USDA Natural Resources
Conservation Service

Ecological site R034AA228UT
Semi-desert Gravel (Bluebunch wheatgrass/ Wyoming big sagebrush)

Last updated: 9/07/2023
Accessed: 05/18/2024

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 to 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 moderately deep to deep
o are skeletal within 20” of the soil surface; and have greater than 35 percent rock fragments in the soil subsurface
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

R034AA235UT	**Semi-desert Shallow Loam (Wyoming big sagebrush)**

Similar sites

R034AY212WY	**Gravelly Foothills and Basins West (Gr)**
R034AY162WY	**Shallow Loamy Green River and Great Divide Basins (SwLy)**

Table 1. Dominant plant species

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

Physiographic features

This site is located on toes slopes, alluvial fans, and ridges at elevations between 5,700 and 7,000 feet. It occurs on all aspects at slopes between 3 and 30 percent. Runoff is medium and flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	1,737–2,134 m
Slope	3–30%
Water table depth	152 cm
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. April, May, September and October are the wettest months; December, January, February and July are the driest.

Table 3. Representative climatic features

Frost-free period (average)	79 days
Freeze-free period (average)	112 days
Precipitation total (average)	330 mm

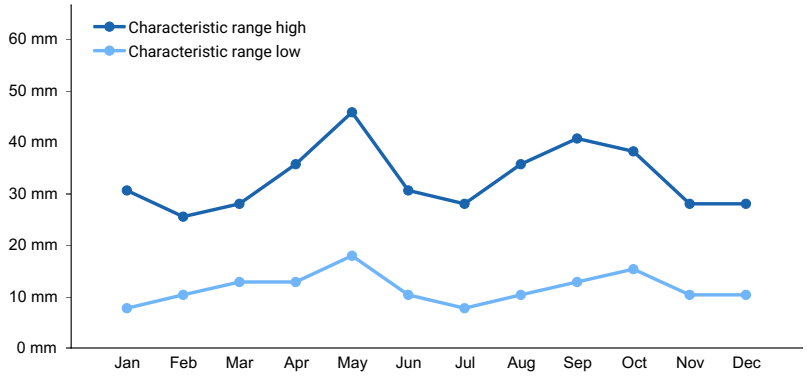

Figure 1. Monthly precipitation range

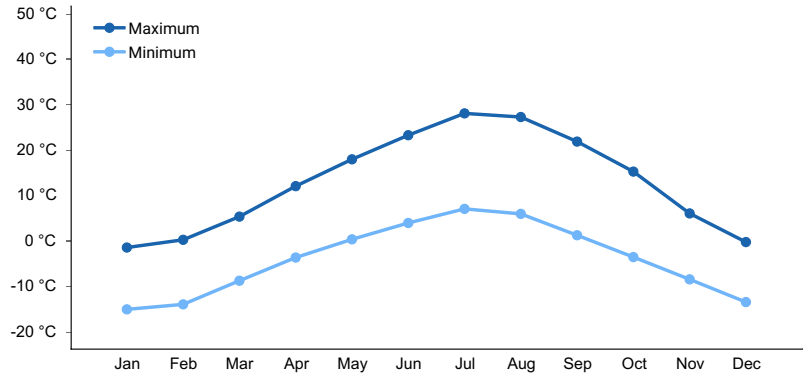

Figure 2. Monthly average minimum and maximum temperature

Influencing water features

This site is not typically influenced by streams or wetlands.

Wetland description

N/A

Soil features

This soils of this site are moderately deep to deep and formed in alluvium and colluvium derived from limestone, sandstone, and conglomerate rocks. Surface and subsurface textures are gravelly loams and sandy loams. Rock fragments are usually found on the soil surface and throughout the soil profile. These soils are somewhat excessively well-drained and permeability is moderate to moderately-rapid. Available water-holding capacity ranges from 3 to 6 inches in the upper 40 inches of soil. The soil moisture regime is xeric and the soil temperature regime is frigid.

Table 4. Representative soil features

Parent material	(1) Alluvium–metamorphic and sedimentary rock (2) Colluvium–metamorphic and sedimentary rock
Surface texture	(1) Gravelly loam (2) Sandy loam
Family particle size	(1) Loamy
Drainage class	Somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	51–152 cm
Surface fragment cover <=3"	15–35%

Surface fragment cover >3"	15–60%
Available water capacity (0-101.6cm)	7.62–15.24 cm
Soil reaction (1:1 water) (0-101.6cm)	8.4–9
Subsurface fragment volume <=3" (Depth not specified)	15–90%
Subsurface fragment volume >3" (Depth not specified)	0–35%

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/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 and transition model

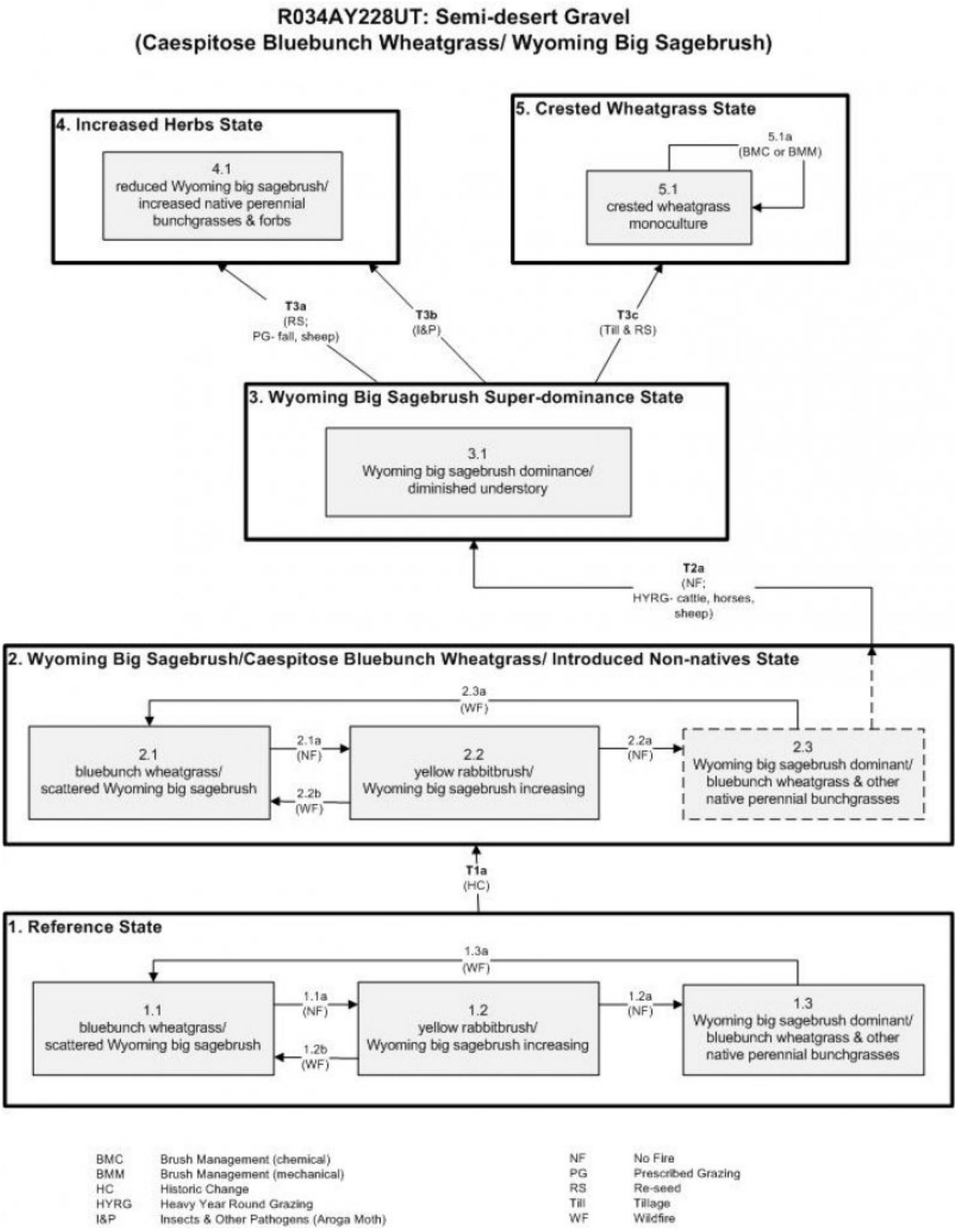

Figure 3. State and Transition Model

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 familiarity with rangeland relict areas where they exist. Before Euro-American settlement, this would have been a moderately vegetated variant of semi-desert sagebrush with about 60 percent of the forage production from grasses, 15 percent forbs, and 15 percent woody plants, primarily from Wyoming big sagebrush (*Artemisia tridentata* spp. wyomingensis). The productivity would have been relatively higher than nearby non-gravelly (e.g. R034AY2ggUT Semi-desert Loam Ecological Site) because of the Inverse Texture Principle (Noy-Meir, 1973). In deserts and semi-deserts, finer textured soils are effectively drier and thus typically have lower production potential than coarser textured soils. The major grasses would have included a caespitose form of bluebunch wheatgrass (*Pseudoroegneria spicata*), slender wheatgrass (*Elymus trachycaulus*), Western wheatgrass (*Pascopyrum smithii*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread (*Hesperostipa comata*). Other grasses and grass-likes would have included prairie junegrass (*Koeleria macrantha*), bottlebrush squirreltail (*Elymus elymoides*), Sandberg bluegrass (*Poa secunda*), and thickspike wheatgrass (*Elymus lanceolatus*). Other associated woody species may have included yellow rabbitbrush (*Chrysothamnus viscidiflorus*), black sagebrush (*Artemisia nova*), and winterfat (*Krascheninnikovia lanata*). 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. Total annual forage production of these sites would have averaged approximately 400 to 700 pounds per acre. The fire return interval would have averaged approximately 20 to 25 years. The phases of this ESD would have depended on the time since last fire, starting with a bluebunch wheatgrass-dominated site (1.1) immediately following fire (1.3a, 1.2b), with yellow rabbitbrush becoming temporarily dominant 5 to 15 years post-fire (1.1a), followed by return to Wyoming big sagebrush dominance with a bunchgrass understory (1.3) 15 to 20 years post-fire (1.2a).

Community 1.1
Reference State

Community Phase 1.1: bluebunch wheatgrass/ scattered Wyoming big sagebrush This plant community would have been characterized by the temporary dominance of assorted native perennial bunchgrasses, primarily a caespitose form of bluebunch wheatgrass, and a scattering of Wyoming big sagebrush. Dominant grasses would have included Western wheatgrass, needle-and-thread, Indian ricegrass, prairie junegrass, and bottlebrush squirreltail. This community would have existed for approximately the first decade following fire.

Community 1.2
Yellow rabbitbrush/ Wyoming big sagebrush increasing

Community Phase 1.2: yellow rabbitbrush/ Wyoming big sagebrush increasing This plant community would have existed approximately 5 to 15 years post-wildfire, and would have had yellow rabbitbrush as the dominant species with a slight increase in Wyoming big sagebrush.

Community 1.3
Wyoming big sagebrush dominant/ bluebunch wheatgrass & other native perennial bunchgrasses

Community Phase 1.3: Wyoming big sagebrush dominant/ bluebunch wheatgrass & other native perennial bunchgrasses The balance between Wyoming big sagebrush and bluebunch wheatgrass would have returned following at least a 25 year period since the last wildfire. Other native perennial bunchgrasses such as Western wheatgrass, needle and thread, Indian ricegrass, prairie junegrass, and bottlebrush squirreltail would have also been present.

Pathway CP 1.1A
Community 1.1 to 1.2

Community Pathway 1.1a: As time increased since the last wildfire, yellow rabbitbrush and Wyoming big sagebrush would have increased.

Pathway CP 1.2B

Community 1.2 to 1.1

Community Pathway 1.2b: Wildfire would have reset the successional clock back to a graminoid dominated site, temporarily removing most of shrubs.

Pathway CP 1.2A
Community 1.2 to 1.3

Community Pathway 1.2a: As the length of time increased since last wildfire, (i.e. greater than 25 years), the balance between Wyoming big sagebrush and bluebunch wheatgrass would have slowly returned.

Pathway CP 1.3A
Community 1.3 to 1.1

Community Pathway 1.3a Wildfire would have reset the successional clock back to a graminoid dominated site by removing the majority of the sagebrush and allowing the native perennial bunchgrass, mainly bluebunch wheatgrass, to increase and be temporarily dominant.

State 2
Wyoming big Sagebrush/ Caespitose bluebunch Wheatgrass/ Introduced Non-natives State

State 2 is very similar 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 immediately following Euro-American settlement, and is considered the current potential for this site. The phases of this State vary between a bluebunch wheatgrass dominated phase (2.1), to a yellow rabbitbrush/ Wyoming big sagebrush invaded phase (2.2), to a Wyoming big sagebrush with bluebunch wheatgrass understory phase (2.3), which develop according to the time since last wildfire (2.3a or 2.2b, 2.1a, 2.2a, respectively). This State is maintained by periodic wildfire, which reduces the sagebrush component, and a productive understory capable of providing a seed source for native herbaceous species. The resiliency of this state is reduced by lack of occasional wildfire and loss of native seed source. Moderate levels of growing-season livestock utilization will allow this State to maintain its resiliency, but excessive levels of growing-season livestock utilization will reduce its resiliency.

Community 2.1
Bluebunch wheatgrass/ Scattered Wyoming big sagebrush

Community Phase 2.1: bluebunch wheatgrass/ Scattered Wyoming big sagebrush This plant community is characterized by the temporary dominance of assorted native perennial bunchgrasses, primarily a caespitose form of bluebunch wheatgrass, and a scattering of Wyoming big sagebrush. Dominant grasses include Western wheatgrass, needle-and-thread, Indian ricegrass, prairie junegrass, and bottlebrush squirreltail. This community is typically found to occur within the first 5 years following wildfire.

Community 2.2
Yellow rabbitbrush/ Wyoming big sagebrush increasing

Community Phase 2.2: yellow rabbitbrush/ Wyoming big sagebrush increasing This plant community is typical approximately 5 to 15 years post-wildfire, where yellow rabbitbrush is the current dominant species, and with a slight increase in Wyoming big sagebrush.

Community 2.3
Wyoming big sagebrush dominant/ bluebunch wheatgrass & other native perennial bunchgrasses

Community Phase 2.3: Wyoming big sagebrush dominant/ bluebunch wheatgrass & other native perennial bunchgrasses The balance between Wyoming big sagebrush and bluebunch wheatgrass will return following at least a 20 year period since the last wildfire. Other native perennial bunchgrasses such as Western wheatgrass, needle and thread, Indian ricegrass, prairie junegrass, and bottlebrush squirreltail will also be present.

Pathway CP 2.1A
Community 2.1 to 2.2

Community Pathway 2.1a: As time increases since the last wildfire, yellow rabbitbrush and Wyoming big sagebrush will increase.

Pathway CP 2.2B
Community 2.2 to 2.1

Community Pathway 2.2b: Wildfire will reset the successional clock back to a graminoid dominated site, temporarily removing most of shrubs.

Pathway CP 2.2A
Community 2.2 to 2.3

Community Pathway 2.2a: After approximately 20 to 25 years since the last wildfire, a balance between Wyoming big sagebrush and bluebunch wheatgrass will return.

Pathway CP 2.3A
Community 2.3 to 2.1

Community Pathway 2.3a Wildfire will reset the successional clock back to a graminoid dominated site, removing the majority of the sagebrush and allowing the native perennial bunchgrasses, mainly bluebunch wheatgrass, to increase and be temporarily dominant.

State 3
Wyoming Big Sagebrush Super-dominance State

The plant community that characterizes this state is a tall, dense stand of Wyoming big sagebrush with a diminished understory. The Wyoming big sagebrush will remain super-dominant as wildfire continues to be suppressed, and with heavy unrestricted grazing of livestock. The chance of wildfire has diminished due to lack of fine fuels. This State is maintained by the continuation of fire suppression and heavy livestock grazing.

Community 3.1
Wyoming Big Sagebrush Super-dominance

Plant Community Phase 3.1: Wyoming big Sagebrush Super-dominance This plant community is dominated by tall, dense Wyoming big sagebrush that have increased at the expense of associated understory species.

State 4
Increased Herbs State

It is possible to see a reduction in the super-dominance of sagebrush through prescribed grazing using sheep in fall months or, alternatively, following an outbreak of Aroga moth. Sheep will focus on sagebrush when no other forage is available, and Aroga moths are capable of killing off large stands of sagebrush. Reducing the sagebrush dominance could allow the native perennial grasses and forbs to re-establish in the following spring (4.1). While there has been some invasion of exotics, such as the mustards (primarily Descurainia spp. and Sisymbrium altissimun) and cheatgrass (*Bromus tectorum*) in this State, the examples of where they occur in Rich County are only for short periods of time unless the disturbance is continuous. This is because the Wasatch Formation from which these soils are derived had their nutrients depleted when subtropical forests of the Miocene occupied these parent materials. Persisting dominance of invasives such as cheatgrass, require the higher planes of soil nutrients available from younger, less-leached parent materials. This State can be maintained by deferring growing-season grazing in some years, but a return to intense growing-season grazing will reduce the resiliency of this State.

Community 4.1
Reduced Wyoming big sagebrush/ increased native perennial bunchgrasses & forbs

Community Phase 4.1: reduced Wyoming big sagebrush/ increased native perennial bunchgrasses & forbs This plant community may have some decrease in Wyoming big sagebrush, but a noticeable increase in the native perennial understory.

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. 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 crested wheatgrass monoculture. Community Pathway 5.1a: Maintenance of this state requires 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 Wyoming big Sagebrush/ Caespitose bluebunch Wheatgrass/ 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. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

Transition T2A
State 2 to 3

Transition T2a: from State 2 to State 3 (Wyoming Big Sagebrush/ Caespitose Bluebunch Wheatgrass/ Introduced Non-natives State to Wyoming Big Sagebrush Super-dominance State) The major driving factors behind this transition include several decades of fire suppression, which allows the sagebrush component to increase in age, height, and density. This, combined with heavy, near year-around grazing by cattle and horses, results in a diminishment of the graminoids. Subsequent use by sheep results in further loss of the native forb component. The approach to this transition is indicated by a loss of understory species. This transition is triggered by heavy livestock utilization during the growing season of desirable understory species. It may be possible to restore this community (return to State 2) if accelerated soil erosion has not ensued.

Transition T3A and T3B
State 3 to 4

Transition T3a: from State 3 to State 4 (Wyoming Big Sagebrush Super-dominance State to Increased Herbs State) Recent work by Woodland (2007) shows that the sagebrush dominance can be broken and, at minimum, the graminaceous understory can be enhanced if supplemental fall sheep grazing is employed. Recovery of the native perennial forb component will probably require simultaneous reseeding in conjunction with the supplemented sheep grazing during the fall when every plant except sagebrush is dormant. Transition T3b: from State 3 to State 4 (Wyoming Big Sagebrush Super-dominance State to Increased Herbs State) The transition from a Sagebrush Super-dominant State to an Increased Herb State can also take place following an outbreak of Aroga moth (Woodland 2007). This transition may be possible if accelerated soil erosion has not ensued.

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. This requires, however, occasional reduction of re-

invading brush by chemical or mechanical means.

Additional community tables

Animal community

The suitability for livestock grazing is fair to good. This site provides grazing for cattle and sheep year-round, however prolonged heavy grazing during spring will lead to loss of the perennial grasses and expansion of unpalatable shrubs and exotics.

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]

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	05/18/2024
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:**