USDA Natural Resources Conservation Service

Ecological site EX043B23A121
Limy Skeletal (LiSk) Absaroka Lower Foothills

Last updated: 3/04/2024
Accessed: 04/19/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 043B–Central Rocky Mountains

Major Land Resource Unit (MLRA) 43B: Central Rocky Mountains

43B – Central Rocky Mountains – The Central Rocky Mountains extends from northern Montana to southern extent of Wyoming and from Idaho to central Wyoming. The southern extent of 43B is comprised of a combination of metamorphic, igneous, and sedimentary mountains and foothills. Climatic changes across this extent are broad and create several unique breaks in the landscape.

Further information regarding MLRAs, refer to: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.
Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook.

LRU notes

Land Resource Unit (LRU) 43B23A: Absaroka Lower Foothills

Based on the shifts in geology, precipitation patterns and other climatic factors, as well as elevations and vegetation, the Absaroka Range was divided into LRU 23. Further division of this LRU is necessary due to the gradient moving from the foothills to the summit, as well as aspect shifts (north/east face versus south/west face). Subset A is set for the lower elevations within the foothills with 10 to 14 inches of precipitation. To verify or identify the LRU A (the referenced LRU for this ecological site), refer to the Wyoming LRU matrix key contained within the Ecological Site Key. This particular LRU occurs along the eastern lower foothills of the Absaroka Range. This LRU starts north of Clark, WY and runs to the Thermopolis, WY area. Once the foothills cross into the Northern Beartooth Range, the climatic patterns and elevational changes shifts the plant community and allows for a break in LRU's near the Montana state line. As the LRU follows to the south and tracks east with the intersection of the Absaroka and Owl Creek Ranges, the face changes aspect and geology creating a shift in plant dynamics and a break in the LRU. The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soils are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRA’s/LRU’s based on elevation, landform, and biological references.

Moisture Regime: Aridic Ustic or Ustic Aridic – Progressive Initial mapping has shown that soil correlations completed prior to 2014 were identified as ustic aridic, after further evaluation of climatic and soil taxonomy information the proper moisture regime is aridic ustic. Both are recorded here until an update project is completed to correct the previous correlations.

Temperature Regime: Frigid

Dominant Cover: Rangeland – Sagebrush Steppe (major species is Wyoming Big Sagebrush)
Representative Value (RV) Effective Precipitation: 10-14 inches (254 – 355 mm)
RV Frost-Free Days: 80-110 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
3 Xeromorphic Woodland, Scrub & Herb Vegetation Class
3.B Cool Semi-Desert Scrub & Grassland Subclass
3.B.1 Cool Semi-Desert Scrub & Grassland formation
3.B.1.NE Western North American Cool Semi-Desert Scrub & Grassland Division
M169 Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe Macrogroup
G302 Artemisia Tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe Group
CEGL001535 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata Herbaceous Vegetation or
CEGL001009 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata Shrubland

Ecoregions (EPA):
Level I: 10 North American Deserts Level II: 10.1 Cold Deserts
Level III: 10.1.18 Wyoming Basin
Level IV: 10.1.18.b Big Horn Basin and
10.1.18.d Foothills and Low Mountains

Ecological site concept

• Site receives no additional water.
• Slope is less than 30 percent
• Soils are:
o Moderately deep to very deep (20-78 plus inches (50-200+ cm)
o less than 5 percent stone and boulder cover and greater than 35 percent cobble and gravel cover
o Skeletal (greater than or equal to 35 percent rock fragments) within 20 inches (50 cm) of mineral soil surface
o Violently effervescent starting within 4 inches (10 cm) of the mineral soil surface; calcium carbonates increases with depth
o Clay content is less than 35 percent in top 4 inches (10 cm) of mineral soil surface; Textures range from fine sandy loam to clay loam in top 4 inches (10 cm) of mineral soil surface
o All subsurface horizons in the particle size control section have a weighted average of greater than 18 percent but less than or equal to 35 percent clay. (The particle size control section is the segment of the profile from either the start of an argillic horizon for 50 cm’s or from 25-100 cm).
o Non-saline, sodic, or saline-sodic

Associated sites

EX043B23B175	**Skeletal (Sk) Absaroka Upper Foothills** Skeletal ecological site will occur in concave areas or areas with a deeper deposit of non-carbonitic alluvial materials. Where limy skeletal will occur on more convex or areas with a greater deposit of calcic materials.
EX043B23A122	**Loamy (Ly) Absaroka Lower Foothills** Loamy ecological site will occur in similar locations as the skeletal site, in areas were fewer rocks were deposited and may be associated with Limy Upland ecological site.

Similar sites

EX043B23A120	**Limy Upland (LiU) Absaroka Lower Foothills** Site has fewer rock fragments throughout the soil profile, a shift in grasses species, and greater management responses.

EX043B23A123	**Loamy Calcareous (LyCa) Absaroka Lower Foothills** Site has fewer rock fragments throughout the soil profile, carbonates starting lower in the profile, greater production, and a shift in plant species between the two sites.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia nova* (2) *Krascheninnikovia lanata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Elymus albicans*

Legacy ID

R043BX521WY

Physiographic features

This site occurs on nearly level to gently rolling land and on slopes generally less than 30 percent. Within the lower foothills of the Absaroka Range and associated mountains, this site is found to exist predominately on the gently sloping summits of erosional remnants or fan remnants that flow from the foothills into the basin proper. These landforms cross several climatic zones and are influenced by multiple geomorphic processes, for example: fan remnants covered by landslides, or breached by uplifts/escarpments. On a smaller scale, this site occurs in a patch-work dynamic as water moves and shifts sediments, derived from carbonate rich parent material, across the landscape (alluvium).

Table 2. Representative physiographic features

Landforms	(1) Foothills > Colluvial apron (2) Foothills > Fan remnant (3) Foothills > Escarpment (4) Foothills > Dip slope
Runoff class	Low to high
Elevation	5,800–7,200 ft
Slope	0–30%
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 10 to 14 inches (254 – 355 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. This amounts to about 50% of the mean annual precipitation. Much of the moisture that falls in the latter part of the summer is lost by evaporation and much of the moisture that falls during the winter is lost by sublimation. Average snowfall is about 20 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. High winds are generally blocked from the basin by high mountains, but can occur in conjunction with an occasional thunderstorm. Growth of native cool-season plants begins about April 15th and continues until about July 1st. Cool weather and moisture in September may produce some green up of cool season plants that will continue through late October.

Review of a 30 year trend of data for Average Temperature as well as Average Precipitation, there has been a

warming trend, but as the last 12 years graphed, the temperatures have swayed high and low, but overall it has maintained a steady trajectory, neither increasing nor decreasing. Where on the moisture side, the trajectory in trend has been a slow decline. The swings of when spring warm up and first frost hit with the decline in average precipitation have produced a drought effect where the moisture is not being received when the plants and ground is able to utilize the moisture. And in some cases, the late precipitation has encouraged the warm season or mat forming species over the cool season bunchgrasses that are the drivers of the natural system. Early frosts, with dry open winters has created a more arid or desert effect on plants resulting in high rates of winter kill, loss of vigor or overall damage to the plant.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. “Buffalo Bill Dam", "Cody 21SW", "Thermopolis", "Thermopolis 9NE", "Thermopolis 25WNW" and "Wapiti 1NE" are the representative weather stations within LRU D. The following graphs and charts are a collective sample representing the averaged normals and 30 year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3. Representative climatic features

Frost-free period (characteristic range)	66-109 days
Freeze-free period (characteristic range)	108-145 days
Precipitation total (characteristic range)	11-13 in
Frost-free period (actual range)	65-119 days
Freeze-free period (actual range)	103-147 days
Precipitation total (actual range)	10-13 in
Frost-free period (average)	88 days
Freeze-free period (average)	124 days
Precipitation total (average)	12 in

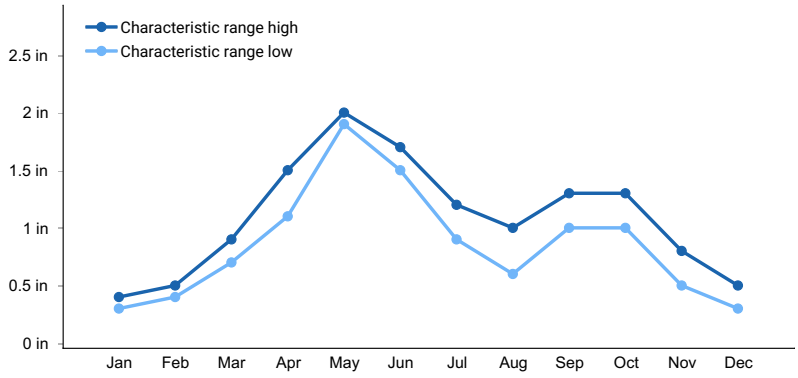


Figure 1. Monthly precipitation range

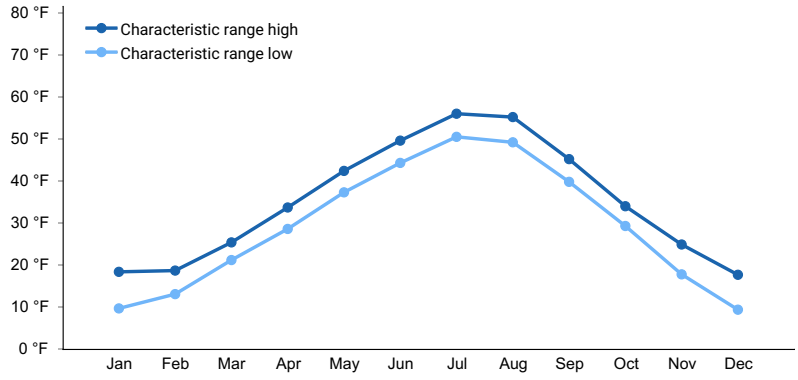


Figure 2. Monthly minimum temperature range

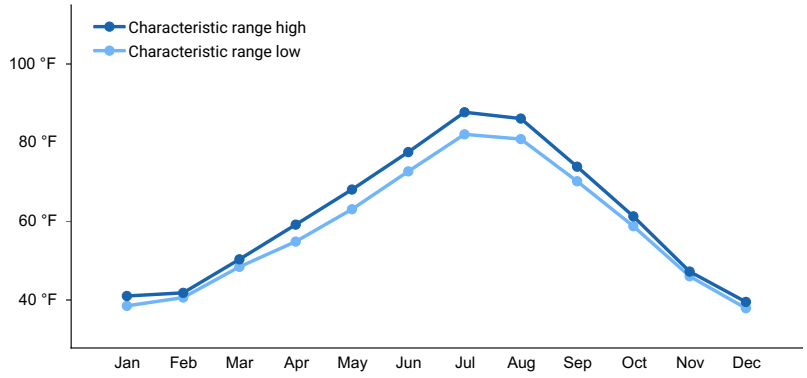


Figure 3. Monthly maximum temperature range

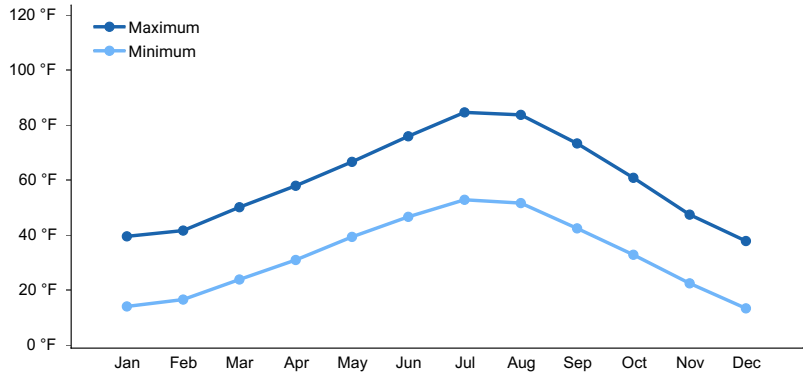


Figure 4. Monthly average minimum and maximum temperature

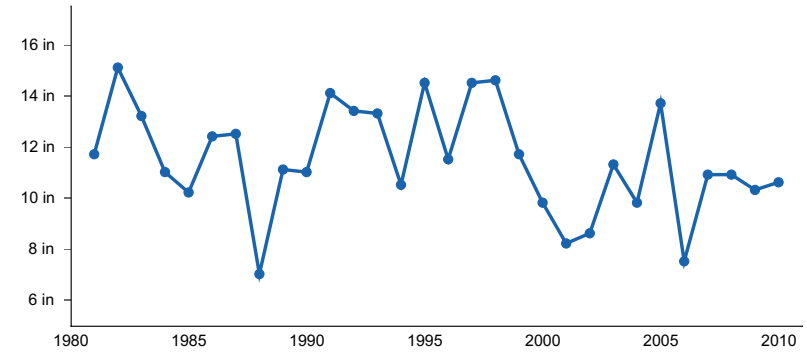


Figure 5. Annual precipitation pattern

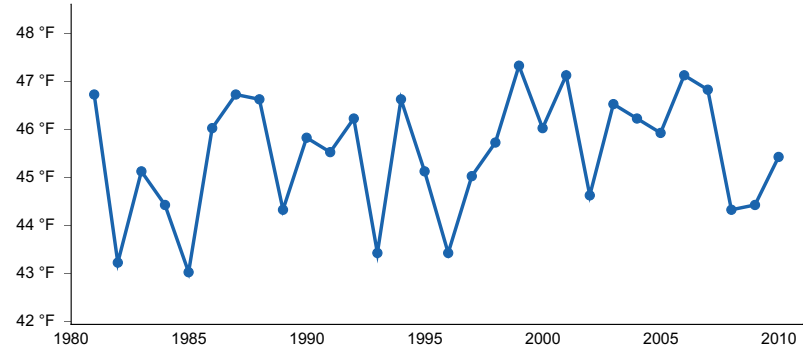


Figure 6. Annual average temperature pattern

Climate stations used

- (1) THERMOPOLIS 25WNW [USC00488888], Thermopolis, WY
- (2) THERMOPOLIS [USC00488875], Thermopolis, WY
- (3) THERMOPOLIS 9NE [USC00488884], Thermopolis, WY

- (4) BUFFALO BILL DAM [USC00481175], Cody, WY
- (5) WAPITI 1NE [USC00489467], Cody, WY
- (6) CODY 21 SW [USC00481855], Cody, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches or 150 cm) and have minimal influence from surface water and overland flow. There may be isolated features that are affected by snowpack that persists longer than surrounding areas due to position on the landform (shaded or protected pockets), but overflow is not a suitable fit. No streams are classified within this ecological site.

Soil features

The soils of this site are moderately deep to very deep (greater than 20” to bedrock), moderately well to well drained, and moderately slow to moderate permeability. The soil characteristic having the most influence on the plant community is available moisture (affected by the calcium carbonates throughout the soil profile) and the potential to develop soluble salt near the surface. More data is needed to quantify these characteristics specifically for this site.

Major Soil Series correlated to this site include: Amalia, Broback, Bronec, Cragnot-like, Crago-like, Foy-like, Trimad, Twinadams

Figure 7. Soils pit excavated by hand on an eroded fan remnant.

Table 4. Representative soil features

Parent material	(1) Slope alluvium–limestone and dolomite (2) Colluvium–igneous, metamorphic and sedimentary rock (3) Residuum–calcareous conglomerate
Surface texture	(1) Very gravelly, very cobbly, very stony sandy clay loam (2) Very bouldery clay loam (3) Loam
Family particle size	(1) Loamy-skeletal (2) Clayey-skeletal
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	20 in
Surface fragment cover <=3"	15–60%
Surface fragment cover >3"	5–35%
Available water capacity (Depth not specified)	3.1–6.2 in

Calcium carbonate equivalent (Depth not specified)	15–35%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–13
Soil reaction (1:1 water) (Depth not specified)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	15–65%
Subsurface fragment volume >3" (Depth not specified)	10–75%

Ecological dynamics

The Limy Skeletal ecological site within the Absaroka Lower Foothills was originally correlated as a coarse upland range site. During the review of the coarse upland range site, several communities presented with more rock fragments throughout the profile than expected and there were areas that were found to have calcareous characteristics throughout the profile. Historically, classification of the soils in the Big Horn Basin did not recognize the calcareous tendencies. Although this site is similar to the Coarse Upland range site, the community potential and system resilience are altered by the chemistry within the soil. The dominance of black sagebrush, bluebunch wheatgrass, increased bare ground or lichen cover and reduced production express the “shallow” acting characteristic of the site. Wyoming big sagebrush has been replaced by black sagebrush but is present in scattered areas of this site, and is generally restricted in vigor and production compared to the Coarse Upland range site. Minimal research can be found for this particular ecological site.

Potential vegetation on the Limy Skeletal ecological site, as with the Loamy ecological site, is dominated by mid-stature cool-season perennial grasses. Other significant vegetation includes black sagebrush, winterfat and a variety of forbs. The expected potential composition is 75 percent grasses, 10 percent forbs, and 15 percent woody plants. The composition and production will vary due to historic use and fluctuating precipitation.

As the Limy Skeletal ecological site deteriorates species such as threadleaf sedge, Sandberg bluegrass, and broom snakeweed will increase. Plains pricklypear and weedy annuals will invade. Cool-season grasses such as bluebunch wheatgrass, needle and thread, and Indian ricegrass will decrease in frequency and production.

Due to the amount and pattern of the precipitation, in combination with soil limitations, the black sagebrush component has a lower structure than similar ecological sites within the same area. Sagebrush may not be resilient once it has been removed or severely reduced if a vigorous stand of grass exists and is maintained. Threadleaf sedge may become the dominant vegetation if the area is subjected to frequent and severe (continuous season-long) periods of grazing, especially year-long grazing; resulting in a dense sod cover of threadleaf sedge.

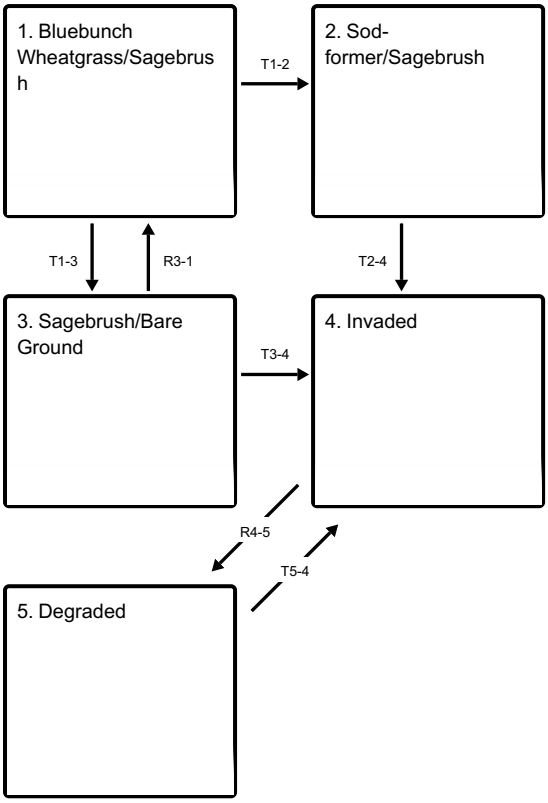
The reference plant community (description follows the plant community diagram) has been determined by study of relic rangeland sites, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model (STM) Diagram for this ecological site. An STM has five fundamental components: states, transitions, restoration pathways, community phases and community pathways. The state, designated by the bold box, is a single community phase or suite of community phases. The reference state is recognized as State 1. It describes the ecological potential and natural range of variability resulting from the natural disturbance regime of the site. The designation of alternative states (State 2, etc) in STMs denotes changes in ecosystem properties that cross a certain threshold.

Transitions are represented by the arrows between states moving from a higher state to a lower state (State 1 - State 2) and are denoted in the legend as a “T” (T1-2). They describe the variables or events that contribute directly to loss of state resilience and result in shifts between states. Restoration pathways are represented by the arrows between states returning back from a lower state to a higher state (State 2 - State1 or better illustrated by State 1

State and transition model

Ecosystem states



T1-2 - Frequent and severe grazing (yearlong grazing) or compaction from surface traffic, will weaken the mid-stature grasses and allow threadleaf sedge to increase.

T1-3 - Frequent and severe grazing as well as prolonged drought weakens the herbaceous cover reducing the community to a sagebrush dominated canopy.

T2-4 - Drought with or without hoof impact or mechanical soil impact to displace the sod opens the niche for invasive species to establish.

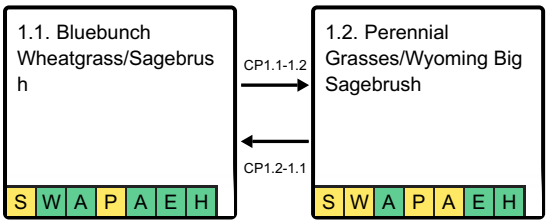
R3-1 - Brush management with seeding and long-term prescribed grazing with rest will allow this community to improve.

T3-4 - Disturbance to the soil surface provides the opportunity for invasive species to find their niche in a community.

R4-5 - Integrated weed management, seeding and grazing management will establish a community similar to Reference.

T5-4 - Any disturbance to or failure in reclaiming the community leaves this State at risk to invasion.

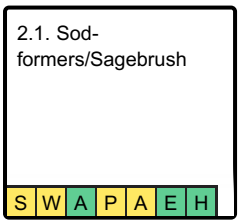
State 1 submodel, plant communities



CP1.1-1.2 - Moderate, continuous season-long grazing, especially with drought, will reduce the key grasses moving this community to the Perennial Grasses/Sagebrush Community Phase.

CP1.2-1.1 - Prescribed grazing with deferment over time will allow the key bunchgrasses to increase in the community.

State 2 submodel, plant communities



State 3 submodel, plant communities

3.1. Sagebrush/Bare Ground

State 4 submodel, plant communities

4.1. Perennial Grasses/Invasive Species/Sagebrush

S W A P A E H

State 5 submodel, plant communities

5.1. Disturbed Lands

S W A P A E H

State 1
Bluebunch Wheatgrass/Sagebrush

The Bluebunch Wheatgrass/Sagebrush State (State 1) is the reference community for the Limy Skeletal ecological site. The prominent cover of bluebunch wheatgrass, king-spike fescue and other mid-stature cool-season bunchgrasses with perennial forbs and a mix of black sagebrush and winterfat make for a productive and stable site.

Characteristics and indicators. Bluebunch wheatgrass is the dominant herbaceous species on this site with black sagebrush as the dominant woody cover. Lichen provide a significant soil cover in combination with other cryptogamic crusts.

Resilience management. The hardiness of the vegetation that thrive within the harsh conditions of the soil characteristics of the Limy Skeletal ecological site create a plant community resistant to change. But once disturbed, the herbaceous component of this site is difficult to restore, reducing the resiliency of the community.

Community 1.1
Bluebunch Wheatgrass/Sagebrush

Figure 8. Diverse mix of mid-stature cool-season bunchgrasses and black sagebrush are the markers for the reference community phase.

This plant community is the interpretive plant community for the Limy Skeletal ecological site and is considered to be the Reference Plant Community. This state evolved with grazing by large herbivores and infrequent periodic fires. This plant community can be found on areas that are properly managed with grazing and on areas receiving occasional short periods of rest. The potential vegetation is about 75% grasses or grass-like plants, 10% forbs, and 15% woody plants. This state is dominated by mid-stature cool-season grasses. The major grasses include bluebunch wheatgrass, king-spike fescue, Indian ricegrass, and Montana wheatgrass. Other grasses occurring in this state include needle and thread, prairie junegrass, and Sandberg bluegrass. Black sagebrush is an important element of this state, occurring in a mosaic pattern, and making up 5 to 15% of the annual production. Winterfat is common in the community as are a variety of forbs. The total annual production (air-dry weight) of this state is about 400 lbs./acre, but it can range from about 250 lbs./acre in unfavorable years to about 650 lbs./acre in above average years.

Resilience management. This plant community is extremely stable and well adapted to the climatic conditions. The diversity in plant species is high across this community which allows for a high drought tolerance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Dominant plant species

- black sagebrush (*Artemisia nova*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass
- spike fescue (*Leucopoa kingii*), grass
- tapertip hawksbeard (*Crepis acuminata*), other herbaceous
- spiny phlox (*Phlox hoodii*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Wind erosion
- Plant productivity and health
- Plant structure and composition

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	125	200	300
Shrub/Vine	100	150	250
Forb	25	50	100
Total	**250**	**400**	**650**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	5-15%
Litter	10-25%
Surface fragments >0.25" and <=3"	5-45%
Surface fragments >3"	0-15%
Bedrock	0%

Water	0%
Bare ground	10-30%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	5-10%	5-10%	0-5%
>0.5 <= 1	–	0-5%	10-45%	0-5%
>1 <= 2	–	0-5%	0-20%	0-2%
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

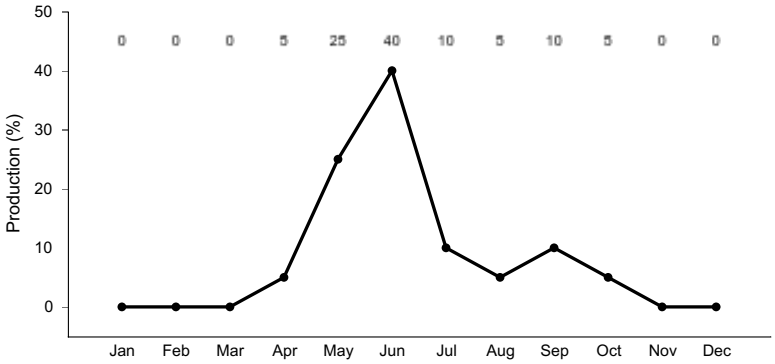


Figure 10. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Community 1.2
Perennial Grasses/Wyoming Big Sagebrush

Figure 11. Bluebunch wheatgrass and Sandberg bluegrass are prominent in this community with increasing threadleaf sedge.

Historically, this plant community evolved under grazing and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock and will be exacerbated by prolonged drought conditions. This plant community is still dominated by cool-season grasses, while short-stature tillering grass-likes and miscellaneous forbs account for the balance of the understory. Black sagebrush black sagebrush is the larger part of the overall production and accounts for the majority of the upper canopy. The bluebunch wheatgrass is still abundant in the

community although it is decreasing. Rhizomatous wheatgrasses, Sandberg bluegrass, and threadleaf sedge are increasing. Forbs commonly found in this plant community include fringed sagewort, broom snakeweed, and spiny phlox. Black sagebrush can make up to 25 percent of the annual production. The upper canopy of sagebrush and lower canopy of grasses and forbs provide a diverse plant community. When compared to the Reference Community 1.1, the change in sagebrush accompanied by the increase of threadleaf sedge, and plains pricklypear cactus are indicators of a transition. Indian ricegrass will only occur in trace amounts under the sagebrush canopy or within the patches of prickly pear. In addition, the amount of winterfat may or may not have changed depending on the season and species of use. The total annual production (air-dry weight) of this state is about 375 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 600 lbs./acre in above average years.

Resilience management. Rangeland Health Implications/Indicators: The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may be occurring but only on steeper slopes. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact. This plant community is resilient, but is subject to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term year-long or continuous season-long grazing or natural and man-made disturbances.

Dominant plant species

- black sagebrush (*Artemisia nova*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- spiny phlox (*Phlox hoodii*), other herbaceous
- broom snakeweed (*Gutierrezia sarothrae*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Feed and forage imbalance

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	100	200	300
Grass/Grasslike	75	125	225
Forb	25	50	75
Total	**200**	**375**	**600**

Table 9. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	5-20%

Litter	10-25%
Surface fragments >0.25" and <=3"	5-45%
Surface fragments >3"	0-15%
Bedrock	0%
Water	0%
Bare ground	10-40%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-5%	10-30%	0-10%
>0.5 <= 1	–	5-20%	5-25%	0-5%
>1 <= 2	–	0-5%	0-5%	0-2%
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

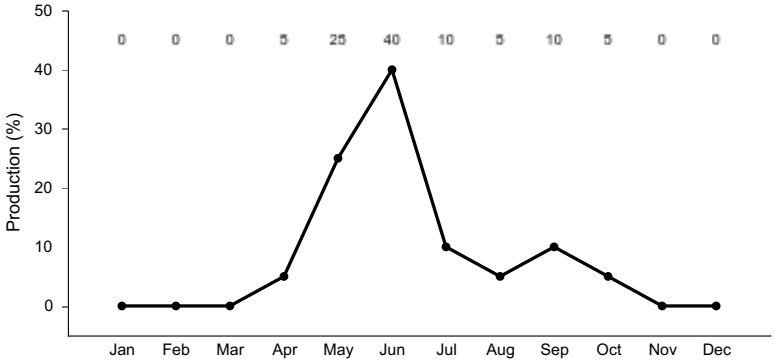
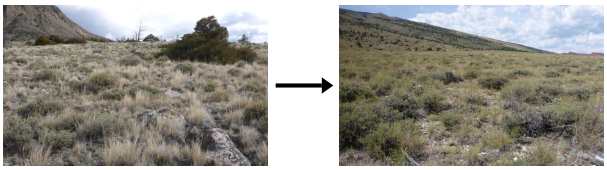


Figure 13. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Pathway CP1.1-1.2
Community 1.1 to 1.2



Bluebunch Wheatgrass/Sagebrush

Perennial Grasses/Wyoming Big Sagebrush

Moderate, continuous season-long grazing will convert the plant community to the Perennial Grass/Sagebrush Community Phase. Prolonged drought will exacerbate this transition. The continuous use reduces the key mid-stature bunchgrasses such as bluebunch wheatgrass, needle and thread, and Indian ricegrass; allowing the short-stature bunchgrasses and sod-formers to increase in the community.

Pathway CP1.2-1.1
Community 1.2 to 1.1

Perennial Grasses/Wyoming Big Sagebrush

Bluebunch Wheatgrass/Sagebrush

Prescribed grazing or possibly long-term prescribed grazing, will allow recovery to the Reference Community Phase. Rotational grazing with deferment is implemented as part of the prescribed method of use. Prescribed fire or brush management may encourage rejuvination of sagebrush and will remove old standing growth of bluebunch wheatgrass and other bunchgrasses. Consideration of the risk of invasive species needs to be taken before using prescribed fire on this community.

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Upland Wildlife Habitat Management
Grazing management to improve wildlife habitat
Patch-burning to enhance wildlife habitat

State 2
Sod-former/Sagebrush

The Sod-former/Sagebrush ecological site is a low-stature community that has shifted from the cools-season bunchgrasses to tillering grass-likes (threadleaf sedge). Fringed sagewort and pricklypear cactus are common.

Characteristics and indicators. Black sagebrush is still the prominent woody cover, however there may be a notable composition of winterfat. Season of use and species of grazing ungulate will be a factor affecting this cover. The sagebrush cover is still dwarfed or droughty in appearance and generally has been reduced in vigor by the shift in hydrology of this community. Most other mid and short-stature cool-season bunchgrasses are limited to within the canopy of the sagebrush or within the protective cactus clumps.

Resilience management. The dense root map of threadleaf sedge makes this community extremely resistant to change, and resilient to disturbance. Although the establishment of threadleaf sedge is a slow process, it will recover with time. Removal of grazing or disturbance does not provide a shift in the herbaceous cover within this community. The overall health and vigor of both the herbaceous as well as woody cover will improve with the removal of the grazing pressure or disturbance from the community.

Community 2.1
Sod-formers/Sagebrush

Figure 14. Black sagebrush and threadleaf sedge dominated community on the lower foothills of the Absaroka mountain range.

This plant community is the result of frequent and severe (year-long or continuous season-long) grazing, which has adversely affected the perennial grasses as well as impacted the shrub component. Other factors that can affect this community include drought, shift in climate, wildlife browsing and alternative uses. A dense sod of threadleaf sedge dominates this state. When compared to the Reference Communities, pricklypear cactus has increased as black sagebrush is reduced or in some cases removed. Rubber rabbitbrush and fringed sagewort may persist in the community. All cool-season mid-grasses and forbs have been greatly reduced. Production has significantly decreased. The total annual production (air-dry weight) of this state is not available. At this time, sufficient data has not been collected to provide dependable production.

Resilience management. Rangeland Health Implications/Indicators: This community is resistant to change and continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of threadleaf sedge. Eventually, the shrub component can be removed from the plant community. The biotic integrity is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. This sod-bound plant community is very resistant to water infiltration. While this sod protects the site itself, off-site areas are affected by excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in areas of bare ground and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The watershed may or may not be functioning, as runoff may affect adjoining sites.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- black sagebrush (*Artemisia nova*), shrub
- threadleaf sedge (*Carex filifolia*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- spiny phlox (*Phlox hoodii*), other herbaceous
- broom snakeweed (*Gutierrezia sarothrae*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Feed and forage imbalance

State 3
Sagebrush/Bare Ground

The loss of most of the herbaceous understory in the community leaves a barren and generally decadent (in appearance) stand of black sagebrush, with rubber rabbitbrush in some areas. Lichen and cryptogramic crust cover may or may not be in tact, health of this living soil cover is dependent on the type of disturbance and period of recovery following the disturbances that has lapsed.

Characteristics and indicators. The dominance of sagebrush cover and the lack of most herbaceous cover is the indication of the Sagebrush/*Bare Ground* State. Remnant populations of perennial grasses will occur in the canopy of sagebrush or within the protective niche within cactus clumps.

Resilience management. The lack of native propagates and the limitations of this calcic soil restrict the ability of most native species to recover, lowering the resiliency of this State. This ecological state is at risk of transitioning to an invaded state due to the lack of soil cover and competitive native species.

Community 3.1
Sagebrush/Bare Ground

Figure 15. Community transitioning to the Sagebrush/Bare Ground community phase with drought and high wildife use.

This plant community is the result of frequent and severe grazing and drought. Black sagebrush dominates this plant community, with an absence of most perennial grasses. Forbs may be present, especially lower growing annual forbs. The dominant grasses are Montana wheatgrass, Sandberg bluegrass, and threadleaf sedge. Cactus often invades. The interspaces between plants have expanded leaving the amount of bare ground more prevalent. As compared with the Reference State, the annual production declines, with the loss of herbaceous production. Shrub production may fluctuate slightly; however, the historic presumption of shrub increasing significantly has not been documented. Overall sagebrush cover maintains or may increase but will occur over a signficant period of time. The open interspaces leave this site vulnerable to weedy annual species such as cheatgrass to occupy the site if a seed source is available. If invasive species gain a foothold, they push the state across a threshold into the Invaded State. The total annual production (air-dry weight) of this state is not available. At this time, sufficient data has not been collected to provide dependable production.

Resilience management. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent. These areas hold a lower fire threat because of the lack of fine fuels and the increase of bare ground between sagebrush plants. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably less when compared to reference communities. Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestalling are obvious. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces and gullies may be establishing where rills have concentrated down slope.

State 4
Invaded

The Invaded State has a range of variability that is distinguished by its population of invasive or introduced (non-

native) species that has successful established and become significant within the composition of the community. A significant component of this community initially is native species common to the Limy Skeletal ecological site.

Characteristics and indicators. The composition by weight of ten percent or more of an invasive species is the factor tipping a community over the threshold into the Invaded State. The community can be relatively intact, having a representative composition of native species similar to the Reference State, but with a significant composition (minimum of five percent) cover of an invasive species or mix of invasive species. Cheatgrass is the most significant threat at this time; however, there are other aggressive non-native species that pose a concern on this ecological site. These species include field cottonrose, mustards, Russian thistle, and Kochia.

Resilience management. The competitive edge of most invasive species makes this site resistant to change and resilient following disturbance. Cheatgrass has been seen to respond with a positive potential following disturbances (fire, mechanical).

Community 4.1
Perennial Grasses/Invasive Species/Sagebrush

The Perennial Grasses/Invasive Species/Sagebrush phase has maintained a representative sample of the perennial grasses and forbs that are typical of the site with black sagebrush. The invasive species are present and hold a significant (10 percent or greater) composition of the landscape, and are prominent on the site (referring to a more wide scale composition, not one isolated patch in an isolated portion of the landscape). Production of the desired perennial species is generally reduced but the total production is maintained or elevated due to the production potential of the invasive species.

Resilience management. Rangeland Health Implications/Indicators: This plant community is resistant to change. These areas may be more prone to fire as fine fuels are more available and the bare ground between the sagebrush plants is decreased. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated, this variability also applies to water flow patterns and pedestalling. Infiltration is reduced and runoff is increased due to loss of perennial vegetation and root density.

Dominant plant species

- black sagebrush (*Artemisia nova*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- needle and thread (*Hesperostipa comata*), grass
- cheatgrass (*Bromus tectorum*), grass
- spike fescue (*Leucopoa kingii*), grass
- prairie sagewort (*Artemisia frigida*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- broom snakeweed (*Gutierrezia sarothrae*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Aggregate instability
- Plant structure and composition
- Plant pest pressure

State 5
Degraded

The Degraded State could be drafted as a stand-alone box within the state and transition model diagram. No matter what state a site originally is ranked in, once the site is mechanically disturbed, or suffers a catastrophic or

significant natural disaster that alters the soil properties (erosional, depositional, hydrological or chemical), the site potential is altered. Mechanical disturbances and reclamation practices using non-native species could qualify some stages of this state to be considered as a land use shift. The end result in either case is the shift in potential and response in management so that it is no longer similar to the reference community. The potential shifts are highly variable, so a dynamic state was captured to highlight the altered communities that exist on the landscape.

Characteristics and indicators. The soil disturbance and mechanical or physical removal of the vegetative canopy is the key characteristic of the Disturbed State. The initial indicators are the primary successional species that establish following a disturbance including kochia, six weeks fescue, and sunflowers. These initial colonizers will then be followed by any seeded species, or other species from within the locations seed bank.

Resilience management. The Disturbed State is highly variable and in a state of flux as the successional processes occur. Continued disturbance of these communities is a potential threat; and the communities are at high risk of transitioning to the Invaded State.

Community 5.1
Disturbed Lands

The title Disturbed Lands is encompassing two broad classifications of these land types. Go-back fields are referring to sites that were once cultivated or have had minor surface disturbance, and have since been left to natural processes. Homestead and abandoned farming sites can be identified on the landscape (through photo-tone shifts in aerial photographs) and are generally a mix of natives that have moved into disturbed sites or a co-mingling of introduced species and natives. These sites are difficult to reclaim, generally due to the introduced species that persist on the landscape. And once reclaimed, do not tend to respond to the natural disturbance regimes in the same manner that a native, mechanically undisturbed site would respond. The Limy Skeletal ecological site was not typically farmed specifically, but was influenced by homesteading or irrigation processes. The extent of this type is limited on the landscape. In a similar process, mined lands or lands affected by energy development including gravel or mineral excavation pits, transmission corridors, transportation corridors and oil and gas development sites provide a host of successional processes. Many times, these locations are re-exposed to disturbance frequently by mechanical means leaving annual weeds and primary successional species as the dominate canopy. Older, established sites or abandoned locations, have established communities similar to those expected on go-back fields and may be stable in nature. The growth curve of this plant community will vary depending on the species that are selected for seeding. For a more accurate portrait of the growth curve for the seeded community, the species used and the climatic tendencies of the region must be considered.

Resilience management. Rangeland Health Implications/Indicators: The plant community is variable and depending on the age of the stand and the stage of successional tendencies that the location is in will determine how stable (resilient/resistant) the community is. Plant diversity is generally strong, but is usually lacking in the structural groups that are desired on the site. Soil erosion is variable depending on the disturbance regime that is occurring on the site and again on the specific community that has established on a specific location. The variability of the water flow and pedestalling as well as infiltration and runoff is determined again by the species that establishes on this site.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- threadleaf sedge (*Carex filifolia*), grass
- burningbush (*Bassia scoparia*), other herbaceous
- tansymustard (*Descurainia*), other herbaceous
- broom snakeweed (*Gutierrezia sarothrae*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Wind erosion
- Compaction

- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Transition T1-2
State 1 to 2

Frequent and severe (year-long or continuous season-long) grazing or compaction from surface traffic, will convert the plant community to a Threadleaf Sedge Sod Plant Community. The impact to of frequent or repeated hits during grazing, hoof impact, and lack of rest for recovery weakens and removes the key grass species in the community. As the mid-stature grasses decline, threadleaf sedge is able to increase and alter the hydrology of the site.

Constraints to recovery. The dense root mat formed by threadleaf sedge alters the hydrology, effectively removing moisture from the site, limiting the available resources for other native species. The dense sod also limits the available soil space for seedling establishment. Interpspaces between sod patches are prone to erosion and runoff (limited infiltration of moisture).

Transition T1-3
State 1 to 3

Frequent and severe grazing plus no fire on soils with limited soluble salts, will convert the plant community to the Sagebrush/*Bare Ground* Plant Community. This is especially evident on areas with historically higher precipitation and the sagebrush stand is not adversely impacted by drought or heavy browsing. Grazing impacts to the herbaceous cover repeatedly removes it from the community leaving a sagebrush dominated community. Drought, insect damage, and other natural disturbances can assist in this transition.

Constraints to recovery. The lack of a seed bank and the harsh environment of the soils limits seedling establishment and survival. The unpredictable and variable spring precipitation also limits success of recovery for the Limy Skeletal ecological site.

Transition T2-4
State 2 to 4

Drought, Frequent or severe grazing, Disturbance – Drought as the only factor or drought with grazing intensity together can work to weaken or kill Wyoming big sagebrush on the landscape, and once it has declined or been removed from an area it is not known if or how long it will take for it to come back without cultural methods, which do not carry a reliable success rate. Threadleaf sedge have been seen to die back or die out with prolonged drought opening the canopy and the community's vulnerability to invasive species. Disturbance by mechanical means or human activities that break the root masses or disturb the soil surface open this closed community to potential invasive species, especially when there is a readily available seed source for those invasive species.

Constraints to recovery. The dense sod of threadleaf sedge will continue to impact the hydrology and competition for limited resources in this community limiting the potential for recovery. The lack of other key herbaceous species also is a constraint on this site. The inability, at this time, to eradicate cheatgrass does not allow for a complete recovery of an invaded community.

Restoration pathway R3-1
State 3 to 1

Brush management with prescribed grazing or rest allows for this community to improve. Trials completed in the local area have demonstrated the ability for these Limy Skeletal ecological sites to recover herbaceous cover following a sagebrush mowing treatment. The recovery is dependent on the remnant population the is present, the current weather patterns, and timing.

Conservation practices

Brush Management
Prescribed Burning
Critical Area Planting
Mulching
Prescribed Grazing
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)

Transition T3-4
State 3 to 4

Drought, soil disturbances, or high-intensity grazing with a seed source present can open the soil surface and weaken the sod allowing invasive species to establish. Although not common, fire can provide the niche for cheatgrass to establish on this site.

Constraints to recovery. Once invasive species, especially cheatgrass, establish, it is costly and difficult (if even possible) to remove. The lack of the key grass species also limits recover of this site.

Restoration pathway R4-5
State 4 to 5

Integrated Pest Management, with Seeding the site to a native mixture - Success is not known to have occurred, and is rated to be low and highly variable for the rate of control of most species. Cheatgrass is one of the most invasive species for many of these sites, although there are other challenges. With intensive weed control and inputs this community can resemble an at-risk community within the reference state, but it is not possible to reach the reference community condition once annuals have established on a site.

Conservation practices

Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management

Transition T5-4
State 5 to 4

Frequent or Severe Grazing, Disturbance with a seed Source, or Drought - Any disturbance that occurs or stress that is placed on the herbaceous cover, weakens the canopy and allows for invasive species to establish if a seed source is present. This State is at high risk of transitioning to an Invaded State. The challenge of successful seedings on a calcareous soil opens the community to invasion.

Constraints to recovery. The challenge of eradicating or reducing invasive species such as cheatgrass prevents recovery of most invaded communities without significant inputs for weed control, seeding with long-term grazing management.

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature Cool-season Bunchgrasses**			50–200	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	50–150	10–25
	needle and thread	HECO26	*Hesperostipa comata*	0–50	0–10
	spike fescue	LEKI2	*Leucopoa kingii*	0–50	0–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–25	0–5
2	**Rhizomatous Cool-season Grasses**			0–50	
	Montana wheatgrass	ELAL7	*Elymus albicans*	5–50	2–10
	western wheatgrass	PASM	*Pascopyrum smithii*	0–50	0–10
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–25	0–5
3	**Short-stature Cool-season Bunchgrasses**			0–50	
	squirreltail	ELEL5	*Elymus elymoides*	0–25	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–25	0–5
	muttongrass	POFE	*Poa fendleriana*	0–25	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–25	0–5
4	**Miscellaneous Grasses**			0–25	
	threadleaf sedge	CAFI	*Carex filifolia*	0–25	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–25	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–25	0–5
Forb					
5	**Perennial Forbs**			25–100	
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–25	0–5
	milkvetch	ASTRA	*Astragalus*	0–25	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–25	0–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–25	0–5
	prairie sagewort	ARFR4	*Artemisia frigida*	0–25	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–25	0–5
Shrub/Vine					
6	**Dominant Shrubs**			25–150	
	black sagebrush	ARNO4	*Artemisia nova*	0–150	0–15
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–50	0–10
7	**Miscellaneous Shrubs**			0–100	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–50	0–5
	curl-leaf mountain mahogany	CELE3	*Cercocarpus ledifolius*	0–50	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–25	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–25	0–5

Table 12. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature Cool-season Bunchgrasses**			25–75	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	25–75	5–25
	needle and thread	HECO26	*Hesperostipa comata*	0–25	0–5
	spike fescue	LEKI2	*Leucopoa kingii*	0–25	0–5
2	**Rhizomatous Cool-season Grasses**			0–75	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–50	0–10
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–50	0–10
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–25	0–5
3	**Short-stature Cool-season Grasses**			25–75	
	squirreltail	ELEL5	*Elymus elymoides*	5–50	2–10
	Sandberg bluegrass	POSE	*Poa secunda*	5–50	2–10
	muttongrass	POFE	*Poa fendleriana*	0–25	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–25	0–5
4	**Miscellanous Grasses**			0–25	
	threadleaf sedge	CAFI	*Carex filifolia*	0–25	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–25	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–25	0–5
Forb					
5	**Perennial Forbs**			5–75	
	milkvetch	ASTRA	*Astragalus*	0–25	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–25	0–5
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–25	0–5
	prairie sagewort	ARFR4	*Artemisia frigida*	0–25	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	5–25	2–5
	Forb, perennial	2FP	*Forb, perennial*	0–25	0–5
6	**Annual Forbs**			0–15	
	woolly plantain	PLPA2	*Plantago patagonica*	0–5	0–2
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–5	0–2
	western tansymustard	DEPI	*Descurainia pinnata*	0–5	0–2
	Forb, annual	2FA	*Forb, annual*	0–5	0–2
Shrub/Vine					
7	**Dominant Shrubs**			50–250	
	black sagebrush	ARNO4	*Artemisia nova*	50–200	10–25
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–50	0–5
8	**Miscellaneous Shrubs**			0–100	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–50	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–50	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–50	0–5

Animal community

Animal Community – Wildlife Interpretations:

1.1 - Bluebunch Wheatgrass/Black Sagebrush (Reference Community): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

1.2 - Perennial Grasses/Black Sagebrush Plant Community: The combination of an overstory of sagebrush and an understory of grasses and forbs provide a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer and antelope may use this state for foraging and cover year-round, as would cottontail and jack rabbits. It provides important winter, nesting, brood-rearing, and foraging habitat for sage grouse. Brewer's sparrows' nest in big sagebrush plants and hosts of other nesting birds utilize stands in the 20-30% cover range.

2.1 - Threadleaf Sedge/Black Sagebrush Plant Community: This community provides limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse where reference state community phases are limited. Generally, these are not target plant communities for wildlife habitat management.

3.1 - Black Sagebrush/*Bare Ground* Plant Community: This plant community can provide important winter foraging for elk, mule deer and antelope, as sagebrush can approach 15% protein and 40-60% digestibility during that time. This community provides excellent escape and thermal cover for large ungulates, as well as nesting habitat for sage grouse.

4.1 - Perennial Grasses/Invasive Species/Black Sagebrush Plant Community: The retained combination of sagebrush and the added diversity with the invasive grasses and/or forbs provide an extended plant community for wildlife. The similarities to Community Phase 1.2 are to some extent enhanced for some species with the added forage provided by the invasive species. But as the invasive species increase, decreasing the desirable species, the wildlife species benefits are decreased as well.

5.1 - Disturbed Lands Plant Community: The variability of this site prevents a detailed review of wildlife benefits. However, many of the introduced grasses, forbs and shrubs can provide adequate cover, feed and nesting sites for those wildlife species that would have selected the site prior to disturbance. Limitations and enhancements need to be considered by specific locations.

Animal Community – Grazing Interpretations:

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. 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 (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

The Carrying capacity is calculated as the production for a normal year X .25 efficiency factor / 912.5 #/AUM to calculate the AUM's/Acre.

Plant Community Production Carrying Capacity*
Plant Community Description/Title: Lbs./Acre AUM/Acre Acres/AUM
1.1 Bluebunch Wheatgrass/Black Sagebrush 250-400-650 0.11 9.13
1.2 Perennial Grasses/Black Sagebrush 200-375-600 0.10 9.73
2.1 Threadleaf Sedge/Black Sagebrush ** **
3.1 Black Sagebrush/*Bare Ground* ** **
4.1 Perennial Grasses/Invasive Species/Black Sagebrush ** **
5.1 Disturbed Lands ** **

* - Carry Capacity is figured for continuous, season-long grazing by cattle under average growing conditions.
** - Sufficient data for invaded and reclaimed communities has not be collected or evaluated, at this time, so no projection of a stocking rate recommendation or production range will be established at this time.

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

Distance to water, shrub density, and slope can affect carrying capacity (grazing capacity) within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% 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 graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderately slow to moderate. Runoff potential for this site varies from low to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (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. Pedestals are only slightly present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. The wide varieties of plants which bloom from spring until fall have an aesthetic value that appeals to visitors. Outside of plants, the extent offers a variety of Culture Resources to view on the landscape based on the location of many of these sites on higher ground on the benches and fans which also provides a rich source of geology for exploration. The extent of this ecological site is found within wild horse use areas; Pryor Mountain and McCullough Peaks. Wild horse/Wildlife Excursions are found as recreational venues for BLM lands and State lands within the Big Horn Basin. This ecological site, however, can prove to have limitations when associated with roadways and trails in relation to erosion potential and functionality. The soils will be sticky or slick when wet and are erosive.

Wood products

No appreciable wood products are present on the site. Utah juniper, Rocky Mountain juniper, limber pine, and mountain mahogany may be present in scattered patches, but no logging or timber harvest for commercial use is occurring.

Other products

Herbs: Several of the forb species within the communities of the Loamy Calcareous Ecological site have medicinal characteristics and have been used by the Native Americans in this area and more recently by the naturopathic profession.

Ornamental Species: The forbs commonly found as well as the shrub component of these communities have been used in landscaping and xeriscaping.

Inventory data references

Information presented was derived from NRCS inventory data. Field observations from range-trained personnel also were used. Those involved in the development of the new concept for the Limy Skeletal ecological site include Tricia Hatle, Range Management Specialist, US Department of the Interior-Bureau of Land Management (USDI-BLM); Karen Hepp, Range Management Specialist, USDI-BLM; Blaise Allen, Multi-county Rangeland Management Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, USDI and USDA Interpreting Indicators of Rangeland Health Version 3, and USDA NRCS Soil Surveys from various counties.

Quality control and quality assurance completed by NRCS: Dan Mattke, Area Resource Soil Scientist; Daniel Wood, MLRA Soil Survey Leader; John Hartung, Wyoming State Rangeland Management Specialist; Jeff Goats, Wyoming State Soil Scientist; and Scott Woodall, Regional Quality Assurance Ecological Site Specialist.

For specific data inquiries, contact the Powell, Wyoming Soil Survey Office (USDA-NRCS).

Inventory Data References:
Ocular field estimations observed by trained personnel were completed at each site. Then sites were selected where a 100-feet tape was stretched, and the following sample procedures were completed by inventory staff. For full sampling protocol and guidelines with forms please refer to the Wyoming ESI Operating Procedures, compiled in 2012 for the Powell and Rock Springs Soil Survey Office, USDA-NRCS.
• Double Sampling Production Data (9.6 hoop used to estimate 10 points, clipped a minimum of three of these estimated points, with two 21-foot X 21-foot square extended shrub plots).
• Line Point Intercept (overstory and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect.)
• Continuous Line Intercept (Woody Canopy Cover, with minimum gap of 0.2 foot for all woody species and succulents. Intercept height collected at each measurement.),
• Gap Intercept (Basal Gap measured with a minimum gap requirement of 0.7 foot.),
• Sample Point (Ten 1-meter square point photographs taken at set distances on transect. Read using the sample point computer program established by the High Plains Agricultural Research Center, WY).
• Soil Stability (Slake Test – surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

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Approval

Kirt Walstad, 3/04/2024

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.

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Date	04/29/2020
Approved by	Kirt Walstad

Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to nonexistent. Where present, short and widely spaced.

2. **Presence of water flow patterns:** Barely observable.

3. **Number and height of erosional pedestals or terracettes:** Rare to nonexistent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 5-40%.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous and large woody litter not expected to move.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 1 (interspaces) to 5 (under plant canopy), but average values should be 3.0 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil Organic Matter of less than 2% is expected.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 45-75% grasses, 10% forbs, and 15-35% shrubs. Evenly distributed plant canopy (50-75%) and litter plus moderate infiltration rates result in minimal runoff. Basal cover is typically less than 10% and marginally affects runoff on this site. Surface rock fragments of 5-30% provide stability to the site, but reduce infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

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: Mid-stature, Cool-season Bunchgrasses

    Sub-dominant: Perennial Shrubs < Rhizomatous, Cool-season Bunchgrasses

    Other: Perennial Forbs < Short-stature, Cool-season Bunchgrasses

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component.

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 10-25% of total canopy measurement with total litter (including beneath the plant canopy) from 50-80% expected. Herbaceous litter depth typically ranges from 3-10 mm. Woody litter can be up to a couple inches (4-6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production ranges from 250 -650 lb/ac (280-729 kg/ha); with an average of 400 lbs/ac (448 kg/ha).

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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:** Bare ground greater than 40% is the most common indicator of a threshold being crossed. Bluegrasses, sagebrush, and fringed sagewort are common increasers. Annual weeds such as cheatgrass and mustards are common invasive species in disturbed sites.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in extreme drought years.
