Ecological site group R021XG910CA
Loamy

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Key Characteristics

- Upland sites
- 12-30" ppt
- > 20" depth
- Loamy texture

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

This ESG is on hills, mountains, and scarp slopes on lava flows that have slopes of 5 to 50 percent.

Climate

The climate is semi-arid with warm, dry summers and cold, moist winters. The mean annual precipitation is 12 to 16 inches (305 to 406 millimeters), with 25 to 50 inches (635 to 1,270 millimeters) of snow. The mean annual temperature is 40 to 44 degrees F (4 to 7 degrees C). Mean July temperature is 58 to 63 degrees F (14 to 17 degrees C), and mean January temperature is 22 to 28 degrees F (-6 to -2 degrees C). The frost-free season is 60 to 100 days.

Soil features

This ESG is typically on soils that are moderately deep and well drained. The soils may have formed in material weathered from andesite, tuff, or basalt. Some soils formed in surface mantles of volcanic ash over residuum and colluvium derived from basalt or andesite.

Representative soils for this ESG include:

Petescreek: Fine-loamy, mixed, superactive, frigid Pachic Ultic Haploxerolls.
Fredonyer: Loamy-skeletal, isotic, frigid, Vitrandic Haploxerolls.
Royst: Clayey-skeletal, smectitic, frigid Vitrandic Argixerolls.
Ninekar: Fine, smectitic, meric Xerertic Haplargids.

Some soils that are correlated to this group do not fit in the mountain big sagebrush concept and may be dominated by wet meadow soils or large acreages of conifer-dominated forest. These areas likely develop due to their deep, ashy, fertile nature and high water-holding capacity, which allows conifers to thrive despite average precipitation falling below the minimum required for conifers. These soils would need to be evaluated and split from this ESG in the future.

Vegetation dynamics

Mountain big sagebrush is a late-seral dominant or "climax" species in steppe communities that can persist as a habitat-dominant species in late-seral stages in the absence of fire or other large-scale disturbances. Important large-scale disturbances in mountain big sagebrush communities include fire, herbivory, freeze-kill, snow mold, and drought. In the absence of disturbances, mountain big sagebrush communities may become dense, and stands

adjacent to woodlands may succeed to woodlands.

Post-fire successional patterns in sagebrush communities are considered "predictable," although the composition of post-fire communities and rates of post-fire succession vary considerably depending on numerous interacting variables including pre-fire plant community and seed bank composition; site characteristics and management history; fire size, severity, and patchiness; and post-fire weather. Typically, annual herbaceous plant cover increases immediately after fire. Perennial grasses, forbs, and sprouting shrub species, if present, then increase and dominate for up to 20 years. Mountain big sagebrush may establish early in post-fire succession from the soil seed bank and from seed dispersed from surviving plants in unburned patches and the burn perimeter. Most mountain big sagebrush seedling establishment occurs within the first four years after fire, although it is influenced by several factors. After the first few post-fire years, mountain big sagebrush seedling establishment typically slows because of depleted soil seed banks and increased competition for resources with grasses and forbs.

Because mountain big sagebrush must establish from seed and has slower growth rates, it dominates the post-fire plant community much later in succession than grasses, forbs, and sprouting shrubs. Following the initial post-fire establishment period, secondary peaks in establishment occur when mountain big sagebrush individuals that established soon after fire mature and contribute seeds to subsequent establishment. Thereafter, establishment may be episodic. Canopy cover of mountain big sagebrush in mountain big sagebrush communities typically increases after fire or other disturbances. As mountain big sagebrush cover increases during succession, cover of grasses, forbs, and other shrub species declines. Shrub canopy cover in undisturbed mountain big sagebrush communities is typically 15 to 40 percent but can surpass 50 percent.

Early-, mid-, and late-seral mountain big sagebrush communities in Carbon County, Wyoming on moderately deep to deep loamy soils have less than 5 percent, 5 to 40 percent, and greater than 40 percent mountain big sagebrush canopy cover, respectively. Mid-seral communities in this area support the largest, most biodiverse wildlife populations.

On moderately deep to deep loamy soils in southeastern Oregon, research identified four general successional phases as follows:

• Early-seral phase: Grasses and forbs dominate and mountain big sagebrush seedlings are present (less than 1 percent mountain big sagebrush cover).
• Mid-seral, open phase: Grasses and forbs dominate and mountain big sagebrush is subdominant (1 to 10 percent mountain big sagebrush cover).
• Late-seral, open phase: Mountain big sagebrush, grasses, and forbs co-dominate (10 to 30 percent mountain big sagebrush cover).
• Late-seral, closed phase: Mountain big sagebrush is dominant (greater than 30 percent mountain big sagebrush canopy cover).

The time required for mountain big sagebrush communities to develop late-seral attributes is influenced by several factors and therefore varies substantially among sites. To model succession in mountain big sagebrush communities in southeastern Oregon, two assumptions were made: mountain big sagebrush populations begin with a single plant and double every two years, and it takes six years for a seedling to reach reproductive maturity. The modeled communities reached the late-seral, closed phase in about 31 years in the absence of disturbance. When disturbance effects from insects, voles, freeze-kill, snow mold, drought, and fire were added to the model, it took 33 years to reach that phase. Review and analysis of mountain big sagebrush post-fire recovery data shows that few sites fully recover (i.e., have mountain big sagebrush canopy cover that was equal to or greater than that on similar, unburned sites) before 25 years. While most sites studied (67 percent) had fully recovered after 25 years, sample size was small and variability was high for burns greater than 25 years old, and about a third of them had not fully recovered. Computations of post-fire recovery are complicated by variability in mountain big sagebrush canopy cover on unburned sites, which was 4 to 71 percent, and is influenced by several variables, including site characteristics, land use history, and successional stage.

Fire or other disturbance is not necessary to maintain mountain big sagebrush stands in a "relatively young, productive state" or to prevent them from becoming "decadent." Mean plant age of mountain big sagebrush on 33 relatively undisturbed sites on the Northern Yellowstone Winter Range, where vegetation cover averaged 14% (range: 3 to 39 percent), was 32 years, with only 12% of individuals over 50 years old and 5% over 60 years old. The average age of dead plants was 41 years old. The author of the study concluded that mountain big sagebrush

plants established, matured, died, and were replaced within about 50 years. A 30-year study of a mountain big sagebrush stand in the Gravelly Mountains of southwestern Montana showed that mountain big sagebrush stands may persist indefinitely in the absence of large-scale disturbances. Based upon observations of the stand from 31 to 61 years after initial establishment, the author concluded that a dense stand of mountain big sagebrush "had to age sufficiently to break down into a more open stand before conditions were right for new plants to come in," and that "many plants died before the stand was open enough for the sunlight to reach the ground and permit seedlings to come in." No mountain big sagebrush seedlings were observed until 51 years after initial establishment.

Woodlands can expand into mountain big sagebrush communities when the interval between fires becomes long enough for trees to establish, mature, and dominate a site. Conifer expansion is most common in sagebrush communities on cool to warm, relatively moist sites, including mountain big sagebrush communities at high elevations. Where soil temperature and moisture regimes are suitable, mountain big sagebrush and other sagebrush plants can act as nurse plants, providing safe germination and establishment sites for junipers and pinyons.

Woodland succession has been categorized in the literature for mountain big sagebrush communities in three phases:

• Early-successional stage (Phase I): Shrubs and herbs dominate, and few trees are present.
• Mid-successional stage (Phase II): Trees co-dominate with shrubs and herbs.
• Late-successional stage (Phase III): Trees dominate, and shrubs and herbs are reduced.

A fourth, late-successional, closed stage or "mature" phase is sometimes included in woodland succession where trees are dominant, shrubs and herbaceous plant cover is minimal or absent, and shrubs are at least 90 percent dead. The time required to transition between phases in woodland succession is variable. In southeastern Oregon and southwestern Idaho, the development of western juniper woodlands in mountain big sagebrush and low sagebrush communities from the time of tree establishment to dominance (shift from Phase I to Phase III) varies from 80 years on cool, moist sites to greater than 120 years on warm, dry sites. Based on tree age chronology, the minimum time for western juniper stands to approach dominance on mesic mountain big sagebrush/Idaho fescue sites in Oregon and California is 60 to 70 years and nearly 80 percent of western juniper trees established within a 30-year period. Based on this and other data, Johnson and Miller developed a chart for mountain big sagebrush communities with varying productivity that hypothesizes the time necessary to transition from initial western juniper establishment to development of late-seral woodlands. The transition from mid-seral to late-seral woodlands causes a shift from shrub and herbaceous fuels to a predominance of tree canopy fuels, which influences fire behavior and severity.

Major Land Resource Area

MLRA 021X
Klamath and Shasta Valleys and Basins

Stage

Provisional

State and transition model

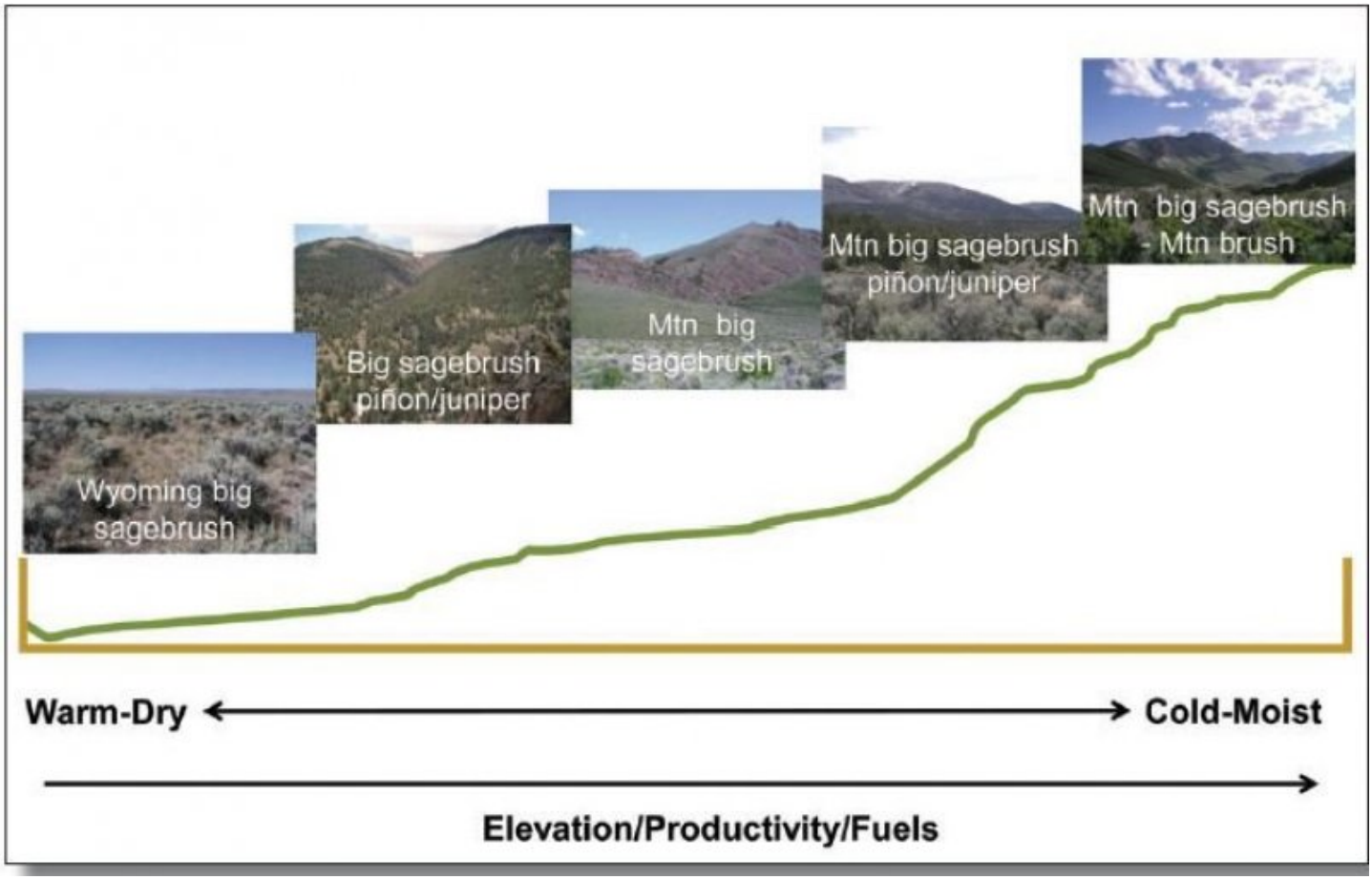
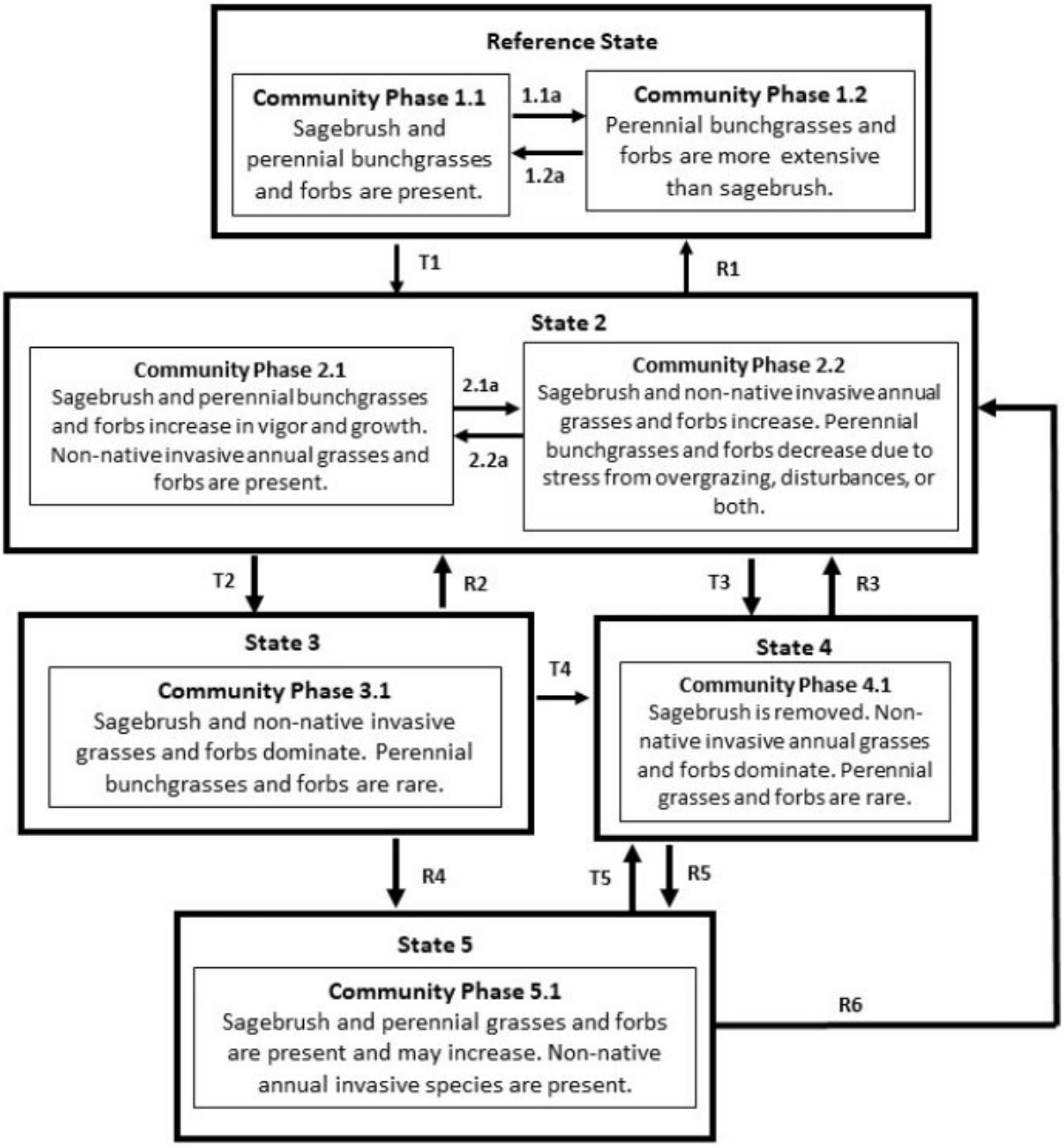


Figure . General catena for big sagebrush habitat dominance (Courtesy of the USFS RMRS GTR 326).

Mountain big sagebrush (cool mesic to cool frigid/xeric)
Moderate resilience and resistance

**Adapted from USDA Forest Service Gen. Tech. Rep. RMRS-GTR-326 (2014)



Community Pathway 1.1a: Perennial grasses and forbs increase due to disturbances that decrease sagebrush such as wildfires, insects, diseases, and pathogens.

Community Pathway 1.2a: Sagebrush increases with time.

T1: The presence of an invasive seed source coupled with disturbances such as fires, improper grazing, insects, diseases, or pathogens, trigger a threshold-crossing event.

R1: A combination of management strategies that reduce pressures toward sagebrush and native perennial grasses and forbs include use of fires, herbicides, mechanical treatments, and grazing management strategies that fit site-specific conditions. This restoration pathway is time, labor, and money intensive once the invasive annuals rule the ecological functions and processes on the site.

Community Pathway 2.1a: Perennial grasses and forbs decrease, and sagebrush and invasive species increase due to improper grazing by wildlife or domestic livestock. The site enters an at-risk phase. Decreases in sagebrush due to insects, diseases, or pathogens can further increase the presence of invasive species.

Community Pathway 2.2a: This community pathway occurs when the site experiences one or both of the following: decreased grazing pressure from wild and domestic ungulates; multiple (two to four) years of good winter and spring or summer moisture. Reduced grazing pressure and abundant moisture promote the competitive growth and vigor of perennial grasses and forbs, and may provide an opportunity for native components to return to dominance.

T2: All or most of the perennial grasses and forbs are removed from the site by continued grazing pressures from wild and/or domestic livestock, prolonged droughts, or both.

T3, T4, and T5: Sagebrush is removed by fire or other disturbances, resulting in a state dominated by annual invasive species. Perennial grasses and forbs are rare and recovery potential is significantly reduced. Repeated fires can cause sites on drier soils and landscape positions to cross an ecological threshold and become dominated by annual grasses and forbs. Root sprouting shrubs may also increase.

R4 and R5: A seeded state results from seeding following fires, invasive species control, or both. Sagebrush may recolonize depending on patch size, but annual invasive species are still present.

R6: Cooler sites with greater soil moisture, either at higher elevations or due to soil/site characteristics, may begin to resemble State 2 over time. While it is possible with enough time for a site to return to the reference state, this pathway has not been witnessed and therefore is not addressed in this model.

Citations

Innes, R.J. 2017. Artemisia tridentata subsp. vaseyana, mountain big sagebrush. Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer).