USDA Natural Resources Conservation Service

# Ecological site R046XH122WY
# Loamy Wyoming Front

Last updated: 9/05/2018
Accessed: 05/19/2024

## General information

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


**Figure 1. Mapped extent**

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

## MLRA notes

Major Land Resource Area (MLRA): 046X–Northern and Central Rocky Mountain Foothills

46X-Northern Rocky Mountain Foothills
For further information regarding MLRAs, refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

## LRU notes

Land Resource Unit (LRU) 46X-H:
• Moisture Regime: typic ustic
• Temperature Regime: cryic
• Dominant Cover: rangeland
• Representative Value (RV) Effective Precipitation: 15-19 inches
• RV Frost-Free Days: 15-45 days

## Classification relationships

Site Name: Loamy Wyoming Front
Site Type: Rangeland

Site ID: R046XH122WY
Precipitation or Climate Zone: 15-19” P.Z
National Vegetation Classification System (NVC):
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 Steppe & Shrubland Macrogroup
G304 Intermountain Mountain Big Sagebrush Steppe & Shrubland Group
A3208 Mountain Big Sagebrush – Mixed Steppe & Shrubland Alliance
CEGL001036 *Artemisia tridentata* ssp. vaseyana – Symphoricarpos oreophilus/*Festuca idahoensis* Shrubland Association
CEGL001038 *Artemisia tridentata* ssp. vaseyana – Symphoricarpos oreophilus/*Pseudoroegneria spicata* Shrubland Association

Ecoregions (EPA):
Level I: 6 Northwestern Forested Mountains
Level II: 6.2 Western Cordillera
Level III: 6.2.10 Middle Rockies

## Ecological site concept

• Site does not receive any additional water.
• Soils are:
o not saline or saline-sodic.
o moderately deep, deep, with < 3% stone (10-25”) and boulder (>25”) cover.
o not skeletal within 20” of soil surface.
o not violently effervescent in the top 15” of mineral soil.
o textures usually range from very fine sandy loam to clay loam in surface mineral 6”
• Slope is < 30%.
• Clay content is ≤ 32% in surface mineral 6”.
• Site does not have an argillic horizon with > 35% clay.

## Associated sites

| | |
|---|---|
| R043BY204WY | **Clayey Foothills and Mountains West**<br>Clayey sites have heavier clay loam surface (>35% clay) |
| R043BY230WY | **Overflow Foothills and Mountains West**<br>Overflow sites are located in drainage landscape positions and receive additional water from runoff or temporary higher water tables |
| R043BY262WY | **Shallow Loamy Foothills and Mountains West**<br>Shallow Loamy sites are often skeletal with lower available water holding capacity and on steeper slopes |

## Similar sites

| | |
|---|---|
| DX034A02X122 | **Loamy Pinedale Plateau (Ly PP)**<br>has lower production and lacks Idaho fescue, spike fescue, mountain brome, and Columbia needlegrass |
| R043BY222WY | **Loamy Foothills and Mountains West**<br>R043BY222WY is an older site concept that includes a larger geographic range than the Wyoming Front LRU. Loamy sites in this LRU were once correlated to this site. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | (1) *Artemisia tridentata ssp. vaseyana* |
| Herbaceous | (1) *Achnatherum nelsonii*<br>(2) *Festuca idahoensis* |

## Physiographic features

The Loamy Wyoming Front (Ly) ecological site (R046XH122WY) is located within LRU “H” in MLRA “46.” This ecological site occurs in foothill landscapes on hillslopes, landslides, ridges and eroded fan remnant landforms (see definitions below). The slope ranges from level to 15%. This site occurs on all aspects.
eroded fan remnant –All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an erosional fan remnant (FFP). It consists primarily of a) eroded and highly dissected sides (eroded fan-remnant sideslopes) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan “summit” area best described as a tread.
hillslope –A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill. Compare – mountain slope

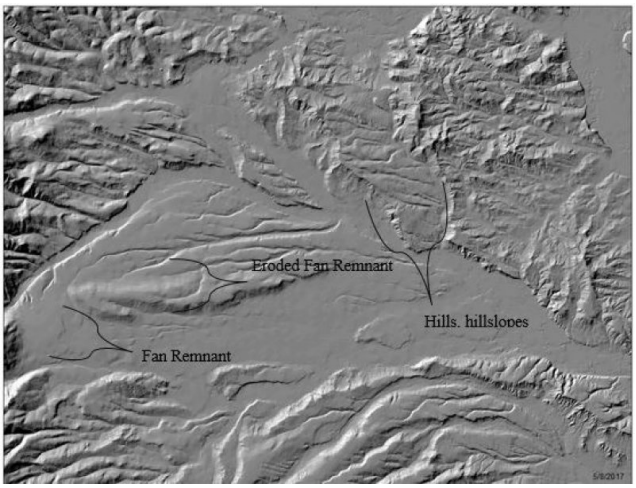



**Figure 2.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Foothills > Hillslope<br>(2) Ridge<br>(3) Eroded fan remnant |
| Elevation | 2,134–2,682 m |
| Slope | 0–30% |
| Aspect | Aspect is not a significant factor |

## Climatic features

Annual precipitation ranges from 15-19 inches per year. 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. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. Prevailing winds are from the southwest, and strong winds are less frequent than over other areas of Wyoming. Occasional storms, however, can bring brief periods of high winds with gusts exceeding 50 mph. Growth of native cool season plants begins about May 15 and continues to about August 15.

The following information is from the “Merna” climate station:

Minimum Maximum 5 yrs. out of 10 between

Frost-free period (days): 11 59 July 5 – August 15
Freeze-free period (days): 43 94 June 15 – August 24

Annual Precipitation (inches): <9.15 >20.17 (2 years in 10)

Average annual precipitation: 15.21 inches

Average annual air temperature: 34.2□F (20.3□F Avg. Min. to 48.2□F Avg. Max.)

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | |
| Freeze-free period (average) | |
| Precipitation total (average) | 381 mm |

## Influencing water features

None

## Soil features

The soils of this site are deep to moderately deep (greater than 20" to bedrock), and well-drained. Textures range from loams to very fine sandy loam on the coarse end to light clay loam (<30% clay content) on the heavy end. The most common textures include loam, silt loam, and sandy clay loam. A highly common scenario is to have a 1 to 3” cap of sandy loam over a sandy clay loam due to young soil development of weathered sandstone and shale parent materials.

Major Soil Series correlated to this site includes: Millerlake, Beaveridge, and Beavmid series.

Typical taxonomy: fine-loamy, mixed, superactive, Ustic Argicryolls

Other Soil Series correlated to this site in MLRA 34A include: Onionspring, Leavitt, and Philipsburg series.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Alluvium–sedimentary rock<br>(2) Slope alluvium–sandstone and shale |
| Surface texture | (1) Gravelly fine sandy loam<br>(2) Loam<br>(3) Sandy clay loam |
| Drainage class | Moderately well drained to well drained |
| Permeability class | Moderately rapid to rapid |
| Soil depth | 51–152 cm |
| Surface fragment cover <=3" | 0–20% |
| Surface fragment cover >3" | 0–3% |
| Available water capacity (19.7-28.6cm) | Not specified |
| Calcium carbonate equivalent (0-38.1cm) | Not specified |
| Electrical conductivity (0-12.7cm) | Not specified |
| Sodium adsorption ratio (0-12.7cm) | Not specified |
| Soil reaction (1:1 water) (15.5-19.8cm) | Not specified |

## Ecological dynamics

This ecological site is dominated (species composition by dry weight) by big sagebrush and perennial grasses with forbs as a minor component. The site consists of four states: the Reference State (1), Grazing Resistant State (2), Dense Sagebrush State (3), Invaded State (4), and Highly Disturbed State (5). The Reference State is a collection of 2 distinct Plant Communities that exist on a continuum relative to disturbances, primarily grazing, pests, drought, and fire with no disturbance causing successional changes as well over time. These Plant Communities represent the best adapted plant communities to the soils and climate found on the site, and they represent the best estimatior of ecological dynamics present on this site at the time of European settlement.

The Reference Plant Community (sagebrush/bunchgrass) of this site is dominated by non-sprouting shrubs, mainly mountain big sagebrush (*Artemisia tridentata* ssp. vaseyana) and mid-sized cool-season perennial bunchgrass species, primarily Idaho fescue (*Festuca idahoensis*) spike fescue (*Leucopoa kingii*) Letterman's needlegrass (*Achnatherum lettermanii*) Indian Ricegrass (*Achnatherum hymenoides*) Columbia needlegrass(*Achnatherum nelsonii*), and to a lesser extent bluebunch wheatgrass ( *Pseudoroegneria spicata*), mountain brome (*Bromus marginatus*), mutton bluegrass ( *Poa fendleriana*). Rhizomatous grasses like western wheatgrass ( *Pascopyrum smithii*) and thickspike wheatgrass (*Elymus lanceolatus* ssp. lanceolatus) are a minor grass component. Subdominant functional groups include short-statured bunchgrasses such as Sandberg bluegrass (*Poa secunda*), perennial forbs, and sprouting shrubs. Annual forbs are a very minor functional group on this site.

After a sagebrush killing disturbance, the Plant Community transitions to the Bunchgrass/Sagebrush Plant Community which is dominated by the mid-stature bunchgrasses mentioned above. Sagebrush is a minor component of this Plant Community, and only time without a sagebrush killing disturbance will advance this to the Sagebrush/Bunchgrass Plant Community.

Mid-stature bunchgrasses act as decreaser species in the Reference Community. Low stature bunchgrasses and rhizomatous grasses tolerate higher grazing pressure and grow on less fertile soils (USDA/NRCS 2007) than mid stature bunchgrasses. They often fill in the vegetation gaps created when mid stature bunchgrasses decline, hence they are collectively referred to as increaser species.

Big sagebrush is the dominant shrub on this site. Mountain big sagebrush is the sub-species present. Snow catchment is a significant hydrologic component of this site, and the hydrology changes when shrubs are removed from this site.

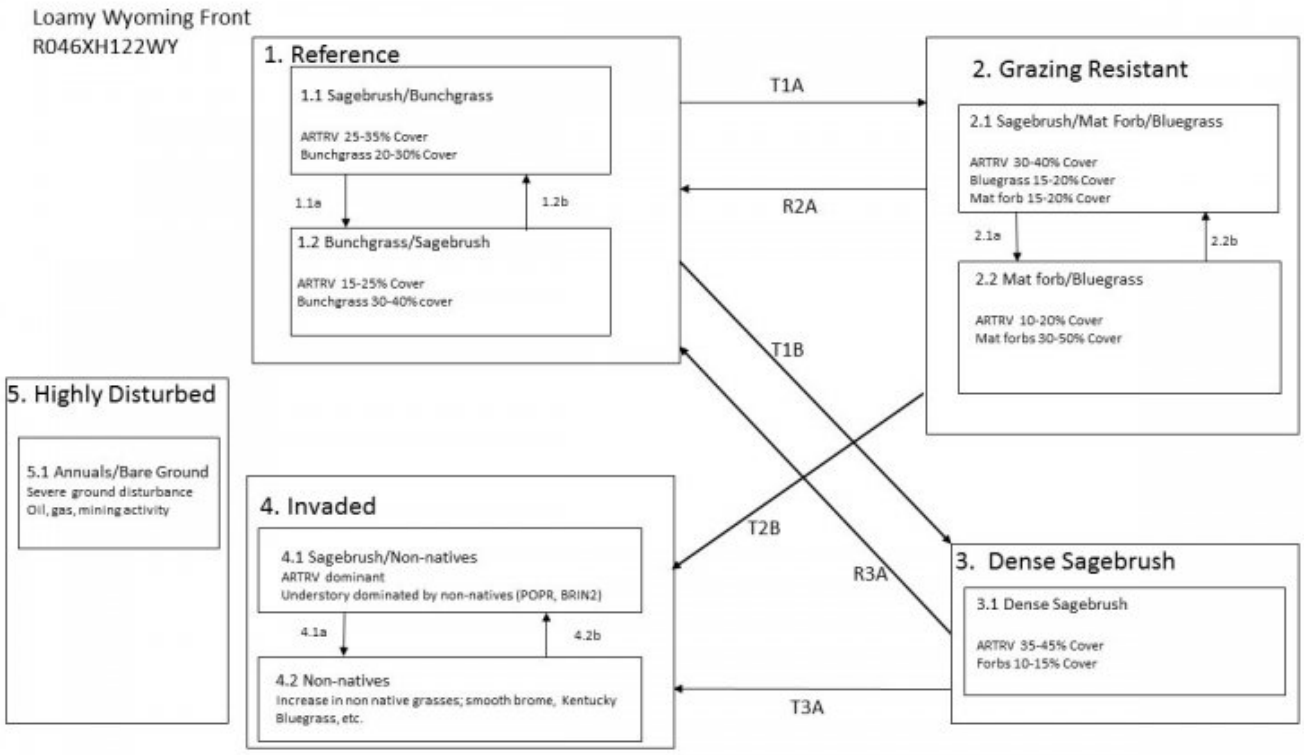
Prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk, mule deer, and pronghorn grazed this ecological site, primarily as transitional range (early spring, late fall). Significant livestock grazing has occurred on most of this ecological site for more than 100 years. The Trans-Continental Railroad in the 1860s brought the first livestock herds, and homesteaders began settling the area during the turn of the century.

Without ground disturbing activities, this site is relatively free of invasive weeds, but once mechanically or physically disturbed it is prone to weed invasion, primarily by annuals such as blue mustard (*Chorispora tenella*), flixweed (*Descurainia sophia*), and other annual mustards. The most common noxious species affecting this site after soil disturbance are Canada thistle (*Cirsium arvense*) and musk thistle (*Carduus nutans*). Soil disturbance can be caused by vehicles, equipment, severe over-utilization of the herbaceous vegetation, or large amounts of bare ground created by extended drought conditions combined with over-utilization.
The most prevalent noxious weed in Sublette County is Canada thistle (*Cirsium arvense*). It can be found in all plant community types but is mostly associated with riparian areas and disturbances. Developments and disturbance of the soil usually will result in a new infestation of Canada thistle. Canada thistle is from Eurasia, it was introduced via Canada as a seed contaminate in the 18th Century. It is prevalent though out the United States as seeds are transported via wind and its aggressive rhizomatous root system sustains very dense patches.
A noxious mustard of concern is whitetop or hoary cress (*Cardaria draba*). This species is also found in all habitat types within the Green River Basin and associated foothills. It is found in irrigated hay meadows, roadsides, rangelands, but most significantly invades rangelands or fields that have had a disturbance event. This disturbance can be from over utilization of forage or native plant thinning due to drought. This deep-rooted perennial mustard completes its life cycle in early summer. There are several varieties of *Cardaria draba* in the area, which are difficult

to distinguish but all seem to have the same effect, they but bloom at different times of the summer.
Another species of concern is the invasive annual cheatgrass (*Bromus tectorum*). There is a limited population that has invaded disturbances in oil and gas production fields and the south and west facing slopes of the foothills.
Emerging noxious weed concerns on this site include: bull thistle (*Cirsium vulgare*), houndstongue (*Cynoglossum officinale*), black henbane (*Hyoscyamus niger*), leafy spurge (*Euphorbia esula*), Russian and spotted knapweed (*Acroptilon repens* and *Centaurea stoebe*), yellow and Dalmation toadflax (*Linaria vulgaris* and *L. dalmatica*), and Dyer's woad (*Isatis tinctoria*l).
Emerging invasive species concerns on this site include: field brome (*Bromus arvensis*), and bulbous bluegrass (*Poa bulbosa*).

Plant Communities and Transitional Pathways
Thorough descriptions of each state, transition, plant community, and pathway are found after the State and Transition Model (STM) diagram in this document. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. While based on the best available information, the STM will change over time as knowledge of ecological processes increases.
Plant communities within the same ecological site differ across the LRU due to the naturally occurring variability in weather, soils, and aspect. Not all managers will choose the reference plant community as the management goal. Other plant communities may be desired to meet land management objectives. This is valid as long as the Rangeland Health attributes assessment departures are slight to moderate or none to slight for the Reference State. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.
Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent cover for woody species (trees and shrubs). Foliar cover drives the transitions between communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight remains an important descriptor of the herbaceous community and of site productivity as a whole. Woody species are included in species composition by weight for the site. Calculating similarity index requires use of species composition by dry weight.
Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), quantitative information is lacking that specifically identifies threshold parameters between reference states and degraded states in this ecological site. For information on STMs, see the following citations: (Bestelmeyer, et al., 2003), (Bestelmeyer, Herrick, Brown, Trujillo, & Havstad, 2004), (Bestelmeyer & Brown, State-and-transition models 101: a fresh look at vegetation change, 2005), (Stringham, Kreuger, & Shaver, 2003).

## State and transition model




- **Community Pathways**
- 1.1a: Sagebrush killing event (fire, chemical, mechanical, biological)
- 1.2b: Natural Succession
- 2.1a: Sagebrush killing event (fire, chemical, mechanical, biological)
- 2.2b: Natural Succession
- 4.1a: Sagebrush killing event (fire, chemical, mechanical, biological)
- 4.2b: Natural Succession

- **State Transitions**
- T1A: Continuous early season grazing (moderate to high stocking)
- T1B: No Disturbance (lack of fire or other sagebrush killing event, low grazing use)
- T2B: Introduction of invasive species
- T3A: Catastrophic (very hot) fire event (natural or prescribed) with introduction of invasive species
- **State Restorations**
- R2A: Sagebrush killing event (chemical, mechanical, biological), possibly seeding, and time in combination with proper grazing management
- R3A: Sagebrush killing event (chemical, mechanical, biological) in combination with proper grazing management

## State 1
## Reference State

The Reference State consists of two Plant Communities: the Sagebrush/Bunchgrass Community (1.1) the Bunchgrass/Sagebrush Plant Community (1.2). Each community differs in percent composition of bunchgrasses and percent woody canopy cover. Forbs are a minor component on this site. Woody canopy cover is less than 30 percent. In the Wyoming Front LRU, the Loamy site has the highest productivity potential of all upland sites because of high available water holding capacity and low amount of coarse fragments. With high amounts of winter snow, these soils retain soil moisture longer than other sites during seasonal dry periods in the late summer months. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. These

plants have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. The dominant shrub species is Mountain Big Sagebrush in the Reference State (1). Two important processes occurring in this state result in plant community changes within Reference State: sagebrush killing disturbances (fire, browse, insects, and drought) and periods of time without those disturbances. The process of plant community change over time in the absence of disturbance is generally referred to as “natural succession.” Historically, periodic wildfire played the role in removing sagebrush, resulting in an increase in herbaceous vegetation (Wright, 1982). More recently mechanical and chemical treatments have been used as they do not pose a threat of fire escape (Mueggler, 1958). Positive responses in increasing perennial grass production have been shown as a result of mowing dense mountain big sagebrush, although these responses were in the second growing season after treatment (Davies, Bates, & Nafus, 2012). The shift from Bunchgrass/Sagebrush Plant Community (1.2) to the Sagebrush/Bunchgrass Plant Community (1.1) is dependent on an increase of woody cover. Without sagebrush killing disturbance, shrubs will increase on this ecological site even with proper grazing management. Improper grazing management may accelerate the rate of increase for woody species and/or result in higher shrub canopy cover than in the Reference State. The shift from the Sagebrush/Bunchgrass or Bunchgrass/Sagebrush Plant Communities is dependent on sagebrush killing disturbances such as fire, drought, herbivory, disease and insect outbreaks. Management actions can and are often used to mimic these processes through mechanical and chemical treatments. The Reference State is well adapted to the Northern Rocky Mountain Foothills climatic conditions. The diversity in plant species allows for drought tolerance, and plant mortality is low. These plants have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention and is properly distributed with very little movement off-site. This State provides for soil stability and a properly functioning hydrologic cycle. The soils associated with this site hold moderately large amounts of soil moisture, providing a very favorable soil-water-plant relationship. Plant community phases can occur in large contiguous blocks or in a small to large mosaic pattern, but typically this plant community is maintained within a larger mosaic at the landscape level with the other plant communities phases identified in the Reference State (Bukowski & Baker, 2013). Mechanical and chemical treatment of shrubs have replaced natural sagebrush killing events in many cases. However, some chemical treatments impact nontarget species, particularly broad-leafed species (forbs and shrubs) differently than natural processes. Chemical treatment of sagebrush with tebuthiuron can have impacts the understory, depending on application rate (Wyoming Wildlife Consultants, LLC, 2009). Many historical treatments with continuous grazing both pre- and post-treatment have resulted in a transition to the Disturbed State. Good historical records of the pre-treatment State are not available, but it is presumed that they were already in the Grazing Resistance State, and thus this result may not apply to treatments planned on communities in the Reference State.

### Community 1.1
### Sagebrush/Bunchgrass

This community can occur over time without disturbance (i.e. “natural succession”), or it can be accelerated with moderate herbaceous grazing pressure. Mountain big sagebrush is dominant with sagebrush foliar cover ranging from 15% to 35%. At this level of sagebrush cover in this precipitation zone, there is competition between the shrub over-story and the herbaceous understory (Winward, 2007). A Sagebrush/Bunchgrass Community with a degraded understory is an “at-risk” community, particularly when occurring homogeneously across the landscape. There are generally few canopy gaps, and most basal gaps are small (1-2 feet). Rock cover on the soil surface is low. Many plant interspaces have canopy or litter cover. Production of grasses is lower than in the Bunchgrass/Sagebrush

Community (1.2).

**Table 5. Annual production by plant type**

| Plant Type | Low (Kg/Hectare) | Representative Value (Kg/Hectare) | High (Kg/Hectare) |
|---|---|---|---|
| Shrub/Vine | 673 | 1009 | 1233 |
| Grass/Grasslike | 471 | 706 | 863 |
| Forb | 202 | 303 | 370 |
| **Total** | **1346** | **2018** | **2466** |

**Table 6. Ground cover**

| | |
|---|---|
| Tree foliar cover | 0% |
| Shrub/vine/liana foliar cover | 0% |
| Grass/grasslike foliar cover | 0% |
| Forb foliar cover | 0% |
| Non-vascular plants | 0% |
| Biological crusts | 0% |
| Litter | 60-90% |
| Surface fragments >0.25" and <=3" | 0% |
| Surface fragments >3" | 0% |
| Bedrock | 0% |
| Water | 0% |
| Bare ground | 0-5% |

**Figure 4. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 10 | 35 | 30 | 20 | 5 | | | |

## Community 1.2
## Bunchgrass/Sagebrush

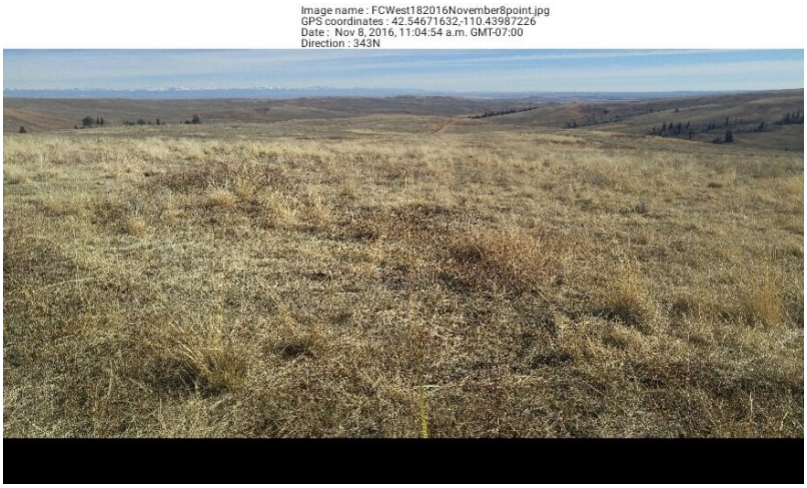



**Figure 5. 4 years post fire**

This community can occur after a sagebrush thinning event, such as fire, drought, insects, or disease, or it can take longer to occur after a stand replacing event. Mid-stature bunchgrasses dominate with Mountain big sagebrush, with sagebrush cover ranging from 0% to 15% depending on the amount of time post-disturbance. At this

sagebrush canopy level in this precipitation zone, there is little if any competition between the shrub overstory and the herbaceous understory. In fact, there is evidence to suggest that the understory receives more benefit from the sage over-story than negative effects. (Winward, 2007) There are generally few canopy gaps, and most basal gaps are in the 1-2 foot and 2-3 foot categories. Rock cover on the soil surface is low. Many plant interspaces have canopy or litter cover. Bare ground may temporarily exceed 5%, but will return to <5% within 3 years post-disturbance

**Table 7. Annual production by plant type**

| Plant Type | Low (Kg/Hectare) | Representative Value (Kg/Hectare) | High (Kg/Hectare) |
|---|---|---|---|
| Grass/Grasslike | 807 | 1211 | 1480 |
| Shrub/Vine | 336 | 504 | 616 |
| Forb | 202 | 303 | 370 |
| **Total** | **1345** | **2018** | **2466** |

**Table 8. Ground cover**

| | |
|---|---|
| Tree foliar cover | 0% |
| Shrub/vine/liana foliar cover | 0% |
| Grass/grasslike foliar cover | 0% |
| Forb foliar cover | 0% |
| Non-vascular plants | 0% |
| Biological crusts | 0% |
| Litter | 60-90% |
| Surface fragments >0.25" and <=3" | 0% |
| Surface fragments >3" | 0% |
| Bedrock | 0% |
| Water | 0% |
| Bare ground | 0-10% |

**Figure 7. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 10 | 35 | 30 | 20 | 5 | | | |

## State 2
## Grazing Resistant State

The Grazing Resistant State is characterized by an herbaceous component dominated by rhizomatous wheatgrasses, Sandberg bluegrass and/or mat-forming forbs, with limited mid-stature bunchgrasses. Once mid-stature bunchgrasses become scarce, it is unlikely there will be sufficient reproductive capability (seed source, tillering, or re-sprouting) to recover dominance in a reasonable time frame without extra energy being added to the system (Cagney, et al., 2010). The plant community is highly resistant to changes in composition, due to the dominance and competition of grazing tolerant species. However, the community can be restored back to the Reference State (1) with sagebrush treatment (chemical, mechanical, or biological brush management) and grazing deferment followed by a grazing system that allows periodic rest during the critical growth period. Seeding maybe needed in some instances to achieve desired results.

### Community 2.1
### Sagebrush/Mat Forb/Bluegrass

Mountain big sagebrush dominates with cover as high as 40%. Areas that catch and retain snow are more likely to have higher shrub cover. Mid-stature bunchgrasses have declined with an increase in shrub cover, mat forming forbs such as sulphur-flower buckwheat, have also increased to a co-dominance. Sandberg bluegrass replaces the mid-stature bunchgrasses with increased herbivory. Productivity is highly variable and fluctuates drastically in response to drought and wet cycles. Production is less than in the Reference State (1), and plant species composition is quite different leading to lower soil organic matter content from low litter producing forbs and therefore lower soil stability than in the Reference State. Ground cover is still high, but infiltration is lower than in the Reference State and the hydrologic function is impaired due to decreased soil organic matter.

### Community 2.2
### Mat Forb/Bluegrass

Mat forbs and bluegrasses dominate, and mountain big sagebrush foliar cover is typically 5% to 15%. This plant community phase occurs if there is a sagebrush killing event after the herbaceous component has already been degraded. Further exposing the soil surface to erosional forces as well as impairing carbon, nutrient, and water cycles. Productivity is highly variable and fluctuates drastically in response to drought and wet cycles. Production is lower than in the Reference State (1), leading to lower soil organic matter content and therefore lower soil stability than in the Reference State. Hydrologic function is impaired due to decreased soil organic matter.

## State 3
## Dense Sagebrush State

The Dense Sagebrush State can occur over time with lack of the normal disturbance regime. Mountain big sagebrush is dominant with sagebrush foliar cover >35%. At this level of sagebrush cover in this precipitation zone, there is competition between the shrub over-story and the herbaceous understory (Winward, 2007). The herbaceous understory is largely intact, but forage production for livestock is severely limited in this state. Furthermore, stands with sagebrush this dense are often avoided and hard to walk through. Impacts are often seen to adjacent ecological sites when grazing pressure increases due to avoidance of this site when in this state. This state is “at-risk” for catastrophic fire and transition to the Invaded State (State 4), particularly when occurring

homogeneously across the landscape.

### Community 3.1
### Dense Sagebrush

Mountain big sagebrush dominates with cover >35%. Mid-stature bunchgrass production has significantly declined with an increase in shrub cover, but species diversity is relatively intact. Productivity is less than the Reference State (1) and largely composed of sagebrush. Ground cover is still high, but infiltration is lower than in the Reference State and the hydrologic function is impaired due to high sagebrush canopy.

## State 4
## Invaded State

The Invaded State occurs after the introduction of non-native species that are invasive and dominate the herbaceous understory. Mountain big sagebrush can be either dominant or not, depending on the disturbance regime. There are two plant communities, the Sagebrush/Non-native Plant Community (4.1) or the Non-native Plant Community (4.2). Common non-native species introduced to this site include smooth brome or Kentucky bluegrass. In the early 1900s, it was common for livestock herders to carry bags of Kentucky bluegrass seed on their saddles and “dribble” seed across the landscape in hopes of improving forage conditions (anectdotal). Some areas that were once farmed during homestead days were planted to smooth brome as a forage grass and then abandoned, with sagebrush eventually returning to the site. In some instances, the disturbance regime was altered with an increase in disturbances, resulting in sprouting shrubs such as rabbitbush or three-tip sagebrush, to dominate.

### Community 4.1
### Sagebrush/Non-Native

This community phase results from natural succession and a lack of the normal disturbance regime. Mountain big sagebrush dominates with cover >25% and may be co-dominant with rabbitbrush or three-tip sagebrush. The understory is dominated by non-natives. Kentucky bluegrass is effective at using much of the surface moisture available on the site and out-competing many of the natives. Production is less and much more variable in dry vs. wet cycles than in the Reference State (1) because of moisture dependent non-natives. Diversity is lacking, and habitat values are compromised. Ground cover is still high, but infiltration is lower than in the Reference State and the hydrologic function is impaired due to high sage canopy and dominance of functional groups that are either not expected or that should be minor in the plant community

### Community 4.2
### Non-Native

This community phase results from disturbance, often an increase in the normal disturbance regime. Non-natives, noxious weeds, and/or invading native sprouting shrubs such as rabbitbrush or three-tip sagebrush dominate. Production is less and much more variable in dry vs. wet cycles than in the Reference State (1) because of moisture dependent non-natives. Diversity is lacking, and habitat values are compromised. Ground cover is still high, but infiltration is lower than in the Reference State and the hydrologic function is impaired lack of sagebrush

and dominance of functional groups that are either not expected or that should be minor in the plant community. The ability to hold snow over winter is reduced and site is drier.

### State 5
### Highly Disturbed State

All sites may transition to this state following a severe soil disturbance such as oil and gas development or surface mining extraction.

### Community 5.1
### Annuals/Bare Ground

The Annuals/*Bare Ground* Community (5.1) occurs after severe disturbance, most often physical soil disturbance that removes all topsoil. Populations of annuals bare ground reach critical levels and impact the ecological processes on the site until restoration of the site occurs. As part of succession, all sites that are severely disturbed go through this plant community as part of the restoration process, but the time in this plant community phase is largely dependent on the use of restoration Best Management Practices (BPMs) and climate cycles. Due to lack of perennial vegetation, the soil surface is susceptible to erosional forces, impairing carbon, nutrient, and water cycles.

### Transition T1A
### State 1 to 2

The drivers for transition from the Reference State to the Grazing Resistant State are continuous spring grazing with or without severe drought. Continuous spring grazing and extended drought can lead to a decline in palatable mid-stature bunchgrasses. Slender wheatgrass, Idaho fescue, bluebunch wheatgrass, Columbia needlegrass, and Spike fescue will decline with grazing pressure and lack of disturbances that kill sagebrush. Letterman's needlegrass can be an increaser when other mid-stature bunchgrasses have been removed by overgrazing (Natural Resouces Conservation Service, 2007). As bunchgrasses diminish or die during periods of stress, low-stature bunchgrasses and rhizomatous grasses gain a competitive advantage, creating a shift in species composition towards less productive, shorter species. While bare ground may not change significantly, the pattern of bare ground will shift to larger gaps in the canopy and fewer herbaceous plants between shrubs. Many of the remaining desirable bunchgrasses will be only found in the understory of the sagebrush canopy. Once mid-stature bunchgrass species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or re-sprouting) to recover dominance in a reasonable time frame without management changes and extra energy being added to the system (Cagney, et al., 2010). When the understory vegetation has been degraded to this point, the transition to the Grazing Resistant State (2) can occur from either the Bunchgrass/Sagebrush Plant Community (1.2) or the Sagebrush/Bunchgrass Plant Community (1.1). The transition is not dependent on the increase of shrub cover, but rather the lack of mid-stature bunchgrasses in the canopy interspaces. Management should focus on grazing management strategies that will prevent further degradation. This can be achieved through a grazing management scheme that varies the season of use to provide periodic deferment during the critical growth period (roughly May-June). Forage quantity and/or quality in the Grazing Resistant State (2) may be substantially reduced compared to the Reference State, and will dramatically fluctuate in dry vs. wet years.

### Transition T1B
### State 1 to 3

The drivers for transition from the Reference State to the Dense Sagebrush State is a lack of sagebrush killing disturbances (mainly fire). Indicators of this transition include significant increase in sagebrush cover leading to a decline in herbaceous cover or total annual aboveground biomass production falls. The trigger of this transition is total sagebrush cover of >35% and a decline in the understory. Increased shrub cover in this LRU can lead to an increase in fire activity, which can be catastrophic, triggering a transition to the Invaded State (4). Several other key factors signal the approach of a threshold: a decrease in soil surface aggregate stability, and/or evidence of erosion, including water flow patterns, development of pedestals, and litter movement

### Restoration pathway R2A
### State 2 to 1

The drivers for this restoration pathway are reduction of woody species and restoration of native herbaceous species by mechanical or chemical treatment of sagebrush, and grazing rest or deferment. If some mid- stature bunchgrasses remain under the sage canopy, light to moderate stocking with periodic critical growth period rest every 2 or 3 years can move the site back to the Reference State (1) combined with a mechanical or chemical sagebrush treatment. Most probable restoration pathway is from Sagebrush/Mat forb/Bluegrass Community (2.1) to the Bunchgrass/Sagebrush Community (1.2). This could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment. (Derner, Schuman, Follett, & Vance, 2014). Seeding may be needed to achieve desired results, if seedbank has been depleted.

### Transition T2B
### State 2 to 4

The driver for transition from the Grazing Resistant State to the Invaded State (T2B) is the introduction of non-native species and an increase in the disturbance cycle (i.e. fire, drought, mechanical, chemical, biological treatments). Most notable is a catastrophic (very hot) fire event and continuous high intensity grazing. High stocking densities are soil disturbing, and adding sagebrush treatment(s) to this regime result in an increase in the disturbance cycle. Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the upper soil horizon, and the site can degrade to the Invaded State (4). Consequences of this transition are decreased soil fertility, soil erosion, and decrease of soil surface aggregate stability. Indicators of the Invaded state are a shift in shrub dominance away from sagebrush and toward non-native (invading) species such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*), and/or sprouting shrubs such as rabbitbrush or three-tip sagebrush.

### Transition T2C
### State 2 to 5

The driver for transition from the Grazing Resistant to the Highly Disturbed State (T2C) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

### Restoration pathway R3A
### State 3 to 1

The drivers for this restoration pathway to the Reference State (1) are reduction of woody species by prescribed fire, mechanical, or chemical treatment of sagebrush, and grazing rest or deferment. Post-treatment grazing management is an important part of site restoration, and 1-2 years of grazing deferment will allow release of the existing herbaceous understory. Periodic rest or deferment are important to maintain productivity, health, and vigor of the plant community and will prevent acceleration of the site from the Reference State (1) to the Grazing Resistant State (2). Allowing the normal disturbance regime (fire cycle) to occur will prevent the site from returning to the Dense Sagebrush State (3)

### Transition T3A
### State 3 to 4

The driver for transition from the Dense Sagebrush State (3) to the Invaded State (4) is most often catastrophic fire and the introduction of non-native species. Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the upper soil horizon, and the site can degrade to the Invaded State (4). Consequences of this transition are decreased soil fertility, soil erosion, and decrease of soil surface aggregate stability. Indicators of the Invaded state are a shift in shrub dominance away from sagebrush and toward non-native (invading) species such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*), and/or sprouting shrubs such as rabbitbrush or three-tip sagebrush.

### Transition T3B
### State 3 to 5

The driver for transition from the Dense Sagebrush State (3) to the Highly Disturbed State (5)) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

### Transition T4A
### State 4 to 5

The driver for transition from the Invaded State (4) to the Highly Disturbed State (5)) is a topsoil removing event with mechanical equipment. Examples include construction sites, oil and gas activity, and borrow areas.

### Restoration pathway R5B
### State 5 to 2

The Highly Disturbed State (5) is can be restored to the Grazing Resistant State (2) unintentionally when inappropriate seed mixes are used and post-seeding grazing does not provide adequate and periodic critical growth period rest. There is low potential for recovery without significant inputs of energy and resources if topsoil has been removed. Seed mixes that mimic an adjacent “reference area” rather than the site potential as described in the Reference State (1) will often result in a plant community resembling the Grazing Resistant State (2) due to pre and post-seeding grazing management of the area.

### Restoration pathway R5D
### State 5 to 4

The Highly Disturbed State (5) is often restored to the Invaded State (4) if non-native species are used, noxious weeds are not controlled, and/or disturbed areas result in only partial topsoil removal, leaving rootstock available for sprouting shrubs such as rabbitbrush or three-tip sagebrush.

## Additional community tables

**Table 9. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Perennial Mid-size Cool Season Grasses** | | | 101–404 | |
| | Idaho fescue | FEID | *Festuca idahoensis* | 20–404 | 1–20 |
| | Columbia needlegrass | ACNE9 | *Achnatherum nelsonii* | 20–303 | 1–15 |
| | bluebunch wheatgrass | PSSP6 | *Pseudoroegneria spicata* | 20–303 | 1–15 |
| | slender wheatgrass | ELTRT | *Elymus trachycaulus ssp. trachycaulus* | 20–303 | 1–15 |
| | mountain brome | BRMA4 | *Bromus marginatus* | 0–202 | 0–10 |
| | spike fescue | LEKI2 | *Leucopoa kingii* | 20–202 | 1–10 |
| | Sandberg bluegrass | POSE | *Poa secunda* | 20–202 | 1–10 |
| 2 | **Rhizomatous Grasses** | | | 0–101 | |
| | thickspike wheatgrass | ELLAL | *Elymus lanceolatus ssp. lanceolatus* | 20–101 | 1–5 |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 101 | 5 |
| 3 | **Misc Grasses/Grasslikes** | | | 101–202 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–101 | 0–5 |
| | Letterman's needlegrass | ACLE9 | *Achnatherum lettermanii* | 20–101 | 1–5 |
| | sleepygrass | ACRO7 | *Achnatherum robustum* | 0–101 | 0–5 |
| | Porter brome | BRPO2 | *Bromus porteri* | 0–101 | 0–5 |
| | needleleaf sedge | CADU6 | *Carex duriuscula* | 0–101 | 0–5 |
| | threadleaf sedge | CAFI | *Carex filifolia* | 0–101 | 0–5 |
| | sedge | CAREX | *Carex* | 0–101 | 0–5 |
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|---|---|---|---|---|---|
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–101 | 0–5 |
| | needle and thread | HECO26 | *Hesperostipa comata* | 0–101 | 0–5 |
| | blue wildrye | ELGL | *Elymus glaucus* | 0–101 | 0–5 |
| | basin wildrye | LECI4 | *Leymus cinereus* | 0–101 | 0–5 |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 0–101 | 0–5 |
| | oniongrass | MEBU | *Melica bulbosa* | 0–101 | 0–5 |
| | Sandberg bluegrass | POSE | *Poa secunda* | 0–101 | 0–5 |
| | muttongrass | POFE | *Poa fendleriana* | 0–101 | 0–5 |
| | Sandberg bluegrass | POSE | *Poa secunda* | 0–101 | 0–5 |
| | mountain muhly | MUMO | *Muhlenbergia montana* | 0–20 | 0–1 |
| | mountain rush | JUARL | *Juncus arcticus ssp. littoralis* | 0–20 | 0–1 |
| **Forb** | | | | | |
| 4 | **Perennial Forbs** | | | 101–262 | |
| | arrowleaf balsamroot | BASA3 | *Balsamorhiza sagittata* | 0–101 | 0–5 |
| | larkspur | DELPH | *Delphinium* | 0–101 | 0–5 |
| | elkweed | FRSP | *Frasera speciosa* | 0–101 | 0–5 |
| | sticky purple geranium | GEVI2 | *Geranium viscosissimum* | 0–101 | 0–5 |
| | oneflower helianthella | HEUN | *Helianthella uniflora* | 0–101 | 0–5 |
| | sulphur-flower buckwheat | ERUM | *Eriogonum umbellatum* | 20–101 | 1–5 |
| | western stoneseed | LIRU4 | *Lithospermum ruderale* | 0–101 | 0–5 |
| | lupine | LUPIN | *Lupinus* | 20–101 | 1–5 |
| | hoary tansyaster | MACA2 | *Machaeranthera canescens* | 20–101 | 1–5 |
| | locoweed | OXYTR | *Oxytropis* | 0–101 | 0–5 |
| | ragwort | PACKE | *Packera* | 0–101 | 0–5 |
| | cinquefoil | POTEN | *Potentilla* | 20–101 | 1–5 |
| | aster | SYMPH4 | *Symphyotrichum* | 0–101 | 0–5 |
| | western meadow-rue | THOC | *Thalictrum occidentale* | 0–61 | 0–3 |
| | sagebrush buttercup | RAGL | *Ranunculus glaberrimus* | 0–61 | 0–3 |
| | goldenrod | SOLID | *Solidago* | 0–61 | 0–3 |
| | Munro's globemallow | SPMU2 | *Sphaeralcea munroana* | 0–61 | 0–3 |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–61 | 0–3 |
| | longleaf phlox | PHLO2 | *Phlox longifolia* | 0–61 | 0–3 |
| | flowery phlox | PHMU3 | *Phlox multiflora* | 0–61 | 0–3 |
| | beardtongue | PENST | *Penstemon* | 0–61 | 0–3 |
| | bluebells | MERTE | *Mertensia* | 0–61 | 0–3 |
| | aster | EUCEP2 | *Eucephalus* | 0–61 | 0–3 |
| | strawberry | FRAGA | *Fragaria* | 0–61 | 0–3 |
| | milkvetch | ASTRA | *Astragalus* | 20–61 | 1–3 |
| | Lewis flax | LILE3 | *Linum lewisii* | 0–61 | 0–3 |
| | hairy false goldenaster | HEVI4 | *Heterotheca villosa* | 0–61 | 0–3 |
| | scarlet gilia | IPAG | *Ipomopsis aggregata* | 0–61 | 0–3 |
| | old man's whiskers | GETR | *Geum triflorum* | 0–61 | 0–3 |
| | fleabane | ERIGE2 | *Erigeron* | 0–61 | 0–3 |
| | buckwheat | ERIOG | *Eriogonum* | 20–61 | 1–3 |

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|---|---|---|---|---|---|
| | pussytoes | ANTEN | *Antennaria* | 20–61 | 1–3 |
| | elk thistle | CIFO | *Cirsium foliosum* | 0–61 | 0–3 |
| | pale bastard toadflax | COUMP | *Comandra umbellata ssp. pallida* | 0–61 | 0–3 |
| | western yarrow | ACMIO | *Achillea millefolium var. occidentalis* | 20–61 | 1–3 |
| | stemless mock goldenweed | STAC | *Stenotus acaulis* | 0–61 | 0–3 |
| | nettleleaf giant hyssop | AGUR | *Agastache urticifolia* | 0–20 | 0–1 |
| | pale agoseris | AGGL | *Agoseris glauca* | 0–20 | 0–1 |
| | onion | ALLIU | *Allium* | 0–20 | 0–1 |
| | rockcress | ARABI2 | *Arabis* | 0–20 | 0–1 |
| | sandwort | ARENA | *Arenaria* | 0–20 | 0–1 |
| | sego lily | CANU3 | *Calochortus nuttallii* | 0–20 | 0–1 |
| | bluebell bellflower | CARO2 | *Campanula rotundifolia* | 0–20 | 0–1 |
| | Indian paintbrush | CASTI2 | *Castilleja* | 0–20 | 0–1 |
| | draba | DRABA | *Draba* | 0–20 | 0–1 |
| | stickseed | HACKE | *Hackelia* | 0–20 | 0–1 |
| | bitter root | LERE7 | *Lewisia rediviva* | 0–20 | 0–1 |
| | phacelia | PHACE | *Phacelia* | 0–20 | 0–1 |
| | knotweed | POLYG4 | *Polygonum* | 0–20 | 0–1 |
| | longstalk starwort | STLO2 | *Stellaria longipes* | 0–20 | 0–1 |
| | spearleaf stonecrop | SELA | *Sedum lanceolatum* | 0–20 | 0–1 |
| | clover | TRIFO | *Trifolium* | 0–20 | 0–1 |
| | vetch | VICIA | *Vicia* | 0–20 | 0–1 |
| | deathcamas | ZIGAD | *Zigadenus* | 0–20 | 0–1 |
| 5 | **Annual Forbs** | | | 0–20 | |
| | pygmyflower rockjasmine | ANSE4 | *Androsace septentrionalis* | 0–20 | 0–1 |
| | tiny trumpet | COLI2 | *Collomia linearis* | 0–20 | 0–1 |
| | bushy bird's beak | CORA5 | *Cordylanthus ramosus* | 0–20 | 0–1 |
| | sanddune cryptantha | CRFE3 | *Cryptantha fendleri* | 0–20 | 0–1 |
| | groundsmoke | GAYOP | *Gayophytum* | 0–20 | 0–1 |
| | broomrape | OROBA | *Orobanche* | 0–20 | 0–1 |
| | yellow owl's-clover | ORLU2 | *Orthocarpus luteus* | 0–20 | 0–1 |
| **Shrub/Vine** | | | | | |
| 6 | **Shrubs** | | | 202–706 | |
| | mountain big sagebrush | ARTRV | *Artemisia tridentata ssp. vaseyana* | 202–706 | 10–35 |
| 7 | **Misc Shrubs** | | | 101–303 | |
| | Woods' rose | ROWO | *Rosa woodsii* | 0–101 | 0–5 |
| | western snowberry | SYOC | *Symphoricarpos occidentalis* | 20–101 | 1–5 |
| | mountain snowberry | SYOR2 | *Symphoricarpos oreophilus* | 0–101 | 0–5 |
| | yellow rabbitbrush | CHVI8 | *Chrysothamnus viscidiflorus* | 20–101 | 1–5 |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–101 | 0–5 |
| | black sagebrush | ARNO4 | *Artemisia nova* | 0–101 | 0–5 |
| | chokecherry | PRVI | *Prunus virginiana* | 0–101 | 0–5 |
| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | | | | | |
|---|---|---|---|---|---|
| | antelope bitterbrush | PUTR2 | *Purshia tridentata* | 0–101 | 0–5 |
| | prostrate pigweed | AMAL | *Amaranthus albus* | 0–101 | 0–5 |
| | little sagebrush | ARARL | *Artemisia arbuscula ssp. longiloba* | 0–61 | 0–3 |
| | silver sagebrush | ARCAV2 | *Artemisia cana ssp. viscidula* | 0–61 | 0–3 |
| | currant | RIBES | *Ribes* | 0–61 | 0–3 |
| | threetip sagebrush | ARTRT2 | *Artemisia tripartita ssp. tripartita* | 0–61 | 0–3 |
| | alderleaf mountain mahogany | CEMO2 | *Cercocarpus montanus* | 0–61 | 0–3 |
| | slender buckwheat | ERMIL2 | *Eriogonum microthecum var. laxiflorum* | 0–61 | 0–3 |
| | spineless horsebrush | TECA2 | *Tetradymia canescens* | 0–61 | 0–3 |
| | granite prickly phlox | LIPU11 | *Linanthus pungens* | 0–20 | 0–1 |
| | creeping barberry | MARE11 | *Mahonia repens* | 0–20 | 0–1 |

**Table 10. Community 1.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Perennial Mid-size Cool Season Grasses** | | | 404–807 | |
| | Idaho fescue | FEID | *Festuca idahoensis* | 20–404 | 1–20 |
| | Columbia needlegrass | ACNE9 | *Achnatherum nelsonii* | 20–303 | 1–15 |
| | slender wheatgrass | ELTRT | *Elymus trachycaulus ssp. trachycaulus* | 20–303 | 1–15 |
| | mountain brome | BRMA4 | *Bromus marginatus* | 0–202 | 0–10 |
| | spike fescue | LEKI2 | *Leucopoa kingii* | 20–202 | 1–10 |
| 2 | **Rhizomatous Grasses** | | | 0–101 | |
| | thickspike wheatgrass | ELLAL | *Elymus lanceolatus ssp. lanceolatus* | 20–101 | 1–5 |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 101 | 5 |
| 3 | **Misc Grasses/Grasslikes** | | | 101–303 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–101 | 0–5 |
| | Letterman's needlegrass | ACLE9 | *Achnatherum lettermanii* | 20–101 | 1–5 |
| | sleepygrass | ACRO7 | *Achnatherum robustum* | 0–101 | 0–5 |
| | Porter brome | BRPO2 | *Bromus porteri* | 0–101 | 0–5 |
| | needleleaf sedge | CADU6 | *Carex duriuscula* | 0–101 | 0–5 |
| | threadleaf sedge | CAFI | *Carex filifolia* | 0–101 | 0–5 |
| | sedge | CAREX | *Carex* | 0–101 | 0–5 |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–101 | 0–5 |
| | needle and thread | HECO26 | *Hesperostipa comata* | 0–101 | 0–5 |
| | blue wildrye | ELGL | *Elymus glaucus* | 0–101 | 0–5 |
| | basin wildrye | LECI4 | *Leymus cinereus* | 0–101 | 0–5 |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 0–101 | 0–5 |
| | oniongrass | MEBU | *Melica bulbosa* | 0–101 | 0–5 |
| | mountain muhly | MUMO | *Muhlenbergia montana* | 0–20 | 0–1 |
| | mountain rush | JUARL | *Juncus arcticus ssp. littoralis* | 0–20 | 0–1 |
| **Forb** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 4 | **Perennial Forbs** | | | 101–282 | |
| | arrowleaf balsamroot | BASA3 | *Balsamorhiza sagittata* | 0–101 | 0–5 |
| | larkspur | DELPH | *Delphinium* | 0–101 | 0–5 |
| | elkweed | FRSP | *Frasera speciosa* | 0–101 | 0–5 |
| | sticky purple geranium | GEVI2 | *Geranium viscosissimum* | 0–101 | 0–5 |
| | oneflower helianthella | HEUN | *Helianthella uniflora* | 0–101 | 0–5 |
| | sulphur-flower buckwheat | ERUM | *Eriogonum umbellatum* | 20–101 | 1–5 |
| | western stoneseed | LIRU4 | *Lithospermum ruderale* | 0–101 | 0–5 |
| | lupine | LUPIN | *Lupinus* | 20–101 | 1–5 |
| | hoary tansyaster | MACA2 | *Machaeranthera canescens* | 20–101 | 1–5 |
| | locoweed | OXYTR | *Oxytropis* | 0–101 | 0–5 |
| | ragwort | PACKE | *Packera* | 0–101 | 0–5 |
| | cinquefoil | POTEN | *Potentilla* | 20–101 | 1–5 |
| | aster | SYMPH4 | *Symphyotrichum* | 0–101 | 0–5 |
| | western meadow-rue | THOC | *Thalictrum occidentale* | 0–61 | 0–3 |
| | sagebrush buttercup | RAGL | *Ranunculus glaberrimus* | 0–61 | 0–3 |
| | goldenrod | SOLID | *Solidago* | 0–61 | 0–3 |
| | Munro's globemallow | SPMU2 | *Sphaeralcea munroana* | 0–61 | 0–3 |
| | beardtongue | PENST | *Penstemon* | 0–61 | 0–3 |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–61 | 0–3 |
| | longleaf phlox | PHLO2 | *Phlox longifolia* | 0–61 | 0–3 |
| | flowery phlox | PHMU3 | *Phlox multiflora* | 0–61 | 0–3 |
| | stemless mock goldenweed | STAC | *Stenotus acaulis* | 0–61 | 0–3 |
| | bluebells | MERTE | *Mertensia* | 0–61 | 0–3 |
| | aster | EUCEP2 | *Eucephalus* | 0–61 | 0–3 |
| | strawberry | FRAGA | *Fragaria* | 0–61 | 0–3 |
| | milkvetch | ASTRA | *Astragalus* | 20–61 | 1–3 |
| | Lewis flax | LILE3 | *Linum lewisii* | 0–61 | 0–3 |
| | hairy false goldenaster | HEVI4 | *Heterotheca villosa* | 0–61 | 0–3 |
| | scarlet gilia | IPAG | *Ipomopsis aggregata* | 0–61 | 0–3 |
| | old man's whiskers | GETR | *Geum triflorum* | 0–61 | 0–3 |
| | fleabane | ERIGE2 | *Erigeron* | 0–61 | 0–3 |
| | buckwheat | ERIOG | *Eriogonum* | 20–61 | 1–3 |
| | pussytoes | ANTEN | *Antennaria* | 0–61 | 1–3 |
| | elk thistle | CIFO | *Cirsium foliosum* | 0–61 | 0–3 |
| | pale bastard toadflax | COUMP | *Comandra umbellata ssp. pallida* | 0–61 | 0–3 |
| | western yarrow | ACMIO | *Achillea millefolium var. occidentalis* | 20–61 | 1–3 |
| | nettleleaf giant hyssop | AGUR | *Agastache urticifolia* | 0–20 | 0–1 |
| | pale agoseris | AGGL | *Agoseris glauca* | 0–20 | 0–1 |
| | onion | ALLIU | *Allium* | 0–20 | 0–1 |
| | sego lily | CANU3 | *Calochortus nuttallii* | 0–20 | 0–1 |
| | bluebell bellflower | CARO2 | *Campanula rotundifolia* | 0–20 | 0–1 |
| | Indian paintbrush | CASTI2 | *Castilleja* | 0–20 | 0–1 |

| | | | | | |
|---|---|---|---|---|---|
| | Indian paintbrush | CASTI2 | *Castilleja* | 0–20 | 0–1 |
| | rockcress | ARABI2 | *Arabis* | 0–20 | 0–1 |
| | sandwort | ARENA | *Arenaria* | 0–20 | 0–1 |
| | draba | DRABA | *Draba* | 0–20 | 0–1 |
| | stickseed | HACKE | *Hackelia* | 0–20 | 0–1 |
| | bitter root | LERE7 | *Lewisia rediviva* | 0–20 | 0–1 |
| | knotweed | POLYG4 | *Polygonum* | 0–20 | 0–1 |
| | phacelia | PHACE | *Phacelia* | 0–20 | 0–1 |
| | longstalk starwort | STLO2 | *Stellaria longipes* | 0–20 | 0–1 |
| | spearleaf stonecrop | SELA | *Sedum lanceolatum* | 0–20 | 0–1 |
| | clover | TRIFO | *Trifolium* | 0–20 | 0–1 |
| | vetch | VICIA | *Vicia* | 0–20 | 0–1 |
| | deathcamas | ZIGAD | *Zigadenus* | 0–20 | 0–1 |
| 5 | **Annual Forbs** | | | 0–20 | |
| | pygmyflower rockjasmine | ANSE4 | *Androsace septentrionalis* | 0–20 | 0–1 |
| | tiny trumpet | COLI2 | *Collomia linearis* | 0–20 | 0–1 |
| | bushy bird's beak | CORA5 | *Cordylanthus ramosus* | 0–20 | 0–1 |
| | sanddune cryptantha | CRFE3 | *Cryptantha fendleri* | 0–20 | 0–1 |
| | groundsmoke | GAYOP | *Gayophytum* | 0–20 | 0–1 |
| | broomrape | OROBA | *Orobanche* | 0–20 | 0–1 |
| | yellow owl's-clover | ORLU2 | *Orthocarpus luteus* | 0–20 | 0–1 |
| **Shrub/Vine** | | | | | |
| 6 | **Shrubs** | | | 101–202 | |
| | mountain big sagebrush | ARTRV | *Artemisia tridentata ssp. vaseyana* | 101–202 | 5–10 |
| 7 | **Misc Shrubs** | | | 101–303 | |
| | Saskatoon serviceberry | AMAL2 | *Amelanchier alnifolia* | 0–101 | 0–5 |
| | Woods' rose | ROWO | *Rosa woodsii* | 0–101 | 0–5 |
| | western snowberry | SYOC | *Symphoricarpos occidentalis* | 20–101 | 1–5 |
| | mountain snowberry | SYOR2 | *Symphoricarpos oreophilus* | 0–101 | 0–5 |
| | yellow rabbitbrush | CHVI8 | *Chrysothamnus viscidiflorus* | 20–101 | 1–5 |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–101 | 0–5 |
| | black sagebrush | ARNO4 | *Artemisia nova* | 0–101 | 0–5 |
| | chokecherry | PRVI | *Prunus virginiana* | 0–101 | 0–5 |
| | antelope bitterbrush | PUTR2 | *Purshia tridentata* | 0–101 | 0–5 |
| | currant | RIBES | *Ribes* | 0–61 | 0–3 |
| | threetip sagebrush | ARTRT2 | *Artemisia tripartita ssp. tripartita* | 0–61 | 0–3 |
| | alderleaf mountain mahogany | CEMO2 | *Cercocarpus montanus* | 0–61 | 0–3 |
| | slender buckwheat | ERMIL2 | *Eriogonum microthecum var. laxiflorum* | 0–61 | 0–3 |
| | spineless horsebrush | TECA2 | *Tetradymia canescens* | 0–61 | 0–3 |
| | little sagebrush | ARARL | *Artemisia arbuscula ssp. longiloba* | 0–61 | 0–3 |
| | silver sagebrush | ARCAV2 | *Artemisia cana ssp. viscidula* | 0–61 | 0–3 |
| | granite prickly phlox | LIPU11 | *Linanthus pungens* | 0–20 | 0–1 |
| | creeping barberry | MARE11 | *Mahonia repens* | 0–20 | 0–1 |

## Animal community

Animal Community
The following table lists suggested initial 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 be calculated using field 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, but recovery time for upland sites is much longer than in a low intensity system. If distribution problems occur, stocking rates must be reduced or facilitating conservation practices (i.e. cross-fencing, water development) used to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) Low-RV-High AUM/AC AC/AUM
Sagebrush/Bunchgrass 1200-1800-2200 0.25 4
Bunchgrass/Sagebrush 1200-1800-2200 0.32 3
Sagebrush/Mat forb/bluegrass 800-1200-1400 0.1 10
Mat forb/bluegrass 600-900-1200 0.15 7
Dense Sagebrush 1000-1400-2000 0.13 8
Non-natives/Sagebrush 800-1400-2000 0.28 4

* - Continuous, season-long grazing by cattle under average growing conditions.
**Calculation for these stocking rates are as follows: using RV values for production, take only forage palatable to cattle and multiply by 0.25 harvest efficiency and divide by 913 (pounds of air dried weight forage per Animal Unit Month based on intake rate of 2.6%) to arrive at carrying capacity

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, protein supplement is recommended because the quality does not meet minimum livestock requirements.
Distance to water, shrub density, and slope can affect grazing capacity within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than 1 mile from water; therefore the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates

Wildlife

Reference State:
1.1 Big Sagebrush/Bunchgrass: This community phase provides optimal transitional and summer habitat for sage-grouse, mule deer, pronghorn, and elk. A diverse suite of herbaceous species also provide important micro-nutrient requirements for big game species throughout the year. These areas also provide high quality bird nesting habitat where sagebrush canopy and residual bunchgrasses hide nests and young from predators. This very common community is used widely as migration and stopover habitat by big game. Spring green-up of grass is a critical nutritional component of this community for migrating big game.

1.2 Bunchgrass/WY Big Sagebrush: This community phase tends to have higher herbaceous plant diversity that may attract more diverse wildlife use. The plant community provides suitable forage and cover for sagebrush obligate species. The more open canopy promotes higher diversity and quantity of forbs that are important for early sage-grouse broodrearing habitat. It also provides high quality habitat for mule deer, elk and pronghorn as they transition between winter and summer ranges. This very common community is used widely as migration and stopover habitat by big game. Spring green-up of grass and forb diversity is a critical nutritional component of this

community for migrating big game. This community also provides suitable habitat for burrowing animals.

Grazing Resistant State:
2.1 Big Sagebrush/Mat Forb/Bluegrass: This community phase is variable in its value to wildlife. The value of the sagebrush community is similar to the reference state but the value of the grass community decreases. In periods of high plant vigor, the herbaceous understory provides cover for nesting birds and small mammals. In periods of drought and low plant vigor, the herbaceous understory is short and not dense enough to provide adequate cover and habitat value declines. Diversity is low, and mat-forming forbs often occupy the space and nutrients needed for more desirable forbs.

2.2 Mat Forb/Bluegrass: This community phase is variable in its value to wildlife. Value is low for species dependent on sagebrush unless in close proximity to areas with sagebrush cover. In periods of high plant vigor, herbaceous species provide cover for some birds and small mammals. In periods of drought and low plant vigor, the herbaceous community is often too short and not dense enough to provide adequate cover and habitat. Plant and animal diversity is low.

Dense Sagebrush State:
3.1 Dense Sagebrush: This community phase provides potential foraging habitat for big game and sagegrouse when the sagebrush plants are in a healthy condition. If the sagebrush is old and has poor leader production, it may not be providing forage for browsing animals either. The lack of herbaceous species limits the value of the site for birds and small mammals due to the lack of cover in the interspaces of the sagebrush plants. The lack of plant diversity limits the diversity of insects used by wildlife species.

Invaded State:
4.1 Non-natives: This community phase is highly variable in its value to wildlife. It typically is less diverse, has lower forage value and has limited structure that wildlife need for cover. This state is vulnerable to repeated disturbance which can result in a complete loss of value for wildlife. In addition, sites in this state are more susceptible to invasion of non-native species, further degrading the value for wildlife.

Highly Disturbed State:
5.2 Reclaimed: This community phase is highly variable in its value to wildlife. Reclamation success, size and configuration of the reclaimed area, the species planted, and the time it takes for plants to establish will determine the value of the site for wildlife. A fully reclaimed site containing a diversity of herbaceous and woody native plants can eventually provide the same wildlife habitat benefits as the reference state. In most cases, grasses and forbs establish early in the reclamation process, whereas shrubs take significantly longer to establish. Wildlife species dependent on herbaceous plant communities for forage (such as elk) will benefit from reclamation sooner than those species dependent on a mixed shrub/grass community. Suitable habitat for wildlife species that require tall, dense sagebrush (sage-grouse, pronghorn, mule deer, and sagebrush obligate songbirds) is likely possible within a decade, providing appropriate shrub species were planted. It is possible to achieve successful, diverse reclamation on linear disturbances (i.e. pipelines) without seeding shrubs, but it will take longer than a decade for seed from shrubs adjacent to the area to established on-site.

## Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B (infiltration rate of 0.15-0.3 in/hr), with localized areas in hydrologic groups A (infiltration rate of 0.3 in/hr) and C (infiltration rate of 0.05-0.15 in/hr). Permeability ranges from rapid to moderate. Runoff potential for this site varies from low to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information). Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Litter typically falls in place, and signs of movement are not common unless slopes >10%. Chemical and physical crusts are rare to non-existent.

## Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, bird watching, and upland game hunting. The forbs have a variety of colors and shapes that appeal to photographers. This site provides

valuable open space when located in large, un-fragmented landscapes.

## Wood products

None

## Other products

None

## Other information

Similarity Index is based on species composition by air-dry weight. Calculations of allowable pounds per acre for each species are based on the sum of the maximum end of the production range or actual production (whichever is less) in the plant table for the Desired Plant Community until the maximum allowable is reached for the plant grouping. The sum is then divided by the Representative Value (RV) of total annual production for the Desired Plant Community.

Plant Preference Table:
https://docs.google.com/viewera=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxtbHJhMzRhfGd4OjIyZWEyYzIyMGE5NWE4MzM

## Inventory data references

Inventory Data References (narrative):
Information presented was derived from 1988 Range Site Descriptions (Loamy Foothills and Mountains West – Ly 15-19W), NRCS clipping data, literature, field observations (based on sampled sites and observations), and personal contacts with range-trained personnel (i.e. agency specialists, landowners, land managers, and scientists).

Inventory Data References:
Data Source # of Records Sample Period State County
Field Data 12 (1.1 Reference) 1968-2018 WY Sublette
Field Data 11 (1.2 Reference) 1968-2018 WY Sublette
Field Data 13 (2.1 P.C.) 1978-2018 WY Sublette
Field Data 8 (2.2 P.C.) 1978-2018 WY Sublette
Field Data. 11 (3.1 P.C.) 1978-2018 WY Sublette
Field Obs. 2 (4.1 P.C.) 2004-2018 WY Sublette
Field Obs. 2 (4.2 P.C.) 2004-2018 WY Sublette

## Other references

Bestelmeyer, B., & Brown, J. (2005). State-and-transition models 101: a fresh look at vegetation change. The Ouivira Coalition Newsletter, Vol. 7, No. 3.
Bestelmeyer, B., Brown, J., Havstad, K., Alexander, B., Chavez, G., & Herrick, J. (2003). Development and use of state and transition models for rangeland. Journal of Range Management, 56(2): 114-126.
Bestelmeyer, B., Herrick, J., Brown, J., Trujillo, D., & Havstad, K. (2004). Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management, 34(1): 38-51.
Bukowski, B. E., & Baker, W. L. (2013). Hisotrical Fire Regimes, Reconstructed from Land-Survey Data, Led to Complexity and Fluctuation in Sagebrush Landscapes. Ecological Applications 23(3), 546-564.
Cagney, J., Bainter,, E., Budd, B., Christiansen, T., Herren, V., Holloran, M., . . . Williams, J. (2010, March). Grazing Influence, Objective Development, and Mangement in Wyoming's Greater Sage-Grouse Habitat. B-1203, 36. University of Wyoming.
Carney, J., Bainter, E., Budd, B., Christiansen, T., Herren, V., Holloran, M., . . . Williams, J. (2010). Grazing Influence, Objective Development, and Mangement in Wyoming's Greater Sage-Grouse Habitat. Unpublished, 36.
Chambers, J. C., Beck, J., Cambell, S., Carlson, J., Christiansen, T., Clause, K., . . . Pyke. (2016). Using Resilience and Resistance Concepts to Manage Threats to Sagebrush Ecosystems, Gunnison Sage-Grouse, and Greater Sage-Grouse in Their Eastern Range: A Strategic Multi-Scale Approach. Fort Collins, CO: USDA, Forest Service, Rocky Mountain Research Station: Gen. Tech. Rep. RMRS-GTR-356.

Clause, K., & Randall, J. (2014). Sage Die-Off Report. Pinedale, WY: unpublished.
Davies, K., Bates, J., & Nafus, A. (2012). Vegetation Response to Mowing Dense Mountain Big Sagebrush Stands. Rangeland Ecology and Management, 65: 268-276.
Derner, J. D., Schuman, G. E., Follett, R. F., & Vance, G. F. (2014). Plant and Soil Consequences of Shrub Management in a Big Sagebrush-Dominated Rangeland Ecosystem. Environment and Natural Resources Research, 19-30.
Mueggler, W. a. (1958). Effects on Associated Species of Burning, Rotobeating, Spraying and Railing Sagebrush. Journal of Range Management, 11: 61-66.
Natural Resouces Conservation Service. (2007). USDA Plants Database. Retrieved from http://plants.usda.gov/java/
Natural Resouces Conservation Service. (n.d.). USDA Plants Database. Retrieved from http://plants.usda.gov/java/
Natural Resources Conservation Service. (1997). Introduction to Microbiotic Crusts. USDA Soil Quality Institute, Grazing Lands Technology Institute.
Paolo Sioli. (1883). Historical Souvenir of El Dorado County, California: With Illustrations and Biographical Sketches of Its Prominent Men & Pioneers. Paolo Sioli, p. 118.
Rosentrater, R., & M. Bowker, a. J. (2007). A Field Guide to Biological Soil Crusts of Western U.S. Drylands. Denver, Colorado: U.S. Government Printing Office.
Sommers, J. (1994). Green River Drift- A History of the Upper Green River Cattle Association. ISBN: 1-56044-280-8.
Stiver, S., Rinkes, E., & Naugle, D. (2010). Sage-Grouse Habitat Assessment Framework. Unpublished, 100-106.
Stringham, T., Kreuger, W., & Shaver, P. (2003). State and transition modeling: an ecological process approach. Journal of Range Management, 56(2): 106-113.
Tanner, R. L. (2016, May 25). Leasing the Public Range: The Taylor Grazing Act and the BLM. Retrieved from WyoHistory.org: http://www.wyohistory.org/encyclopedia/leasing-public-range-taylor-grazing-act-and-blm
USDI, B. o. (2015). Allotment files. Rock Springs, WY: unpublished.
Winward, A. (2007). Boulder, Squaretop Area Field Notes. Unpublished.
Wright, H. A. (1982). Fire ecology: United States and southern Canada. New York, NY: John Wiley & Sons, Inc.
Wyoming Wildlife Consultants, LLC. (2009). Greater Sage-Grouse Focused Herbaceous Monitoring of Moxa Arch Sagebrush Vegetation Treatments. Kemmerer, WY: Bureau of Land Management.

## Approval

Scott Woodall, 9/05/2018

## 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) | K Clause, B Christensen |
| Contact for lead author | Karen Clause |
| Date | 09/05/2018 |
| Approved by | |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:** Rills not expected

2. **Presence of water flow patterns:** Not expected on this site. Some minor evidence of water movement may be found around perennial plant bases at upper end of the slope range (>10%), but they will be short (<3 ft), not common, and there will be no evidence of active erosion.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals and terracettes not expected

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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 <5% expected. Canopy gaps comprise up to <5% of the ground surface, and are primarily in the 1-2 ft category with 1% in the 2-3 foot. Canopy gaps >3 ft are not expected. Basal gaps up to 15% are expected (10% in 1-2 ft, 5% in 2-3 ft and 3-6 ft categories). Basal gaps >6 ft are not expected.

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5. **Number of gullies and erosion associated with gullies:** Gullies not expected.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scour, blowouts and/or depositional areas are not expected for this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter not expected to move due to wind, but may occasionally be found in small concentrations in water flow patterns on slopes >10%. Large woody debris from sagebrush will show no movement.

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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 are expected to be variable for plant canopy and interspaces. Values of >4 are expected under plant canopy, and values >3 are expected in the interspaces. Average values >4 are expected.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil organic matter (SOM) 2-4% is common in surface layer. Typically soil surface consists of an A-horizon of 4-8 inches (10-20 cm) thick with weak to strong fine and medium granular structure that is dark grayish brown (10YR 4/2), dark gray (10YR 4/1), or dark brown (10YR 3/3) in color (dry). Field indicators of departure from the reference condition include exposure of subsoil with moderate medium sub-angular blocky structure, and further supported by excessive pedestalling, terracettes, and/or surface disturbance.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 35-60% grasses, 15% forbs, and 25-50% shrubs (predominantly non-sprouting) composition by dry weight. Foliar cover (plant canopy) >80% and basal plant cover 5-10% is expected for this site.

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional: 1.1 non-sprouting shrubsmid-size, cool season bunchgrassessprouting shrubs=perennial forbscool season rhizomatous grasses=short cool season bunchgrassesannual forbs
    1.2 mid-size, cool season bunchgrassessprouting shrubsperennial forbscool season rhizomatous grasses=short cool season bunchgrasses=non-sprouting shrubsannual forbs

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

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14. **Average percent litter cover (%) and depth ( in):** Litter ranges from 5-15% of total canopy measurement with total litter (including beneath the plant canopy) from 60-90% expected. Herbaceous litter depth typically ranges from 3-10mm. Woody litter can be up to a couple inches (4-6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 1400-2200 lb/ac (1800 lb/ac average); Metric 1570-2465 kg/ha (2020 kg/ha average).

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Encroachment by native conifers can occur when the disturbance regime is altered to exclude fire. Weeds that can invade and become dominant include: Canada thistle, musk thistle, houndstongue, black henbane, leafy spurge, Russian and spotted knapweed, yellow and Dalmation toadflax, Dyer's woad, and hoary cress (whitetop). Annual weeds such as mustards are common in disturbed sites.
    Cheatgrass, an invasive annual grass, is not expected in undisturbed rangelands, but has been found in disturbed areas and on nearby sites on southerly aspects. Field brome and bulbous bluegrass are invasive grasses of concern that have been documented, but are not expected for the site. The ecological dynamics of this site are in imminent danger of being forever altered with the presence of these invasive grasses.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing, with rhizomatous wheatgrass reproducing from tillers as well as seed, except in drought years.

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