USDA Natural Resources
Conservation Service

Ecological site DX032X02B144
Saline Upland (SU) Wind River Basin Rim

Last updated: 9/17/2020
Accessed: 05/13/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

MLRA notes

Major Land Resource Area (MLRA): 032X–Northern Intermountain Desertic Basins

032X–Northern Intermountain Desertic Basins: This Major Land Resource Area (MLRA) is composed of two major basins, the Big Horn and the Wind River. These two basins are distinctly different and are split by Land Resource Units (LRUs) to allow individual ecological site descriptions (ESD). These warm basins are surrounded by uplifts and rimmed by mountains, creating a unique set of plant responses and communities. Unique characteristics of the geology and geomorphology further individualize these two basins.

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): 32X02B (WY): This LRU is the Wind River Basin within MLRA 32X. It tends to be just a fraction higher in elevation, slightly cooler (by 1 degree Celsius), and snowpack tends to persist longer into the spring than the Big Horn Basin (LRU 01). This LRU was originally divided into two LRUs: LRU C which was the core and LRU D which was the rim. With the most current standards, this LRU is divided into two subsets. This subset is the rim of the Wind River Basin and is comprised of eroded fan remnants and stream terraces. The Rim subset is driven by the relation to the mountains, creating minor shifts in climate and geology that affect the soil chemistry, influencing the variety of ecological sites and plant interactions.

The extent of soils currently correlated to the Saline Upland ecological site does not fit within the current subset or LRU boundary. Many of the map unit components are correlated to ecological sites outside of this MLRA, but will be reviewed and corrected during mapping update projects.

Moisture Regime: Ustic Aridic
Temperature Regime: Mesic
Dominant Cover: Rangeland, with sagebrush steppe intermixed with saltbush flats, is the dominant vegetative cover.
Representative Value (RV) Effective Precipitation: 9-12 inches (229–305 mm)
RV Frost-Free Days: 85-115 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 Macro group
G302 Artemisia Tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe Group
A3182 Artemisia tridentata ssp. wyomingensis Mesic Steppe & Shrubland Alliance
CEGL001051 - Artemisia tridentata ssp. wyomingensis/Hesperostipa comata 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.a Semi-arid Rolling Sagebrush Steppe (and)
10.1.18.g Big Horn Salt Desert Shrub Basin

Ecological site concept

• Site receives no additional water.
• slopes are less than 30 percent
• The soils are:
- saline, sodic, or saline-sodic, gypsic
- shallow, moderately deep, deep, or very deep (depth to restrictive layer is greater than 10 inches (25 cm).
- with less than 3 percent stone and boulder cover and less than 20 percent cobble and gravel cover
- not skeletal (less than 35 percent rock fragments) within 20 inches (51 cm) of mineral soil surface
- textures usually range from very fine sandy loam to clay loam
- clay content is less than 40 percent in mineral soil surface 4 inches.
- with an average particle size class of less than 60 percent clay

The site concept is based on soils that are well drained and formed in alluvium or residuum derived from alkaline or sodic sedimentary rock. Originally, Saline Upland spanned the full spectrum of textural classes (sandy through clayey), grouping them based on the chemical similarities. Closer review in the Big Horn Basin showed a shift in plant communities as this ecological site transitioned across the soil textural gradient. The Saline Upland ecological site for the Wind River Basin will be reviewed to determine if it should be divided into: Saline Upland, Loamy; Saline Upland, Sandy; and Saline Upland, Clayey as the Big Horn Basin was divided. There is a further necessity to evaluate the differences in saline/sodic soils that are influenced strongly by gypsum or calcium carbonate accumulations, lab samples should be collected and processed to document if it is warranted. Until such time, these communities will be documented within the original scope of the Saline Upland site.

Associated sites

DX032X02B122	**Loamy (Ly) Wind River Basin Rim** Loamy sites are found in intermingled pockets with Saline Upland sites. Interbedded shales and sandstone formations as well as alluvial deposits create a mosaic of Loamy and Saline Upland ecological sites.
R032XY340WY	**Saline Lowland Drained (SLDr) 10-14" East Precipitation Zone** Saline Lowland Drained have lost the recognizable water table and salt indicators in the soils but maintain the salt dominated vegetation, specifically greasewood and possibly remnants of alkali sacaton. They are found on relic stream terraces, along drainageways, or on alluvial fans. The soils transition into Saline Upland the further up on the landform, as they shift off of old floodplains and stream terraces.
R032XY304WY	**Clayey (Cy) 10-14" East Precipitation Zone** Clayey sites are found in pockets with interspersed deep soils where salts are not an influence on the plants. Many times Clayey and Saline Upland ecological sites will be found in bands or patchy complexes along toe slopes or fans forming below shale outcroppings.
R032XY354WY	**Shale (Sh) 10-14" East Precipitation Zone** Shale ecological sites are very shallow soils that occur on weathered shale. As the landform transitions lower on the landscape, Shale ecological sites will transition to deeper soils grouped into a Saline Upland ecological site.

Similar sites

DX032X02A144	**Saline Upland (SU) Wind River Basin Core** This is the Saline Upland site developed to fit the drier core of the Wind River Basin. Production is lower and plant species are varied from the Rim ecological site.
R032XY244WY	**Saline Upland (SU) 5-9” Wind River Basin Precipitation Zone** The Saline Upland 5-9" precipitation zone Wind River Basin ecological site is the legacy site that covered the lower band of the now Saline Upland Wind River Basin Rim ecological site. Production is lower and plants are less vigorous in this site.
R032XY344WY	**Saline Upland (SU) 10-14" East Precipitation Zone** The Saline Upland 10-14" precipitation zone Foothills and Basins East ecological site is the legacy site that covered the upper band of the now Saline Upland Wind River Basin Rim ecological site. Production is higher and plants are more robust in this site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex gardneri* (2) *Artemisia pedatifida*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Elymus elymoides*

Legacy ID

R032XD144WY

Physiographic features

These sites generally occur on slopes ranging from nearly level to 20 percent. Commonly, these soils occur where marine shale outcrop and interbedded sandstone and shale is the parent material. They may also occur on soils that formed in residuum or fan deposits along foothills and lower mountain ranges with lower precipitation. The interbedded and dissected geomorphic features within the Wind River Basin have a range of saline-driven communities. The dominant landform associated with this site is erosional remnants. Fan aprons (including alluvial fans and fan remnants) also are common landforms across this landscape. There are sites that occur on relict stream terraces just a step above incised drainage channels, and will be associated with Saline Lowland and Saline Lowland Drained ecological site.

Many of these landforms are erosional remnants and have soils ranging from shallow to very deep. The variability of soils across the landform is influenced by the geology and its inherent chemistry. This will create pockets of calcareous or saline or sodic soils as well as areas that are not influenced by chemistry. Transitioning across the landform positions, soils shift with the deposition of salt-laden materials. With these transitions, the break between one ecological site and another (and the representative plant community for each) is often a broad and nondescript band between the two sites. This can make it difficult, when on the landscape, to identify clearly which site is dominant for a specific point along that transitional gradient.

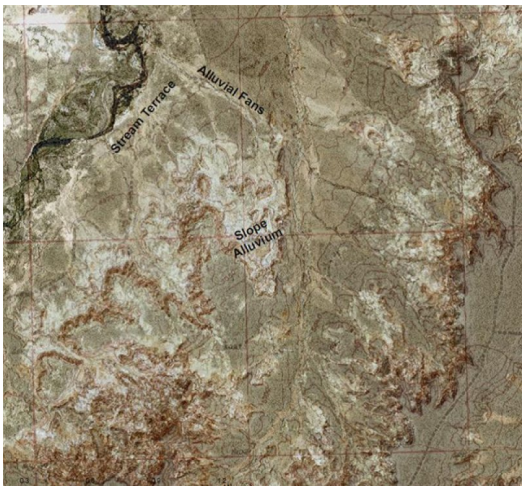


Figure 1. Landscape diagram illustrating common areas where the Saline Upland ecological site will occur.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Alluvial fan (2) Intermontane basin > Stream terrace (3) Intermontane basin > Erosion remnant
Runoff class	Medium to very high
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to rare
Elevation	1,448–1,981 m
Slope	0–30%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 9 to 12 inches (229–305 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 totals about 20 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Average 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 generally are 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 1st 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 30-year trend data for average temperature, as well as average precipitation, indicates there has been a warming trend. The last 12 years graphed, however, show temperatures have swayed high and low, but overall have maintained a steady trajectory, neither increasing nor decreasing. On the moisture side, the trajectory in trend has been a slow decline. The swings of when spring warm-up and first frost hit, combined with the decline in average precipitation, have produced a drought effect where the moisture is not being received when the plants and soils are able to utilize the moisture. 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 have 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/. Burris and Diversion Dam are the representative weather stations within LRU 02B. 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)	76-83 days
Freeze-free period (characteristic range)	107-118 days
Precipitation total (characteristic range)	229 mm
Frost-free period (actual range)	74-85 days
Freeze-free period (actual range)	105-120 days
Precipitation total (actual range)	229 mm
Frost-free period (average)	80 days
Freeze-free period (average)	113 days
Precipitation total (average)	229 mm

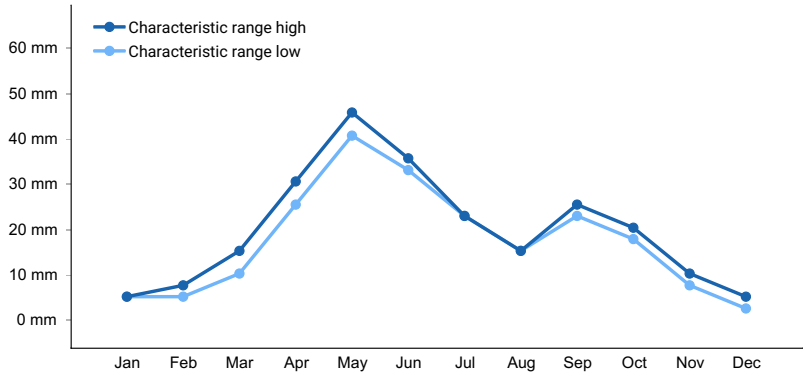


Figure 2. Monthly precipitation range

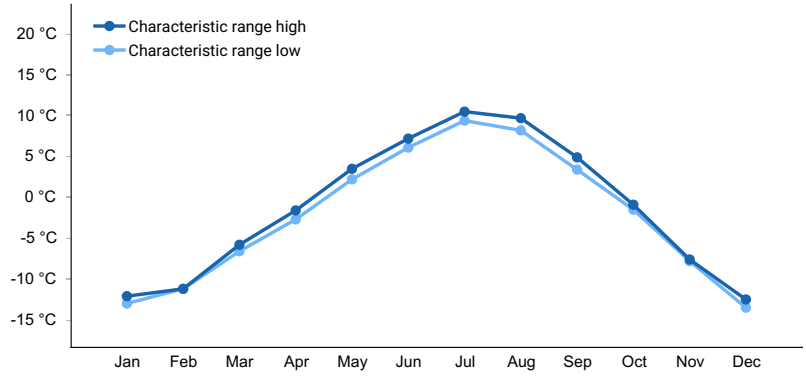


Figure 3. Monthly minimum temperature range

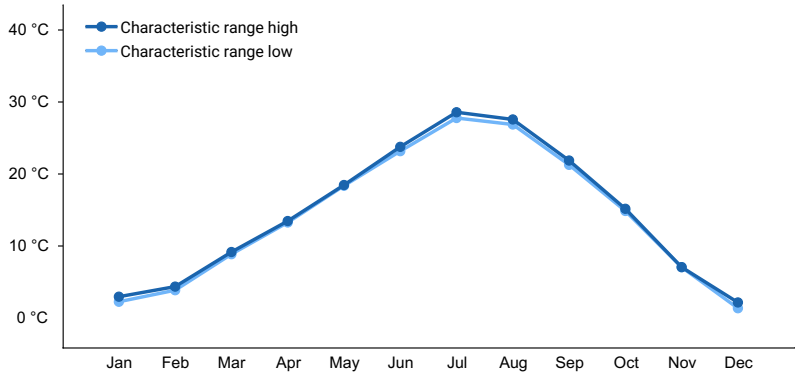


Figure 4. Monthly maximum temperature range

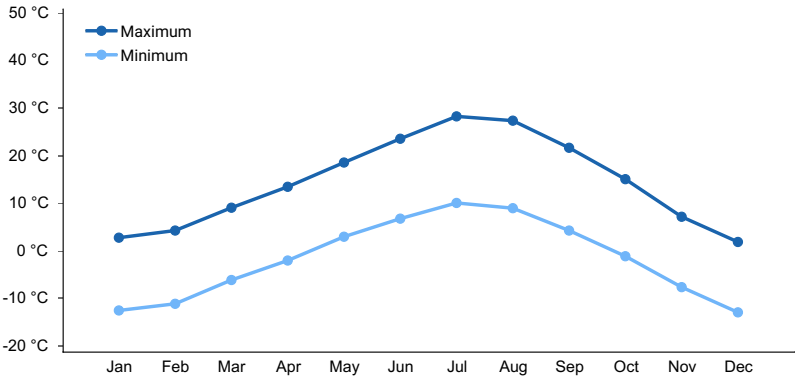


Figure 5. Monthly average minimum and maximum temperature

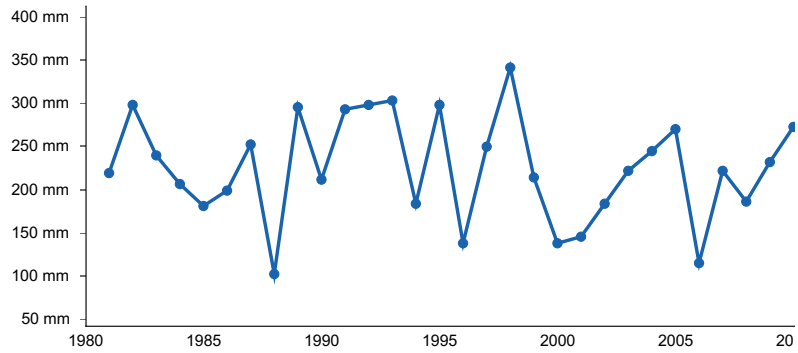


Figure 6. Annual precipitation pattern

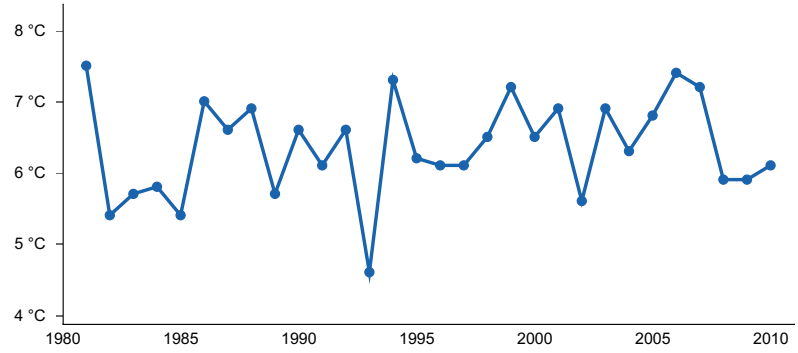


Figure 7. Annual average temperature pattern

Climate stations used

- (1) DIVERSION DAM [USC00482595], Kinnear, WY
- (2) BURRIS [USC00481284], Crowheart, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches or 150 cm) and have minimal influence from surface water and overland flow. There may be isolated features that are affected by snow pack that persists longer than surrounding areas due to position on the landform (shaded and protected pockets); but overflow is not a suitable fit. No streams are classified within this ecological site.

Wetland description

Although ponding may occur on these sites, the surface water does not persist for any duration of time to support a wetland designation.

Soil features

The soil characteristics of Saline Upland ecological sites are shallow to very deep (greater than 10” (25 cm) to bedrock), well drained with moderate to slow permeability. These soils are slightly to strongly saline, moderately to very strongly alkaline, and range from non-sodic to sodic. The mineral soil surface will vary from 2 to 6 inches (5-15 cm) in thickness. The most influential soil characteristics on the plant community are the high quantity of soluble salts and the limited available soil moisture. Soil moisture is influenced by the climatic pattern of this ecological site as well as the influence of salts on soil structure, decreasing water infiltration. Some soils may contain more soluble salts in the subsurface than in the surface.

Major soil series correlated to this site include Arvada, Kishona, Rairdent-like, Yamo, Elkol, Winnett-like, and Absher. Soil series are subject to change upon completion and correlation of the initial soil surveys. It is recognized that some of these series are classified as typic aridic (5-9" precipitation, Mesic); however, map units were mapped across zones that are both typic aridic and ustic aridic (10-14" precipitation, Mesic). As surveys are correlated, this will be corrected.

Figure 8. Saline Upland soil profile located in the Wind River Basin Rim subset.

Table 4. Representative soil features

Parent material	(1) Residuum–shale (2) Alluvium–sandstone
Surface texture	(1) Gravelly loam (2) Sandy clay loam (3) Fine sandy loam (4) Silty clay loam (5) Clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained

Permeability class	Slow to moderate
Soil depth	25–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.84–21.08 cm
Calcium carbonate equivalent (0-101.6cm)	0–14%
Electrical conductivity (0-101.6cm)	4–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	3–40
Soil reaction (1:1 water) (0-101.6cm)	7.9–9.6
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

Salt-tolerant plant species are dominant on this site; specifically, drought-tolerant low woody shrub species and mid-stature cool-season perennial grasses. The expected potential composition is 40 percent grasses, 10 percent forbs, and 50 percent shrubs (woody species). The composition and production will vary naturally due to fluctuations in timing and intensity of precipitation. Historic use has shifted the vigor and plant community; however, fire frequency is not a factor due to the lack of fine fuels necessary to sustain a fire.

As this site deteriorates, birdfoot sagebrush increases with a corresponding decrease in the cool-season grasses (Indian ricegrass, bottlebrush squirreltail, and rhizomatous wheatgrasses), in both frequency and production. Finally, weedy annuals will begin to invade, primarily cheatgrass and annual mustards.

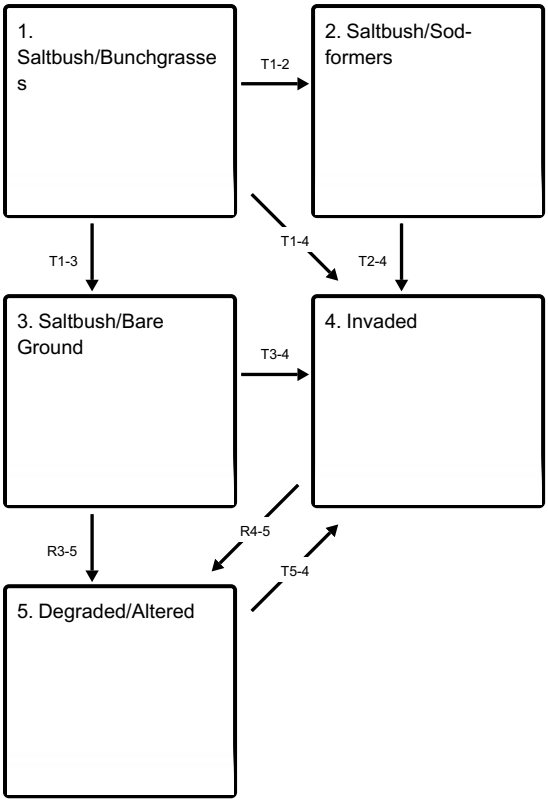
The Reference Community (description follows the State-and-Transition diagram) has been determined by study of rangeland relict areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily to lightly grazed areas, seasonal use pastures, and historical accounts 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 to 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 to State 1) or better illustrated by State 1, and are denoted in the legend as a "R" (R2-1).

State and transition model

Ecosystem states



T1-2 - Drought alone or in conjunction with frequent or severe grazing (continuous, season-long) will reduce the key grass species, and encourage sod-forming grasses and grass-likes, forcing this transition.

T1-3 - Frequent and severe (continuous, season-long) grazing, ground disturbance, and drought will reduce the herbaceous cover, leaving a shrub-dominated community. Remnant grasses persist in the protection of shrub or cactus clumps.

T1-4 - Drought, ground disturbance, frequent or severe Grazing or non-use with seed source present allows the soil surface to be opened and vulnerable to invasive species. Non-use has shown to create a “fluffy” soil scenario in which seeds are readily able to establish, but not necessarily persist.

T2-4 - Soil disturbance with a seed source present is the trigger for this transition.

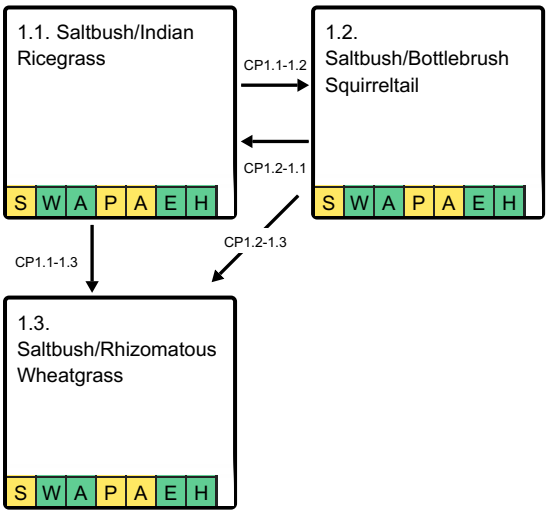
T3-4 - Drought, Frequent or Severe Grazing, Non-Use, or Ground Disturbance with a seed source present reduces the stability and function of saltbush, allowing invasive species to establish.

R3-5 - Grazing lands mechanical treatment, or rangeland seeding with prescribed grazing will be required inputs to alter the soils and hydrology of this site and allow a desirable plant cover to establish and reduce invasive species (species-dependent.)

R4-5 - Integrated Pest Management, Grazing Lands Mechanical Treatment, or Rangeland Seeding with Prescribed Grazing will be required inputs to alter the soils and hydrology of this site, but allow a desirable plant cover to establish and reduce the invasive species (species-dependent.)

T5-4 - Drought, frequent and severe (continuous, season-long) grazing, ground disturbance, or non-use with seed source present leaves restored or reclaimed sites vulnerable to invasive species.

State 1 submodel, plant communities



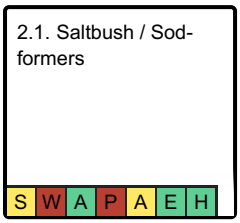
CP1.1-1.2 - Long-term prescribed grazing allows existing populations to gain vigor and encourages seedlings if seed source is available and climatic conditions are favorable. This site may require mechanical or cultural inputs to allow minor improvements in a foreseeable time frame.

CP1.1-1.3 - Drought alone or in conjunction with frequent or severe grazing will reduce the grass species, specifically Indian ricegrass and bottlebrush squirreltail and encourage bluegrasses, forcing this transition.

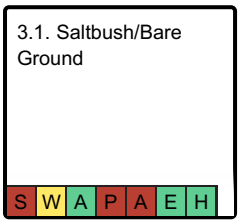
CP1.2-1.1 - Prescribed grazing (possibly long-term), allows the sensitive “decreaser” species a chance to recover where remnant populations are still viable.

CP1.2-1.3 - Frequent and severe grazing of cool-season grasses during growing season, and drought removes or reduces bottlebrush squirreltail on these sites, allowing western wheatgrass to increase.

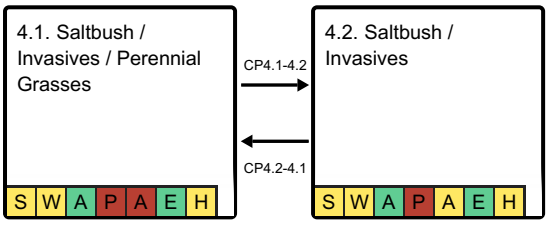
State 2 submodel, plant communities



State 3 submodel, plant communities



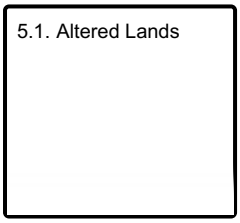
State 4 submodel, plant communities



CP4.1-4.2 - Drought, non-use, disturbance, or frequent or severe grazing weakens the herbaceous species on this site, allowing invasive species to increase in dominance.

CP4.2-4.1 - Integrated Pest management with Prescribed Grazing reduces the density of the weed population and allows the native species to increase only with proper deferment and seed bank.

State 5 submodel, plant communities



State 1
Saltbush/Bunchgrasses

Saline and sodic soils within the fine-loamy particle-size class, including influences from gypsum and calcium carbonate accumulations, support plant communities that are dominated by salt-tolerant dwarf shrubs. A variety of bunchgrasses are secondary on this site with a minor cover of perennial forbs.

Characteristics and indicators. The dominant cover is Gardner's saltbush and birdfoot sagebrush, with minor cover of greasewood and winterfat in some locations. These dominant low sub-shrubs comprise approximately 50 percent of the production on the site. The grasses, which make up 40 percent of the plant community, predominately are bottlebrush squirreltail and Indian ricegrass. As the sites transition, Sandberg bluegrass,

threadleaf sedge, and blue grama will begin to increase. Needle and thread and western wheatgrass also are contributors in this state. The forb component is minor with only 10% of the production comprised by a select few forbs. A variety of desert parsley (biscuitroot or Lomatiums), wild onion, milkvetch, and tansyaster are found within this State. The general ground cover is open with 25 to 35 percent bare ground, but it is stable.

Resilience management. The drought tolerance of this state allows for a wide flexibility in production and composition shifts from year to year, but maintains the base diversity for each community phase.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- Indian ricegrass (*Achnatherum hymenoides*), grass
- squirreltail (*Elymus elymoides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- needle and thread (*Hesperostipa comata*), grass
- desertparsley (*Lomatium*), other herbaceous
- leafy wildparsley (*Musineon divaricatum*), other herbaceous
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous

Community 1.1
Saltbush/Indian Ricegrass

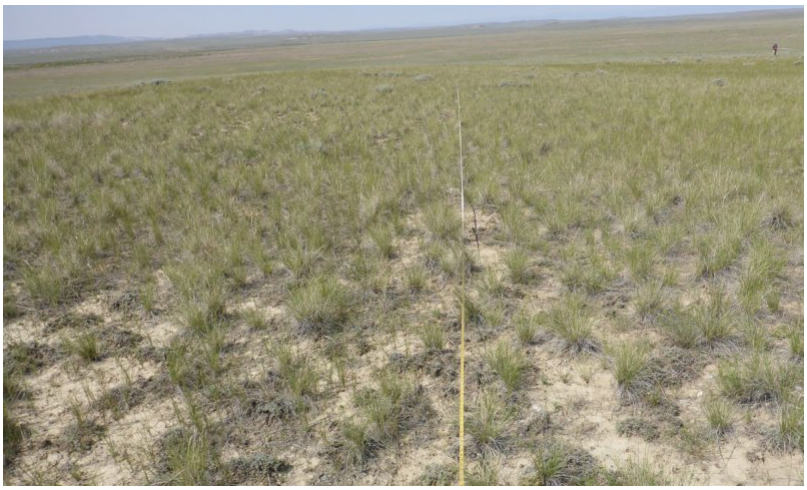


Figure 9. Needle and thread with Indian ricegrass are prominent in the Saline Upland Reference Community.

Equal composition of saltbush and perennial grasses with a minor component of perennial forbs is the signature characteristic of the Reference Plant Community for the Saline Upland ecological site. The dominant plant community can be found on areas that are properly managed with prescribed grazing including short periods of rest or deferment. Potential vegetation is about 50 percent grasses or grass-like plants, 10 percent forbs, and 40 percent woody plants. Gardner's saltbush, Indian ricegrass, and needle and thread dominate Plant Community Phase 1.1, and birdfoot sagebrush, winterfat, rhizomatous wheatgrasses, bottlebrush squirreltail and Sandberg bluegrass being subdominant. Other potential salt-tolerant shrubs, namely greasewood, can be found in small populations on this ecological site. The total annual production (air-dry weight) of this community is about 400 pounds per acre, but it can range from about 150 lbs./acre in unfavorable years to about 600 lbs./acre in above-average years.

Resilience management. This state is fragile, but well adapted to the Northern Intermountain Desertic Basins climatic conditions. The diversity in plant species allows for high tolerance for drought. This is a sustainable plant community but is difficult to reestablish when damaged, in reference to ecological site and soil stability, watershed function, and biologic integrity.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub

- Indian ricegrass (*Achnatherum hymenoides*), grass
- needle and thread (*Hesperostipa comata*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- desertparsley (*Lomatium*), other herbaceous
- tansyaster (*Machaeranthera*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Aggregate instability
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock shelter
- 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)
Shrub/Vine	84	280	448
Grass/Grasslike	84	140	224
Forb	6	28	56
Total	**174**	**448**	**728**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	25-35%

Table 7. Canopy structure (% cover)

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

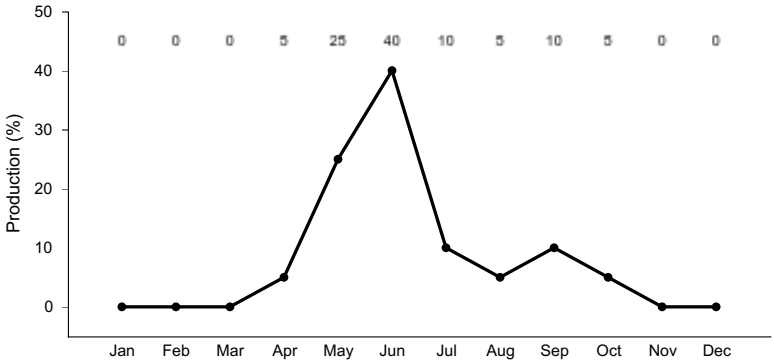


Figure 11. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Community 1.2
Saltbush/Bottlebrush Squirreltail

Figure 12. Bottlebrush squirreltail is the dominant species in this Saline Upland site, Community 1.2.

The Saltbush/Bottlebrush Squirreltail Community (1.2) is found under moderate season-long grazing by livestock. Prolonged drought can play an important role in the transition to and from this community. Gardner’s saltbush, birdfoot sagebrush, and bottlebrush squirreltail are the major species components, with other cool-season grasses increasing in the understory. Short warm-season grasses and miscellaneous forbs are found in pockets within the community. Historically, this plant community evolved under grazing by large ungulates, so it is not uncommon to find many of these species rooted within the crown of Gardner's saltbush. Dominant grasses include bottlebrush squirreltail, Sandberg bluegrass, and blue grama. Forbs commonly found in this plant community include smooth woodyaster, desertparsley(biscuitroot), and wild onion. Plains pricklypear and winterfat may also occur. When compared to the Reference Community (1.1), birdfoot sagebrush has increased while Indian ricegrass has decreased and may only exist in trace amounts. In addition, winterfat may or may not have changed depending on

the season of use. The total annual production (air-dry weight) of this state is about 325 pounds per acre but it can range from 150 lbs./acre in unfavorable years to about 475 lbs./acre in above average years.

Resilience management. Rangeland Health Indicators: This plant community is relatively resistant to change. The herbaceous species are well adapted to grazing; however, species composition can be altered through long-term grazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may occur, but is not extensive. Incidence of pedestalling is minimal. Soils mostly are stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- squirreltail (*Elymus elymoides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- tansyaster (*Machaeranthera*), other herbaceous
- desertparsley (*Lomatium*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Aggregate instability
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock shelter
- 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)
Shrub/Vine	112	196	280
Grass/Grasslike	56	140	196
Forb	6	28	56
Total	**174**	**364**	**532**

Table 9. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-35%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	10-30%	15-30%	0-10%
>0.15 <= 0.3	–	0-10%	0-5%	0-5%
>0.3 <= 0.6	–	0-2%	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

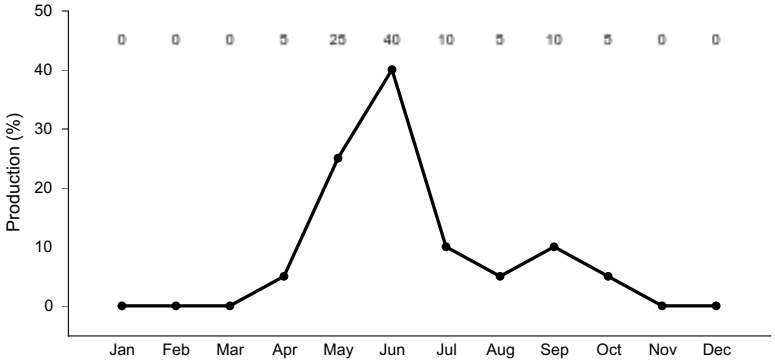


Figure 14. Plant community growth curve (percent production by month). WY0701, 10-14E upland sites.

Community 1.3
Saltbush/Rhizomatous Wheatgrass

Figure 15. Western wheatgrass is the dominant cover with Gardner's saltbush and birdfoot sagebrush in Community Phase 1.3.

Saltbush/Rhizomatous Wheatgrass plant community is found under similar conditions to Plant Community Phase 1.2, (moderate, season-long grazing) and may show similar disturbance traits. This community responds shift in production from wet to dry growing seasons. The fire threat typically is minimal because of the lack of fine fuels; however, in wet, early springs or late fall, bluegrass response may provide the cover and fuels to increase the risk of fire. This plant community is still dominated by saltbush and has a stronger composition of short warm-season grasses and miscellaneous forbs than previous community phases. Under continued drought or intense grazing, this community is at-risk of shifting to a sod-forming, warm-season-dominated grass community. The dominant plants for this community are Gardner’s saltbush and rhizomatous wheatgrass. When compared to the Reference Community, Sandburg bluegrass, blue grama, and plains pricklypear cactus have increased. Indian ricegrass,

needle and thread, and bottlebrush squirreltail have decreased and may occur in only trace amounts within the canopy of saltbush and cactus. Season of use may have limited or removed winterfat from this community. The total annual production (air-dry weight) of this state is about 325 pounds per acre, but it can range from about 125 lbs./acre in unfavorable years to about 525 lbs./acre in above average years.

Resilience management. Rangeland Health Implications/Indicators: This plant community is resistant to change, the herbaceous species present are well adapted to grazing. 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 mostly are stable and the surface shows minimum soil loss. The watershed is functioning, and the biotic community is intact.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- tansyaster (*Machaeranthera*), other herbaceous
- woolly plantain (*Plantago patagonica*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock shelter
- 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	78	196	280
Grass/Grasslike	56	140	224
Forb	6	28	84
Total	**140**	**364**	**588**

Table 12. Soil surface cover

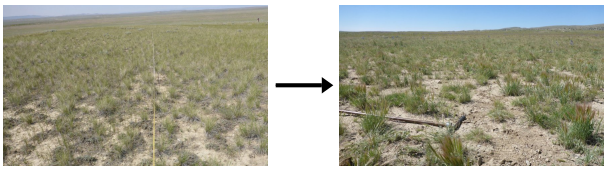
Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	5-20%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%

Bare ground	30-50%

Table 13. Canopy structure (% cover)

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

Pathway CP1.1-1.2
Community 1.1 to 1.2

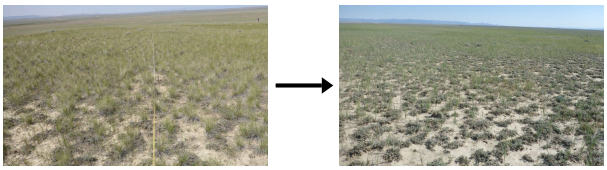


Saltbush/Indian Ricegrass

Saltbush/Bottlebrush Squirreltail

Moderate continuous season-long grazing, drought–Gardner's saltbush has shown a tolerance or resilience under slight and moderate grazing pressures over a period of time; however, the herbaceous component is susceptible and is weakened under year-long use. Indian ricegrass is the main species that will decrease initially. As the pressure persists, the vigor and frequency of Indian ricegrass will begin to decrease while Sandberg bluegrass will increase, and bottlebrush squirreltail will remain fairly stable. Production may not be altered depending on the precipitation for the year, but with continued stress the production will decrease as overall diversity and herbaceous cover is reduced. The transition into Community Phase 1.2 can be reversed with shifts in management and climatic improvements.

Pathway CP1.1-1.3
Community 1.1 to 1.3



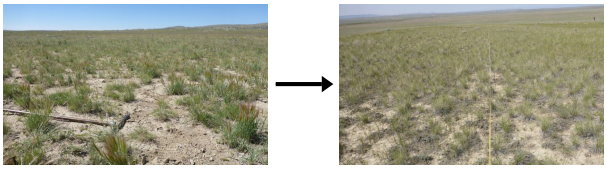
Saltbush/Indian Ricegrass

Saltbush/Rhizomatous Wheatgrass

Drought, frequent or severe grazing–Drought conditions over extended periods of time weaken plant species, reducing the community to the most drought-resistant species. Drought combined with added stress of frequent, severe grazing can expedite the process. Frequent severe grazing of key species causes the site to become dominated by less desirable herbaceous species. Any combination of these factors reduces or removes the key bunchgrasses (Indian ricegrass and bottlebrush squirreltail), and causes Sandberg bluegrass or blue grama to become dominant.

Context dependence. The loss of seed source, lack of hydrology (dry climate, sporadic rainfall, and alteration to water infiltration and runoff), and salt-laden soils limit the ability for seedling establishment. The transition from 1.2 or 1.3 can be a factor of a seed source present during optimal seed germination.

Pathway CP1.2-1.1
Community 1.2 to 1.1



Saltbush/Bottlebrush Squirreltail

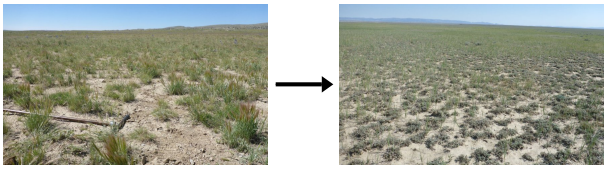
Saltbush/Indian Ricegrass

Prescribed Grazing or Long-term Prescribed Grazing–Given there is a viable seed source in close proximity, and with the appropriate rest and recovery time between grazing periods, Indian ricegrass can reestablish. The recovery process is slow and, along with low precipitation and poor seedling establishment conditions, it may take several decades (10-30 years) for recovery with no outside inputs. At this stage, seeding or other mechanical treatments are not suggested. Ground disturbance provides for a higher risk potential for erosion and invasive species.

Conservation practices

Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Prescribed Grazing
Grazing Management Plan - Applied

Pathway CP1.2-1.3
Community 1.2 to 1.3



Saltbush/Bottlebrush Squirreltail

Saltbush/Rhizomatous Wheatgrass

Frequent and severe utilization of cool-season midgrasses during the growing season, Drought–The rhizomatous wheatgrasses, western and thickspike, as well as the low-growing cool- and warm-season grasses, Sandberg bluegrass and blue grama are encouraged with continued high utilization of the cool-season mid-stature grasses and bottlebrush squirreltail. As severe grazing reduces bottlebrush squirreltail, western wheatgrass and Sandberg bluegrass increase in density between or within Gardner’s saltbush plants. Drought will also decrease squirreltail and allows western wheatgrass, to gain dominance in this community.

State 2
Saltbush/Sod-formers

A combination of environmental disturbances and utilization has reduced the resiliency of the plant community, shifting the community to the Saltbush/Sod-formers State (State 2). Low-stature, warm-season tillering grasses (blue grama) and cool-season tillering grass-likes (threadleaf sedge) have increased in composition, reducing the overall diversity of State 2. Although this state (State 2) is stable with approximately 30 percent ground cover by Gardner's saltbush or salt-tolerant shrubs, the production is slightly reduced. The trend noted during sampling was an increase of annual forbs with the decrease of Indian ricegrass and bottlebrush squirreltail. Current and historic data has documented extreme swings in productivity between years (on an 8-10 year cycle) for Sandberg bluegrass and Gardner's saltbush specifically, but can be referred to many of the species present (based on a 50-year data set). This swing in production can provide a false sense that a threshold has been crossed, when in actuality, it is a natural response to drought and climatic changes. These changes are what allow the Reference State and this state (State 2) to be sustainable.

Characteristics and indicators. The Saltbush/Sod-formers State, State 2, is characterized by the intermixed

community of Gardner's saltbush, blue grama, and threadleaf sedge.

Community 2.1
Saltbush / Sod-formers

Figure 17. Blue grama is dominant with other intermixed grasses on this Saline Upland ecological site.

This plant community (Community Phase 2.1) is the result of frequent and severe (year-long) grazing, which has adversely affected the mid-stature cool-season grasses. Unlike other ecological sites, the shrub component is less affected, but a change in vigor and stature will occur with continued grazing pressure. The droughty nature of the tillering species is caused by a decrease of infiltration of water in response to the thick, shallow mat of roots, channelizing runoff between established clumps or patches of vegetation. The density of the “patches” is smaller than seen in similar sagebrush communities. The lower soil cover by plants with the lack of structure to hold moisture, further compounded by drought, can reduce the stability of the soil and make erosion a more significant problem. When compared to the Reference Plant Community (1.1), threadleaf sedge and blue grama have increased, and pricklypear cactus has invaded. All cool-season mid-stature grasses and most perennial forbs have been greatly reduced. Production has decreased in response to the loss of perennial grasses. The total annual production (air-dry weight) of this state is about 225 lbs./acre, but it can range from about 100 lbs./acre in unfavorable years to about 450 lbs./acre in above average years.

Resilience management. Rangeland Health Implications/Indicators: This community is resistant to change and the removal of grazing does not seem to affect the plant composition or structure. The biotic integrity of this community is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. The sod-bound nature of this plant community is resistant to water infiltration; however, the open, dissected nature of the "patches" of the site only has a minimal impact on infiltration. Sodded areas are protected by root structure, but impact off-site areas with excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in areas of bare ground and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and downslope. The watershed may or may not be functioning, as runoff may affect adjoining sites.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- threadleaf sedge (*Carex filifolia*), grass
- blue grama (*Bouteloua gracilis*), grass
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates

- Inadequate livestock shelter
- 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)
Shrub/Vine	56	140	280
Grass/Grasslike	50	84	140
Forb	6	28	84
Total	**112**	**252**	**504**

Table 15. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	5-20%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
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	–	10-30%	5-20%	0-10%
>0.15 <= 0.3	–	0-10%	0-5%	0-5%
>0.3 <= 0.6	–	0-2%	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

State 3
Saltbush/Bare Ground

The management and climatic interactions that were speculated to have led to the Saltbush/ *Bare Ground*-dominated State are not the only cause for this community. It is recognized that with continued grazing pressure and drought conditions, the productivity and sustainability of most perennial grasses will decrease, leaving a shrub-dominated state, and that in the absence of invasive species, this community can persist on the landscape. Correlation data from soil and ecological sites document that many of the communities that fit this definition were found to have a heavier textured soil (Clayey or Fine). The slow infiltration and sealing potential of fine soils restricts

the potential plant community. There were sites, however, that were classified as fine-loamy (coarser soils) and were dominated by this community that were a product of management and drought.

Characteristics and indicators. The Saltbush/*Bare Ground* State is a Gardner's saltbush community with few other species existing in the community. The community is distinct on the landscape and has little variability.

Resilience management. Once this state is established on the landscape, it is resistant to most change. However, the open canopy is prone to invasive species when growing conditions are appropriate.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- povertyweed (*Iva axillaris*), other herbaceous

Community 3.1
Saltbush/Bare Ground

This plant community is found in areas subjected to continuous, year-long grazing. Gardner’s saltbush comprises nearly 100 percent of the plant community. Most cool-season grasses have been eliminated or greatly reduced, and the forb component has transitioned into mostly annual weedy species. The interspaces between plants have expanded significantly, leaving the amount of bare ground wide spread and the soil surface exposed to erosive elements. This open and exposed community is highly susceptible to invasion by noxious weeds such as cheatgrass. When compared to the Reference State (Community Phases 1.1, 1.2, and 1.3), plant production is diminished due to the excessive amount of bare ground and lack of perennial grasses. The ability for Gardner's saltbush to respond to precipitation patterns leads to a variability in productivity from one year to the next; however, composition is relatively stable. Long-term prescribed grazing and grazing land mechanical treatment (with possibly seeding) may be practices that can be used to bring this community to near or similar to Reference (Community 1.1 or 1.2). Remnant populations of native perennial grasses will persist in pockets within the Gardner's saltbush community, but in some instances, seeding may be required to help bring herbaceous species back to the community. No research has been located for large areas of revegetation, but minor success has occurred with seeding trials completed by Bureau of Land Management and University of Wyoming. These seeding trials occred on small, isolated areas and required periods of rest and will require long-term management to bring them back to a state that will resemble the Reference State. The total annual production (air-dry weight) of this state is about 175 pounds per acre, but it can range from about 75 lbs./acre in unfavorable years to about 400 lbs./acre in above-average years.

Resilience management. Rangeland Health Indicators: This plant community is resistant to change as the stand becomes more decadent. These areas are resistant to fire due to the lack of fine fuels and the increase of bare ground between the salt-tolerant shrubs. Continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure. Plant diversity is extremely low. The plant vigor is diminished, and replacement capabilities are severely reduced due to the decrease in the number of cool-season grasses. Plant litter is noticeably less when compared to the Reference State. 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 downslope.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- woolly plantain (*Plantago patagonica*), other herbaceous
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous

Dominant resource concerns

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

- Plant structure and composition
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	84	168	336
Forb	–	28	56
Grass/Grasslike	–	–	56
Total	**84**	**196**	**448**

Table 18. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-7%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

Table 19. Canopy structure (% cover)

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

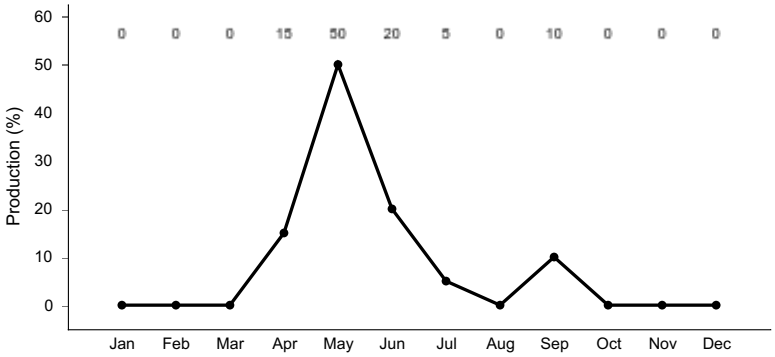


Figure 20. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

State 4
Invaded

The Saline Upland site has proven to be more resistant to invasion by many of the aggressive weedy species threatening the rangelands today. However, there are a few species that still present issues as more land is disturbed by development, continued drought, and shifts in use (grazing, recreation, mining, etc). Cheatgrass (downy brome) poses the greatest threat, with annual mustards, clasping pepperweed, and woolly plantain holding their niches on the landscape. The persistence, resistance, and resilience of specific communities within this state will be further discussed.

Characteristics and indicators. The presence of at least 5 percent cover of an invasive species, dominantly cheatgrass, within the community is the threshold forcing this community into the invaded state.

Resilience management. Managing to maintain the remaining native species will working to reduce the invasive species is the best management practice focus for the Invaded State.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- cheatgrass (*Bromus tectorum*), grass
- woolly plantain (*Plantago patagonica*), other herbaceous
- mustard (*Brassica*), other herbaceous
- clasping pepperweed (*Lepidium perfoliatum*), other herbaceous

Community 4.1
Saltbush / Invasives / Perennial Grasses

The Saltbush/Invasives/Perennial Grasses phase has maintained a representative sample of the perennial grasses and forbs that are commonly found in the community within State 1 and State 2, with the accompanying Gardner’s saltbush composition. The invasive species are present and hold a significant (5 percent or greater) composition of the landscape, and are prominent in the community (referring to large scale composition, not few isolated patches on the landscape). Production of desired perennial species are generally reduced but the total production is maintained or elevated due to the production potential of many of the annual or invasive species. Production of this community phase will vary depending on the invasive species. Site-specific investigations must be completed to determine productivity and to select the growth curve that is best suited. The curve selected below is for a cheatgrass-influenced community. Rangeland Health Implications/Indicators: Plant diversity is similar to Reference or possibly higher, but will be reduced with further transition to a more degraded phase. The plant vigor and replacement capabilities are limited but are still sustainable. Plant litter is noticeably more when compared to Reference communities due to the potential biomass produced by the invasive species (species-dependent). Soil erosion is variable depending on the species of invasion and the associated litter accumulation. This variability also applies to water flow patterns and pedestalling. Infiltration and runoff are unaltered, but will degraded quickly as the community shifts to a more invaded phase.

Resilience management. Grazing potential on this site remains, with consideration to the cheatgrass (or other specific invasive species). Grazing to minimize the weed threat while maintaining or protecting the native species is key to the resiliency of this site. Eradication of the invasive species is not been successfully achieved at this time on this site.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- cheatgrass (*Bromus tectorum*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- squirreltail (*Elymus elymoides*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- woolly plantain (*Plantago patagonica*), other herbaceous
- clasping pepperweed (*Lepidium perfoliatum*), other herbaceous
- mustard (*Brassica*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

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

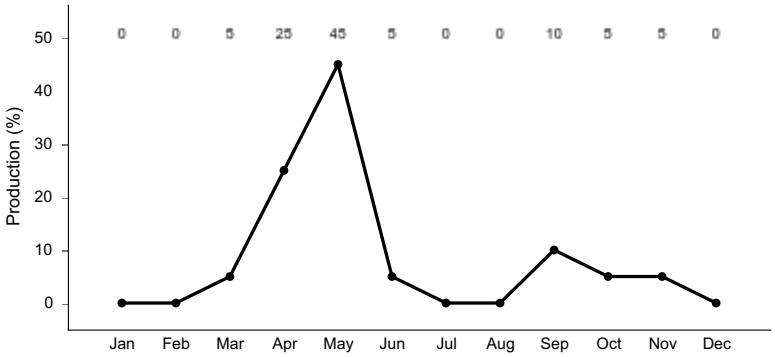


Figure 21. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Community 4.2
Saltbush / Invasives

This community phase is the at-risk community. As the native populations of perennial grasses and forbs become weakened, the site becomes invader driven, and is extremely difficult to improve. Gardner’s saltbush is able to compete and maintain a strong community under a heavy infestation level, but with continued stress will continue to degrade. The system is low in resistance. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to Reference communities due to the potential biomass produced by the invasive species (species-dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated. The variability of the water flow and pedestalling as well as infiltration and runoff is determined by the

invasive species inhabiting the community.

Resilience management. Management of the invasive species to maintain healthy cover and to minimize expansion is the targeted management. Eradication is not achievable within cheatgrass communities at this time; however, they do provide a forage benefit during select periods of the growing season.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- cheatgrass (*Bromus tectorum*), grass
- woolly plantain (*Plantago patagonica*), other herbaceous
- mustard (*Brassica*), other herbaceous
- clasping pepperweed (*Lepidium perfoliatum*), other herbaceous

Dominant resource concerns

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

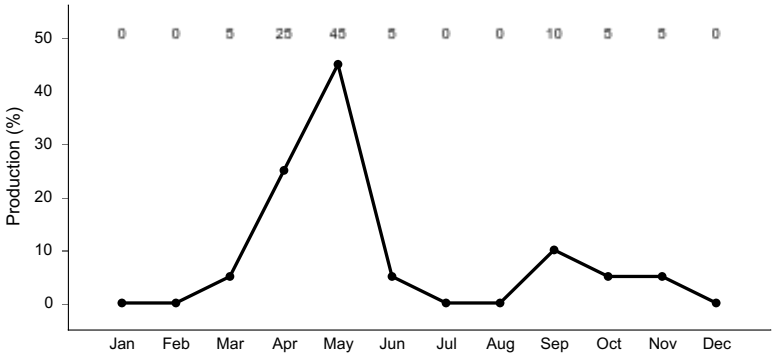


Figure 22. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Pathway CP4.1-4.2
Community 4.1 to 4.2

Drought, non-use, disturbance, or frequent or severe (continuous, season-long) grazing – After crossing the threshold into the Invaded State, the community will continue to degrade if disturbance or continuous, season-long grazing continues. Drought and non-use can leave soils dispersed and susceptible to invasion and loss of perennial grasses. Once an invasive species has gained a niche within a community and is able to begin to establish and propagate, the transition from the initial phase in this state to a more degraded phase may happen quickly when multiple factors are influencing the community. However, the transition can be stable and resistant to further degradation in many management situations. Proactive early detection and rapid response can be an effective tool at this stage to prevent this transition.

Pathway CP4.2-4.1
Community 4.2 to 4.1

Integrated Pest Management with Prescribed Grazing – The native grasses displaced by the invasive species

generally will persist in remnant populations within the crowns of the Gardner's saltbush or scattered in small pockets on the landscape. If a site is addressed in the preliminary stages of the transition to this phase, there is a higher likelihood that integrated pest management (weed control) and grazing management will encourage the perennial grasses to increase or persist on the landscape. But as the site continues to degrade or transition to an invasive-dominated community, the ability to recover becomes more and more minimal. Halogeton maintains a more desirable community for grasses to persist. Cheatgrass tends to overpower and remove or inhibit the perennial grasses from the system, making recovery more difficult without major inputs.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Grazing Management Plan - Applied

State 5
Degraded/Altered

Energy development, mining, gravel or borrow pits, farming, irrigation canals, drainage laterals, and roads are only a few of the land uses that have had an impact on these arid, salt-affected landscapes. Much of this site is deemed unfit or non-productive; attempts to reclaim are marginal, and many attempts have failed. Historic attempts to improve productivity have altered the resilience and response pathways, affecting the site potential and stability. Specific references will be further discussed.

Community 5.1
Altered Lands

Altered lands have been impacted by human settlement and land use advancement. Many areas within the Wind River Basin were farmed during settlement periods, but as water and times became difficult many homesteads were abandoned. Rangeland improvement projects were completed in the late 1940s and early 1950s by the Bureau of Land Management in conjunction with University of Wyoming. Sections of salt-affected barren landscapes were contour furrowed or dissected with water-spreader dikes and seeded with predominantly a variety of grasses. Seeding trails were completed using species including crested wheatgrass, Russian wildrye, wheatgrasses, and Indian ricegrass. The furrows and dikes were created to increase water-holding capacity, which in turn improved vigor and production of Nuttall’s or Gardner’s saltbush and assisted the establishment of grasses. Remnants of the furrowing and spreader dikes are still visible and in some areas the seeded grass species are persistant in small scattered populations. Productivity variances were found negligible between treated and untreated locations; however, within the spreader systems, an increase in vigor and production are seen within the immediate vicinity of the dikes. Spaces between the dikes do not show any lasting benefit. Mechanical alteration of these areas in conjunction with seeding of an introduced species carried a lasting effect to hydrology; and even though the introduced species did not persist in all locations, these sites are altered from the Reference State functionality. Given more time the furrows may completely disappear from view. The benefits of the remaining furrows will be decreased but the altered hydrology will persist, and the community will not respond the same as an unaltered, natural state. Similarly, with lands that were farmed or irrigated, then abandoned to return to a natural state of vegetation, they will not be the same as the Reference Community in response to management and natural disturbances.

Resilience management. The persistence of an introduced, non-native species is a very indicative trait that will

assist in identifying this community phase. These non-native species are not invasive, although they may be persistent and aggressive species. Crested wheatgrass, Russian wildrye, and a variety of hybrid wheatgrasses are a few cultivars that have been planted that have persisted on the landscape, altering the site. The act of seedbed preparation alone, without consideration of the original disturbance can be seen as an alteration to the soil function. Productivity of these sites varies greatly depending on the exact disturbance, age and successional stage of recovery from this disturbance, and what, if any, species were seeded into the site. Composition variability of this plant community limits the ability to provide accurate averages and grow curves, so no production values or growth curves are provided for this community phase.

Transition T1-2
State 1 to 2

Drought, frequent or severe grazing–Extended periods of drought have the ability to weaken the plant community's resilience, forcing the community over the threshold into the next state. Drought with added stress of frequent or severe grazing (i.e. continuous, season-long grazing) can expedite the process, removing the key species leaving the site dominated by the less desirable herbaceous species. Any combination of these factors will reduce or remove the key bunchgrasses, Indian ricegrass, needle and thread, bottlebrush squirreltail, and Sandberg bluegrass, and leave a blue grama dominated site.

Transition T1-3
State 1 to 3

Frequent and severe grazing, severe ground disturbance, drought–The combination of frequent and severe grazing (i.e. continuous, season-long grazing), especially when drought is a factor, continues the process of decreasing the forbs and grasses within the community. The desirable herbaceous species may become very sparse or are removed, leaving a saltbush-dominated community. Extended long periods of drought alone or severe ground disturbance will remove or inhibit the sustainability of the herbaceous component of this community.

Constraints to recovery. The lack of seed source and the harsh environment for seed germination (lack of timely precipitation, soil crusting, and arid climate) reduce the viability of seedling establishment on this site.

Transition T1-4
State 1 to 4

Frequent and severe grazing, drought, non-use, or ground disturbance (with seed source present)–Cheatgrass (downy brome), and many of the invasive weeds that are present in the Wind River Basin are drought-tolerant and able to establish in poor soils and growing conditions. The barren, open canopy that is typical of the Saline Upland ecological site is a prime target for these invaders. Given any level of disturbance, whether it is from heavy and frequent grazing use (i.e. continuous, season-long grazing), drought, or other ground disturbances, if there is a seed source present, these invaders will find a niche for establishment. The dispersed nature of salt-affected soils, especially in the absence of compaction by hoof action or traffic, allows for any variety of invasive species to quickly transition from the Reference State to the Invaded State.

Constraints to recovery. The inability to eradicate fully the invasive species (cheatgrass and halogeton) from a community is the limiting constraint to recover. Cost for initial treatment and the necessity for continued treatment limit the economic feasibility of recovery as well.

Transition T2-4
State 2 to 4

Drought, ground disturbance, frequent or severe grazing or non-use with a seed source present–The vulnerability of this state to transition to the Invaded State is increased as the canopy is opened with further disturbance, drought or grazing use (i.e. continuous, season-long grazing). Non-use is also a factor, because of the nature of the soils to become dispersed (loose) and open to seedling establishment. If the seed source is present (in the area), drought or abnormal precipitation patterns as well as non-use provide the opportunity for invasive species to establish. Many of the sources of disturbance (recreational vehicles, animals, and development activities) provide a source to bring invasive species into an area.

Constraints to recovery. The difficulty and in some instances inability to eradicate or effectively control some invasive species is the limitation to restoring this site to the any community.

Transition T3-4
State 3 to 4

Drought, Frequent or Severe Grazing, Non-Use, or Ground Disturbance with a seed source present–Once the community has transitioned into a saltbush-dominated state, productivity and functionality are at risk. If further disturbance occurs from severe (continuous, season-long) grazing, human impacts, or environmental), saltbush will begin to decrease and invasive species will increase in dominance, forcing this community to transition into the Invaded State. The effect of this plant composition shift is a decrease in hydrologic function and increase in the erosional hazard within the community.

Constraints to recovery. Weed control is the major constraint to recovery of this site.

Context dependence. The species of invasion and circumstances of each site specifically may offer more options for recovery.

Restoration pathway R3-5
State 3 to 5

Grazing Land Mechanical Treatment or Rangeland Seeding with Prescribed Grazing–The large-scale success of contour furrowing on the rangelands with a mixture of crested wheatgrass and other introduced or cultivated species has shown that this landscape can be restored to a functional community using improved varieties and selective grazing land mechanical treatments. Once established, management is required to encourage establishment and to sustain the species. Once the soil is disturbed there is a risk of erosion until seedling establishment can occur. Management of undesired species (noxious or invasive weed species) must be completed to ensure that the community is restored to an acceptable composition. Seedbed preparation and ground disturbance by any mechanical means will alter the soil structure and hydrology of an area, preventing the location from returning to Reference (Community Phase 1.1, 1.2, and 1.3). Although they may appear similar, post-disturbance response to management is altered from the Reference State and so is recognized as a reclaimed or restored community (State 5).

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Grazing Management Plan - Applied

Restoration pathway R4-5
State 4 to 5

Integrated pest management, grazing land mechanical treatment, or rangeland seeding with prescribed grazing–Once a community has degraded to the Invaded State, especially if cheatgrass is dominant; eradication is not a feasible option, preventing restoration to the Reference State. An invaded community, however, can be restored to a functional plant community through intensive and integrated pest management and grazing land mechanical treatments. Removal of or reducing existing populations and establishment of forage species that are desirable and

able to tolerate and compete with the invasive species helps to improve the function of the landscape. When a community has been significantly invaded, losing all of the key grazing species, reseeding the site to a competitive species may be the only option. Establishment will be slow and the variety of available seed sources for salt-affected soil conditions is minimal, but small-scale projects have been achieved with marginal success.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Livestock Use Area Protection
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Agrichemical Handling Facility
Grazing Management Plan - Applied

Transition T5-4
State 5 to 4

Drought, severe and frequent grazing, ground disturbance, or non-use with seed source present–Loose soils as a result of no hoof action during non-use or the decrease in key herbaceous species due to severe and frequent grazing (i.e. continuous, season-long grazing), drought, or disturbance opens the canopy and provides opportunity for invasive species to establish. Continued stress or addition of undesirable species will weaken this community even further.

Constraints to recovery. The inability to eradicate fully the invasive species (cheatgrass) from a community is the limiting constraint to recover. Cost for initial treatment, and the necessity for continued treatment limit the economic feasibility of recovery as well.

Additional community tables

Table 20. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature, Cool-season Bunchgrass**			56–140	
	needle and thread	HECO26	*Hesperostipa comata*	28–84	10–30
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	28–84	10–30
2	**Rhizomatous, Cool-season Grass**			28–84	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–28	0–5
3	**Short-stature, Cool-season Bunchgrass**			0–56	
	squirreltail	ELEL5	*Elymus elymoides*	28–84	5–10
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
Forb					
4	**Perennial Forbs**			6–56	
	milkvetch	ASTRA	*Astragalus*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	1–28	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	woodyaster	XYLOR	*Xylorhiza*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–22	0–5
	textile onion	ALTE	*Allium textile*	0–22	0–5
Shrub/Vine					
5	**Dominant Shrub**			84–336	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–336	10–40
6	**Miscellaneous Shrub**			0–140	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–10
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 21. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature, Cool-season Bunchgrass**			0–11	
	needle and thread	HECO26	*Hesperostipa comata*	0–11	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	0–2
2	**Rhizomatous, Cool-season Grass**			0–56	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–56	0–10
3	**Short-stature, Cool-season Bunchgrass**			56–112	
	squirreltail	ELEL5	*Elymus elymoides*	28–84	10–30
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
4	**Miscellaneous Grass/Grass-likes**			0–28	
	blue grama	BOGR2	*Bouteloua gracilis*	0–28	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
Forb					
5	**Perennial Forbs**			0–56	
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	0–11	0–5
6	**Annual Forbs**			0–56	
	tansyaster	MACHA	*Machaeranthera*	0–28	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–11	0–5
Shrub/Vine					
7	**Dominant Shrub**			56–280	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–224	10–30
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	28–112	5–25
8	**Miscellaneous Shrub**			0–56	
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 22. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous, Cool-season Grass**			28–112	
	western wheatgrass	PASM	*Pascopyrum smithii*	28–112	5–15
2	**Short-stature, Cool-season Grass**			6–56	
	Sandberg bluegrass	POSE	*Poa secunda*	6–56	1–10
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
3	**Short-stature, Tillering, Grass/Grass-like**			0–56	
	blue grama	BOGR2	*Bouteloua gracilis*	0–28	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
4	**Miscellaneous Grass/Grass-like**			0–28	
	Grass-like, perennial	2GLP	*Grass-like, perennial*	0–28	0–5
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
Forb					
5	**Perennial Forbs**			0–56	
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	0–11	0–5
6	**Annual Forbs**			0–56	
	tansyaster	MACHA	*Machaeranthera*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–11	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	0–5
Shrub/Vine					
7	**Dominant Shrubs**			56–280	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	56–224	10–30
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	5–20
8	**Miscellaneous Shrubs**			0–28	
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 23. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Short-stature, Cool-season Grass**			0–56	
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	0–5
2	**Short-stature, tillering Grass/Grass-like**			11–84	
	blue grama	BOGR2	*Bouteloua gracilis*	11–84	10–20
	threadleaf sedge	CAFI	*Carex filifolia*	0–56	0–10
3	**Miscellaneous Grass/Grass-like**			0–28	
	Grass, perennial	2GP	*Grass, perennial*	0–28	0–5
	Grass, annual	2GA	*Grass, annual*	0–28	0–5
Forb					
4	**Perennial Forbs**			0–56	
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–28	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	0–11	0–5
5	**Annual Forbs**			0–56	
	tansyaster	MACHA	*Machaeranthera*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–11	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	0–5
Shrub/Vine					
6	**Dominant Shrub**			56–280	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	56–224	10–30
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–112	0–20
7	**Miscellaneous Shrub**			0–56	
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–28	0–5

Table 24. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Miscellaneous Grasses**			0–28	
	Grass, perennial	2GP	*Grass, perennial*	0–6	0–2
Forb					
2	**Perennial Forbs**			0–56	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–28	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–28	0–5
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–28	0–5
	desertparsley	LOMAT	*Lomatium*	0–11	0–5
	textile onion	ALTE	*Allium textile*	0–11	0–5
3	**Annual Forbs**			0–56	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–28	0–5
	Forb, annual	2FA	*Forb, annual*	0–28	0–5
	mustard	BRASS2	*Brassica*	0–28	0–5
	tansyaster	MACHA	*Machaeranthera*	0–28	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–11	0–5
Shrub/Vine					
4	**Dominant Shrubs**			84–336	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	84–280	10–30
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–56	0–10
5	**Miscellaneous Shrubs**			0–56	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	0–2
	seepweed	SUAED	*Suaeda*	0–6	0–2

Animal community

Animal Community – Wildlife Interpretations

1.1 - Saltbush/Bunchgrasses: The predominance of woody plants in this plant community provides winter grazing for mixed feeders, such as elk and antelope. Suitable thermal and escape cover for these animals are limited due to the low quantities of tall woody plants. When found adjacent to sagebrush-dominated states, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Some grassland-obligate small mammals would occur here.

1.2 - Saltbush/Squirreltail: The combination of shrubs, grasses, and forbs can provide a forage source for large grazers, such as wild horses, deer, and antelope. Suitable thermal and escape cover for these animals is limited due to the low quantities of tall woody plants. When found adjacent to sagebrush-dominated states, this plant community may provide lek sites for sage grouse. Other birds that would frequent this plant community include western meadowlarks, horned larks, and golden eagles. Some grassland-obligate small mammals would occur here.

2.1 - Saltbush/Rhizomatous Wheatgrasses: Decreased diversity of grasses and forbs reduces the value for the large grazers slightly, but rhizomatous wheatgrasses are a key forage source for them. Thermal and Escape cover suitable for large animals is still very limited due to the low quantities of tall woody plants. Areas with sagebrush-dominated states adjacent to this plant community may provide lek sites for sage grouse, and in productive years provides better cover for birds and some of the grassland obligate small mammals.

2.2 - Saltbush/Sod-formers: Forage value for large grazers has shifted to provide a late spring early summer source of green forage, although less accessible due to low growth stature. Cover is essentially non-existent, but when adjacent to sagebrush-dominated states, this plant community provides lek sites for sage grouse.

3.1 - Saltbush/*Bare Ground*: This plant community exhibits a low level of plant species diversity. It may have forage value for antelope and deer, but in most cases is not a desirable plant community due to the lack of cover and selectivity by the wildlife. It is not, for most cases, a desirable plant community to select as a wildlife habitat management objective. Due to the open and exposed nature of this community, it may be a location for sage grouse leks, if there is edge effect provided by a sagebrush site surrounding the saltbush community.

4.1 - Perennial Grasses/Invasives/Saltbush: The unpalatable nature of many of the invasive species would reduce the value of this plant community for large grazers; however, there would still be forage available depending on the forage composition. Suitable thermal and escape cover is very limited and highly variable. Seeds from invasive species would serve as a forage source for sage grouse and other birds as well as small mammals.

4.2 - Invasives/Saltbush: This plant community exhibits a low level of plant species diversity. It is not a desirable plant community to select as a wildlife habitat management objective. However, seeds produced by many of the invasive species serve as a forage source for sage grouse and other birds as well as grassland-obligate small mammals. Knapweeds provide good cover for small mammals and birds as well.

5.1 - Disturbed/Restored/Reclaimed: Depending on the stage of succession of these sites or the selected seed mixture planted, locations may vary widely on value for wildlife habitat management.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous, season-long grazing with 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 pant 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 (Animal Unit Month) to calculate the AUMs/Acre.

Plant Community Production (lbs./ac); Carrying Capacity* (AUM/ac); (Ac/AUM)
Below Avg. - Normal - Above Avg.
1.1 - Saltbush/Indian Ricegrass 150-400-600 0.11 9.12
1.2 – Saltbush/Bottlebrush Squirreltail 150-325-475 0.09 11.23
1.3 – Saltbush/Rhizomatous Wheatgrasses 125-300-525 0.08 12.17
2.1 – Saltbush/Sod-formers 100-225-450 0.06 16.22
3.1 – Saltbush/*Bare Ground* 75-175-400 0.05 20.86
4.1 – Saltbush/Annuals/Perennial Grasses ** **
4.2 – Saltbush/Annuals ** **
5.1 - Disturbed – Restored/Reclaimed ** **

* - Continuous, season-long grazing by cattle under average growing conditions.
** - Production and carrying capacity is dependent on the species mixture that is present and the stage of succession in which each community is located. Site-specific investigation is necessary due to the highly variable composition.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. Supplementation of livestock may be necessary during the dormant season (protein and minerals) if the quality does not meet minimum livestock requirements.

Distance to water, terrain, slope and length of slope, access, shrub density, fencing, and management can affect

carrying capacity (grazing capacity) within a management unit as well as kind, class, and breeds of livestock. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30 percent of the unit (i.e. 50 percent reduction on 30 percent of the management unit).

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 an area where shortgrasses 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 marginal hunting opportunities for upland game species. Because of the raw nature of these sites, cultural artifacts can be found or viewed in the area, especially along the drainages that typically dissect these landforms. The extent of this ecological site is found within wild horse range and tribal horse ranges. This ecological site, however, proves to be limited in association with roadways and trails in relation to erosion potential and functionality. The soils will be sticky or slick when wet and are more erosive than other associated ecological sites. These soils need to be taken into consideration when crossing the area with trails or roadways. The site is generally rough and provides no soft cover for camping or resting.

Wood products

No appreciable wood products are present on the site.

Other products

Herbs: There are a select few forb species that are found on this site that have medicinal characteristics and have been used by the Native Americans in this area, and currently are in use by the naturopathic profession.

Ornamental Species: The flowering forbs of this site have been found useful in landscaping and xeriscaping. The shrub component has cultivated species that have been used in conservation plantings and in more natural landscaping schemes.

Inventory data references

Information presented in the original site description was derived from NRCS inventory data. Field observations from range-trained personnel were also used. Those involved in developing the original site include: Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist. 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 3, 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 developing the Saline Upland range site include Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist.

Those involved in the development of the new concept for Saline Upland Ecological site include: Ray Gullion, Area

Range Management Specialist, Jim Haverkamp, Area Range Management Specialist, NRCS; Mandi Hirsch, Range Management Specialist, Popo Agie Conservation District; Jim Wolf, Resource Manager, USDI-BLM; John Likins, Range Management Specialist, Retired USDI-BLM; Jeremy Artery, Rangeland Management Specialist, USDI-BLM; Leah Yandow, Wildlife Biologist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

Quality control and quality assurance completed by: John Hartung, State Rangeland Management Specialist, NRCS; Brian Jensen, State Wildlife Biologist, NRCS; Scott Woodall, Regional Quality Assurance 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 (overstory and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect.)
• Continuous Line Intercept (woody canopy cover, with minimum gap of 0.2 foot for all woody species and succulents. Intercept height collected at each measurement.)
• Gap Intercept (basal gap measured with a minimum gap requirement of 0.7 foot.)
• Sample Point (10 – 1 meter square point photographs taken at set distances on transect. Read using the sample point computer program established by the High Plains Agricultural Research Center, WY).
• Soil Stability (slake test) – surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

Type locality

Location 1: Park County, WY	
Township/Range/Section	T52N R99W S10
UTM zone	N
UTM northing	4930049.16
UTM easting	679910.268
Latitude	44° 30′ 4″
Longitude	108° 44′ 12″
General legal description	162m W, 55m S of NE corner of Sec. 10. Travel 17 mi E of Cody, WY on Hwy 14 (Greybull Highway). Turn N on BLM Access road, travel 1.9 mi NW. Site is 175m W of access road.

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Contributors

Marji Patz

Approval

Scott Woodall, 9/17/2020

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Marji Patz, Ray Gullion, Everet Bainter
Contact for lead author	Marji.patz@wy.usda.gov; 307-271-3130
Date	02/23/2015
Approved by	Scott Woodall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to non-existent. Where present, short and widely spaced.

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2. **Presence of water flow patterns:** Barely observable.

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3. **Number and height of erosional pedestals or terracettes:** Not evident on slopes less than 9%, but erosional pedestals will be present with terracettes at debris dams on slopes greater than 9%.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground will range from 25 to 45%, occurring as small openings between plants.

5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present, except in concentrated water flow pattern zones on steeper slopes (>5% slope).

6. **Extent of wind scoured, blowouts and/or depositional areas:** Minimal to non-existent.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter movement expected to move only small amounts (to leeward side of shrubs) due to wind. May see minor litter damming between shrubs on steeper slopes along water flow areas.

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 average at 4.7 in the interspaces, and 5.2 under plant canopy. Average values should be 4.0 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Typically the surface is comprised of an A-Horizon of 1-6 inches (2-15 cm) with medium platy structure parting to granular structure and color hues of 10YR or 5Y, values of 5-7 and chromas of 2-4. In some soils a shallow E-Horizon of 1-3 inches (2-7 cm) with a weak platy structure parting to granular structure that is grayish brown (i.e 2.5Y 5/2) will replace the A-Horizon. Organic matter typically ranges from 0.5-2%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The evenly distributed, clustered plant community provides 30-60% foliar cover, with minimal basal footprint. The tendency for the surface to seal slows infiltration rates and results in slight to moderate runoff. The lack of basal cover (less than 5%) does little to effect runoff from this site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer exists, but some soil crusting in dry conditions is typical. The soil structure may appear platy in nature due to the dispersion of particles from salts in the soil. The caps of the natric horizon may be platy parting to granular structure, and could be mistaken as a compaction layer.

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: Low Growing Perennial Shrubs > Mid-stature Grasses

    Sub-dominant: Mid-stature Grasses > Perennial Forbs

    Other: Forbs = Short-stature Grasses

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal or very low incidence of decadence is expected, but minor loss is seen.

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-25% of total canopy cover with the total litter (including beneath the plant canopy) from 15-35%. Herbaceous litter depth is typically shallow ranging from 2-7 mm. Woody litter depth ranges from from .1 to 0.5 of an inch (0.25-1.25 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The average total above ground production on a normal year is 450 lbs./acre (504 kg/ha); ranging from 275 to 600 lbs/acre (308-672 kg/ha) in poor to above average years.

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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:** Birdfoot sagebrush, Greasewood, Sandberg bluegrass, Woolly Plantain, native annual mustards and pepperweeds and a variety of other native annual forbs will invade the site as it degrades. Invasive species that are common include but are not limited to: Halogeton, Cheatgrass, Knapweeds (Russian and Spotted have been located) and a variety of thistles. For a current and more complete list consult the County and State Weed and Pest Noxious Weed List.

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17. **Perennial plant reproductive capability:** All species are capable of reproducing, but are limited due to effective soil moisture and seed/soil contact. The lack of perennial canopy with the dispersal tendencies of the soil create a crusting effect from rain drop impact/wetting and drying of the soil. The cracking of these soils as they dry provide small areas for seeds to catch and germinate. Drought inhibits seed viability as well as reduces the root propagation potential.
