

Ecological site R048AY518UT High Mountain Gravelly Loam (Mountain Big Sagebrush)

Last updated: 3/05/2024
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General information

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.

MLRA notes

Major Land Resource Area (MLRA): 048A–Southern Rocky Mountains

MLRA 48A makes up about 45,920 square miles (119,000 square kilometers) and is the southern part of the Rocky Mountains. The Southern Rocky Mountains lies east of the Colorado Plateau, south of the Wyoming Basin, west of the Great Plains, and north of the Rio Grande Rift. It is in western and central Colorado, southeastern Wyoming, eastern Utah, and northern New Mexico. The headwaters of major rivers such as the Colorado, Yampa, Arkansas, Rio Grande, North Platte and South Plate rivers are located here. This MLRA has numerous national forests, including the Medicine Bow National Forest in Wyoming; the Routt, Arapaho, Roosevelt, Pike, San Isabel, White River, Gunnison, Grand Mesa, Uncompahgre, Rio Grande, and San Juan National Forests in Colorado; the Carson National Forest and part of the Santa Fe National Forest in New Mexico. Rocky Mountain National Park also is in this MLRA.

MLRA 48A is the southern Rocky Mountains physiographic region. The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. Several basins, or parks, are between the belts. Some high mesas and plateaus are included. It is characterized by mountain ranges that were uplifted during the Laramide Orogeny and then had periods of glaciation. The ranges include the Sangre de Cristo Mountains, the Laramie Mountains, and the Front Range in the east and the San Juan Mountains and the Sawatch and Park Ranges in the west. The ranges are dissected by many narrow stream valleys having steep gradients. In some areas the upper mountain slopes and broad crests are covered by snowfields and glaciers. Elevation typically ranges from 6,500 to 14,400 feet (1,980 to 4,390 meters) in this area. The part of this MLRA in central Colorado includes the highest point in the Rockies, Mount Elbert, which reaches an elevation of 14,433 feet (4,400 meters). More than 50 peaks in the part of the MLRA in Colorado are at an elevation of more than 14,000 feet (4,270 meters). Many small glacial lakes are in the high mountains.

The mountains in this area were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. This large MLRA can be subdivided into at least 4 large general divisions. First is the Rockies on the east side of this area are called the "Front Range," which is a fault block that has been tilted up on edge and uplifted and is largely igneous and metamorphic geology. It was tilted up on the east edge, so there is a steep front on the east and the west side is more gently sloping and in the south east there are rocks exposed in the mountains are mostly Precambrian igneous and metamorphic rocks. Second is the tertiary rocks, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are throughout this area (San Juan Mountains Area). The third division is Northwest part of the MLRA is dominantly sedimentary rock from the cretaceous/tertiary and Permian/Pennsylvanian periods. The fourth subset is the long and narrow Sangre de Cristos mountains uplifted in the Cenozoic are between the Rio Grande rift and the great plains. Many of the highest mountain ranges were reshaped by glaciation during the Pleistocene. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. They also are important sources of sand and gravel.

The average annual precipitation ranges predominantly from 12 to 63 inches. Summer rainfall commonly occurs as high-intensity, convective thunderstorms. About half of the annual precipitation occurs as snow in winter; this proportion increases with elevation. In the mountains, deep snowpacks accumulate throughout the winter and

generally persist into spring or early summer, depending on elevation. Some permanent snowfields and small glaciers are on the highest mountain peaks. In the valleys at the lower elevations, snowfall is lighter and snowpacks can be intermittent. The average annual temperature is 26 to 54 degrees F (-3 to 12 degrees C). The freeze-free period averages 135 days and ranges from 45 to 230 days, decreasing in length with elevation. The climate of this area is strongly dependent upon elevation; precipitation is greater, and temperatures are cooler at the higher elevations. The plant communities vary with elevation, aspect and change in latitudes due to changing in precipitation kind and timing and temperature.

The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an ustic or udic soil moisture regime. Mineralogy is typically mixed, smectitic, or paramicaceous. In areas with granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on mountain slopes. Dystrocryepts (Leighcan and Mummy series) formed on mountain slopes and summits at the higher elevations. In areas of andesite and rhyolite bedrock, Dystrocryepts (Endlich and Whitecross series) formed in colluvium on mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on mountain slopes at low elevations and with low precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on mountain slopes at high elevations.

Ecological site concept

The soils of this site formed mostly in colluvium and/or slope alluvium over residuum weathered from limestone, sandstone, and shale. Surface soils are gravelly silt loam in texture. Rock fragments may be present on the soil surface and throughout the profile and make up more than 35 percent of the soil volume. These soils are shallow, well-drained, and have moderate permeability. Available water-holding capacity ranges from 1.4 to 2.0 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is cryic. Precipitation ranges from 22 to 35 inches annually.

Associated sites

F048AY506UT	High Mountain Loam (Aspen) Often occur adjacent to each other.
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Similar sites

R048AY516UT	High Mountain Loam (Mountain Big Sagebrush) Similar plant communities but has less rock fragments in the soil profile.
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Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Artemisia tridentata ssp. vaseyana</i>
Herbaceous	(1) <i>Pseudoroegneria spicata</i> (2) <i>Achnatherum lettermanii</i>

Physiographic features

This site occurs at elevations between 6,300 and 10,500 feet. It is found on ridges and mountain slopes with slopes ranging from 4 to 45 percent. Flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Ridge
Runoff class	High
Flooding frequency	None
Ponding frequency	None

Elevation	1,920–3,200 m
Slope	4–45%
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation is 22 to 35 inches. Approximately 55 percent occurs as rain from May through October. On the average, November through June are the driest months and July through October are the wettest months. Cool temperatures and length of growing season are important environmental factors in this site. In average years, plants begin growth around April 20 and end growth around September 30.

Table 3. Representative climatic features

Frost-free period (characteristic range)	50-70 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	559-889 mm

Influencing water features

Due to its landscape position, this site is not influenced by streams or wetlands.

Soil features

The soils of this site formed mostly in colluvium and/or slope alluvium over residuum weathered from limestone, sandstone, and shale. Surface soils are gravelly silt loam in texture. Rock fragments may be present on the soil surface and throughout the profile and make up more than 35 percent of the soil volume. These soils are shallow, well-drained, and have moderate permeability. Available water-holding capacity ranges from 1.4 to 2.0 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is cryic. Precipitation ranges from 22-35 inches annually.

Table 4. Representative soil features

Parent material	(1) Colluvium–limestone, sandstone, and shale (2) Slope alluvium–limestone, sandstone, and shale (3) Residuum–limestone, sandstone, and shale
Surface texture	(1) Gravelly silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	20–51 cm
Soil depth	20–51 cm
Surface fragment cover ≤3"	25%
Surface fragment cover >3"	1%
Available water capacity (Depth not specified)	3.56–5.08 cm
Subsurface fragment volume ≤3" (Depth not specified)	10%
Subsurface fragment volume >3" (Depth not specified)	29%

Ecological dynamics

It is impossible to determine in any quantitative detail the historic climax plant community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area. However, up to the 1870s the Shoshone Indians, prevalent in northern Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs. Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long. Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

The plant communities shown in this State and Transition Model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, and/or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range & Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

State 1: Reference State

Community Phase 1.1: Reference State

The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information and familiarity with rangeland relict areas where they exist. The least modified plant community would have been co-dominated by mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and a mixture of herbaceous species (1.1). The primary disturbance factor prior to European colonization would have been wildfire (1.1a), which would have removed the sagebrush and allowed the herbs to dominate for a time (1.2). As the time elapsed since the last wildfire grew longer (1.2a), mountain big sagebrush would have increased, and the herbaceous component would have decreased correspondingly. A more complete list of species by lifeform for the Reference State is available in the accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this document.

Community Phase 1.1: mountain big sagebrush-steppe/ rich & productive herbaceous component

This plant community would have been characterized by the presence of mountain big sagebrush with a rich and productive herbaceous layer.

Community Pathway 1.1a:

Wildfire would remove sagebrush, allowing the herbs to dominate for a time.

Community Phase 1.2: herb dominated

This phase would have been dominated by herbaceous species and having few, if any, mountain big sagebrush present.

Community Pathway 1.2a:

Over time, sagebrush would increase, and the herbaceous understory would decrease slightly.

Transition T1a: (State 1 to State 2)

The simultaneous introduction of exotic species, both plants and animals, possible extinctions of native flora and fauna, and climate change has caused State 1 to transition to State 2. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

State 2: Mountain Big Sagebrush-Steppe/ Introduced Non-natives State

Community Phase 2.1: Mountain Big Sagebrush-Steppe/ Introduced Non-natives State

State 2 is identical to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, and a different climate. State 2 is a description of the ecological site shortly following Euro-American settlement. This State can be regarded as the current potential. This State varies in the amount of mountain big sagebrush present based upon the time elapsed since the last wildfire. The least modified plant community is a mountain big sagebrush-steppe, characterized by the co-dominance shrubs and herbaceous species. Mountain big sagebrush is the dominant shrub, but other minor shrubs may be present. There is a rich and diverse mixture of herbs as well. Dominant grasses include slender wheatgrass, bluebunch wheatgrass, and Letterman's needlegrass, and forbs include sticky purple geranium, shortstem buckwheat, and lupines, among others (2.1). A small component of non-natives will also be present. Wildfire (2.1a) will remove sagebrush and allow the community to become dominated by herbaceous species for a time (2.2). As the length of time elapsed since the last wildfire grows longer (2.2a), sagebrush will re-establish, and the herbs will decrease slightly. This State is maintained by periodic wildfire and by a healthy, productive, and diverse plant community that can provide native seed sources and promotes soil stability, water infiltration, and soil moisture retention. These sites are more resistant to accelerated soil erosion because of the self-armoring of many of these gravelly soils. The resiliency of this State will be maintained by reducing or altering seasons of use and number of livestock. Conversely, this State's resiliency will be negatively impacted by continuous season-long livestock use.

Community Phase 2.1: Mountain big sagebrush-steppe/ rich & productive herbaceous component

This plant community is characterized by co-dominance of mountain big sagebrush and a rich and productive understory of herbs.

Community Pathway 2.1a:

Wildfire will remove sagebrush, allowing the herbs to dominate for a time.

Community Phase 2.2: herb dominated

This phase is dominated by herbaceous species and having few, if any, mountain big sagebrush present.

Community Pathway 2.2a:

Over time, sagebrush will increase, and the herbaceous understory will decrease slightly.

Transition T2a: from State 2 to State 3 (Mountain Big Sagebrush-Steppe/ Introduced Non-natives State to Mountain Big Sagebrush Super-dominance State)

Lack of fire and continued heavy livestock grazing during the growing season of grasses will cause State 2 to transition into the Mountain Big sagebrush Super-dominance State (State 3). The approach to this transition is indicated by a loss of the perennial grass understory, an increase in the shrub component relative to the grasses, and evidence of soil loss. The trigger causing this transition is heavy growing season grazing.

State 3: Mountain Big Sagebrush Super-dominance State

Community Phase 3.1: Mountain Big Sagebrush Super-dominance State

This State is characterized by a super-dominance of mountain big sagebrush with a markedly diminished grass component which occurs in the absence of fire and with continued heavy impacts from livestock grazing. The stability of this State is maintained by the lack of a healthy, productive and diverse herb component capable of providing native seed source, soil stabilization, and soil moisture retention, and by an abundant seed source for mountain big sagebrush. The resiliency of this State will be maintained by decreased grazing during the growing season of grasses. Conversely, the resiliency of this State will be negatively impacted by continued heavy growing season livestock use.

Community Phase 3.1: abundant Mountain big sagebrush / diminished perennial herbs

This plant community is characterized by a dramatic increase in mountain big sagebrush with substantial reduction in the perennial herbaceous component as compared to State 2.

Transition T3a: from State 3 to State 4 (Mountain Big Sagebrush Super-dominance State to Yellow Rabbitbrush State)

Wildfire or brush management, either by mechanical means or prescribed fire, will temporarily remove the mountain big sagebrush. However, an increase in yellow rabbitbrush (*Chrysothamnus viscidiflorus*) is expected in most circumstances. The herbaceous component will also increase after fire or brush beating. The approach to this transition is indicated by an increase in rabbitbrush seedlings. The transition is triggered by wildfire or mechanical removal of sagebrush accompanied by heavy grazing.

Transition T3b: from State 3 to State 5 (Mountain Big Sagebrush Super-dominance State to Native Perennial Grass State)

Brush management using 2, 4-D or 2, 4-5T will remove both the shrub and forb components, leaving the grasses. This transition is triggered by herbicide application.

Transition T3c: from State 3 to State 6 (Mountain Big Sagebrush Super-dominance State to Introduced Grassland State)

This transition occurs when a decision is made to increase forage production by tilling and re-seeding with intermediate wheatgrass (*Thinopyrum intermedium*), smooth brome (*Bromus inermis*), or orchardgrass (*Dactylis glomerata*) –all introduced (non-native) species.

Restoration Pathway: R3a

Prescribed grazing during the non-growing season of the grasses and forbs will allow the native perennial herbaceous species to re-establish, returning the community to a mountain big sagebrush-steppe (State 2).

State 4: Yellow Rabbitbrush State

Community Phase 4.1: Yellow Rabbitbrush State

This State is characterized by having an abundance of yellow rabbitbrush and forb species and a reduced amount of mountain big sagebrush. This State occurs when the sagebrush is removed by fire or mechanical means from an area where it was previously super-dominant. This State is maintained by lack of sagebrush seedling establishment. It could also be maintained by periodic sagebrush removal by fire.

Community Phase 4.1: yellow rabbitbrush & forbs abundant/ mountain big sagebrush reduced

This Phase is characterized by having an abundance of yellow rabbitbrush and forb species and having a reduced amount of mountain big sagebrush.

Transition T4a: from State 4 to State 3 (Yellow Rabbitbrush State to Mountain Big Sagebrush Super-dominance State)

Heavy continuous season long grazing will impact the herbaceous component, allowing the shrubs to return to dominance.

State 5: Native Perennial Bunchgrass State

Community Phase 5.1: Native Perennial Bunchgrass State

This State is dominated by native perennial bunchgrasses such as slender wheatgrass, bluebunch wheatgrass, and Letterman's needlegrass. Shrubs and have been reduced and forbs eliminated by 2,4-D™ or 2,4-5T™ application. This State is maintained by the lack of shrub and forb seed source, and the abundance of native perennial grass seed source.

Community Phase 5.1: increased native perennial grasses/ shrubs reduced/ forbs eliminated

This Phase is characterized by the dominance of perennial native bunchgrasses such as slender wheatgrass, bluebunch wheatgrass, and Letterman's needlegrass. Shrubs and have been reduced and forbs eliminated.

Transition T5a: from State 5 to State 3 (Native Perennial Bunchgrass State to Mountain Big Sagebrush Super-dominance State)

Heavy continuous season long grazing will impact the native graminoids, allowing the shrubs to return to

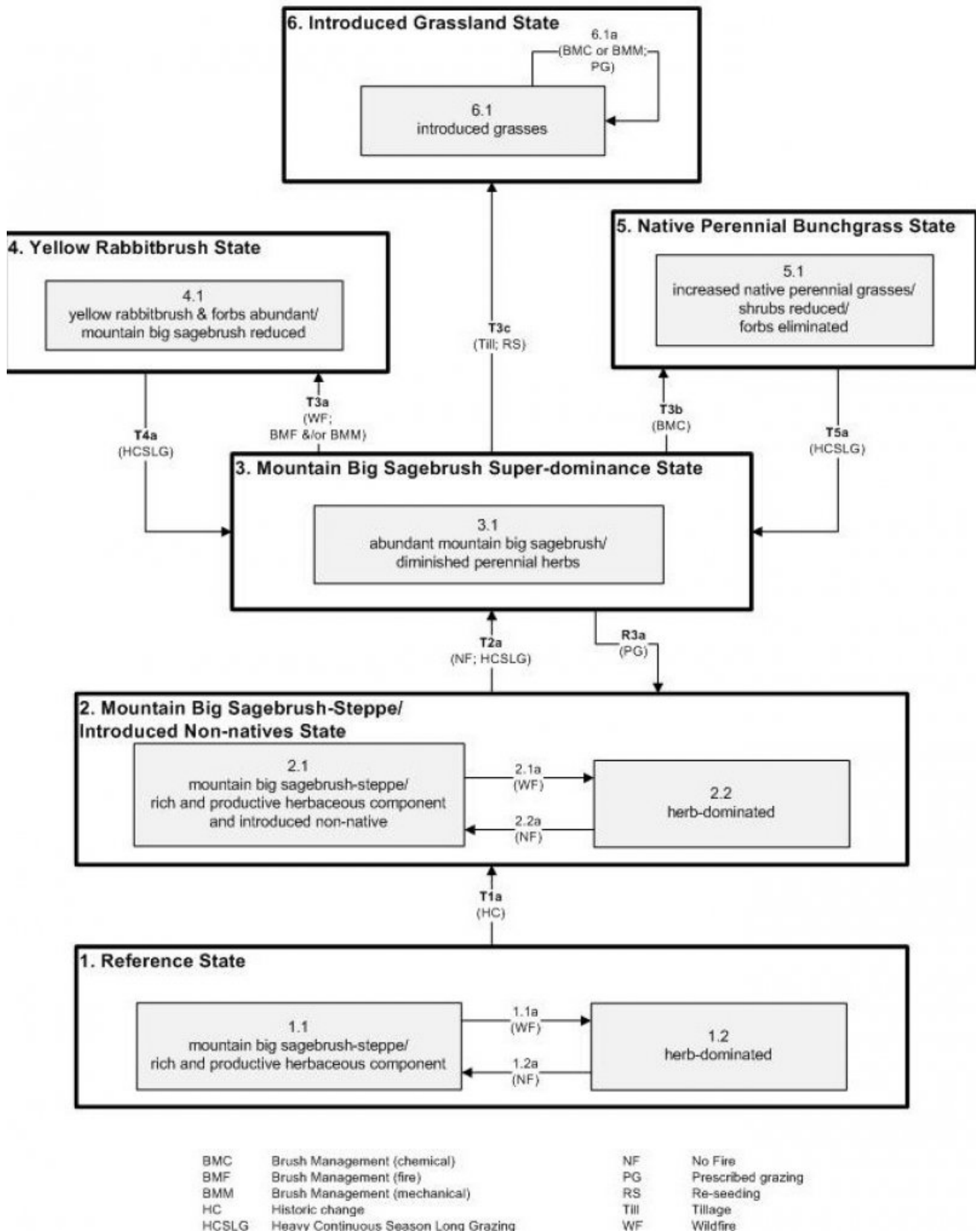
dominance. The approach to this transition is indicated by an increase in sagebrush seedlings. This transition is triggered by heavy growing season livestock grazing.

State 6: Introduced Grassland State

Community Phase 6.1: Introduced Grassland State

This state is characterized by the dominance of seeded grasses such as intermediate wheatgrass, smooth brome, or orchardgrass. This state occurs when a decision is made to increase forage production by tilling and re-seeding introduced grasses. Periodic brush management is required to maintain the grass-dominance of this state. This resiliency of this State can be maintained by sustainable levels of livestock grazing as determined by monitoring. Conversely, continued heavy use will negatively impact the resiliency of this state.

State and transition model



Inventory data references

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

Type Location: Consult the soil survey report

Other references

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Contributors

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Approval

Kirt Walstad, 3/05/2024

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/11/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**
