Ecological site group R008XG226WA
Stony Foothills, south aspect, bitterbrush

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Key Characteristics

None specified

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Physiography

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

LRU – Common Resource Areas (CRA):
8.1 - Channeled Scablands
8.2 - Loess Islands
8.3 - Okanogan Drift Hills
8.4 - Moist Pleistocene Lake Basins
8.5 - Moist Yakima Folds
8.7 - Okanogan Valley

Site Concept Narrative:
Diagnostics:

Stony foothills, south aspect, bitterbrush is an upland shrub-steppe site occurring on south-facing slopes in the foothill areas below the lower tree-line of MLRA 6 (East Slope of Cascades).

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.

Fire sensitive, bitterbrush dominates the reference state overstory, while bluebunch wheatgrass is 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 current.

Bitterbrush areas in MLRA 8 are east of, or adjacent to, the Ponderosa pine forests including: Klickitat and Yakima counties, and then from central Kittitas County northward to the Canadian border

Principle Vegetative Drivers:

The coarse soils and aspect drive the vegetative expression of this site. Bitterbrush prefers well drained, coarse soils. The south slope is good for bluebunch wheatgrass but is unable to support 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

Stony foothills, south slope, bitterbrush receives more solar radiation and the soils dry out much more rapidly than adjacent ecological sites.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Stony foothills, south aspect, bitterbrush is commonly found on south-facing hillslopes, but not on neutral or north slopes.

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

Landscapes: Hills, valleys and plateaus
Landform: Sideslopes, terraces, outwash terraces

Elevation: Dominantly 700 to 4,000 feet
Central tendency: 1,000 to 3,000 feet

Slope: Total range: 0 to 90 percent
Central tendency: 2 to 30 percent
Aspect: Occurs on all aspects except northerly slopes

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

Bitterbrush areas tend to be both cooler and wetter than Wyoming sagebrush areas (Daubenmire). Stony foothills, south aspect, bitterbrush, doesn’t favor Idaho fescue, has a warmer micro-climate than the northern facing Stony foothills, bitterbrush. The climate is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to the rain shadow effect of the Cascades. Taxonomic soil climate is either xeric (12 – 16 inches PPT) or aridic moisture regimes (10 – 12 inches PPT) with a mesic temperature regime.

Mean Annual Precipitation:
Range: 10 – 16 inches
Seventy to seventy-five percent of the precipitation comes late October through March as a mixture of rain and snow. June through early October is mostly dry.

Mean Annual Air Temperature:

Range: 45 to 52 F
Central Tendency: 47 – 50 F
Freezing temperatures generally occur from late-October through early-April. Temperature extremes are 0 degrees in winter and 110 degrees in summer. Winter fog is variable and often quite localized, as the fog settles on some areas but not others.

Frost-free Period (days):
Total range: 110 to 190
Central tendency: 120 to 160
The growing season for Stony foothills, south aspect, bitterbrush is March through mid-July.

Soil features

Edaphic:

The Stony foothills, south aspect, bitterbrush ecological site occurs with Stony foothills bitterbrush, Cool Loamy, Stony, and Loamy ecological sites.

Representative Soil Features:

This ecological site components are dominantly Aridic, Xeric and Vitrandic taxonomic subgroups of Haploxerolls, Argixerolls, Torripsamments great groups of the Mollisols and Entisols taxonomic orders. Soils are deep to very deep. Average available water capacity of about 4.5 inches (11.4 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly mixed loess, colluvium and residuum with influence of volcanic ash possible.

The associated soils are Antilon, Cashmont, Conconully, Ewall, Pogue, Quincy and similar soils.

Dominate soil surface is loam to loamy sand, with ashy modifier sometimes occurring as well.

Dominant particle-size class is ashy to sandy skeletal.

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

Fragments within surface horizon > 3 inches (% Volume):
Minimum: 0
Maximum: 30
Average: 5

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 30
Average: 15

Subsurface fragments > 3 inches (% Volume):
Minimum: 0
Maximum: 25
Average: 15

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

Drainage Class: Dominantly 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: High to moderately high
10 to 40 inches: High to moderately high

Depth to root-restricting feature (inches):
Minimum: 40
Maximum: Greater than 60 inches

Electrical Conductivity (dS/m):
Minimum: 0
Maximum: 5

Sodium Absorption Ratio:
Minimum: 0
Maximum: 5

Calcium Carbonate Equivalent (percent):
Minimum: 0
Maximum: 25

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: 1.0
Maximum: 9.7
Average: 5.5

Vegetation dynamics

Ecological Dynamics:

Stony foothills, south aspect, bitterbrush produces about 900-1300 pounds/acre of biomass annually.

Antelope bitterbrush and bluebunch wheatgrass are the primary dominant species on the Stony Foothills South Slope 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.

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

spread of exotic weeds.

Needle and thread is another perennial bunchgrass commonly associated with the Stony Foothills South Slope. Stems are erect, unbranched and about 4 feet in height. Needle and thread produces one seed per set of glumes in a narrow panicle. The seeds have a 4 to 5-inch long twisted awns. With wetting and drying the 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 grass, bluebunch wheatgrass, needle and thread increases.

The stability and resiliency of the reference communities is directly linked to the health and vigor of bluebunch wheatgrass. Research has found that the community remains resistant to medusahead if the site maintains at least 0.8 mid-sized bunchgrass plant/sq. ft. (Davies). Bluebunch wheatgrass holds the system together. If bluebunch wheatgrass is lost from the ecological site/community, the ecosystem begins to unravel.

The effect of fire on the main species is mixed for the Stony Foothills South Slope site. Bitterbrush is very susceptible to fire kill and is considered a weak sprouter. Needle and thread and bluebunch wheatgrass are fire tolerant in most instances. Bluebunch wheatgrass and needle and thread keep the site resistant to change, while bitterbrush makes the site more at risk.

How one answers fire return intervals for bitterbrush communities depends on the frame of reference used. Currently conditions for Stony Foothills are communities often dominated by dense canopies of bitterbrush. 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.

A low intensity, high frequency fire regime favors quick recovery with bitterbrush sprouting and rapid tillering by bluebunch wheatgrass. A high intensity, low frequency fire regime hinders recovery as bluebunch wheatgrass is set back and bitterbrush regeneration is 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 is 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 in this ecological site. Grazing pressure can be defined as heavy grazing intensity, or frequent grazing during reproductive period, or season-long grazing (same plants grazed more than once). As grazing pressure increases the plant community unravels in stages:
1. Bluebunch wheatgrass declines while Sandberg bluegrass, needle and thread and sagebrush increase
2. As bluebunch wheatgrass continues to decline, invasive species such as cheatgrass and knapweed colonize the site

3. With further decline the site can become a sagebrush-cheatgrass 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. Bluebunch wheatgrass plants rely principally on tillering, rather than establishment of new plants through natural reseeding. During seed formation, the growing points 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 (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.

Bluebunch wheatgrass 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

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 South Aspect bitterbrush is associated with Stony Foothills, Loamy and Stony in MLRA 8, and Stony Foothills South Aspect in MLRA 6 East Slope of the Cascades ecological sites.

Similar Sites:
MLRA 8 Columbia Plateau Stony Foothills, MLRA 6 East Slope of the Cascades Stony Foothills South Aspect, and Stony Foothills in MLRA 9 Palouse Prairie are also bitterbrush 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 008X
Columbia Plateau

Subclasses

- R008XY226WA–Stony Foothills South Aspect bitterbrush

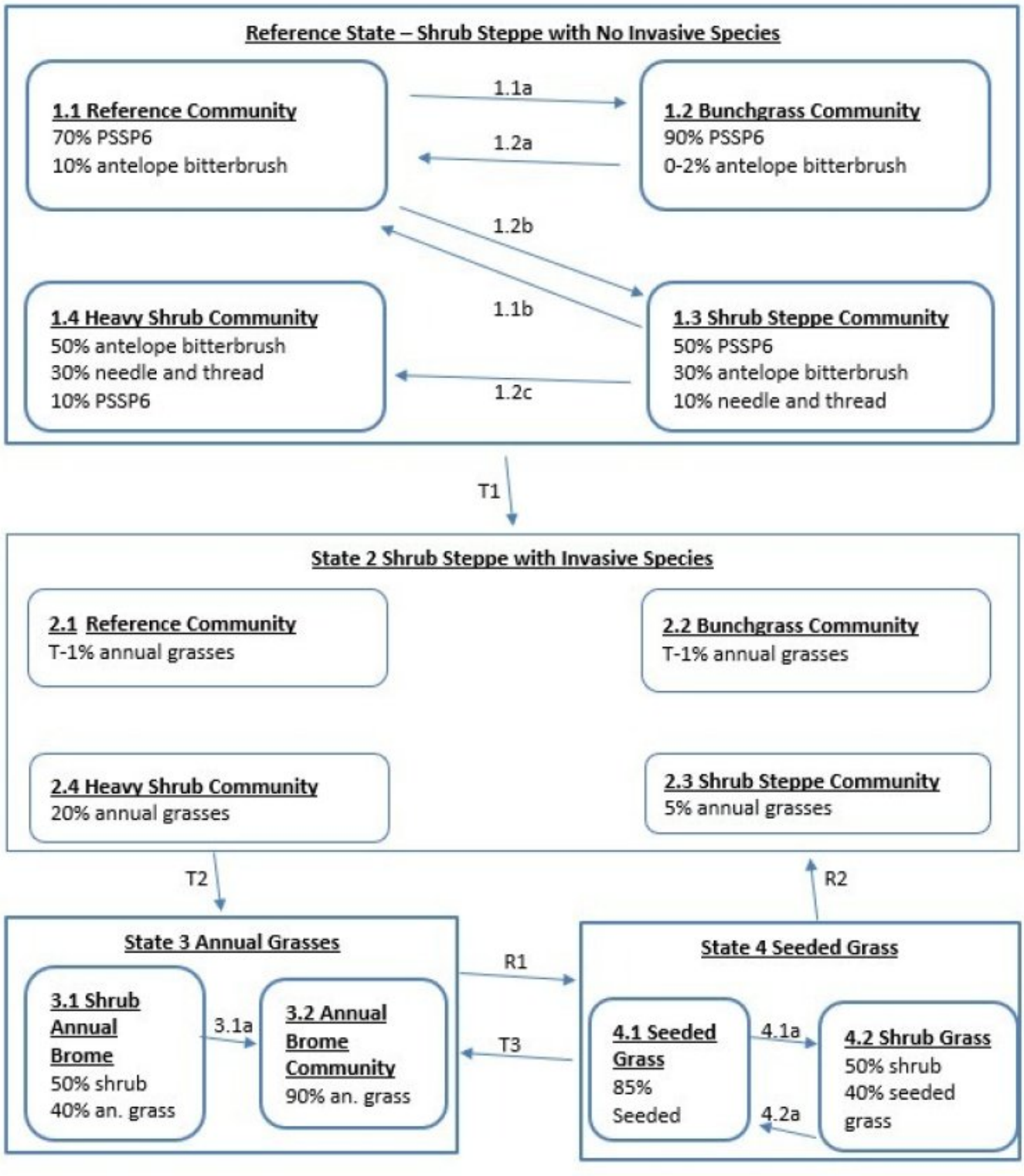
Stage

Provisional

Contributors

Provisional Site Author: Kevin Guinn
Technical Team: K. Moseley, G. Fults, R. Fleenor, W. Keller, C. Smith, K. Bomberger, C. Gaines, K. Paup-Lefferts

State and transition model



Reference Community 1.1 for Stony Foothills, south aspect, bitterbrush in MLRA 8

Percentages for plant species composition below are by weight and are an approximation. The composition of pristine sites can vary somewhat due to variations in site conditions.

Pounds listed below are the maximum allowable for Similarity Index. Many numbers have been rounded to not show more precision than our current state of knowledge.

	Similarity Index		Similarity Index
Non-Sprouting Shrubs – Subdominant (3-7% canopy)	10% 130 lbs.	**Sprouting Shrubs - Minor**	less than 5% 50 lbs.
PUTR2 bitterbrush ARTRW Wyoming sagebrush ARTRT basin big sagebrush		CHRYS rabbitbrush RIBES currant ROSA5 rose ARTR4 three-tip sage	
Dominant Mid-Size Bunchgrass	70% 925 lbs.	**Other Mid-Size Bunchgrasses – Minor**	less than 5% 50 lbs.
PSSP6 bluebunch wheatgrass		ELEL5 bottlebrush squirreltail ACTH7 Thurber needlegrass HECOC needle and thread	
Short Grass – Minor	less than 5% 50 lbs.	**Grass Like – Trace-Minor**	
POSE Sandberg bluegrass		CAFI threadleaf sedge	Trace
Native Forbs – Minor			10% 130 lbs.
BASA3 arrowleaf balsamroot LUPIN lupine CREPI hawksbeard ERIGE2 fleabane ERIOG buckwheat CASTI2 paintbrush LIPU11 granite gilia COLLO collomia PLPA2 woolly plantain		MICRO6 microseris CALOC Mariposa lily PHLO2 longleaf phlox LOMAT lomatium / biscuitroot ASTRA milkvetch / locoweed ANDI2 low pussytoes PHHO spiny phlox LIRU stoneseed ACMI2 yarrow	

	Below	Normal	Above
Estimated Production (pounds / acre)	900	1100	1300

State 1
Reference State - Shrub Steppe with No Invasive Species

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 Bluebunch wheatgrass – bitterbrush 1.2 Bunchgrass Bluebunch wheatgrass 1.3 Shrub Steppe Bitterbrush – 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. Dominate Reference State Species: Antelope bitterbrush – bluebunch wheatgrass At-risk Communities: • All communities in the reference state are at risk of moving to State 2. The seed source of cheatgrass is nearby and blowing onto most sites annually • Community Phases 1.1, 1.2 and 1.3 have high amounts of bluebunch wheatgrass cover and are at low risk of moving to State 3 • Community Phase 1.4 is at-risk because of low density for bluebunch wheatgrass. Community 1.4 should be seeded after fire • Any community with more than 40% bitterbrush 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 bluebunch wheatgrass, and any site with moderate to heavy cover of cheatgrass should be seeded after fire

Community 1.1
Reference

Community 1.2
Bunchgrass

Community 1.3
Shrub Steppe

Community 1.4
Heavy Shrub

Community 1.4, heavy shrub, is dominated by bitterbrush with needleandthread as sub-dominate. There is not enough bluebunch wheatgrass remaining for community 1.4 to shift back to the other communities in the reference state.

Pathway 1.1a
Community 1.1 to 1.2

1.1a Result: Shift from reference community to bunchgrass community. Shrub cover (bitterbrush and sagebrush) is all but eliminated, while bluebunch wheatgrass has a moderate increase in cover. The community shifts from a shrub steppe to a bunchgrass appearance. Causes: Moderate-severity 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. 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. Ecological process: Fire kills sagebrush and it does not have any sprouting ability. A few sagebrush plants remain, but only in patches that did not burn. The reduction in sagebrush releases resources and increases light for grasses and forbs. Bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings.

Pathway 1.2b
Community 1.1 to 1.3

1.2b Result: shift from bunchgrass or reference community to shrub steppe community. There is a moderate increase in bitterbrush while bunchgrasses have a moderate corresponding decrease. Causes: With excessive grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) and a period of no fire, bitterbrush and sagebrush increase its cover while bluebunch wheatgrass suffers a big decline. The increased shade and grazing pressure cause lower bunchgrass vigor and a decline. Ecological process: With consistent defoliation pressure plant vigor decreases to such a degree that grass roots begin to die. So, bluebunch wheatgrass experiences shrinking crowns and some plant mortality. The open niche space allows bitterbrush and sagebrush to set new seedlings and expand. Needleandthread, a prolific seeder, expands with many seedlings.

Pathway 1.2a
Community 1.2 to 1.1

1.2a Result: Shift from bunchgrass community to reference community. There is a minor reduction of bluebunch wheatgrass cover and a minor increase of bitterbrush. Causes: Over time with no fire bitterbrush and sagebrush will re-enter the community. With a slight increase in shade and some grazing pressure, perennial bunchgrasses experience a slight decline. Ecological process: With some consistent defoliation pressure Idaho fescue and bluebunch wheatgrass have lower vigor and shrinking crowns. Bitterbrush and sagebrush set new seedlings and expand. Rodents cache bitterbrush seed in the soil. Post-fire some of this cached seed will germinate. Also, spots with soil disturbance receive sagebrush seed from remnant plants in unburned patches or from adjacent sites, seed

germinates in the spring and a few sagebrush seedlings establish.

Pathway 1.1b
Community 1.3 to 1.1

1.1b Result: Shift from shrub steppe community to reference community or to bunchgrass community. Shrub cover is reduced by two-thirds which is coupled with a significant increase in the cover of native bunchgrasses. Causes: Moderate-severity 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. Fire removes surface vegetation but has no impact on the root crown of bunchgrasses. So, bunchgrasses and forbs return post-fire. 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. Ecological process: Bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings. The reduction in bitterbrush releases resources and increases light for grasses and forbs. Bunchgrasses must have high vigor both pre- and post-fire, to expand its cover.

Pathway 1.2c
Community 1.3 to 1.4

1.2c Result: Shift from shrub steppe community to heavy shrub community. Bitterbrush and needleandthread have a big increase in cover while bluebunch wheatgrass is 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. Causes: With no fire, more shade and grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing), the bunchgrasses experience weakened vigor and declining crowns. Grazing animals selectively target and eliminate most of the remaining bluebunch wheatgrass plants from the community. Bitterbrush and needleandthread both expand. Ecological process: With consistent defoliation pressure plant vigor decreases to such a degree that grass roots die. Bluebunch wheatgrass experiences shrinking crowns and a lot of plant mortality. Bitterbrush and needleandthread, however, set new seedlings and expand. The open niche space gives bitterbrush and sagebrush opportunity to set new seedlings. Needleandthread, a prolific seeder, expands with many seedlings.

State 2
Shrub Steppe with Invasive Species

State 2 Narrative: State 2 represents 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 if 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. This state can occur with or without bitterbrush. For communities 2.1, 2.2, and 2.3 the amount of cheatgrass is minor. Cheatgrass is more prominent in community 2.4. 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 for Reference State. Dominate State 2 Species: Bitterbrush, bluebunch wheatgrass Pathways within State 2: Same as for Reference State

Community 2.1
Reference

Community Phases for State 2: Same four communities as for Reference State. Dominate State 2 Species: Bitterbrush, bluebunch wheatgrass

Community 2.2
Bunchgrass

Community 2.3
Shrub Steppe

Community 2.4
Heavy Shrub

State 3
Annual Grasses

State 3 Narrative: State 3 represents communities 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 shrubs. Important species can include cheatgrass, Japanese brome, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed. Community Phases for State 3: 3.1 Shrub – Annual Grass Bitterbrush – Annual bromes 3.2 Annual Grass Annual bromes Dominate State 3 Species: Annual grasses such as cheatgrass, with or without shrubs The main species can include Japanese brome, medusahead, ventenata, mustard, prickly lettuce and diffuse knapweed. This state can occur with or without shrubs.

Community 3.1
Shrub Annual Grass

Community 3.2
Annuals Grass

Pathway 3.1a
Community 3.1 to 3.2

3.1a Result: shift from shrub-annual brome community to annual brome community Causes: Moderate intensity fire kills most or all sagebrush. Annual bromes and other invasive species 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 Secar Snake River wheatgrass, Sherman big bluegrass, crested wheatgrass or intermediate wheatgrass. The communities in State 4 are stable as long as they maintain 0.8 plant / sq. ft. or greater of the desired grasses Dominate Species for State 4: Desirable seeded grass species with or without shrubs and legumes Community Phases for State 4: 4.1 Seeded Grass 4.2 Shrub – Seeded Grass

Community 4.1
Seeded Grasses

State 4 Narrative: State 4 represents a site that has been seeded to desirable grasses such as Secar Snake River wheatgrass, Sherman big bluegrass, crested wheatgrass or intermediate wheatgrass. The communities in State 4 are stable as long as they maintain 0.8 plant / sq. ft. or greater of the desired grasses Dominate Species for State 4: Desirable seeded grass species with or without shrubs and legumes Community Phases for State 4: 4.1 Seeded Grass 4.2 Shrub – Seeded Grass

Community 4.2
Shrub Grass

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 Causes: Excessive grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) on seeded grasses reduce plant vigor. Grass root crowns shrink in size and some grasses die allowing shrubs to re-enter the site. Ecological Process: With consistent defoliation pressures seeded grasses experiences poor plant vigor to such a degree that grass roots begin to die. So, the seeded grasses experience shrinking crowns and some mortality. This gives shrubs the opportunity to set new seedlings and expand its cover. Increased shade from the new sagebrush plants also plays a role in this process.

Pathway 4.2a
Community 4.2 to 4.1

4.2a Result: Shift from shrub-grass to seeded grass community. The shrub layer is decreased to all but eliminated and grasses increase to dominate the community. Causes: (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 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 T1
State 1 to 2

T1 Result: shift from Reference State to State 2 with a few annual grasses. Ecological process: annual grass seeds blow onto the site awaiting an opportunity to colonize. Loss of soil biological crusts also contributes to the invasion be annual grasses. Primary trigger: soil disturbances from rodent or badger activity provide great opportunity for invasive annual species. Fire, drought and grazing pressure can create holes in the plant community. Indicators: A few annual grasses have colonized the site.

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 bluebunch wheatgrass declines to less than 10% and invasive species cover is greater than 40%. Primary trigger: Grazing pressure (heavy grazing, season long grazing or frequent late spring grazing) causes low vigor and reduced cover of bluebunch wheatgrass. Initially both needleandthread and the annual grasses increase. As the grazing pressure continues, needleandthread will also decrease. Secondary trigger: repeated fire which is not a common occurrence in MLRA 8. Ecological process: With consistent defoliation pressures bluebunch wheatgrass and needleandthread experience poor plant vigor to such a degree that grass roots begin to die. So, bunchgrasses have shrinking crowns and some mortality. This gives invasive annual grasses opportunity to expand its cover to a position of dominance. Indicators: Significant decline in vigor and cover of one or more of the dominant reference state species – bluebunch wheatgrass, bitterbrush. Increasing cover of annual grasses. Increasing canopy gaps between bluebunch wheatgrass plants.

Restoration pathway R1
State 3 to 4

Equipment limitations from surface rock and rock in the profile will cause issues and some treatment options may not be feasible on some sites. R1 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.

Restoration pathway R2
State 4 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 of 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. Introduced grasses must be killed before seeding native species. 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 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: 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 weakened vigor and less cover of the seeded grasses. Invasive annual grasses colonize the site and become more and more common with the loss of each bunchgrass. Ecological process: consistent defoliation pressure causes weakened vigor, roots dying and less cover for the seeded grasses. Invasive annual grasses colonize the site and become more and more common with the loss of each bunchgrass plant. Indicators: shrinking crowns and mortality of desirable species, increasing caps gaps between seeded plants, 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, LANDFIRE project, 2008 Rocchio, Joseph & Crawford, Rex C., Ecological Systems of Washington State. A Guide to Identification. Washington State Department of Natural Resources, October 2015. Pages 156-161 Inter-Mountain Basin Big Sagebrush. Rouse, Gerald, MLRA 8 Ecological Sites as referenced from Natural Resources Conservation Service-Washington FOTG, 2004 Soil Conservation Service, Range Sites for MLRA 8 from 1980s and 1990s Tart, D., Kelley, P., and Schlafly, P., Rangeland Vegetation of the Yakima Indian reservation, August 1987, YIN Soil and Vegetation Survey

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