USDA Natural Resources
Conservation Service

Ecological site R034AA205UT
Semi-desert Stony Loam (Black sagebrush)

Last updated: 9/07/2023
Accessed: 04/25/2024

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 (2900m) 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 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, deep, or very deep
o are skeletal within 20” of the soil surface; and have greater than 35 percent rock fragments at the soil surface
o are 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

R034AA207UT	**Semi-desert Shallow Loam (Black sagebrush)**

Similar sites

R034BY227UT	**Semidesert Shallow Loam (Black Sagebrush)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia nova*
Herbaceous	(1) *Achnatherum hymenoides*

Physiographic features

This site occurs on alluvial fans, benches and gentle slopes at elevations between 5,700 and 7,000 feet. It occurs on all aspects and at slopes ranging from 2 to 30 percent. The water table is greater than 60 inches below the soil surface. Runoff is medium and flooding and ponding do not occur on this site.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan
Flooding frequency	None
Ponding frequency	None
Elevation	5,700–7,000 ft
Slope	2–30%
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. 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)	13 in

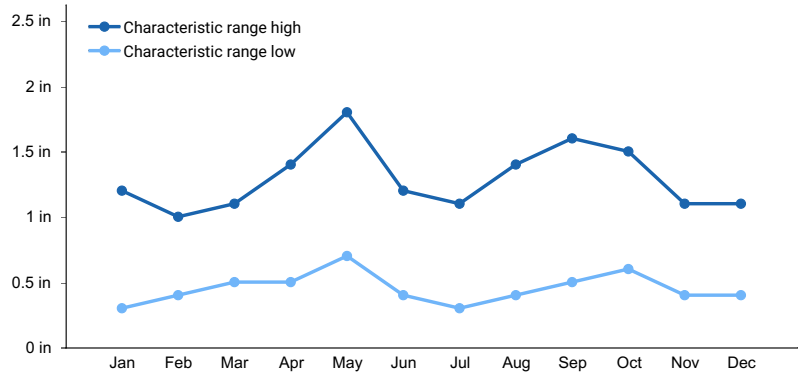

Figure 1. Monthly precipitation range

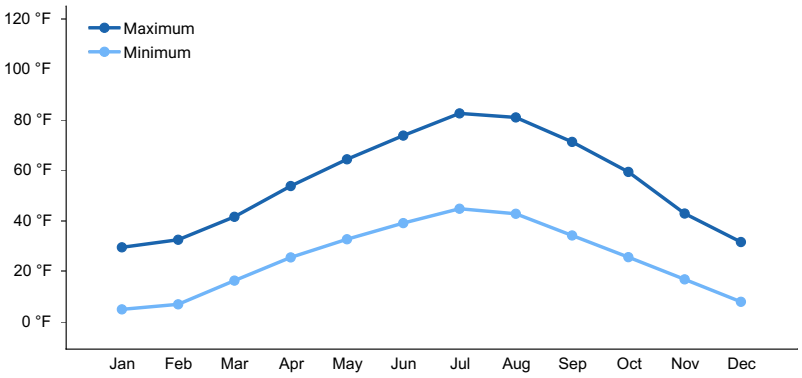

Figure 2. Monthly average minimum and maximum temperature

Influencing water features

This site is not typically influenced by streams or wetlands.

Wetland description

N/A

Soil features

The soils of this site are moderately deep to deep and formed in colluvium or residuum derived from limestone, sandstone, shale, or conglomerate rock. Surface and subsurface textures are loams or sandy loams. Rock fragments may be present on the soil surface and throughout the profile and may constitute up to 60 percent of the soil volume. These soils are well- to somewhat excessively well-drained with moderate to moderately rapid permeability. Available water holding capacity ranges from 4 to 6 inches of water 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) Colluvium–metamorphic and sedimentary rock (2) Residuum–metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	20 in
Surface fragment cover <=3"	0–60%

Surface fragment cover >3"	15–60%
Available water capacity (0-40in)	4–6 in
Soil reaction (1:1 water) (0-40in)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	0–60%
Subsurface fragment volume >3" (Depth not specified)	15–60%

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

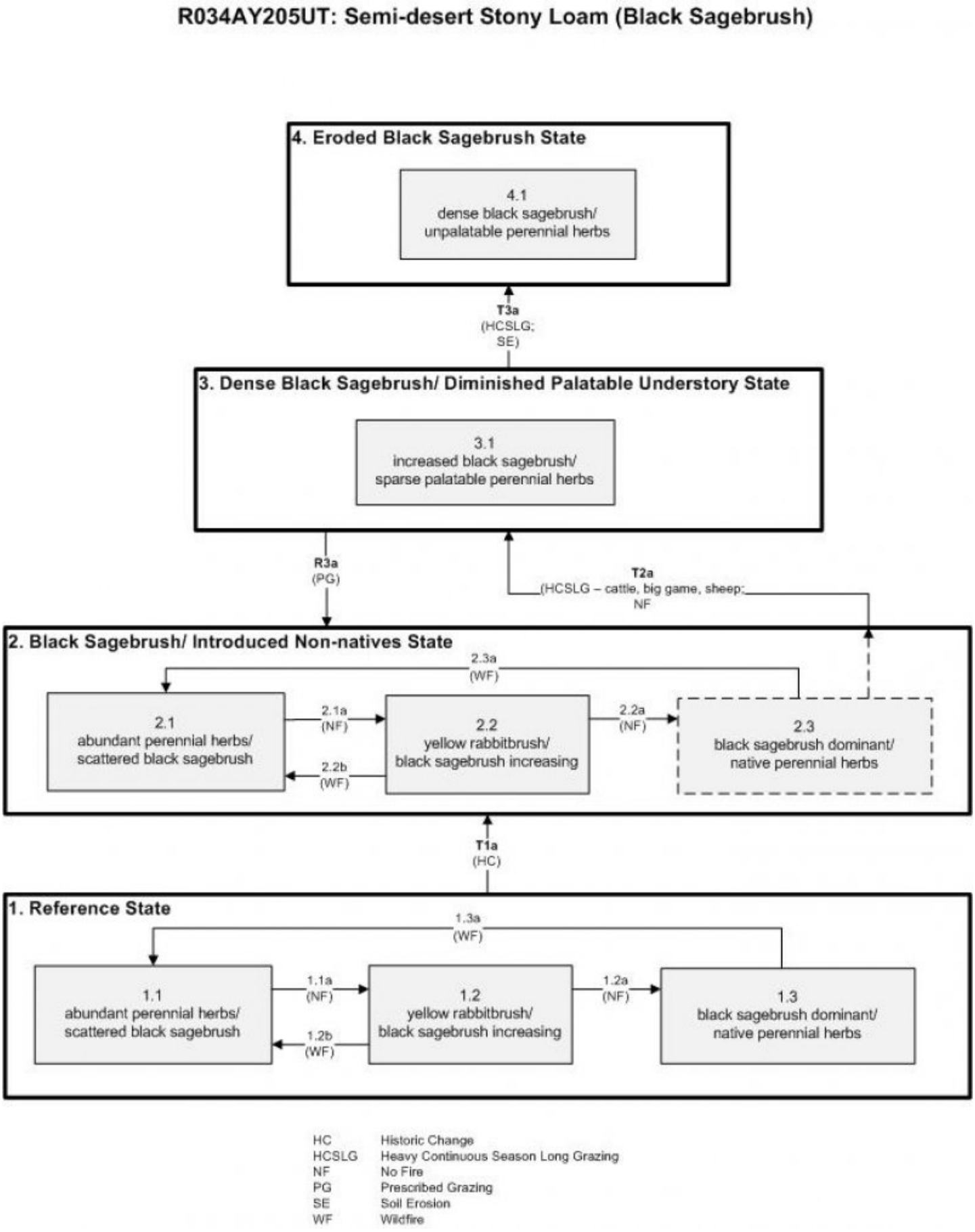

Figure 3. State and Transition Model

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, the Reference plant community (1.1) would have been characterized by scattered black sagebrush (*Artemisia nova*) and abundant perennial herbs. The major grasses would have included Indian ricegrass (*Achnatherum hymenoides*) and needle-and-thread (*Hesperostipa comata*). Primary forbs would have included various buckwheat species (*Eriogonum caespitosum*, *E. microthecum*, *E. ovalifolium*, *E. umbellatum*), globemallow (Sphaeralcea spp.), and spiny phlox (*Phlox hoodii*). 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. The productivity would have been relatively higher than the similar, but shallow loamy sites (e.g. 034AY2ppUT Semi-desert Shallow 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 phases of this State would have depended on the time since last fire, starting with a perennial herb-dominated phase (1.1) immediately following fire (1.3a, 1.2b), with yellow rabbitbrush (*Chrysothamnus viscidiflorus*) becoming temporarily dominant (1.2) approximately 5 to 15 years post fire (1.1a), and finally the re-establishment of black sagebrush (1.3) approximately 20 to 30 years post fire (1.2a).

Community 1.1
Abundant perennial herbs/ scattered black sagebrush

Community Phase 1.1: abundant perennial herbs/ scattered black sagebrush This plant community would have been characterized by the temporary dominance of assorted native perennial bunchgrasses, primarily Indian ricegrass and needle-and-thread, and a scattering of black sagebrush. Primary forbs would have included buckwheats and globemallow. This community would have existed for up to15 years following the most recent fire event.

Community 1.2
Yellow rabbitbrush/ black sagebrush increasing

Community Phase 1.2: yellow rabbitbrush/ black sagebrush increasing This plant community would have existed approximately 20 to 30 years post wildfire, and would have had yellow rabbitbrush as the dominant species, and a slight increase in black sagebrush.

Community 1.3
Black sagebrush dominant/ native perennial herbs

Community Phase 1.3: black sagebrush dominant/ native perennial herbs The balance between black sagebrush the native perennial forbs and grasses would have returned following at least a 40 year period since the last wildfire.

Pathway CP 1.1A
Community 1.1 to 1.2

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

Pathway CP 1.1B
Community 1.1 to 1.3

Community Pathway 1.1B: As length of time increased since the last wildfire, (i.e. greater than 30 years) the balance between black sagebrush and the native perennial understory would have slowly returned.

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 the shrubs.

Pathway CP 1.2A
Community 1.2 to 1.3

Community Pathway 1.2a Wildfire would have reset the successional clock back to a graminoid dominated site, removing the majority of the sagebrush and allowing the native perennial bunchgrasses to increase and be temporarily dominant.

State 2
Black Sagebrush/ 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 native bunchgrass dominated phase (2.1), to a yellow rabbitbrush/ black sagebrush invaded phase (2.2), to a black sagebrush with native perennial understory phase (2.3), which develop according to the time since last wildfire (2.3a or 2.2b, 2.1a, 2.2a, respectively). The resiliency of this state is maintained by the availability of native seed sources for both the herbaceous species and for black sagebrush, and by wildfire. The resiliency of this State can be negatively impacted by heavy livestock and big game grazing.

Community 2.1
Black Sagebrush/ Introduced Non-natives State

Community Phase 2.1: abundant perennial herbs/ scattered black sagebrush This plant community is characterized by the temporary dominance of assorted native perennial bunchgrasses, primarily Indian ricegrass and needle-and-thread, and a scattering of black sagebrush. Common forb species include buckwheats, globemallow, and prickly phlox. A small component of introduced species will also be present. This community is typically found to occur within the first 15 years following wildfire.

Community 2.2
Yellow rabbitbrush/ black sagebrush increasing

Community Phase 2.2: yellow rabbitbrush/ black sagebrush increasing This plant community is typical approximately 15 to 30 years post wildfire, where yellow rabbitbrush is the currant dominant species, and with a slight increase in black sagebrush.

Community 2.3
Black sagebrush dominant/ native perennial herbs

Community Phase 2.3: black sagebrush dominant/ native perennial herbs The balance between black sagebrush and the native perennial herbs will return following at least a 30 year period since the last wildfire. A small component of introduced species 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 black 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 30 years since the last wildfire, a balance between black sagebrush and the native perennial herbs 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 to increase and be temporarily dominant.

State 3
Dense Black Sagebrush/ Diminished Palatable Understory State

A denser stand of black sagebrush and an understory diminished in palatable herbaceous species (3.1) will be found on sites where continuous season-long grazing by either cattle or big game has taken place. A similar outcome will develop if fire is suppressed. At the higher/moister range of this ESD, juniper (*Juniperus osteosperma*) and/or pinyon pine (*Pinus monophylla* in Rich County, *Pinus edulis* in other parts of this MLRA) may begin to invade the site with continued fire suppression. A return to the Black Sagebrush/ Introduced Non-natives State is possible if the site is grazed during the non-growing season for desirable herbs. Continued heavy livestock and big game use with reduce the resiliency of this State.

Community 3.1
Dense Black Sagebrush/ Diminished Palatable Understory State

Community Phase 3.1: Increased black sagebrush/ Sparse palatable perennial herbs This plant community is dominated by black sagebrush with few palatable perennial herbs.

State 4
Eroded Black Sagebrush State

Very dense black sagebrush and unpalatable forbs are found on sites where heavy continuous season-long grazing and accelerated soil erosion has occurred. Self-armoring of soils will occur when enough rocks are exposed at the soil surface. This self-armored soil surface helps to maintain this State. Continued heavy grazing will reduce the resiliency of this state. At the higher/moister range of this ESD, juniper and/or pinyon pine may invade the site. Mechanical and chemical treatments are not recommended at these sites because the low responses by native perennial herbs after reseeding make them economically inadvisable.

Community 4.1
Eroded Black Sagebrush State

Community Phase 4.1: dense black sagebrush/ unpalatable perennial herbs Black sagebrush and unpalatable forbs and grasses will increase following heavy continuous season-long grazing by cattle during the growing season and accelerated soil erosion will occur.

Transition T1A
State 1 to 2

Transition T1a: from State 1 to State 2 (Reference State to Black Sagebrush/ 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, have 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 (Black Sagebrush/ Introduced Non-natives State to Dense Black Sagebrush/ Diminished Palatable Understory State) Moderate grazing by livestock and/or big game during the growing season

of the herbaceous component will cause the herbs to diminish, but not irreversibly if pressure is light and accelerated soil erosion does not take place. Subsequent use by sheep results in further loss of the native forb component. A similar outcome will develop if fire is suppressed. The approach to this transition is indicated by an increase in black sagebrush and a decrease in the proportion of palatable understory species.

Restoration pathway R3A
State 3 to 2

Restoration Pathway R3a: from State 3 to State 2 (Dense Black Sagebrush/ Diminished Palatable Understory State to Black Sagebrush/ Introduced Non-natives State) Restoration back to the Black Sagebrush/ Introduced Non-natives State is possible if the site is grazed during the non-growing season for desirable herbs.

Transition T3A
State 3 to 4

Transition T3a: from State 3 to State 4 (Dense Black Sagebrush/ Diminished Palatable Understory State to Eroded Black Sagebrush State) The Dense Black Sagebrush/ Diminished Palatable Understory State will transition to an Eroded Black Sagebrush State following heavy continuous season-long grazing and accelerated soil erosion. At the higher/moister range of this ESD, juniper and/or pinyon pine may invade the site. The approach to this transition is indicated by evidence of accelerated soil erosion, a decrease in plant cover, and an increase in bare ground and exposed rock. This transition is triggered by accelerated soil erosion.

Additional community tables

Animal community

The suitability for livestock grazing is fair to good. This site provides grazing for cattle and sheep year-round, although prolonged heavy spring grazing will lead to loss of native perennial herbs and an increase in unpalatable shrubs and exotics.

Recreational uses

Recreation activities include hunting, horseback riding, ATV riding, birdwatching, etc.

Wood products

There are no wood products from this site unless there is Utah juniper invasion onto the site. With this event you will be able to harvest cedar posts and firewood.

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]

Noy-Meir I. 1973. Desert ecosystem: environment and producers. Annual review of ecology and systematics: 4: 25–51.

Parson, R. E. 1996. A History of Rich County. Utah State Historical Society, County Commission, Rich County, Utah. Keywords: [Rich County, Utah, Historic land use, European settlements]

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]

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	04/25/2024
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:**
