USDA Natural Resources
Conservation Service

Ecological site R034AA235UT
Semi-desert Shallow Loam (Wyoming big sagebrush)

Last updated: 9/07/2023
Accessed: 05/04/2024

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): 034A–Cool Central Desertic Basins and Plateaus

Major Land Resource Area (MLRA) 34A, Cool Central Desertic Basins and Plateaus, consists of approximately 21 million acres in Wyoming, Colorado and Utah, it consists of 11 Land Resource Units (LRU). These units are divisions of the MLRA based on geology, landscape, common soils, water resources and plant community potentials. The elevation spans from approximately 5600 feet (1700 m) along the Green River in UT and CO to approximately 9500 feet (2900 m) near Jeffrey City, WY. Annual precipitation ranges from 7 to 16 inches (177 to 406 mm), with the driest areas in the Green River and Great Divide Basins and the wettest areas in northern Carbon County, Southeast Fremont County and Albany County. There is a seasonal weather pattern that trends west to east, with more winter precipitation in the west and more spring/summer in the east, illustrated by diminishing amounts of Big Sagebrush in the eastern part of the MLRA.

LRU notes

The Bear River Valley LRU is located on the far western side of MLRA 34A between the Bear River Divide and the Monte Cristo Range, from Woodruff, Utah at the southern end to Cokeville, Wyoming at the northern end. The total area of the LRU is approximately 340,000 acres. It shares a boundary with MLRA 47, 43B and 46 (proposed).
This LRU differs from the others in its geology, which is comprised mostly of alluvium and colluvium from the Stump Formation. Its weather patterns are such that the soil moisture is xeric, there is a slight peak in winter precipitation in this LRU, with typical yearly precipitation between 9 to 15 inches (230 to 380 mm). The soil temperature regime of this LRU is frigid with mean annual soil temperatures ranging from 44 to 48 degrees Fahrenheit (6.7 to 8.8°C). The elevation range is from 5700 to 7000 feet (1730-2130 m). The soils in the Bear River Valley are dominated by young aged very deep soils developed from sandstone and shale parent material re-worked with recent alluvium. Soils are dominated by Alfisols with young argillic horizons and by Fluvents in more recent alluvium.
The Bear River runs through this LRU, allowing for ample amounts of irrigation water used in the lowland areas to produce hay. Smaller tributaries originating from the neighboring mountains.

Ecological site concept

• This site does not receive any additional water.
• These soils:
o are not saline or saline-sodic
o are shallow
o are skeletal within 20” of the soil surface; and have greater than 35 percent rock fragments at the soil surface
o are not strongly or violently effervescent in the surface mineral layer (within top 10”)
o have surface textures that usually range from sandy loam to loam in surface mineral layer (4”)
• have slopes less than 30 percent
• clay content is not greater than 35% in mineral soil surface layer (1-2”)

Associated sites

R034AA220UT	**Semi-desert Loam (Wyoming big sagebrush/ Bluebunch wheatgrass)**

Similar sites

R034AY263WY	**Shallow Loamy Calcareous Foothills and Basins West (SwLyCa)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata var. wyomingensis*
Herbaceous	Not specified

Physiographic features

This site occurs on hills and gentle slopes at elevations between 5,700 and 7,000 feet. Runoff is medium and flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	5,700–7,000 ft
Slope	4–25%
Water table depth	60 in
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by warm, dry summers and cold, snowy winters. This climate is modified by local topographic conditions. The mountains appreciably modify both the precipitation and temperature patterns. December, January, February, and July are the driest months; April, May, September and October are the wettest.

Table 3. Representative climatic features

Frost-free period (average)	79 days
Freeze-free period (average)	112 days
Precipitation total (average)	13 in

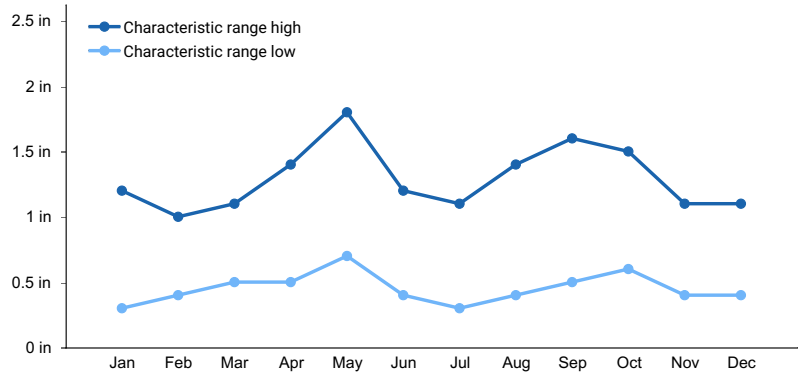

Figure 1. Monthly precipitation range

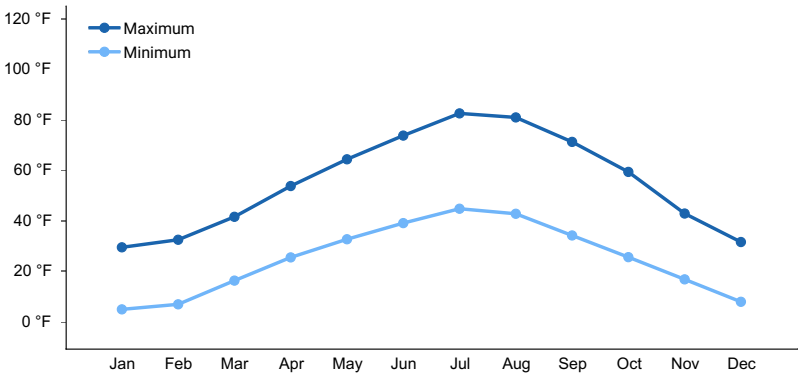

Figure 2. Monthly average minimum and maximum temperature

Influencing water features

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

Wetland description

N/A

Soil features

The soils of this site are shallow and formed in alluvium and colluvium derived from sandstone and conglomerate rock. The surface and subsurface textures are gravelly loams. Rock fragments increase with increasing depths. Bedrock is usually within 20 inches of the soil surface. These soils are moderately permeable and well to somewhat excessively drained. Given the shallow soils of this site, water-holding capacity is about 2 inches. The soil moisture regime is xeric, and the soil temperature regime is frigid.

Table 4. Representative soil features

Parent material	(1) Alluvium–conglomerate (2) Colluvium–sandstone
Surface texture	(1) Loam (2) Gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate
Soil depth	10–20 in
Surface fragment cover <=3"	15–35%

Available water capacity (0-40in)	2 in
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	60–90%

Ecological dynamics

It is impossible to determine in any quantitative detail the Reference Plant Community 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 (Galatowitsch 1990). 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 (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long (Parson 1996). 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.

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.

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 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 and transition model

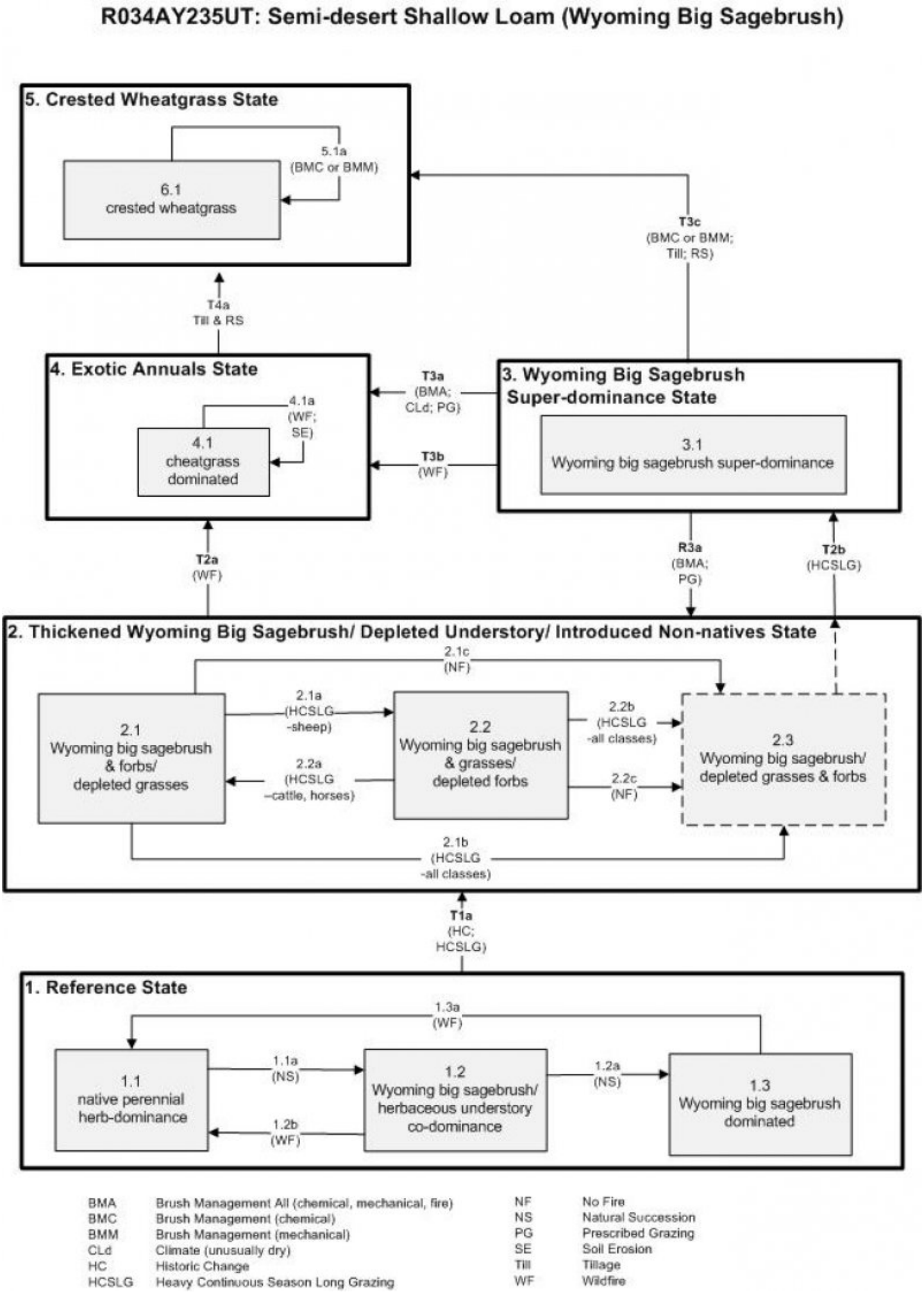

Figure 3. State and Transition Model

State 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 the familiarity of rangeland relict areas where they exist. The Reference State would have been characterized by varying amounts of Wyoming big sagebrush (*Artemisia tridentata* ssp. wyomingensis) and associated herb species. Phases would vary from herb-dominated (1.1) to shrub dominated (1.3) depending mainly on how long it had been since the last wildfire. Wildfire (1.3a, 1.2b) would have reset the successional clock back to an herb-dominated community (1.1). Over the course of an approximately a 30 to 40 year fire free period, through natural succession (1.1a), the site would have first developed into near equal coverage of brush and herbaceous components (1.2), but eventually (1.2a) Wyoming sagebrush would have ultimately become more dominant (1.3). The primary grasses would have included bluebunch wheatgrass (*Pseudoroegneria spicata*), Western wheatgrass (*Pascopyrum smithii*), Indian ricegrass (*Achnatherum hymenoides*), and needle and thread (*Hesperostipa comata*). Forbs would have included a mixture of buckwheat (Eriogonum spp.), tapertip hawksbeard (*Crepis acuminata*), stemless mock goldenweed (*Stenotus acaulis*), spiny phlox (*Phlox hoodii*), and granite prickly phlox (*Linanthus pungens*), among others. 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 1.1
Native perennial herb-dominance

Community Phase 1.1: native perennial herb-dominance This plant community would have been found shortly after the last wildfire and would have been dominated by assorted native perennial grasses including bluebunch wheatgrass, Western wheatgrass, Indian ricegrass, and needle and thread. Forbs would have included a mixture of buckwheats, tapertip hawksbeard, stemless mock goldenweed, spiny phlox, and granite prickly phlox.

Community 1.2
Wyoming big sagebrush/ herbaceous understory co-dominance

Community Phase 1.2: Wyoming big sagebrush/ herbaceous understory co-dominance This plant community would have been characterized as the co-dominance between shrubs, primarily Wyoming big sagebrush, and the herbaceous component.

Community 1.3
Wyoming big sagebrush dominance

Community Phase 1.3: Wyoming big sagebrush dominance This plant community would have been dominated by Wyoming big sagebrush. The native perennial understory would have been slightly less abundant compared to earlier successional phases (1.1 and 1.2).

Pathway CP 1.1A
Community 1.1 to 1.2

Community Pathway 1.1a: In the absence of any major disturbance (e.g. fire), through natural succession the Wyoming big sagebrush component would have slowly returned to this site.

Pathway CP 1.2B
Community 1.2 to 1.1

Community Pathway 1.2b: Wildfire would have temporarily removed the shrub component, resetting the vegetation back to an herb-dominated site.

Pathway CP 1.2A
Community 1.2 to 1.3

Community Pathway 1.2a: In the absence of any major disturbance such as fire, through natural succession the Wyoming big sagebrush component would have continued to increase and ultimately become more dominant than the herbaceous component.

Pathway CP 1.3A
Community 1.3 to 1.1

Community Pathway 1.3a: Wildfire would have temporarily removed the shrub component resetting the vegetation back to an herb-dominated site.

State 2
Thickened Wyoming Big Sagebrush/ Depleted Understory/ Introduced Non-natives State

State 2 is similar to State 1, 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 after the first few decades of Euro-American settlement, and can be regarded as the current potential. The irreversible historic changes and heavy growing season livestock utilization depleted the native perennial understory allowing the shrubs to thicken and dominate the site. A small component of introduced non-native species has now become part of the understory. Where cattle and horses were abundant (2.2a), the grasses were depleted (2.1), but with the later shift to sheep (2.1a), the forbs declined (2.2). Where combined grazing took place (2.1c), the shrubs continued to expand at the expense of both forbs and grasses (2.3). Lack of wildfire also served to allow increasing dominance of Wyoming big sagebrush, to the detriment of the herbs (2.1b, 2.2c). The stability of this State is maintained by a healthy, productive, and diverse plant community that can provide native seed sources and promotes soil stability, water infiltration, and soil moisture retention. The resiliency of this State will be maintained by a reduction in livestock grazing, especially during the growing season of desirable herbs. Conversely, continued heavy livestock grazing, especially during the growing season of desirable herbs, will negatively impact the resiliency of this State.

Community 2.1
Wyoming big sagebrush & forbs/ Depleted grasses

Community Phase 2.1: Wyoming big sagebrush & forbs/ Depleted grasses This plant community is found where heavy utilization by cattle and horses has taken place, leaving the Wyoming big sagebrush and a perennial forb-dominated understory.

Community 2.2
Wyoming big sagebrush & grasses/ Depleted forbs

Community Phase 2.2: Wyoming big sagebrush & grasses/ Depleted forbs This plant community is found where heavy utilization by sheep has taken place, leaving the Wyoming big sagebrush and a perennial bunchgrass-dominated understory.

Community 2.3
Wyoming big sagebrush/ depleted forbs & grasses

Community Phase 2.3: Wyoming big sagebrush/ depleted forbs & grasses This plant community is found where heavy utilization by all grazers has taken place and where there has been prolonged fire suppression. Both the grass and forb components are reduced and Wyoming big sagebrush is dominant.

Pathway CP 2.1A
Community 2.1 to 2.2

Community Pathway 2.1a: Heavy continuous grazing by sheep will deplete the native forbs.

Pathway CP 2.1B and CP 2.2C
Community 2.1 to 2.3

Community Pathway 2.1b: Heavy utilization by all classes of livestock will reduce both the grass and forb

components, allowing the Wyoming big sagebrush to become dominant. Community Pathway 2.1c: Fire suppression serves to allow the sagebrush to become increasingly dominant at the expense of the herbs.

Pathway CP 2.2A
Community 2.2 to 2.1

Community Pathway 2.2a: Heavy continuous grazing by cattle and horses will deplete the native bunchgrass component.

Pathway CP 2.2B
Community 2.2 to 2.3

Community Pathway 2.2b: Heavy utilization by all classes of livestock will reduce both the grass and forb components, allowing the Wyoming big sagebrush to become dominant. Community Pathway 2.2c: Fire suppression serves to allow the sagebrush to become increasingly dominant at the expense of the herbs.

State 3
Wyoming Big Sagebrush Super-dominance State

The Wyoming Big Sagebrush Super-dominance State is characterized by very dense Wyoming big sagebrush and an understory much depleted of its native herbaceous understory. Some introduced non-native species such as cheatgrass (*Bromus tectorum*) are present. This State is maintained by an abundant seed source for Wyoming big sagebrush, the lack of a healthy, productive and diverse herb component capable of providing native seed source, soil stabilization, and soil moisture retention, and also by lack of fire. Continued heavy grazing, particularly during the growing season of perennial herbs, will reduce the resiliency of this State; lighter grazing will allow for the State to remain resistant to change.

Community 3.1
Wyoming Big Sagebrush Super-dominance

Community Phase 3.1: Wyoming big sagebrush super-dominance This plant community is characterized by very dense Wyoming big sagebrush and a much reduced perennial herbaceous understory.

State 4
Exotic Annuals State

Exotic annuals may come to dominate the site if brush removal treatments take place during an extreme dry period, treatments are not provided adequate time to rest post-treatment, and subsequent grazing is light. The fire return interval is dramatically shortened compared to previous states, and many areas may also experience accelerated soil erosion (4.1a) which further contributes to the spiral of degradation. The stability of this State is maintained by recurrent fire and by soil erosion.

Community 4.1
Cheatgrass dominated

Community Phase 4.1: cheatgrass dominated This plant community is dominated by exotic annuals, primarily cheatgrass. Rabbitbrush (Chrysothamnus spp.) may also occur in this phase if frequent wildfire has not removed them. Community Pathway 4.1a: Wildfires become frequent, driven by the heavy fuel loading of exotic annuals. Accelerated soil erosion further contributes to the spiral of degradation.

State 5
Crested Wheatgrass State

Crested wheatgrass (5.1) will be found on sites where it has been planted to provide a higher level of productivity or to control soil erosion. To keep the shrubs from re-invading, it may be necessary to follow up with additional chemical or mechanical treatment (5.1a). This resiliency of this State can be maintained by moderate livestock grazing, but excessive livestock grazing will reduce its resiliency.

Community 5.1
Crested Wheatgrass

Community Phase 5.1: crested wheatgrass This plant community is characterized by a near-monoculture of crested wheatgrass. Community Pathway 5.1a: Maintenance of this state may require retreatment of the brush using chemicals or tilling to maintain grass dominance and remove re-invaded shrubs.

Transition T1A
State 1 to 2

Transition T1a: from State 1 to State 2 (Reference State to Thickened Wyoming Big Sagebrush/ Depleted Understory/ Introduced Non-natives State) The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, has caused State 1 to transition to State 2. The introduction of European livestock and exotic plants, in large part, led to diminishment of the native understory and a thickening of Wyoming big sagebrush. Graminoids were decimated under cattle and horse grazing; forbs were decimated if sheep were the dominant livestock. Where there was combined grazing (the more usual history), both grasses and forbs were decimated. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

Transition T2B
State 2 to 3

Transition T2b: from State 2 to State 3 (Thickened Wyoming Big Sagebrush/ Depleted Understory/ Introduced Non-natives State to Wyoming Big sagebrush Super-dominance State) With further heavy season-long grazing, sagebrush develops into a super-dominant that must be broken by mechanical, chemical, pyric, or biological means (R3a). The approach to this transition is indicated by an increase in the size and age of sagebrush, and a depletion of the native perennial herbaceous understory. This transition is triggered by continued heavy season-long grazing.

Constraints to recovery. Heavy season-long grazing

Transition T2A
State 2 to 4

Transition T2a: from State 2 to State 4 (Thickened Wyoming Big Sagebrush/ Depleted Understory/ Introduced Non-natives State to Exotic Annual State) Wildfire is capable of changing a Wyoming big sagebrush-dominated state (State 2) and converting it to one dominated by cheatgrass (State 4), particularly when the presence of cheatgrass has already appeared in the understory.

Constraints to recovery. Wildfire

Restoration pathway R3A
State 3 to 2

Restoration Pathway R3a: from State 3 to State 2 (Wyoming Big sagebrush Super-dominance State to Thickened Wyoming Big Sagebrush/ Depleted Understory/ Introduced Non-natives State) It may be possible to reduce the sagebrush super-dominance through mechanical, chemical, pyric, or biological means. Of the latter, high intensity short duration grazing (Washington-Allen 2003) or supplemented fall sheep grazing (Woodland 2007) offer promise for breaking the sagebrush super-dominance and allowing partial recovery of the herbaceous understory.

Transition T3A and T3B
State 3 to 4

Transition T3a: from State 3 to State 4 (Wyoming Big sagebrush Super-dominance State to Exotic Annuals State) If brush management of any type (with mechanical, chemical, or prescribed fire) takes place during a period of declining rainfall, is not rested immediately following the treatment, and is subsequently grazed conservatively, there is danger of these areas slipping into a cheatgrass-dominated state. This transition is triggered by brush management followed by inadequate rest from grazing. Transition T3b: from State 3 to State 4 (Wyoming Big

sagebrush Super-dominance State to Exotic Annuals State) The occurrence of a hot wildfire in the Wyoming Big Sagebrush Super-dominance State can trigger a transition to the Exotic Annuals State. This could occur following the buildup of fine fuels in State 3, which may be encouraged by an unusually wet winter or spring and subsequent light grazing. The approach to this transition is indicated by a buildup of fine, continuous fuels. Subsequent fires tend to re-occur every 3 to5 years.

Transition T3C
State 3 to 5

Transition T3c: from State 3 to State 5 (Wyoming Big sagebrush Super-dominance State to Crested Wheatgrass State) Land managers unhappy with diminished herbage production in State 3 can opt for mechanical or chemical removal of shrubs and seeding with crested wheatgrass (*Agropyron cristatum*). This requires, however, occasional reduction of re-invading brush by chemical or mechanical means.

Transition T4A
State 4 to 5

Transition T4a: from State 4 to State 5 (Exotic Annuals State to Crested Wheatgrass State) It may be possible for land managers to improve forage conditions by tilling and reseeding with crested wheatgrass to assist the transition from a purely dominated cheatgrass site to one dominated more by crested wheatgrass, a more desirable species for livestock.

Additional community tables

Inventory data references

Data gathered by qualified range professionals within NRCS and cooperating partners.

Other references

Galatowitsch, S.M. 1990. Using the original land survey notes to reconstruct pre-settlement landscapes in the American West. Great Basin Naturalist: 50(2): 181-191. Keywords: [Western U.S., conservation, history, human impact]

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USDA-NRCS. 2003. National Range and Pasture Handbook. in USDA, editor, USDA-Natural Resources Conservation Service-Grazing Lands Technology Institute. Keywords: [Western US, Federal guidelines, Range pasture management]

Washington-Allen, R. A. 2003. Retrospective ecological risk assessment of rangeland health using multi-temporal satellite imagery. Dissertation. Utah State University, Logan, UT. Keywords: [Rich County, Utah, Ecological assessment, rangelands, remote sensing, historic land use, rangeland health]

Woodland, R.D., 2007. Influence of fall grazing by sheep on plant productivity, shrub age class structure, and herbaceous species diversity in sagebrush steppe. Master’s Thesis, Utah State University, Utah, USA.

Contributors

USU

Approval

Kirt Walstad, 9/07/2023

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	05/04/2024
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:**