Ecological site group R008XG546WA
Sand, 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:
Diagnostics:

Sand, south aspect, Columbia Hills is an upland grassland site occurring on the south side of the Columbia Hills in Klickitat county. Soils are moderately deep to deep, coarse textured and well drained. The most common textures are sand and loamy fine sand.

Note: due to historic farming and grazing the south side of the Columbia Hills has been heavily disturbed. No pristine remnant is known, so the reference state has been reconstructed based on experience in MLRA 8.

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.

Needle and thread and Indian ricegrass would be the dominate species in the reference state. Onespike oatgrass, Eriogonum species and balsamroot would also be common.

Principle Vegetative Drivers:

The coarse-textured soils and south aspect drive the vegetative expression of this site. The soil would favor sand-loving species such as needle and thread and Indian ricegrass.

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

Sand, south aspect, Columbia Hills ecological sites are well drained and dry down quicker than adjacent Loamy ecological sites.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Sand, south aspect, Columbia Hills is commonly found on terraces, terrace escarpments, benches and plateaus of the Columbia Hills in Klickitat County.

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

Landscapes: Hills and plateaus
Landform: Terraces, terraces escarpments, hillslopes, dunes

Elevation: Dominantly 150 to 1,700 feet
Central tendency: 300 to 1,500 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 180
Central tendency: 120 to 150
The growing season for Sands is March through mid-May.

Soil features

Edaphic:

The Sand, south aspect, Columbia Hills ecological site occurs with Loamy, Shallow Stony, and Very Shallow ecological sites.

Representative Soil Features:

This ecological site components are dominantly Typic and Xeric taxonomic subgroups of Haploxerolls and Xeropsamments great groups of the Mollisols and Entisols taxonomic orders. Soils are dominantly very deep. Average available water capacity of about 3.0 inches (7.6 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly mixed eolian deposits with colluvium and residuum.

The associated soils are Dallesport, Ewall, Haploxerolls and similar soils.

Dominate soil surface is sand to very cobbly fine sandy loam.

Dominant particle-size class is loamy to sandy-skeletal.

Fragments on surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 2
Average: 0

Fragments within surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 25
Average: 10

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 25
Average: 10

Subsurface fragments > 3 inches (% Volume):
Minimum: 0
Maximum: 25
Average: 10

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 50
Average: 20

Drainage Class: Well drained to excessively drained
Water table depth: Greater than 60 inches

Flooding:
Frequency: None

Ponding:
Frequency: None

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

Depth to root-restricting feature (inches):
Minimum: Greater than 60
Maximum: Greater than 60

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

Sodium Absorption Ratio:
Minimum: 0
Maximum: 0

Calcium Carbonate Equivalent (percent):
Minimum: 0
Maximum: 10

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 6.1 to 8.4
10 - 40 inches: 6.6 to 8.4

Available Water Capacity (inches, 0 – 40 inches depth):
Minimum: 1.3
Maximum: 4.6
Average: 3.0

Vegetation dynamics

Ecological Dynamics:

Sand, south aspect, Columbia Hills produces about 450-750 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 grassland area of southeastern Adams and eastern Franklin counties have more precipitation in March. The same for the grasslands in Walla Walla, Asotin and Garfield counties. The Goldendale Prairie and the high elevation grassland above Coulee Dam in Douglas county also have higher spring precipitation. So, the grassland areas of MLRA 8 are consistent with Daubenmire’s findings.

Needle and thread and Indian ricegrass would be dominant in the reference state and warrants a degree of understanding. Needle and thread is a very drought tolerant perennial bunchgrass. It prefers excessively drained sandy and coarse textured gravelly loam soils. Needle and thread produces erect, unbranched stems about 3 feet in height. The seeds have a 4 to 5-inch long twisted awn. With wetting and drying the seed drills itself into the ground. Thus, needle and thread is one of the best seeders in the reference community. With grazing pressure needle and thread initially increases.

Indian ricegrass is a winter hardy, cool-season bunchgrass. It has tightly rolled, slender leaves. Indian ricegrass is known for its ability to reseed and stabilize shifting sand.

The stability and resiliency of the reference communities is directly linked to the health and vigor of needle and thread and Indian ricegrass 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). These two grasses help hold the system together. If we lose either grass the ecosystem begins to unravel.

The natural disturbance regime for grassland communities is periodic lightning-caused fires. The fire return intervals (FRI) listed in research for sagebrush steppe communities is quite variable. Ponderosa pine communities have the shortest FRI of about 10-20 years (Miller). The FRI increases as one moves to wetter forested sites or to dries shrub steppe
communities. Given the uncertainties and opinions or reviewers, a mean of 75 years was chosen for Wyoming sagebrush communities (Rapid Assessment Model). This would place the historic FRI for grassland steppe around 30-50 years.

The effect of fire on the community depends upon the severity of the burn. With a light to moderate fire there can be a mosaic of burned and unburned patches. Bunchgrasses thrive as the fire does not get into the crown. With adequate soil moisture the bunchgrasses can make tremendous growth the year after the fire. Largely, the community is not affected by lower intensity fire. Needle and thread and Indian ricegrass are native species that can increase via new seedlings following a fire.

A severe fire puts stress on the entire community. Spots and areas that were completely sterilized are especially vulnerable to exotic invasive species. Sterilized spots must be seeded to prevent invasive species (annual grasses, tumble mustard) from totally occupying the site. Needle and thread and Indian ricegrass may have weak vigor for a few years but generally survive.

Grazing is another common disturbance that occurs in this ecological site. Grazing pressure can be defined as heavy grazing intensity, or frequent grazing during reproductive growth, or season-long grazing (the same plants grazed more than once). As grazing pressure increases the plant community unravels in stages:
1. Indian ricegrass declines while needle and thread increase
2. Needle and thread declines as invasive species such as cheatgrass and knapweed colonize the site
3. With further decline the site can become a cheatgrass community

Managing grasslands to improve the vigor and health of needle and thread and Indian ricegrass begins with an understanding their needs. New growth each year begins from basal buds. Both grasses reproduce via seed and need to produce viable seed on a regular basis. During seed formation, the growing points of Indian ricegrass become elevated and are vulnerable to damage or removal??

Repeated critical period grazing (boot stage through seed formation) is especially damaging. Over several years each native bunchgrass pasture should be rested during the critical period two out of every three years (approximately April 15–July 15). And each pasture should be rested the entire growing-season every third year (approximately
March 1 – July 15).

In the spring each year it is important to monitor and maintain an adequate top growth: (1) so plants have enough energy to replace basal buds annually, (2) to optimize regrowth following spring grazing, and (3) to protect the elevated growing points of bluebunch wheatgrass.

Needle and thread and Indian ricegrass remains competitive if:
(1) Basal buds are replaced annually,
(2) Enough top-growth is maintained for growth and protection of growing points, and
(3) The timing of grazing and non-grazing is managed over a several-year period. Careful management of late spring grazing is especially critical

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, needle and thread-Indian ricegrass communities provide habitat for a variety of upland wildlife species.

Supporting Information:

Associated Sites:
Sand, south aspect s is associated with other ecological sites in the Columbia Hills grassland steppe areas of MLRA 8, including Shallow Stony and loamy. Very Shallow may also be nearby.

Similar Sites:
The MLRA 7 Columbia Basin Sands is a needle-and-thread – Indian ricegrass ecological site, but with sagebrush and rabbitbrush as well.

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

- R008XY546WA–Sand South Aspect Columbia Hills

Stage

Provisional

Contributors

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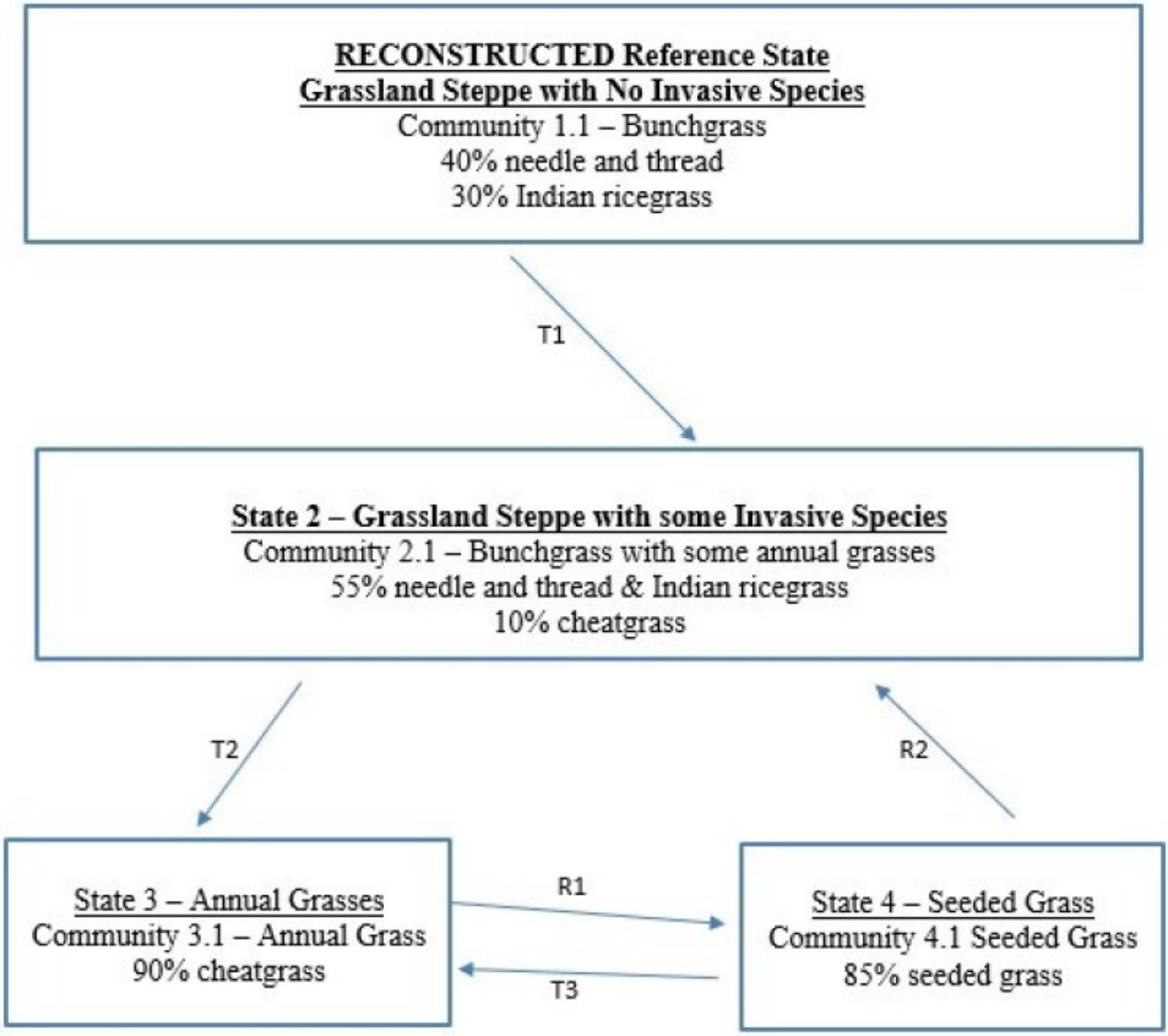
State and transition model

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

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



RECONSTRUCTED Reference Community 1.1 for Sand, 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
Dominant Mid-Size Bunchgrasses	**70%**	**Other Mid-Size Bunchgrasses – Minor**	10-15% 115 lbs.
HECO needle and thread	40% 300 lbs.	SPCR sand dropseed PSSP6 bluebunch wheatgrass ELEL5 bottlebrush squirreltail ACTH7 Thurber needlegrass	
ACHY Indian ricegrass	30% 225 lbs.		
Short Grass – Minor	less than 5% 25 lbs.		
POSE Sandberg bluegrass VUOC sixweeks fescue			
Native Forbs – Minor			15-20% 150 lbs.
BASA3 arrowleaf balsamroot LUPIN lupine CREPI hawksbeard ERIGE2 fleabane ERIOG buckwheat CASTI2 paintbrush PHHO spiny phlox LIPU11 granite gilia COLLO collomia PLPA2 woolly plantain FRPU2 yellowbells		MICRO6 microseris CALOC Mariposa lily PHLO2 longleaf phlox LOMAT lomatium / biscuitroot ASTRA milkvetch / locoweed ANDI2 low pussytoes CHDO Douglas dusty-maiden ERNI2 snow buckwheat DELPH larkspur LIRU4 stoneseed ACMI2 yarrow	

	Below	Normal	Above
Estimated Production (pounds / acre)	450	600	750

State 1
RECONSTRUCTED Reference State: Grassland Steppe with No Invasive Species

Note: most Sand sites on the south side of the Columbia Hills have already crossed the threshold into State 3 State 1 Narrative: State 1 represents grassland steppe with no invasive or exotic weed species. All the functional, structural groups are represented by one or more native species. 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 would be dominated by needle and thread and Indian ricegrass. Native forbs are also present. Reference State Community Phases: 1.1 Reference Needle and thread – Indian ricegrass Dominate Reference State Species: would be needle and thread, Indian ricegrass 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.

State 2
Grassland Steppe with some Invasive Species

Note: most Sand sites on the south side of the Columbia Hills have already crossed the threshold into State 3 State 2 Narrative: State 2 represents native grassland with the inclusion of a few invasive annual grasses such as cheatgrass. All the native functional, structural groups would be represented by one or more species. Once a community has been invaded by cheatgrass the chance of going back to State 1 is small. The Reference Community 2.1 would be dominated by needle and thread and Indian ricegrass. Native forbs would also be present. Community Phases for State 2: 2.1 Bunchgrass Needle and thread – Indian ricegrass Dominate State 2 Species: Needle and thread, Indian ricegrass

State 3
Annual Grasses

State 3: Annual Grasses Note: most Sand sites on the south side of the Columbia Hills have already crossed the threshold into State 3 State 3 Narrative: State 3 represents sites dominated by invasive annual species and has crossed a biological threshold. As State 1 or State 2 begins to unravel the dominant bunchgrasses decline while invasive grasses become more and more prominent. Virtually all the native functional, structural groups are missing in State 3. Community Phases for State 3: 3.2 Annual Grass Cheatgrass Dominate State 3 Species: Annual grasses such as cheatgrass. The main species can include other annual bromes, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed.

State 4
Seeded Grass

State 4 Narrative: State 4 represents a site that has been seeded to desirable grasses such as needle and thread, Indian ricegrass, Secar Snake River wheatgrass, Sherman big bluegrass, or Siberian wheatgrass. State 4 is stable if 0.8 plant per sq. ft. or greater of the desired bunchgrasses is maintained. Dominate Species for State 4: Desirable seeded grass species with or without legumes Community Phases for State 4: 4.1 Seeded Grass

Transition T1
State 1 to 2

T1 Result: transition from Reference State to State 2 (grassland steppe w/ a few annuals). The Reference State would not have invasive species. State 2 is the same as Reference State but with minor addition of invasive annual grasses such as cheatgrass. Primary Trigger: soil disturbances (rodents, badgers) create openings or opportunities in the community or a high moisture year causes a micro-burst of cheatgrass and is the principle means of colonization. Ecological process. Annually cheatgrass seed blows onto most Reference State sites. With seed-soil contact this seed germinates and competes with the native species for space, light and moisture. The loss of soil biological crusts also contributes to the invasion. Even pristine communities in the Reference State are susceptible to colonization by invasive annual grasses. Indicators: The occurrence of annual grasses on sites where they had been absent.

Transition T2
State 2 to 3

T2 Result: shift from State 2 with a few annuals to State 3 which is dominated by annual grasses. This transition occurs once the cover of needleandthread & Indian ricegrass declines to less than 10% and invasive species cover is greater than 40%. Primary trigger: Grazing pressure causes low vigor and reduces cover of Indian ricegrass and needleandthread. Initially both needleandthread and the annual grasses increase. As the grazing pressure continues, needleandthread will decrease allowing the annual grasses to become dominate. Grazing pressure is defined as heavy grazing, season long grazing or frequent late spring grazing. Secondary Trigger: Repeated fire does the same thing. In Washington, chronic season-long grazing caused more acres of State 2 than repeated fire. Repeated fire is a much more common event in south Central Washington than elsewhere in MLRA 8. Ecological process: the unraveling of the native plant community begins with consistent defoliation pressures to bluebunch wheatgrass. This causes poor vigor, shrinking crowns and plant mortality. With more and more of the soil surface and upper soil rooting surfaces open, opportunistic weeds that take advantage of the available niche space and

expand. The invasive annual grasses in State 2 communities make a dramatic increase to dominate the community. Indicators: Decreasing cover of needleandthread and Indian ricegrass 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.

Restoration pathway R2
State 3 to 2

R2 Result: Shift from State 3 back to State 2. This restoration transition does not occur without a significant commitment of time & resource inputs to restore ecological processes, native bunchgrasses, bitterbrush and native forb species. Attention needs to be paid to each step of the process: weed control, seedbed preparation, seeding and planting operations and post-seeding management. Shifting from State 3 to State 4: If the goal is to restore back to a native plant community, State 3 must first be shifted to State 4. It will take two years or longer to kill annual species and to exhaust the seedbank of invasive species. Site will then need to be seeded to perennial species such as crested wheatgrass to restore soil properties before native species can survive and thrive on site. The seeded species rebuild some of the basic soil properties including increased soil organic matter, increased soil moisture, and likely would also require the soil's pore spaces, bulk density and soil microorganisms to return before the native species that used to survive in this ecological site can return. The site would also need several years with no significant fires and proper grazing management as well. See narrative for R1 transition above. Shifting from State 4 to State 2: This assumes that the shift from State 3 to State 4 has been successful and that seeds of native species are available and affordable. State 4 stand must be killed before proceeding. The seeding of native species should occur in two steps: (1) a seeding of native bunchgrasses so that broadleaf weeds may be controlled, (2) a re-introduction of native forbs. The site would also need several years of no significant fires and proper grazing management as well to ensure plant establishment and vigor.

Restoration pathway R1
State 3 to 4

R1 Result: shift from State 3 dominated by annual grasses to State 4 desirable seeded grasses. This restoration transition does not occur without significant time and inputs to control weeds, prepare a seedbed, seed desirable species, and post-seeding weed control and management. This requires a commitment of two years or more for weed control. Care must be taken to maintain soil structure so that the seedbed has many safe-sites for the seed. Seed placement must be managed to achieve seed-soil contact at very shallow depth (about 1/8 inch is desired). Proper grazing management is essential to maintain the stand post-seeding. Needleandthread, Indian ricegrass, Secar Snake River wheatgrass, thickspike wheatgrass, Sherman big bluegrass, Sandberg bluegrass, and intermediate wheatgrass are typical species seeded on Loamy ecological site. The actual transition occurs when the seeded species have successfully established and are outcompeting the annual species for cover and dominance of resources.

Transition T3
State 4 to 3

T3 Result: Transition from State 4 seeded grass to State 3 annual grasses. This transition occurs when the desirable seeded grasses become minor to the dominant annual grasses. Primary trigger: chronic grazing pressure on the seeded grasses reduce the vigor and density of key bunchgrass species. Ecological process: the unraveling of the seeded grass community begins with consistent defoliation pressures to seeded grasses. This causes poor vigor, shrinking crowns and plant mortality. With more and more of the soil surface and upper soil rooting surfaces open, invasive annual grasses become more and more common with the loss of each bunchgrass. The invasive annual grasses in State 2 communities make a dramatic increase to dominate the community. Indicators: shrinking crowns and mortality of desirable species, increasing caps gaps between perennial species, increasing cover by annual grasses. 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

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Citations