Ecological site group R008XG001WA
Very Shallow

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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):
8.1 - Channeled Scablands
8.2 - Loess Islands
8.3 - Okanogan Drift Hills
8.4 - Moist Pleistocene Lake Basins
8.5 - Moist Yakima Folds
8.6 - Lower Snake and Clearwater Canyons
8.7 - Okanogan Valley

Site Concept Narrative:
Diagnostics:

Very Shallow is a sparsely vegetated, low shrub-short grass, upland site on very shallow soils (generally less than 8 inches deep). Very Shallow sites are often found on windswept ridges and adjacent to exposed rocky ledges. Daubenmire writes that there appears to be no regular difference in either soils or vegetation between lithosols produced by glaciofluvial erosion or those or ridges where only wind and rain could have kept the basalt exposed.

Generally, there are sharp lines on the landscape between Very Shallow and the adjacent ecological site. One can stand with one foot on Very Shallow and the other foot on Stony or some other ecological site.

Occasionally the edge of Very Shallow is not so abrupt. This has been witnessed several times – less than 8 inches of soil depth has classic Very Shallow species, while 8-13 inches is a narrow band of Thurber needlegrass, and greater than 13 inches soil depth is a bluebunch wheatgrass site.

Usually, there are abundant rock and soil biotic crust cover, in the interspaces between plants. The lichen and moss play a critical role in water infiltration and resistance to erosion. On some but not all Very Shallow sites, are a few micro-pockets of taller vegetation in association with bedrock fracturing.

The most common reference community is stiff sagebrush-Sandberg bluegrass. Sandberg bluegrass is the short grass in all instances, but the low shrub component is variable. Stiff sagebrush is the predominant low shrub, but one to several different eriogonum species are present on some sites, instead of, or with stiff sagebrush. While there are minor ecological differences between these low shrubs, they are considered functionally equivalent for the purposes of this ecological site. These low shrubs have been combined into one site for several reasons: (1) the co-dominant short grass is Sandberg bluegrass in all cases, (2) Very Shallow has low plant productivity and extreme

site limitations. (3) it is common to find three or more of these low shrub species on the same site, and (4) the hydrologic and watershed characteristics is similar regardless of low shrub.

According to Daubenmire, stiff sage occurs on basalts with highly fractured parent material. Eriogonums occupy various parent materials and may dominate on gravelly soils and granitic parent materials.

Principle Vegetative Drivers:

The very shallow soil depth and the fracturing of, or the lack of fracturing in the underlying basalt bedrock drive the vegetative expression of this site. Deep-rooted steppe species do not grow on Very Shallow because of the limited soil depth. The fracture system accounts for variation in the low shrub component and the occasional mid-sized bunchgrass such as bluebunch wheatgrass or Thurber needlegrass.

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

The lower part of the soil profile of Very Shallow has high clay content. With winter rain and melting snow, water perches and creates saturated conditions.

In wet years during spring runoff, water runs on the surface of Very Shallow sites for a short period. Even more water runs beneath the surface to sites below. This increases the effective precipitation to the adjacent sites below.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Very shallow sites occur on ridgetops, shoulders, benches, mesas, and hillslopes.

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

Landscapes: Hills, canyonlands, valleys and plateaus
Landform: Terraces, sideslopes, shoulders, ridges, benches

Elevation: Dominantly 500 to 5,000 feet
Slope: Total range: 0 to 65 percent
Central tendency: 2 to 20 percent
Aspect: Occurs 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

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. Taxonomic soil climate is either xeric (12 – 16 inches PPT) or aridic moisture regimes (10 – 12 inches PPT) with a mesic temperature regime.

Mean Annual precipitation:
Range: 10 – 16 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: 44 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. Winter fog is variable and often quite localized, as the fog settles on some areas but not others.

Frost-free Period (days):
Total range: 75 to 200
Central tendency: 110 to 160
The growing season for Very Shallow is generally October through mid-November and March through mid-May.

Soil features

Edaphic:

The Very Shallow ecological site commonly occurs with rock outcrop, Loamy, Shallow Stony and Stony ecological sites. Typical soil surface has about 40% rock, 10-20% bare ground, 10-20% biotic crust and 30% vegetative cover. Sites with less than 10% vegetative cover can be considered rock outcrop.

Very Shallow sites are sensitive to soil disturbances. When the Very Shallow site is saturated and muddy, physical damage to the site – from vehicle ruts and hoof prints from cows, horses or deer for example – remain intact for many years.

Rocks or plants sitting on pedestals is called pedestaling. Two completely different processes cause the pedestaling. The first process is frost-heaving which pushes the plants upward and is evident across the entire site. The lower part of the soil profile has higher clay content. With winter rain and melting snow, water perches and creates saturated conditions. Freezing weather causes these saturated soils frost-heave, and then during spring thaw, the site becomes muddy. The second pedestaling process is erosion which washes soil away from plants and rocks but only in water flow patterns.

The degree of pedestaling on Very Shallow is quite variable. On many sites the soil surface is smooth and shows little to no evidence of pedestaling. But other sites show a high degree of pedestaling. The difference is presumed to be the amount of clay in the soil and the shrink-swell potential. In some years water runs on the surface and some erosion may occur.

If a site has a high degree pedestaling, the observer must determine whether this process is natural or human-induced (water running off cropland onto the rangeland for example).

Representative Soil Features:

This ecological site components are dominantly lithic taxonomic subgroups of Haploxerolls, Argixerolls and Torriorthents great groups of the Mollisols taxonomic order, with Aridisols occurring as well. Soils are dominantly very shallow. Average available water capacity of about 0.8 inches (2.0 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly mixed loess, colluvium and possibly small amounts of ash over residuum.

The associated soils are Argabak, Bakeoven, Laric, Nevo, Onepennee, Rockly and similar soils.

Dominate soil surface is cobbly silt loam to very cobbly loam, with ashy modifier sometimes occurring as well.

Dominant particle-size class is loamy to loamy-skeletal

Fragments on surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 10

Fragments within surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 35
Average: 5

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 10
Average: 10

Subsurface fragments > 3 inches (% Volume):
Minimum: 0
Maximum: 25
Average: 5

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 60
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: 4
Maximum: Dominantly 10

Electrical Conductivity (dS/m):
Minimum: 0
Maximum: 1

Sodium Absorption Ratio:
Minimum: 0
Maximum: 0

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

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 6.1 to 8.4

Available Water Capacity (inches, 0 – 40 inches depth):
Minimum: 0.8
Maximum: 9.7
Average: 5.0

Vegetation dynamics

Ecological Dynamics:

Very Shallow produces about 100-250 pounds/acre of biomass annually.

The Very Shallow ecological site in MLRA 8 has at least four different variations on the low shrub-short grass theme for the Reference Community. Sandberg bluegrass is co-dominant in every variation:
1. Stiff sagebrush – Sandberg bluegrass
2. Stiff sagebrush / thyme-leaved buckwheat / rock buckwheat – Sandberg bluegrass
3. Thyme-leaved buckwheat – Sandberg bluegrass
4. Narrowleaf goldenweed (Stenotus s.) – Sandberg bluegrass

In the spring this site has a rich diversity of native annual and perennial forbs on most sites. Very Shallow supports edible species that have been an important food source for the Native Americans for many generations. Bitterroot and biscuitroot are the main species harvested for food.

Sandberg bluegrass is a shallow rooted, perennial bunchgrass, perfectly suited to Very Shallow sites. It has short leaves and a green to purplish panicle seed head. On most sites Sandberg is an understory grass, but on Very Shallow it is the dominant grass. It begins growth in the fall then grows rapidly in the spring and sets seed before moisture is gone. Sandberg bluegrass is resistant to drought, grazing, trampling and fire.

Stiff sagebrush is strongly scented with the characteristic sage odor. It is low and spreading with a conspicuously woody base. The base is often heaved from the soil by frost action. The trunk is very irregular, spreading above the base in a dense cluster of short, rigid, and rather brittle branches up to sixteen inches in length. Stiff sagebrush leaves are forked into three deep lobes like fingers. Unlike other sagebrush species, the leaves of stiff sage are deciduous, and by fall, all of the leaves have dropped. The ground under each plant will have a pile of dead leaves.

The Goldendale Prairie has more precipitation (14-20”) than anywhere else in MLRA 8 and, has been highly disturbed by farming practices. Thus, Very Shallow sites on the Goldendale Prairie are dominated by cheatgrass, medusahead, ventenata or bulbous bluegrass. Lomatium or other native forbs are prominent as well.

Very Shallow is resistant to most natural disturbances and ecologically stable. However, if this site does experience a major disturbance it is not resilient and may be extremely difficult to stabilize once altered. For example, vehicle traffic when the soil is saturated will leave ruts that remain for years to come.

The vegetative cover is too low to carry fire, so these sites rarely burn. In many pastures, due to surface rocks and limited forage, Very Shallow sites are not attractive to grazing animals and so receive only incidental grazing grazed. Based on inherent protection from both fire and grazing, most Very Shallow sites are stable.

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 most years many bunchgrasses remain dormant in the fall. Sandberg bluegrass, however, greens up every year. And so, from late fall through winter and into early spring these Very Shallow sites provide important green forage for deer, elk and upland birds. But these sites also dry up sooner than adjoining sites due to the very shallow soil depth. Grasses are dry from May through September.

Supporting Information:

Associated Sites:
Very Shallow is associated with Sagebrush Steppe ecological sites (Shallow Stony, Stony, Loamy & Cool Loamy) and Grassland Steppe ecological sites (Loamy and North Aspect). Very Shallow is also associated with rock outcrop. It is common for Very Shallow sites to transition back and forth with rock outcrop, Shallow Stony, Stony or other ecological sites.

Similar Sites:
In MLRA 8 the swale portion of biscuit-swale topography is Very Shallow. Very Shallow sites in MLRA 6 East Slope of Cascade, MLRA 7 Columbia Basin, and MLRA Palouse Prairie are quite similar.

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

- R008XY001WA–Very shallow

Stage

Provisional

Contributors

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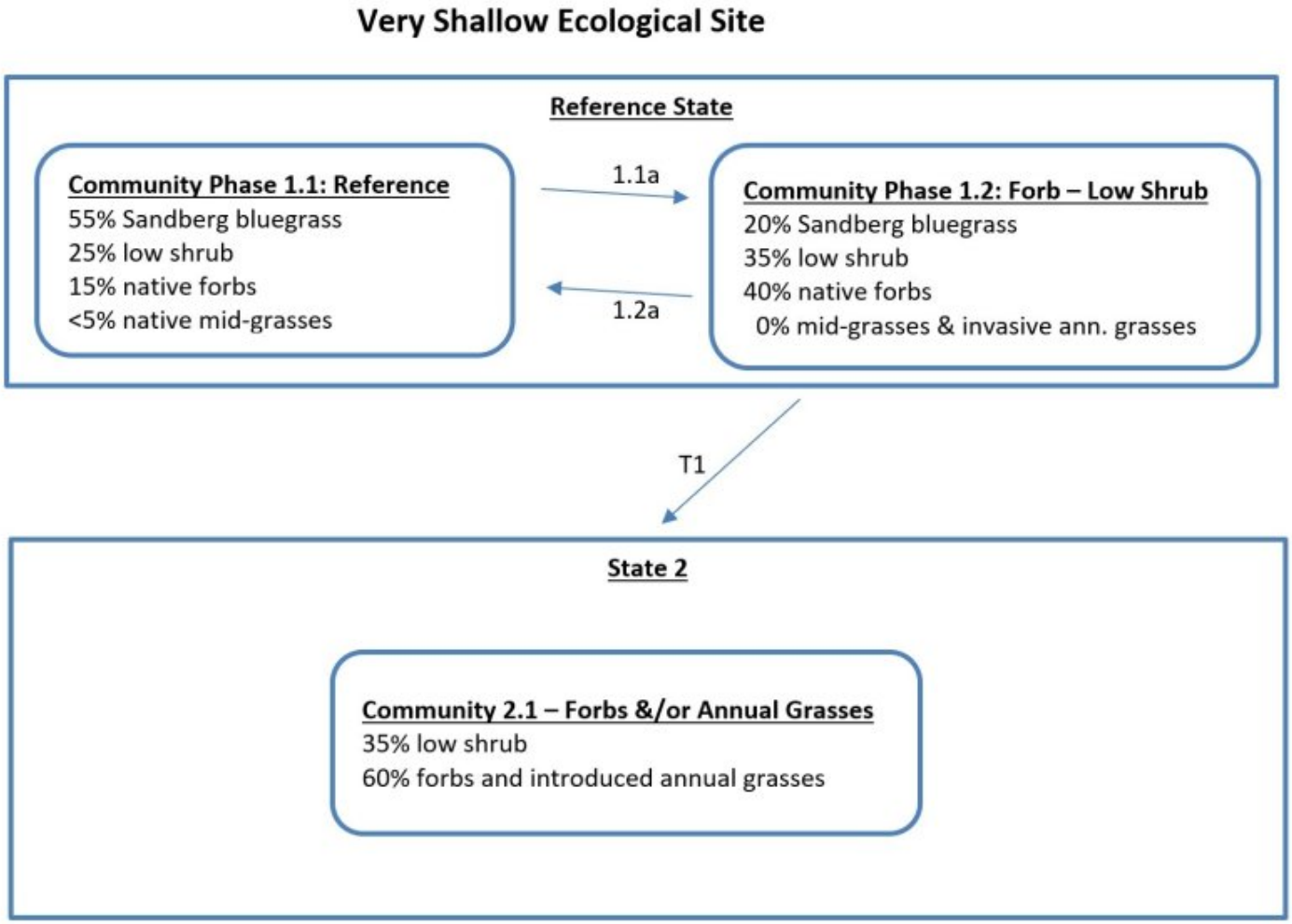
State and transition model

State and Transition Diagram: Very Shallow in MLRA 8

This state and transition model (STM), explains the general ecological dynamics for the Very Shallow 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.



Reference Community 1.1 for Very Shallow in MLRA 8:

Percentages for plant species composition below are by weight and are an approximation. 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	
Dominant Low Shrub		25%	65 lbs.	**Other Low Shrubs – Minor**		less than 5%	10 lbs.
ARRI2	stiff sagebrush			SADOI	purple sage		
ERTH4	thymeleaf buckwheat			PUTR2	antelope bitterbrush		
ERSP7	rock buckwheat			ERDO	Douglas buckwheat		
				ERMI4	Wyeth buckwheat		
Dominant Short Grass				**Mid-Size Bunchgrasses – Minor**			
						less than 5%	10 lbs.
POSE	Sandberg bluegrass	55%	150 lbs.	ELEL5	bottlebrush squirreltail		
				ACTH7	Thurber needlegrass		
				PSSP6	bluebunch wheatgrass		
Annual Grass – Trace							
VUOC	sixweeks fescue	Trace					
Native Forbs – Subdominant						15%	40 lbs.
STST5	narrowleaf goldenweed			ERIGE2	fleabane		
PHHO	spiny phlox			LERE7	bitterroot		
LEPU	granite gilia			ERNI2	snow buckwheat		
LOMAT	lomatium / biscuitroot			PENST	penstemon		
BAHO	Hooker balsamroot			ASPU9	woollypod locoweed		
VIVAV	sagebrush violet			PENI	pediocactus		
ALLIU	wild onion						

	Below	Normal	Above
Estimated Production (pounds / acre)	100	200	250

State 1
Reference State

State 1 Narrative: The Reference State represents non-invaded communities composed of native species. Invasive annual grasses are not present. Very Shallow sites rarely burn, and in most cases, receives minimal grazing. This ecological site is the most stable ecological site on the landscape. Reference State Community Phases: 1.1 Reference Sandberg bluegrass – low shrub 1.2 Forb – low shrub Native forbs with low shrub Dominant Reference State Species: Sandberg bluegrass and stiff sage &/or other low shrub Eriogonum species At-risk Communities: • All communities in the reference state are at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually • Community 1.1 has a high Sandberg bluegrass cover and is thus, at lower risk of moving to State 2, Forb-Annual Grass • Community 1.2, has less Sandberg bluegrass cover and a high amount of forb cover, and is at considerable risk of moving to State 2

Community 1.1
Reference Sandberg bluegrass – low shrub

Reference Community 1.1 is the classic Very Shallow, dominated by Sandberg bluegrass with one or more low shrub species. The low shrub component may be stiff sage &/or one or more Eriogonum low shrub species.

Community 1.2

Forb – low shrub Native forbs with low shrub

Community 1.2 represents a phase which is quite rare in most of MLRA 8. The species are native, but Sandberg bluegrass has a diminished presence while forbs are more prominent. Community 1.2 still has enough Sandberg bluegrass present, to shift back to reference community 1.1.

Pathway 1.1a
Community 1.1 to 1.2

1.1a Result: Shift from Reference Community (low shrub – short grass) to Community 1.2 (forb – low shrub). Sandberg bluegrass has been much reduced but remains in the community. The native forb component has increased. There may be a few invasive forbs. Primary Trigger: heavy spring grazing pressure (heavy to severe grazing intensity) to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses. Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and mortality. Grass roots begin to die, and this opens the soil for native forbs to increase via seedlings. The hoof action by large ungulates can disturb the soil surface enough to make them vulnerable to annual grass and forb invasion. Indicators: decreasing Sandberg bluegrass cover and increasing cover of native forbs.

Pathway 1.2a
Community 1.2 to 1.1

1.2a Result: Shift from forb – low shrub community back to the Reference Community. Sandberg bluegrass reestablishes dominance over the native annual forb component as it exerts competitive advantage for resources and space. So, Sandberg bluegrass displaces the forbs to become co-dominant with the low shrub component. Primary Trigger: Defoliation pressures are removed, allowing Sandberg bluegrass to recover and reestablish dominance over the forb component. Ecological process: With reduced grazing pressure Sandberg bluegrass experiences increased plant vigor and root production, expanding its size and competitive abilities through seedlings and tillering. Soils stabilize with the removal of the hoof action and increased volume of roots.

State 2
Forbs and/or Annual Grass

State 2 Narrative: This state represents the ecological changes that occur when there is a shift from dominance by perennial native grasses to forbs or annual grass dominance in the herbaceous layer. The shrub components generally remain in the overstory. Most Very Shallow sites never cross the threshold into State 2 as they are not attractive to grazing animals and rarely burn (limited forage values and surface rocks). The exception being chronic heavy grazing in the spring from migrating elk, feral horses or livestock. As the cover of Sandberg bluegrass significantly declines the site becomes open to invasion by invasive annuals, however. Invasive annual grasses, which are common & frequently dominant on adjacent Loamy ecological sites, do not often compete as well on Very Shallow sites. However, the cheatgrass seed blows onto Very Shallow sites annually and can become a minor component. In a year with heavy snowfall and early spring rain, such as 2017, the site had far more moisture that the plant community could utilize. This is the perfect opportunity for cheatgrass seed, which is capable of rapid germination and growth to establish in significant amounts across the site. In following years when moisture is normal or below normal, native species will utilize most of the available moisture and cheatgrass seed will not germinate or make viable plants. Therefore, in most cases, these micro-bursts of cheatgrass tend to be episodic and mostly a temporary condition on Very Shallow sites. However, due to long term disturbances and higher precipitation, Very Shallow sites in the Goldendale Prairie portion of MLRA 8 are now dominated by cheatgrass, medusahead, ventenata or bulbous bluegrass. Sites have been significantly impacted by heavy grazing pressure from livestock that have removed much of the native grass components, leaving niches for these invasive annuals to take hold. Native forbs such as Lomatium may be prominent, but the grass component has shifted completely. A reduction to Sandberg bluegrass cover allows annual grasses the opportunity to colonize and invade on a more permanent basis. Heavy grazing use disrupts the soil surface and the moss-lichen layer via animal hooves, which in turn, causes loss of both soil structure and biological crust. When this happens site resistance to erosional forces are greatly diminished as well. State 2 may exhibit either a significant decrease in pedestaling due to the lack of bunchgrass cover and heavy use trampling by ungulates, or there will be a significant increase in pedestaling due to increased erosion from water flows around the remaining bunchgrasses. Community Phases for State 2: Community Phase 2.1: dominated by native forbs and/or invasive annual grasses. Forbs which increase in the altered conditions and are competitive with invasive grasses, can include lomatium, fleabane, willow herb, yarrow

and onion. Typical invasive grasses may include annual bromes, medusahead and sixweeks fescue.

Community 2.1
Forbs and/or Annual Grasses

Transition T1
State 1 to 2

T1 Result: Shift from Reference Community Phase 1.1 to Sate 2 Community Phase 2.1, resulting in the shift in functional groups to forbs and non-native annual grass dominance. Primary Trigger: Extensive spring grazing with heavy use to Sandberg bluegrass. The grazing pressure can come from elk, cattle or feral horses. Secondary Trippers: a micro-burst of cheatgrass could put Community 1.2 at risk. The trampling of Very Shallow soils, displacing and disturbing the surface soil structure by grazing animals could also trigger transition to State 2. A micro-burst of annual grasses could allow even pristine sites to be invaded. Community 1.2 is the community most at risk and is also the pathway for crossing the threshold from State 1 to State 2. Ecological process: consistent spring defoliation pressure to Sandberg bluegrass causes poor vigor, shrinking crowns and plant mortality. Most or all Sandberg bluegrass plants are lost from the community, and this allows native forbs to increase and invasive annuals (forbs and grasses) to colonize and expand. This facilitates plant community changes from Community 1.2 to Community 2.1. Indicators: Declining vigor and cover of Sandberg bluegrass, declining soil biotic crust and, increasing gaps between perennial bunchgrasses.

Restoration pathway R2
State 2 to 1

State 2 is considered non-reversible. Restoration of Sandberg bluegrass, the low shrub component, native forbs and the soil biotic crust would be extremely difficult, labor intensive and costly. Seedlings and plugged plants need soil moisture and time to germinate and become established. In most years, seeds and plugs may not have a chance as site conditions on Very Shallow can change quickly and the non-native species are much more adaptable under these conditions. Drying winds and bright sun can turn a snowy or muddy site into a hard crust before plants are established. Timing of all recovery efforts would have an extremely narrow window of opportunity on these altered sites of Very Shallow. 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