Ecological site group R009XG220WA
Stony Foothills, Channeled Scabland

Last updated: 11/22/2023
Accessed: 10/12/2024

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):
9.1 - Channeled Scablands
9.12 - Moist Loess Islands

Site Concept Narrative:
Diagnostics:

The channeled scabland-loess island region is the only portion of MLRA 9 that is shrub steppe. Stony foothills, channeled scabland occurs on two Common Resource Areas – 9.1 channeled scabland and 9.12 loess islands. This site is also found in Daubenmire's Threetip Sagebrush-Fescue vegetative zone.

Fire sensitive, bitterbrush dominates the reference state overstory, while perennial bunchgrasses such as Idaho fescue and bluebunch wheatgrass are dominant in the herbaceous understory. The shrub layer is typically waist- to shoulder-height bitterbrush with a mix of other shrub steppe species scattered throughout including Wyoming sagebrush, rabbitbrush, and currant.

Stony foothills, channeled scabland is an upland bitterbrush-bunchgrass site occurring in the transition between threetip sagebrush and forest in eastern Lincoln, southwestern Spokane, and northwestern Whitman counties. The soils are deep (60 inches or greater), coarse textured and rocky. Textures are mostly sandy loam and sand with some loams. Soils are often gravelly to very gravely to extremely stony. Soils are well drained.

Principle Vegetative Drivers:

The coarse soils and neutral to north aspect drive the vegetative expression of this site. Bitterbrush prefers well drained, coarse soils, while the neutral or north slopes are good for both bluebunch and Idaho fescue.

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 plant cover and litter, the water infiltrates into Stony Foothills readily. These sites are well drained and are saturated for only a short period.

Physiographic Features:

The landscape is part of the Columbia basalt plateaus and Northern Rocky foothills. 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.

MLRA 9 has three distinct geographical areas:
(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

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

Landscapes: plateaus and loess hills
Landform: Dominantly benches, terraces, terraces escarpments

Elevation: Dominantly 1,800 to 3,000 feet
Slope: Total range: 0 to 60 percent
Aspect: Occurs 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.

The Channeled Scabland was impacted by the Missoula Floods, but the Loess Islands were not inundated or scoured by the floodwaters.

Climate

The channeled scabland region is the coldest and driest part of MLRA 9. The climate across MLRA 9 is characterized by moderately cold, wet winters, and relatively dry summers.

Mean Annual Precipitation:
Range: 14 – 18 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: 47 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.

Areas with threetip sagebrush and Idaho fescue when compared to Wyoming sagebrush-bluebunch wheatgrass regions, are cooler from late fall to early spring (October through April), and has higher P (precipitation) and P/T (precipitation-transpiration) for five months (September, November, December, January and March) (Daubenmire).

Frost-free period (days):
Total range: 60 to 180
Central tendency: 100 to 140
The growing season for Stony foothills is April through end of July.

Soil features

Edaphic:

The Stony foothills, channeled scabland ecological site occurs with Cool loamy, channeled scabland and Ponderosa pine ecological sites.

Representative Soil Features:

This ecological site components are dominantly Vitrandic and Lithic taxonomic subgroups of Argixerolls and Haploxerolls taxonomic great group of the Mollisols taxonomic order. Soils are dominantly very deep. Average available water capacity of about 2 inches (5.1 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly glaciofluvial deposits with loess and volcanic as in the upper part, residuum and colluvium.

The associated soils are Alecanyon, Cheney and similar soils.

Dominate soil surface is silt loam to gravelly ashy coarse sandy loam.

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

Fragments within surface horizon > 3 inches (% Volume):
Minimum: 5
Maximum: 20
Average: 15

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 5
Maximum: 20
Average: 10

Subsurface fragments > 3 inches (% Volume):
Minimum: 10
Maximum: 30
Average: 20

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 10
Maximum: 40
Average: 30

Drainage Class: Excessively and well drained
Water table depth: Dominantly 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: Dominantly greater than 60, but strongly contrasting textural stratification can occur up to 20 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: 0

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 6.1 to 7.8
10 - 40 inches: 6.1 to 7.8

Available Water Capacity (inches, 0 – 40 inches depth):
Minimum: 3.5
Maximum: 9.3
Average: 7

Vegetation dynamics

Ecological Dynamics:

Stony foothills, channeled scabland produces about 1100-1600 pounds/acre of biomass annually.

Antelope bitterbrush, Idaho fescue and bluebunch wheatgrass are at the core of the Stony Foothills ecological site and warrant a degree of understanding. Antelope bitterbrush is a very palatable, high quality shrub for big game and livestock. It is adapted to a wide range of soils and precipitation. Bitterbrush is usually 2-6 feet in height and up to 8 feet in width. Rodents normally cache bitterbrush seed within 50-75 feet of an existing seed source. Following a fire, the rodent seed caches become an important source of regeneration. Another important source of regeneration are pockets of unburned rangeland that provide much needed seed to the system.

Idaho fescue is shorter and has a dense clump of shoots, while bluebunch wheatgrass is taller and is less dense. Both species are long-lived bunchgrasses. Bluebunch has an awned or awnless inflorescence arranged in a spike while Idaho fescue has an awned inflorescence arranged in a panicle. The ratio of Idaho fescue to bluebunch wheatgrass plants on any site can vary due to aspect and elevation.

Needle-and-thread is another perennial bunchgrass on Stony Foothills. It produces erect, unbranched stems about 3 feet in height. The sharp-pointed seeds have a 4 to 5-inch long twisted awn. With wetting and drying needle and thread seed drills itself into the ground. Thus, needle and thread is one of the best seeders in the reference plant community. With grazing pressure on the dominant bunchgrasses, needle-and-thread increases.

In healthy communities, these mid-sized grasses provide 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. This root-network stabilizes the soils, provides organic matter and nutrients, and helps to maintain soil pore space for water infiltration and retention un the soil profile. The extensive rooting system of mid-sized grasses leave very little space for invasion by other species. This drought resistant root mass 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 Idaho fescue and bluebunch wheatgrass. Research has found that on similar rangeland the community remains resistant to medusahead if the site maintains at least 0.8 mid-sized bunchgrass plant/sq. ft. (Davies). These two bunchgrasses hold the system together. If we lose either or both bunchgrass the ecosystem begins to unravel.

The natural disturbance regime for grassland communities is periodic lightning-caused fires. How one answers fire return intervals for bitterbrush communities depends on the frame of reference used. Current conditions for Stony Foothills are communities often dominated by dense canopies of bitterbrush, some of which has become decadent. These shrubs are 50-100 years old or older due to fire suppression. These bitterbrush plants do not readily re-sprout following fire. Germinating seeds, especially from rodent caches is the primary source to bitterbrush re-establishment. The framework of current conditions suggests a fire return interval of 50-100 years or longer.

Miller et al, paint a totally different picture for pre-settlement mountain big sage-bitterbrush-fescue communities. These communities were dominated by the herb layer. Shrubs were widely scattered and patchy. The fire regime was high frequency (10-20 years), low severity, low intensity. The landscape would have been a mosaic of burned and unburned patches. In any given fire some bitterbrush plants would have survived the fire. Also, bitterbrush plants were likely much younger (10-30 years old), more vigorous and more likely to sprout following fire. In recent years sprouting bitterbrush after low severity fire supports the notion of sprouting bitterbrush. Seedlings from rodent caches would have also been important for the recovery of the shrub layer.

The effect of fire on the main species is mixed for the Stony Foothills site. Bitterbrush is very susceptible to fire kill and is considered a weak sprouter. Bluebunch wheatgrass and needle and thread are fire tolerant, but Idaho fescue is much more sensitive to fire. Under windy conditions, a fire can burn into the crown of Idaho fescue, leaving behind “black holes” or nothing but ash. When a site loses its Idaho fescue, the holes will be filled by vigorous native species or exotic weeds. Bluebunch wheatgrass keeps the site resistant to change, while bitterbrush and Idaho fescue makes the site more at risk.

A low intensity, high frequency fire regime favors bitterbrush sprouting and rapid tillering by both Idaho fescue and bluebunch wheatgrass. A high intensity, low frequency fire regime hinders recovery – Idaho fescue plants may be devastated, bluebunch wheatgrass set back, and bitterbrush regeneration limited to seedlings.

Fires with light severity will remove less bitterbrush and open smaller patches for grass and forb recovery, whereas the more severe fires will remove almost all the bitterbrush and leave vast areas open to return to bunchgrass dominance. This is how the patchy distribution occurs. So, fire resets the competitive advantage back to the bunchgrasses by removing much of the overstory. This, in turn, maintains the stability and overall resilience of the site. However, this is not always true as some fires are spotty or do not burn hot enough to fully remove the bitterbrush. Rabbitbrush and horsebrush are sprouting shrubs and may also increase following fire.

The longer the site goes without fire and the more grazing pressure added to the bunchgrasses, the more bitterbrush cover increases, and the more bunchgrasses decline. This leaves the dense bitterbrush community phase more vulnerable to outside pressures. Invasive species take advantage of the available soil rooting spaces in the interspaces. The once extensive grass roots are largely absent. Soils are no longer receiving the organic inputs, and there is less surface cover by grass litter. Both water infiltration into the soil, and water percolation through the soil, are affected, leaving open soil space that is drier and more vulnerable to wind and water erosion, and invasion by undesirable species. Once these undesirable species have colonized, the site is at high risk of crossing a threshold if a disturbance such as fire were to occur.

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 (same plants grazed more than once). As grazing pressure increases the plant community unravels in stages:
1. Cusick bluegrass is eliminated. Adjacent natives fill the void
2. Idaho fescue declines while bluebunch wheatgrass and threetip sagebrush increase
3. Both Idaho fescue and bluebunch wheatgrass decline while threetip sage and threadleaf sedge increase
4. With further decline invasive species colonize the site
5. The site can become a shrub-annual grass community

Managing shrub steppe to improve the vigor and health of native bunchgrasses begins with an understanding of

grass physiology. New growth each year begins from basal buds. Given the opportunity Idaho fescue readily produces new seedlings while bluebunch wheatgrass plants rely principally on tillering. During seed formation, the growing points of bluebunch wheatgrass become elevated and are vulnerable to damage or removal.

If defoliated during the formation of seeds, bluebunch wheatgrass has limited capacity to tiller compared with other, more grazing resistant grasses (Caldwell et al., 1981). Repeated critical period grazing 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, (3) to protect the elevated growing points of bluebunch wheatgrass, and (4) to avoid excessing defoliation of Idaho fescue with its weak stems.

Bluebunch wheatgrass and Idaho fescue remain 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

Antelope bitterbrush is an important browse species for big game animals and needs special management consideration with livestock in mind. There is no problem with spring grazing as livestock do not focus their attention to bitterbrush in the spring. Fall is a different story. Feeding some alfalfa every second or third day helps minimize livestock use of bitterbrush in the fall.

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, antelope bitterbrush / Idaho fescue /bluebunch wheatgrass communities provide habitat for big game and sharp-tailed grouse.

Supporting Information:

Associated Sites:
Stony Foothills, channeled scabland is associated with Cool Loamy and ponderosa pine forest sites.

Similar Sites:
MLRA 6 East Slope of the Cascades and MLRA 8 Columbia Plateau have comparable Stony Foothills ecological sites.

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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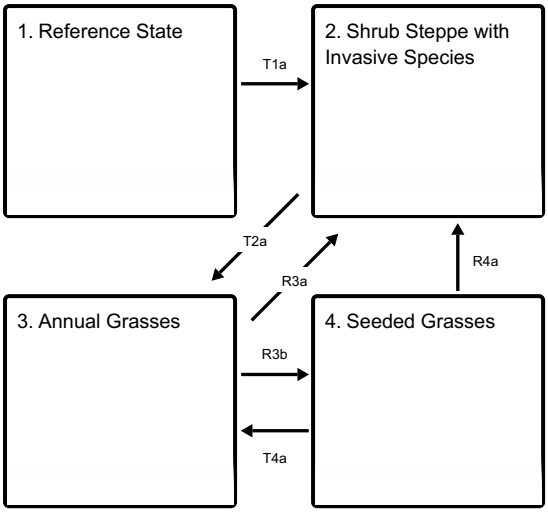
State and transition model

Ecosystem states



T1a - Soil disturbances , fire, drought and grazing pressure

T2a - grazing pressure

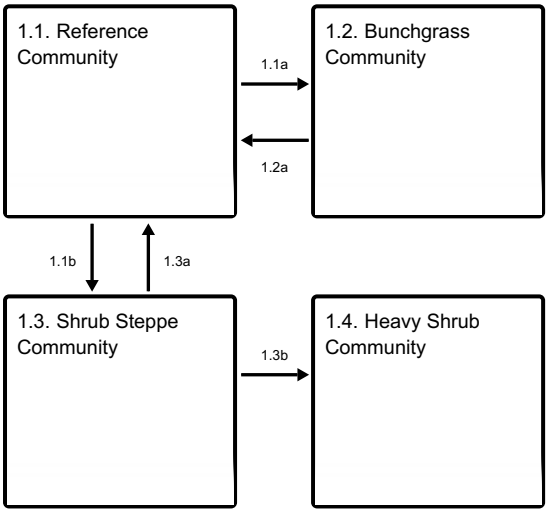
R3a - restoration

R3b - restoration

R4a - weed control, reseeding, grazing management

T4a - grazing pressure

State 1 submodel, plant communities



1.1a - Moderate-severity fire

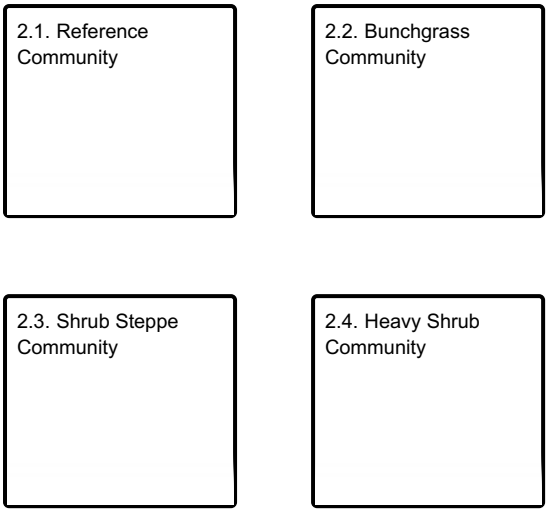
1.1b - grazing pressure

1.2a - time with no fire

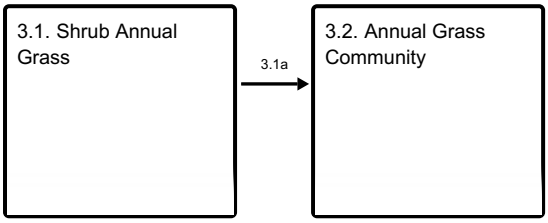
1.3a - light to moderate-severity fire

1.3b - grazing pressure

State 2 submodel, plant communities

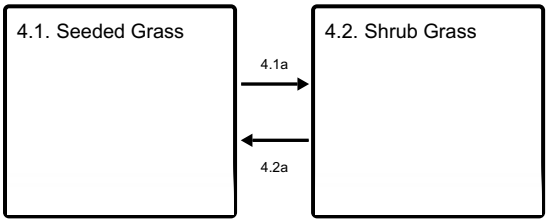


State 3 submodel, plant communities



3.1a - Moderate intensity fire

State 4 submodel, plant communities



4.1a - grazing pressure

4.2a - shrub control/management, reseeding, weed management, grazing management

State 1
Reference State

State 1 Narrative: State 1 represents shrub steppe with no invasive or exotic weed species. All the functional, structural groups are represented by one or more native species. Reference State Community Phases: 1.1 Reference Idaho fescue-bluebunch wheatgrass – bitterbrush 1.2 Bunchgrass Idaho fescue-bluebunch wheatgrass. 1.3 Shrub Steppe Bitterbrush – Idaho fescue-bluebunch wheatgrass 1.4 Heavy Shrub Bitterbrush – needle and thread Communities 1.1, 1,2 and 1.3 can shift to the other two communities and back again. Dominant Reference State Species: Antelope bitterbrush – Idaho fescue – bluebunch wheatgrass At-risk Communities: • All communities in the reference state are at risk of moving to State 2. The seed source of cheatgrass and other invasives are nearby and move into most sites annually • Community Phases 1.1, 1.2 and 1.3 have high amounts of Idaho fescue and bluebunch wheatgrass cover and are at lower risk of moving to State 3 • Community Phase 1.4 is most at-risk because of low density for Idaho fescue and bluebunch wheatgrass. Community 1.4 should be seeded after fire • Communities with more than 40% bitterbrush cover with low bunchgrass cover • When fire kills the Idaho fescue plants, these sites should be seeded after fire • Community 1.4, and any site with low cover of Idaho fescue/bluebunch wheatgrass, and any site with moderate to heavy cover of cheatgrass should be seeded after fire

Community 1.1

Reference Community

Reference Community 1.1 for Stony Foothills, channeled scabland 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.

Note: Stony Foothills, channel scabland is the interface between threetip sage & ponderosa pine forest sites.

Similarity Index		Similarity Index		
Non-sprouting Shrubs – Subdominant (3-7% canopy)		**Sprouting Shrubs – Minor**		
	10% 175 lbs.		less than 5% 50 lbs.	
PUTR2	bitterbrush	CHVI8	rabbitbrush	
ARTRW8	Wyoming sagebrush	ERNA10	rubber rabbit brush	
ARTR2	basin big sagebrush	RIBES	currant	
		ROSA5	rose	
		ARTR4	three-tip sage	
		SYAL	snowberry	
Dominant Mid-Size Bunchgrasses		**Other Mid-Size Bunchgrasses – Minor**		
	70% 1150 lbs.		5% 100 lbs.	
PSSP6	bluebunch wheatgrass	ELEL5	bottlebrush squirreltail	
FEID	Idaho fescue	ACTH7	Thurber needlegrass	
		HECO26	needle-and-thread	
		POCU3	Cusick's bluegrass	
		KOMA	prairie junegrass	
Short Grass – Minor		**Grass-Like – Trace**		
	less than 5% 50 lbs.			
POSE	Sandberg bluegrass	CAFI	threadleaf sedge	Trace
Native Forbs – Minor				
			10% 175 lbs.	
BASA3	arrowleaf balsamroot	MINU	microseris	
LUPIN	lupine	CALOC	Mariposa lily	
CREPI	hawksbeard	PHLO2	longleaf phlox	
ERIGE2	fleabane	LOMAT	lomatium / biscuitroot	
ERIOG	buckwheat	ASTRA	milkvetch / locoweed	
CASTI2	paintbrush	ANDI2	low pussytoes	
LIPU11	granite prickly phlox	COLLO	collomia	
ACMI2	yarrow	LIRU4	stoneseed	
PLPA2	woolly plantain			

Estimated Production (pounds / acre)	Below	Normal	Above
	1100	1300	1600

Idaho fescue-bluebunch wheatgrass – bitterbrush 70% Idaho fescue/bluebunch wheatgrass 10% antelope bitterbrush 10% native forbs

Community 1.2
Bunchgrass Community

Bunchgrass Idaho fescue-bluebunch wheatgrass. 90% Idaho fescue/bluebunch wheatgrass 0-2% antelope bitterbrush

Community 1.3
Shrub Steppe Community

Bitterbrush – Idaho fescue-bluebunch wheatgrass 50% Idaho fescue/bluebunch wheatgrass 30% antelope bitterbrush 10% needle and thread

Community 1.4
Heavy Shrub Community

Bitterbrush – needle and thread Community 1.4, heavy shrub, is dominated by bitterbrush with needle and thread as co-dominate. There is not enough Idaho fescue or bluebunch remaining for community 1.4 to shift back to the other communities in the reference state. 50% antelope bitterbrush 30% needle and thread 10% Idaho fescue/bluebunch wheatgrass

Pathway 1.1a
Community 1.1 to 1.2

1.1a Result: Shift from reference community 1.1 to bunchgrass community 1.2. Shrub cover (bitterbrush and sagebrush) is all but eliminated, while Idaho fescue and bluebunch wheatgrass have a moderate increase in cover.

Primary Trigger: Moderate-severity fire Ecological process: fire is complete enough and hot enough to remove most of the shrubs. Fire is not hot enough to affect the soil conditions. The fire removes surface vegetation but has no impact on the crown of bunchgrasses. So, bunchgrasses and forbs return post-fire with good vigor. Idaho fescue expands via new seedlings while bluebunch wheatgrass expands via tillering. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures will need two growing seasons recovery prior to resuming grazing, or to be lightly grazed but only during dormant season the first two years post-fire. Beyond two years for the bunchgrasses to expand, moderate grazing intensity, and both critical period & growing season deferments must be implemented on burned pastures.

Pathway 1.1b
Community 1.1 to 1.3

1.1b Result: shift from reference community 1.1 to shrub steppe community. There is a moderate increase in bitterbrush while bunchgrasses have a moderate corresponding decrease. Primary Trigger: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to bluebunch wheatgrass and Idaho fescue. Ecological process: consistent defoliation pressure to native bunchgrasses results in poor vigor and shrinking crowns. The release of resources and niche space allow the shrubs to gain the competitive edge.

Pathway 1.2a
Community 1.2 to 1.1

1.2a Result: Shift from bunchgrass community 1.2 to reference community 1.1. There is a minor reduction of bluebunch wheatgrass cover and a minor increase of bitterbrush. Primary Trigger: over time with no fire bitterbrush and sagebrush will re-enter the community naturally. Ecological process: fires are often patchy so the seed source for shrubs is generally nearby. Also, rodents cache bitterbrush seeds which is important aspect to shrub regeneration. Soil disturbances enhance seed-soil contact and new shrub seedlings establish. After shrubs re-enter the community the shading reduces bunchgrass cover somewhat.

Pathway 1.3a
Community 1.3 to 1.1

1.3a Result: Shift from shrub steppe community 1.3 to reference community 1.1. There is a major decrease in bitterbrush cover and a major increase in the cover of bluegrasses. Primary Trigger: light to moderate-severity fire Ecological process: fire is patchy and dependent on temperature, wind, fuel load and fuel moisture. Some areas burn completely while other areas are unburned to lightly burned. Fire is not hot enough to affect the soil conditions. The reduction in bitterbrush releases resources and increases light for grasses and forbs. Fire removes surface vegetation but has no impact on the root crown of bunchgrasses. So, bunchgrasses and forbs return post-fire. Idaho fescue expand via new seedlings while bluebunch wheatgrass expands via tillering. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures will need two growing seasons recovery prior to resuming grazing, or to be lightly grazed but only during dormant season the first two years post-fire. Beyond two years, for the bunchgrasses to continue to expand, the grazing plan must consider moderate grazing intensity, and both critical period & growing season deferments.

Pathway 1.3b
Community 1.3 to 1.4

1.3b Result: Shift from shrub steppe community 1.3 to heavy sage community 1.4. Bitterbrush and needle and thread have a big increase in cover while Idaho fescue and bluebunch are reduced significantly. Invasive annual grasses have not invaded but Community 1.4 is most at risk and is the segue between Reference State and States 2 & 3. Pathway 1.3b is a continuation of the process that started with Pathway 1.1b. Primary Trigger: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to bluebunch wheatgrass and Idaho fescue. Ecological process: consistent defoliation pressure to native bunchgrasses results in poor vigor, shrinking crowns and plant mortality. Grazing animals selectively target and eliminate most of the remaining Idaho fescue and bluebunch wheatgrass plants from the community. As the bunchgrasses decline bitterbrush and needle and thread sew new seedlings and expands their cover to a position of dominance.

State 2

Shrub Steppe with Invasive Species

State 2 Narrative: State 2 represents the invasion by annual grasses and is the gradation between Reference State and State 3. State 2 is shrub steppe with the inclusion of invasive annual grasses such as cheatgrass. The loss of soil biological crusts and annual grass seed blowing onto the site annually contributes to the annual grass invasion. All the native functional, structural groups are still represented by one or more species. For communities 2.1, 2.2, and 2.3 the amount of cheatgrass is minor. Annual grasses are more prominent in community 1.4. Once a community has been invaded by cheatgrass the chance of going back to State 1 is small. This state can occur with or without bitterbrush. Community Phases for State 2: Same four communities as Reference State Dominate Species for State 2: Antelope bitterbrush, Idaho fescue and bluebunch wheatgrass Pathways within State 2 The pathways in State 2 are basically the same as in the reference State. Community 2.4 is most at risk of transitioning to State 3.

Community 2.1
Reference Community

1% annual grasses

Community 2.2
Bunchgrass Community

1% annual grasses

Community 2.3
Shrub Steppe Community

5% annual grasses

Community 2.4
Heavy Shrub Community

20% annual grasses

State 3
Annual Grasses

State 3 Narrative: State 3 is dominated by invasive annual species and has crossed a biological threshold. Virtually all the native functional, structural groups are missing. This state can occur with or without sagebrush. Other important species can include annual bromes, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed. Community Phases for State 3: 3.1 Shrub – Annual Grass Bitterbrush – Cheatgrass 3.2 Annual Grass Cheatgrass Dominate Species for State 3: Cheatgrass or other annual grass with bitterbrush

Community 3.1
Shrub Annual Grass

Bitterbrush – Cheatgrass 50% shrub 40% annual grasses

Community 3.2
Annual Grass Community

Cheatgrass 90% annual grasses

Pathway 3.1a
Community 3.1 to 3.2

3.1a Result: shift from shrub-cheatgrass community to cheatgrass community Primary Trigger: Moderate intensity fire Ecological Process: fire kills bitterbrush and other shrubs. Cheatgrass and other invasive species expand to fully

occupy the site.

State 4
Seeded Grasses

State 4 Narrative: State 4 represents a site that has been seeded to desirable grasses such as Snake River wheatgrass, Sherman big bluegrass, or intermediate wheatgrass. State 4 has two community phases that are stable if they maintain 0.8 plant per square foot or greater of the desired bunchgrasses. Community 4.1 is dominated by the desirable seeded species. State 4 has two community phases: Seeded grass phase and shrub – seeded grass phase. Community 4.2 is a shrub-grass community. Community Phases for State 4: 4.1 Seeded grasses 4.2 Shrub – Seeded Grasses Dominant Species for State 4: Desirable seeded grasses and legumes.

Community 4.1
Seeded Grass

85% seeded

Community 4.2
Shrub Grass

50% shrub 40% seeded

Pathway 4.1a
Community 4.1 to 4.2

4.1a Result: Shift from seeded grass to shrub-grass community. Shrubs colonize the site and increase cover and density while seeded grasses decline Primary Trigger: grazing pressure (heavy grazing intensity, season long grazing and frequent late spring grazing). to seeded grasses. Ecological Process: consistent defoliation pressure to seeded grasses results in poor vigor, shrinking crowns and plant mortality. This allows shrubs to establish new seedlings and enter the community.

Pathway 4.2a
Community 4.2 to 4.1

4.2a Result: Shift from shrub-grass to seeded grass community. Shrubs are decreased to all but eliminated and grasses increase to dominate the community. Primary Trigger: (1) For communities with fire sensitive shrubs (sagebrush, bitterbrush) and a good population of desirable grasses, the best course of action is to reduce the shrubs by fire, chemical or mechanical treatment, and to use proper grazing management to ensure grasses recover. (2) For communities with fire tolerant shrubs (rabbitbrush, three-tip sage) and a good population of desirable grasses, the best course of action is to reduce the shrubs by chemical treatment and to use proper grazing management to ensure grasses recover. (3) Communities that do not have much seeded grass remaining will require a seedbed to be prepared and a seeding operation. Seedbed preparation can use a combination of fire, mechanical tillage and chemical application. Post-seeding the site will need 1-2 years of rest while the seeded grasses are established. Broadleaf weed control may also be necessary. Afterward, proper grazing must be used to maintain the stand.

Transition T1a
State 1 to 2

T1a Result: Transition from Reference State with no invasive species to State 2 with a few invasive annual grasses. Primary trigger: Soil disturbances from rodent or badger activity provide great opportunity for invasive annual species. Fire, drought and grazing pressure can also create holes in the plant community. Ecological process: Annual grass seeds blow onto the site awaiting an opportunity to colonize. Loss of soil biological crusts also contributes. Indicators: A few annual grasses have colonized the site.

Transition T2a

State 2 to 3

T2a Result: Transition from State 2 with a few annuals to State 3 which is dominated by annual grasses. This transition occurs once the cover of bunchgrasses (Idaho fescue and bluebunch wheatgrass) declines to less than 10% and invasive species cover is greater than 40%. Primary trigger: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to Idaho fescue and bluebunch wheatgrass. A second primary trigger would be a severe fire which can eliminate virtually every Idaho fescue plant from the community. This void is quickly filled by the annual grasses. Ecological process: consistent defoliation to bluebunch wheatgrass and Idaho fescue results in poor vigor, shrinking crowns and plant mortality. Initially both needle and thread and the annual grasses increase. As the grazing pressure continues, needle and thread will decrease allowing the annual grasses to become dominate. Indicators: Significant decline in cover of the dominant reference state species – Idaho fescue, bluebunch wheatgrass, bitterbrush. Increasing cover of annual grasses. Increasing gaps between bunchgrass crowns (Idaho fescue & bluebunch).

Restoration pathway R3a
State 3 to 2

R3a Result: Shift from State 3 invasive species back to State 2 with native species. 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.

Restoration pathway R3b
State 3 to 4

R3b Result: Shift from State 3 dominated by annual grasses to State 4 seeded grasses. This restoration transition is not likely to occur without significant time and inputs for weed control, seedbed preparation, seeding operation and post-seeding management & weed control. Two years of weed control, 1-2 years of deferment post-seeding, and proper grazing management afterward. Shifting from State 3 to State 4: If the goal is to restore back to a native plant community, State 3 should 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 restore the soil's pore spaces, bulk density and soil microorganisms before the native species that used to survive in this ecological site can return. The site would also need several years of no significant fires and proper grazing management as well. See narrative for R1 transition above.

Restoration pathway R4a
State 4 to 2

R4a Result: Shifting from State 4 to State 2: This assumes that the shift from State 3 to State 4 has been successful. To make the switch from State 4 to state 2, all introduced grasses must be killed first. 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 sagebrush and 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. Shrubs and native forbs should not be planted until broadleaf weeds have been controlled.

Transition T4a
State 4 to 3

T4a 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: grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to the seeded grasses Ecological process: consistent defoliation pressure to seeded grasses results in poor vigor, shrinking crowns and plant mortality. Invasive annual grasses colonize the site, and as the pressure continues, expands to a position of dominance. Indicators: decreasing cover of seeded grasses and increasing cover of invasive species. 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

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Citations