listed below are the maximum allowable for Similarity Index. Many numbers have been rounded to not show more precision than our current state of knowledge.

	Similarity Index		Similarity Index
		Shrubs – Minor	
		ERSP7 rock buckwheat	Trace
Dominant Mid-Size Bunchgrass	60% 360 lbs.	**Other Mid-Size Bunchgrasses – Minor**	5% 30 lbs.
PSSP6 bluebunch wheatgrass		ELEL5 bottlebrush squirreltail ACTH7 Thurber needlegrass HECOC needleandthread	
Short Grass – Subdominant	20% 120 lbs.		
POSE Sandberg bluegrass VUOC sixweeks fescue			
Native Forbs – Subdominant			15% 100 lbs.
PHHO spiny phlox LIPU11 granite gilia ERNI2 snow buckwheat LOMAT lomatium / biscuitroot ERIGE2 fleabane ANDI2 low pussytoes ACMI2 yarrow		BAHO Hooker balsamroot NEST5 narrowleaf goldenweed ERHE2 Wyeth buckwheat ALLIU wild onion ASTRA milkvetch / locoweed PLPA2 woolly plantain PENST penstemon	

	Below	Normal	Above
Estimated Production (pounds / acre)	300	450	600

State 1
RECONSTRUCTED Reference State

Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this is not true for Shallow stony, south aspect, Columbia Hills. State 1 Narrative: State 1 represents grassland steppe with no invasive or exotic weed species. Each functional, structural group has one or more native species. Communities with a dominance of annual grasses have never been seen on Shallow Stony, south aspect, Columbia Hills. The south side of the Columbia Hills has no sagebrush or bitterbrush, and except for a spot along the Columbia River, the south side of the Columbia Hills also has no rabbitbrush. The Reference Community 1.1 is dominated by bluebunch wheatgrass with native buckwheat species prominent. Reference State Community Phases: 1.1 Reference Bluebunch wheatgrass-Eriogonum species At-risk Communities: • Any community in the reference state is at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually. • Reference community is quite stable as it receives limited grazing pressure and rarely burns • State 3 has not been seen on Shallow Stony sites in the Columbia Hills

Community 1.1
Reference Community - Bluebunch wheatgrass-Eriogonum species

The Reference Community 1.1 would be dominated by bluebunch wheatgrass with native buckwheat species prominent.

State 2
Grassland Steppe with Annuals

Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this is not true for Shallow Stony, south aspect, Columbia Hills. State 2 Narrative: State 2 represents grassland steppe with minor inclusion of invasive annual grasses such as cheatgrass. All the native functional, structural groups would be represented by one or more species. Cheatgrass will colonize Shallow Stony, south aspect, Columbia Hills sites on the south side of the Columbia Hills, and retain, a presence in the community. In State 2 cheatgrass in a minor component. But once a community has been invaded by cheatgrass the chance of going back to State 1 is small. Community Phases for State 2: 2.1 Bunchgrass Bluebunch wheatgrass Dominate Species in State 2: bluebunch wheatgrass and buckwheat species

Community 2.1
Bunchgrass - Bluebunch wheatgrass

The Reference Community 2.1 is dominated by bluebunch wheatgrass. Native forbs are also present.

State 3
Annual Grasses

State 3: Annual Grasses Note: most sites on the south side of Columbia Hills have already crossed the threshold into State 3. But this has not been seen for Shallow Stony, south aspect, Columbia Hills. State 3 Narrative: State 3 represents sites that are dominated by invasive annual species and has crossed a biological threshold. State 3 is rare for Shallow stony, south aspect, Columbia Hills sites. The main species include cheatgrass, mustard, prickly lettuce and diffuse knapweed. Community Phases for State 3: 3.1 Annual Grass cheatgrass

Community 3.1
Annual Grass - Cheatgrass

Dominate Species in State 3: Annual grasses such as cheatgrass. The main species can include Japanese brome, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed.

Transition T1
State 1 to 2

T1 Result: transition from Reference State to State 2 (grassland steppe w/ a few annuals). The Reference State does not have invasive species. State 2 is the same as Reference State but with minor addition of invasive annual grasses such as cheatgrass. Primary Triggers: A high moisture year causes a micro-burst of cheatgrass and is the principle means of colonization. Loss of soil biological crusts contributes to the invasion. Also, soil disturbances (rodents, badgers) create openings in the community and encourage weed germination. Ecological process: Most sites in the Reference State have cheatgrass seed as the seed blows onto the sites annually. Cheatgrass is a prolific seeder and the seed is waiting for enough moisture to germinate and to compete with the native species for space, light and moisture. When there is more moisture available than the plant community can utilize, even pristine communities in the Reference State are susceptible to colonization by cheatgrass. The addition of cheatgrass to the community is generally a temporary condition on Shallow Stony sites. Indicators: The occurrence of annual grasses on sites where they had been absent.

Restoration pathway R1
State 2 to 1

State 2 is considered non-reversible. Due to shallow soil depth, surface rock and rock within the soil profile, and the equipment limitations thereof, seeding is not practical for the Shallow Stony ecological site. Restoration of bluebunch wheatgrass, sagebrush, native forbs and the soil biotic crust would be very problematic at best on Shallow Stony. Seeds must germinate. Seedlings and plugged plants need soil moisture and time to become

established. In most years, seeds and plugs may not have a chance as site conditions on Shallow Stony can change quickly. Drying winds and bright sun can turn a snowy or muddy site into a hard crust before plants are established. So, the timing of all recovery efforts would have an extremely narrow window of opportunity on Shallow Stony. Perhaps the only avenue for recovery would be to plant plugs of native species which is a very costly and risky proposition.

Transition T2
State 2 to 3

T2 Result: Shift from State 2 to State 3 which is dominated by annuals. This state is rare and has not been seen on Shallow Stony sites. This transition occurs once there is more invasive species cover than bluebunch wheatgrass cover. Primary Trigger: Chronic heavy grazing, season-long grazing, or late spring grazing causes poor vigor and bluebunch wheatgrass has a significant reduction in cover. Ecological Process: Consistent defoliation pressure to bluebunch wheatgrass causes poor plant vigor, shrinking crowns and mortality. With more and more of the soil surface and upper soil rooting surface open, opportunistic weeds take advantage of the available niche space to colonize and expand. The invasive annual grasses in State 2 communities make a dramatic increase to dominate the community. Indicators: Decreasing cover of bluebunch wheatgrass and increasing cover of invasive annual species. Increasing distance between perennial species. Decreasing soil organic matter, soil water retention, limited water infiltration and percolation in the soil profile. References: Boling M., Frazier B., Busacca, A., General Soil Map of Washington, Washington State University, 1998 Daubenmire, R., Steppe Vegetation of Washington, EB1446, March 1968 Davies, Kirk, Medusahead Dispersal and Establishment in Sagebrush Steppe Plant Communities, Rangeland Ecology & Management, 2008 Environmental Protection Agency, map of Level III and IV Ecoregions of Washington, June 2010 Miller, Baisan, Rose and Pacioretty, “Pre and Post Settlement Fire regimes in mountain Sagebrush communities: the Northern Intermountain Region Natural Resources Conservation Service, map of Common Resource Areas of Washington, 2003 Rapid Assessment Reference Condition Model for Wyoming sagebrush , LANDFIRE project, 2008 Rocchio, Joseph & Crawford, Rex C., Ecological Systems of Washington State. A Guide to Identification. Washington State Department of Natural Resources, October 2015. Pages 156-161 Inter-Mountain Basin Big Sagebrush. Rouse, Gerald, MLRA 8 Ecological Sites as referenced from Natural Resources Conservation Service-Washington FOTG, 2004 Soil Conservation Service, Range Sites for MLRA 8 from 1980s and 1990s Tart, D., Kelley, P., and Schlafly, P., Rangeland Vegetation of the Yakima Indian reservation, August 1987, YIN Soil and Vegetation Survey

Citations