USDA Natural Resources Conservation Service

Ecological site EX043B23A116
Igneous (Ig) Absaroka Lower Foothills

Last updated: 3/04/2024
Accessed: 05/14/2024

General information

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

MLRA notes

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

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

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

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

LRU notes

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

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

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

Temperature Regime: Frigid

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

Classification relationships

Relationship to Other Established Classification Systems:

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

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

Ecological site concept

• Site receives no additional water.
• Slope is < 75%
• Soils are:
o Textures range from sandy loam to clay loam in top 4” (10 cm) of mineral soil surface
o Clay content is ≤ 35% in top 4” (10 cm) of mineral soil surface
o All subsurface horizons have a weighted average of < 35% clay.
o very shallow (< 10 in. (25 cm)) to igneous, metamorphic or other volcanic bedrock.
o <3% stone and boulder cover and < 15% cobble and gravel cover
o Generally not skeletal (< 35% rock fragments) but occasionally will have up to 75% gravels and cobbles.

Associated sites

EX043B23A160	**Shallow Igneous (Swlg) Absaroka Lower Foothills** Shallow Igneous ecological site will be located below a band of Igneous or lower on the slope in a patchwork dynamic, with the Shallow Igneous appearing where more weathering has occurred or slope alluvium deposits have buried the bedrock deeper.
EX043B23A175	**Skeletal (Sk) Absaroka Lower Foothills** Skeletal ecological site occurs around the lower third of the slope or on the summit above the exposed bedrock, where extensive weathering or deposits have occurred of both colluvial and alluvial rock fragments have accumulated as well as finer material. Skeletal and Igneous is more common in conglomerate beds of igneous materials interbedded with limestone.
EX043B23A112	**Gravelly (Gr) Absaroka Lower Foothills** Gravelly ecological site occurs around the lower third of the slope or on the summit above the exposed bedrock, where extensive weathering or deposits have occurred of both colluvial and alluvial rock fragments have accumulated as well as finer material. Gravelly and Igneous is more common in conglomerate beds of igneous materials interbedded with sandstone.

Similar sites

EX043B23A176	**Very Shallow (VS) Absaroka Lower Foothills** Very Shallow ecological site is similar in depth to bedrock or paralithic contact, however, Very Shallow is derived from sedimentary parent material and Igneous is volcanic or metamorphic/igneous parent material.
EX043B23B116	**Igneous (Ig) Absaroka Upper Foothills** Igneous Absaroka Upper Foothills is the same concept, however, production increases and vegetation species shift to the 15-19

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia nova* (2) *Artemisia frigida*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Lesquerella*

Legacy ID

R043BX516WY

Physiographic features

This site occurs on steep slopes and ridge tops, but may occur on all slopes.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Erosion remnant (2) Foothills > Escarpment
Runoff class	Very low to very high
Elevation	1,585–2,073 m
Slope	3–75%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

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

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

Review of a 30 year trend of data for Average Temperature as well as Average Precipitation, there has been a warming trend, but as the last 12 years graphed, the temperatures have swayed high and low, but overall it has maintained a steady trajectory, neither increasing nor decreasing. Where on the moisture side, the trajectory in

trend has been a slow decline. The swings of when spring warm up and first frost hit with the decline in average precipitation have produced a drought effect where the moisture is not being received when the plants and ground is able to utilize the moisture. And in some cases, the late precipitation has encouraged the warm season or mat forming species over the cool season bunchgrasses that are the drivers of the natural system. Early frosts, with dry open winters has created a more arid or desert effect on plants resulting in high rates of winter kill, loss of vigor or overall damage to the plant.

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

Table 3. Representative climatic features

Frost-free period (characteristic range)	64-106 days
Freeze-free period (characteristic range)	101-144 days
Precipitation total (characteristic range)	279-330 mm
Frost-free period (actual range)	46-118 days
Freeze-free period (actual range)	88-147 days
Precipitation total (actual range)	254-330 mm
Frost-free period (average)	80 days
Freeze-free period (average)	117 days
Precipitation total (average)	305 mm

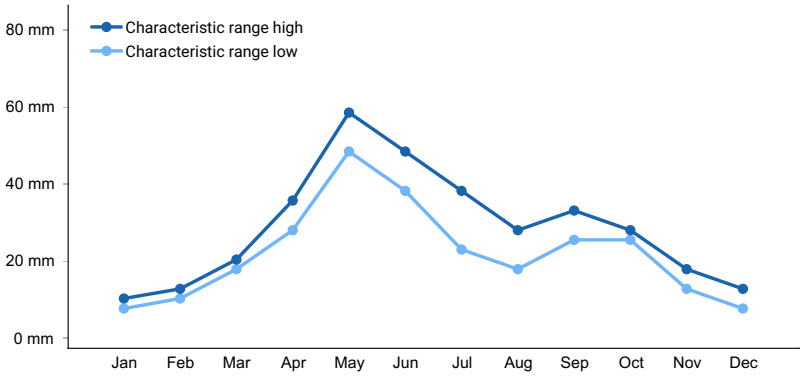


Figure 1. Monthly precipitation range

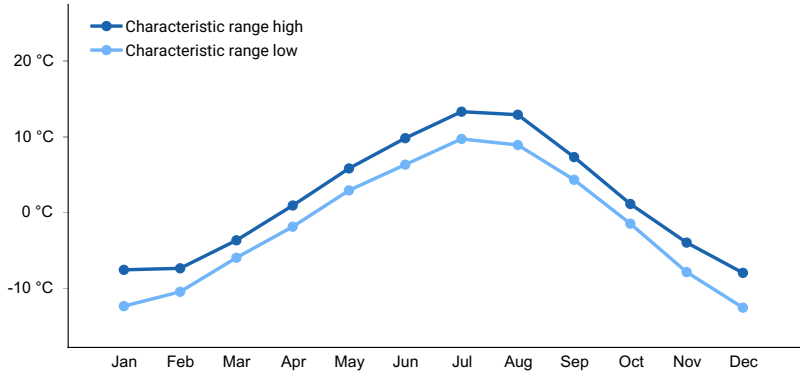


Figure 2. Monthly minimum temperature range

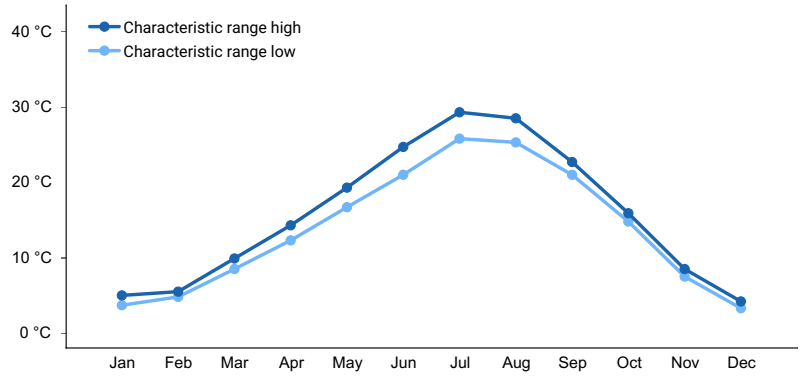


Figure 3. Monthly maximum temperature range

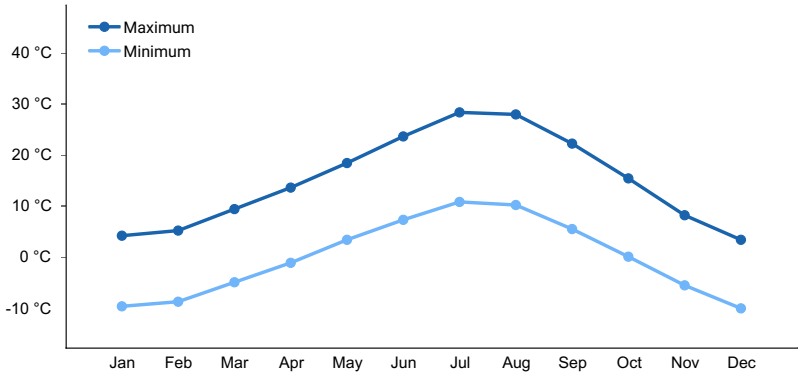


Figure 4. Monthly average minimum and maximum temperature

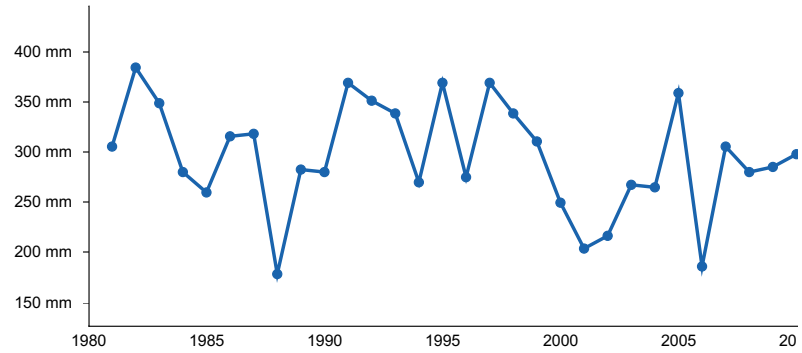


Figure 5. Annual precipitation pattern

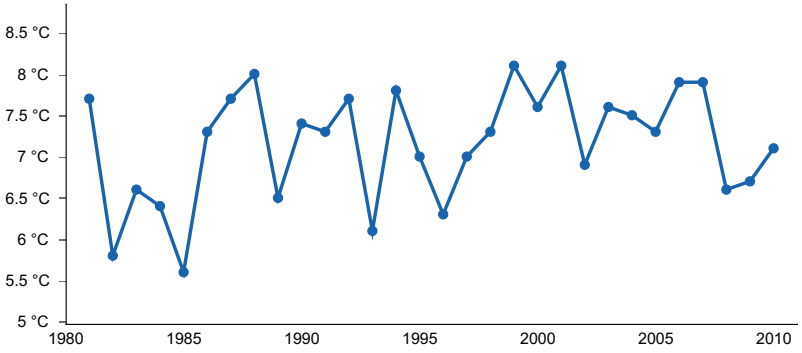


Figure 6. Annual average temperature pattern

Climate stations used

- (1) THERMOPOLIS [USC00488875], Thermopolis, WY
- (2) THERMOPOLIS 25WNW [USC00488888], Thermopolis, WY
- (3) SUNSHINE 3NE [USC00488758], Meeteetse, WY

- (4) CODY 21 SW [USC00481855], Cody, WY
- (5) WAPITI 1NE [USC00489467], Cody, WY
- (6) BUFFALO BILL DAM [USC00481175], Cody, 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 and 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 or protected pockets). Shallow depth to igneous bedrock limits the amount of holding capacity, and vegetation responds to rain events more than stored water. Site is sensitive to drought and flash storm events.

Wetland description

N/A

Soil features

The soils associated with this site were derived from volcanic bedrock. These soils are generally less than 10 inches in depth and virtually impermeable to plant roots. Pockets of deep soil may occur in this site. The bedrock will include igneous, metamorphic and other volcanic material. The soil characteristics having the most influence on the plant community are the shallow depths, dark coloration, and heavy textures.

Figure 7. Soil profile for the Igneous ecological site.

Table 4. Representative soil features

Parent material	(1) Residuum–igneous and metamorphic rock (2) Colluvium–volcanic rock
Surface texture	(1) Gravelly loam (2) Sandy clay loam (3) Clay loam
Family particle size	(1) Loamy (2) Clayey
Drainage class	Well drained
Permeability class	Moderate to slow
Depth to restrictive layer	3–25 cm
Soil depth	10–25 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–20%

Available water capacity (0-101.6cm)	5.59–16.76 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.6–7.8
Subsurface fragment volume <=3" (0-38.1cm)	Not specified
Subsurface fragment volume >3" (0-25.4cm)	Not specified

Ecological dynamics

Potential vegetation on this site is dominated by mid cool-season perennial grasses. Other significant vegetation includes black sagebrush, Wyoming big sagebrush, fringed sagewort, and a variety of forbs. The expected potential composition for this site is about 75 percent grasses, 15 percent forbs and 10 percent woody plants. The composition and production will vary naturally due to historical use, fluctuating precipitation and fire frequency.

As this site deteriorates species such as bluegrasses and fringed sagewort will increase. Cool season grasses such as bluebunch wheatgrass, montana wheatgrass, and spike fescue will decrease in frequency and production. As the site continues to deteriorate, annual forbs and grasses such as cheatgrass will invade.

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

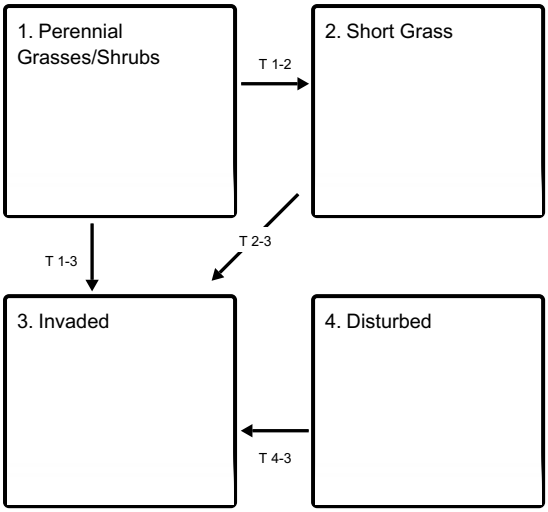
The reference plant community (description follows the plant community diagram) has been determined by study of relic rangeland sites, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical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

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

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

State and transition model

Ecosystem states



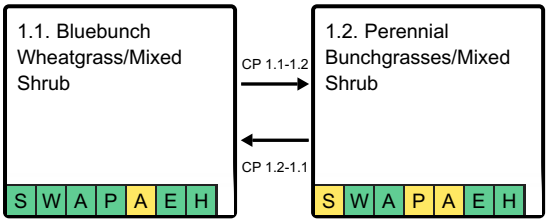
T 1-2 - Frequent and severe grazing (yearlong grazing) or compaction from surface traffic, will weaken the mid-stature grasses and allow threadleaf sedge to increase.

T 1-3 - Disturbance to the soil surface provides the opportunity for invasive species to find their niche in a community.

T 2-3 - Drought with or without hoof impact or mechanical soil impact to displace the sod opens the niche for invasive species to establish.

T 4-3 - Any disturbance to or failure in reclaiming the community leaves this State at risk to invasion.

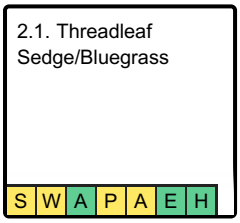
State 1 submodel, plant communities



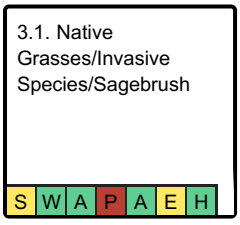
CP 1.1-1.2 - Duration and intensity of grazing, especially with drought conditions, will force a conversion in this community.

CP 1.2-1.1 - Prescribed grazing and drought contingency planning allows recovery of this plant community.

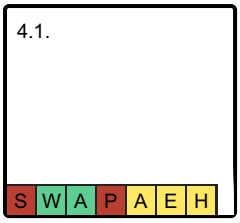
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Perennial Grasses/Shrubs

The Perennial Grasses/Shrubs State (State 1) is the reference state for the Igneous ecological site. The prominent cover of bluebunch wheatgrass, king-spike fescue and other mid-stature cool-season bunchgrasses with perennial forbs and a mix of black sagebrush, Wyoming big sagebrush, and fringed sagewort make for a productive and stable site.

Characteristics and indicators. Bluebunch wheatgrass is the dominant herbaceous species on this site, shrubs are less prominent on this landscape, but are found scattered within the community. Sagebrush cover will vary across this site in response to underlying geology. In limestone interbeds black sagebrush is the dominant woody cover, and in sedimentary interbeds Wyoming big sagebrush prevails.

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

Community 1.1
Bluebunch Wheatgrass/Mixed Shrub

Figure 8. Bluebunch wheatgrass is dominant in the Reference Community.

The reference plant community for the Igneous ecological site is the Bluebunch Wheatgrass/Mixed Shrub plant community. This community evolved with grazing by large herbivores, and an occasional wildfire. The shallow depth to bedrock, generally steeper slopes, and droughty nature of the soils for this community prevents sagebrush from being the dominant landscape. Potential vegetation is about 75% grasses or grass-like plants, 15% forbs, and 10% woody plants. The major grasses include bluebunch wheatgrass, spike fescue, prairie junegrass, and rhizomatous wheatgrass. Woody plants are black and Wyoming big sagebrush and fringed sagewort. A variety of forbs also occurs in this plant community and plant diversity is high (see Plant Composition Table). The total annual production (air-dry weight) of this state is about 350 pounds per acre, but it can range from about 250 lbs./acre in unfavorable years to about 500 lbs./acre in above average years.

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

- black sagebrush (*Artemisia nova*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- phlox (*Phlox*), other herbaceous
- buckwheat (*Eriogonum*), other herbaceous
- fleabane (*Erigeron*), other herbaceous

Dominant resource concerns

- Inadequate livestock water quantity, quality, and distribution

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	252	308	420
Forb	22	56	84
Shrub/Vine	6	28	56
Total	**280**	**392**	**560**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-5%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-20%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-10%
Bedrock	0-5%
Water	0%
Bare ground	30-60%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-10%	0-5%
>0.15 <= 0.3	–	0-2%	10-30%	0-5%
>0.3 <= 0.6	–	0-1%	0-5%	0-2%
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

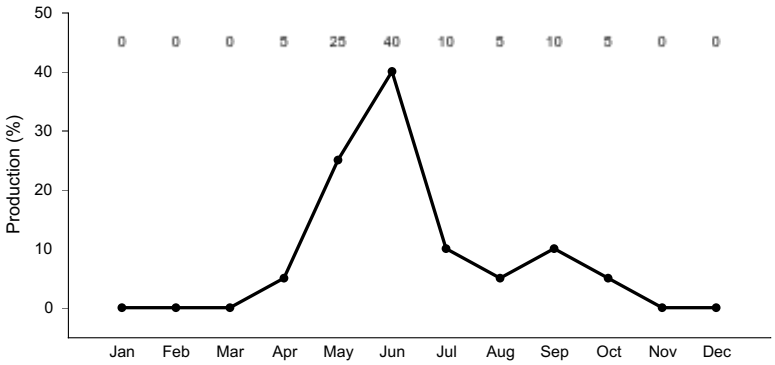


Figure 10. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Community 1.2
Perennial Bunchgrasses/Mixed Shrub

Figure 11. As the Reference State degrades, the at-risk community increases in short-stature bluegrasses and prairie Junegrass as bluebunch wheatgrass decreases.

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. 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 prairie junegrass, western wheatgrass and of less frequency bluebunch wheatgrass. Grasses of secondary importance include bluegrasses, and needleandthread. Forbs commonly found in this plant community include hawksbeard, fleabane, buckwheat, phlox, and sandwort. Shrubs such as black sagebrush, fringed sagewort, Wyoming big sagebrush, and rubber rabbitbrush can make up to 20% of the total annual production. When compared to the Reference plant community, fringed sagewort and rubber rabbitbrush, bluegrasses, and prairie junegrass have increased. Production of specific species such as bluebunch wheatgrass and spike fescue, has been reduced. The total annual production (air-dry weight) of this state is about 300 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 450 lbs./acre in above average years.

Resilience management. Rangeland Health Implications/Indicators: 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 overgrazing. 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

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

- western wheatgrass (*Pascopyrum smithii*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- phlox (*Phlox*), other herbaceous
- Franklin's sandwort (*Arenaria franklinii*), other herbaceous
- stemless four-nerve daisy (*Tetraneuris acaulis var. acaulis*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	168	224	336
Shrub/Vine	28	84	112
Forb	28	28	56
Total	**224**	**336**	**504**

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-10%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	5-10%	10-30%	0-10%
>0.15 <= 0.3	–	0-10%	5-20%	0-5%
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

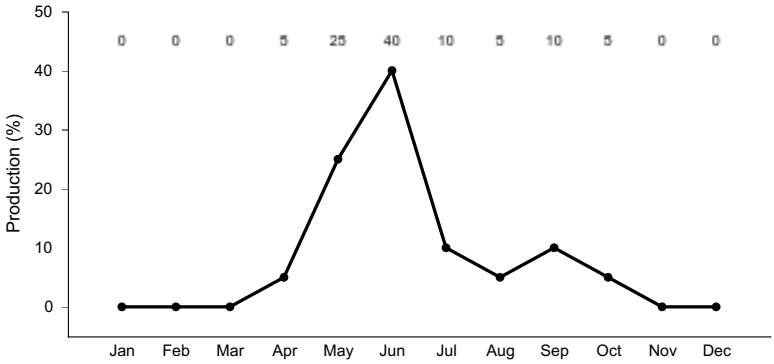


Figure 13. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

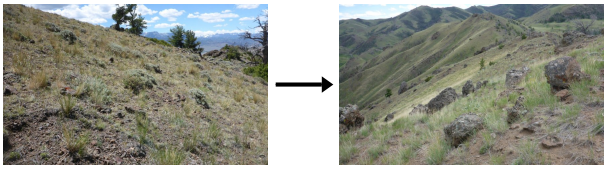
Pathway CP 1.1-1.2
Community 1.1 to 1.2

Bluebunch Wheatgrass/Mixed Shrub

Perennial Bunchgrasses/Mixed Shrub

Moderate, continuous season-long grazing will convert the Reference plant community to the Perennial Grasses/Mixed Shrubs plant community. Prolonged drought will exacerbate this transition. Repetitive increased utilization of the grasses in this community and lack of moisture impacts the taller structure of this community, and encourages the shorter statured plants.

Pathway CP 1.2-1.1
Community 1.2 to 1.1



Perennial Bunchgrasses/Mixed Shrub

Bluebunch Wheatgrass/Mixed Shrub

Prescribed grazing with drought management will convert this plant community to the Reference Community. The probability of this occurring is high especially if varied season of use and periods of rest are allowed as part of the prescribed method of use. Stabilization practices following fire or disturbance will aid the recovery of this community as well.

Conservation practices

Critical Area Planting
Access Control
Prescribed Grazing
Upland Wildlife Habitat Management

State 2
Short Grass

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

Characteristics and indicators. The prominent cover is threadleaf sedge. Scattered sagebrush may persist with rubber rabbitbrush and skunkbush sumac. Season of use and species of grazing ungulate will be a factor affecting this cover. The sagebrush cover is dwarfed or droughty in appearance and is reduced in vigor by the shift in hydrology of this community. Most other mid-stature cool-season bunchgrasses are limited to within the canopy of the sagebrush or within the protective cactus clumps.

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

Community 2.1
Threadleaf Sedge/Bluegrass

Figure 14. Threadleaf sedge will become dominant in a dispersed patchwork pattern in degraded communities.

The Threadleaf Sedge/Bluegrass plant community is created when the Reference State plant communities (1.1 and 1.2) are subjected to extended drought or intense storms, especially when under high intesntity yearlong grazing. Threadleaf sedge and weedy annuals are the most dominant plants. Threadleaf sedge will be more scattered (less dense in growth) than other similar communities. Compared to the Reference State, cactus and fringed sagewort have invaded significantly. Cool-season mid-stature grasses are absent or severely decreased. Threadleaf sedge is the dominant cover. Shrubs are limited on the Igneous ecological site, and plant diversity is low. Rubber rabbitbrush is advantageous in the open canopy of the Igneous ecological site with black sagebrush and Wyoming big sagebrush. However, heavy browsing by large ungulates will significantly reduce or remove the limited shrub cover. Shadscale saltbush can also be found on this site. The total annual production (air-dry weight) of this state is about 250 pounds per acre, but it can range from about 100 lbs./acre in unfavorable years to about 400 lbs./acre in above average years.

Resilience management. This plant community is relatively stable and resistant to overgrazing. Sod forming grasses are effectively competing against the establishment of perennial mid-stature cool-season grasses. Plant diversity is altered and the herbaceous component is not intact. Recruitment of perennial grasses is limited. The biotic integrity is missing. On areas with a well established sod plant community, water infiltration is affected, but not to the extent as deeper soils. While this sod protects the area itself, adjacent on-site and off-site areas are impacted by runoff that can cause rill channels and gully erosion. Water flow patterns and pedestalling are obvious. The watershed may or may not be functional.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- black sagebrush (*Artemisia nova*), shrub
- threadleaf sedge (*Carex filifolia*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- muttongrass (*Poa fendleriana*), grass
- sandwort (*Arenaria*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- cryptantha (*Cryptantha*), other herbaceous

Dominant resource concerns

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

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	112	196	280
Shrub/Vine	–	56	112
Forb	–	28	56
Total	**112**	**280**	**448**

Table 12. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	2-10%
Grass/grasslike foliar cover	20-50%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0-5%
Water	0%
Bare ground	25-60%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-10%	10-40%	0-10%
>0.15 <= 0.3	–	0-5%	5-20%	0-2%
>0.3 <= 0.6	–	0-1%	0-1%	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

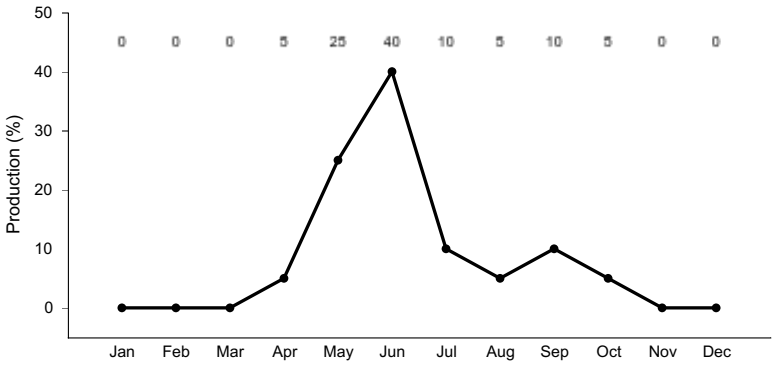


Figure 16. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

State 3
Invaded

Cheatgrass or downy brome (*Bromus tectorum*) is an aggressive annual invader that threatens rangelands across the west, including Wyoming. The ability of cheatgrass to persist through the winter under a blanket of snow and grow early allow it to take advantage of early spring precipitation and snowmelt (winter annual). Multiple growth cycles throughout a year leaves a thick litter (duff) layer and builds a significant seedbank. This annual invader has an aggressive growth habit that creates a hostile environment for most native species, including sagebrush. Climatic shifts, changes in management, and exposure to human activity are a few of the explanations for the current flush and rapid expanse across the western United States. Although cheatgrass is the most prevalent large-scale threat for rangeland managers, a variety of thistles, in combination with other aggressive invaders such as toadflax are increasing in density and frequency. Each species produces their own set of challenging management issues. As new species are identified, or as other species become more prevalent on a large-scale, the community dynamics in this State will shift in response to the concerns of the identified species.

Characteristics and indicators. This State is characterized by the presence and then dominance of invasive/non-native species. The competitive nature of annuals and other invasive species, creates a complex environment that inhibits control, and makes it implausible to attain complete eradication once an invasive species has established on the landscape. Increased access, increased travels of individuals, and other natural and man-made disturbances has opened the door for invasion in most native communities.

Resilience management. The lack of tools to achieve complete eradication, and variable success on long-term reduction of most invasive species has led to this State being resilient and resistant to change. The shallow depth, slope, and access to these areas limit the ability and cost effectiveness to treat. Mechanical means to treat invasions are generally not recommend, and so not transition to a disturbed condition is modeled. However, under select circumstances, mining and other human activities including wildfire may create such a transition.

Community 3.1
Native Grasses/Invasive Species/Sagebrush

The Perennial Grasses/Invasive Species/Sagebrush community phase has maintained a representative composition of native perennial grasses and forbs that are key to this ecological site with the accompanying Black or Wyoming big sagebrush component. This community phase (4.1) is characterized by a significant composition of invasive species (5 percent or greater) on the landscape. These invasive species have a wider scale of distribution; rather than one isolated patch in an isolated portion of the landscape. Extent of improvement is limited, and the cost and labor required determines the economic feasibility. Access and slope of the specific location increases the cost and decreases the feasibility of restoring a desired community. The depth to bedrock in combination with access and slope makes this community phase, the “At-Risk” community. Litter cover within this phase is increasing with the duff layer specifically associated with cheatgrass. This duff layer creates a barrier that can impede water infiltration and increase runoff, accelerating erosion. This is aggravated with increased slope. The age and extent of the cheatgrass stand will determine the extent of duff in the system. Production yields of the perennial grasses and forbs are reduced but the total production will maintain or may be slightly elevated due to the overall biomass and expanded growth potential of many of the annual or invasive species. A specific production range is not provided due to the variability of composition that will affect overall production.

Resilience management. Rangeland Health Implications/Indicators: Plant diversity is moderate for this phase, with perennial grasses, forbs, and shrub components still present, sustaining the diversity of the community. The plant vigor is reduced, and replacement capabilities are limited due to the limited moisture and nutrients available after cheatgrass has sprouted. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is minimal but will vary with species; as is the water flow patterns and pedestalling. Infiltration is unaltered or slightly reduced; however, as the duff layer or litter builds, infiltration will decrease, and runoff will increase.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- black sagebrush (*Artemisia nova*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- cheatgrass (*Bromus tectorum*), grass
- sandwort (*Arenaria*), other herbaceous
- bladderpod (*Lesquerella*), other herbaceous
- locoweed (*Oxytropis*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion
- Aggregate instability
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

State 4
Disturbed

Disturbance to these highly erodible soils (whether it was mechanical, cultural, or natural) reduced the resilience or resistance to support native vegetation or the ability to respond to management in the same manner as an undisturbed site. Changes to soil structure and hydrologic processes reduce the stability and ability to recover. Reclamation or restoration of an area is limited or restrictive due to slope, access, and lack of depth to bedrock. These "altered" lands may, after significant inputs and time, resemble the Reference Communities (1.1 or 1.2), but they will not respond or function the same as the Reference State. One catastrophic event or several smaller disturbances can lead to the transition to the Altered State from any identified state within the State-and-Transition

Model. The soils have not been altered to the extent that they are outside the site characteristics, but the potential has shifted enough that it will not respond like the Reference State. The time required to allow the redevelopment of structure and the cryptogrammic crust is beyond the natural function of management. The initial flush of vegetation is annual forbs, including mustards, a successional plant community. The site begins its own recovery, but the time required to return to the original conditions (pre-disturbance) can be extensive. The site, however, may become similar in composition to the Reference State.

Characteristics and indicators. The Disturbed State is characterized by a landscape that has had significant soil disturbance. Early successional plant communities, evidence of mining, or the presence of introduced species (crested wheatgrasses, russian wildrye, etc.) are indicators of this State.

Resilience management. Stabalization and preservation of as much soil as possible is the mechanism to provide resiliency to this State. The use of mulch or other slope stabilization materials will help in reducing erosional impact and allowing vegetation to establish.

Community 4.1

Disturbed or degraded lands are characterized by alteration of the soils to a degree that the functionality (erosional, depositional, hydrological, or chemical) and potential of the soils has been impacted. Site-specific evaluations need to be completed to determine the level of effect. The method and severity of alternation, as well as the spatial extent of the disturbance will determine vegetation response and management needs. Linear disturbances, such as trails and roads, will hold a different risk than patchwork or polygonal disturbances, such as well-pads or parking areas. Small-scale or isolated disturbances (spot fires, prairie dog town) can be just as significant of a risk as a large-scale disturbance (mine lands). The growth curve of this plant community will vary depending upon the successional or seeded species that are able to establish in an area. For an accurate growth curve, a site-specific species inventory and documentation of the climatic tendencies should be collected.

Resilience management. Rangeland Health Implications/Indicators: This plant community is variable and, depending upon the age of the stand and the stage of successional tendencies, determines how stable (resilient/resistant) the community is. Plant diversity is low for successional communities. This flexibility within the community creates a variable level of biotic integrity. In areas of new or frequent disturbance, annual weedy species or early successional plants will be the dominant cover, providing some diversity, but gives minimal structural cover for wildlife. As the site matures or as the period between disturbances is lengthened, perennial or taller-statured, stronger-rooted species will increase providing protection and help to improve hydrologic processes and stability to allow grasses and shrubs to begin to establish. Soil erosion is dependent on the disturbance regime and the biotic integrity of the community which determines water flow, infiltration, and runoff. Other factors that are influential are surface roughness and brokenness (tire tracks, hoof action, smoothed, denuded surfaces, trails that may concentrate water flow).

Dominant resource concerns

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

Transition T 1-2
State 1 to 2

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

Constraints to recovery. The dense root mat formed by threadleaf sedge alters the hydrology, effectively removing

moisture from the site, limiting the available resources for other native species. The dense sod also limits the available soil space for seedling establishment. Interpspaces between sod patches are prone to erosion and runoff (limited infiltration of moisture).

Transition T 1-3
State 1 to 3

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

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

Transition T 2-3
State 2 to 3

Drought, or drought with grazing intensity together, weakens a water limited system allowing invasive species the opportunity to take advantage of the limited moisture. Threadleaf sedge has been seen to die back or die out with prolonged drought opening the canopy and the community's vulnerability to invasive species. Disturbance by mechanical means or human activities that break the root masses or disturb the soil surface open this closed community to potential invasive species, especially when there is a readily available seed source for those invasive species.

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

Transition T 4-3
State 4 to 3

Any disturbance that occurs or stress that is placed on the herbaceous cover, weakens the canopy and allows for invasive species to establish if a seed source is present. This State is at high risk of transitioning to an Invaded State. The challenge of successful seedings on a very shallow soils and steep slopes leaves the community vulnerable to invasion.

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

Additional community tables

Table 14. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature Cool-season Bunchgrasses**			112–280	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	84–224	20–50
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	28–56	5–10
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
	spike fescue	LEKI2	*Leucopoa kingii*	0–28	0–2
2	**Rhizomatous Cool-season Grasses**			11–56	
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–28	0–5

			lanceolatus		
	western wheatgrass	PASM	*Pascopyrum smithii*	0–28	0–5
3	**Short-stature Cool-season Bunchgrasses**			11–56	
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	6–28	1–5
	Sandberg bluegrass	POSE	*Poa secunda*	6–28	1–5
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
4	**Tillering Cool-season Grasses and Grass-likes**			0–28	
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
5	**Miscellaneous Grasses and Grass-likes**			0–28	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
Forb					
6	**Perennial Forbs**			0–84	
	pussytoes	ANTEN	*Antennaria*	0–28	0–5
	fleabane	ERIGE2	*Erigeron*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	woolly groundsel	PACA15	*Packera cana*	0–28	0–5
	phlox	PHLOX	*Phlox*	0–28	0–5
	Franklin's sandwort	ARFR	*Arenaria franklinii*	0–28	0–5
	stonecrop	SEDUM	*Sedum*	0–28	0–5
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
Shrub/Vine					
7	**Miscellaneous Shrubs**			0–56	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–28	0–10
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–28	0–5
	black sagebrush	ARNO4	*Artemisia nova*	0–28	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–28	0–5
	skunkbush sumac	RHTR	*Rhus trilobata*	0–28	0–2
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–2

Table 15. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature Cool-season Bunchgrasses**			0–84	
	needle and thread	HECO26	*Hesperostipa comata*	0–56	0–10
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–56	0–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–28	0–5
2	**Rhizomatous Cool-season Grasses**			28–112	
	western wheatgrass	PASM	*Pascopyrum smithii*	28–112	5–20
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5

	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–28	0–5
3	**Short-stature Cool-season Bunchgrasses**			28–56	
	Sandberg bluegrass	POSE	*Poa secunda*	11–56	2–10
	prairie Junegrass	KOMA	*Koeleria macrantha*	11–56	2–10
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
4	**Tillering Grasses and Grass-likes**			0–28	
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
5	**Miscellaneous Grass/Grass-likes**			0–28	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–28	0–5
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
Forb					
6	**Perennial Forbs**			0–56	
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–28	0–5
	Franklin's sandwort	ARFR	*Arenaria franklinii*	0–28	0–5
	fleabane	ERIGE2	*Erigeron*	0–28	0–5
	woolly groundsel	PACA15	*Packera cana*	0–28	0–5
	phlox	PHLOX	*Phlox*	0–28	0–5
	stonecrop	SEDUM	*Sedum*	0–28	0–5
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	0–28	0–5
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
7	**Annual/Other Forbs**			0–28	
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–28	0–5
	pepperweed	LEPID	*Lepidium*	0–28	0–5
	aster	ASTER	*Aster*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
Shrub/Vine					
8	**Miscellaneous Shrubs**			28–112	
	prairie sagewort	ARFR4	*Artemisia frigida*	28–56	5–10
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–56	0–10
	black sagebrush	ARNO4	*Artemisia nova*	0–28	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–28	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 16. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					

1	**Mid-stature Cool-season Bunchgrasses**			11–56	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	11–56	2–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–28	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
2	**Rhizomatous Cool-season Grasses**			0–28	
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5
	western wheatgrass	PASM	*Pascopyrum smithii*	0–28	0–5
3	**Short-stature Cool-season Grasses**			11–56	
	Sandberg bluegrass	POSE	*Poa secunda*	11–28	2–10
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
4	**Tillering Grass and Grass-Like**			28–168	
	threadleaf sedge	CAFI	*Carex filifolia*	28–168	10–50
5	**Miscellaneous Grasses**			0–28	
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–11	0–2
	Grass, annual	2GA	*Grass, annual*	0–11	0–2
Forb					
6	**Perennial Forbs**			0–28	
	pussytoes	ANTEN	*Antennaria*	0–28	0–5
	Franklin's sandwort	ARFR	*Arenaria franklinii*	0–28	0–5
	fleabane	ERIGE2	*Erigeron*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	phlox	PHLOX	*Phlox*	0–28	0–5
	woolly groundsel	PACA15	*Packera cana*	0–28	0–5
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
7	**Annual Forbs**			0–28	
	bladderpod	LESQU	*Lesquerella*	0–28	0–5
	stonecrop	SEDUM	*Sedum*	0–28	0–5
	pepperweed	LEPID	*Lepidium*	0–28	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
Shrub/Vine					
8	**Miscellaneous Shrubs**			0–112	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–56	0–10
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	0–5
	black sagebrush	ARNO4	*Artemisia nova*	0–28	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–28	0–5
	skunkbush sumac	RHTR	*Rhus trilobata*	0–28	0–5

	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Animal community

Animal Community – Wildlife Interpretations

Bluebunch Wheatgrass/Mixed Shrub Plant Community (Reference): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as deer, 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. Due to the location of these sites on the foot slopes of mountains they are valuable for elk and deer winter ranges. 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 meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous Hawks, and golden eagles. Many grassland obligate small mammals would occur here.

Rhizomatous Wheatgrass/Mixed Shrub Plant Community:
The combination of an overstory of sagebrush and an understory of grasses and forbs provides a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer, elk, 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 to 30 percent cover range. Other birds that would frequent this plant community include western meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous Hawks, and golden eagles.

Short Grasses Plant Community: The production of herbaceous species provided for good foraging for grazers. However, the lack of tall or mid growing shrubs does not benefit browsers nor provides cover for many wildlife species. As these site greens-up sooner in the spring, this site tends to provide early new growth for foraging large and small mammals. If located adjacent to shrub dominated sites, It provides good foraging habitat for sage grouse.

Invaded Plant Community: This community provides limited foraging for elk and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover. Generally, these are not target plant communities for wildlife habitat management.

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
Bluebunch WG/Mixed Sagebrush 250 - 350 - 500 0.10 10.4
Rhizomatous WG/Mixed Sagebrush 200 - 300 - 450 0.08 12.2
Short Grasses 100 - 250 - 400 0.07 14.6
Invaded **
Disturbed **

* - 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 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30 percent of the unit (i.e. 50 percent reduction on 30 percent of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of 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 percent 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 percent 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 one to two percent of the soil surface.

Recreational uses

This site provides hunting opportunities for a variety of large ungulates. The varieties of plants which bloom from spring until fall have an aesthetic value that appeals to visitors. Outside of plants, the location of many of these sites on benches and fans 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. Douglas fir, Rocky Mountain juniper, and limber pine may be present in scattered patches, but no logging or timber harvest for commercial use is occurring.

Other products

Herbs: The forb species within the communities of the Igneous 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 were also used. 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 5, and USDA NRCS Soil Surveys from various counties.

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 Igneous ecological site include: Blaise Allen, Area Range Management Specialist, NRCS; 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.)

Other references

Baker, William L. 2006. Fire and Restoration of Sagebrush Ecosystems. Wildlife Society Bulletin 34(1): 177-185.

Bestelmeyer, B., and J. R. Brown. 2005. State-and-transition models 101: a fresh look at vegetation change. The Quivira Coalition Newsletter, Vol. 7, No. 3.

Bestelmeyer, B., J. R. Brown, K. M. Havstad, B. Alexander, G. Chavez, J. E. Herrick. 2003. Development and use of state and transition models for rangelands. Journal of Range Management 56(2):114-126.

Bestelmeyer, B., J. E. Herrick, J. R. Brown, D. A. Trujillo, and K. M. Havstad. 2004. Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management 34(1):38-51.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume I Quick Start. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume II: Design, supplementary methods and interpretation. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

NRCS. 2014. (electronic) National Water and Climate Center. Available online at http://www.wcc.nrcs.usda.gov/

NRCS. 2014. (electronic) Field Office Technical Guide. Available online at http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=WY NRCS. 2009. Plant Guide: Cheatgrass. Prepared by Skinner et al., National Plant Data Center.

Pellant, M., P. Shaver, D. A. Pyke, and J. E. Herrick. 2005. Interpreting indicators of rangeland health. Version 4. Technical Reference 1734-6. USDI-BLM. Ricketts, M. J., R. S. Noggles, and B. Landgraf-Gibbons. 2004. Pryor Mountain Wild Horse Range Survey and Assessment. USDA-Natural Resources Conservation Service.

Schoeneberger, P. J., D. A. Wysocki, E. C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE. (http://soils.usda.gov/technical/fieldbook/)

Stringham, T. K. and W. C. Krueger. 2001. States, transitions, and thresholds: Further refinement for rangeland applications. Agricultural Experiment Station, Oregon State University. Special Report 1024.

Stringham, T. K., W. C. Kreuger, and P. L Shaver. 2003. State and transition modeling: an ecological process approach. Journal of Range Management 56(2):106-113.

United States Department of Agriculture. Soil Survey Division Staff. 1993. Soil Survey Manual, United States Department of Agriculture Handbook No. 18, Chapter 3: Examination and Description of Soils. Pg.192-196.

USDA, NRCS. 1997. National Range and Pasture Handbook. (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html)

Trlica, M. J. 1999. Grass growth and response to grazing. Colorado State University. Cooperative Extension. Range. Natural Resource Series. No. 6.108.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS). 2007. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS), Soil Survey Staff. 2010. Keys to Soil Taxonomy, Eleventh Edition, 2010.

USDA/NRCS Soil survey manuals for appropriate counties within MLRA 32X.
Western Regional Climate Center. (2014) (electronic) Station Metadata. Available online at: http://www.wrcc.dri.edu/summary/climsmwy.html.

Contributors

Dan Mattke, Resource Soil Scientist - Rocky Mountain Area Office

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.

Author(s)/participant(s)	Marji Patz, Ray Gullion, E. Bainter
Contact for lead author	marji.patz@usda.gov; 307-271-3130
Date	02/03/2022
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Few rills will be present with slopes up to 30% and increase in occurrence as slopes increase.

2. **Presence of water flow patterns:** Barely observable but occur on steeper slopes (greater than 30%)

---

3. **Number and height of erosional pedestals or terracettes:** Slight pedestalling evident.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is 25 to 60% occurring in small patch-like areas throughout site.

---

5. **Number of gullies and erosion associated with gullies:** Active gullies, where present, should be rare.

---

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 litter expected to move in moderate amounts. Large woody debris will show only slight movement down slope.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 40 to 75% of soil surface and maintains soil surface integrity. Soil stability class is anticipated to be 3.0 or greater on average. Ranging from 1 in interspaces and up to 6 under plant canopy.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. A-horizons vary in depth from 1 to 2 inches with OM of of less than 3%.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 50-70% grasses, 10% forbs, and 20-40% shrubs. Sparse plant canopy (40-60%) and litter plus slow to moderate infiltration rates result in slight to moderate runoff. Basal cover is typically less than 10% and marginally affects runoff on this site. Surface rock outcrop of 10-30% provide stability to the site, but reduce infiltration. Runoff can be rapid on this site with a moderate to high erosion hazard associated with steep slopes.

---

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

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Mid- stature Cool-season Bunchgrasses >> Perennial Shrubs

    Sub-dominant: Perennial Forbs = Cool-season Rhizomatous Grasses

    Other: Short-stature Cool-season Bunchgrasses

Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence noted, typically associated with shrub canopy. Through drought conditions will see some decadence with Bluebunch Wheatgrass.

---

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 10-30% of total canopy measurement with total litter (including beneath the plant canopy) from 30-50% expected. Herbaceous litter depth typically ranges from 3-10mm. Woody litter can be up to several inches (>6 cm).

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total normal or average production is estimated at 350 lb/ac; with a low of 250 lbs/acre and a high of 500 lb/ac. (Metric 280-560 kg/ha (392 kg/ha average).

---

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 60% is the most common indicator of a threshold being crossed. Bluegrasses and fringed sagewort are common increasers. Annual weeds such as cheatgrass, thistles, and mustards are common invasive species in disturbed sites.

---

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