USDA Natural Resources
Conservation Service

Ecological site EX043B23B121
Limy Skeletal (LiSk) Absaroka Upper Foothills

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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) 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 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

EX043B23B122	**Loamy (Ly) Absaroka Upper 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.
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.

Similar sites

EX043B23B120	**Limy Upland (LiU) Absaroka Upper Foothills** Site has fewer rock fragments throughout the soil profile, a shift in grasses species, and greater management responses.
EX043B23B123	**Loamy Calcareous (LyCa) Absaroka Upper 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.

Figure 1. Soils Pit excavated by hand.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia nova* (2) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Festuca idahoensis* (2) *Leucopoa kingii*

Legacy ID

R043BX621WY

Physiographic features

This site occurs on nearly level to gently rolling land and on slopes generally less than 30 percent. Within the upper foothills of the Absaroka Range and associated mountains, this site is found to exist predominately on the gently sloping summits of 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: alluvial fans 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 > Alluvial fan (2) Foothills > Dip slope (3) Foothills > Erosion remnant (4) Foothills > Homoclinal ridge (5) Foothills > Landslide
Runoff class	Low to very high
Elevation	6,800–8,500 ft
Slope	0–30%
Aspect	Aspect is not a significant factor

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

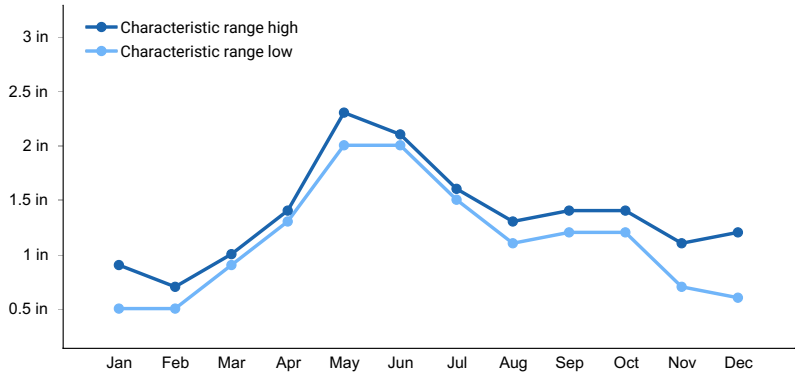


Figure 2. Monthly precipitation range

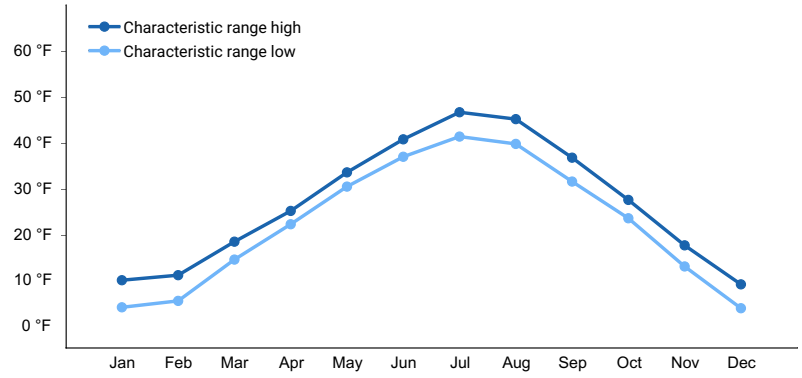


Figure 3. Monthly minimum temperature range

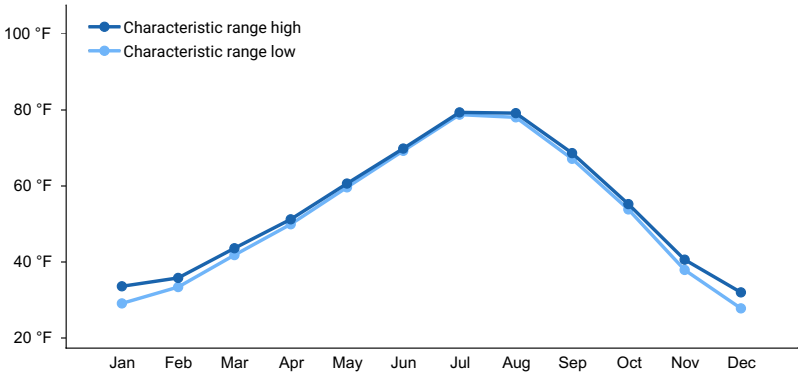


Figure 4. Monthly maximum temperature range

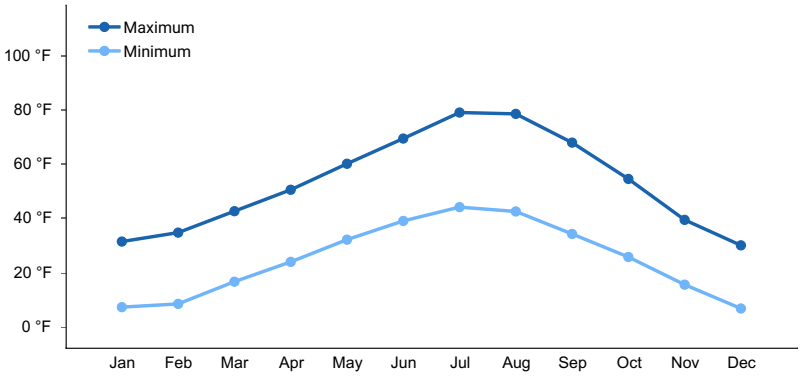


Figure 5. Monthly average minimum and maximum temperature

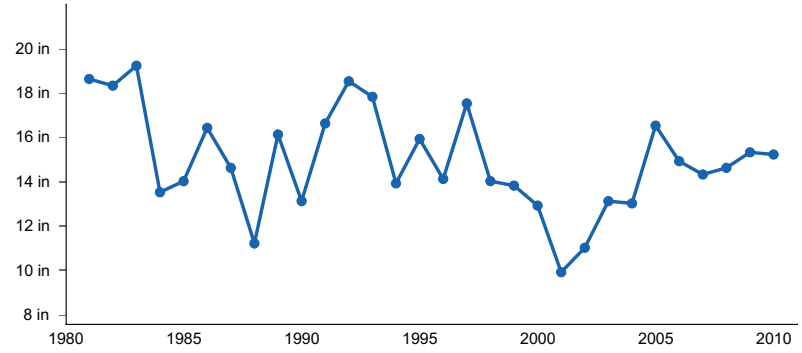


Figure 6. Annual precipitation pattern

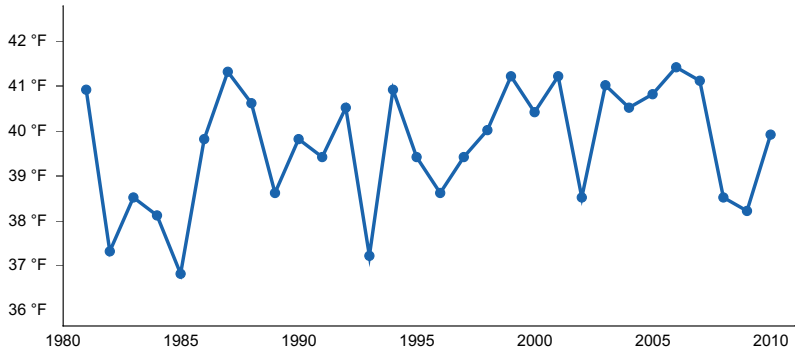


Figure 7. Annual average temperature pattern

Climate stations used

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

Table 4. Representative soil features

Parent material	(1) Colluvium–limestone and dolomite (2) Slope alluvium–igneous, metamorphic and sedimentary rock (3) Residuum–calcareous conglomerate
Surface texture	(1) Very cobbly, very stony, very gravelly sandy clay loam (2) Clay loam (3) Loam
Family particle size	(1) Loamy-skeletal (2) Clayey-skeletal
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderately rapid
Soil depth	20 in
Surface fragment cover <=3"	15–45%
Surface fragment cover >3"	5–35%
Available water capacity (Depth not specified)	1.1–3.5 in
Calcium carbonate equivalent (Depth not specified)	10–30%

Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Soil reaction (1:1 water) (Depth not specified)	7–8.4
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 Upper Foothills was originally correlated as a coarse upland range site. During the review of existing range sites, 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 but not shallow to igneous bedrock. Historically, classification of the soils did not recognize the calcareous tendencies. 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 chemistry within the moderate to very deep soil. The dominance of mountain big and black sagebrush, bluebunch wheatgrass, increased bare ground or lichen 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 Limy Skeletal ecological site is dominated by tall to mid-stature cool-season perennial grasses. Other significant vegetation includes black sagebrush, mountain big sagebrush, arrowleaf balsamroot, 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 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.

Mountain big sagebrush is intermixed with black sagebrush, the dominance between these two sagebrush species will vary across the site. Due to the variability in precipitation and soil limitations, the sagebrush component (mountain big and black) has a lower structure than similar ecological sites within the same area. Sagebrush 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, especially year-long grazing.

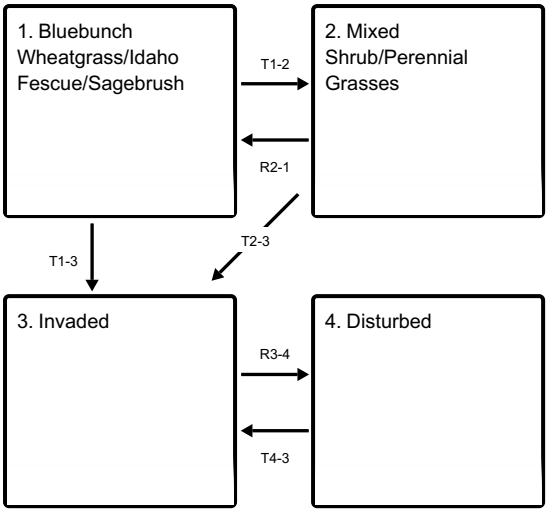
The reference plant community (description follows the plant community diagram) has been determined by study of relic rangeland sites, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical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



T1-2 - Frequent and severe grazing with the change in fire frequency, drought, and other significant impacts to the herbaceous cover force this transition.

T1-3 - Fire, drought, and other major disturbances with a seed source present aid in this transition.

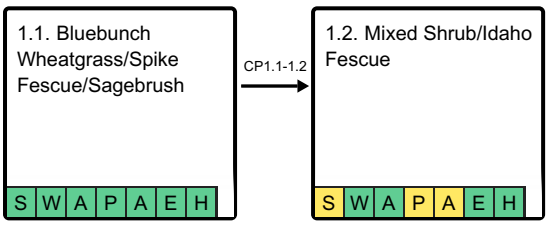
R2-1 - Prescribed grazing with rest or deferment and time will allow recovery of this site. Brush management will assist the process.

T2-3 - 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.

R3-4 - An integrated weed management plan with a native seeding and long-term prescribed grazing aids the transition of this site.

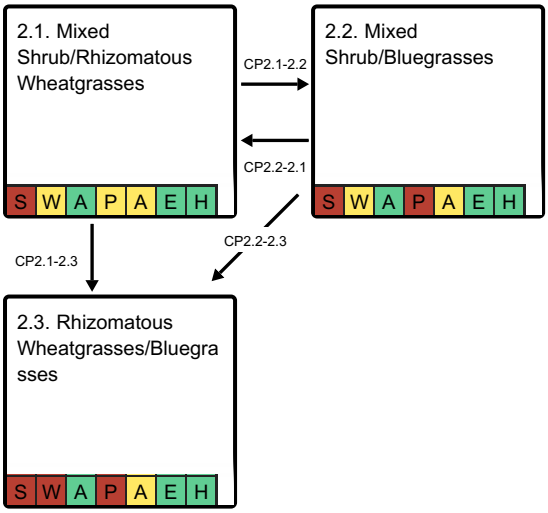
T4-3 - Lack of management, continued disturbance, failure of a reclamation process, or catastrophic events with seed source present will transition this community to the invaded state.

State 1 submodel, plant communities



CP1.1-1.2 - Moderate, continuous season-long grazing will convert the Reference Community Phase, and prolonged drought will exacerbate this transition.

State 2 submodel, plant communities



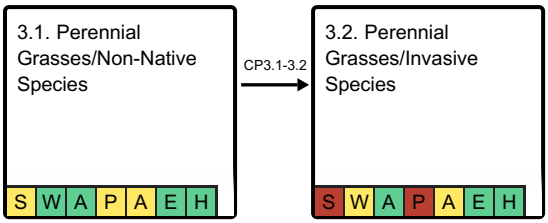
CP2.1-2.2 - Grazing impacts with the lack of fire or other shrub management shifts this community to a Mixed Shrub/Bluegrasses Community Phase.

CP2.1-2.3 - Brush management or Wildfire with no change in grazing management will convert this plant community to the Rhizomatous Wheatgrasses/Bluegrasses Community Phase.

CP2.2-2.1 - Prescribed Grazing with rest will convert this plant community to a Mixed Shrub/Rhizomatous Wheatgrasses Community Phase as the more palatable plants regain vigor.

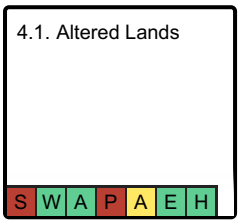
CP2.2-2.3 - Brush management or Wildfire with only minor or no change in grazing management will convert this plant community to the Rhizomatous Wheatgrasses/Bluegrasses Community Phase.

State 3 submodel, plant communities



CP3.1-3.2 - 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/Idaho Fescue/Sagebrush

The Bluebunch Wheatgrass/Idaho Fescue/Sagebrush State (State 1) is the reference community for the Limy Skeletal 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 and black sagebrush providing the dominant woody cover. Lichen common in this community with ground covering forbs.

Resilience management. The vegetation that thrives in the harsh conditions of the Limy Skeletal ecological site create 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.

Dominant plant species

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- black sagebrush (*Artemisia nova*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- spike fescue (*Leucopoa kingii*), grass
- Columbia needlegrass (*Achnatherum nelsonii*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- buckwheat (*Eriogonum*), other herbaceous
- hawksbeard (*Crepis*), other herbaceous

Community 1.1
Bluebunch Wheatgrass/Spike Fescue/Sagebrush

Figure 8. Bluebunch wheatgrass and Columbia needlegrass are dominant with mountain big sagebrush and black sagebrush.

This is the Reference Community Phase. This state evolved with grazing by large herbivores and periodic fires. This plant community can be found on areas that are properly managed with grazing and/or prescribed burning, and on areas receiving periods of rest. The cyclical nature of the fire regime in this community prevents sagebrush from being the dominant landscape; however, the return interval is low. Tall and mid-stature cool-season grasses dominate the state. The major grasses include Bluebunch wheatgrass, spikefescue, Columbia needlegrass, Idaho fescue, and rhizomatous wheatgrasses. Mountain big sagebrush, black sagebrush, rubber rabbitbrush, and juniper are conspicuous elements of this state, occurring in a mosaic pattern, and making up 15% of the annual production. A variety of forbs also occur in this state and plant diversity is high (see Plant Composition Table). Annual production on this state ranges from 550 to 1000 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
- black sagebrush (*Artemisia nova*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- spike fescue (*Leucopoa kingii*), grass
- Columbia needlegrass (*Achnatherum nelsonii*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- silvery lupine (*Lupinus argenteus*), other herbaceous
- hawksbeard (*Crepis*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Wildfire hazard from biomass accumulation

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	375	500	700
Shrub/Vine	150	200	300
Forb	25	50	100
Total	**550**	**750**	**1100**

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	0-10%
Litter	15-30%
Surface fragments >0.25" and <=3"	10-45%
Surface fragments >3"	5-30%
Bedrock	0%
Water	0%
Bare ground	5-20%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	0-5%	0-5%	0-5%
>0.5 <= 1	–	5-15%	5-25%	0-10%
>1 <= 2	–	0-10%	5-50%	0-2%
>2 <= 4.5	–	0-2%	0-5%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.2
Mixed Shrub/Idaho Fescue

Figure 10. Idaho fescue and rhizomatous wheatgrasses have become the dominant herbaceous cover 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 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.

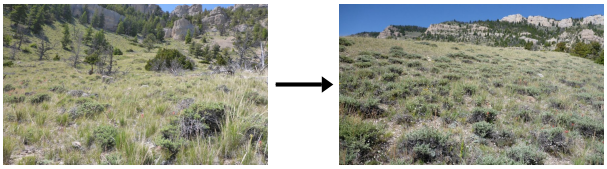
Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- black sagebrush (*Artemisia nova*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- spike fescue (*Leucopoa kingii*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- silvery lupine (*Lupinus argenteus*), other herbaceous
- agoseris (*Agoseris*), other herbaceous
- buckwheat (*Eriogonum*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Plant productivity and health
- Plant structure and composition
- Wildfire hazard from biomass accumulation

Pathway CP1.1-1.2
Community 1.1 to 1.2



Bluebunch Wheatgrass/Spike Fescue/Sagebrush

Mixed Shrub/Idaho Fescue

Over time, moderate, continuous season-long grazing will reduce the vigor of the desirable tall and mid-stature cool-season grasses, and eventually reducing or removing them from the community. This decrease in the taller species, encourages Idaho fescue to become dominant in the community. Prolonged drought will exacerbate this transition.

State 2
Mixed Shrub/Perennial Grasses

After significant pressure on the herbaceous understory and with the lack of fire to rejuvenate the woody

component, this State has shifted to a 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 rhizomatous wheatgrasses, letterman's needlegrass, prairie junegrass, and of less frequency Columbia needlegrass, spike fescue, Idaho fescue and bluebunch wheatgrass. Grasses of secondary importance include slender wheatgrass, spike trisetum, one-spike oatgrass, and bluegrasses. Forbs commonly found in this plant community include balsamroot, agoseris, buckwheat, arnica, phlox, lupine, asters, and pussytoes. Fringed sagewort, mountain big sagebrush, black 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.

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- black sagebrush (*Artemisia nova*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- buckwheat (*Eriogonum*), other herbaceous
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- phlox (*Phlox*), other herbaceous

Community 2.1
Mixed Shrub/Rhizomatous Wheatgrasses

Figure 11. Sagebrush and Montana wheatgrass dominated community on the Limy Skeletal ecological site.

This plant community currently is found under heavy continuous season-long grazing by livestock and protection from fire. Shrubs are a significant component of this plant community. Cool-season grasses make up the majority of the understory, but some of the preferred grasses have been reduced or are absent. Dominant grasses include rhizomatous wheatgrasses, Letterman's needlegrass, prairie junegrass. A noted decrease in Columbia needlegrass, spike fescue, Idaho fescue and bluebunch wheatgrass is seen. Grass species that may be more readily observed are slender wheatgrass, spike trisetum, one-spike oatgrass, and bluegrasses. Forbs commonly found in this plant community include balsamroot, agoseris, buckwheat, arnica, phlox, lupine, asters, pussytoes, common yarrow, and field chickweed. Rubber rabbitbrush, fringed sagewort, mountain big sagebrush, black sagebrush, and juniper can

make up to 30% of the total annual production. When compared to the Reference State, sagebrushes, bluegrasses, prairie junegrass, and rhizomatous wheatgrasses have increased. Most of the preferred grasses have been reduced and some are absent. Sufficient Data has not been collected to establish Annual Production ranges at this time.

Resilience management. This plant community is resistant to change as the shrubs become more abundant. These areas may actually be more resistant to fire as less fine fuels are available and the bare ground between the shrubs is increased. The herbaceous component is not as diverse and plant vigor and species regeneration capabilities of some cool-season perennials are deficient. The removal of grazing does not seem to affect the plant composition or structure of the plant community. Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestalling is more noticeable. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces on steeper areas and gullies may be establishing where rills have concentrated down slope.

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- black sagebrush (*Artemisia nova*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- Montana wheatgrass (*Elymus albicans*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- Letterman's needlegrass (*Achnatherum lettermanii*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- phlox (*Phlox*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- field chickweed (*Cerastium arvense*), other herbaceous

Dominant resource concerns

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

Community 2.2
Mixed Shrub/Bluegrasses

This plant community is the result of frequent and severe grazing and protection from fire. Shrubs are a dominant component of this plant community and annual production of shrubs can exceed 30%. Mountain big sagebrush, black sagebrush, rubber rabbitbrush, and bluegrasses are the primary components of the plant community as the preferred cool season grasses have been eliminated or greatly reduced. The dominant grasses are the bluegrasses such as Sandberg, mutton, big, and Canby. The interspaces between plants have expanded leaving the amount of bare ground more prevalent. When compared with the Reference State, the annual production is less, as the major cool-season grasses are reduced, but the shrub production has increased significantly and compensates for some of the decline in the herbaceous production. Sufficient Data has not been collected to establish Annual Production ranges at this time.

Resilience management. This plant community is resistant to change as the stand becomes more decadent. These areas may actually be more resistant to fire as less fine fuels are available and the bare ground between the shrubs is increased. The herbaceous component is not as diverse and plant vigor and species regeneration capabilities of cool-season perennials are deficient. The removal of grazing does not seem to affect the plant composition or structure of the plant community. 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.

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- black sagebrush (*Artemisia nova*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- phlox (*Phlox*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- field chickweed (*Cerastium arvense*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Compaction
- Aggregate instability
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Feed and forage imbalance

Community 2.3
Rhizomatous Wheatgrasses/Bluegrasses

This plant community currently is found under heavy continuous season-long grazing by livestock and is perpetuated by either brush management or a wildfire, which removes or greatly reduces the shrubs. Some of the major cool-season bunchgrasses associated with this site have been reduced and some may have been removed. Dominant grasses include rhizomatous wheatgrasses, bluegrasses, prairie junegrass, and Montana wheatgrass. There may be incedential occurances of Columbia needlegrass, Idaho fescue, bluebunch wheatgrass, and spikefescue; however these species are greatly reduced. Forbs commonly found in this plant community include balsamroot, agoseris, buckwheat, arnica, phlox, lupine, asters, pussytoes, and field chickweed. Rubber rabbitbrush, fringed sagewort as well as pockets of mountain big sagebrush and black sagebrush can comprise as much as 15% of the total production. Overall, the shrub community has been impacted by the use or disturbances to this community. When compared to the Reference State, rhizomatous wheatgrasses, Montana wheatgrass, bluegrasses and fringed sagewort have increased. Columbia needlegrass, bluebunch wheatgrass, Idaho fescue, and sagebrush have decreased or have been removed. Production of the preferred cool-season grasses has been reduced. Sufficient Data has not been collected to establish Annual Production ranges at this time.

Resilience management. This plant community is resistant to change as the herbaceous species present are well adapted to grazing and if rubber rabbitbrush or fringed sagewort becomes the dominant shrub it is difficult for other shrubs to become established. However, species composition can be altered through long-term overgrazing. The herbaceous component is mostly intact, but some cool-season bunchgrasses associated with the site have been reduced or removed. Plant vigor and replacement capabilities are sufficient for some species but not all. Water flow patterns and litter movement is occurring but only on steeper slopes. Incidence of pedestalling is moderate to slight. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is partially intact.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- Montana wheatgrass (*Elymus albicans*), grass

- Sandberg bluegrass (*Poa secunda*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- phlox (*Phlox*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- field chickweed (*Cerastium arvense*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Compaction
- Aggregate instability
- Drifted Snow
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock shelter

Pathway CP2.1-2.2
Community 2.1 to 2.2

Frequent and Severe Grazing with the lack of fire or other brush control mechanisms will impact the herbaceous understory, allowing the sagebrush and other shrubs to increase in dominance on the site. This change in understory will convert the plant community to the Mixed Shrub/Bluegrasses Community Phase. The probability of this occurring is high and is especially evident on areas where drought or heavy browsing does not adversely impact the shrub stand.

Pathway CP2.1-2.3
Community 2.1 to 2.3

The driver for this transition is the removal or reduction in the woody cover, namely sagebrush from this community. Brush management or wildfire is the primary process with no change in the grazing impact that will convert this plant community to the Rhizomatous Wheatgrasses/Bluegrasses Community Phase.

Pathway CP2.2-2.1
Community 2.2 to 2.1

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

Brush Management
Prescribed Grazing
Grazing Land Mechanical Treatment
Heavy Use Area Protection
Upland Wildlife Habitat Management

Pathway CP2.2-2.3
Community 2.2 to 2.3

Wildfire is a possible occurrence in this community, that removes the old growth sagebrush and may encourage

sprouter species to increase. Impact to the herbaceous understory is generally minor. Severe or extended drought, insect infestations, or other natural disturbances can exacerbate the process. Brush management or prescribed fire will effectively remove or improve the woody cover, but if grazing management is in place with the brush removal the community will transition to the Rhizomatous Wheatgrasses/Bluegrasses Community Phase.

Conservation practices

Brush Management
Prescribed Burning
Grazing Land Mechanical Treatment

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.

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- black sagebrush (*Artemisia nova*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- cheatgrass (*Bromus tectorum*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- phlox (*Phlox*), other herbaceous
- field chickweed (*Cerastium arvense*), other herbaceous
- common dandelion (*Taraxacum officinale*), other herbaceous

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 smooth brome, 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

- mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- black sagebrush (*Artemisia nova*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- common dandelion (*Taraxacum officinale*), other herbaceous
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- phlox (*Phlox*), other herbaceous

Dominant resource concerns

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

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

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub

- cheatgrass (*Bromus tectorum*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- smooth brome (*Bromus inermis*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- common dandelion (*Taraxacum officinale*), other herbaceous
- tansymustard (*Descurainia*), other herbaceous
- field chickweed (*Cerastium arvense*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Compaction
- Aggregate instability
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance

Pathway CP3.1-3.2
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

Although to a much smaller extent than in lower elevations, there are areas that have been excavated for gravel, or have been accessed for irrigation convenience ditches or were part of a homestead. These areas have remnants of introduced species for haylands or have been left to recover and may be in at varying stages of succession. Or there are areas that are heavily impacted by recreational vehicles, parking, trails, roadways, or other land disturbances that have reduced or removed most native perennial vegetation and left a highly disturbed land. 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 these communities is a potential threat; and the communities are at high risk of transitioning to the Invaded State.

Community 4.1
Altered Lands

The title Disturbed Lands is encompassing two broad classifications of these land types. Go-back fields or tilled areas form Type one. The soils were once cultivated or were impacted by cultivation pracites 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 and introduced herbacous species as well as trees. Cottonwood breaks, elm, and other species of trees on tehs upland sites are key markers of old homestead locations. 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. 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. 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 and functional groups that are desired on the site. Soil erosion is variable depending on 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 plant species

- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- tansymustard (*Descurainia*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- aster (*Aster*), other herbaceous

Dominant resource concerns

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

Transition T1-2
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/Perennial Grasses 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.

Context dependence. The probability of this occurring is dependent on the density of Idaho fescue in the community, the shifts in use patterns historically, and the specific soil characteristics.

Transition T1-3
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.

Restoration pathway R2-1
State 2 to 1

Prescribed grazing will convert this plant community to the Reference State, with time. The probability of this occurring is high especially if rotational grazing along with short deferred grazing is implemented as part of prescribed method of use. In addition, the removal of fire suppression will allow a somewhat natural fire regime to reoccur to more easily transition between this plant community and the Reference State. A prescribed fire treatment can be useful to hasten this transition if desired, or other means of brush management.

Conservation practices

Brush Management
Critical Area Planting
Prescribed Grazing
Grazing Land Mechanical Treatment

Transition T2-3
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 R3-4
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.

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 T4-3
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 on invasive species limit the recovery potential of this community.

Context dependence. Many of the altered landscapes may have non-native species initially, but the significant alteration of the soils with tillage or back-fill (pit reclamation) change the management response and hydrology of this ecological site.

Additional community tables

Table 8. 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**			50–200	
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–100	0–10
	mountain brome	BRMA4	*Bromus marginatus*	0–50	0–5
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	0–50	0–5
2	**Rhizomatous, Cool-season Grasses**			25–100	
	Montana wheatgrass	ELAL7	*Elymus albicans*	25–75	0–10
	western wheatgrass	PASM	*Pascopyrum smithii*	0–25	0–5
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–25	0–5
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–25	0–5
3	**Mid-stature, Cool-season Bunchgrasses**			25–500	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	25–350	0–50
	Idaho fescue	FEID	*Festuca idahoensis*	0–125	0–15
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–25	0–5
4	**Short-stature, Cool-season Bunchgrasses**			0–75	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–50	0–5
	muttongrass	POFE	*Poa fendleriana*	0–50	0–5
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–50	0–5
5	**Miscellaneous Grasses/Grass-likes**			0–50	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–25	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–25	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–25	0–5
Forb					

6	**Perennial Forbs**			25–100	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	0–100	0–10
	hawksbeard	CREPI	*Crepis*	0–25	0–5
	silvery lupine	LUAR3	*Lupinus argenteus*	0–25	0–5
	phlox	PHLOX	*Phlox*	0–25	0–5
	buckwheat	ERIOG	*Eriogonum*	0–25	0–5
	Indian paintbrush	CASTI2	*Castilleja*	0–25	0–5
	American vetch	VIAM	*Vicia americana*	0–25	0–5
	milkvetch	ASTRA	*Astragalus*	0–25	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–25	0–5
Shrub/Vine					
7	**Dominant Shrubs**			50–200	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	50–150	5–15
	black sagebrush	ARNO4	*Artemisia nova*	0–100	0–10
8	**Miscellaneous Shrubs**			0–150	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–50	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–50	0–5
	common snowberry	SYAL	*Symphoricarpos albus*	0–50	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–50	0–5
	prairie sagewort	ARFR4	*Artemisia frigida*	0–50	0–5

Animal community

Animal Community – Wildlife Interpretations:

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 - 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.

2.1 - Mixed Shrub/Rhizomatous Wheatgrass: 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.

3.1 - Perennial Grasses/Introduced Species/Sagebrush: The retained combination of sagebrush and 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 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/Spike Fescue/Sagebrush 550-750-1000 0.21 4.87
1.2 Idaho Fescue/Sagebrush 450-700-950 0.19 5.21
2.1 Mixed Shrub/Rhizomatous Wheatgrass ** **
5.1 Perennial Grasses/Introduced Species/Sagebrush ** **
4.1 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. 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. 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.

Other products

Herbs: Several of the forb species within the communities of the Limy Skeletal 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 IV, 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	04/06/2020
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 0-30%.

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 2 (interspaces) to 6 (under plant canopy), but average values should be 3.5 or greater.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil Organic Matter of less than 3% 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 45-75% grasses, 10% forbs, and 15-45% 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.

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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 = Tall-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 15-30% 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):** English: 550 -1000 lb/ac (750 lb/ac average); Metric 616 - 1121 kg/ha (841 kg/ha average).

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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.
