USDA Natural Resources
Conservation Service

Ecological site EX043B23B170
Steep Stony Upland (SStU) Absaroka Upper Foothills

Last updated: 3/06/2025
Accessed: 05/10/2025

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): 043B–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) 43B23B: Absaroka Upper 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 B is set for the higher elevations within the foothills, with 15 to 19 inches of precipitation. To verify or identify Subset B (the referenced subset for this ecological site), refer to the Wyoming LRU matrix key contained within the Ecological Site Key.

This particular LRU/Subset occurs along the eastern 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 then tracks east to the intersection of the Absaroka Range and the Owl Creek Range, 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: Typic Ustic
Temperature Regime: Frigid
Dominant Cover: Rangeland – Sagebrush Steppe (major species is Mountain Big Sagebrush)
Representative Value (RV) Effective Precipitation: 15-19 inches (381 – 483 mm)
RV Frost-Free Days: 37 - 80 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
2 Shrub & Herb Vegetation Class
2.B Temperate & Boreal Grassland & Shrubland Subclass
2.B.2 Temperate Grassland & Shrubland Formation
2.B.2.Na Western North American Grassland & Shrubland Division Division
M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland Macrogroup
G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group

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 > 20 but <70% (mostly 25-50%)
• Soils are:
o 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 >18% but <35% clay. (The particle size control section is the segment of the profile from either the start of an argillic horizon for 50 cm or from 25-100 cm).
o Moderately deep to very deep (20-80+ in. (50-200+ cm)
o > 5% stone and boulder cover and < 20% cobble and gravel cover
o Skeletal (≥35% rock fragments) within 8-20 inches (20-50 cm) of mineral soil surface
o Non-saline, sodic, or saline-sodic

Associated sites

EX043B23B168	**Steep Loamy (SLy) Absaroka Upper Foothills** Steep Loamy is found in similar area where deposition has occurred without the influence of the rock. On landslides or erosional side slopes, Steep Loamy will be found in more concave segments of the slope where Steep Stony Upland tends to be on convex or back slopes.
EX043B23B175	**Skeletal (Sk) Absaroka Upper Foothills** Skeletal soils are found in more eroded surfaces or areas with less deposition where the entire profile is skeletal.
EX043B23B162	**Shallow Loamy (SwLy) Absaroka Upper Foothills** Shallow Loamy will occur on slopes near rock outcropping, where Steep Stony Upland will be found in deeper profiles below or above outcrops.

Similar sites

EX043B23A172	**Stony Upland (StU) Absaroka Lower Foothills** Stony Upland is on lower sloping landforms and is generally on ridge tops or toe slopes with Steep Stony Upland occurring on side slopes
EX043B23B109	**Cobbly Upland (CoU) Absaroka Upper Foothills** Cobbly Upland will occur on similar slopes, but is also found on gentle slopes and is comprised of cobbles and gravels with very few stones and boulders, where Steep Stony Upland is mainly stones and boulders but does have cobbles and gravels.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Leucopoa kingii*

Legacy ID

R043BX670WY

Physiographic features

This site occurs on steep slopes of the upper portion of the foothills, landslides, and alluvial fans. The slopes are 20 percent or greater. The surface is marked with prominent cover of stones and boulders.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Landslide (2) Foothills > Alluvial fan (3) Foothills > Eroded fan remnant sideslope
Runoff class	Negligible to high
Elevation	6,000–9,000 ft
Slope	20–70%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 15 to 19 inches (381 – 483 mm). The normal precipitation pattern shows peaks in June tapering into September. This amounts to about 50 percent of the mean annual precipitation. Average snowfall is about 150 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation. Because of the varied topography, the wind will vary considerably for different parts of the area. The wind is usually much lighter at the lower elevations and in the valleys as compared with the higher terrain. The average winter wind velocity is 8.5 mph while the summer wind velocity averages 7.5 mph. Winds during storms and on ridges may exceed 45 mph.

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. High winds are generally blocked by high mountains but occur in conjunction with thunderstorms, which are common in late summer. Growth of native cool-season plants begins about May 1 to May 15 and continues until about October 15.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. Historically, Crandall Creek was the representative weather stations within this subset. However, Sunshine 3NE, Yellowstone Park Mammoth, and Tower Falls are the only available weather stations within a close proximity in location and characteristics for this subset. 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)	17-57 days
Freeze-free period (characteristic range)	43-100 days
Precipitation total (characteristic range)	14-16 in

Frost-free period (actual range)	5-65 days
Freeze-free period (actual range)	22-108 days
Precipitation total (actual range)	14-16 in
Frost-free period (average)	36 days
Freeze-free period (average)	70 days
Precipitation total (average)	15 in

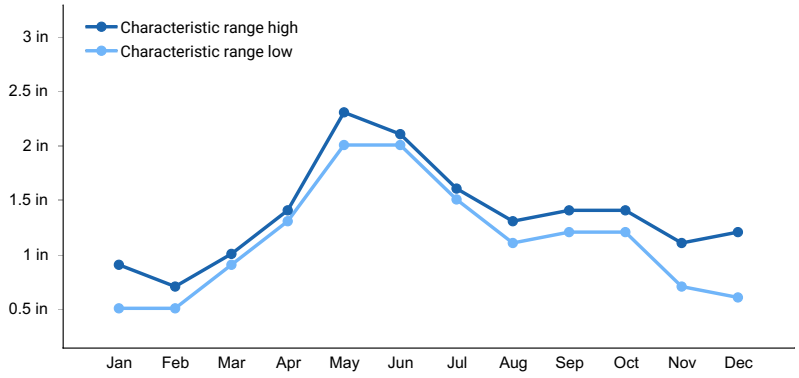


Figure 1. Monthly precipitation range

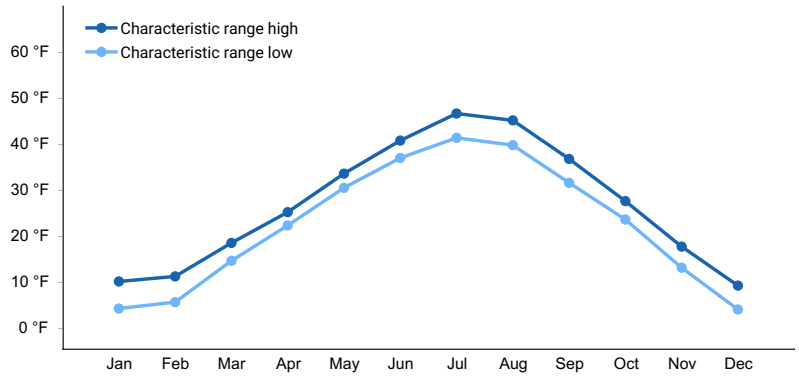


Figure 2. Monthly minimum temperature range

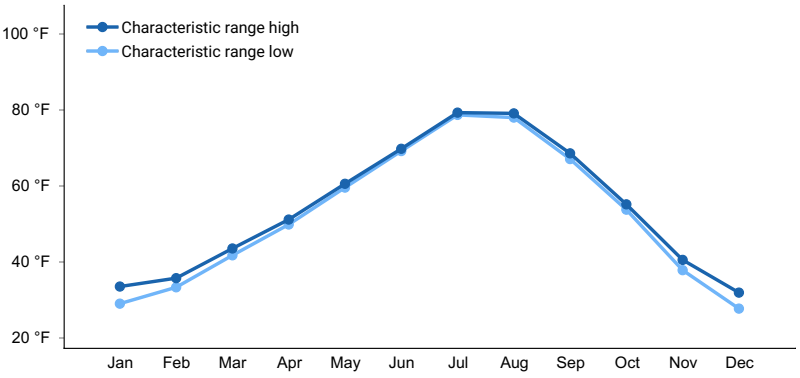


Figure 3. Monthly maximum temperature range

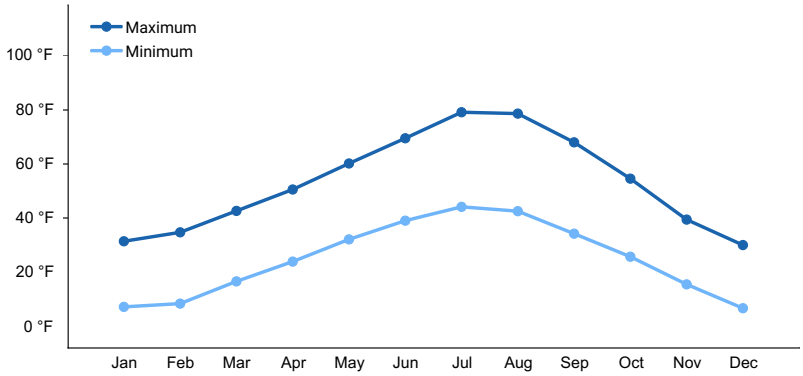


Figure 4. Monthly average minimum and maximum temperature

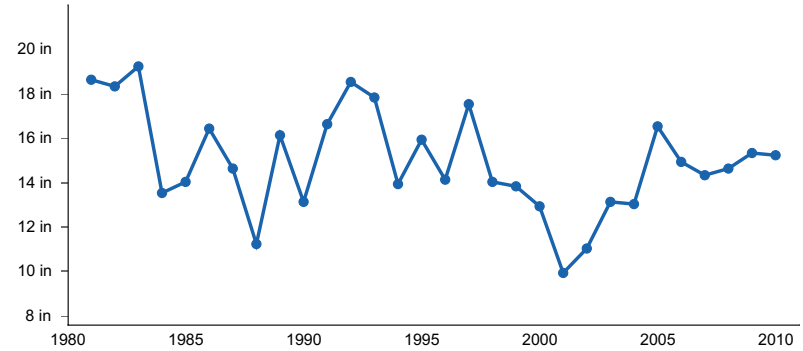


Figure 5. Annual precipitation pattern

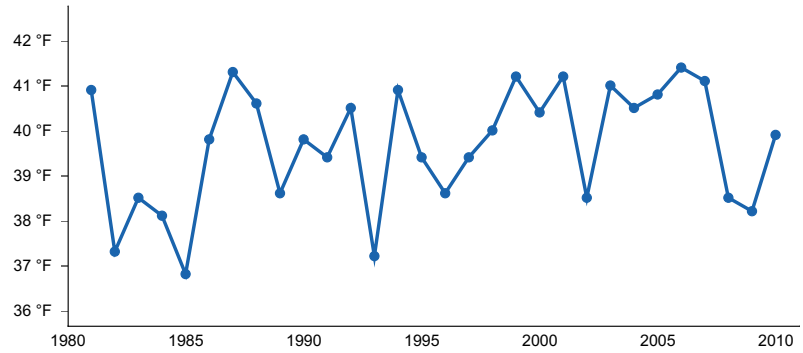


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SUNSHINE 3NE [USC00488758], Meeteetse, WY
- (2) TOWER FALLS [USC00489025], Yellowstone National Park, WY
- (3) YELLOWSTONE PK MAMMOTH [USC00489905], Yellowstone National Park, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches (150 cm)) and have minimal influence from surface water/overland flow. There may be isolated features that are affected by snow pack that persists longer than surrounding areas due to position on the landform (shaded/protected pockets).

Soil features

The soils of this site are deep to moderately deep (greater than 20" to bedrock), moderately well to somewhat excessively well-drained & moderately slow to moderately rapidly permeable. This site consists of stony and cobbly coarse fragment soils. The soil surface can be covered extensively with stones and boulders; and as such, plant density can be reduced. The soil characteristics most influential to the plant community are volume of coarse

fragments in the profile that reduces the available moisture and the extensive cover of these coarse fragments, which can reduce the plant density.

Figure 7. Steep Stony Upland ecological site has a fine-loamy cap over a stony skeletal subsurface (starting within 10-20 inches) as illustrated with this hand excavated pit.

Table 4. Representative soil features

Parent material	(1) Colluvium–igneous, metamorphic and sedimentary rock (2) Slope alluvium (3) Slide deposits (4) Till
Surface texture	(1) Extremely bouldery, extremely stony loam (2) Fine sandy loam (3) Sandy clay loam (4) Clay loam
Family particle size	(1) Fine-loamy (2) Loamy-skeletal (3) Fine-loamy over sandy or sandy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	20 in
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	5–35%
Available water capacity (Depth not specified)	1.8–5.4 in
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Soil reaction (1:1 water) (Depth not specified)	6.4–8.2
Subsurface fragment volume <=3" (8-40in)	0–50%
Subsurface fragment volume >3" (8-40in)	5–35%

Ecological dynamics

The Steep Stony Upland ecological site within the Absaroka Upper Foothills was originally correlated as a coarse

upland range site. During the review of existing range sites, several communities presented with the expected cap of soils without significant rock fragments overlying a skeletal profile comprised of stones. The steep slopes and the prominent surface cover of stones and boulders restricted production and shifted plants to where it was not the reacting as similar sites on lower slopes or without the larger rock fragments.
Although this site is similar to both the Coarse Upland and Shallow Igneous range site, the community potential and system resilience are altered by the rock fragments within the moderate to very deep soil. The dominance of mountain big sagebrush, bluebunch wheatgrass, increased bare ground and stone and boulder cover and reduced production express the “shallow” acting characteristic of the site. No research can be found for this particular ecological site.

Potential vegetation on the Steep Stony Upland ecological site is dominated by mid-stature cool-season perennial grasses. Other significant vegetation includes mountain big sagebrush, fringed sagewort, wild rose, arrowleaf balsamroot, and a variety of forbs. The expected potential composition is 75 percent grasses, 15 percent forbs, and 10 percent woody plants. The composition and production will vary due to historic use and fluctuating precipitation.

As the Steep Stony Upland ecological site deteriorates species such as Idaho fescue, Sandberg bluegrass, and broom snakeweed will increase. Cool-season grasses such as bluebunch wheatgrass, Columbia needlegrass and letterman's needlegrass will decrease in frequency and production.

Variability in precipitation and soil limitations, the sagebrush component may not be as resilient once it has been removed or severely reduced if a vigorous stand of grass exists and is maintained. Idaho fescue and rhizomatous wheatgrass may become the dominant vegetation if the area is subjected to frequent and severe (continuous season-long) periods of grazing.

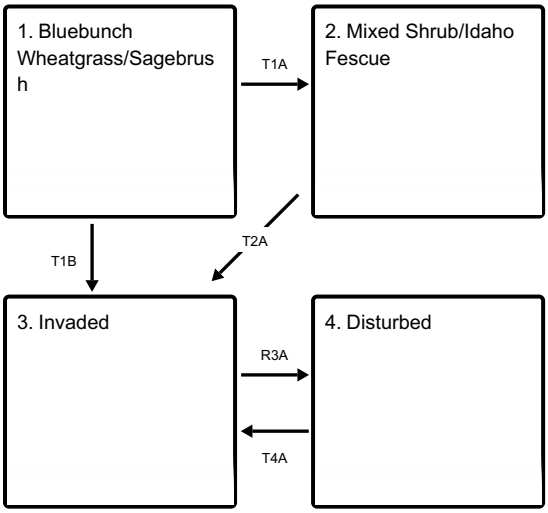
The reference plant community (description follows the plant community diagram) has been determined by study of relic rangeland sites, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical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



T1A - Frequent and severe grazing with the change in fire frequency, drought, and other significant impacts to the herbaceous cover force this transition.

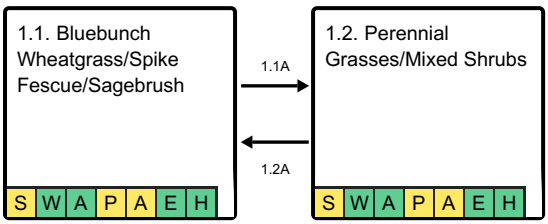
T1B - Fire, drought, and other major disturbances with a seed source present aid in this transition.

T2A - Continued frequent and severe use patterns, significant soil disturbance, drought, and other catastrophic events with a seed source present will transition this site to the Invaded State.

R3A - An integrated weed management plan with a native seeding and long-term prescribed grazing aids the transition of this site.

T4A - Lack of management, continued disturbance, failure of a reclamation process, or catastrophic events with seed source present will transition this community to the invaded state.

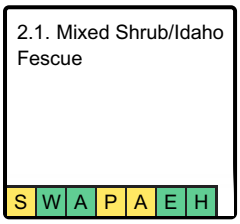
State 1 submodel, plant communities



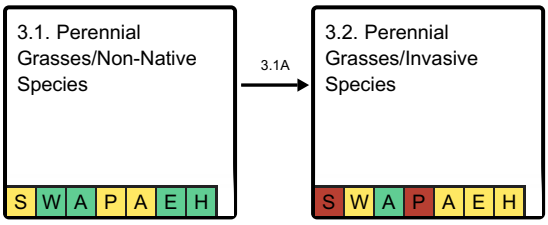
1.1A - Moderate, continuous season-long grazing will convert the Reference Community Phase, and prolonged drought will exacerbate this transition.

1.2A - Prescribed Grazing with rest and time will allow the tall-stature and desired grasses to regain vigor and sagebrush to recover.

State 2 submodel, plant communities

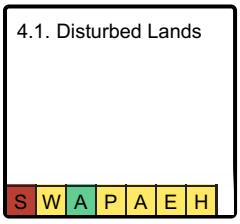


State 3 submodel, plant communities



3.1A - Severe and frequent grazing (continuous season-long) alone, or with drought, fire or other disturbance, will encourage invasive species when a seed source is present.

State 4 submodel, plant communities



State 1
Bluebunch Wheatgrass/Sagebrush

The Bluebunch Wheatgrass/Sagebrush State (State 1) is the Reference State for the Steep Stony Upland ecological site. The diverse mix of perennial grasses, and forbs make for a productive and stable site.

Characteristics and indicators. Bluebunch wheatgrass is the dominant herbaceous species on this site with an intermixed composition of mountain big sagebrush, snowberry, and fringed sagewort providing the dominant woody

cover. Buckwheat is common in this community with other ground covering forbs.

Resilience management. The vegetation that thrives in the harsh conditions of the Steep Stony Upland ecological site creates a plant community resistant to change. But once disturbed, the shift in the perennial grasses and shift in shrubs is difficult and takes time to recover, reducing the resiliency of the community.

Community 1.1
Bluebunch Wheatgrass/Spike Fescue/Sagebrush

Figure 8. One year post-fire, this Steep Stony Upland site has a strong herbaceous cover and the shrub component is recovering.

The Bluebunch Wheatgrass/Spike Fescue/Sagebrush Community Phase (1.1) is the Reference Community Phase for the Steep Stony Upland ecological site. Community Phase 1.1 evolved with grazing by large herbivores and periodic fires. This plant community can be found on areas that are properly managed with grazing, and on areas receiving periods of rest. Tall and mid-stature cool-season grasses are the dominant cover with mountain big sagebrush. The major grasses include Bluebunch wheatgrass, spike fescue, Columbia needlegrass, Idaho fescue, and rhizomatous wheatgrasses. Mountain big sagebrush, rubber rabbitbrush, and fringed sagewort are conspicuous elements of this state, occurring in a mosaic pattern, and making up 10% of the annual production. A variety of forbs occur in this community and plant diversity is high (see Plant Composition Table). Annual production on this state ranges from 500 to 900 pounds depending on climatic conditions. Average annual production is estimated at 750 pounds.

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

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- spike fescue (*Leucopoa kingii*), grass
- Columbia needlegrass (*Achnatherum nelsonii*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- prairie sagewort (*Artemisia frigida*), other herbaceous
- sulphur-flower buckwheat (*Eriogonum umbellatum*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Inadequate livestock water quantity, quality, and distribution

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	425	500	650
Shrub/Vine	50	150	200
Forb	25	50	100
Total	**500**	**700**	**950**

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	0-5%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-50%
Surface fragments >3"	5-35%
Bedrock	0%
Water	0%
Bare ground	5-25%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-2%	0-5%	0-10%
>0.5 <= 1	–	0-5%	10-50%	0-5%
>1 <= 2	–	0-10%	10-25%	0-5%
>2 <= 4.5	–	0-2%	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

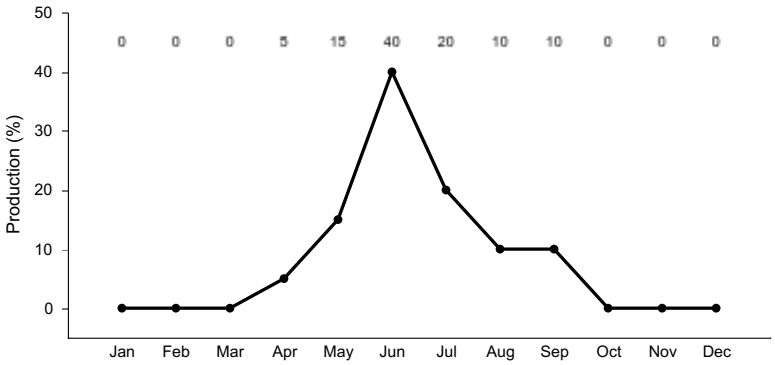


Figure 10. Plant community growth curve (percent production by month). WY0601, 15-19E all upland sites.

Community 1.2
Perennial Grasses/Mixed Shrubs

Figure 11. Post-fire recovery has shrubs lacking, otherwise this community has a great mix of grasses and forbs.

Historically, this plant community evolved under grazing by large ungulates and a low fire frequency. Currently, it occurs under moderate, season-long grazing by livestock and is exacerbated by prolonged drought conditions. In addition, the fire regime for this site has been modified and extended periods without fire is now common. Shrubs are major components of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of miscellaneous forbs. Dominant grasses include bluebunch wheatgrass, prairie junegrass, spike fescue, Montana wheatgrass, Idaho fescue, and of less frequency Columbia needlegrass. Grasses of secondary importance include bluegrasses and onespike oatgrass. Forbs commonly found in this plant community include hawksbeard, groundsel, balsamroot, asters, buckwheat, phlox, and penstemons. Shrubs such as mountain big sagebrush, rubber rabbitbrush, fringed sagewort, snowberry, and wild rose can make up to 25% of the total annual production. When compared to the Reference Community Phase, mountain big sagebrush, rubber rabbitbrush, fringed sagewort, bluegrasses, and rhizomatous wheatgrasses have increased. Production of specific species such as Columbia needlegrass and spike fescue has been reduced. Annual production ranges from 450 to 950 pounds; with average annual production of 700 pounds.

Resilience management. This plant community is resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term continuous season-long or year-long grazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement is not uncommon especially on steeper slopes. Incidence of pedestalling is minimal but normal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Cusick's bluegrass (*Poa cusickii*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- lupine (*Lupinus*), other herbaceous
- sulphur-flower buckwheat (*Eriogonum umbellatum*), other herbaceous

Dominant resource concerns

- Ephemeral gully erosion
- Aggregate instability
- Plant productivity and health

- Plant structure and composition
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	275	400	500
Shrub/Vine	150	250	350
Forb	25	50	100
Total	**450**	**700**	**950**

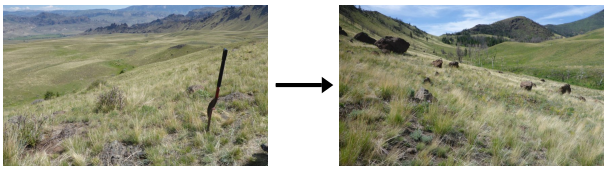
Table 9. Soil surface cover

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	0-5%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-50%
Surface fragments >3"	5-35%
Bedrock	0%
Water	0%
Bare ground	5-25%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-5%	0-15%	0-10%
>0.5 <= 1	–	5-5%	5-50%	0-10%
>1 <= 2	–	5-20%	0-10%	0-5%
>2 <= 4.5	–	0-5%	0-2%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Pathway 1.1A
Community 1.1 to 1.2

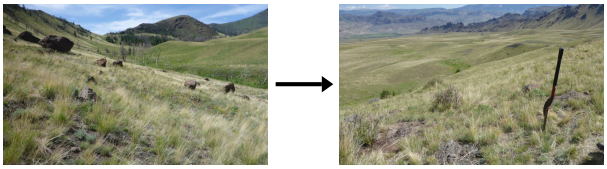


Bluebunch Wheatgrass/Spike Fescue/Sagebrush

Perennial Grasses/Mixed Shrubs

The driver for this transition is the removal or reduction in the woody cover, namely sagebrush from this community with an impact to the taller statured cool-season grasses. Grazing impacts with fire will convert this plant community to the Perennial Grasses/Mixed Shrub Community Phase. Prolonged drought will help to exacerbate this transition.

Pathway 1.2A
Community 1.2 to 1.1



Perennial Grasses/Mixed Shrubs

Bluebunch Wheatgrass/Spike Fescue/Sagebrush

Prescribed grazing to allow rest (rest-rotation or deferred grazing) will encourage the desirable tall and mid-stature cool-season grasses to recover. With time, the shrub component may recover. If grass stands are too dense, they can shade out or inhibit sagebrush and other shrub species form establishing.

Conservation practices

Prescribed Grazing
Heavy Use Area Protection
Upland Wildlife Habitat Management

State 2
Mixed Shrub/Idaho Fescue

After significant pressure on the herbaceous understory and with the lack of fire to rejuvenate the woody component, this State has shifted to a mid and short-stature cool-season grasses with shrubs becoming a significant component of this state. Some of the preferred grasses have been reduced or are absent, and forbs (ground covering) have increased in the community. When compared to the Reference State, sagebrush, native bluegrasses, prairie junegrass, and rhizomatous wheatgrasses have increased. Most of the preferred grasses have been reduced and some are absent.

Characteristics and indicators. Dominant grasses include Idaho fescue, rhizomatous wheatgrasses, prairie junegrass, and bluegrasses. Columbia needlegrass, spike fescue, and bluebunch wheatgrass are significantly reduced or absent. Grasses of secondary importance include slender wheatgrass, spike trisetum, one-spike oatgrass. Forbs commonly found in this plant community include balsamroot, agoseris, buckwheat, arnica, phlox, lupine, asters, and pussytoes. Fringed sagewort, mountain big sagebrush, and juniper can make up to 30% of the total annual production.

Resilience management. This State is resistant to change without a major disturbance or inputs to start the change. But it is also at risk of degrading further and is susceptible to invasion due to the decreased herbaceous cover and increased woody structure.

Community 2.1
Mixed Shrub/Idaho Fescue

Figure 13. Idaho fescue, mountain big sagebrush and snowberry are prominent in this community.

Historically, this plant community evolved under grazing by large ungulates and a low fire frequency. Currently, it occurs under moderate, season-long grazing by livestock and is exacerbated by prolonged drought conditions. In addition, the fire regime for this site has been modified and extended periods without fire is now common. Shrubs are significant components of this plant community. Cool-season grasses make up the majority of the understory with the balance made up of miscellaneous forbs. Dominant grasses include Idaho fescue, bluebunch wheatgrass, prairie junegrass, Montana wheatgrass, and of less frequency Columbia needlegrass, and spike fescue. Grasses of secondary importance include bluegrasses and onespike oatgrass. Forbs commonly found in this plant community include hawksbeard, groundsel, balsamroot, asters, buckwheat, phlox, and penstemons. Shrubs such as mountain big and black sagebrushes, rubber rabbitbrush, fringed sagewort, and juniper can make up to 25% of the total annual production. When compared to the Reference Community Phase, mountain big and black sagebrush, rubber rabbitnbrush, fringed sagewort, bluegrasses, and rhizomatous wheatgrasses have increased. Production of specific species such as Columbia needlegrass and spike fescue has been reduced. Annual production ranges from 500 to 850 pounds; with average annual production of 650 pounds.

Resilience management. This plant community is resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term continuous season-long or year-long grazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement is not uncommon especially on steeper slopes. Incidence of pedestalling is minimal but normal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- Cusick's bluegrass (*Poa cusickii*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- sulphur-flower buckwheat (*Eriogonum umbellatum*), other herbaceous
- pussytoes (*Antennaria*), other herbaceous

Dominant resource concerns

- Ephemeral gully erosion
- Classic gully erosion
- Plant productivity and health
- Plant structure and composition
- Wildfire hazard from biomass accumulation
- Inadequate livestock water quantity, quality, and distribution

Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	325	350	425
Shrub/Vine	150	250	350
Forb	25	50	75
Total	**500**	**650**	**850**

Table 12. 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	0-5%
Litter	5-20%
Surface fragments >0.25" and <=3"	0-50%
Surface fragments >3"	5-35%
Bedrock	0%
Water	0%
Bare ground	5-25%

Table 13. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-10%	0-15%	0-10%
>0.5 <= 1	–	0-15%	0-50%	0-5%
>1 <= 2	–	0-5%	0-5%	0-2%
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

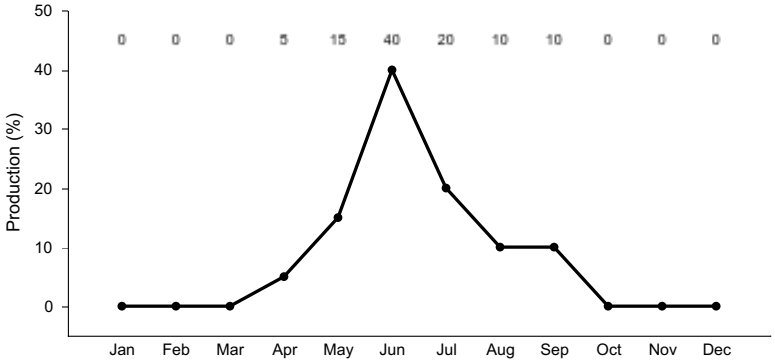


Figure 15. Plant community growth curve (percent production by month).

State 3
Invaded

Any disturbance provides an opportunity for aggressive species, such as many of our introduced invaders, to establish in a community. Catastrophic events or natural climatic events (drought, wildfire, etc) can be a source of this invasion.

Characteristics and indicators. The major indication of entering this State is the abundant or significant presence of an introduced species, whether invasive or just an invader. To meet the terms of abundant or significant, the presence has to account for greater than or equal to ten percent cover of the community. Species considered in this category are Kentucky bluegrass, smooth brome, or timothy for non-native invaders; or cheatgrass for invasive species. Thistle and common dandelion are other species of concern on this ecological site.

Resilience management. Once established, these aggressive and persistent species will exclude many of the native species and are extremely difficult to reduce or remove from the community. These species are able to tolerate repeated abuse and drastic climatic swings without losing their foothold in the community, creating a resistant and resilient community.

Community 3.1
Perennial Grasses/Non-Native Species

The Perennial Grasses/Non-Native Species Community Phase has maintained a representative sample of the perennial grasses and forbs that are typical of the site with a mixed shrub community. Non-native or invader species have established in the community and are a significant component in the community (10 percent or greater by foliar cover or 5 percent or greater by weight), and are prominent (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 non-native species. The species most common are timothy, Kentucky bluegrass, and common dandelion.

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. 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 non-native 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

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- timothy (*Phleum pratense*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- thistle (*Cirsium*), other herbaceous
- phlox (*Phlox*), other herbaceous
- sulphur-flower buckwheat (*Eriogonum umbellatum*), other herbaceous
- common dandelion (*Taraxacum officinale*), other herbaceous

Dominant resource concerns

- Classic gully erosion

- Plant structure and composition
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Community 3.2
Perennial Grasses/Invasive Species

The Perennial Grasses/Invasive Species Community Phase has maintained a fractured sample of the perennial grasses and forbs that are typical of the site with invasive species. This plant community evolved under frequent and severe grazing. The shrub component has been impacted and possibly removed by heavy browsing, wildfire or human means. Weedy annuals and bluegrasses are the most dominant plants. Invasive species, most commonly cheatgrass, hold a significant (10 percent or greater) composition of the landscape, and are prominent (referring to a more wide scale composition, not isolated patches on the landscape). Fringed sagewort and rubber rabbitbrush may be more abundant than other shrubs, as they are strong resprouters and may quickly re-establish the site after a disturbance. The interspaces between plants have expanded leaving the amount of bare ground more prevalent and more soil surface exposed to erosive elements. With the decrease or loss of most desirable mid-stature cool-season grasses, bluegrass will persist on the site (bluegrass includes natives: Sandberg, mutton, Canby, and big; as well as introduced species: Kentucky). Smooth brome, dandelion, and other introduced species will increase if present on the site. Other noxious weeds such as Canada thistle may invade the site if a seed source is available. 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 continued herbivory. Annuals and bluegrasses are effectively competing against the establishment of perennial cool-season grasses. Plant diversity is greatly altered and the herbaceous component is not intact. Recruitment of the major perennial grasses is not occurring and the replacement potential is absent. The biotic integrity is missing. The state is unstable and is not protected from excessive erosion. Rill channels and maybe even gullies may be present on site and adjacent areas are impacted by excessive runoff. Water flow patterns and pedestalling are obvious. The watershed is not functioning.

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- snowberry (*Symphoricarpos*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- cheatgrass (*Bromus tectorum*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- phlox (*Phlox*), other herbaceous
- sulphur-flower buckwheat (*Eriogonum umbellatum*), other herbaceous
- common dandelion (*Taraxacum officinale*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Classic gully erosion
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

- Inadequate livestock water quantity, quality, and distribution

Pathway 3.1A
Community 3.1 to 3.2

Frequent and Severe Grazing will convert this plant community to a Perennial Grasses/Invasive Species Community Phase. Drought or a fire (man-made or wild) are drivers that will encourage this transition as well, if a seed source is present. If fringed sagewort and common yarrow are present more than likely it will persist in varying degrees as it is difficult to control.

State 4
Disturbed

Catastrophic natural events, including fresh land slides, fire followed by extreme climatic events, or areas that are heavily impacted by recreational vehicles, trails, roadways, or other land disturbances have reduced or removed most native perennial vegetation and left a highly disturbed land. These points of disturbance can be large scale, encompassing several ecological sites. However, many times they are isolated in nature, especially on steeper sloeps. The Disturbed 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 result 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 Russian thistle, 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 this community is a potential threat; and the community is at high risk of transitioning to the Invaded State.

Community 4.1
Disturbed Lands

The title Disturbed Lands is encompassing two broad classifications of these land types. Go-back fields or tilled areas form Type one. The slope and rock cover of the Steep Stony Upland ecological site does not lend well for this type of disturbance. However, 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. A subset of Type one are those areas that were or currently are being impacted by recreation - camp sites, trails, parking areas, roadways. The varying stages of healing once abandoned, or the state of disturbance at each location leave a variable community. 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. The plant community is variable and depending on the slope extent, 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 and functional groups that are desired on the site. Soil erosion is variable depending on the slope extent and the disturbance regime that is occurring on the site and will vary with the specific community that has established on a specific location. Site-specific evaluation is needed to determine the water flow and pedestalling as well as infiltration and runoff potential and associated risks for each community.

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Classic gully erosion
- Compaction
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Transition T1A
State 1 to 2

Heavy, continuous, season-long grazing plus no fires or altered fire frequency will convert the plant community to the Mixed Shrub/Idaho Fescue State. This is especially evident on areas where drought or heavy browsing has adversely impact the shrub stand. The impacts required to force this transition are significant, and this does not happen in a short time period.

Constraints to recovery. The loss of sagebrush in some of these communities and the lack of necessary seed bank and recovery time are limiting factors for this State to recover. Slope and erosional risks are also slows or inhibits recovery.

Transition T1B
State 1 to 3

Fire, wild or prescribed, with no change in grazing management and seed source present allows for a rapid transition to the Invaded State. Drought or other catastrophic events will aid in this transition.

Constraints to recovery. The lack of effective treatment to eradicate or significantly control invasive species long term or to remove non-native species without impact to the native community limit the recovery of this State.

Transition T2A
State 2 to 3

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. Fire is a primary means of provide the niche for cheatgrass to establish on this site.

Constraints to recovery. The nature of non-native (introduced) as well as invasive species, especially cheatgrass, once they are established, they are prolific reproducers and are hardy plants, making it costly and difficult (if even possible) to remove. The lack of key grass species also limits recover of this site.

Restoration pathway R3A
State 3 to 4

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 there is a significant composition of non-native and invasive species that have established on a site.

Context dependence. Access due to slope and large rock fragments limit areas that can readily be treated.

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 T4A
State 4 to 3

Lack of management resulting in continued disturbance, catastrophic events, or failure in the restoration process are major causes for a disturbed or altered landscape to transition to an invaded state.

Constraints to recovery. The change in the soils and potentially the hydrology of the site as well as the presence of invasive species limit the recovery potential of this community. Access limitations due to slope and surface roughness will limit the types of treatment and ability to manage a community.

Additional community tables

Table 14. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall-stature, Cool-season Bunchgrasses**			50–150	
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	50–100	5–10
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	0–50	0–5
	blue wildrye	ELGL	*Elymus glaucus*	0–50	0–5
2	**Mid-stature, Cool-season Bunchgrasses**			100–400	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	50–300	5–30
	Idaho fescue	FEID	*Festuca idahoensis*	0–100	0–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–50	0–5
3	**Rhizomatous, Cool-season Grasses**			25–100	
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–50	0–5
	western wheatgrass	PASM	*Pascopyrum smithii*	0–50	0–5
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–50	0–5
4	**Short-stature, Cool-season Bunchgrasses**			0–50	
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–50	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	0–5
	spike trisetum	TRSP2	*Trisetum spicatum*	0–50	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–50	0–5
5	**Miscellaneous Grasses/Grass-likes**			0–25	
	threadleaf sedge	CAFI	*Carex filifolia*	0–25	0–2
	needleleaf sedge	CADU6	*Carex duriuscula*	0–25	0–2
	Grass, perennial	2GP	*Grass, perennial*	0–25	0–2

Forb					
6	**Perennial Forbs**			25–100	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	0–100	0–10
	lupine	LUPIN	*Lupinus*	0–50	0–5
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–50	0–5
	phlox	PHLOX	*Phlox*	0–50	0–5
	beardtongue	PENST	*Penstemon*	0–50	0–5
	Indian paintbrush	CASTI2	*Castilleja*	0–50	0–5
	American vetch	VIAM	*Vicia americana*	0–50	0–5
	milkvetch	ASTRA	*Astragalus*	0–50	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–50	0–5
Shrub/Vine					
7	**Dominant Shrubs**			50–200	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	50–200	5–20
8	**Miscellaneous Shrubs**			0–75	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–50	0–5
	snowberry	SYMPH	*Symphoricarpos*	0–50	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–50	0–5
	prairie sagewort	ARFR4	*Artemisia frigida*	0–50	0–5
	Shrub, other	2S	*Shrub, other*	0–50	0–5

Animal community

1.1 - Bluebunch Wheatgrass/Spike Fescue/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/Mixed Shrubs: 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. Thermal cover and migration corridors will utilize this community.

2.1 - Idaho Fescue/Mixed Sagebrush: 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.

3._ - Invaded State: The added diversity with the introduced 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.

4.1 - Disturbed Lands: 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/Spike Fescue/Sagebrush 500-750-900 0.20 4.9
2.1 Idaho Fescue/Sagebrush ** **
2.2 Idaho Fescue/Forbs ** **
3.1 Mixed Shrub/Rhizomatous Wheatgrass ** **
4._ Invaded State ** **
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 (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 nonexistent. 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. 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. Slope limits accessibility to the site.

Wood products

No appreciable wood products are present on the site. Rocky Mountain juniper, limber pine, and Douglas-fir may be present in scattered patches, but no logging or timber harvest for commercial use is occurring. Slope limits accessibility to the site.

Inventory data references

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in the development of the new concept for Loamy and Loamy Calcareous Ecological site include: Blaise Allen, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Patricia Hatle, Range Management Specialist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

Inventory Data References:
Ocular field estimations observed by trained personnel were completed at each site. Then sites were selected where a 100 foot 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 3 of these estimated points, with two 21 foot X 21 foot square extended shrub plots).
• Line Point Intercept (over story 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 of a 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 (10 – 1 meter square point photographs taken at set distances on transect. Red 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, 3/06/2025

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	04/22/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare. Increase in rill development occurs on slopes located below exposed bedrock or other water shedding areas where increased runoff may occur. When present, rills should be short (2-5 feet), and less than one inch deep and somewhat widely spaced (4-8 feet). Rills may increase in length (3-6 feet) and decrease in spacing (3-6 feet)on slopes greater than 60 percent. A minor increase in rill development may be observed on all slopes following major thunderstorm or spring runoff events but should heal during the next growing season.

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2. **Presence of water flow patterns:** Barely observable. Minor evidence of water flow patterns will be found around perennial plant bases. Occurrences show little evidence of current erosion, and are expected to be short (3-6 feet), stable, sinuous, and not connected. There may be very minor evidence of deposition.

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3. **Number and height of erosional pedestals or terracettes:** Perennial vegetation shows little evidence of erosional pedestalling (1 to 2% of individual plants). Plant roots are covered and litter remains in place around plant crowns. Terracettes are minor and are stable.

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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 5-20%. Bare ground patches should not be greater than 18 inches in diameter.

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent. No evidence of wind generated soil movement is present. Wind caused blowouts and deposition are not present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous and large woody litter not expected to move. Most litter resides in place with some redistribution down slope caused by water movement. The majority of litter accumulates at the base of plants. Some grass leaves and stems may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes >25% and/or increased runoff resulting from heavy thunderstorms.

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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 3 (interspaces) to 6 (under plant canopy), but average values should be

4.0 or greater.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Soil organic matter of 2 to 5% is expected.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 70-80% grasses, 15% forbs, and 5-15% shrubs. Evenly distributed plant canopy (60-95%) and litter plus moderate infiltration rates result in minimal runoff. Basal cover is typically 5-15% for this site and does affect runoff on this site. Surface rock fragments of 15-50% provide stability to the site, but reduce infiltration.

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

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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 >> perennial forbs >>

    Other: tall-stature, cool-season bunchgrasses = cool-season rhizomatous grasses = short-stature, cool-season bunchgrasses

    Additional: Following a disturbance such as fire, drought, rodents or insects that remove woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community for a period of time. These conditions would reflect a functional community phase within the reference state.

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

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-40% of total canopy measurement with total litter (including beneath the plant canopy) from 50-90% expected. Herbaceous litter depth typically ranges from 5-15 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):** Total annual production ranges from 500-900 lb/ac (560-1,009 kg/ha); with an average production of 750 lb/ac (841 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 30% is the most common indicator of a threshold being crossed. Rhizomatous wheatgrasses, Idaho fescue, Sandberg bluegrass, spike trisetum, rocky mountain juniper, and fringed sagewort are common increasers. Kentucky bluegrass, common dandelion, thistles, and 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.
