USDA Natural Resources Conservation Service

Ecological site DX034A02X146
Sands Pinedale Plateau (Sa PP)

Last updated: 2/24/2025
Accessed: 05/11/2025

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 10 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 ranges 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 Pinedale Plateau LRU is in the upper Green River Drainage from Pinedale, Wyoming at the north working southward to Farson, Wyoming and easterly to South Pass, Wyoming. It is situated between the Wyoming Range and Wind River Range largely in Sublette County with some areas in Lincoln County, northern Sweetwater County, and a small portion of Fremont County. The total area of this LRU is approximately 1,210,000 acres. It shares a boundary with MLRA 46-Northern Rocky Mountain Foothills (proposed for the foothills of western Wyoming).
This LRU is dominated by the New Fork Tongue of the Wasatch formation, a large artesian aquifer that is estimated to hold large amounts of water with relatively quick recharge (Martin 1996). It is also home to the Lance Formation, a cretaceous strata that is part of the Mesaverde Group, which holds large amounts of hydrocarbons, giving way to one of the largest on shore natural gas fields (Jonah Field) (Bowker et al 2000). The soils in the Pinedale Plateau are dominated by older Alfisols with thick argillic and calcic horizons and younger deep alluvial soils along drainage ways and in river bottoms. Salts are not a major influence in the Pinedale Plateau compared to the adjacent Green River Basin LRU but do occur, including sodium, calcium carbonate, and other soluble salts. Soils are tied closely to their parent geology but are more developed and older so typically do not have bedrock contact within six feet.
This LRU has an aridic ustic soil moisture regime and frigid (bordering on cryic) soil temperature regime. The precipitation pattern is bimodal with a slight spikes in the spring and fall. Winter temperatures are cold allowing snow to accumulate and stay until spring. This lends perfectly to cool season grasses and forbs to flourish, also allowing big sagebrush to establish and dominate the landscape. The mean annual soil temperatures are between 36 to 40 degrees Fahrenheit (2.2 to 4.4 degrees Celsius) and average precipitation is between 9 and 12 inches (230 to 305 mm) annually. Elevations of this LRU range between 6500 and 7500 feet (1980 to 2280 m).

Classification relationships

Relationship to Other Established Classification Systems
National Vegetation Classification System (NVC):
3 Semi-Desert
3.B.1 Cool Semi-Desert Scrub & Grassland

3.B.1.Ne Western North American Cool Semi-Desert Scrub & Grassland Division
M169 Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe Macrogroup
G302 Intermountain Mesic Tall Sagebrush Steppe and Shrubland Group
A3183 Basin big sagebrush Mesic Steppe and Shrubland Alliance
CEGL002966 Artemisia tridentata ssp. tridentata/Hesperostipa comata Shrubland Association

Ecoregions (EPA):
Level I: 10 North American Deserts
Level II: 10.1 Cold Deserts
Level III: 10.1.4 Wyoming Basin

Ecological site concept

This site not does receive any additional water.
Soils:
o are not saline or saline-sodic
o are typically moderately deep to very deep (greater than 20 inches deep)
o are not skeletal within 20 inches (50 cm) of the soil surface; they do not have greater than 35 percent rock fragments by volume in the top 20 inches (50 cm)
o have surface textures that usually range from loamy sand to loamy coarse sand in surface mineral layer (4 inches; 10 cm)
o have slopes that range from 0-15%
o have clay content less than 12% in mineral soil surface layer (6 inches; 15 cm)
Climate:
aridic ustic moisture regime (ustic bordering on aridic)
frigid (bordering on cryic) temperature regime

Associated sites

DX034A02X130	**Overflow Pinedale Plateau (Ov PP)** Site is located in drainageways and soil surface textures are typically finer (sandy loam to clay loam).
DX034A02X144	**Saline Upland Pinedale Plateau (SU PP)** Site is typically found in the interdune area. Soils are typically clayey textured with a high level of dissolved salts and a natric soil horizon.
DX034A02X150	**Sandy Pinedale Plateau (Sy PP)** Site has soil surface textures that are finer (sandy loam) with different species composition and lower plant production potential.

Similar sites

R034AY246WY	**Sands Foothills and Basins West (Sa)** Previous version of this site, but applied to a larger geographic area.
R034AY146WY	**Sands Green River and Great Divide Basins (Sa)** Similar site with drier climate and lower plant production potential found in the adjacent Green River Basin LRU.
DX034A02X150	**Sandy Pinedale Plateau (Sy PP)** Site has soil surface textures that are finer (sandy loam) with different species composition and lower plant production potential.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. tridentata*
Herbaceous	(1) *Hesperostipa comata* (2) *Achnatherum hymenoides*

Legacy ID

R034AC146WY

Physiographic features

This site occurs in intermontane basin landscapes on hill, dune, and occasionally outwash terrace landforms (see following definitions). It is typically found in a dune complex and on the leeward side of hills. Slopes are typically from 0 to 10 percent, but can occur on any slope, and at elevations from 6500 to 7500 feet.

Landscape:
intermontane basin - A generic term for wide structural depressions between mountain ranges that are partly filled with alluvium and called "valleys" in the vernacular. Intermontane basins may be drained internally (bolsons) or externally (semi-bolson).

Landform:
hill -- A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill.

dune -- A low mound, ridge, bank or hill of loose, windblown, subaerially deposited granular material (generally sand), either barren and capable of movement from place to place, or covered and stabilized with vegetation, but retaining its characteristic shape.

outwash terrace -- A flat-topped bank of outwash with an abrupt outer face (scarp or riser) extending along a valley downstream from an outwash plain or terminal moraine; a valley train deposit.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Dune (2) Hill (3) Outwash terrace
Flooding frequency	None
Ponding frequency	None
Elevation	6,500–7,500 ft
Slope	0–10%
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 9 to 12 inches per year. Wide fluctuations may occur in yearly precipitation and result in more below average years than those with above average precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Much of the precipitation accumulation (45 percent) comes in the winter in the form of snow (October to April). The wettest month is May (1.69 inches). The dominant plants (sagebrush and cool season grasses) are well adapted to these conditions. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour. The growing season is short (less than 60 day) and cool. Critical growth period: primary growth typically occurs between May and June.
Growth of native cool-season plants begins in April and continues to approximately early August. Some green-up of cool-season plants usually occurs in September with adequate fall moisture.

All data is based on the 30-year average from 1981-2010.

Table 3. Representative climatic features

Frost-free period (characteristic range)	30-70 days
Freeze-free period (characteristic range)	50-80 days
Precipitation total (characteristic range)	9-12 in
Frost-free period (actual range)	15-70 days
Freeze-free period (actual range)	45-90 days
Precipitation total (actual range)	9-13 in
Frost-free period (average)	36 days
Freeze-free period (average)	64 days
Precipitation total (average)	11 in

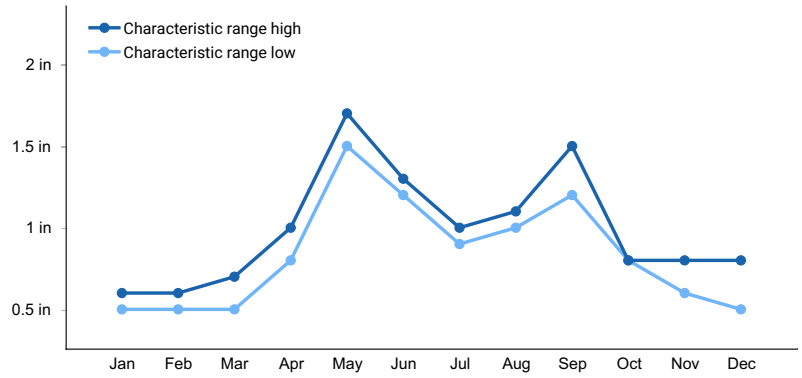


Figure 1. Monthly precipitation range

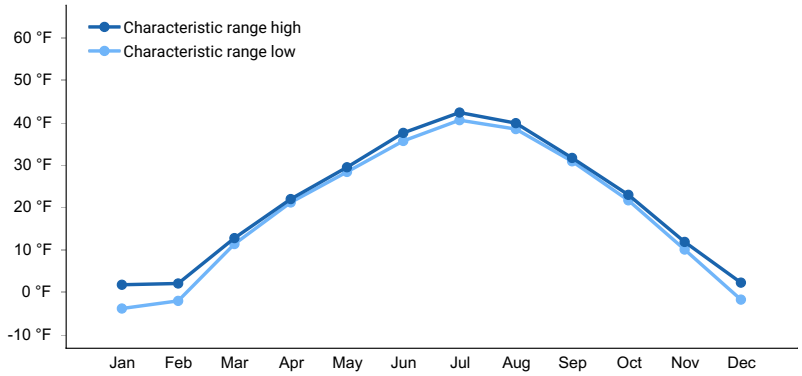


Figure 2. Monthly minimum temperature range

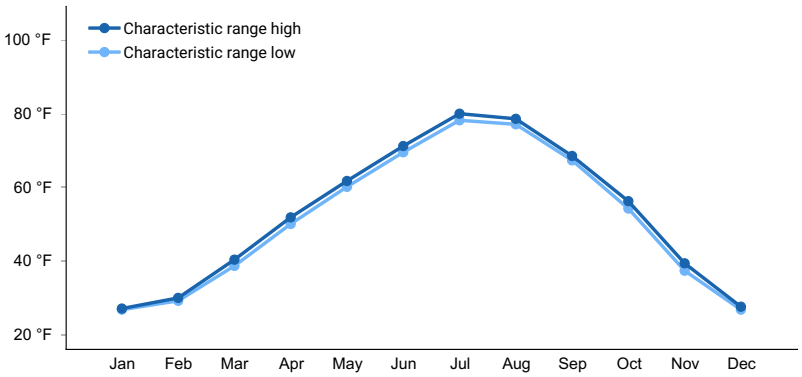


Figure 3. Monthly maximum temperature range

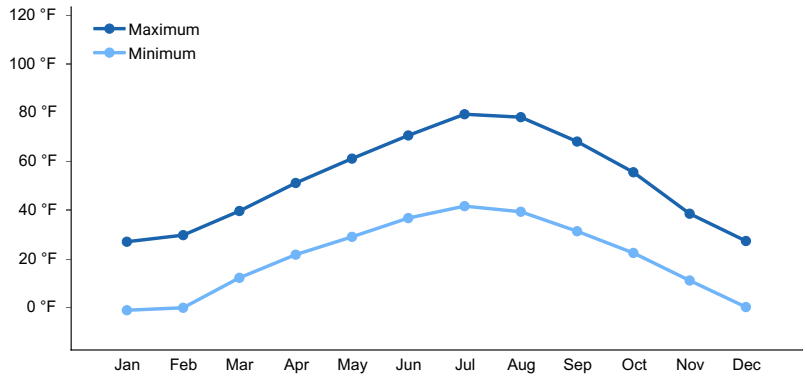


Figure 4. Monthly average minimum and maximum temperature

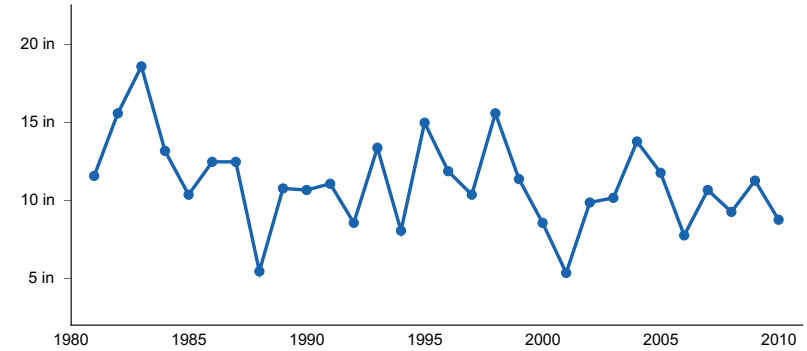


Figure 5. Annual precipitation pattern

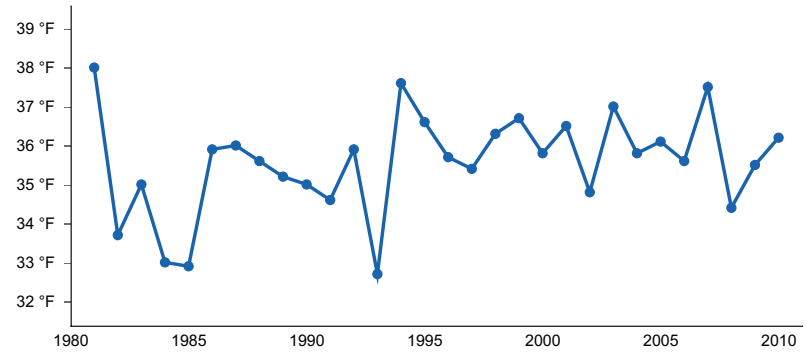


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CORA [USC00482054], Cora, WY
- (2) PINEDALE [USC00487260], Pinedale, WY
- (3) BOULDER REARING STN [USC00480951], Boulder, WY

Influencing water features

There are no influencing water features.

Wetland description

N/A

Soil features

The soils of this site are moderately deep to very deep (20 to 200 inches) and formed in alluvium derived from inter-bedded sedimentary rock and eolian deposits (active sand dunes). Surface and subsurface textures are loamy sand to loamy coarse sand. Rock fragments may be found on the soil surface or in the profile, but make up less than 15

percent of the soil volume. These soils are somewhat excessively to excessively drained and have rapid permeability.
The soil moisture regime is aridic ustic (ustic bordering on aridic) and the soil temperature regime is frigid bordering on cryic.
Major Soil Series correlated to this site include: Yetull
Representative Taxonomy: Mixed, frigid Aridic Ustipsamments

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone (2) Eolian deposits
Surface texture	(1) Loamy sand (2) Loamy coarse sand
Family particle size	(1) Sandy
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	20–200 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	0.9–4.3 in
Calcium carbonate equivalent (0-20in)	0–5%
Electrical conductivity (0-20in)	0–3 mmhos/cm
Sodium adsorption ratio (0-20in)	0
Soil reaction (1:1 water) (0-20in)	6.6–7.3
Subsurface fragment volume <=3" (0-20in)	0–25%
Subsurface fragment volume >3" (0-20in)	0–5%

Ecological dynamics

A State-and-Transition Model (STM) diagram is depicted in this section. Narrative descriptions of each state, transition, plant community phase, and pathway are found after the model in this document. This diagram is based on available experimental research, field observations, professional consensus, logical extrapolations, and interpretations. While based on the best available information, the STM will change over time as knowledge of ecological processes increases. Although there is considerable qualitative experience supporting the pathways and transitions within the State-and-Transition Model, no quantitative information exists that specifically identifies threshold parameters between reference states and degraded states in this ecological site. For information on STMs, see the following citations: Bestelmeyer et.al. 2003, Bestelmeyer et.al. 2004, Bestelmeyer and Brown 2005, Briske et.al. 2008, and Stringham et,al. 2003.

Plant community composition within the same ecological site has a natural range of variability across the LRU due to the naturally occurring variability in weather, soils, and aspect. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent cover are used in this ESD. Most observers find it easier

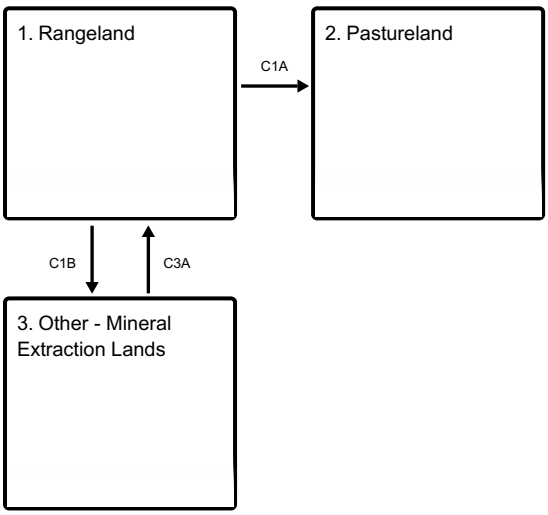
to visualize or estimate percent cover for woody species (trees and shrubs). Foliar cover is used to define plant community phases and states in the State-and-Transition Model. Cover drives the transitions between communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight remains an important descriptor of the herbaceous community and of site productivity as a whole and includes both herbaceous and woody species. Calculating Similarity Index requires data on species composition by dry weight.

Not all managers will choose the Reference Plant Community as the management goal. Other plant communities may be desired to meet land management objectives. This is valid as long as the rangeland health attributes assessment departures are none to slight or slight to moderate from the Reference State as described in the Range Health Reference sheet.

A resource concern risk assessment and dominant resource concerns are provided for each Land Use, State, and/or Plant Community Phase based on NRCS resource concern and planning criteria used to determine resource treatment levels during the conservation planning process. A resource concern is a resource condition that does not meet the minimum accepted levels established by planning criteria as shown in Section III of the NRCS Field Office Technical Guide (https://efotg.sc.egov.usda.gov/#/).
• Low risk means a low probability for the category of resource concerns and additional assessment is typically not necessary.
• Medium risk means that the category of resource concerns could occur, and additional assessment is recommended if the identified resource is a client concern and/or objective.
• High risk means that a resource concern in that category is likely to occur.
The resource categories are: S (soil), W (water), A (air), P (plant), A (animal), E (energy), and H (human). The dominant resource concerns further refine the resource category to a specific resource concern within that category.

State and transition model

Land uses

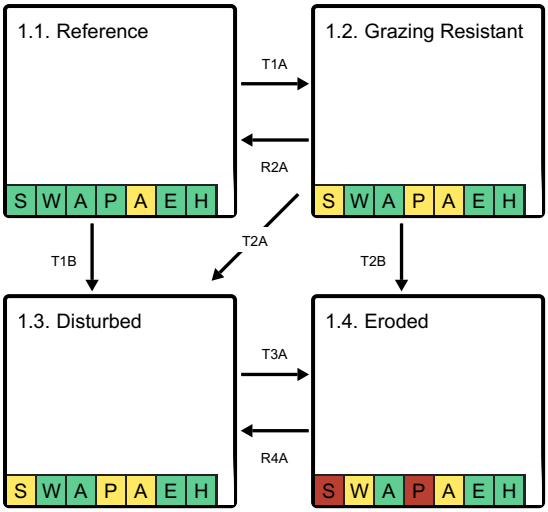


C1A - Flood irrigation, tillage, and seeding

C1B - Vegetation and extreme soil disturbance (heavy equipment)

C3A - Re-shaping/re-contouring; deep ripping; topsoil replacement; seedbed preparation; seeding; weed and grazing management

Land use 1 submodel, ecosystem states



T1A - Herbivory pressure (moderate to high intensity continuous spring grazing or low intensity season-long grazing)

T1B - Multiple soil disturbances or extreme herbivory combined with catastrophic drought

R2A - Brush management; prescribed grazing (rotational grazing system that incorporates periodic rest during critical growth period)

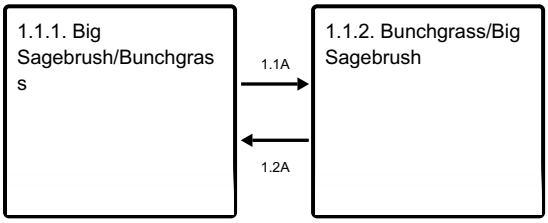
T2A - Multiple soil disturbances or extreme herbivory combined with catastrophic drought

T2B - Extreme herbivory (high intensity season-long or bedding/animal congregation)

T3A - Extreme herbivory (high intensity season-long or bedding/animal congregation)

R4A - Brush management and prescribed grazing (rotational grazing system that incorporates periodic rest during critical growth period)

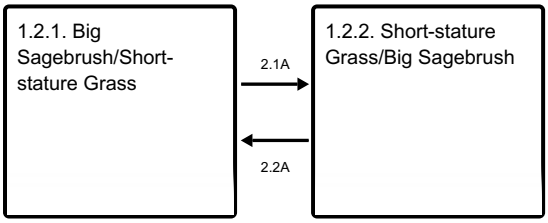
State 1 submodel, plant communities



1.1A - Sagebrush thinning event (low to moderate intensity fire, anthropogenic treatments, drought, freeze-kill, snow mold, herbivory, insects, disease)

1.2A - Natural succession (time without sagebrush killing event)

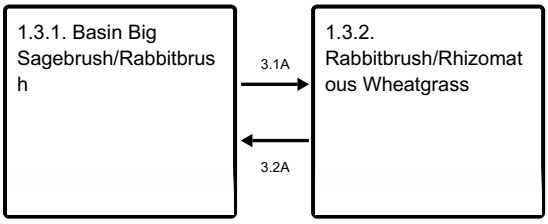
State 2 submodel, plant communities



2.1A - Sagebrush killing event (anthropogenic treatments, drought, freeze-kill, snow mold, herbivory,)

2.2A - Natural succession (time without a sagebrush killing event)

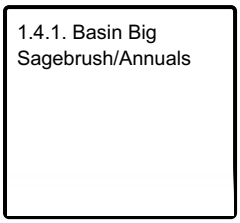
State 3 submodel, plant communities



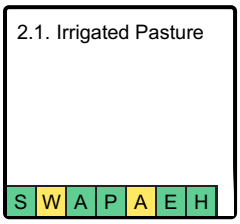
3.1A - Sagebrush killing event (fire, drought, mechanical or chemical treatment)

3.2A - Natural succession (time without sagebrush killing event)

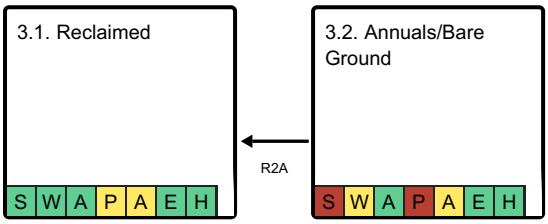
State 4 submodel, plant communities



Land use 2 submodel, ecosystem states



Land use 3 submodel, ecosystem states



R2A - Reclamation (re-contouring, deep ripping, seeding, mulching, prescribed grazing)

Land use 1
Rangeland

Rangeland is the dominant land use for this site and provides the most diverse ecosystem services. Range is land on which the historic and introduced vegetation is predominantly grasses, grass-like plants, forbs or shrubs managed as a natural ecosystem. Range may include natural grasslands, savannas, shrublands, tundra, alpine communities, marshes and meadows.

Characteristics and indicators. This landuse consists of diverse native plant communities dominated by basin big sagebrush and perennial cool season grasses that provide for site stability, hydrologic function, and biotic integrity of the site.

State 1.1
Reference

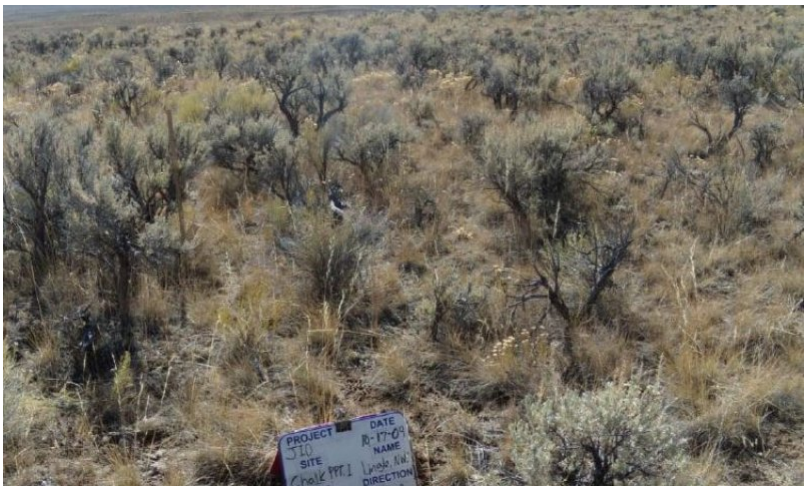


Figure 7. Reference State

The Reference State consists of two plant communities: the Big Sagebrush/Bunchgrass community and the Bunchgrass/Big sagebrush community. Each plant community differs in percent composition and foliar cover of bunchgrasses and shrubs. Forbs are a minor component on this site. Shrub canopy cover is less than 25 percent. Dominant shrubs are Wyoming and basin big sagebrush. Two important processes occur in the reference state and result in plant community changes: 1) sagebrush-killing disturbances such as fire, herbivory, drought, and flood; and 2) time without those disturbances, generally referred to as "natural succession."

Characteristics and indicators. The shift between plant community phases is dependent upon sagebrush-killing disturbances, and without them it will increase even with proper grazing management that includes light to moderate utilization, adequate recovery, and periodic critical growth period rest. Improper grazing management that includes high utilization, inadequate recovery, and continuous season-long grazing may accelerate the rate of increase for the shrub component. Management actions can be used to mimic the natural disturbance regime, however due to the fragile nature of soils are not often used.

Resilience management. This site has moderate resilience due to its ustic bordering on aridic soil moisture regime and frigid bordering on cryic temperature regime (Chambers et.al. 2014). Precipitation is typically adequate with good timing and more effective with cooler temperatures. This site typically recovers after minor disturbances, but is susceptible to delays in recovery during extreme climatic events such as drought. The site has moderate resistance to invasion by annual grasses because of climate limitations (dry and cold). Coarse soil surface textures lower resistance, but cold climatic conditions provide some resistance. The site is susceptible to invasion during hotter climatic periods. On a local scale, this site is more susceptible to annual weed invasion than sites with heavier soil textures.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass

Dominant resource concerns

- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Community 1.1.1
Big Sagebrush/Bunchgrass

This community is well adapted to Cool Central Desertic Basins and Plateaus climatic conditions. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. These plants have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site. This plant community provides for soil stability and a properly functioning hydrologic cycle. The coarse soils

associated with this site provide a favorable soil-water-plant relationship. The Big Sagebrush/Bunchgrass Community can occur across the entire ecological site or can occur in a mosaic with the Bunchgrass/Big Sagebrush Community. This plant community occurs in the absence of sagebrush killing disturbances and with grazing that mimics the historic herbivory regime (light, episodic, and associate with mid-size ungulate migration). Wyoming and basin big sagebrush are dominant with mountain big sagebrush at the upper end of the precipitation range for this site. Sagebrush canopy cover ranges from 15 to 25 percent. At this sagebrush canopy level in this precipitation zone, there is some competition between the shrub over-story and the herbaceous understory (Winward, 2007). Forb diversity is naturally low on this site. A Big Sagebrush/Bunchgrass Community with a degraded understory is an “at-risk” community that could transition to the Grazing Resistant State. Chemical treatment of shrubs is occasionally used to replace natural sagebrush killing events. However, chemical treatments impact non-target species, particularly broad-leafed species (forbs and shrubs) differently than natural events such as drought or fire. Where fire tends to result in a short-term increase in forbs, some chemical treatments result in a short-term (or long-term) reduction in forb density and diversity. Mechanical treatments are not often used due to the fragile nature of the coarse-textured soil surface. There are generally few canopy gaps, and most basal gaps are small (one to two feet). Rock fragment (gravels) cover on the soil surface is common. Many plant interspaces have canopy or litter cover. Production of grasses is lower than in the Bunchgrass/Big Sagebrush community.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	500	600	700
Grass/Grasslike	400	480	560
Forb	100	120	140
Total	**1000**	**1200**	**1400**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	1-2%
Litter	30-60%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	10-30%

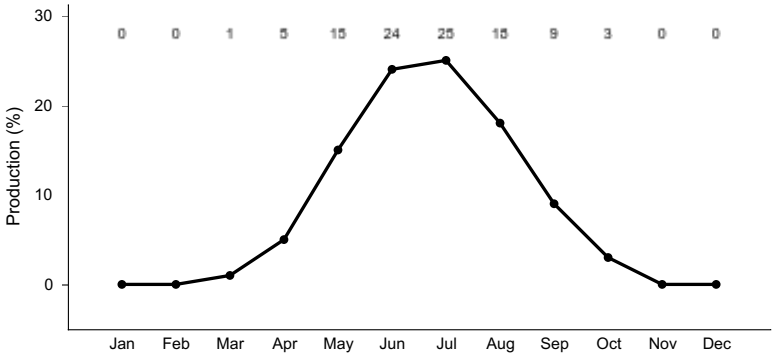


Figure 9. Plant community growth curve (percent production by month). WY34A02Xa, MLRA34A-Pinedale Plateau-all. Forage Production (herbaceous only) Developed by using the Rangeland Analysis Platform (RAP).

Community 1.1.2
Bunchgrass/Big Sagebrush

This plant community is well adapted to Cool Central Desertic Basins and Plateaus climatic conditions. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. Perennial plants that dominate this site have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site. This plant community provides for soil stability and a properly functioning hydrologic cycle. The Bunchgrass/Big Sagebrush Community can occur across the entire ecological site or can occur in a mosaic associated with the disturbance cycle at any given time and location with the Big Sagebrush/Bunchgrass Community. This plant community occurs after a recent sagebrush killing disturbances and with grazing that mimics the historic herbivory regime (light, episodic, and associate with mid-size ungulate migration). Mid-stature cool season bunchgrasses dominate and sagebrush is sub-dominant with foliar cover ranging from 5 to 15 percent. At this sagebrush canopy level in this precipitation zone, there is little, if any, competition between the shrub over-story and the herbaceous understory. In fact, there is evidence to suggest that the understory receives more benefit from the sage over-story than negative effects (Winward, 2007). There are few canopy gaps and basal gaps are generally small (one to two feet). Surface rock fragments are not a significant source of site stability. Many plant interspaces have canopy or litter cover, which provides site stability. Production of grasses is higher than in the Big Sagebrush/Bunchgrass community.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- needle and thread (*Hesperostipa comata*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	600	720	840
Shrub/Vine	300	360	420
Forb	100	120	140
Total	**1000**	**1200**	**1400**

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-2%
Forb basal cover	0-1%

Non-vascular plants	0%
Biological crusts	1-2%
Litter	30-60%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	10-30%

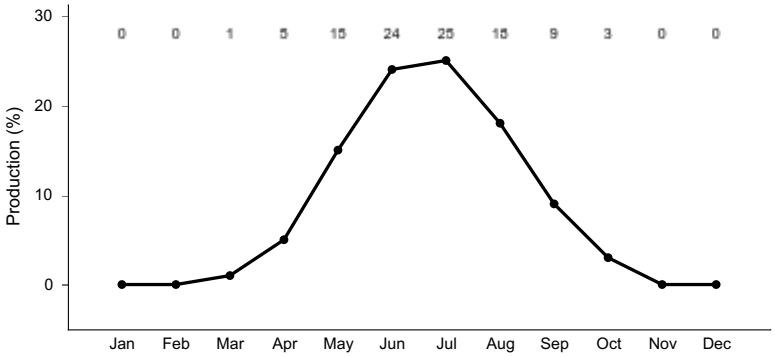


Figure 11. Plant community growth curve (percent production by month). WY34A02Xa, MLRA34A-Pinedale Plateau-all. Forage Production (herbaceous only) Developed by using the Rangeland Analysis Platform (RAP).

Pathway 1.1A
Community 1.1.1 to 1.1.2

This pathway occurs after a sagebrush thinning event, such as low to moderate intensity fire, drought, freeze-kill, snow mold, or herbivory from insects or disease. Brush Management is a conservation practice used to achieve this plant community. Chemical treatment of shrubs has replaced natural sagebrush killing events on many sites in the area. However, chemical treatments impact non-target species, particularly broad-leafed species (forbs and shrubs) differently than natural events such as drought or fire. Where fire tends to result in a short-term increase in forbs, some chemical treatments result in a short-term (or long-term) reduction in forb density and diversity. Chemical treatment of sagebrush with tebuthiuron can have impacts to the understory, depending on application rate (WWC, 2009). There is a danger of transition to the Disturbed State due to the fragile nature of coarse textured soils as well as if multiple consecutive treatments occur.

Context dependence. This pathway relies upon close to normal precipitation and temperature as well as a grazing regime that is low to moderate intensity. If extreme conditions/disturbances such as hot temperatures, drought, catastrophic fire, or high intensity grazing occur, there is risk of a transition to either the Grazing Resistant or Disturbed State depending upon severity and cumulative disturbance. A successful pathway is contingent upon a grazing regime that allows for periodic critical growth period rest (May through June). The historic herbivory regime was light and episodic, sometimes including spring/fall migration patterns by mid-size ungulates who "ride the green wave" from winter to summer ranges (Aikens et.al. 2017).

Pathway 1.2A
Community 1.1.2 to 1.1.1

Natural succession (time without a sagebrush killing event).

Context dependence. The time period for this pathway is dependent upon weather events such as drought and above normal precipitation years. Drought results in a faster pathway while favorable precipitation can result in a slower pathway. A grazing regime that mimics the historic regime (light intensity, episodic grazing events) will not alter the pathway, but a continuous grazing regime at moderate to heavy intensity can accelerate the pathway and puts the plant community "at-risk" for transition to the Grazing Resistant State.

State 1.2
Grazing Resistant

Figure 12. Grazing Resistant State

The Grazing Resistant State consists of two plant communities; the Big Sagebrush/Short-stature Grass community and the Short-stature Grass/Big Sagebrush community. There has been a shift in understory functional/structural group dominance. Due to herbivory pressure or possibly catastrophic drought, there is a shift from mid-stature cool-season bunchgrasses to short-stature cool-season bunchgrasses, rhizomatous wheatgrasses, and grass-likes. Canopy gap interspace and bare ground has increased from the Reference State, while herbaceous foliar cover has decreased.

Characteristics and indicators. There are fewer mid-size bunchgrasses and they are typically found under the shrub canopy where they are protected from herbivory. The shrub canopy interspaces are occupied by grazing tolerant grasses as well as patches of bare ground that are often connected. Needle and thread, a dominant grass in the Reference State, is fairly tolerant to grazing and is typically present. However, Indian ricegrass is a short-lived perennial that relies on an adequate seedbank and is often absent in this state. Annual grasses such as cheatgrass and annual weedy forbs such as desert alyssum may be found in small amounts (less than five percent composition by dry weight). Drier site conditions result in lower productivity and less herbaceous production potential. In many cases, the transition to the Grazing Resistant State may have occurred many decades ago during an era of higher stocking rates and continuous season-long grazing. However, continual grazing during the critical growth period (roughly May through June) at proper stocking rates will facilitate the transition to this state or maintain it as a stable state.

Resilience management. Site resilience is lower than the Reference State. Site hydrology has been modified due to moisture being utilized by shallower rooting species. Therefore, the site is drier earlier in the season and unable to recover as quickly after a disturbance such as drought. This state is more drought-prone, and therefore sees wider productivity swings during dry versus wet years and due to coarse soil surface textures is more vulnerable to invasion by annual invasive species. However, existing sagebrush canopy and remnant perennial vegetation provide some amount of resiliency. Overall soil stability is lower than the reference state, primarily due to a reduction in foliar cover and soil organic matter due to a reduction in productivity and litter. Site resistance to invasion by annual grasses and weedy annual forbs is lower due to niches in the understory for establishment as well as site water availability during the time suited for winter annuals such as cheatgrass (*Bromus tectorum*). Episodic and limited moisture is more suited to annual life forms. Localized conditions on this site, including coarse soil textures, further reduce site resistance.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass
- needleleaf sedge (*Carex duriuscula*), other herbaceous

Dominant resource concerns

- Wind erosion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

Community 1.2.1
Big Sagebrush/Short-stature Grass

This plant community is characterized by a dense stand of big sagebrush with a diminished understory. It has a mix of basin big sagebrush and Wyoming big sagebrush, with basin big sagebrush being dominant. The under-story has lost many of the mid-stature cool-season bunchgrasses, although needle and thread remains a dominant due to its high grazing tolerance. Low-stature bunchgrasses, rhizomatous wheatgrasses, and upland sedges have increased in dominance. Shrub canopy cover is often higher than in the reference state, typically making up greater than 40 percent of total annual production (species composition by dry weight), and herbaceous production and foliar cover has decreased. There may be small amounts of annual invasive grasses, mostly less than five percent foliar cover. There is often a slight increase in sprouting shrubs (less than 10 percent composition by weight). The site is susceptible to wind erosion and may have varying amounts of scouring and/or deposition. Hydrologic Function has been altered through higher than normal sagebrush canopy and more bare ground. Biotic Integrity is reduced due to low vegetative production, relative dominance of structural/functional groups , and potentially invasive species if present. Total annual production ranges from 600 to 1,000 pounds per acre with a Representative Value (RV) of 800 pounds per acre. Productivity is highly variable and fluctuates drastically in response to drought and wet cycles.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- needle and thread (*Hesperostipa comata*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass

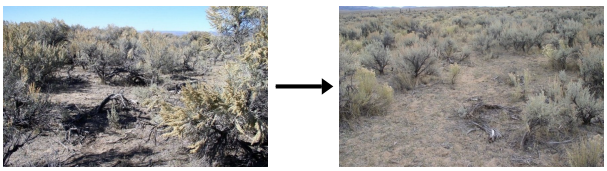
Community 1.2.2
Short-stature Grass/Big Sagebrush

This plant community is characterized by a dominance of short-stature bunchgrasses, rhizomatous grasses, and upland sedges. A sagebrush killing event has happened recently, and big sagebrush foliar cover is typically less than 15 percent. There could be a mix of basin big sagebrush and Wyoming big sagebrush, with basin big sagebrush being dominant. The under-story has lost many of the mid-stature cool-season bunchgrasses except needle and thread which has a high tolerance for grazing. There is often a slight increase in sprouting shrubs (less than 10 percent composition by weight). The site is susceptible to wind erosion and may have varying amounts of scouring and deposition. Hydrologic Function has been altered through higher than normal bare ground. Biotic Integrity is reduced due to low vegetative production, relative dominance of structural/functional groups , and potentially invasive species if present. Total annual production ranges from 600 to 1,000 pounds per acre with a Representative Value (RV) of 800 pounds per acre. Productivity is highly variable and fluctuates drastically in response to drought and wet cycles. This plant community is at-risk of transitioning to the Eroded State with additional disturbance such as heavy grazing, sagebrush treatment, or ground-disturbing activity.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass
- needle and thread (*Hesperostipa comata*), grass

Pathway 2.1A
Community 1.2.1 to 1.2.2



Big Sagebrush/Short-stature Grass

Short-stature Grass/Big Sagebrush

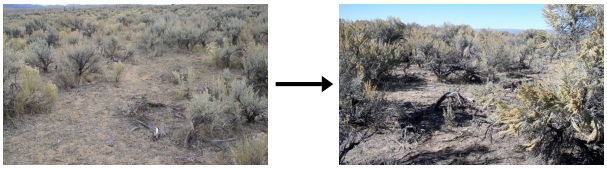
Sagebrush killing event, typically anthropogenic sagebrush treatments, such as chemical (tebuthiuron) or mechanical (mowing, aerator, etc.), and herbivory. Natural climatic events such as drought, freeze-kill, or snow mold can also occur. Fire is not typically a driver in this state due to the lack of fine fuels in the under-story.

Context dependence. This pathway relies upon close to normal precipitation and temperature as well as a grazing regime that is low to moderate intensity. If extreme conditions/disturbances such as hot temperatures, drought, catastrophic fire, or high intensity grazing occur, there is risk of a transition to either the Disturbed State or Eroded State depending upon severity and cumulative disturbance.

Conservation practices

Brush Management

Pathway 2.2A
Community 1.2.2 to 1.2.1



Short-stature Grass/Big Sagebrush

Big Sagebrush/Short-stature Grass

Natural succession (time without a sagebrush killing event).

Context dependence. The time period for this pathway is dependent upon weather events such as drought and above normal precipitation years. Drought results in a faster pathway while favorable precipitation can result in a slower pathway. A grazing regime that mimics the historic regime (light intensity, episodic grazing events) will not alter the pathway, but a continuous grazing regime at moderate to heavy intensity can accelerate the pathway.

State 1.3
Disturbed

The disturbed state is a result of soil-disturbing activities outside of the normal disturbance regime expected for this site. Examples are high intensity hoof action, anthropogenic activity, rodent activity, or frequent flooding, which includes occasional irrigation. It may also occur after brush management (or multiple treatments in rapid succession) preceded and followed by improper grazing techniques that include high-intensity grazing use without appropriate recovery periods.

Characteristics and indicators. There is a shift toward sprouting shrub dominance or codominance with big sagebrush depending on how long it has been since the disturbance(s). Both green (*Chrysothamnus viscidiflorus*) and rubber rabbitbrush (Ericameria nauseosus) may be present, but rubber rabbitbrush is typically more dominant. Along with a shift in shrub species, the herbaceous under-story also shifts toward more disturbance tolerant species such as thickspike wheatgrass (*Elymus lanceolatus* ssp. lanceolatus) and needleleaf sedge (*Carex duriuscula*). Annual weeds such as bur buttercup (*Ceratocephala testiculata*), flixweed (*Descurainia sophia*), and lambsquarter (*Chenopodium album*), and invasive annual grasses such as cheatgrass (*Bromus tectorum*) are are often present in small amounts (less than five percent composition by dry weight).

Resilience management. Site resilience is lower than the Reference State or Grazing Resistant State, but higher than the Eroded State. Site hydrology has been modified due to moisture being utilized by shallower rooting species. Therefore, the site is drier earlier in the season and unable to recover as quickly after a disturbance. However, existing shrub canopy and remnant perennial vegetation provide some amount of resiliency. Site resistance to invasion by annual grasses is lower due to niches in the under-story for establishment as well as coarse soil surface textures. Episodic moisture is more suited to annual life forms during drought.

Dominant plant species

- yellow rabbitbrush (*Chrysothamnus viscidiflorus*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass
- needleleaf sedge (*Carex duriuscula*), other herbaceous

Dominant resource concerns

- Wind erosion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

Community 1.3.1
Basin Big Sagebrush/Rabbitbrush

Basin big sagebrush and rabbitbrush dominate with foliar cover often exceeding 30 percent, typically making up over 50 percent of total annual production (species composition by dry weight). The understory has decreased and bare ground often exceeds 30 percent. Dominant perennial grasses include rhizomatous species that are resistant to soil disturbance. Bunchgrasses are limited to the protected areas under shrubs. Annuals grasses and forbs may be present, but are not dominant. Common annuals include desert alyssum, flixweed, and occasionally cheatgrass if a seed source has been introduced to the site. The site is typically adequately protected, but wind erosion can occur, resulting in scouring and/or deposition. Biotic Integrity is reduced due to low vegetative production, relative dominance and unexpected structural/functional groups, and potentially invasive species if present. Total annual production ranges from 500 to 900 pounds per acre with a Representative Value (RV) of 700 pounds per acre.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass

Community 1.3.2
Rabbitbrush/Rhizomatous Wheatgrass

Rabbitbrush dominates with foliar cover often exceeding 20 percent, typically making up over 30 percent of total annual production (species composition by dry weight). Rhizomatous wheatgrasses are the dominant perennial grass, and annual grasses and forbs are often present. Common annuals include desert alyssum, flixweed, and occasionally cheatgrass if a seed source has been introduced to the site. The under-story has decreased and bare ground exceeds 30 percent. Bunchgrasses are limited to the protected areas under shrubs. The site is typically adequately protected, but wind erosion can occur, resulting in scouring and deposition. Biotic Integrity is reduced due to low vegetative production, relative dominance and unexpected structural/functional groups, and potentially invasive species if present. Total annual production ranges from 500 to 900 pounds per acre with a Representative Value (RV) of 700 pounds per acre.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass

Pathway 3.1A
Community 1.3.1 to 1.3.2

Sagebrush killing event, typically high intensity fire or consecutive climatic events (drought, etc.), or anthropogenic sagebrush treatments such as chemical (tebuthiuron) or mechanical (mowing, aerator, etc.).

Context dependence. Continued disturbances can maintain this plant community for long periods of time. Prolonged drought and improper grazing (high intensity, season-long) can accelerate the pathway back to a sagebrush dominated plant community.

Conservation practices

Brush Management

Pathway 3.2A
Community 1.3.2 to 1.3.1

Natural succession (time without sagebrush killing event). Sagebrush and rabbitbrush will eventually become co-dominant.

Context dependence. The time period for this pathway is dependent upon weather events such as drought and

above normal precipitation years. Drought results in a faster pathway while favorable precipitation can result in a slower pathway. A grazing regime that mimics the historic regime (light intensity, episodic grazing events) will not alter the pathway, but a continuous grazing regime at moderate to heavy intensity can accelerate the pathway.

State 1.4
Eroded

The Eroded State has seen a shift in functional/structural group dominance to a monotypic old-aged, decadent basin big sagebrush stand. Disturbances have removed the herbaceous understory and bare ground exceeds 30 percent. The site is prone to wind erosion and often experiences "blow outs" with active erosion.

Characteristics and indicators. In this state, sagebrush canopy varies, but the under-story has seen a decrease in herbaceous grasses/grasslikes and forbs and an increase in bare ground. There will be indicators of reduced soil and site stability as well as reduced hydrologic function, mainly "blow outs" and wind erosion features. Soil surface loss and degradation is likely. Biotic integrity is affected by functional/structural groups not expected for the site, weedy species, and the loss of perennial species and functional/structural groups. The site is more prone to drought with large fluctuations in annual production in response to weather events. The site is less diverse with lower quality habitat for wildlife and pollinators.

Resilience management. Site resilience is lower than all other states because the site hydrology has been modified by the lack of herbaceous perennial under-story and subsequent wind erosion. Annual weedy forbs and invasive grasses are more likely to invade after drought or ground disturbing activities.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub

Dominant resource concerns

- Wind erosion
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

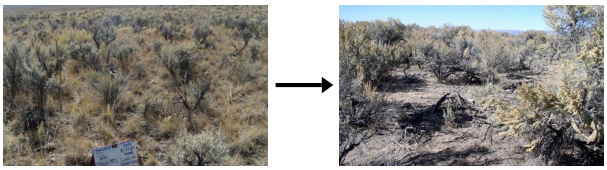
Community 1.4.1
Basin Big Sagebrush/Annuals

Basin big sagebrush and rabbitbrush are dominant with foliar cover often exceeding 30 percent, typically making up over 50 percent of total annual production (species composition by dry weight). The under-story has decreased and bare ground exceeds 40 percent. Perennial grass and forbs are sparse and bunchgrasses are limited to the protected areas under shrubs. Annual grasses and forbs dominates herbaceous understory cover. Common annuals include desert alyssum, flixweed, and occasionally cheatgrass if a seed source has been introduced to the site. The site is not well protected from wind erosion and Site Stability is Moderate or greater departure from the Reference State. Biotic integrity is affected by the change in functional/structural group dominance. Due to the fragile nature of soils, it is difficult to restore this plant community. Total annual production ranges from 400 to 800 pounds per acre with a Representative Value (RV) of 600 pounds per acre.

Dominant plant species

- basin big sagebrush (*Artemisia tridentata ssp. tridentata*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub

Transition T1A
State 1.1 to 1.2



Reference Grazing Resistant

Herbivory pressure in excess of normal Reference State conditions. Typical scenarios include moderate to high intensity continuous spring grazing or low intensity season-long grazing.

Constraints to recovery. Recovery is inhibited by continued herbivory pressure, reduced seedbank, and drought conditions. Annual grasses and forbs may occur in the shrub understory.

Context dependence. Warmer and drier climate trends contribute to uncertainty of restoration efforts. Coarse soil textures put this site at risk of transitioning to the Disturbed State with continued or additive disturbances.

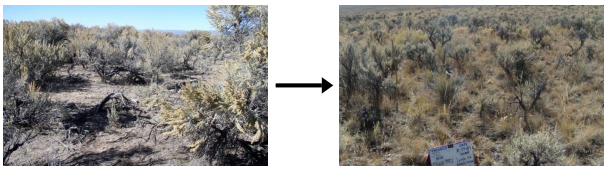
Transition T1B
State 1.1 to 1.3

Soil-disturbance outside of the normal disturbance regime expected for this site. Examples include high intensity fire, high intensity hoof action, anthropogenic activity (e.g. mechanical and chemical treatments), rodent activity, or prolonged soil saturation, typically occasional irrigation. Extreme herbivory in combination with catastrophic drought may be a trigger for this transition as well.

Constraints to recovery. Persistent drought conditions, and herbivory pressure are constraints to recovery to the Reference State. Recovery is further inhibited by consecutive disturbances repeated over a relatively short time period and prolonged drought conditions. There is a risk of annual grass and forb invasion.

Context dependence. This transition typically occurs after multiple consecutive disturbances. Warmer and drier climate trends contribute to uncertainty of restoration efforts.

Restoration pathway R2A
State 1.2 to 1.1



Grazing Resistant Reference

The drivers for this restoration pathway are reduction in woody species and restoration of native herbaceous species by mechanical or chemical treatment of sagebrush, and a rotational grazing system that incorporates periodic rest during the critical growth period (May through June).

Context dependence. If some mid-stature bunchgrasses remain under the sagebrush canopy, proper grazing management can move the site back to the Reference State combined with a mechanical or chemical sagebrush treatment. Due to the fragile nature of soils, care must be taken to appropriately prescribe the treatment to avoid excessive soil disturbance or over application of chemicals that may be more active with coarser soil textures such as tebuthiuron. Restoration could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment. (Derner, Schuman, Follett, & Vance, 2014).

Conservation practices

Brush Management
Prescribed Grazing

Transition T2A

State 1.2 to 1.3

Soil-disturbance outside of the normal disturbance regime expected for this site. Examples include high intensity fire, high intensity hoof action, anthropogenic activity (e.g. mechanical and chemical treatments), rodent activity, or prolonged soil saturation, typically occasional irrigation. Extreme herbivory in combination with catastrophic drought may be a trigger for this transition as well.

Constraints to recovery. Persistent drought conditions, and herbivory pressure are constraints to recovery to the Reference State. Recovery is further inhibited by consecutive disturbances repeated over a relatively short time period and prolonged drought conditions. There is a risk of annual grass and forb invasion.

Context dependence. This transition typically occurs after multiple consecutive disturbances. Warmer and drier climate trends contribute to uncertainty of restoration efforts.

Transition T2B
State 1.2 to 1.4

Extreme herbivory pressure in excess of normal Reference State, livestock husbandry practices, or concentrated animal use result in conditions that remove the herbaceous understory. Typical scenarios include high intensity season-long grazing and bedding activities.

Constraints to recovery. As bare ground increases, the site is prone to wind erosion and blowouts. Persistent drought conditions, and herbivory pressure are constraints to recovery to the Reference State. Recovery is further inhibited by consecutive disturbances repeated over a relatively short time period and prolonged drought conditions. There is a risk of annual grass and forb invasion.

Context dependence. This transition typically occurs after prolonged high intensity grazing and concentrated animal use for grazing and bedding. Warmer and drier climate trends contribute to uncertainty of restoration efforts.

Transition T3A
State 1.3 to 1.4

Extreme herbivory pressure in excess of normal Reference State, livestock husbandry practices, or concentrated animal use result in conditions that remove the herbaceous understory. Typical scenarios include high intensity season-long grazing and bedding activities.

Constraints to recovery. As bare ground increases, the site is prone to wind erosion and blowouts. Persistent drought conditions, and herbivory pressure are constraints to recovery to the Reference State. Recovery is further inhibited by consecutive disturbances repeated over a relatively short time period and prolonged drought conditions. There is a risk of annual grass and forb invasion.

Context dependence. This transition typically occurs after prolonged high intensity grazing and concentrated animal use for grazing and bedding. Warmer and drier climate trends contribute to uncertainty of restoration efforts.

Restoration pathway R4A
State 1.4 to 1.3

The drivers for this restoration pathway are reduction in woody species and restoration of native herbaceous species by mechanical or chemical treatment of sagebrush, and a rotational grazing system that incorporates periodic rest during the critical growth period (May through June).

Context dependence. If some mid-stature bunchgrasses remain under the sage canopy, proper grazing management can move the site back to the Reference State combined with a mechanical or chemical sagebrush treatment. Due to the fragile nature of soils, care must be taken to appropriately prescribe the treatment to avoid excessive soil disturbance or over application of chemicals that may be more active with coarser soil textures such as tebuthiuron. Restoration could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment. (Derner, Schuman, Follett, & Vance, 2014).

Conservation practices

Brush Management
Prescribed Grazing

Land use 2
Pastureland

This is a moderately deep to very deep site with some limitations for agriculture production, mainly low available water-holding capacity (AWC). Therefore, this site is not often converted to irrigated pasture, but pasture occasionally occurs when supported by low slopes and landscape position that lends itself to tillage and irrigation practices. Pasture is land composed of introduced or domesticated native forage species that is used primarily for the production of livestock. Pastures receive periodic renovation and cultural treatments, such as tillage, fertilization, mowing/haying, weed control, and may be irrigated. Pastures are not in rotation with annual crops.

Characteristics and indicators. Plant communities can be very diverse with a mixture of native and non-native forage species or as a monoculture of a highly competitive forage grass such as creeping meadow foxtail. Hay production with aftermath grazing is the most common management scenario, but pastures on this site can also managed for grazing throughout the growing season with some dormant season grazing as well.

State 2.1
Irrigated Pasture

This site belongs to the Sandy, Dry Forage Suitability Group (FSG) which covers coarse textured soils with 3 to 6 inches available water-holding capacity (AWC) in the top 60 inches of the soil profile with rapid permeability. Production expected to range from 2,000 to 4,000 pounds per acre. with representative value (RV) of 3,000 pounds per acre. Adapted species for use as irrigated pasture include native species such as prairie junegrass, Canby's bluegrass, basin wildrye, slender wheatgrass, and western wheatgrass; introduced species including meadow brome, timothy, beardless wildrye, Altai wildrye, red fescue, sheep fescue, tall fescue, creeping meadow foxtail, Canada bluegrass, and Kentucky bluegrass; legume and forb species such as cicer milkvetch, birdsfoot trefoil, small burnett, white clover, alsike clover, red clover, and strawberry clover. Since this site is well-drained it is capable of supporting certain varieties of alfalfa when under an improved irrigation system such as sprinkler. Selection of species should be based on production goals and intended use (goals and objectives). More information regarding preferred varieties for irrigated pasture can be found at
http://animalrange.montana.edu/documents/extension/mteb99.pdf AND
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mtpmctn10704.pdf See the description for Sandy, Dry FSG for MLRA 34A LRU E (10-14" ppt, <70 day growing season) for more information at Wyoming's electronic Field Office Technical Guide, Section II, Forage Suitability Groups
https://efotg.sc.egov.usda.gov/references/public/WY/mlra34A_fsg_sandy_dry_lru_E_.pdf

Characteristics and indicators. Irrigated pasture on this site is varies from a very diverse mix of forage species to a monoculture of creeping meadow foxtail. Improved irrigation systems allow for legume production.

Resilience management. Resilience on this site when in irrigated pasture is much higher than Reference State due to the additional moisture available for site recovery after disturbance. Resistance to weed invasion is typically much higher than the reference state. However, improper grazing or irrigation water management techniques could result in noxious weed invasion by perennials such as whitetop, perennial pepperweed, musk thistle, and Canada thistle.

Dominant resource concerns

- Inefficient irrigation water use
- Terrestrial habitat for wildlife and invertebrates

Land use 3
Other - Mineral Extraction Lands

Land that is barren, sandy, rocky, or that is impacted by the extraction of natural resources, such as minerals, gravel or sand, coal, shale, rock, oil, or natural gas.

Characteristics and indicators. This land use can be many things, but in this LRU is most often associated with oil and gas development. Barren land. A land cover/use category used to classify lands with limited capacity to support life and having less than five percent vegetative cover. Vegetation, if present, is widely spaced. [NRI-87] Typically, the surface of barren land is sand, rock, exposed subsoil, or salt-affected soils. Subcategories include salt flats; sand dunes; mud flats; beaches; bare exposed rock; quarries, strip mines, gravel pits, and borrow pits; river wash; oil wasteland; mixed barren lands; and other barren land. [NRI-92]

State 3.1
Reclaimed

The Reclaimed State is highly variable based on weather conditions during reclamation activities, the management practices used to implement the reclamation, the seed mix, and timing/method of stockpiling topsoil during the disturbance.

Characteristics and indicators. The most common scenario is a reclaimed oil and gas well pad planted to crested wheatgrass (*Agropyron cristatum*) without appropriate topsoil stockpiling. If topsoil is stockpiled, it may have been stored for too long or stored too deep resulting in fewer soil microorganisms. Over time, basin or Wyoming big sagebrush will spread into the reclaimed area, but the understory will be dominated by introduced species. Biological soil crusts are minimal, further exposing the soil surface to erosional forces as well as impairing carbon, nutrient, and water cycles.

Resilience management. Resilience is lower than the Reference State, but with best management practices, a certain amount of resilience can be restored. Successful reclamation will result in reduced soil erosion and improved hydrologic function. Biotic integrity is highly variable. Because soil disturbance previously occurred on the site, resistance to invasive species is lower unless reclamation is highly successful with all available niches occupied by desirable perennial species.

Dominant resource concerns

- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

State 3.2
Annuals/Bare Ground

The Annuals/*Bare Ground* community occurs after severe disturbance, most often physical soil disturbance that removes topsoil, but it can also occur as a transition from the Eroded State after severe drought, flooding, pests, or disease, leaving the site with no perennial vegetation.

Characteristics and indicators. Populations of annual weedy forbs can reach critical levels and impact the ecological processes on the site until restoration or reclamation of the site occurs. As part of succession, all sites that are severely disturbed go through this plant community as part of the restoration process, but the time in this plant community phase is largely dependent on the use of restoration Best Management Practices (BPMs) and climate cycles. Biological soil crusts are non-existent, further exposing the soil surface to erosional forces as well as impairing carbon, nutrient, and water cycles.

Resilience management. Site resilience is at its lowest, and recovery is largely dependent on management practices and weather patterns. Resistance to invasion is at its lowest, and the site is vulnerable to all of the common annual weedy forbs such as Russian thistle (*Salsola tragus*)), flixweed (*Descurainia sophia*), lambsquarter (*Chenopodium album*), and halogeton (Halogeton glomeraturs) as well as existing or newly emerging noxious weed threats. Due to coarse surface textures, this site is particularly susceptible to cheatgrass (*Bromus tectorum*).

Dominant resource concerns

- Wind erosion
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Restoration pathway R2A
State 3.2 to 3.1

Reclamation efforts include re-seeding. In cases where heavy equipment caused the disturbance, contouring, or deep ripping may be necessary to provide a suitable site for re-seeding. Care must be taken to stockpile and replace surface layers separately from the subsurface. Prescribed grazing and restricting vehicle traffic on the site is necessary to facilitate successful seeding of perennial species.

Context dependence. Drought conditions and herbivory pressure may hinder restoration efforts, and multiple seeding efforts may be necessary if failure is caused by drought. Mulch can be effective for soil moisture retention and erosion control.

Conservation practices

Critical Area Planting
Mulching
Prescribed Grazing

Conversion C1A
Land use 1 to 2

Most range conversion to pasture occurred at the beginning of the 20th century through the use of horse-drawn implements and hand tools. Flood irrigation infrastructure was installed and introduced species, such as Kentucky bluegrass and clover, were planted. Wild flooding, or "Mountain Meadow Flooding," is the most common irrigation system which has little directional control and low efficiency. Land smoothing and land leveling are not common practices due to the potential of a thin topsoil or the economic cost for an area with such a short growing season. Because of the undulating natural surface, resulting microtopography ranges from 2.5 to 20 cm and sometimes greater. The field is over-irrigated to increase the water table, a practice called "sub-irrigating," or locally referred to as "getting the sub up," that results in hydrophytic vegetation and hydric soil development in the lower landscape positions. The goal with this irrigation system is to saturate the soil with enough water to supplement the higher areas. Over the years, willows have colonized the ditch systems and provide additional wildlife habitat. Late season return flow to streams are often cited as another added benefit to this type of system.

Conversion C1B
Land use 1 to 3

The conversion from Range to Other - Mineral Extraction Lands occurs when vegetation and soil is manipulated for the purpose of mineral extraction. Common practices are oil and natural gas pad and pipeline infrastructure, gravel pits, and road construction. Vegetation and topsoil is removed and topsoil is often stockpiled for on or off-site reclamation.

Conversion C3A
Land use 3 to 1

Conversion from Other - Mineral Extraction Lands to Range occurs, sometimes over a long period of time, as part of the reclamation or restoration process after mineral extraction. There is low potential for recovery without significant inputs of energy and resources, especially if topsoil has been removed. Seed mixes that mimic an adjacent “reference area” rather than the site potential as described in the Reference State (1.1) will often result in a plant community resembling the Grazing Resistant State (1.2) due to inappropriate seed mixes and pre- and post-

seeding grazing management that does not provide adequate recovery and periodic critical growth period rest.

Additional community tables

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			132–300	
	needle and thread	HECO26	*Hesperostipa comata*	120–300	10–25
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	12–240	1–20
	squirreltail	ELEL5	*Elymus elymoides*	0–120	0–10
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	12–120	1–10
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–60	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–60	0–5
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–60	0–5
2	**Rhizomatous Grasses**			60–120	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	60–120	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	60–120	5–10
3	**Miscellaneous Grasses/Grasslikes**			24–60	
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–60	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	12–60	1–5
	threadleaf sedge	CAFI	*Carex filifolia*	12–60	1–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–60	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	12–60	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–60	0–5
	spike fescue	LEKI2	*Leucopoa kingii*	0–60	0–5
Forb					
4	**Perennial Forbs**			48–108	
	buckwheat	ERIOG	*Eriogonum*	12–60	1–5
	lupine	LUPIN	*Lupinus*	12–60	1–5
	spiny phlox	PHHO	*Phlox hoodii*	12–60	1–5
	longleaf phlox	PHLO2	*Phlox longifolia*	0–36	0–3
	beardtongue	PENST	*Penstemon*	0–36	0–3
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–36	0–3
	locoweed	OXYTR	*Oxytropis*	0–36	0–3
	flaxleaf plainsmustard	SCLI	*Schoenocrambe linifolia*	0–36	0–3
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–36	0–3
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–36	0–3
	milkvetch	ASTRA	*Astragalus*	0–36	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–36	0–3
	fleabane	ERIGE2	*Erigeron*	0–36	0–3
	aster	SYMPH4	*Symphyotrichum*	0–36	0–3
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–36	0–3
	bluebells	MERTE	*Mertensia*	0–36	0–3

	bluebells	MERTE	*Mertensia*	0–36	0–3
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–12	0–1
	evening primrose	OENOT	*Oenothera*	0–12	0–1
	western wallflower	ERAS2	*Erysimum asperum*	0–12	0–1
	bladderpod	LESQU	*Lesquerella*	0–12	0–1
	desertparsley	LOMAT	*Lomatium*	0–12	0–1
	Townsend daisy	TOWNS	*Townsendia*	0–12	0–1
	clover	TRIFO	*Trifolium*	0–12	0–1
	American vetch	VIAM	*Vicia americana*	0–12	0–1
	violet	VIOLA	*Viola*	0–12	0–1
	deathcamas	ZIGAD	*Zigadenus*	0–12	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–12	0–1
	spearleaf stonecrop	SELA	*Sedum lanceolatum*	0–12	0–1
	nailwort	PARON	*Paronychia*	0–12	0–1
	cryptantha	CRYPT	*Cryptantha*	0–12	0–1
	larkspur	DELPH	*Delphinium*	0–12	0–1
	phacelia	PHACE	*Phacelia*	0–12	0–1
	buttercup	RANUN	*Ranunculus*	0–12	0–1
	agoseris	AGOSE	*Agoseris*	0–12	0–1
	onion	ALLIU	*Allium*	0–12	0–1
	pussytoes	ANTEN	*Antennaria*	0–12	0–1
	rockcress	ARABI2	*Arabis*	0–12	0–1
	sandwort	ARENA	*Arenaria*	0–12	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–12	0–1
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	0–12	0–1
5	**Annual Forbs**			0–12	
	rockjasmine	ANDRO3	*Androsace*	0–12	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–12	0–1
	cryptantha	CRYPT	*Cryptantha*	0–12	0–1
	groundsmoke	GAYOP	*Gayophytum*	0–12	0–1
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–12	0–1
	Forb, annual	2FA	*Forb, annual*	0–12	0–1
Shrub/Vine					
6	**Sagebrush**			216–480	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	180–480	15–25
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	180–360	0–15
	prairie sagewort	ARFR4	*Artemisia frigida*	0–36	0–3
	black sagebrush	ARNO4	*Artemisia nova*	0–36	0–3
7	**Miscellaneous Shrubs**			48–120	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	12–60	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–60	0–5
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–60	0–5
	Woods' rose	ROWOW	*Rosa woodsii var. woodsii*	0–36	0–3
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–36	0–3

	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–36	0–3
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	0–36	0–3
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–36	0–3
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–36	0–3
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–36	0–3
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–36	0–3
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–36	0–3
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–36	0–3
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–12	0–1

Table 10. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			240–540	
	needle and thread	HECO26	*Hesperostipa comata*	240–480	20–35
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	60–360	5–25
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	12–180	1–10
	squirreltail	ELEL5	*Elymus elymoides*	0–120	0–10
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	60–120	5–10
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–120	0–5
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–60	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–60	0–5
2	**Rhizomatous Wheatgrasses**			60–120	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	60–120	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	60–120	5–10
3	**Miscellaneous Grasses/Grasslikes**			24–60	
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–60	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	12–60	1–5
	threadleaf sedge	CAFI	*Carex filifolia*	12–60	1–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–60	0–5
	spike fescue	LEKI2	*Leucopoa kingii*	0–60	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	12–60	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–60	0–5
Forb					
4	**Perennial Forbs**			48–108	
	buckwheat	ERIOG	*Eriogonum*	12–60	1–5
	lupine	LUPIN	*Lupinus*	0–60	0–5
	spiny phlox	PHHO	*Phlox hoodii*	12–60	1–5
	longleaf phlox	PHLO2	*Phlox longifolia*	0–36	0–3
	flaxleaf plainsmustard	SCLI	*Schoenocrambe linifolia*	0–36	0–3
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–36	0–3
	bluebells	MERTE	*Mertensia*	0–36	0–3
	locoweed	OXYTR	*Oxytropis*	0–36	0–3
	beardtongue	PENST	*Penstemon*	0–36	0–3

	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–36	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–36	0–3
	aster	SYMPH4	*Symphyotrichum*	0–36	0–3
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–36	0–3
	milkvetch	ASTRA	*Astragalus*	0–36	0–3
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–36	0–3
	fleabane	ERIGE2	*Erigeron*	0–36	0–3
	agoseris	AGOSE	*Agoseris*	0–12	0–1
	onion	ALLIU	*Allium*	0–12	0–1
	pussytoes	ANTEN	*Antennaria*	0–12	0–1
	rockcress	ARABI2	*Arabis*	0–12	0–1
	sandwort	ARENA	*Arenaria*	0–12	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–12	0–1
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	0–12	0–1
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–12	0–1
	cryptantha	CRYPT	*Cryptantha*	0–12	0–1
	larkspur	DELPH	*Delphinium*	0–12	0–1
	western wallflower	ERAS2	*Erysimum asperum*	0–12	0–1
	bladderpod	LESQU	*Lesquerella*	0–12	0–1
	desertparsley	LOMAT	*Lomatium*	0–12	0–1
	Townsend daisy	TOWNS	*Townsendia*	0–12	0–1
	clover	TRIFO	*Trifolium*	0–12	0–1
	violet	VIOLA	*Viola*	0–12	0–1
	deathcamas	ZIGAD	*Zigadenus*	0–12	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–12	0–1
	phacelia	PHACE	*Phacelia*	0–12	0–1
	nailwort	PARON	*Paronychia*	0–12	0–1
	evening primrose	OENOT	*Oenothera*	0–12	0–1
	spearleaf stonecrop	SELA	*Sedum lanceolatum*	0–12	0–1
5	**Annual Forbs**			0–12	
	rockjasmine	ANDRO3	*Androsace*	0–12	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–12	0–1
	cryptantha	CRYPT	*Cryptantha*	0–12	0–1
	groundsmoke	GAYOP	*Gayophytum*	0–12	0–1
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–12	0–1
	Forb, annual	2FA	*Forb, annual*	0–12	0–1
Shrub/Vine					
6	**Sagebrush**			108–240	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	0–240	5–15
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	60–180	0–10
	prairie sagewort	ARFR4	*Artemisia frigida*	0–60	0–5
7	**Miscellaneous Shrubs**			48–120	

	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	12–60	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–60	0–5
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–60	0–5
	Woods' rose	ROWOW	*Rosa woodsii var. woodsii*	0–36	0–3
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–36	0–3
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–36	0–3
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–36	0–3
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–36	0–3
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–36	0–3
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–36	0–3
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–12	0–1
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–12	0–1

Animal community

The following table lists initial suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions with a harvest efficiency (HE) of 25 percent. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community described in this ecological site description. A field visit is required to document actual plant composition and production. More precise carrying capacity estimates, considering forage preference and accessibility (slope, distance to water, etc.), should be calculated using this information, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies (up to 35 percent) can result in an increased carrying capacity, but recovery time for upland sites is much longer. If distribution problems occur, stocking rates should be reduced or facilitating conservation practices (i.e., cross-fencing, water development) implemented to maintain plant health and vigor.
Stocking rates are expressed in Animal Unit Months (AUMs) which is defined as the amount of forage consumed by a 1,000 pound cow with a less than 4 month old calf at her side.

Plant Community - Production (lb./ac) Low-RV-High - AUMs/ac - ac/AUM
1.1.1 Big Sagebrush/Bunchgrass 1000-1200-1400 0.13 8
1.1.2 Bunchgrass/Big Sagebrush 1000-1200-1400 0.2 5
1.2.1 Big Sagebrush/Short-stature Grass 600-800-1000 0.07 14
1.2.2 Short-stature Grass/Big Sagebrush 600-800-1000 0.11 9
1.3.1 Big Sagebrush/Rabbitbrush 500-700-900 0.05 20
1.3.2 Rabbitbrush/Short-stature Grass 500-700-900 0.07 14
1.4.1 Big Sagebrush/Annuals 400-600-800 0.01 100
2.1.1 Irrigated Pasture 2,000-3,000-4,000 0.8 1
3.1.1 Reclaimed 1,000-1,200-1,400 0.25 4
3.1.2 Annuals 100-500-900 0.01 100
* Continuous, season-long grazing by cattle under average growing conditions.

Calculation for stocking rates are as follows: Using Representative (RV) values for production, take forage palatable to grazing cattle and multiply by 0.25 Harvest Efficiency (HE) and divide by 912.5 pounds per AUM air-dry weight (ADW) to arrive at the initial suggested stocking rate in AUMs per acre.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. During the dormant period, the forage for livestock must be supplemented with protein because the quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect grazing capacity within a management unit. Accessibility adjustments should be made for the planning area as necessary. For example, 30 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water, resulting in a 50 percent reduction in grazing access; therefore, the adjustment is calculated for 30 percent of the unit (i.e. 50 percent reduction on 30

percent of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of grazing access within a management unit. Adjustments should be made that incorporate these factors when calculating the carrying capacity of a management unit.

Wildlife:
Land Use 1 - Range
Reference State:
1.1.1 Big Sagebrush/Bunchgrass: This community phase provides winter, transitional and summer habitat for Sage Grouse, mule deer and pronghorn. Although this community makes up a small portion on the overall landscape, the site occurs within areas highly used by big game species, primarily during winter months. These areas also provide some nesting habitat for sagebrush obligates, such as Sage Thrashers and Brewer's Sparrow.
1.1.2 Bunchgrass/Big Sagebrush: This community phase provides foraging opportunities for ungulates during winter, transitional and summer seasonal ranges, however, suitable cover due to lower canopy of sagebrush is lacking. Year-round habitat is provided for many other sagebrush obligate species including both generalists and specialists. This community can be used as migration and stopover habitat by big game, but is generally a small component of the landscape. Spring green-up of grass can be an important nutritional component of this community for migrating big game.

Grazing Resistance State:
1.2.1 Big Sagebrush/Short-stature Grass: This community phase is variable in its value to wildlife. The site provides suitable protective and thermal cover as a result of the density of big sagebrush. The diminished understory limits value of the site for birds and small mammals due to the lack of cover in the interspaces of the sagebrush plants.
1.2.2 Short-stature Grass/Big Sagebrush: This community phase is variable in its value to wildlife. A dominance of short-stature grasses, such as Sandberg bluegrass, provides foraging opportunities during spring green-up and is an important nutritional component of this community for migrating ungulates. A lack of big sagebrush limits foraging opportunities and protective cover for a suite of wildlife species including birds, small mammals, and big game.
Disturbed State:
1.3.1 Basin Big Sagebrush/Rabbitbrush: These communities provide limited forage for ungulates such as pronghorn and mule deer, but still provide some protective and thermal cover. The areas are used by Sage Grouse and sagebrush generalists, or seasonally used by cottontail or jack rabbits.
1.3.2 Rabbitbrush/Rhizomatous Wheatgrass: These communities provide limited forage for pronghorn and mule deer due to low production and lack of sagebrush. They may be used as a foraging site by Sage Grouse and sagebrush generalists if proximal to woody cover, or seasonally used by small mammals. The overall dominance of rabbitbrush is generally not ideal to support a wide variety of wildlife.
Eroded State:
1.4.1 Basin Big Sagebrush/Annuals: This site is highly variable in its value to wildlife. The overall lack of an understory and increased bare ground is not ideal to support a wide range of wildlife. Sites with a dominance of basin big sagebrush can provide suitable cover for thermal protection and escape cover for a variety of species.

Land Use 2 – Pasture
2.1 Irrigated Pasture: While not ideal, this community phase when properly managed can provide brood rearing habitat for Sage Grouse when in proximity to areas with denser sagebrush cover. In areas with a higher diversity of forage species (and where accepted), this type provides forage value for wintering elk, and mule deer and pronghorn during transition between winter and summer ranges. It can provide habitat for a variety of small mammals and birds when adjacent to plant communities with higher densities of sagebrush.

Land Use 3 – Mineral Extraction
3.1 Reclaimed: This community phase is highly variable in its value to wildlife. Reclamation success, size and configuration of the reclaimed area, the species planted, and the time it takes for plants to establish will determine the value of the site for wildlife. A fully reclaimed site containing a diversity of herbaceous and woody native plants can eventually provide the same wildlife habitat benefits as the reference state. In most cases, grasses and forbs establish early in the reclamation process, whereas shrubs take significantly longer to establish. Wildlife species dependent on herbaceous plant communities for forage (elk, prairie dogs, and fox) will benefit from reclamation sooner than those species dependent on a mixed shrub/grass community. Small mammals, such as mice (Peromyscus spp.) and birds can be found foraging in these areas shortly after reclamation practices.
3.2 Annuals/Bareground: This state is highly variable in its value to wildlife. Lack of perennial forbs, grasses, and

shrub cover severely reduce the quality of forage for wildlife including ungulates such as mule deer and pronghorn. The area does provide limited foraging opportunities for small mammals and birds, but lacks any structure for escape cover.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group A, with localized areas in hydrologic group B. Infiltration potential for this site varies from moderately rapid to very rapid depending on soil hydrologic group and ground cover. Runoff varies from very low to moderately low (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Litter typically falls in place, and signs of movement are not common. Cryptogamic crusts are present, but only cover one to two percent of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants that bloom in the spring have an aesthetic value that appeals to recreationists.

Inventory data references

Information presented here has been derived from historic and recent clipping data and other inventory data. Field observations from range trained personnel were also used. Inventory Data Resources include:
5 National Resource Inventory (NRI) points (2015-2016)
9 Bureau of Land Management Assessment, Inventory, and Monitoring (BLM-AIM) points (2011-2016) - 4 points are duplicate of NRI
3 Tier I NRCS Ecological Site Inventory (NRCS-ESI) points (2007)
8 BLM-ESI points (2009-2019)

References

. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

. 2021 (Date accessed). USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.. USNVC: http://usnvc.org/.

. March 2021. National Resources Inventory Grazing Land On-Site Data Collection Handbook of Instructions. Natural Resources Conservation Service.

. 2002. Management considerations for sagebrush (Artemisia) in the western U.S.: A selective summary of cumulative information about the ecology and biology of woody N. American sagebrush taxa. USDI-BLM, Washington, D.C..

Aikens, E.O., M.J. Kauffman, J.A. Merkle, Dwinnell, G.A. Fralick, and K.L. Monteith. 2017. The greenscape shapes surfing of resource waves in a large migratory herbivor.. Ecology Letters 20:741–750.

Bestelmeyer, B., J.R. Brown, K.M. Havstad, B. Alexander, G. Chavez, and J.E. Herrick. 2003. Development and Use of State and Transition Models for Rangelands. Jornal of Range Management 56:114–126.

Bestelmeyer, B., J.R. Brown, J.E. Herrick, D.A. Trujillo, and K.M. Havstad. 2004. Land Management in the

American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management 34:38–51.

Bestelmeyer, B. and J. Brown. 2005. State-and-Transition Models 101: A Fresh look at vegetation change.

Bestelmeyer, B.T., K. Moseley, P.L. Shaver, H. Sanchez, D.D. Briske, and M.E. Fernandez-Gimenez. 2010. Practical guidance for developing state-and-transition models. Rangelands 32:23–30.

Bowker, K.A. 2000. Jonah Field: A Shallow Sweetspot in the Basin-Centered Gas Accumulation of the Northern Green River Basin, Wyoming..

Briske, D.D., B.T. Bestelmeyer, T.K. Stringham, and P.L. Shaver. 2008. Recommendations for Development of Resilience-Based State-and-Transition Models. Rangeland Ecology & Management 61:359–367.

Chambers, J.C., J.L. Beck, T.J. Christiansen, K.J. Clause, J.B. Dinkins, K.E. Doherty, K.A. Griffin, D.W. Havlina, K.F. Henke, L.L. Kurth, J.D. Maestas, M. Manning, K.E. Mayer, B.A. Mealor, C. McCarthy, M.A. Perea, and D.A. Pyke. 2016. Using resilience and resistance concepts to manage threats to sagebrush ecosystems, Gunnison sage-grouse, and Greater sage-grouse in their eastern range: A strategic multi-scale approach.. Gen. Tech. Rep. RMRS-GTR-356.. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 1–143.

Clause, K. and J. Randall. 2014. Wyoming Sagebrush Die-Off Report. Unpublished.

Innes, R.J. 2019. Fire regimes of Wyoming big sagebrush and basin big sagebrush communities.. Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory.

Martin, J.L. 1996. Geohydrology of Tertiary Rocks in the Green River Structural Basin in Wyoming, Utah, and Colorado.. Water-Resources Investigations Report 92-4164. US Geological Survey.

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. “Precipitation-Frequency Atlas of the United States” NOAA Atlas 2, Volume 2 (Wyoming). National Weather Service, Silver Spring, Maryland.

Schoeneberger, P.J. and D.A. Wysocki. 2017. Geomorphic Description System, Version 5.0..

Shultz, L.M. 2009. Monograph of Artemisia Subgenus Tridentatae (Asteraceae-Anthemideae). Systematic Botany Monographs 89:1–131.

Stringham, T.K., W.C. Kreuger, and P.L. Shaver. 2003. State and Transition Modeling: an ecological process approach. Journal of Range Management 56:106–113.

U. S. Environmental Protection Agency. 2010. Level III and IV ecoregions of the continental United States. U.S. EPA, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, U.S..

Winward, A. 2007. Boulder, Squaretop Area Field Notes. Field Notes. Unpublished.

Other references

Site concept, plant community data, and interpretations are based on ecological site descriptions (ESDs) from MLRA 34A-Foothills and Basins West (10-14W).
This ESD replaces R034AY246WY Sands MLRA 34A-Foothills and Basins West (Sa 10-14W), but only within geographic extent of the Pinedale Plateau LRU.
Further data collection and ecological site refinement are ongoing until the ESD has reached "Approved" status.

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Approval

Kirt Walstad, 2/24/2025

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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	05/01/2024
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:**

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17. **Perennial plant reproductive capability:**
