USDA Natural Resources
Conservation Service

Ecological site EX043B23A160
Shallow Igneous (Swlg) Absaroka Lower Foothills

Last updated: 3/04/2024
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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

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 Derived from igneous, metamorphic, or other volcanic parent material
o Textures range from very fine sandy loam to clay loam in top 4” (10 cm) of mineral soil surface
o All subsurface horizons have a weighted average of >18% clay but < 60% clay
o Clay content is ≤ 35% in top 4” (10 cm) of mineral soil surface
o Shallow (10-20+ in. (25-50+ cm))
o < 10% stone and boulder cover and < 20% cobble and gravel cover
o Not skeletal (<35% rock fragments) within 20” (50 cm) of mineral soil surface
o Non-saline, sodic, or saline-sodic

Associated sites

EX043B23A122	**Loamy (Ly) Absaroka Lower Foothills** Loamy ecological site occurs on the lowest position below the exposed bedrock with few rock fragments throughout the profile, and a deep soil. Loamy will have more robust shrubs, higher vigor in grasses and less exposed soil.
EX043B23A175	**Skeletal (Sk) Absaroka Lower Foothills** Skeletal ecological site will occur lower in the profile where the weathered conglomerate, colluvium, or slope alluvium have accumulated or have been mixed to form a deep soil with significant rock fragments throughout the profile (35 percent or greater by volume).
EX043B23A116	**Igneous (Ig) Absaroka Lower Foothills** Igneous ecological site will occur in bands or as pockets within the Shallow Igneous; predominately where bedrock is uplifted or deposits have eroded down closer to the bedrock. Igneous will have lower production, fewer shrubs and less vigor in similar grass species. More pincushion forbs will be present.

Similar sites

EX043B23A158	**Shallow Clayey (SwCy) Absaroka Lower Foothills** Shallow Clayey ecological site is similar in depth to bedrock or paralithic contact, however, Shallow Clayey is derived from sedimentary parent material and Shallow Igneous is volcanic or metamorphic/igneous parent material.

EX043B23B160	**Shallow Igneous (Swlg) Absaroka Upper Foothills** Shallow Igneous Absaroka Upper Foothills is the same concept, however, production increases and vegetation species shift to the 15-19
EX043B23A162	**Shallow Loamy (SwLy) Absaroka Lower Foothills** Shallow Loamy ecological site is similar in depth to bedrock or paralithic contact, however, Shallow Loamy is derived from sedimentary parent material and Shallow Igneous is volcanic or metamorphic/igneous parent material.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis* (2) *Artemisia nova*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Achnatherum hymenoides*

Legacy ID

R043BX560WY

Physiographic features

This site occurs on most slopes and along ridge tops.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Escarpment (2) Foothills > Ridge (3) Foothills > Erosion remnant
Runoff class	Negligible to very high
Ponding frequency	None
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

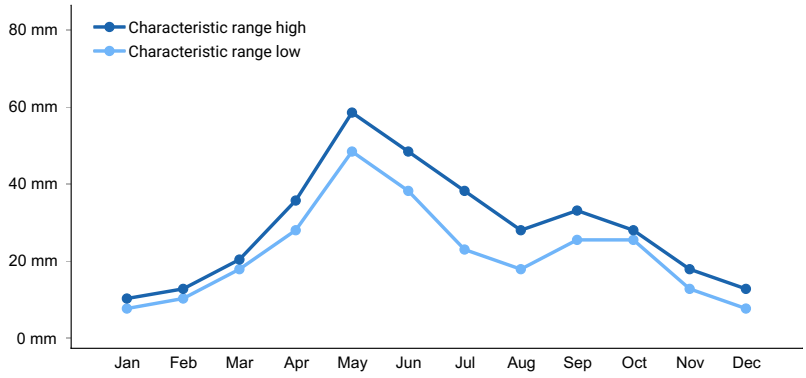


Figure 1. Monthly precipitation range

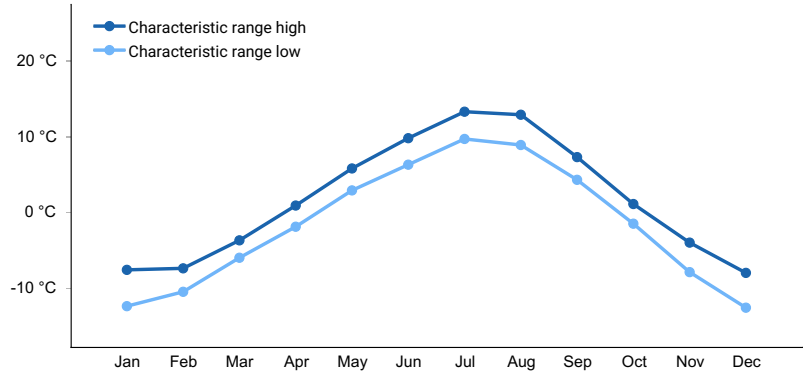


Figure 2. Monthly minimum temperature range

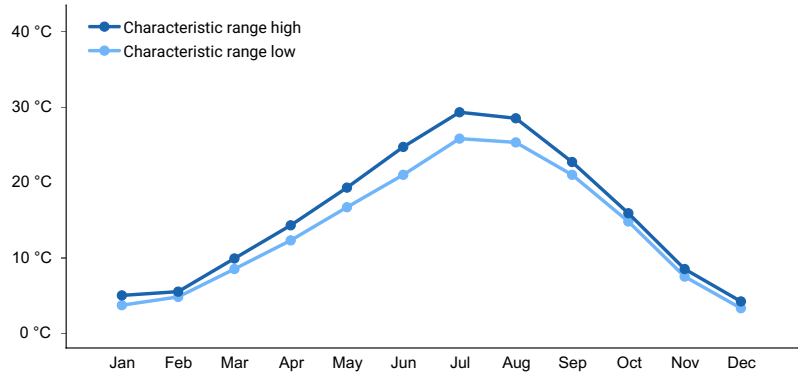


Figure 3. Monthly maximum temperature range

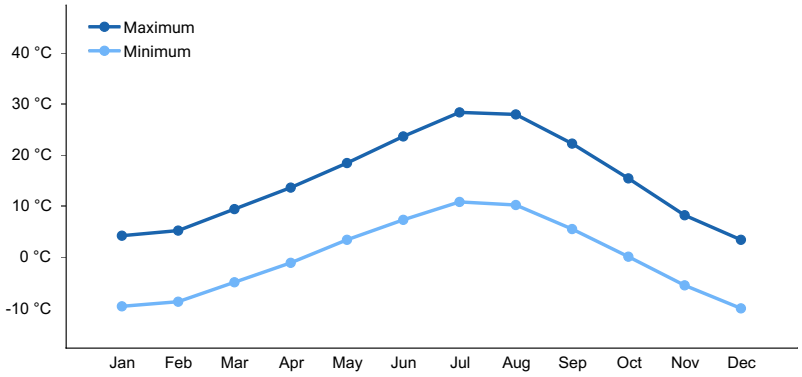


Figure 4. Monthly average minimum and maximum temperature

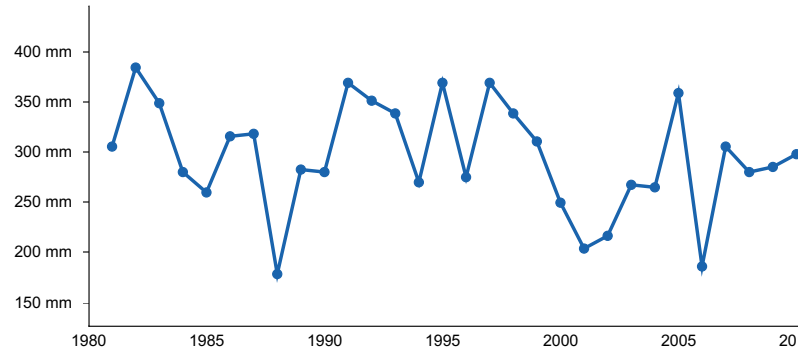


Figure 5. Annual precipitation pattern

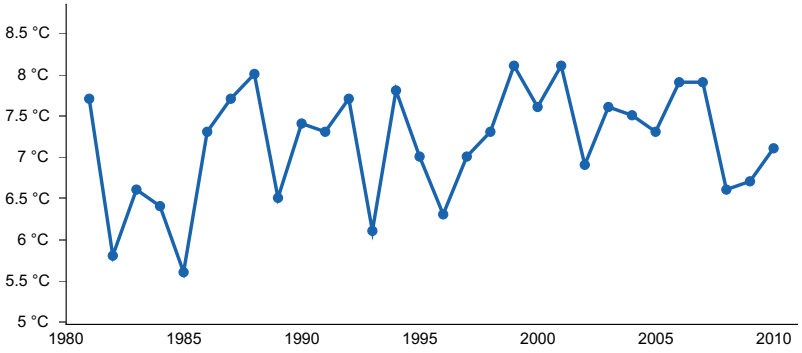


Figure 6. Annual average temperature pattern

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 granitic or volcanic bedrock. These soils are generally less than 20 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. Pit profile of the Shallow Igneous ecological site.

Table 4. Representative soil features

Parent material	(1) Colluvium–igneous and metamorphic rock (2) Residuum–volcanic rock
Surface texture	(1) Gravelly loam (2) Clay loam (3) Sandy clay loam
Family particle size	(1) Loamy (2) Clayey
Drainage class	Well drained
Permeability class	Moderate
Soil depth	25–51 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" (Depth not specified)	0–20%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

Potential vegetation on this site is dominated by mid cool-season perennial grasses. Other significant vegetation includes yellow rabbitbrush, Wyoming big sagebrush, fringed sagewort and a variety of forbs. The expected potential composition for this site is about 75 to 80 percent grasses, 10 percent forbs and 10 to 15 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 threadleaf sedge and fringed sagewort will increase. Plains pricklypear and weedy annuals will invade. Cool season grasses such as bluebunch wheatgrass, Indian ricegrass, and rhizomatous wheatgrasses will decrease in frequency and production.

Due to the amount and pattern of the precipitation, in combination with soil limitations, the shrub component has a lower structure than similar ecological sites within the same area. Sagebrush is not resilient once it has been removed or impacted. Black sagebrush is found commonly intermingled with Wyoming big sagebrush, and when limestone is interbedded with the volcanic soils, black sagebrush will be dominant.

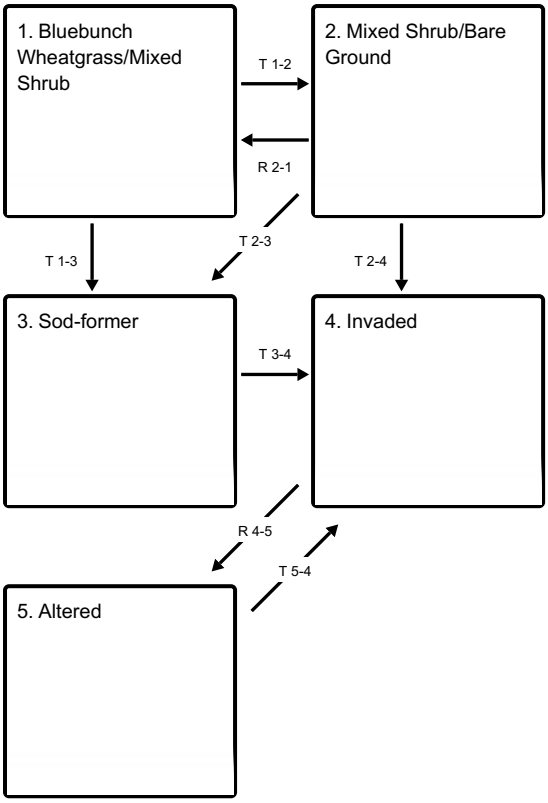
The reference plant community (description follows the plant community diagram) has been determined by study of relic rangeland sites, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical 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 - Severe and frequent grazing and lack of browse or brush control will transition this State to the Mixed Shrub/Bare Ground State.

T 1-3 - Frequent and severe grazing (yearlong grazing) or compaction from surface traffic, will weaken the mid-stature grasses and allow threadleaf sedge to increase.

R 2-1 - Brush management, prescribed grazing, and potential range seeding will aid in the restoration to Reference.

T 2-3 - Brush management, or an intense wildfire followed by frequent and severe grazing, will convert the plant community to the Sod-former State..

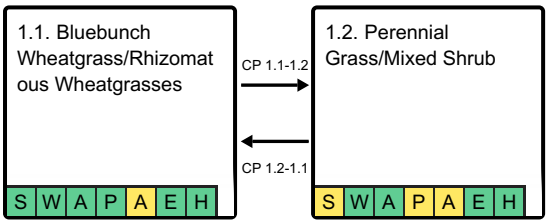
T 2-4 - Disturbance to the soil surface provides the opportunity for invasive species to find their niche in a community.

T 3-4 - Drought with or without hoof impact or mechanical soil impact to displace the sod opens the niche for invasive species to establish.

R 4-5 - Integrated weed management, seeding and grazing management will establish a community similar to Reference.

T 5-4 - Any disturbance to or failure in reclaiming the community leaves this State at risk to invasion.

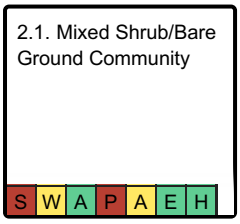
State 1 submodel, plant communities



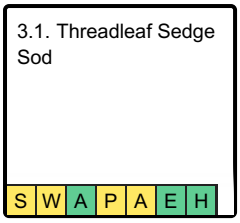
CP 1.1-1.2 - Continuous season-long grazing, especially with drought conditions, will transition this community.

CP 1.2-1.1 - Long-term prescribed grazing with potentially brush management will provide time for recovery to Reference.

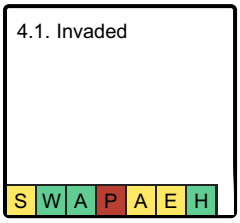
State 2 submodel, plant communities



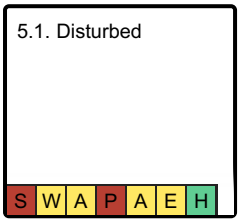
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Bluebunch Wheatgrass/Mixed Shrub

The Reference State, State 1, is the Bluebunch Wheatgrass/Mixed Shrub State, in response to the dominance of bluebunch wheatgrass and other mid-stature cool-season bunchgrasses that are prominent in each community. Rhizomatous wheatgrasses and short-stature cool-season bunchgrasses are secondary in these communities. Sagebrush and rabbitbrush is present on the site, but is not the major cover class.

Characteristics and indicators. Bunchgrass/Sagebrush State (State 1 - Reference) is characterized by the key species including fifteen percent or less composition by cover of Wyoming big sagebrush, black sagebrush, and fringed sagewort; with 30 percent cover of bluebunch wheatgrass, rhizomatous wheatgrasses (Western and Thickspike), Indian ricegrass, and needle and thread. Minor component to the overall composition is made up of bottlebrush squirreltail, Sandberg bluegrass, mutton bluegrass, prairie junegrass, and threadleaf sedge.

Resilience management. This state occurs in areas that are grazed moderately with periods of rest by large ungulates include livestock (cattle and/or sheep) as well as antelope, deer, and elk. Prescribed grazing and drought planning allows this State to persist. The community is adaptable to drought with management.

Community 1.1
Bluebunch Wheatgrass/Rhizomatous Wheatgrasses

Figure 8. Bluebunch wheatgrass dominated community with spike fescue and Montana wheatgrass.

The interpretive plant community for the Shallow Igneous ecological site is the Bluebunch Wheatgrass/Rhizomatous Wheatgrasses plant community. This plant community evolved with grazing by large herbivores and periodic fires. This plant community can be found on areas that are properly managed with grazing, and on areas receiving occasional short periods of rest. Potential vegetation is about 75-80 percent grasses or grass-like plants, 10 percent forbs, and 10-15 percent woody plants. Mid-stature cool-season bunchgrasses dominate the community. The major grasses include bluebunch wheatgrass, needle and thread, Indian ricegrass, and rhizomatous wheatgrass. Other grasses occurring are Sandberg bluegrass, prairie junegrass, and bottlebrush squirreltail. Green needlegrass and spike fescue occur in the upper limit of this precipitation zone. Black and Wyoming big sagebrush are conspicuous elements of this state, which can make up 10percent of the annual production. A variety of forbs also occurs in this community phase and plant diversity is high (see Plant Composition Table). The total annual production (air-dry weight) of this state is about 500 pounds per acre, but it can range from about 325 lbs./acre in unfavorable years to about 700 lbs./acre in above average years.

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

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- black sagebrush (*Artemisia nova*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- needle and thread (*Hesperostipa comata*), grass
- spike fescue (*Leucopoa kingii*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- buckwheat (*Eriogonum*), other herbaceous
- hairy false goldenaster (*Heterotheca villosa*), 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	336	476	616
Shrub/Vine	17	56	112
Forb	11	28	56
Total	**364**	**560**	**784**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	0-15%
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	10-25%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	0-5%	0-5%
>0.15 <= 0.3	–	0-10%	15-40%	0-10%
>0.3 <= 0.6	–	0-2%	0-5%	0-1%
>0.6 <= 1.4	–	0-1%	0-1%	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

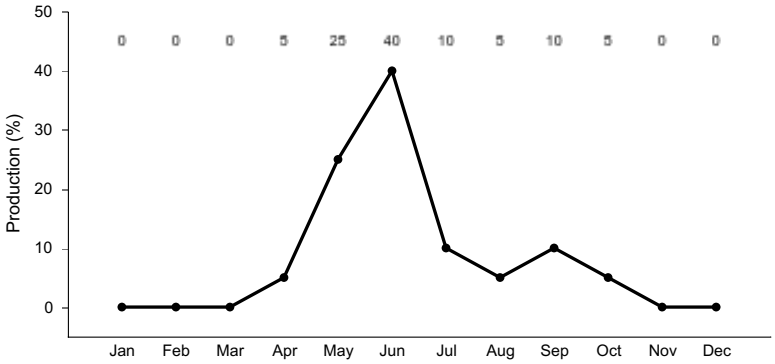


Figure 10. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Community 1.2
Perennial Grass/Mixed Shrub

Figure 11. Bluebunch wheatgrass and Wyoming big sagebrush community with bluegrass and needle and thread.

Historically, this plant community evolved under grazing and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock and will be exacerbated by prolonged drought conditions. This plant community is still dominated by cool-season grasses, while miscellaneous forbs account for the balance of the understory. A variety of shrubs is now a conspicuous part of the overall production. The dominant grasses include bluebunch and Montana wheatgrasses, rhizomatous wheatgrasses, and needleandthread. Grasses and grass-like species of secondary importance include prairie Junegrass, , Sandberg bluegrass, and threadleaf sedge. Green needlegrass and spike fescue occur on sites in the upper limit of this precipitation zone. Forbs commonly found in this plant community include pussytoes, buckwheat, hairy goldenaster, Indian paintbrush, and phlox. Big sagebrush, black sagebrush, and rabbitbrush dominate the overstory. Shrubs can make up to 20 percent of the annual production. The overstory of shrubs and understory of grass and forbs provide a diverse plant community. When compared to the Reference plant community, shrubs, prairie Junegrass, and threadleaf sedge have increased. Plains prickly pear cactus may also have invaded, but occurs only in small patches. Indian ricegrass, bluebunch and Montana wheatgrasses has decreased and Indian ricegrass may occur in only trace amounts under the sagebrush canopy or within the patches of prickly pear. The total annual production (air-dry weight) of this state is about 400 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 600 lbs./acre in above average years.

Resilience management. 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 may be occurring but only on steeper slopes. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact.

Dominant plant species

- black sagebrush (*Artemisia nova*), shrub
- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Montana wheatgrass (*Elymus albicans*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- needle and thread (*Hesperostipa comata*), grass
- rosy pussytoes (*Antennaria rosea*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- hairy false goldenaster (*Heterotheca villosa*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Plant structure and composition
- 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	157	308	448
Shrub/Vine	56	112	168
Forb	11	28	56
Total	**224**	**448**	**672**

Table 9. Ground cover

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

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	5-10%	5-10%	0-5%
>0.15 <= 0.3	–	5-15%	10-30%	0-10%
>0.3 <= 0.6	–	0-5%	0-5%	–
>0.6 <= 1.4	–	0-1%	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

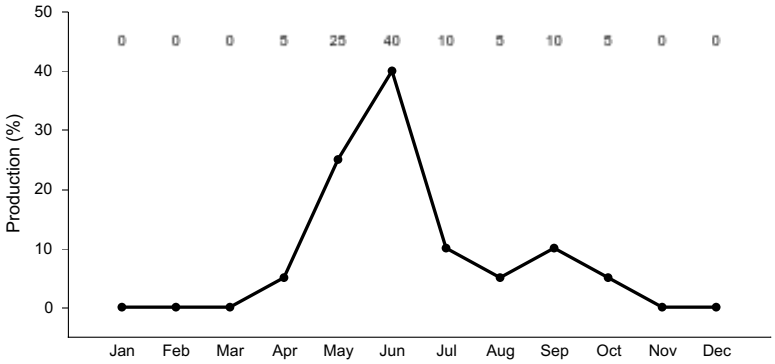
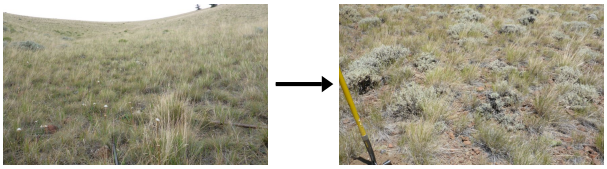


Figure 13. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Pathway CP 1.1-1.2
Community 1.1 to 1.2

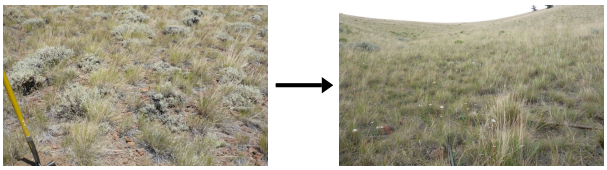


Bluebunch Wheatgrass/Rhizomatous Wheatgrasses

Perennial Grass/Mixed Shrub

Moderate, continuous season-long grazing will convert the plant community to the Perennial Grass/Mixed Shrub Plant Community. Prolonged drought will exacerbate this transition.

Pathway CP 1.2-1.1
Community 1.2 to 1.1



Perennial Grass/Mixed Shrub

Bluebunch Wheatgrass/Rhizomatous Wheatgrasses

Prescribed grazing or possibly long-term prescribed grazing, will convert this plant community to the Reference plant community (1.1). The probability of this occurring is high especially if rotational grazing along with short deferred grazing is implemented as part the prescribed method of use. Brush treatment can be useful to hasten this transition if desired.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing
Grazing Land Mechanical Treatment
Upland Wildlife Habitat Management

State 2
Mixed Shrub/Bare Ground

Shrubs or woody vegetation creates a niche for most herbaceous understory to persist and maintain some vigor in difficult conditions by utilizing the moisture and shelter provided by the canopy as well as protection from grazing. Persistence of drought and/or frequent over use by livestock and wildlife leads to a decline of the herbaceous species, creating the Mixed Shrub/*Bare Ground* state. This State can be exacerbated by insects and other human disturbances.

Characteristics and indicators. There is a high level of variability of species in this State, that will shift in response to precipitation and to past management. Only one defined community will be provided, with discussion of transitions or variances from this community. The total woody canopy cover does not necessarily always increase with this community, but the percent composition by cover and production is swayed by the decrease of herbaceous vegetation and the relative stability of production by the woody species, creating the appearance of increased canopy by sagebrush.

Resilience management. Risk of wildfire within this state is minimal due to the lack of fine fuels within the understory, but the canopy of the woody vegetation can easily carry a fire under certain climatic conditions. Depending on the prescription of use, trailing and other erosional patterns are highly visible in this State. Protection from wildfire and use, on a long-term perspective can aid in the transition of the Reference Communities (1.1 or 1.2)

to this State as shrubs reach maturity reducing the ability for the herbaceous component to maintain vigor; leading to a high rate of bare ground and shrub cover. As the herbaceous cover declines and the site continues to weaken, the woody cover is susceptible to attack by insects, disease, and general old age that can remove it from the system creating a system that is at risk of invasion or transition to a more degraded State.

Community 2.1
Mixed Shrub/Bare Ground Community

Figure 14. Sagebrush is dominant with only remnants of the perennial grasses remaining.

This plant community is the result of frequent and severe grazing and protection from fire. Soils on these sites are typically low in soluble salts. Shrubs and especially sagebrush dominate this plant community, as the annual production of sagebrush exceeds 20 percent.. Shrubs are significant components of the plant community and the preferred cool season grasses have been eliminated or greatly reduced. The dominant grasses/grass-likes are prairie junegrass, Sandberg bluegrass, and threadleaf sedge. Cactus often invades. The interspaces between plants have expanded leaving the amount of bare ground more prevalent. As compared with the Reference Plant Communities (1.1 or 1.2), the annual production is reduced, but the shrub production compensates for some of the decline in the herbaceous production. The total annual production (air-dry weight) of this state is about 275 pounds per acre, but it can range from about 175 lbs./acre in unfavorable years to about 375 lbs./acre in above average years.

Resilience management. Rangeland Health Implications/Indicators: 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 sagebrush plants is increased. Continued frequent and severe grazing or the removal of grazing does not seem to affect the composition or structure of the plant community. Plant diversity is moderate to poor. 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

- Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), shrub
- black sagebrush (*Artemisia nova*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- yellow salsify (*Tragopogon dubius*), other herbaceous
- spiny phlox (*Phlox hoodii*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Ephemeral gully erosion

- Classic gully erosion
- Aggregate instability
- Naturally available moisture use
- Sediment transported to surface water
- 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)
Shrub/Vine	112	168	224
Grass/Grasslike	73	112	140
Forb	11	28	56
Total	**196**	**308**	**420**

Table 12. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	5-20%
Forb foliar cover	2-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-10%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	5-10%	0-5%	0-5%
>0.15 <= 0.3	–	10-20%	0-15%	0-5%
>0.3 <= 0.6	–	0-5%	0-2%	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

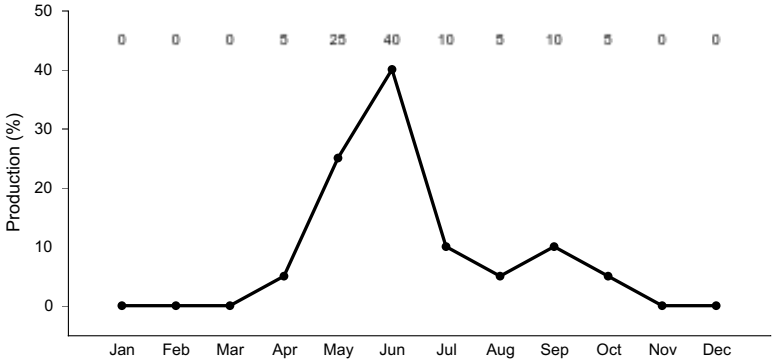


Figure 16. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

State 3
Sod-former

The Sod-former State 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 shift in hydrology of this State leads to low vigor shrubs. 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 State extremely resistant to change, and resilient to disturbance. Although the establishment of threadleaf sedge is a slow process, it will become a near monoculture stand. 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 3.1
Threadleaf Sedge Sod

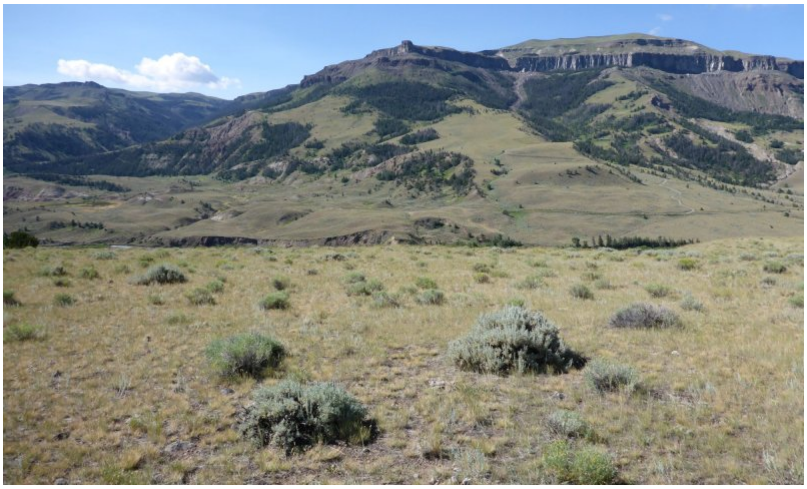


Figure 17. Threadleaf sedge has become the dominant cover with scattered cover of sagebrush and rabbitbrush.

This plant community is the result of frequent and severe year-long grazing, which has adversely affected the perennial grasses as well as the shrub component. Other factors that can affect the shrubs include drought, heavy browsing, wildfires, and/or human brush control measures. A dense sod of threadleaf sedge dominates this site. Prickly pear cactus can become dense enough in patches so that livestock cannot graze forage growing within the cactus clumps. Sagebrush has been significantly reduced and in some cases removed. When compared to the Reference Plant Community, threadleaf sedge has increased. All mid-stature cool-season bunchgrasses and forbs have been greatly reduced and the shrub component is lacking. Total production has been significantly decreased. The total annual production (air-dry weight) of this state is about 150 pounds per acre, but it can range from about

100 lbs./acre in unfavorable years to about 250 lbs./acre in above average years.

Resilience management. This sod is extremely resistant to change and continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the plant community. The biotic integrity of this state is not functional and plant diversity is extremely low. This sod bound plant community is very resistant to water infiltration. While this sod protects the site itself, areas amid these patches or off-site areas are affected by excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in the bare ground areas and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The watershed may or may not be functioning, as runoff may affect adjoining sites.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- rubber rabbitbrush (*Ericameria nauseosa*), shrub
- black sagebrush (*Artemisia nova*), shrub
- threadleaf sedge (*Carex filifolia*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- yellow salsify (*Tragopogon dubius*), other herbaceous
- woolly plantain (*Plantago patagonica*), 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

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	101	112	168
Forb	11	28	56
Shrub/Vine	–	28	56
Total	**112**	**168**	**280**

Table 15. 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	10-20%
Surface fragments >0.25" and <=3"	0-20%
Surface fragments >3"	0-15%
Bedrock	0%
Water	0%

Bare ground	25-50%

Table 16. Canopy structure (% cover)

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

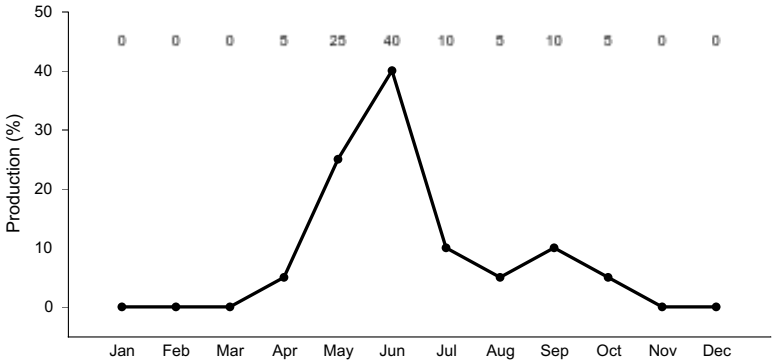


Figure 19. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

State 4
Invaded

The transition into the Invaded State, is typically a result of wildfire, a failed controlled burn or other event that removes the sagebrush from the site and allows a readily available seed bank or seed source of the undesirable species to flourish.

Characteristics and indicators. The most common invasive community that is found in the foothills and through the Big Horn Basin and much of the surrounding regions is Cheatgrass. However, there are other threats present, such as thistles, that can develop into near monoculture stands. The loss of diversity, changes to the potential of a site due to allelopathy or other deterrent characteristics of invasive species, and risks or land use capabilities associated with the various invasive species creates a hostile environment for both native species and grazers.

Resilience management. The resilience and resistance of the invaders create a management road block that is usually financially driven. Many times, once an invasion reaches this point, many land managers have no choice but to learn to utilize what they have rather than to try to treat or improve the site, specifically in relation to cheatgrass control.

Community 4.1
Invaded

Figure 20. Two-years post burn, this bluebunch dominated site has a dense understory of cheatgrass.

Downy Brome, better known as cheatgrass (*Bromus tectorum*), is able to green up and grow late into the fall and green up early spring before snowmelt. This early and late growth pattern allows cheatgrass to utilize fall and spring resources that are otherwise stored for the cool-season perennial vegetation before the native species can begin to break dormancy. Seeds are able to persist for long periods of time until growing conditions are optimal, allowing growth before most native species. The plant's ability to grow quickly utilizing minimal available resources and the ability to produce large quantities of seed quickly, and to reproduce in poor conditions are what drives this plant above the natives and many improved varieties of grass. The morphology of the seed allows for easy dispersal and longevity creating a widespread and long-term seed bank. These traits create a management challenge that has not been successfully met at this time. Once this species has a niche on a landscape it is resistant and resilient to change. In this community, with the absence of sagebrush, there may be native species that will persist in small scattered populations or sparsely under the canopy of the cheatgrass. Certain climatic conditions will allow natives to show their resiliency and respond to the available resources (typically mid spring moisture), but are generally unable to out-compete the annual invader, and remain secondary in the community. The ability for cheatgrass to emerge, bolt, produce seed and mature out two to three times within a year utilizes all available soil nutrients and moisture resources. Chemical control is difficult to attain and maintain success without lasting effects on the native grasses in the area. Chlorosis of wheatgrasses, stunted plants, and loss of certain forbs are a few of the residual chemical effects. This generally comes from the chemical composition and its ability to bind to the chemistry or nutrients in the soil inhibiting the uptake by roots. The extensive fine fuels/biomass load created by cheatgrass can increase the fire frequency interval to an annual to five year cycle, preventing sagebrush and other woody species from establishing on the site, and has negative impacts on many of the native herbaceous species in the understory, by increased evaporation and mineralization/vaporization of many of the nutrients rendering the soils nearly sterile. The grazing potential is limited due to the unpalatable and harsh environment that the mature seeds create with their long awns and chaff. If grazed in early spring or late fall some of this can be avoided, but general use through the middle of the growing season is difficult, and defeats the purpose of intensively grazing the location. In smaller invaded sites or under certain conditions, grazing can be used as a tool within the integrated pest management toolbox, but it is not effective alone.

Resilience management. This plant community is resistant to change. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are non-existent due to the loss of cool-season grasses. Plant litter is noticeably more when compared to reference communities in response to the dense duff layer created by Cheatgrass. Soil erosion is generally reduced in response to the litter accumulation; however, the annual nature of this plant accentuates the water flow patterns and pedestalling. Infiltration is reduced and runoff is increased with the loss of perennial vegetation and root depth and density. Overall biotic integrity is lost in this community.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- thistle (*Cirsium*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Aggregate instability

- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Feed and forage imbalance
- Inadequate livestock water quantity, quality, and distribution

State 5
Altered

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 Altered 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. Stabilization 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 5.1
Disturbed

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
- Ephemeral gully erosion
- Classic 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

Transition T 1-2
State 1 to 2

Frequent and severe grazing plus no fire (lack of browsing on shrubs) will convert the plant community to the Mixed Shrub/*Bare Ground* Plant Community. The probability of this occurring is high, especially evident on areas with historically higher precipitation and where drought or heavy browsing does not adversely impact the sagebrush stand.

Constraints to recovery. The lack of a seed bank and the shallow depth to bedrock limits seedling establishment and survival. The unpredictable and variable spring precipitation also limits success of recovery.

Transition T 1-3
State 1 to 3

Frequent and severe grazing (yearlong grazing) plus wildfire or brush control, will convert the plant community to the Sod-former State. The probability of this occurring is high, especially if the sagebrush stand has been severely affected by drought or heavy use or has been removed altogether.

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).

Restoration pathway R 2-1
State 2 to 1

Brush management, followed by prescribed grazing, will return this plant community at or near the Reference State. Reseeding after brush management with native species may be necessary to ensure a more rapid transition. If prescribed fire is used as a means to reduce or remove the shrubs, sufficient fine fuels will need to be present. This may require deferment from grazing prior to treatment. Post management is critical to ensure success. This can range from two or more years of rest to partial growing season deferment, depending on the condition of the understory at the time of treatment and the growing conditions following treatment. In the case of an intense wildfire that occurs when desirable plants are not completely dormant, the length of time required to reach the Reference maybe increased and seeding of natives is recommended.

Transition T 2-3
State 2 to 3

Brush management, or an intense wildfire followed by frequent and severe grazing, will convert the plant community to the Sod-former State.

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). The lack of sagebrush or other shrubs and the loss of snow catch to the system also impacts the recovery. Sagebrush is slow to re establish and with altered hydrology may not recover in this system.

Transition T 2-4
State 2 to 4

Catastrophic or intense wildfires, prolonged drought with severe use by large herbivores or large scale land disturbance creates an environment ready for Invasion. In areas where invasive species are present, the exposed soil and lack of native vegetation from already stressed communities encourages invasive species to establish as a mono-culture with possibly only small isolated remnants of native species. The canopy of Wyoming big sagebrush is the stabilizer for this community. Once it is removed from a community, it is extremely difficult to re-establish. Wyoming big sagebrush may require 25 years or greater to establish naturally, and in many cases will require outside assistance. The open raw landscape with minimal native species provides the perfect opportunity for invasive species, primarily Cheatgrass, to establish and take over a community. Drought or insects and disease serve to exacerbate the situation.

Constraints to 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 3-4
State 3 to 4

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.

Restoration pathway R 4-5
State 4 to 5

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

Transition T 5-4
State 5 to 4

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. 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.

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 17. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall-stature Cool-season Bunchgrasses**			0–34	
	spike fescue	LEKI2	*Leucopoa kingii*	0–34	0–5
	green needlegrass	NAVI4	*Nassella viridula*	0–34	0–5
2	**Mid-stature Cool-Season Bunchgrasses**			135–404	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	101–269	15–40
	needle and thread	HECO26	*Hesperostipa comata*	17–84	5–15
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	17–67	2–10
3	**Rhizomatous Cool-Season Grasses**			135–303	
	Montana wheatgrass	ELAL7	*Elymus albicans*	67–168	10–25
	western wheatgrass	PASM	*Pascopyrum smithii*	34–67	5–10
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	34–67	5–10
4	**Short-stature Cool-season Bunchgrasses**			0–34	
	squirreltail	ELEL5	*Elymus elymoides*	0–34	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–34	0–5
	muttongrass	POFE	*Poa fendleriana*	0–34	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–34	0–5
5	**Tillering Cool-season Grass-likes**			0–34	
	threadleaf sedge	CAFI	*Carex filifolia*	0–34	0–5
6	**Miscellaneous Grasses/Grass-Likes**			28–67	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–34	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–34	0–5
Forb					
7	**Perennial Forbs**			0–34	
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–34	0–5
	sandwort	ARENA	*Arenaria*	0–34	0–5
	Indian paintbrush	CASTI2	*Castilleja*	0–34	0–5
	buckwheat	ERIOG	*Eriogonum*	0–34	0–5
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–34	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–34	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–34	0–5
Shrub/Vine					
8	**Miscellaneous Shrubs**			0–112	
	black sagebrush	ARNO4	*Artemisia nova*	0–34	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–34	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–34	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–34	0–5
	prairie sagewort	ARFR4	*Artemisia frigida*	0–34	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	0–5

Table 18. Community 1.2 plant community composition

				Annual Production	Foliar Cover

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall-stature Cool-season Bunchgrasses**			0–56	
	green needlegrass	NAVI4	*Nassella viridula*	0–56	0–10
	spike fescue	LEKI2	*Leucopoa kingii*	0–28	0–5
2	**Mid-stature Cool-season Bunchgrasses**			56–280	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	56–224	10–40
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–56	0–10
	needle and thread	HECO26	*Hesperostipa comata*	0–56	0–10
3	**Rhizomatous Cool-season Grasses**			28–112	
	Montana wheatgrass	ELAL7	*Elymus albicans*	28–56	5–10
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–56	0–10
	western wheatgrass	PASM	*Pascopyrum smithii*	0–56	0–10
4	**Short-stature Cool-season Bunchgrasses**			0–56	
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
5	**Tillering Cool-season Grass-likes**			0–28	
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
6	**Miscellaneous Grasses**			0–28	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
Forb					
7	**Perennial Forbs**			11–56	
	common yarrow	ACMI2	*Achillea millefolium*	0–28	0–5
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–28	0–5
	sandwort	ARENA	*Arenaria*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–28	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
8	**Annual Forbs**			0–28	
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	common dandelion	TAOF	*Taraxacum officinale*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
Shrub/Vine					
9	**Miscellaneous Shrubs**			56–168	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	56–112	5–15
	black sagebrush	ARNO4	*Artemisia nova*	0–56	5–10
	prairie sagewort	ARFR4	*Artemisia frigida*	0–28	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–28	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	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

Table 19. 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**			28–84	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	28–56	5–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–28	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
2	**Rhizomatous Cool-season Bunchgrasses**			28–56	
	western wheatgrass	PASM	*Pascopyrum smithii*	28–56	5–10
	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**			11–56	
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	11–28	2–5
4	**Tillering Cool-season Grass-likes**			0–28	
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
5	**Miscellaneous Grasses/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
	Grass, annual	2GA	*Grass, annual*	0–28	0–5
Forb					
6	**Perennial Forbs**			0–28	
	common yarrow	ACMI2	*Achillea millefolium*	0–28	0–5
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–28	0–5
	sandwort	ARENA	*Arenaria*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–28	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
7	**Annual Forbs**			0–28	
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–28	0–5
	common dandelion	TAOF	*Taraxacum officinale*	0–28	0–5
	pepperweed	LEPID	*Lepidium*	0–28	0–5
	mustard	BRASS2	*Brassica*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
Shrub/Vine					

Shrub/Vine					
8	**Miscellaneous Shrubs**			112–224	
	black sagebrush	ARNO4	*Artemisia nova*	0–112	0–20
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	56–112	0–20
	prairie sagewort	ARFR4	*Artemisia frigida*	11–56	0–10
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–28	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–28	0–5
	skunkbush sumac	RHTR	*Rhus trilobata*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 20. Community 3.1 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	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–28	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	11–28	2–5
2	**Rhizomatous Cool-season Grasses**			0–28	
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–28	0–5
	western wheatgrass	PASM	*Pascopyrum smithii*	0–28	0–5
3	**Short-stature Cool-season Bunchgrasses**			11–56	
	Sandberg bluegrass	POSE	*Poa secunda*	11–28	2–5
	muttongrass	POFE	*Poa fendleriana*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
4	**Tillering Cool-season Grass-likes**			56–112	
	threadleaf sedge	CAFI	*Carex filifolia*	56–112	20–50
5	**Miscellaneous Grasses/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
	Grass, annual	2GA	*Grass, annual*	0–28	0–5
Forb					
6	**Perennial Forbs**			0–28	
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	common yarrow	ACMI2	*Achillea millefolium*	0–28	0–5
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–28	0–5
	spiny phlox	PHHO	*Phlox hoodii*	0–28	0–5
	sandwort	ARENA	*Arenaria*	0–28	0–5

	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
7	**Annual Forbs**			0–28	
	woolly plantain	PLPA2	*Plantago patagonica*	0–28	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	common dandelion	TAOF	*Taraxacum officinale*	0–28	0–5
	pepperweed	LEPID	*Lepidium*	0–28	0–5
	mustard	BRASS2	*Brassica*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
Shrub/Vine					
8	**Miscellaneous Shrubs**			0–56	
	prairie sagewort	ARFR4	*Artemisia frigida*	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
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	0–5
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Animal community

Wildlife Interpretations
Bluebunch Wheatgrass/Needleandthread (Reference): 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.

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

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

Sod-former Plant Community: These communities provide limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover and if the Historic Climax Plant Community or the Perennial Grass/ Mixed Shrub Plant Community is limiting. Generally, these are not target plant communities for wildlife habitat management.

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/Needleandthread 325- 500-700 0 .14 7.3
Perennial Grass/Mixed Shrub 200- 400- 600 0.11 9.1
Mixed Shrub/*Bare Ground* 100- 300-375 0.08 12.2
Sod-former 100-175- 250 .05 20.9

* - Continuous, season-long grazing by cattle under average growing conditions.

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.

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 Shallow 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.)

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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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Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to nonexistent. Some very minor rill development may occur on steeper slopes or on areas located below exposed bedrock or other water shedding areas where increased runoff may occur. Any rills present should be <1 inch deep, fairly short (<8 feet long) and somewhat widely spaced (6-8 feet). Minor rill development may be observed following major thunderstorm or spring runoff events but should heal during the next growing season.

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2. **Presence of water flow patterns:** Barely observable. Some very minor evidence of water flow patterns may be found around perennial plant bases. They show little evidence of current erosion. They are expected to be somewhat short (4-8 feet), stable, sinuous and not connected. There may be very minor evidence of deposition. Evidence of water flow may increase somewhat with slope.

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3. **Number and height of erosional pedestals or terracettes:** Rare to nonexistent. Perennial vegetation shows little evidence of erosional pedestalling (2 to 3% of individual plants). Plant roots are covered and litter remains in place around plant crowns. Terracettes should be absent or, if present, stable. A slight increase in both pedestal and terracette development may occur with increasing slope.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 0-30%. Bare ground spaces should not be greater than 3 to 4 feet in diameter.

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5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present. A few gullies may be present in landscape settings where they transport runoff from areas of greater water flow such as exposed bedrock. These gullies will be limited to slopes exceeding 20% slope and adjacent to sites where this runoff accumulation occurs. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent. Wind caused blowouts and deposition are not present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water movement. Minor litter removal may occur in flow channels with deposition occurring within 1 to 2 feet at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes >20% and/or increased runoff resulting from heavy thunderstorms.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 2 (interspaces) to 6 (under plant canopy), but average values should be 3.5 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Currently no soil series are correlated to this ecological site. Soil Organic Matter of less than 3% is expected.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 45-75% grasses, 10% forbs, and 15-45% 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.

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-size, cool season bunchgrasses (3 species)

    Sub-dominant: perennial shrubs

    Other: Community 1.1 = Perennial bunchgrasses > Rhizomatous Cool-Season Grasses > Perennial Forbs = Shrubs
    12b. F/S Groups not expected for the site: Annual Grass
    12c. Number of F/S Groups: 4 groups
    12d. Species number in Dominate and Sub-dominate F/S Groups: 6 species

    Additional: Following a disturbance such as fire, drought, rodents or insects that remove woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community for a period of time. If a disturbance has not occurred for an extended period of time, woody species may continue to increase. These conditions would reflect a functional community phase within the reference state.

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. Slight decadence in the principle shrubs could occur near the end of the fire cycle or during periods of extended drought, or insect infestations. In general, a mix of age classes should be expected with some dead and decadent plants present.

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 15-20% of total canopy measurement with total litter (including beneath the plant canopy) from 50-80% expected. Herbaceous litter depth typically ranges from 3-10mm. Woody litter can be up to a couple inches (4-6 cm).

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 325-700 lb/ac (500 lb/ac average); Metric 364- 784 kg/ha (560 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 75% is the most common indicator of a threshold being crossed. Rabbitbrush, big sagebrush, blue grama, Sandberg bluegrass, buckwheat, and phlox are common increasers. Annual weeds such as kochia, mustards, lambsquarter, and Russian thistle are common invasive species in disturbed sites.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years, except in extreme drought years. Green rabbitbrush sprouts vigorously following fire. There are no restrictions on either seed or vegetative reproduction. Some seedling recruitment of major species is present during average and above average growing years.
