Ecological site group R009XG535WA
Loamy, dwarf shrub, 18-24" ppt.

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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): 9 – Palouse and Nez Perce Prairie

LRU – Common Resource Areas (CRA):
9.2 - Palouse Hills
9.5 - Warm Canyons and Dissected Uplands

Site Concept Narrative:
Diagnostics:

Loamy, dwarf shrub, 18-24” ppt. is an upland site in the Palouse Hills portion of MLRA 9 (Common Resource Area 9.2 Palouse Hills). This site also occurs within Daubenmire’s Fescue-Snowberry and Fescue-Rose vegetative zones. Note that the Fescue-Rose zone is on the lee side of the Blue Mountains and represents a drier and shallower portion of the Palouse Hills and this ecological site.

The soils are non-skeletal loamy or skeletal loamy, and moderately deep (20-40”) to deep (40-60”). Silt loam is the most common texture. This site occurs on all aspects except north to northeast. In the summer the soils dry down to 20 inches (50 cm), which limits conifers (Lichthardt and Mosely 1997).

The maximum species diversity of any shrub steppe or steppe site in eastern Washington is expressed on the Palouse Hills and Daubenmire’s Fescue-Snowberry zone. Daubenmire calls this site a meadow-steppe association to reflect the moisture, lushness and diversity of these communities. The plant community is predominantly herbaceous with many grass species and a great variety of forbs, with considerable variation in forb species present from stand to stand.

Loamy, dwarf shrub, 18-24” ppt. is a grass-forb site with dwarf shrubs. There is a dense herbaceous layer of grasses and many native forbs. Idaho fescue is dominant or co-dominant with bluebunch wheatgrass in the reference state. Prairie junegrass is also common. Bluebunch wheatgrass may be a bunchgrass or strongly rhizomatous on this site.

The Palouse Hills and the Fescue-Snowberry zone have no sagebrush, no bitterbrush and no rabbitbrush. The dwarf shrub element, snowberry and rose, express themselves two different ways. First, there is an inconspicuous layer of solitary stems that is intermixed with the herbaceous species. The stems are sparingly branched and do not project above the herbs. Second, there is also a scattering of taller shrub thickets which gives a mosaic pattern across the landscape. The small and dense shrub thickets, range 4 meters to 25 meters across. Snowberry and rose are generally 0.5-1 meter tall. Some patches have 2-3 meters tall chokecherry in the center. Snowberry plants are mainly sterile with some fertile stems (Daubenmire 1970, p. 23).

Principle Vegetative Drivers:

The moderately deep to deep silt loam soils and the highest precipitation in MLRA 9 drive the vegetative expression of this productive site. Most species have unrestricted rooting on this site. The additional precipitation favors Idaho fescue and the dwarf shrubs.

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 Loamy, dwarf shrub, 18-24" ppt. site consists of deep soils and occurs for the most part on gently sloping landforms with little limitations for water infiltration. On steeper slopes and localized high silt or sodic soils, infiltration may be limited. Calcic and petrocalcic horizons may be present indicating long-term moisture penetration. There is generally no run-in moisture from surrounding sites or long-term soil moisture saturation.

Physiographic Features:

MLRA 9 is south of the Okanogan Highlands and Spokane Valley, east of the Columbia Basin, includes only the wet end of the Channeled Scablands and forms a horseshoe around the Blue Mtns. Palouse Hills Loamy is found on loess hills, outwash plains or terraces, summits, buttes, and plateaus.

MLRA 9 has three distinct geographical types:
(1) the Palouse Hills on the east side
(2) the loess hills to the south and west
(3) the Channeled Scabland-loess islands in the northwest

Note for MLRA 9 there are four ecological sites with "Loamy" in the name:
1. Cool Loamy occurs on the Channeled Scablands
2. Loamy, dwarf shrub, 18-24" ppt. occurs in the Palouse Hills
3. Loamy, bunchgrass, 15-18" ppt occurs in the loess hills
4. Loamy Bottom occurs on bottomland sites

The ecological site description below is for the Loamy, dwarf shrub, 18-24" ppt. which occurs only in the Palouse Hills.

The rolling hills of the Palouse Prairie, as far as the eye could see, were once a lush grassland with native bunchgrasses, a dizzying array of wildflowers, thickets of snowberry, wild rose, serviceberry, ponderosa pine woodlands and seasonal wetlands with camas. Wetlands were extensive in this area. The loess dunes created complex and interconnected drainage channels with low gradients, which would have made for considerable wetland habitat.

The Palouse is also one of the best areas in the world for dryland agriculture and has been highly disturbed. Virtually every acre that could be farmed is now farmed. Wetlands were drained or filled. The Palouse Prairie Land Trust says that with less than 1% of the original habitat remaining, the native Palouse Prairie in the most endangered habitat in the continental United States. And there is a list of endangered plant species as well.

Today the Palouse Prairie exists in small patches of land that either were too rocky or too steep to plow for agriculture. These scattered "remnants" are often no larger than an acre or two in size, and isolated from each other by large swaths of farmland. Occasionally the remnants are altered with broadleaf herbicide drift.

Physiographic Division: Intermontane Plateau and Northern Rocky Mountain System
Physiographic Province: Columbia Plateau and Northern Rocky Mountains
Physiographic Sections: Walla Walla Plateau

Landscapes: hills and foothills

Landform: Dominantly loess hills, plateaus, hillslopes

Elevation: Dominantly 1,600 to 4,000 feet
Slope: Total range: 0 to 90 percent
Aspect: Can occur on all aspects

Geology:

MLRA 9 is almost entirely underlain by Miocene basalt flows. Columbia River basalts are covered by wind-blown loess and volcanic ash with a thickness up to 250 feet thick. The oldest layer of loess accumulated between 2 and 1 million years ago, while the uppermost layers of Palouse Loess accumulated between 15,000 years ago and modern times. The mid layers of loess were deposited episodically between 77,000 years and 16,000 years ago. During the Pleistocene era the channeled scablands, the northwest portion of MLRA 9, were scoured of topsoil by the Lake Missoula Floods about 15,000-17,000 years ago. Flows removed topsoil from exposed ridges and basalt rims in canyons.

Climate

The Palouse Hills are the wettest portion of MLRA 9. It is cooler and wetter than the loess hills region of MLRA 9 and, warmer and wetter than the channeled scabland. The climate across MLRA 9 is characterized by moderately cold, wet winters, and relatively dry summers.

Daubenmire (p. 25) makes the following points: The Fescue-Snowberry zone is cooler and wetter than the Agropyron-Fescue and Agropyron-Poa zones. Compared to the Threetip Sage-Fescue zone, the Fescue-Snowberry has a higher annual precipitation and is also warmer in December and January. These climatic differences affect community structure chiefly in the shrubby elements. The Fescue-Rose zone is on the lee side of the Blue Mountains and has drier climatic conditions than the Palouse Hills.

Mean Annual Precipitation:
Range: 18 – 24 inches
Winter precipitation, primarily snow, occurs during low-intensity, Pacific-frontal storms. During winter these storms produce occasional rains that fall on frozen or thawing ground surfaces. High intensity, convective thunderstorms produce some rain during the growing season. Precipitation is evenly distributed throughout fall, winter and spring.

Mean Annual Air Temperature:
Range: 42 to 52 F
Central Tendency: 46 to 50 F
Freezing temperatures generally occur from late-October through early-April. Temperature extremes are -10 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: 90 to 180
Central tendency: 110 to 150
The growing season for Palouse Hills Loamy is generally March through July.

Soil features

Edaphic:

Loamy, dwarf shrub, 18-24” ppt. ecological site commonly occurs with North aspect, dwarf shrub, 18-24” ppt. and Shallow stony ecological sites. The soils are formed in loess on hills, or in loess and colluvium from basalt with minor amounts of volcanic ash in the surface layers. Soils are moderately deep to deep.

Representative Soil Features:

This ecological site components are dominantly Pachic, Typic and Vitrandic taxonomic subgroups of Argixerolls and Haploxerolls taxonomic great group of the Mollisols taxonomic order. Soils are dominantly very deep but can range

to moderately deep. Average available water capacity of about 5.8 inches (14.8 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly loess, colluvium and residuum derived from basalt, with minor amount of ash in limited surface horizons

The associated soils are Athena, Garfield, Hanning, Naff, Palouse, Uhlig and similar soils.

Dominate soil surface is silt loam.

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

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

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

Subsurface fragments > 3 inches (% Volume):
Minimum: 0
Maximum: 15
Average: 5

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 40
Average: 10

Drainage Class: Dominantly well drained
Water table depth: Dominantly greater than 60 inches, but can range to 40 inches

Flooding:
Frequency: None

Ponding:
Frequency: None

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

Depth to root-restricting feature (inches):
Minimum: Dominantly greater than 60, but bedrock can occur up to 40 inches occurrences
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: dominantly 0
Some soils with calcic horizons have been included in this site. In those cases, the range for CaCO3 would be 0-35

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 5.6 to 8.4
10 - 40 inches: 5.6 to 9.0

Available Water Capacity (inches, 0 – 40 inches depth):
Minimum: 2.8
Maximum: 8.3
Average: 5.8

Vegetation dynamics

Ecological Dynamics:

Loamy, dwarf shrub, 18-24” ppt. in MLRA 9 produces about 1200-2000 pounds/acre of biomass annually.

In the reference condition the Palouse Hills, with the highest mean precipitation, exhibit the maximum species diversity, the densest, and most productive plant communities. While the grass component was diverse, the vast array of wildflowers was stunning and extraordinary, easily the largest forb component in Eastern Washington. And there is considerable variation in wildflowers from stand to stand.

The dwarf shrubs express themselves two different ways: (1) as an inconspicuous layer of solitary stems, same height as herbs, that is intermixed with the herbaceous species, and (2) as a scattering of taller shrub thickets which give the landscape a mosaic pattern. The small and dense shrub patches range from 4 meters to 25 meters across. These patches of deciduous shrubs can be simple to more complex. A smaller patch will be a single species of snowberry or rose. Larger thickets can be half-meter tall snowberry at the edge and 1 meter rose in the center. Even more complex patches can have 2-3 meters tall chokecherry at the core, surrounded by belts of rose and snowberry. Snowberry has predominantly sterile stems with some fertile stems. (Daubenmire 1970, p. 23 Snowberry Phase).

Or Below ground the Palouse plant community provided a network of roots – shallow to deep, fibrous to tap rooted. The deep loamy soils have no root-restrictive horizons so, to a depth of 48”, this root-network from wildflowers, grasses and shrubs stabilized the soils, provided organic matter and nutrients, and maintained soil pore space for water infiltration and retention in the soil profile.

The stability and resiliency of the reference state is directly linked to the health and vigor of the entire community – grasses, wildflowers and shrubs. In healthy communities there is great resistance to invasion. But in the presence of disturbance, some species weaken. If natives are set back enough Kentucky bluegrass colonizes instead of cheatgrass. Once well-established, Kentucky bluegrass becomes persistent and the community will stabilize at a lower ecological level. This process can continue until the stand is dominated by Kentucky bluegrass. Quackgrass, Canadian thistle, medusahead and ventenata are other invasive species.

The natural disturbance regime for grassland communities is periodic lightning-caused fires. 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. The fire return intervals (FRI) listed in research for sagebrush steppe communities is quite variable. Given the uncertainties and opinions of 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 perhaps, even as short as 5-10 years in some locations.

The effect of fire on the community depends upon both the severity and season of the burn. See Vallentine’s Range Improvement for more detail. With a light to moderate fire there can be a mosaic of burned and unburned patches. The perennial grasses thrive as the fire does not get into the crown. With adequate soil moisture Idaho fescue,

bluebunch wheatgrass and prairie junegrass can make tremendous growth the year after the fire. Snowberry is a rhizomatous sprouter after fire. Largely, the community is not affected by lower intensity fire.

A severe fire puts stress on the entire community. Rabbitbrush is likely to increase by crown sprouting. Bluebunch wheatgrass and prairie junegrass, both fire-resilient grasses, will have weak vigor for a few years but generally survive. Reduced vigor of these grasses allows weeds to become established. Some spots and areas can be completely sterilized. Under windy conditions, a fire can burn into the crown of Idaho fescue, leaving behind “black holes” or nothing but ash where fescue plants were incinerated. Sterilized spots and dead Idaho fescue plants makes the site vulnerable to exotic invasive species. So, seeding
should be strongly considered to prevent invasives such as Kentucky bluegrass from totally occupying the site. Prairie junegrass and bluebunch wheatgrass keeps the site resistant to change, while Idaho fescue makes the site more at risk.

Spring burning can be especially damaging to Idaho fescue.

Grazing is another common disturbance that occurs to 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. Idaho fescue, and palatable forbs such as balsamroot decline while bluebunch wheatgrass, prairie junegrass, yarrow and other unpalatable forbs increase
2. All native grasses, shrubs and palatable forbs decline, while unpalatable forbs continue to increase. Invasive species such as Kentucky bluegrass, quackgrass, ventenata and Canadian thistle colonize the site.
3. As grazing progressively thins the native perennials, Kentucky bluegrass and other alien species take their place, finally becoming dominant.

At each level of retrogression, the community stabilizes but at a lower ecological level. Once retrogression allows Kentucky bluegrass there seems to be no reversal when grazing pressure is reduced or eliminated. Dwarf snowberry and rose are highly palatable and decline simultaneously with the herbs.

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 many upland wildlife species.

Supporting Information:

Associated Sites:
Loamy, dwarf shrub, 18-24” ppt. is associated with other ecological sites in MLRA 9 including Very Shallow, North Aspect, dwarf shrub, 18-24” ppt. and Shallow Stony.

Similar Sites:
Loamy, dwarf shrub, 18-24” ppt. is dominated by Idaho fescue, many native forbs, bluebunch wheatgrass, and with dwarf snowberry & rose, shrub thickets, dense canopy of herbaceous species, and high species diversity is unique in eastern Washington. The closest ecological site is North aspect, dwarf shrub, 18-24” ppt.

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 009X
Palouse and Nez Perce Prairies

Stage

Provisional

Contributors

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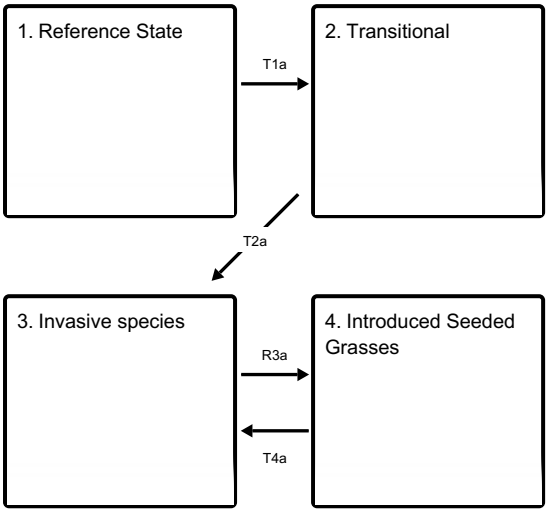
State and transition model

Ecosystem states



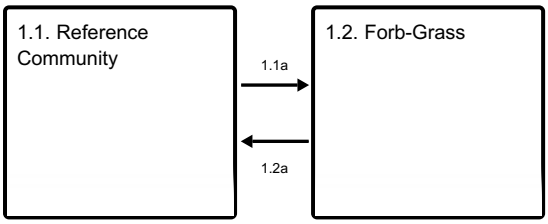
T1a - grazing pressure

T2a - grazing pressure

R3a - restoration

T4a - grazing pressure

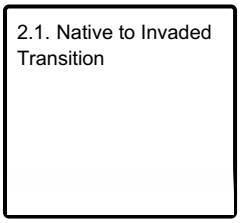
State 1 submodel, plant communities



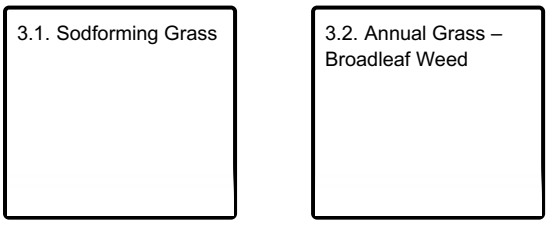
1.1a - Grazing pressure

1.2a - improved grazing management

State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Introduced Seeded Grass

State 1
Reference State

State 1 Narrative: State 1 represents native grass-forb-dwarf shrub stands with no invasive or exotic weed species. The Palouse Hills have no sagebrush and no bitterbrush. All the functional, structural groups have one or more native species present. Reference State Community Phases: 1.1 Reference Community Idaho fescue, bluebunch, native forbs 1.2 Forb-Grass Unpalatable native forbs, native grasses Dominant Reference State Species: Idaho fescue, native forbs, bluebunch wheatgrass At-risk Communities: • Different communities have different degrees of risk • All communities in the reference state are at risk of invasive species • All communities in the reference state are at risk of moving to State 2. The seed source of invasive species is nearby and moving onto most sites annually. Also, Kentucky bluegrass is aggressive with rhizomes or seed • Any community is at risk when fire kills Idaho fescue plants. The holes could quickly be filled by invasive grass or weeds • A community has moved to State 2 when Kentucky bluegrass has colonized the site • Any community becomes at-risk of moving to State 3 when Idaho fescue and bluebunch have low cover and Kentucky bluegrass has colonized the site

Community 1.1
Reference Community

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			
Dwarf Sprouting Shrubs -Minor			10% 200 lbs.	**Other Sprouting Shrubs – Minor**			less than 5% 70 lbs.
SYAL	snowberry			RIBES	currant		
ROSA5	rose			PRVI	chokecherry		
				MARE11	Oregon grape		
				AMAL2	serviceberry		
				CRDO2	hawthorn		
Dominant Mid-Size Bunchgrasses			55%	**Other Mid-Size Bunchgrasses – Minor**			5% 100 lbs.
PSSP6	bluebunch wheatgrass	25%	500 lbs.	POSEJ	big bluegrass		
FEID	Idaho fescue	30%	600 lbs.	ACNE9	Nelson's needlegrass		
				KOMA	prairie junegrass		
				FECA4	rough fescue		
Short Grass – Minor			less than 5% 70 lbs.	**Grass-Like – Trace**			
POSE	Sandberg bluegrass			CAGE2	Geyer's sedge (elk sedge)		Trace
Native Forbs – Subdominant			25% 500 lbs.				
ACMI2	yarrow			WYAM	mule's ears		
BASA3	arrowleaf balsamroot			MINU	microseris		
LUPIN	lupine			ALLIU	wild onion		
CREPI	hawksbeard			CALOC	Mariposa lily		
PHLOX	phlox			ERIGE2	fleabane		
LOMAT	lomatium / biscuitroot			ERIOG	buckwheat		
ASTRA	milkvetch / locoweed			CASTI2	paintbrush		
ANDI2	low pussytoes			HIERA	hawkweed		
COLLO	collomia			DELPH	larkspur		
LIRU4	stoneseed			FRPU2	yellow bells		
TRGRG2	large-flowered brodia			BERU	red besseya		
GEUM	old man's whiskers			GAAR	blanket-flower		
IRMI	Rocky Mtn. iris			POTEN	cinquefoil		
ZIVE	death camas			SENEC	groundsel		
PENST	penstemon			RANUN	buttercup		
CLARK	clarkia			DELPH	larkspur		
DOPU	shooting star			ASTER	aster		

Idaho fescue, bluebunch, native forbs 55% Idaho fescue & bluebunch wheatgrass 25% native forbs 10% dwarf shrubs: snowberry, rose Reference Community 1.1 for Loamy, dwarf shrub, 18-24" ppt. in MLRA 9 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.

Community 1.2
Forb-Grass

Unpalatable native forbs, native grasses 50% native grasses 40% unpalatable forbs 10% shrubs: snowberry, rose

Pathway 1.1a
Community 1.1 to 1.2

1.1a Result: shift from Reference Community 1.1 to forb-grass community 1.2. Moderate reduction in bunchgrasses and a moderate increase in unpalatable native forbs Primary Trigger: Grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) Ecological process: consistent defoliation pressure to Idaho fescue, bluebunch wheatgrass and palatable forbs results in poor vigor, shrinking crowns and some mortality. Unpalatable forbs take advantage of released resources and niche space. Indicators: decreasing cover for Idaho fescue and bluebunch wheatgrass and increasing cover for unpalatable forbs.

Pathway 1.2a
Community 1.2 to 1.1

1.2a Result: shift from forb-grass Community 1.2 to Reference Community 1.1 dominated by native bunchgrasses. Primary Trigger: improved grazing management Ecological process: With decreased defoliation pressure, bunchgrasses have much improved vigor. Idaho fescue sets new seedlings while bluebunch wheatgrass expands via tillering. Perennial grasses can readily out-compete annual native forbs. Indicators: increasing cover of dominant bunchgrasses and decreasing cover of forbs.

State 2
Transitional

State 2 represents transition between State 1 with no invasive species and State 3 which is dominated by invasive species. State 2 has a moderate invasion by invasive species, but native species are still present and dominant. Invasive species have gained a foothold that they do not easily relinquish. Grazing pressure weakens the stand of native species allowing the invasive species to colonize and establish themselves in the community. The invasion can be either Kentucky bluegrass or a combination of invasive annual grasses (annual bromes, ventenata) and broadleaf weeds (Russian knapweed, Canadian thistle). Once retrogression allows Kentucky bluegrass there seems to be no reversal when grazing pressure is reduced or eliminated.

Community 2.1
Native to Invaded Transition

20% Kentucky bluegrass, or 20% annual bromes/broadleaf weeds

State 3
Invasive species

State 3 represents the situation where invasive species dominate the plant community. Retrogression begins a weakened State 1 and then in State 2 the introduction and establishment of invasive species. The community stabilizes but at a lower ecological level. When the native species are further weakened the invasive species increase again. After a series of retrogressions, the stand becomes dominated by alien species. Community 3.1 is mostly Kentucky bluegrass Community 3.2 is either annual bromes or broadleaf weeds such as Russian thistle or Canadian thistle depending on sed source

Community 3.1
Sodforming Grass

Community 3.1 is mostly Kentucky bluegrass 70% Kentucky bluegrass/quackgrass 20% broadleaf weeds

Community 3.2
Annual Grass – Broadleaf Weed

Community 3.2 is either annual bromes or broadleaf weeds such as Russian thistle or Canadian thistle depending on sed source 40% annual grass (annual brome, ventenata, etc) 40% Russian knapweed, Canada thistle

State 4
Introduced Seeded Grasses

State 4 represents a stand of desirable introduced grasses. The State 3 community has been eliminated and the site seeded to desirable grasses such as intermediate wheatgrass. State 4 remains stable a long as a full stand is maintained (1.0 plant / sq. ft. or greater of the desired bunchgrasses)

Community 4.1
Introduced Seeded Grass

85% Introduced seeded grass

Transition T1a
State 1 to 2

T1a Result: Transition from Reference State with no invasive species to State 2 with a stand of native plants with some invasive species. Previously the stand has not had alien species. The result of this transition is the presence of invasive species. Depending on seeds in the soil bank and what is growing nearby, either Kentucky bluegrass or invasive annual grasses and broadleaf weeds enter the stand of native species. Primary trigger: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) Idaho fescue, bluebunch wheatgrass and other palatable species. Ecological process: consistent defoliation pressure to Idaho fescue, bluebunch wheatgrass and other palatable species results in poor vigor, shrinking crowns and plant mortality. This gives invasive species such as Kentucky bluegrass, Russian knapweed and Canadian thistle the opportunity to colonize and establish. Indicators: decreasing cover of Idaho fescue, bluebunch wheatgrass, and other palatable species, and the presence of invasive species where there have been none.

Transition T2a
State 2 to 3

T2 Result: Transition from State 2 (mostly native species with some invasive species) to State 3 which is dominated by invasive species. Primary trigger: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) Idaho fescue, bluebunch wheatgrass and other palatable species. Ecological process: consistent defoliation pressure to Idaho fescue, bluebunch wheatgrass and other palatable species results in poor vigor, shrinking crowns and plant mortality. This releases resources and niche space that invasives take advantage of. The transition can go two directions – to Kentucky bluegrass or to broadleaf weeds and annual bromes. This transition takes place in a series of retrogressions. The palatable native species are weakened, and the invasive species increase to fill the void. After each retrogression the stand stabilizes but at a lower ecological level. Finally, the stand is dominated by invasive species rather than natives. Indicators: decreasing cover of Idaho fescue and other native species and, increasing cover of invasive species.

Restoration pathway R3a
State 3 to 4

R3a Transition from State 3 (a community dominated by invasive species) to State 4, which is predominately introduced seeded grasses with or without legumes. 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. Intermediate wheatgrass, orchardgrass, meadow brome, smooth brome and clover are typical species seeded on Loamy ecological site in the Palouse Hills. The actual transition occurs when the seeded species have successfully established and are outcompeting the annual species for cover and dominance of resources.

Transition T4a
State 4 to 3

T4a Result: shift from State 4 seeded grass to State 3 which is dominated by invasive species. Primary Trigger: grazing pressure (heavy to severe grazing intensity, season long grazing or frequent late spring grazing) to desirable seeded grasses. Ecological process: consistent defoliation pressure to seeded grasses results in poor vigor shrinking crowns and plant mortality. This releases resources and niche space that invasive species such as Kentucky bluegrass, Russian knapweed and Canadian thistle take advantage of. In a series of retrogressions desirable seeded species are weakened and invasive species colonize and increase. After each retrogression the stand stabilizes but at a lower ecological level. Finally, the stand is dominated by invasive species rather than natives. References: Boling M., Frazier B., Busacca, A., General Soil Map of Washington, Washington State University, 1998 Daubenmire, R., Steppe vegetation of Washington, EB1446, Washington State University Cooperative Extension, 1970 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 Lichthardt, Juanita and Mosely, Robert K., 1997 Status and Conservation of the Palouse Grassland in Idaho. Idaho Fish and Game, Boise, ID. USFS Purchase Order 14420-S-0395 Liston, A, B.L. Wilson, W.A. Robinson, P.S. Doescher, N.R. Harris, and T. Svejar. 2003. The Relative Importance of Sexual Reproduction Versus Clonal Spread in an Arid Bunchgrass. Oecologia 137:216-225 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

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