Ecological site group R008XG930WA
Loamy Bottom

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Key Characteristics

None specified

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

Physiography

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

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

Site Concept Narrative:

In the upland setting ecological sites are often expansive, and thus, can be delineated and separated on aerial photos. But in the landscape position of bottoms, basins and depressions this is rarely the case as small changes in soil chemistry, the water table and elevation or aspect results in significant changes in plant community composition. In short distances there are often big swings of available water holding capacity, and soils can go from hydric to non-hydric, or from saline-sodic to not. So, in bottoms, riparian areas and depressions, ecological sites and community phases occur as small spots, strips and patches, or as narrow rings around vernal ponds. And generally, in a matter of steps one can walk across several ecological sites. On any given site location, two or more of these sites occur as a patchwork – Loamy Bottom, Alkali Terrace, Sodic Flat, Wet Meadow, Herbaceous Wetland and Riparian Woodland. These ecological sites may need to be mapped as a complex when doing resource inventory.

Diagnostics:

The first thing that strikes you about Loamy Bottom – the vegetation is much taller, and vastly more productive than any upland site. The tall, upright bunchgrasses and shrubs can be taller than 6 feet. Another striking feature of loamy bottom is that it provides excellent protection from wind for livestock and wildlife, and provides good habitat (hiding cover, nesting cover, standing winter forage).

Loamy Bottom is part of the lentic (standing water) ecosystem, but this site is not a wetland, nor or the soils hydric. It occurs on moisture receiving sites such as bottoms, draws, basins and depressions. This site also occurs as a narrow zonal ring around ponds, lakes and vernal pools. Loamy bottom is an important “hinge site” as it connects upland sites with riparian areas, wetlands and saline-sodic sites.

Soils are deep and unrestricted for plant growth. The soils are silt loam or sandy loam texture and are not saline or sodic, and not hydric. In addition, the landscape position of this site could be conducive to soils possibly containing andic soil properties, i.e. volcanic ash. These andic soil properties can be important for productivity in that they retain larger amounts of water compared to other parent materials (higher water-holding capacity (AWC)), have high cation exchange capacity (CEC) and high availability of organically bound plant nutrients.

Within MLRA 8, Loamy Bottom has several variations with basin wildrye as the constant in all instances. Across most of the sagebrush steppe region, this site is a basin wildrye-basin or Wyoming big sagebrush site. In Douglas County and southern Okanogan County threetip sage is prevalent. But in the grassland regions the only shrub, rabbitbrush, is a minor component. The last variation is basin wildrye-rose. The variations are lumped into one ecological site because Loamy Bottom represents only a fraction of the landscape and basin wildrye is dominant in every variation. Also, use, management and production is similar across all variations.

While tall bunchgrasses and tall, fire-sensitive shrubs dominate the reference state overstory, mid-sized bunchgrasses and forbs fill the interspaces. The overstory layer is basin wildrye with head-high or taller Basin big or Wyoming big sagebrush. Cool-season bunchgrasses form one or two distinct understory layers. Bluebunch wheatgrass or Nelson’s needlegrass, if present, form the mid-grass layer, while Sandberg bluegrass is the shortest grass layer.

The natural fire regime maintains a patchy distribution of shrubs. Depending on the time interval since the last fire, the shrub canopy can be as little 0-3% or as much as 40%.

Principle Vegetative Drivers:

The vegetative expression of Loamy Bottom is driven by two situations. First, this site receives both surface runoff and discharging groundwater from adjacent upland ecological sites. Second, the soils are deep and unrestricted. This makes Loamy Bottom far more productive and any upland site.

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 run off-site or infiltrate into the soil
2. Whether soil condition remain aerobic or become saturated and anaerobic
3. How quickly the soil reaches the wilting point

Loamy Bottom receives both surface runoff and discharging groundwater from nearby upland sites. The soils are deep, well drained, and unrestricted, and thus, remain saturated for only a short period in late winter to early spring. With adequate cover of live plants and litter, there are no water infiltrating restrictions on Loamy Bottom.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Loamy bottom sites commonly occur on non-wetland bottoms, draws, basins, & depressions and often loamy bottom is one of the narrow bands around ponds, lakes, vernal pools, springs and seeps. So, in bottoms, riparian areas and depressions, ecological sites and community phases occur as small spots, strips and patches, or as narrow rings around vernal ponds. Generally, in a matter of steps one can walk across several ecological sites. On any given site location, two or more of these sites occur as a patchwork – Loamy Bottom, Alkali Terrace, Sodic Flat, Wet Meadow, Wetland Complex and Riparian Complex. These ecological sites may need to be mapped as a complex when doing resource inventory.

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

Landscapes: Hills, valleys and plateaus

Landform: Floodplains, drainageways and depressions

Elevation: Dominantly 500 to 3,000 feet
Slope: Total range: 0 to 30 percent
Central tendency: 0 to 5 percent
Aspect: Occurs on all aspects

Geology:

This MLRA is almost entirely underlain by Miocene basalt flows. Columbia River basalt is covered in many areas with as much as 200 feet of loess and volcanic ash. Small areas of sandstones, siltstones, and conglomerates of the Upper Tertiary Ellensburg Formation are along the western edge of this area. Some Quaternary glacial drift covers the northern edge of the basalt flows, and some Miocene-Pliocene continental sedimentary deposits occur south of the Columbia River, in Oregon.

A wide expanse of scablands in the eastern portion of this MLRA, in Washington, was deeply dissected about 16,000 years ago, when an ice dam that formed ancient glacial Lake Missoula was breached several times, creating catastrophic floods. The geology of the northernmost part of this MLRA is distinctly different from that of the rest of the area. Alluvium, glacial outwash, and glacial drift fill the valley floor of the Okanogan River and the side valleys of tributary streams. The fault parallel with the valley separates pre-Tertiary metamorphic rocks on the west, in the Cascades, from older, pre-Cretaceous metamorphic rocks on the east, in the Northern Rocky Mountains. Mesozoic and Paleozoic sedimentary rocks cover the metamorphic rocks for most of the length of the valley on the west.

Climate

The climate is characterized by moderately cold, wet winters, and hot, dry summers, with limited precipitation due to the rain shadow effect of the Cascades. Taxonomic soil climate is either xeric (12 – 16 inches PPT) or aridic moisture regimes (10 – 12 inches PPT) with a mesic temperature regime.

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

Mean Annual Air Temperature:
Range: 44 to 54 F
Central Tendency: 48 – 52 F
Freezing temperatures generally occur from late-October through early-April. Temperature extremes are 0 degrees in winter and 110 degrees in summer. Winter fog is variable and often quite localized, as the fog settles on some areas but not others.

Frost-free Period (days):
Total range: 90 to 200
Central tendency: 110 to 160
The growing season for loamy bottom is March through end of July.

Soil features

Edaphic:

The soils are deep, well drained, formed in loess, alluvium and unrestricted for plant growth. The soils are silt loam or sandy loam texture and are not saline or sodic, and not hydric. Loamy Bottom commonly occurs adjacent to Alkali Terrace, Sodic Flat, Wet Meadow Herbaceous Wetland and Riparian Woodland, ecological sites. It also occurs with upland sites such as Loamy, Stony, and Cool Loamy.

Representative Soil Features:

This ecological site components are dominantly Typic, Xeric, Torrifluventic and Pachic taxonomic subgroups of Haploxerolls, Endoaquolls and Argixerolls great groups of the Mollisols taxonomic order, with Aridisols occurring as well. Soils are dominantly deep or very deep but limited moderately deep occurs as well. Average available water capacity of about 5.0 inches (12.7 cm) in the 0 to 40 inches (0-100 cm) depth range.

Soil parent material is dominantly mixed alluvium and loess.

The associated soils are Benge, Brickmill, Cleman, Esquatzel, Hermiston, Kayak, Onyx, Weirman and similar soils.

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

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

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

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

Fragments within surface horizon ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 35
Average: 10

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

Subsurface fragments ≤ 3 inches (% Volume):
Minimum: 0
Maximum: 45
Average: 10

Drainage Class: Range from somewhat poorly drained to well drained.
Water table depth: 20 to greater than 60 inches

Flooding:
Frequency: None to occasional

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: 40
Maximum: greater than 60

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

Sodium Absorption Ratio:
Minimum: 0
Maximum: 5

Calcium Carbonate Equivalent (percent):
Minimum: 0
Maximum: 30

Soil Reaction (pH) (1:1 Water):
0 - 10 inches: 5.1 to 9
10 - 40 inches: 5.6 to 9

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

Vegetation dynamics

Ecological Dynamics:

Loamy Bottom produces about 4000 pounds/acre of biomass annually.

Loamy Bottom has several variations with basin wildrye as the constant:
1. Basin wildrye – sagebrush (basin, Wyoming)
2. Basin wildrye – three-tip sage (Douglas and Okanogan Co.)
3. Basin wildrye with no shrub in grassland areas in MLRA 8 (a little rabbitbrush)
4. Basin wildrye – rose

Regarding saline-alkali soils Daubenmire (page 50) wrote, “It seems impossible to find areas where one can be confident that the vegetation has not been somewhat altered by domesticated animals.” The same is also true of loamy bottoms, riparian areas and wetlands. Some areas were also manipulated by tillage or other farming practices.

Basin wildrye, also called Great Basin wildrye, is at the core of the Loamy Bottom ecological site and warrants a degree of understanding. Basin wildrye is a cool season bunchgrass but is considered weakly rhizomatous. It has coarse, robust stems and leaves, grows to 5 to 7 feet tall and sometimes exceeds 3 feet in diameter, and thus, is one of the highest producing species. Basin wildrye is commonly found on loamy bottoms, mildly to moderately saline-sodic soils and on the tops of loamy mounds. It tolerates alkaline soils and seasonal flooding but not anaerobic conditions. On a good Loamy Bottom site, basin wildrye, given good plant vigor, can take ownership even with invasive species in the community.

The stability and resiliency of the reference communities on Loamy Bottom sites is directly linked to the health and vigor of basin wildrye. Given the opportunity (good vigor and favorable moisture), basin wildrye can establish ownership and expand across the Loamy Bottom ecological site. Basin wildrye expands via two processes: (1) Tillering from basal buds for new shoots, and (2) new seedlings from germinating seed.

The natural disturbance regime for sagebrush-bunchgrass communities is periodic lightning-caused fires. The fire return intervals (FRI) listed in research for sagebrush steppe communities is quite variable. Ponderosa pine communities have the shortest FRI of about 10-20 years (Miller). The FRI increases as one moves to wetter forested sites or to drier shrub steppe communities. Given the uncertainties and opinions of reviewers, a mean of 75 years and a range of 50-100 was chosen for Wyoming sagebrush communities (Rapid Assessment Model). The FRI for Loamy Bottom is the same as upland sites.

Some fires are spotty or do not burn hot enough to fully remove the sagebrush. Fires with light severity will remove less sagebrush and open smaller patches for grass and forb recovery, whereas the more severe fires will remove almost all the sagebrush and leave vast areas open to return to bunchgrass dominance. This is how the patchy

distribution occurs. Rabbitbrush is a sprouting shrub and may also increase following fire.

Because basin wildrye produces a large amount of biomass, fire can burn and smolder in the crown of the plant for considerable time. This leaves basin wildrye plants much diminished. It can take a few years for basin wildrye to fully recover from the effects of fire.

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. As grazing pressure increases the plant community unravels in stages:
1. More preferred grasses decline first and then basin wildrye plants produce fewer shoots and tillers and crowns become smaller.
2. As some basin wildrye plants die and other plants are weaker yet, native species such as sagebrush expands
3. As the decline continues invasive species such as knapweed, perennial pepperweed and cheatgrass colonize the site
4. With further decline the site can become a sagebrush-invasive weed community

Managing sagebrush steppe to improve the vigor and health of native bunchgrasses begins with an understanding of grass physiology. New growth for existing bunchgrasses begins each year from basal buds. Basin wildrye plants can expand via tillering, or new plants through natural reseeding. Regrowth from spring grazing comes mostly from photosynthesis.

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

During seed formation, the growing points of basin wildrye become elevated 4-6 inches and are vulnerable to damage or removal. Repeated grazing during late spring 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).

Basin wildrye 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

In Washington, basin wildrye-sagebrush communities provide habitat for a variety of upland wildlife species.

Supporting Information:

Associated Sites:
Loamy Bottom is associated with other ecological sites in bottoms and basin areas of MLRA 8, including Alkali Terrace, Sodic Flat, Wet Meadow, Wetland Complex and Riparian Complex. Loamy Bottom is also associated with upland sites such as Loamy, Stony, Very Shallow and Cool Loamy.

Similar Sites:
MLRAs 7 Columbia Basin and MLRA 9 Palouse Prairie have a similar Loamy Bottom ecological site.

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

- R008XY930WA–Loamy Bottom

Stage

Provisional

Contributors

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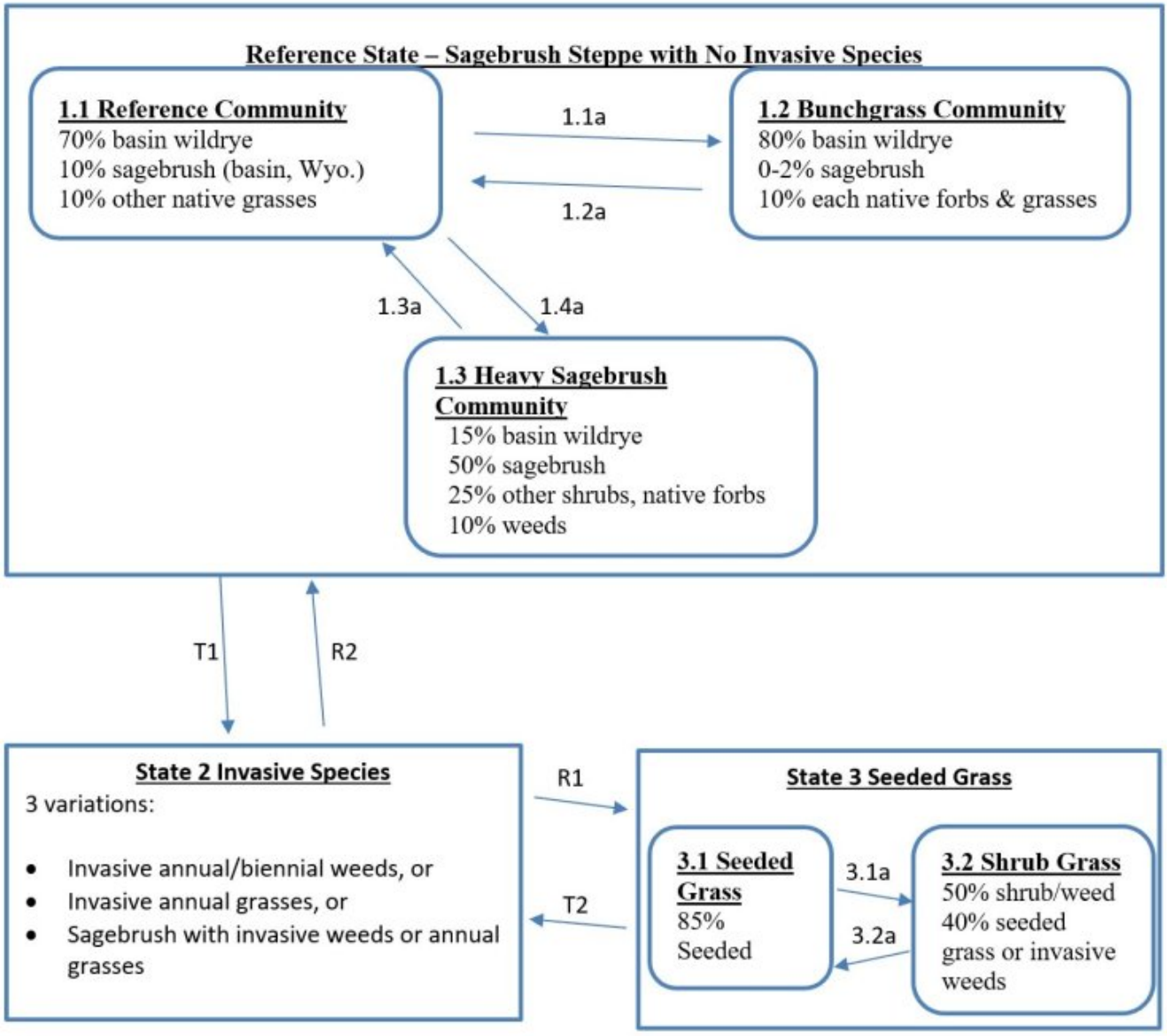
State and transition model

State and Transition Diagram for Loamy Bottom in MLRA 8:

This state and transition model (STM) explains the general ecological dynamics for the Loamy Bottom ecological site. The STM illustrates the common plant communities that can occur on the site. Boxes around each state represent the ecological threshold, which if crossed, is not reversible without human intervention. Arrows within a state represent the pathway between plant communities, while the arrows between states represent the transition or recovery between the states. Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions.



Reference Community 1.1 for Loamy Bottom in MLRA 8

Plant species composition is represented as a percentage of total annual production (pounds). The composition of pristine sites can vary somewhat due to variations in site conditions. Pounds listed below are the maximum allowable for Similarity Index. Many numbers have been rounded to not show more precision than our current state of knowledge.

	Similarity Index			Similarity Index
Non-Sprouting Shrub– Minor (3-7% canopy)	5-10% 500 lbs.		**Sprouting Shrubs – Minor**	<5% 150 lbs.
ARTRW8 Wyoming sagebrush			CHRYS rabbitbrush	
ARTRT basin big sagebrush			RIBES currant	
PUTR2 bitterbrush			ROSA5 rose	
			ARTR4 three-tip sage	
Dominant Tall Bunchgrass	70% 3500 lbs.		**Mid-Size Bunchgrasses – Minor**	10% 500 lbs.
LECI4 basin wildrye			ACTH7 Nelson's needlegrass	
			POCU3 Cusick's bluegrass	
			PSSP6 bluebunch wheatgrass	
			ELGL blue wildrye	
Short Grass	<5% 150 lbs.		**Grass Like – Trace**	
POSE Sandberg bluegrass			CAREX sedge	Trace
Native Forbs – Minor				10% 500 lbs.
BASA3 arrowleaf balsamroot			POGR9 slender cinquefoil	
LUPIN lupine			CALOC Mariposa lily	
CREPI hawksbeard			ERIGE2 erigeron, fleabane	
PHLO2 longleaf phlox			ASTRA milkvetch, locoweed	
PHHO spiny phlox			LOMAT lomatium, biscuitroot, desert parsley	
ERIOG buckwheat			CASTI2 paintbrush	
COLLO collomia, trumpet			LIRU4 stoneseed	
ACMI2 yarrow			PLPA2 woolly plantain	
ANDI2 low pussytoes			HYCA4 ballhead waterleaf	

	Below	Normal	Above
Estimated Production (pounds / acre)	3000	4000	5000

State 1
Reference State – Sagebrush Steppe with No Invasive Species

State 1 Narrative: State 1 represents sagebrush steppe with none to minor amounts of invasive or exotic weed species. All the functional, structural groups have one or more native species. Refer to the Ecological Dynamics section where the variations of Loamy Bottom are discussed. The Reference State discussion below is for basin wildrye – sagebrush, the largest of the variations. Reference State Community Phases: 1.1 Reference Basin wildrye – Basin &/or Wyoming sagebrush 1.2 Bunchgrass Basin wildrye 1.3 Heavy Sage Basin &/or Wyoming sagebrush – other shrubs Dominate Reference State Species: Basin wildrye, Basin &/or Wyoming big sagebrush At-risk Communities: • All communities in the reference state are at risk of invasion by exotic species. Annual or biennial weeds and annual grass seeds blow onto most sites annually • Community Phase 1.3, the heavy sagebrush community, has the highest risk of moving to State 2 which is dominated by invasive weeds or annual grasses • Any Loamy Bottom community with high sagebrush cover and low cover of basin wildrye will also have invasive weeds, and thus, no longer be in the Reference State • To seed or not to seed is the question after a fire. Community 1.3 should be seeded to basin wildrye to minimize weed infestation. Any site with low cover of basin

wildrye and any site with low to moderate cover of weeds should be seeded after a fire. State 2 and Community 3.2 should also be seeded

Community 1.1
Reference Plant Community: Basin wildrye – Basin &/or Wyoming sagebrush

Reference Community 1.1 is dominated by basin wildrye with some sagebrush.

Community 1.2
Bunchgrass: Basin wildrye

Community 1.2 is even more strongly bunchgrass dominated.

Community 1.3
Heavy Sage: Basin &/or Wyoming sagebrush – Basin Wildrye

Community 1.3 is dominated by sagebrush with basin wildrye as sub-dominate. Native forbs and other shrubs are prevalent and there are minor amounts of weeds (broadleaf or annual grasses). There is enough basin wildrye remaining for Community 1.3 to shift back to the other communities in the reference state as basin wildrye can be aggressive on favorable sites such as Loamy Bottom. On a good Loamy Bottom site basin wildrye can and will push out other herbaceous species.

Pathway P1.1a
Community 1.1 to 1.2

1.1a Result: Shift from reference community 1.1 to bunchgrass community 1.2. Sagebrush cover is all but eliminated, while basin wildrye has a moderate increase in cover. Primary Trigger: Moderate-severity fire consumes above-ground plant biomass and kills almost all the sagebrush. With a lot of biomass, the fire burns into the crowns of basin wildrye, but some of the crown remains intact. So, basin wildrye survives and increases its vigor the next few years. For other bunchgrasses and forbs there is no impact to their crowns and these species return post-fire with good vigor. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures need two growing seasons rest before grazing resumes or, the pastures can be lightly grazed during the 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. Secondary Trigger: Several years above of average precipitation. High seasonal water table kills most of the sagebrush, allowing basin wildrye to assert almost total cover dominance. This is a rare occurrence, but it did happen in the mid-1980s. 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. Basin wildrye, bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings.

Pathway P1.4a
Community 1.1 to 1.3

1.4a Result: shift from reference community 1.1 to heavy sagebrush community 1.3. Primary Trigger: With excessive grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) and a period of no fire, sagebrush increases its cover while basin wildrye, bluebunch wheatgrass and other bunchgrasses suffer a big decline. Ecological process: with consistent defoliation pressure basin wildrye and other bunchgrass have low vigor, shrinking crowns and some mortality. This gives sagebrush 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 P1.2a
Community 1.2 to 1.1

1.2a Result: Shift from bunchgrass community 1.2 to reference community 1.1. Primary Trigger: Soil disturbances coupled with a period of no fire. Secondary Trigger: Several years of average or below normal precipitation leading to a significant drop in the lateral water flow and drying out the soil profile, which leads to fine root die-off of basin

wildrye. Slight competitive advantage shifts to sagebrush. Good management is required to keep the basin wildrye loss to a minimum as sagebrush re-enters the community Ecological process: 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. For most locations it may take up to 10 years for sagebrush to re-enter the community. But in Douglas County the re-entry period may only be 2-5 years. With a slight increase in shade perennial bunchgrasses experience a slight decline.

Pathway P1.3a
Community 1.3 to 1.1

1.3a Result: Significant shift from heavy sagebrush community 1.3 to reference community 1.1. Primary Trigger: Moderate-severity fire consumes above-ground plant biomass and kills almost all the sagebrush. With a lot of biomass, the fire burns into the crowns of basin wildrye, but some of the crown remains intact. So, basin wildrye survives and increases its vigor the next few years. For bunchgrasses and forbs there is no impact to their crowns and these species return post-fire with good vigor. Post-fire the bunchgrasses are now more susceptible to grazing damage. Burned rangeland pastures need two growing seasons rest before grazing resumes or, the pastures can be lightly grazed during the 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. Secondary Trigger: Several years above of average precipitation. High seasonal water table kills most of the sagebrush, allowing basin wildrye to assert almost total cover dominance. This is a rare occurrence, but it did happen in the mid-1980s. 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. Basin wildrye can aggressively attains the competitive edge and reclaims niches vacated by sagebrush. Bluebunch wheatgrass and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings.

State 2
Invasive Species – Annual / Biennial Weeds or Annual Grasses

State 2 Narrative: State 2 represents invasive species communities that have crossed a biological threshold. Virtually all the native functional, structural groups are missing. This state can occur with or without sagebrush. Community Phases for State 2: Can have several variations: 1. Invasive annual or biennial weeds (mustard, prickly lettuce, perennial pepperweed) 1. Invasive annual grasses (annual bromes, medusahead) 2. Sagebrush w/ invasive weeds or annual grasses Dominate State 2 Species: Invasive weeds: mustard, prickly lettuce, perennial pepperweed, knapweeds Invasive annual grasses: annual bromes, cheatgrass, medusahead, ventenata Sagebrush, rabbitbrush

State 3
Seeded Grasses

State 3 Narrative: State 3 represents a site that has been seeded to desirable grasses such as basin wildrye or intermediate wheatgrass. Community 3.1 remains stable with 0.8 plant / sq. ft. or greater of mid-sized bunchgrasses or with a full stand of basin wildrye. Community Phases for State 3: 3.1 Seeded Grasses 3.2 Shrub / Invasive Weeds – Seeded Grasses

Community 3.1
Seeded Grasses

Community 3.2
Shrub / Invasive Weeds – Seeded Grasses

Pathway P3.1a
Community 3.1 to 3.2

3.1a Result: shift from seeded grass community 3.1 to shrub grass community 3.2 with a mixture of seeded grasses and shrubs &/or invasive weeds Primary Trigger: Grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) to seeded grasses Ecological process: Due to consistent defoliation pressure seeded

grass have low vigor, shrinking crowns and some mortality. This gives sagebrush 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 P3.2a
Community 3.2 to 3.1

3.2a Result: shift from shrub/weed dominated community 3.2 back to community 3.1 dominated by seeded grasses. Primary Trigger: Human intervention to kill shrubs, reduce invasive weed population and to re-seed or inter-seed desirable grass species. Ecological process: shrub and weed control open the site to allow successful seeding. Herbicide application, tillage and seeding operation must be timely. Seed placement should ensure seed-soil contact at 1/8”-1/4” depth. Post-seeding management should ensure that desirable grass seedlings become established and broadleaf weeds are controlled. After killing shrubs and weeds, and with a good population of remnant desirable grasses, it may be possible that the desirable grasses expand naturally without seeding.

Transition T1
State 1 to 2

T1 Result: Shift from Reference State (native shrub steppe with no invasive species) to State 2 which is dominated by invasive weeds or annual grasses. The pathway from State 1 to State 2 occurs as Community 1.3 declines until it crosses the biological threshold. This transition occurs once the cover of basin wildrye drops to 5% and invasive species cover is at least 40%. Primary Trigger: grazing pressure (heavy grazing, season-long grazing, or late spring grazing) to basin wildrye. Secondary Trigger: Frequent fires or one severe fire can have the same effect. Also, several years of drought can put the basin wildrye in decline. Ecological process: with consistent defoliation pressure basin wildrye and other bunchgrass have low vigor, shrinking crowns and mortality. Weed seeds from invasive species blow onto the site or are carried in with runoff water. On most sites weed seeds are waiting for an opportunity to colonize. As basin wildrye cover declines invasive species increase accordingly. Over time the invasive species expand to a position of dominance. Indicators: Decreasing cover of basin wildrye and increasing cover of invasive species. Increasing canopy gaps between native perennial species. Decreasing soil organic matter, soil water retention, limited water infiltration and percolation in the soil profile.

Restoration pathway R2
State 2 to 1

R2 Result: Shift from invasive species in State 2 back to Reference State. This restoration transition does not occur without a significant commitment of time & resource inputs to restore ecological processes, native bunchgrasses, sagebrush and native forb species. TWO OPTIONS: Option#1: Step 1 seed to introduced grasses; Step 2 seed to native species Step 1 shifting from State 2 to State 3: It will take two years or longer to kill annual species and to exhaust the seedbank of invasive weed seed. Site will then need to be seeded to introduced 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, improved pore spaces and increased soil moisture within the soil profile. The site would also need several years of no significant fires and proper grazing management as well. See narrative for R1 recovery above. Step 2 shifting from State 3 to State 1: This assumes that the shift from State 2 to State 3 has been successful. Introduced grasses and any remaining weeds must be killed while maintaining soil structure to ensure a proper seedbed (cloddy, a little rough and trashy to provide safe sites for the seed). A pulverized dust mulch must be avoided at all costs. The seeding of native species could occur in two steps: (1) first year, use a grass seed mix to duplicate the Reference Community (mostly basin wildrye with other native bunchgrasses) so that broadleaf weeds may be controlled, and (2) second year re-introduce sagebrush and native forbs. Plugs may be used for sagebrush and native forbs rather than seed. Post-seeding the site would also need several years with no significant fires and proper grazing management as well to ensure plant establishment and vigor. Option #2: seed directly to native species Take two years or more to kill weeds and to exhaust the weed seedbank while maintaining soil structure. As in Option 1 above, the seeding of native species could occur in two steps: (1) first year, use a grass seed mix to duplicate the Reference Community (mostly basin wildrye with other native bunchgrasses) so that broadleaf weeds may be controlled, and (2) second year re-introduce sagebrush and native forbs. Plugs may be used for sagebrush and native forbs rather than seed. Post-seeding the site would also need several years with no significant fires and proper grazing management as well to ensure plant establishment and vigor.

Restoration pathway R1
State 2 to 3

R1 Transition from State 2 (a community dominated by invasive annual species) to State 3 seeded grasses (basin wildrye or to introduced grasses). This restoration transition does not occur without significant time and inputs to control weeds, prepare a seedbed, seed desirable species, and post-seeding weed control and management. This can require 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 1/8-1/4 inch is desired). Proper grazing management is essential to maintain the stand post-seeding. Basin wildrye and intermediate wheatgrass are highly adapted to the Loamy Bottom ecological site. The actual transition occurs when the seeded species have successfully established and are outcompeting the annual species for cover and dominance of resources.

Transition T2
State 3 to 2

T2 Result: Shift from State 3 (seeded grasses) to State 2 which dominated by invasive weeds or annual grasses. Primary Trigger: grazing pressure (heavy grazing, season long grazing, or frequent late spring grazing) to seeded grasses. Secondary Trigger: Frequent fires or a severe fire that burn out plant crowns of native species and give competitive advantage to the invasive species. This transition occurs when chronic heavy grazing has removed too much of the perennial bunchgrass cover allowing invasive annual species to colonize the site. As this continues the competitive advantage goes to the exotic species which are opportunistic and take most of the site's resources. Ecological process: with consistent defoliation pressure seeded grasses have low vigor, shrinking crowns and mortality. Weed seeds from invasive species blow onto the site or are carried in with runoff water. On most sites weed seeds are waiting for an opportunity to colonize. As the cover of seeded grass declines invasive species increase accordingly. Over time the invasive species expand to a position of dominance. Indicators: shrinking crowns and mortality of desirable species, increasing gaps between perennial species, and increasing cover by invasive annual 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 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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