

Ecological site group R008XG153WA

Cool Loamy, threetip sagebrush

Last updated: 09/21/2023
Accessed: 05/08/2024

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): 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:

Cool Loamy, threetip sagebrush is an upland sagebrush steppe site occurring on 20 inches and deeper loamy soils. This ecological site occurs principally in two situations: (1) on flat sites at higher elevations and the northern region of MLRA 8, and (2) on north to northeast slopes elsewhere. These sites occur most commonly on silt loam, sandy loam and stony loam soils, but a wide variety of soils and landforms are possible.

As one moves across MLRA 8, the landscape position for Cool Loamy, threetip sagebrush changes. At 10 inches of precipitation Cool Loamy, threetip sagebrush occurs only on the north to northeast slopes. But at 12 inches of precipitation Cool Loamy, threetip sagebrush occurs on all but the south to southwest slopes.

Compared to other upland sites, Cool Loamy, threetip sagebrush has a shift in plant community composition, with threetip sagebrush and Idaho fescue the featured species. Fire tolerant, three-tip sage dominates the reference state shrub layer while Idaho fescue, with or without bluebunch wheatgrass, is dominant in the herbaceous understory. The shrub layer is knee-height three-tip sagebrush with a mix of other shrub species scattered throughout, including Wyoming or basin big sagebrush, rabbitbrush, and horsebrush. The cover of Wyoming and basin sagebrush will depend on how long it has been since the site burned.

Daubenmire identified northern Douglas Co., southern Okanogan Co., northern and eastern portion of both Lincoln and Adams counties, for his threetip sagebrush-fescue vegetative zone.

Principle Vegetative Drivers:

The vegetative expression of this productive site is driven by two factors: (1) moderately deep to deep soil depth

provides unrestricted rooting for most species, and (2) the microclimate which allows the shift in major plant species. With higher elevations or northerly facing slopes this ecological site has cooler temperatures year-round and longer lasting snow pack than other MLRA 8 ecological sites. This site provides crucial water to the vegetation at the hottest time of the growing season allowing the ecological site more resilience when impacted by disturbances. Also, being wetter and cooler, Cool Loamy supports a denser plant cover than the Loamy ecological 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 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

Cool Loamy has cooler temperatures and longer lasting snow than other MLRA 8 ecological sites. Thus, this site supports a denser plant cover and provides water crucial to vegetation when it becomes hot.

Physiographic Features:

The landscape is part of the Columbia basalt plateau. Cool loamy, threetip sagebrush sites are most commonly found on broad ridges, benches and plateaus, stream terraces, drier draw bottoms, north and northeast-facing hillslopes and in small basins.

Physiographic Division: Intermontane Plateau

Physiographic Province: Columbia Plateau

Physiographic Sections: Walla Walla Plateau Section

Landscapes: Hills, valleys and plateaus

Landform: Sideslopes, terraces, benches, alluvial fans

Elevation: Dominantly 600 to 4,200 feet

Central tendency: 1,500 to 3,000 feet

Slope: Total range: 0 to 90 percent

Central tendency: 2 to 30 percent

Aspect: Dominantly northerly aspects, but 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

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). 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 210

Central tendency: 120 to 160

The growing season for Cool Loamy, threetip sagebrush is April through end of July.

Soil features

Edaphic:

The Cool Loamy, threetip sagebrush ecological site occurs with Loamy, sagebrush, stony and loamy bottom ecological sites.

Representative Soil Features:

This ecological site components are dominantly Typic, Calcic and Vitrandic taxonomic subgroups of Haploxerolls, Durixerolls, Argixerolls and Palexerolls great groups of the Mollisols taxonomic orders. Soils are moderately deep to very deep. Average available water capacity of about 6.0 inches (16.3 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 Anders, Badge, Bickleton, Conconully, Endicott, Lainand, Linville, Patron, Pushtay, Tanksel and similar soils.

Dominant soil surface is silt loam to very stony fine sandy loamy, with ashy modifier sometimes occurring as well.

Dominant particle-size class is fine to coarse-loamy

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

Minimum: 0

Maximum: 5

Fragments within surface horizon > 3 inches (% Volume):

Minimum: 0

Maximum: 20

Average: 0

Fragments within surface horizon ≤ 3 inches (% Volume):

Minimum: 0

Maximum: 30

Average: 5

Subsurface fragments > 3 inches (% Volume):

Minimum: 0

Maximum: 30

Average: 10

Subsurface fragments \leq 3 inches (% Volume):

Minimum: 0

Maximum: 40

Average: 10

Drainage Class: Dominantly well drained

Water table depth: Greater than 60 inches

Flooding:

Frequency: None

Ponding:

Frequency: None

Saturated Hydraulic Conductivity Class:

0 to 10 inches: Moderately high to moderately low

10 to 40 inches: Moderately high to moderately low

Depth to root-restricting feature (inches):

Minimum: 20

Maximum: Greater than 60 inches

Electrical Conductivity (dS/m):

Minimum: 0

Maximum: 4

Sodium Absorption Ratio:

Minimum: 0

Maximum: 0

Calcium Carbonate Equivalent (percent):

Minimum: 0

Maximum: 25

Soil Reaction (pH) (1:1 Water):

0 - 10 inches: 5.6 to 9.0

10 - 40 inches: 5.6 to 9.0

Available Water Capacity (inches, 0 – 40 inches depth):

Minimum: 1.4

Maximum: 9.7

Average: 6.0

Vegetation dynamics

Ecological Dynamics:

Cool Loamy, threetip sagebrush produces about 800-1200 pounds/acre of biomass annually

In the sagebrush steppe areas of MLRA 8, Wyoming sagebrush – bluebunch wheatgrass communities reign far and

wide. But Cool Loamy, threetip sagebrush has a shift in plant community composition, with threetip sagebrush and Idaho fescue the featured species. Bluebunch wheatgrass and threadleaf sedge are also important species on this site.

Compared to other upland ecological sites, Cool Loamy, threetip sagebrush has more available soil moisture. This happens twofold: (1) there is more moisture (more spring rain, deeper snowpack, more fog), and (2) the precipitation is more effective (cooler temperatures, less runoff and less evaporation due to closer spacing of plants, and hence, more soil cover). Threetip sage and Idaho fescue are especially linked to the additional soil moisture on this ecological site. The third dominant species in the reference state, bluebunch wheatgrass, is not as linked to the additional soil moisture.

Threetip sagebrush is a short, shallow-rooted, evergreen shrub. Leaves are more deeply lobed than big sagebrush. Compared to big sagebrush, threetip sage grows on sites that are moister or at higher elevations. Threetip sagebrush has a very slow growth rate, reaching a height of one foot after twenty years. In Washington threetip sage generally sprouts following fire but it is not a big-time sprouter like rabbitbrush. It can take years for threetip sage to get back to pre-burn conditions.

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 seed head arranged in a spike, while Idaho fescue has an awned seed head arranged in a panicle. The ratio of Idaho fescue to bluebunch wheatgrass plants on any site can vary due to aspect and elevation.

Both 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. 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.

Threadleaf sedge is a sod-forming, densely tufted, native perennial graminoid. In nature threadleaf sedge seedlings are rare as it reproduces mainly from asexual tillers. Often threadleaf sedge is an increaser when other species in the community are in decline.

The stability and resiliency of the reference communities is directly linked to the health and vigor of Idaho fescue and bluebunch wheatgrass. Refer to page 8 for more details about bunchgrass physiology. Research has found that the community remains resistant to medusahead invasion if the site maintains at least 0.8 mid-sized bunchgrass plant/sq. ft. (K. Davies 2008). 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. 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). Threetip sage-fescue areas should have a comparable fire return interval.

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 and horsebrush are sprouting shrubs and may also increase following fire.

The effect of fire on the main species is mixed for the Cool Loamy site. Threetip sagebrush in Central Washington sprouts from lateral roots or the root crown following fire and bluebunch wheatgrass is fire tolerant. Threetip is also a vigorous, wind-dispersed seeder and in many cases, after fire, threetip will both re-sprout and disperse new seed from the surviving plants. Both species recover quickly. 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. Threetip sage and bluebunch wheatgrass keeps the site resistant to change, while Idaho fescue makes the site more at risk.

A severe fire puts stress on the entire community. The sagebrush layer is completely removed. Spots or patches with heavy sagebrush are sterilized by the fire and must be seeded to prevent invasive species (annual grasses, tumble mustard) from totally occupying the site. Bluebunch wheatgrass and basin wildrye will have weak vigor for a few years but generally survive. Idaho fescue plants are very much at risk with a severe burn coupled with wind. The result can be “black holes” or ash 2-3 inches into the crown. The death of Idaho fescue plants creates holes in the community, and the opportunity for exotic species to colonize. Needle and thread is one native species that can increase via new seedlings.

Idaho fescue and bluebunch wheatgrass exhibit rapid tillering when there is light severity fires and favorable soil moisture. But, the longer the site goes without fire and the more grazing pressure added, the more threetip sagebrush cover increases and the bunchgrasses decline.

Grazing is another common disturbance that occurs to this ecological site. Grazing pressure can be defined as heavy grazing intensity, or frequent grazing during reproductive growth, or season-long grazing (the same plants grazed more than once). As grazing pressure increases the plant community unravels in stages:

1. Cusick bluegrass is eliminated. Adjacent natives fill the void
2. Idaho fescue declines while bluebunch wheatgrass and threetip sage 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 threetip sage-threadleaf sedge community

Managing sagebrush 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. Idaho fescue has weak stems and is much more sensitive to grazing than bluebunch wheatgrass.

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.

These grasses 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

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, threetip sagebrush – Idaho fescue/bluebunch wheatgrass communities provide habitat for a variety of upland wildlife species.

Supporting Information:

Associated Sites:

Cool Loamy, threetip sagebrush in MLRA 8 is associated with other sites in the Sagebrush Steppe area of MLRA 8 including, Loamy, Stony, Stony Foothills, Stony Foothills South Slope

Similar Sites:

Cool Loamy, threetip sagebrush in MLRA 8 has threetip sage with Idaho fescue and bluebunch wheatgrass. Cool Loamy in MLRA 7 Columbia Basin is similar but with less threetip sage and Idaho fescue. The Channel Scabland area on MLRA 9 Palouse Prairie also has a similar Cool Loamy 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

- R008XY153WA—Cool Loamy threetip sagebrush

Stage

Provisional

Contributors

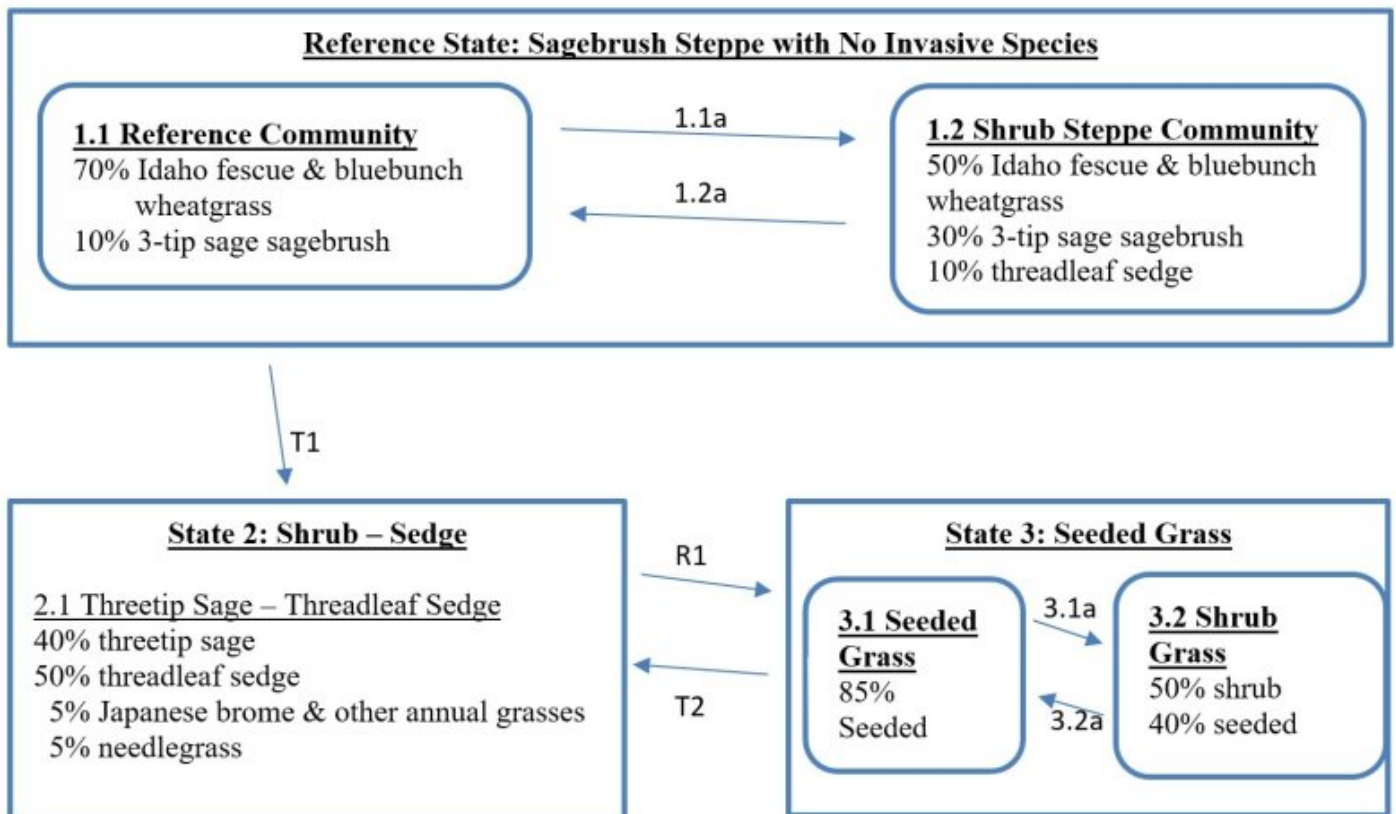
Provisional Site Author: Kevin Guinn

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

State and transition model

State and Transition Diagram for Cool Loamy, threetip sagebrush in MLRA 8:

This state and transition model (STM), explains the general ecological dynamics for the Cool Loamy, threetip sagebrush 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 Cool Loamy, threetip sagebrush 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 Shrubs – Minor		Sprouting Shrubs – Subdominant (3-7% canopy)	
	less than 5% 50 lbs.		10% 120 lbs.
ARTRW	Wyoming sagebrush	ARTR4	three-tip sage
ARTRT	basin big sagebrush	CHRY5	rabbitbrush
PUTR2	bitterbrush	RIBES	currant
		ROSA5	rose
Dominant Mid-Size Bunchgrasses		Other Mid-Size Bunchgrasses – Minor	
	70% 850 lbs.		5% 60 lbs.
FEID	Idaho fescue	POCU3	Cusick's bluegrass
PSSP6	bluebunch wheatgrass	ELEL5	bottlebrush squirreltail
		ACTH7	Thurber needlegrass
		HECO26	needle and thread
		KOMA	prairie junegrass
		ACNE9	Nelson needlegrass
Short Grass – Minor		Tall Bunchgrasses	
	5-10% 120 lbs.		less than 5% 50 lbs.
POSE	Sandberg bluegrass	LECI4	basin wildrye
		Grass like – Trace	
		CAFI	threadleaf sedge Trace
Native Forbs – Minor			
			5% 60 lbs.
BASA3	arrowleaf balsamroot	MICRO6	microseris
LUPIN	lupine	ALLIU	wild onion
CREPI	hawksbeard	CALOC	Mariposa lily
PHLO2	longleaf phlox	ERIGE2	fleabane
PHHO	spiny phlox	LIPU11	granite gilia
LOMAT	lomatium / biscuitroot	ERIOG	buckwheat
ASTRA	milkvetch / locoweed	CASTI2	paintbrush
ANDI2	low pussytoes	COLLO	collomia
PLPA2	woolly plantain	LIRU4	stoneseed
ACMI2	yarrow	HYCA4	waterleaf
		Below	Normal
Estimated Production (pounds / acre)		800	1000
			Above
			1200

State 1

Reference: Sagebrush Steppe with No Invasive Species

State 1 Narrative: State 1 represents sagebrush steppe with no invasive or exotic species. All the functional, structural groups have one or more species. Reference State Community Phases: 1.1 Reference Idaho fescue-bluebunch wheatgrass / threetip sagebrush 1.2 Shrub Steppe Threetip sage / Idaho fescue-bluebunch wheatgrass Communities 1.1 and 1.2 are stable with a high cover of Idaho fescue/bluebunch wheatgrass and low to moderate cover of threetip sage. Both communities have a minor amount of threadleaf sedge which is native, but also rhizomatous. But when the dominant bunchgrasses exhibit low vigor and decline, threadleaf sedge and threetip sage increase and Japanese brome colonizes the disturbed sites. Dominate Reference State Species: Threetip sagebrush, Idaho fescue, bluebunch wheatgrass At-risk Communities: • All communities in the reference state are at risk of invasive species. The seed source for Japanese brome or other invasive annual seed blows onto most

sites annually. • Any community becomes at-risk of moving to State 3 when Idaho fescue and bluebunch have low vigor the cover of threadleaf sedge is expanding, and Japanese brome has colonized the site • Any community is at risk when fire kills the Idaho fescue plants. The holes could quickly be filled by threadleaf sedge or Japanese brome. The site should be inter-seeded that fall or early the following spring

Community 1.1

Reference

Community 1.2

Shrub Steppe

Pathway 1.1a

Community 1.1 to 1.2

1.1a Result: shift from reference community to shrub steppe community. Moderate reduction in bunchgrasses and a moderate increase in threetip sage Causes: Over time with no fire and grazing pressure exerted on the bunchgrasses, the shrubs gain the competitive edge. Grazing pressure is defined as heavy grazing intensity, season long grazing or frequent late spring grazing Ecological process: Idaho fescue and bluebunch wheatgrass have low vigor, shrinking crowns. With less competition from bunchgrasses, threetip sagebrush sets new seedlings and expands. Indicators: increasing cover of threetip sage and decreasing cover of Idaho fescue and bluebunch wheatgrass

Pathway 1.2a

Community 1.2 to 1.1

1.2a Result: shift from shrub steppe community to reference community. Threetip sage declines while bunchgrasses increase Causes: Moderate severity fire sets threetip sage back while Idaho expands given the opportunity and good vigor both pre- and post-fire. Also, the fire would need to not burn into the root crown of Idaho fescue. Ecological process: Threetip sage has moderate sprouting ability, so some but not all plants sprout following fire. Idaho fescue and other bunchgrasses have good vigor post-fire and expand via tillering and new seedlings. Proper grazing management post-fire keep the bunchgrasses vigorous and competitive.

State 2

Shrub-Sedge

State 2 Narrative: State 2 represents a sedge-shrub community. Many native functional, structural groups have been altered or are missing. Annual grasses such as Japanese brome are present but secondary to the shrub and sedge components. Community Phases for State 2: 2.1 Sedge-Shrub Threadleaf sedge-Threetip sage In Community 2.1, sod-forming threadleaf sedge has expanded to a position of dominance. Threetip sage has increased but is quite variable. In some instances, threetip sage is co-dominant and in other instances is secondary to threadleaf sedge. But when the dominant bunchgrasses exhibit low vigor and decline, threadleaf sedge and threetip sage increase. Japanese brome or ventenata may colonize the disturbed sites. The loss of soil biological crusts contributes to the invasion by annual grasses. Dominate Species in State 2: Threadleaf sedge, threetip sagebrush

Community 2.1

Shrub-Sedge

In Community 2.1, sod-forming threadleaf sedge has expanded to a position of dominance. Threetip sage has increased but is quite variable. In some instances, threetip sage is co-dominant and in other instances is secondary to threadleaf sedge. But when the dominant bunchgrasses exhibit low vigor and decline, threadleaf sedge and threetip sage increase. Japanese brome or ventenata may colonize the disturbed sites. The loss of soil biological crusts contributes to the invasion by annual grasses.

State 3

Seeded Grass

Narrative for State 3: State 3 represents sites that have been seeded. The site was no longer productive for intended uses. So, a commitment was made to kill existing stand and seed more desirable species. Control of threadleaf sedge would be critical to success. Community Phases for State 3: 3.1 Seeded grasses 3.2 Shrub – Seeded Grasses Refer to narrative for R1 Dominate Species in State 2: Desirable seeded grass species w/ or w/o legume

Community 3.1 Seeded Grasses

Community 3.2 Shrub - Seeded Grasses

Pathway 3.1a Community 3.1 to 3.2

3.1a Seeded grass community shifts to a shrub-grass community. Causes: Grazing pressure on the desirable grasses put them in decline while the shrubs increase.

Pathway 3.2a Community 3.2 to 3.1

3.2a Shrub-grass community shifts back to seeded grass community Causes: If the stand still has a good stand of bunchgrasses, shrubs are controlled by chemical treatment. Bunchgrasses will need good plant vigor pre- and post-treatment.

Transition T1 State 1 to 2

T1 Transition from Reference State to State 2 (threadleaf sedge-threetip sagebrush). The Reference State has only a minor amount of threadleaf sedge and no invasive species. In State 2 threadleaf sedge makes a significant increase along with threetip sage. Primary Trigger: Heavy grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) on Idaho fescue and bluebunch wheatgrass. Also, soil disturbances by rodents, badgers or rabbits allow annual grasses to colonize. Ecological process. The cover of threadleaf sedge and threetip sagebrush increase as the cover of the dominant bunchgrasses decline. Japanese brome or other invasive annual grasses may colonize disturbed areas and later, expands as opportunity presents itself. Indicators: increasing gaps between dominant bunchgrasses (Idaho fescue and bluebunch wheatgrass). Expanding cover of threadleaf sedge and threetip sage, and invasive species colonizing disturbed sites.

Restoration pathway R1 State 2 to 3

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

Transition T2 State 3 to 2

T2 Transition from State 3 seeded grasses to State 2 threadleaf sedge – threetip sage. Ecological process:

Desirable seeded species have low vigor and are declining. The cover of threadleaf sedge, threetip sage and invasive annuals is expanding. The competitive edge This transition occurs when the cover of dominant bunchgrasses drops to less than 10% threadleaf sedge has assumed a dominant position in the community. Primary trigger: heavy grazing pressure (heavy grazing intensity, season long grazing or frequent late spring grazing) reduces the vigor of the desirable seeded species. Indicators: Declining vigor and cover for the seeded species. Increasing canopy gaps between perennial species. Increasing cover of threadleaf sedge, threetip sage and cover of exotic 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

Citations