USDA Natural Resources
Conservation Service

Ecological site R034BY227UT
Semidesert Shallow Loam (Black Sagebrush)

Last updated: 3/05/2022
Accessed: 05/06/2024

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.

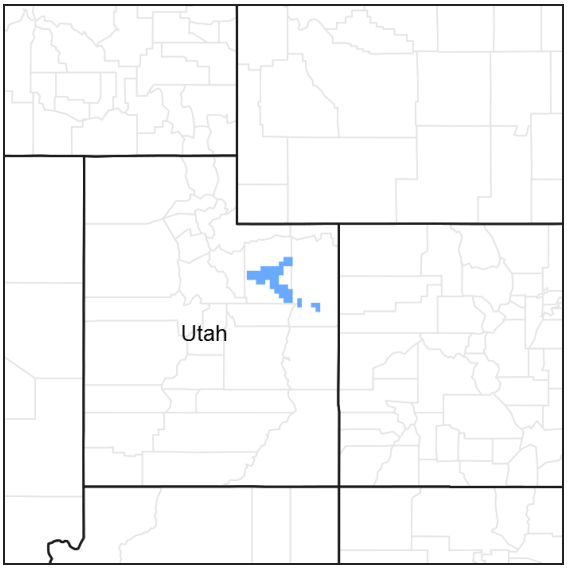


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 034B–Warm Central Desertic Basins and Plateaus

MLRA 34B occurs in is in Utah (70 percent) and Colorado (30 percent). It makes up about 12,850 square miles (33,290 square kilometers). A small part of the area is in the High Plateaus of Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. The northern part of the MLRA occurs in the Uinta Basin Section, which is bounded by the Uinta Mountains to the north, the Wasatch Range to the west, the Roan Plateau to the south, and the Rabbit Hills to the east. The southern part of the MLRA occurs in the northern third of the Canyon Lands Section. This section is bounded by the Roan Plateau to the north, the Wasatch Plateau to the west, the southern end of the San Rafael Swell to the south, and the western slope of the Rocky Mountains to the east. Elevation ranges from 4,100 feet (1,250 meters) near Green River, Utah, to 7,500 feet (2,285 meters) at the base of the Wasatch Range and the Roan Plateau.

Most of this area is covered by residual basin-floor materials and materials washed in from the surrounding mountains and plateaus. Shale and sandstone are the dominant rock types. The Tertiary-age Green River, Uinta, and Duchesne Formations dominate the northern part of the MLRA. The southern part is dominated by Cretaceous-age materials with lesser amounts of Jurassic and Triassic materials. The dominant Cretaceous formations are Mancos Shale, Dakota Sandstone, and the members of the Mesa Verde Group. The dominant Jurassic formations are the Morrison, Entrada, and Navajo. The dominant Triassic formations are the Chinle and Moenkopi. Quaternary alluvial, eolian, and glacial deposits occur in both parts of the MLRA.

The average annual precipitation in most of this area ranges from 6 to 10 inches (150 to 255 millimeters). A small part of this area receives as much as 24 inches of annual precipitation.
Much of the precipitation occurs as high-intensity, convective thunderstorms during the period July through September. May and June are usually the drier months. Precipitation is more evenly distributed throughout the year in the northern part of the MLRA than in the southern part, where there is a significant peak in late summer. The northern part of the MLRA receives more precipitation as snow during winter than the southern part. The average annual temperature ranges from 41 to 54 degrees F (5 to 12 degrees C). The freeze-free period averages 170 days and ranges from 110 to 235 days.

The dominant soil orders in this MLRA are Aridisols and Entisols. Mollisols occur at the higher elevations, particularly in the northern part of the MLRA. The dominant soil temperature regime is mesic, and the dominant soil moisture regime is aridic. The soils receiving less than 8 inches (205 millimeters) of precipitation annually have an aridic soil moisture regime. The soils receiving 8 to 12 inches (205 to 305 millimeters) have an aridic soil moisture regime that borders on ustic. The soils receiving 12 to 16 inches (305 to 405 millimeters) generally have an ustic soil moisture regime that borders on aridic. The dominant soil mineralogy is mixed and soils are formed in slope alluvium or residuum derived from shale or sandstone. Many of the soils are shallow or moderately deep to shale or sandstone bedrock. The soils at the lower elevations generally have significant amounts of calcium carbonate, salts, and gypsum.

Ecological site concept

The soils of this site formed mostly in slope alluvium over residuum from shale and sandstone sources. Surface soils are cobbly loam, parachannery loam to very channery loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 50 percent of the soil volume. These soils are shallow, well-drained, and have moderately slow to moderately rapid permeability. pH is moderately to strongly alkaline. Available water-holding capacity ranges from 0.6 to 2.6 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic aridic and the soil temperature regime is mesic. Precipitation ranges from 8-12 inches annually.

Associated sites

R034BY225UT	**Semidesert Shallow Loam (Wyoming big sagebrush)** Semidesert Shallow Loam (Wyoming big sagebrush)
R034BY233UT	**Semidesert Shallow Loam (Utah Juniper-Pinyon)** Semidesert Shallow Loam (Utah juniper-Pinyon)

Table 1. Dominant plant species

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

Physiographic features

This site occurs on hillslopes and benches. Slopes are mostly 2 to 25 percent. Included also are small areas with slopes up to 50 percent. Elevations range from 5,000 to 6,800 feet on all aspects.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Structural bench
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None

Elevation	1,524–2,073 m
Slope	2–50%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

Average annual precipitation is 8 to 12 inches. Approximately 65% occurs as rain from March through September. On the average, November through February are the driest months and July through October are the wettest months. The mean annual air temperature is 10 degrees celsius and the soil temperatures are in the mesic regime. The average freeze-free period is 110 to 140 days. Much of the moisture that falls on this site runs off. In average years, plants begins growth around March 30 and end growth around September 30.

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	203-305 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 slope alluvium over residuum from shale and sandstone sources. Surface soils are cobbly loam, parachannery loam to very channery loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 50 percent of the soil volume. Rock outcrops are often associated with these soils. These soils are shallow, well-drained, and have moderately slow to moderately rapid permeability. pH is moderately to strongly alkaline. Available water-holding capacity ranges from 0.6 to 2.6 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic aridic and the soil temperature regime is mesic. Precipitation ranges from 8-12 inches annually.

Modal Soil: Atchee CNV-SL 25-50%, 2-25% — loamy-skeletal, mixed (calc.), mesic Lithic Ustic Torriorthents

Table 4. Representative soil features

Parent material	(1) Slope alluvium–sandstone and shale (2) Residuum–sandstone and shale
Surface texture	(1) Cobbly, parachannery loam (2) Very channery sandy loam
Family particle size	(1) Loamy (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	13–51 cm
Soil depth	13–51 cm
Surface fragment cover <=3"	0–37%
Surface fragment cover >3"	0–10%
Available water capacity (Depth not specified)	1.52–6.6 cm

Calcium carbonate equivalent (Depth not specified)	1–20%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–5
Soil reaction (1:1 water) (Depth not specified)	7.9–9
Subsurface fragment volume <=3" (Depth not specified)	0–37%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

Ecological Dynamics of the Site
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 (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 as the proportion of browse 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 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 (1.1) within the Reference State would have been a black sagebrush-dominated (*Artemisia nova*) stand with scattered prickly pear (*Opuntia polyacantha*) and associated bunch grasses as well as common forb species.

The generally shallow and stony soils would have accentuated the effects of drought and reduced the chances of fire altering this state. The reference plant community (1.1) would have been relatively stable with occasional use by wildlife. However, heavy utilization by bison, elk, and Native American horses on these sites (1.1a) would have depleted the grasses creating a near monoculture of black sagebrush (1.2). Heavy browsing by deer during the dormant season of black sagebrush (1.1b) would have created an herbaceous variant (1.3). Occasional very wet years during El Nino-Southern Oscillation periods could have caused temporary soil anoxia (West 2000) (1.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (1.3). Infestation of some insects and pathogens on sagebrush (1.1c) could have led to a similar result where the herbaceous species become temporarily dominant (1.3). The interaction of an unusually dry period and heavy utilization by all grazers (e.g. deer, bison, elk, and horses used by native American) (1.1d) would have removed the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. viscidiflorus), and phlox to predominate (1.4). The depauperate black sagebrush (*Artemisia nova*) community (1.2) could have also shifted to the unpalatable short-lived shrub community phase (1.4) in areas that have sustained heavy browsing by deer (1.2b). Relatively rocky sites such as these typically would not have declined in overall cover or productivity. However, the portion that is palatable may have changed appreciably. Similarly, these soils would have been more resistant to erosion than other stone-free soils. Each of the phases within State 1 could have returned to Community Phase 1.1 if climate conditions were within the normal range of variability and there was a release from heavy grazing and/or browsing pressure (1.2a, 1.3a, 1.4a). A small amount of Wyoming big sagebrush would have also been present. 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 least modified plant community within the Reference State would have been a black sagebrush-dominated stand with scattered prickly pear and associated bunch grasses and commonly associated forbs.

Community Phase Pathway 1.1a
Heavy continuous season-long grazing by bison, elk, and Native American horses would have converted the Reference State to a depauperate black sagebrush community.

Community Phase Pathway 1.1b
Heavy browsing by deer would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and subsequent anoxious soil conditions would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. The same result would occur following a sudden insect (or other pathogen) outbreak on sagebrush.

Community Phase Pathway 1.1c
The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing by all grazers including deer, bison, elk, and Native American horses, would have converted the Reference State to an unpalatable short-lived shrub & perennial forb plant community.

Community Phase 1.2: Depauperate black sagebrush
This plant community would have developed under heavy continuous season-long grazing by bison, elk, and Native American horses. Heavy utilization of grasses would have created a near monoculture of black sagebrush.

Community Phase Pathway 1.2a
The absence of grazing would have allowed the native bunchgrasses and perennial forbs to return to the system converting it back to the Community Phase 1.1.

Community Phase Pathway 1.2b
Heavy browsing by deer would have converted the depauperate black sagebrush community to an unpalatable short-lived shrub community phase.

Community Phase 1.3: Bunch grasses & Perennial Forbs/Sparse black sagebrush
There are several environmental conditions that would have produced this plant community. Heavy browsing by deer would have resulted in an herbaceous-dominated variant because of the utilization of black sagebrush during the dormant season. Under the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could have developed (West 2000), killing the sagebrush and allowing the forbs and grasses

to dominate for a short time. A similar plant community would have also developed following an outbreak of insects and pathogens where sagebrush was the dominant host.

Community Phase Pathway 1.3a
A return to normal climate conditions and the absence of heavy browsing would have allowed black sagebrush to re-establish and convert back to the Community Phase 1.1.

Community Phase 1.4: Short-lived Shrubs/Perennial Forbs
This plant community would have developed under the combined effect of unusual drought conditions and heavy grazing by all grazers including deer, bison, elk, and Native American horses. Focused utilization would have reduced the palatable species while allowing the noxious, unpalatable, and shorter-lived species such as yellow rabbitbrush, and phlox to predominate.

Community Phase Pathway 1.4a
A return to normal climate conditions followed by a prolonged reduction in grazing pressure would have allowed black sagebrush and native bunchgrasses to re-establish returning to the reference plant community (1.1).

Transition 1a
The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, will cause State 1 to transition to State 2. A return pathway back to State 1 would be impracticable because of these issues.

State 2: Black Sagebrush/ 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, which can be regarded as the current potential. The least modified plant community (2.1) within State 2 is a black sagebrush-dominated stand with scattered prickly pear and associated bunch grasses such as bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, muttongrass, and bottlebrush squirreltail. Forbs such as phlox, buckwheat, and yellow cryptantha are common. The generally shallow and stony soils accentuate the effect of drought and reduce the chances of fires altering this state. This plant community is relatively stable under mixed use by wildlife and livestock. However, heavy utilization by bison, elk, horses, and domestic cattle on these sites during the growing season (2.1a) would deplete the grasses creating a near monoculture of black sagebrush (2.2). Heavy browsing by deer and sheep (2.1b) would create an herbaceous variant (2.3) because of year-round utilization of black sagebrush. Occasionally very wet years during El Nino-Southern Oscillation periods can cause temporary soil anoxia (West 2000) (2.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (2.3). Some insects and pathogens on sagebrush (2.1c) can lead to a similar result where the herbaceous species become temporarily dominant (2.3). The interaction of an unusually dry period and heavy utilization of grasses by bison, elk, horses, and domestic cattle (2.1d) would remove the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush, and phlox to predominate. Species composition does not change, jus their abundance (2.4). The depauperate black sagebrush community (2.2) may also shift to the unpalatable short-lived shrub community phase (2.4) with heavy utilization of browse by deer and sheep (2.2b). Relatively rocky sites such as these typically do not decline in overall cover or productivity, however, the portion that is palatable may change appreciably. Similarly, these soils are more resistant to erosion than associated stone-free soils. Each of the phases within State 2 can return to Community Phase 2.1 when climate conditions are within the normal range of variability and grazing pressure is moderated (2.2a, 2.3a, 2.4a). A small amount of Wyoming big sagebrush may also be present.

Community Phase 2.1: Black sagebrush/Sparse bunchgrasses & Perennial forbs

The least modified plant community within the Black Sagebrush/ Introduced Non-natives State is a black sagebrush-dominated stand with scattered prickly pear and associated bunch grasses such as bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, muttongrass, and bottlebrush squirreltail. Phlox, buckwheat, and yellow cryptantha are commonly associated forbs.

Community Phase Pathway 2.1a
Heavy continuous season-long grazing by bison, elk, horses, and cattle would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a depauperate black sagebrush community.

Community Phase Pathway 2.1b
Heavy browsing by deer and sheep would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and subsequent anoxious soil conditions would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. The same result would be seen following a sudden insect (or other pathogen) outbreak on sagebrush.

Community Phase Pathway 2.1c
The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing by all grazers would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to an unpalatable short-lived shrub and perennial forb plant community.

Community Phase 2.2: Depauperate Black sagebrush

This plant community is developed under heavy continuous season-long grazing by bison, elk, cattle, and horses. Heavy utilization of grasses creates a near monoculture of black sagebrush.

Community Phase Pathway 2.2a
This plant community can move back towards the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase when grazing management, particularly of sheep, and use by deer, take place only during the non-growing season of the herbaceous component, along with broadcast re-seeding with native perennial forbs and grasses.

Community Phase Pathway 2.2b
Heavy browsing by deer and sheep would convert the depauperate black sagebrush phase to the unpalatable short-lived shrub and perennial forb community

Community Phase 2.3: Bunch grasses & perennial forbs/ Sparse black sagebrush
There are several environmental conditions that would produce this plant community. Heavy year-round browsing by deer and sheep would result in an herbaceous-dominated variant because of the utilization of black sagebrush. Following the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could develop, (West 2000) killing the sagebrush and allowing the forbs and grasses to dominate for a short time. A similar plant community would also develop following an outbreak of insects and pathogens where sagebrush is the dominant host.

Community Phase Pathway 2.3a
This plant community can move back to the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase with a return to normal climate conditions and when grazing by both livestock and wildlife is concentrated during the spring to put pressure on the herbaceous component, allowing the native woody component to re-establish.

Community Phase 2.4: Short-lived shrubs/perennial forbs
This plant community is developed under extreme drought conditions combined with heavy continuous season-long grazing. Such disturbances will reduce the palatable species and allow the unpalatable, shorter-lived species such as yellow rabbitbrush, and phlox to predominate. Because of the prevalence of historic unrestricted ungulate grazing, this is the most likely of the phases within State 2 to transition to States 3 or 4.

Community Phase Pathway 2.4a
A return to the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase is possible with a return to normal (or wetter) climate conditions and high intensity short duration grazing management to allow the native woody component to re-establish and decrease the competition by herbaceous species.

Transition 2a
The Black Sagebrush/ Introduced Non-natives State will transition to the Introduced Annuals/Biennials State following a sustained period of eutrophication caused by excessive year-long livestock grazing, trampling and bedding, especially by large flocks of domestic sheep. Sheep bedding, salting, watering, and handling locations involve intensive trampling, urination, defecation, and consequent eutrophication, which can be influential in this type of transition. It is also common to see accelerated soil erosion in such locations.

Transition 2b
The Black Sagebrush/ Introduced Non-natives State will transition to the Cushion Plant State under conditions marked by accelerated soil erosion and soil compaction caused by mechanical damage from trail and road development, excessive trail/foot traffic, and/or jeep/ATV impacts resulting in permanent reduction of plant cover.

State 3: Introduced Annuals/Biennials State
Invasive annuals and biennial forbs such as cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola tragus*), knapweeds (Centaurea spp.), and horehound (*Marrubium vulgare*) are favored by an increase in nutrient build-up in old, eutrophicated sheep bedgrounds. Where fire return intervals are frequent (3.2a) annuals such as cheatgrass and Russian thistle will predominate (3.1). Longer intervals between fire events (3.1a) will result in a plant community dominated by biennial forbs (3.2). The soil profiles of the plant communities within this state are mainly intact.

Although there have been previous attempts to apply tillage and chemicals to improve the composition and productivity in areas where the ESD has developed into this state (see files in the State Range Conservationist Office for details), the biological responses may be too low to justify the economic investment. Therefore, currently available rangeland manipulations are not recommended.

Community Phase 3.1: Annual grass/annual forb
This plant community will develop where fire return intervals are frequent and annual species such as cheatgrass and Russian thistle predominate.

Community Phase Pathway 3.1a
When intervals between fire events are prolonged, biennial forbs will dominate the plant community.

Community Phase 3.2: Annual forb/beinnal forb
This plant community will develop when intervals between fires are longer, allowing biennial species such as knapweeds, tumblemustard (*Sisymbrium altissimum*), and Dyer's woad (*Isatis tinctoria*) to become established.

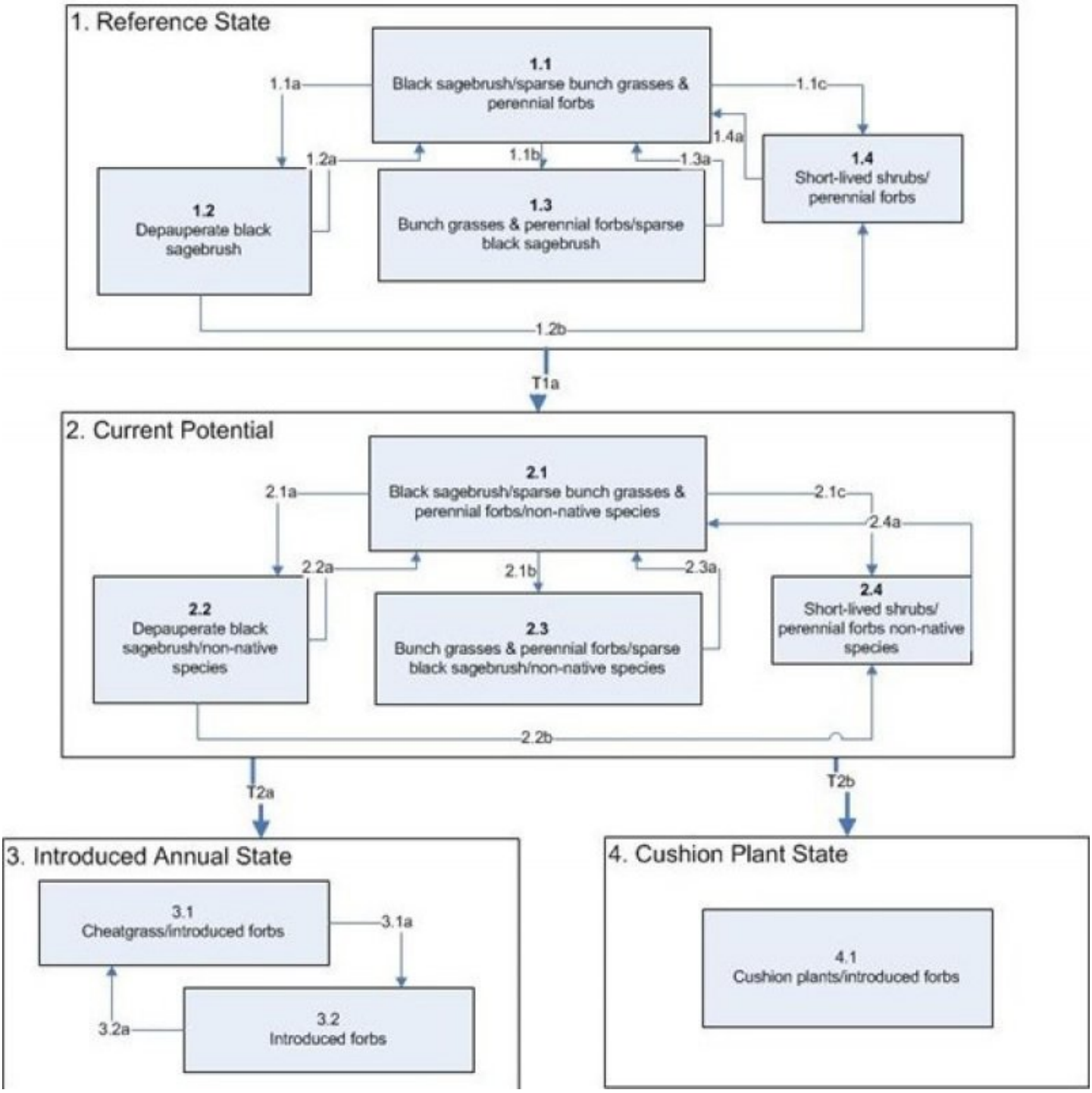
Community Phase Pathway 3.2a
When fire return intervals are frequent, annual forbs and grasses will dominate the plant community.

State 4: Cushion Plant State
Curlycup gumweed (*Grindelia squarrosa*) and other cushion plants such as spiny phlox (*Phlox hoodii*), pricklyphlox (Leptodactylon spp.), etc. are found on highly eroded sites, where accelerated soil erosion and soil compaction caused by mechanical damage has removed the fine soil particles and compacted the soils leaving a rocky self-armored surface (4.1).

As with State 3, although there have been previous attempts to apply tillage and chemicals to improve the composition and productivity in areas where the ESD has developed into this state (see files in the State Range Conservationist Office for details), the biological responses may be too low to justify the economic investment. Therefore, currently available rangeland manipulations are not recommended.

Community Phase 4.1: Cushion Plant/annual forb
his plant community will develop following prolonged mechanical damage caused by trail and road development, excessive trail/foot traffic, and/or jeep/ATV impacts resulting in permanent reduction of plant cover. The only plants remaining are those tolerant of drought, infertile soil, and mechanical disturbances.

State and transition model


1. Reference State
1.1
Black sagebrush/sparse bunch grasses & perennial forbs
1.1a
1.1c
1.2a
1.1b
1.3a
1.4a
1.2
Depauperate black sagebrush
1.3
Bunch grasses & perennial forbs/sparse black sagebrush
1.4
Short-lived shrubs/ perennial forbs
1.2b
T1a
2. Current Potential
2.1
Black sagebrush/sparse bunch grasses & perennial forbs/non-native species
2.1a
2.1c
2.4a
2.2a
2.1b
2.3a
2.2
Depauperate black sagebrush/non-native species
2.3
Bunch grasses & perennial forbs/sparse black sagebrush/non-native species
2.4
Short-lived shrubs/ perennial forbs non-native species
2.2b
T2a
T2b
3. Introduced Annual State
3.1
Cheatgrass/introduced forbs
3.1a
3.2a
3.2
Introduced forbs
4. Cushion Plant State
4.1
Cushion plants/introduced forbs

Community Phase Pathway 1.1a
Heavy continuous season-long grazing by bison, elk, and Native American horses.
Community Phase Pathway 1.1b
Heavy browsing by deer.
Community Phase Pathway 1.1c
The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing.
Community Phase Pathway 1.2a
The absence of grazing .
Community Phase Pathway 1.2b
Heavy browsing by deer.
Community Phase Pathway 1.3a
A return to normal climate conditions and the absence of heavy browsing.
Community Phase Pathway 1.4a
A return to normal climate conditions followed by a prolonged reduction in grazing pressure.
Transition 1a
Introduction of exotic species.
Community Phase Pathway 2.1a
Heavy continuous season-long grazing by bison, elk, horses, and cattle.
Community Phase Pathway 2.1b
Heavy browsing by deer and sheep.
Community Phase Pathway 2.1c
The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing.
Community Phase Pathway 2.2a
Grazing management.
Community Phase Pathway 2.2b
Heavy browsing by deer and sheep.
Community Phase Pathway 2.3a
Return to normal climatic conditions and grazing management.
Community Phase Pathway 2.4a
Return to normal climatic conditions and grazing management.
Transition 2a
Sustained period of eutrophication
Transition 2b
Accelerated soil erosion and soil compaction.
Community Phase Pathway 3.1a
When intervals between fire events are prolonged.
Community Phase Pathway 3.2a
When fire return intervals are frequent.

State 1
Reference State

Community 1.1
Reference Plant Community

The dominant aspect of the plant community is black sagebrush. The composition by air-dry weight is approximately 35 percent perennial grasses, 10 percent forbs and 55 percent shrubs.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	169	231	293
Grass/Grasslike	108	147	186
Forb	31	43	54
Total	**308**	**421**	**533**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	30-40%
Grass/grasslike foliar cover	10-20%
Forb foliar cover	1-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	–
>0.15 <= 0.3	–	–	–	1-10%
>0.3 <= 0.6	–	30-40%	10-20%	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 3. Plant community growth curve (percent production by month). UT2271, PNC. Excellent Condition.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	15	40	30	5	5	0	0	0	0

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Dominant Shrubs**			148–247	

	black sagebrush	ARNO4	*Artemisia nova*	112–157	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	9–22	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	9–22	–
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	9–22	–
	spiny greasebush	GLSPM	*Glossopetalon spinescens var. meionandrum*	4–13	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	4–9	–
3	**Sub-Dominant Shrubs**			49–130	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	13–22	–
	prairie sagewort	ARFR4	*Artemisia frigida*	4–13	–
	yellow rabbitbrush	CHVIS5	*Chrysothamnus viscidiflorus ssp. viscidiflorus var. stenophyllus*	4–13	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	4–13	–
	slender buckwheat	ERMI4	*Eriogonum microthecum*	4–13	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	4–13	–
	green molly	BAAM4	*Bassia americana*	4–13	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	4–13	–
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	4–13	–
Grass/Grasslike					
0	**Dominant Grasses**			90–157	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	45–67	–
	blue grama	BOGR2	*Bouteloua gracilis*	22–45	–
	James' galleta	PLJA	*Pleuraphis jamesii*	22–45	–
1	**Sub-Dominant Grasses**			49–112	
	Grass, annual	2GA	*Grass, annual*	13–22	–
	Grass, perennial	2GP	*Grass, perennial*	13–22	–
	purple threeawn	ARPU9	*Aristida purpurea*	4–13	–
	squirreltail	ELEL5	*Elymus elymoides*	4–13	–
	needle and thread	HECO26	*Hesperostipa comata*	4–13	–
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	4–13	–
	Sandberg bluegrass	POSE	*Poa secunda*	4–13	–
Forb					
0	**Dominant Forb**			9–22	
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	9–22	–
2	**Sub-Dominant Forb**			58–108	
	Forb, annual	2FA	*Forb, annual*	13–22	–
	Forb, perennial	2FP	*Forb, perennial*	13–22	–
	yellow milkvetch	ASFL	*Astragalus flavus*	4–9	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	4–9	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	4–9	–
	manybranched ipomopsis	IPPO2	*Ipomopsis polycladon*	4–9	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	4–9	–
	longleaf phlox	PHLO2	*Phlox longifolia*	4–9	–

	longleaf phlox	PHLO2	*Phlox longifolia*		

Animal community

This site provides proper grazing for sheep and cattle during fall, winter, and spring.

This site provides food and limited cover for wildlife. Wildlife using this site include jackrabbit, snake, lizard, hawk, coyote, and mule deer.

Hydrological functions

The soil is in hydrologic group d. The runoff curve numbers are 80 through 89 depending on the condition of the watershed.

Recreational uses

This site has moderate recreational opportunities and often has scenic vistas.

Wood products

None

Contributors

J. Lee Broadbent
Garth Leishman

Approval

Kirt Walstad, 3/05/2022

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)	V. Keith Wadman (NRCS Retired).
Contact for lead author	shane.green@ut.usda.gov
Date	04/19/2012
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Very few rills present. Some increase in rill development may occur on steeper slopes or on areas located below exposed bedrock, or other water shedding areas where increased runoff may occur. Rills should be < 1 inch deep, fairly short (< 10 feet) and somewhat widely spaced (8-10 feet)on slopes < 10%. On steeper slopes, rills will be 10 to 15+ feet long and spaced 6 to 8 feet apart. More active rill development may be observed following major thunderstorm or spring runoff events but should heal during the next growing season. The expression of rills may be less defined where coarse fragments (i.e., gravels and/or channers) dominate the soil surface.

2. **Presence of water flow patterns:** A very few sinuous flow patterns wind around perennial plants and surface rock. Evidence of flow patterns is expected to increase somewhat with slopes greater than 10%. Water flow patterns are long (15-20 feet), narrow (< 1 foot wide), and spaced widely (10-20 yards) on gentle slopes (<15%) and more closely (<10 yards) on steeper slopes (>15%).

3. **Number and height of erosional pedestals or terracettes:** Small pedestals (1/8 to 1/4 inch) may form at the base of plants that occur on the edge of water flow patterns, but should not show any exposed roots. Terracettes are fairly common, forming behind debris dams of small to medium sized litter (up to 1 inch in diameter) in water flow patterns. These debris dams may accumulate smaller litter (leaves, grass and forb stems) and sediment.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20–30%. (Soil surface is typically covered by 15 to 65% surface fragments). Most bare ground is associated with water flow patterns, rills, and gullies. Poorly developed biological soil crusts that are interpreted as functioning as bare ground should be recorded as bare ground. Base ground spaces should not be greater than 2 to 3 feet and should mostly not be connected.

5. **Number of gullies and erosion associated with gullies:** None on slopes < 10%. Rare on steeper slopes and on areas below exposed bedrock. There they do occur, their length often extends from the exposed bedrock to where the gully reaches a stream or other area where water and sediment accumulate. Gullies may show slightly more indication of erosion as slope increases, or as the site occurs adjacent to steep sites/watershed with concentrated flow patterns.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to very slight. Perennial vegetation helps break the wind and reduces the potential for wind erosion. Coarse fragments on the soil surface help armor it and reduce the potential for wind erosion.

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with minor redistribution caused by water movement. Minor litter removal may occur in flow channels with deposition occurring within 1 to 2 feet at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes > 10% and/or increased runoff resulting from heavy thunderstorms.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have an erosion rating of 4 or 5 under the plant canopies, and a rating of 3 to 4 in the interspaces. The average should be a 4. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** (Splimo) Soil surface horizon is typically 0 to 3 inches deep. Texture is a very cobbly loam, structure is typically weak thin platy parting to moderate very fine sugangular blocky. Color is brown (7.5YR 6/4). A ochric epipedon ranges to a depth of 3 inches. Use the specific information for the soil you are assessing found in the published soil survey to supplement this

description.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Surface coarse fragments combined with perennial vegetation produce sufficient cover and spatial arrangement to intercept most raindrops and reduce raindrop splash erosion. Litter on soil surface and cryptogamic crusting, where present, also protect soil from splash erosion and encourages a higher rate of infiltration. Plant spatial distribution should slow runoff, allowing additional time for infiltration. Bare spaces are expected to be small and irregular in shape and are usually not connected. Vegetative structure is usually adequate to capture snow and ensure that snowmelt occurs in a controlled manner, allowing maximum time for infiltration, and reducing runoff and erosion in all but the most extreme storm events. When perennial grasses and shrubs decrease due to natural events (i.e., drought, insect damage, etc.) which reduce ground cover and increase bare ground, runoff is expected to increase and associated infiltration be reduced.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Fractured conglomerate bedrock occurs at 15 to 19 inches.

---

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: Sprouting shrubs (black sagebrush, winterfat) > Perennial bunchgrasses (Indian ricegrass. needle-and-thread) > Perennial forbs (scarlet globemallow).

    Sub-dominant: Non-sprouting shrubs (bud sagebrush, shadscale) > Perennial bunchgrasses (bottlebrush squirreltail)> Rhizomatous grasses (James galleta, blue grama) > Forbs (yellow milkvetch, cushion wild buckwheat) > Biological soil crusts.

    Other: Biological soil crust is variable in its expression where present on this site and is measured as a component of ground cover. Forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

    Additional: Natural disturbance regimes include fire, drought, and insects. Assumed fire cycle of 30 to 40+ years. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state. Following a disturbance such as fire, drought, rodents or insects that remove woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community for a period of time. If a disturbance has not occurred for an extended period of time, woody species may continue to increase. These conditions would reflect natural functional community phases within the reference state.

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses should be present under average to above average growing conditions. There may be partial mortality on individual bunchgrasses and shrubs during drought periods and complete mortality of individual plants during severe drought periods. Slight decadence in the principle shrubs could occur near the end of the fire cycle or during periods of extended drought, or insect infestations. In general, a mix of age classes should be expected with some dead and decadent plants present.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover will be heavier around perennial plants. Most litter will be herbaceous and depths of 1/4 to 1/2 inch would be considered normal. Perennial vegetation should be well distributed

on the site. Litter cover may increase to 25% on some years due to increased production of plants.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production in air-dry herbage should be approximately 350 - 400#/acre on an average year, but could range from 250 to 500#/acre during periods of prolonged drought or above average precipitation.

---

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:** Few invasive species are capable of dominating this site. When invasion does occur, annual bromes such as cheatgrass, and various non-native annual forbs including alyssum and various mustard species are the most likely to invade.

---

17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years, except in extreme drought years. There are no restrictions on either seed or vegetative reproduction. Some seedling recruitment of major species should be present during average and above average growing years.
