USDA Natural Resources
Conservation Service

Ecological site DX032X01B143
Saline Upland Clayey (SUC) Big Horn Basin Rim

Last updated: 3/04/2025
Accessed: 05/11/2025

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 MLRA is comprised 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 single out these two basins.

For further information regarding Major Land Resource Areas (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) and Subset: 32X01B (WY) This LRU consists of the Big Horn Basin within MLRA 32. The Big Horn Basin is lower in elevation, slightly warmer and receives slightly less overall precipitation compared to the Wind River Basin (LRU 02). This LRU was originally divided into two: LRU A, which was the core and LRU B, which was the rim. With the most current standards, this LRU is divided into two subsets. This subset is Subset B, referred to as the Rim, is a transitional band between the basin floor and the lower foothills. The subset encircles Subset A which was originally called LRU A. As the LRU shifts towards the south and tracks east, changes in geology and relation to the mountain position create a minor shift in soil chemistry, which influences the variety of ecological sites and plant interactions. The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soil map units are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRAs and LRUs based on elevation, landform, and biological references.

Moisture Regime: Ustic Aridic
Prior to 2012, many of the soils within this group were correlated as Frigid Ustic Aridic or as Mesic Typic Aridic, with few mapped within this crossover zone. As progressive soil survey mapping continues, these crossover or transitional areas are identified and corrected.

Temperature Regime: Mesic
Dominant Cover: Rangeland, with saltbush flats as the dominant vegetative cover for this LRU and ESD.
Representative Value (RV) Effective Precipitation: 10-14 inches (254–355 mm)
RV Frost-Free Days: 105-125 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 Saltbush Scrub Macrogroup
G301 Atriplex corrugate – Artemisia pedatifida – Picrothamnus desertorum Dwarf-Scrub Group
CEGL001439 Atriplex gardneri – Bud Sagebrush Dwarf Shrubland
CEGL001445 Atriplex gardneri / Pascopyrum smithii Dwarf 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.g Big Horn Salt Desert Shrub Basin

Ecological site concept

• Site does not receive any additional water.
• Slopes are less than 25 percent
• Soils are:
- saline, sodic, or saline-sodic
- shallow, moderately deep, deep, or very deep
- less than 3 percent stone and boulder cover and less than 20 percent cobble and gravel cover
- not skeletal (contain less than 35 percent rock fragments) within 20 inches (51 cm) of mineral soil surface
- textures ranges from loam to clay in mineral soil surface 4 inches (10 cm) with 20 percent or more clay content
- greater than 35 percent clay in the particle-size control section

The Saline Upland Clayey site concept is based on well-drained soils derived from sodic or alkaline shale. The original Saline Upland range site spanned all textures of soils, grouping them based only by the chemical similarities. As soils transition from a loamy soil profile toward sandy or clayey, the responses to precipitation and management shift. A corresponding shift in plant communities also occurs. The outcome is a division of the Saline Upland ecological site into: Saline Upland, Loamy; Saline Upland, Sandy; and Saline Upland, Clayey. A separation may be warranted based on soils with salts (sodium) as well as high levels of gypsum or calcium carbonate accumulations; laboratory data is necessary to make this determination. Until such time, communities will be documented within the respective textural breaks of the Saline Upland site encompassing all salts (gypsum, sodium, etc).

Associated sites

DX032X01A122	**Loamy (Ly) Big Horn Basin Core** Loamy sites are found adjacent to Saline Upland sites. Generally are in depressional or concave areas on the dorsal edge of the landform, allowing a mixture of parent materials and time and moisture to flush salts lower in the profile.
DX032X01B104	**Clayey (Cy) Big Horn Basin Rim** The Clayey site is a moderately deep to deep soil with similar soil texture characteristics but lacking the soil chemistry. These sites tend to have Wyoming Big Sagebrush and Western Wheatgrass plant communities.
DX032X01B110	**Dense Clay (DC) Big Horn Basin Rim** Dense Clay sites typically are found at the base of shale outcrops that are low or have minimal salts. They are a birdfoot sagebrush-dominant site with only trace amounts of Gardner's saltbush.

DX032X01B154	**Shale (Sh) Big Horn Basin Rim** Shale sites typically are found at the bases of shale outcrops and are the very shallow component of the Saline Upland site. As they transition downslope, soils gain depth to a restrictive layer, increasing in vegetation and productivity.
DX032X01B176	**Very Shallow (VS) Big Horn Basin Rim** Very Shallow sites typically are found at the bases of rock outcrops and are the very shallow component of the Saline Upland site. These sites do not have the soil chemistry or soil content to carry much vegetation. As they transition downslope, soils gain depth to restrictive layer, increasing in vegetation and productivity.

Similar sites

R032XY244WY	**Saline Upland (SU) 5-9” Wind River Basin Precipitation Zone** This site is located in the Wind River Basin and has similar characteristics, but due to varied climatic conditions historically has been written as its own ecological site.
R032XY344WY	**Saline Upland (SU) 10-14" East Precipitation Zone** This site is in the foothills above the basin rim and has higher precipitation than the original description. Production is higher.
R032XY144WY	**Saline Upland (SU) 5-9” Big Horn Basin Precipitation Zone** This site was the original description that included all textural classes of this site. This description also uses a wider area of interest, stretching precipitation zone further up into the foothills region of the Big Horn Basin.
DX032X01A154	**Shale (Sh) Big Horn Basin Core** Shale sites typically are found at the bases of shale outcrops and are the very shallow component of the Saline Upland site. As they transition downslope, soils gain depth to restrictive layer, increasing in vegetation and productivity.

Table 1. Dominant plant species

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

Legacy ID

R032XB143WY

Physiographic features

The Saline Upland Clayey ecological site generally occurs on slopes ranging from nearly level to 25 percent. It has been documented that most of these soils are found on toeslopes and terraces below marine shales outcrop. They are also found to occupy soils of eroded shale outcrops along the toes of the foothills with lower precipitation. The interbedded and dissected Big Horn Basin has a mixture of these soils, creating a wide range of saline-driven communities. Clayey sites are found closer to the originating parent material, Loamy along the central portions of the landforms or following both clayey and sandier parent material sources, and Saline Upland Sandy sites follow the lowest portion of the landscape or at the bases of the salt-laden sandstones or interbedded sandstone and shale.

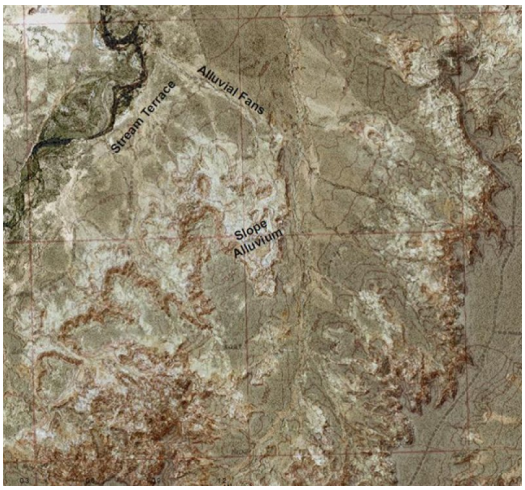


Figure 1. Aerial Imagery depicting landscape positions where Saline Upland Clayey is commonly found.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Alluvial fan (2) Intermontane basin > Stream terrace (3) Intermontane basin > Basin-floor remnant
Runoff class	Medium to very high
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to rare
Elevation	3,610–6,500 ft
Slope	0–25%
Ponding depth	0 in
Water table depth	60 in
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation in the Saline Upland Clayey ecological site ranges from 10 to 14 inches (254–355 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. This amounts to about 50 percent of the mean annual precipitation. Much of the moisture that falls in the latter part of the summer months is lost by evaporation and much of the moisture that falls during the winter time 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.

Temperatures show a wide range between summer and winter months and between daily maximums and minimums, due to the high elevation and dry air, which permit 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 time and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during the late winter and spring months. High winds are generally blocked from the basin by high mountains but can occur in conjunction with an occasional thunderstorm. Growth of native cool-season plants begins about April 1st and continues to about July 1st. Cool weather and moisture in September may produce some green-up of cool season plants that will continue to late October. For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. Clark 3NE, Cody, Cody 12SE, Heart Mtn., and Powell Fld. Stn. are the representative weather stations within LRU D. The following graphs and charts are a collected 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)	87-97 days
Freeze-free period (characteristic range)	113-123 days
Precipitation total (characteristic range)	8-11 in
Frost-free period (actual range)	83-108 days
Freeze-free period (actual range)	111-125 days
Precipitation total (actual range)	7-11 in
Frost-free period (average)	93 days
Freeze-free period (average)	118 days
Precipitation total (average)	9 in

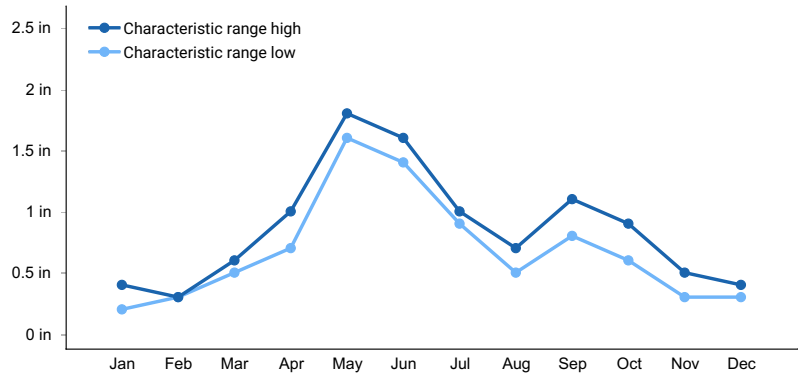


Figure 2. Monthly precipitation range

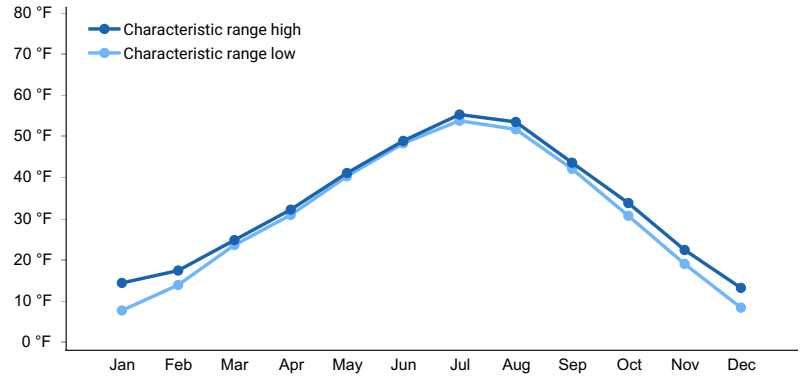


Figure 3. Monthly minimum temperature range

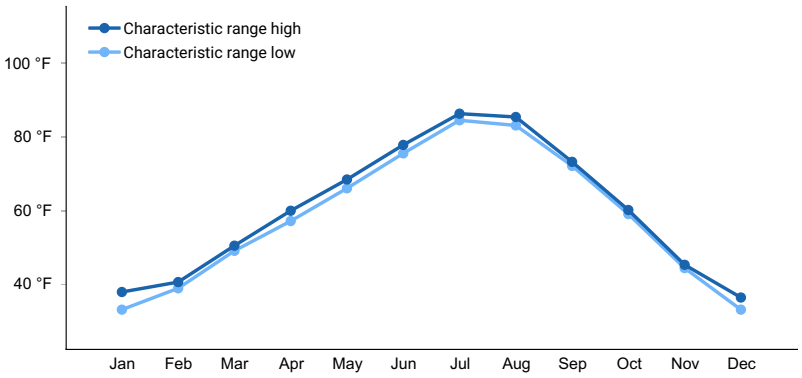


Figure 4. Monthly maximum temperature range

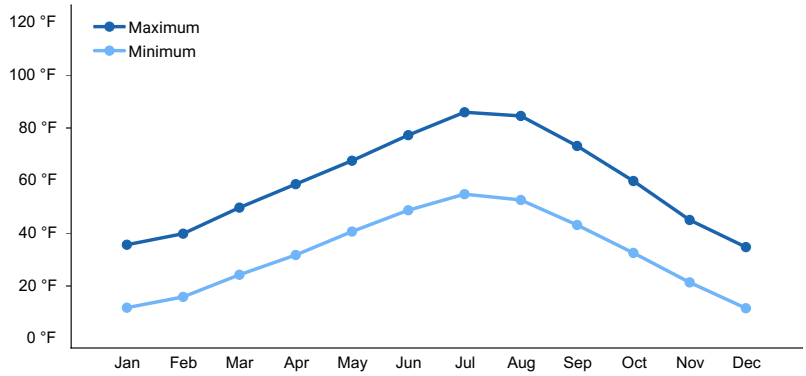


Figure 5. Monthly average minimum and maximum temperature

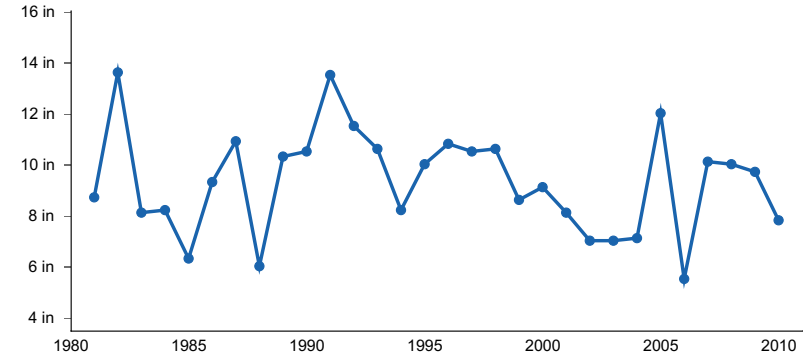


Figure 6. Annual precipitation pattern

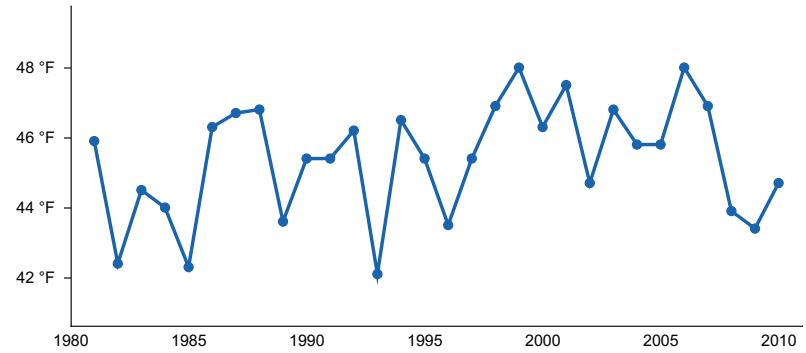


Figure 7. Annual average temperature pattern

Climate stations used

- (1) POWELL FLD STN [USC00487388], Powell, WY
- (2) HEART MTN [USC00484411], Powell, WY
- (3) CODY [USC00481840], Cody, WY
- (4) CODY 12SE [USC00481850], Meeteetse, WY
- (5) SHELL 1NE [USC00488124], Shell, WY

Influencing water features

The characteristics of these upland soils have no influence from groundwater (water table is below 60 inches or 150 cm) and have minimal influence from surface water and overland flow. No streams are classified within this ecological site. The lack of water table above 60 inches (150 cm) during any part of the growing season is a key factor for the Saline Upland sites. As the landscape transitions into the bottomlands (lowlands) or drainageways, gaining overland flow and ground water influence changes the site to a Saline Lowland or Saline Subirrigated ecological site. In areas where there was historically a water table, but the stream or source has downcut or has been depleted, a site labeled Saline Lowland, Drained was created to cover a mixed or relict plant community.

Wetland description

No wetlands are associated with these sites. Small areas of ponded water will persist following intense storms, but they do not persist on the landscape for any extent of time.

Soil features

The soils of the Saline Upland Clayey ecological site are shallow to very deep (greater than 10 inches or 25 cm to bedrock), somewhat poorly to well-drained soils with slow to moderate permeability. The distinctive characteristic of the soils is their moderately to strongly saline or alkaline properties. The surface soil will vary from 1 inch to 6 inches (2-15 cm) in thickness. Some soils may contain more soluble salts in the subsurface than in the surface. The soil characteristics that have the most influence on the plant community are the high quantity of soluble salts within the profile compounded by the heavy clay textures.

Several soils sampled were found to have significant amounts of visible gypsum crystals and masses within the profile, especially lower depths of 20-40 inches (50-100 cm) below the mineral soil surface. Many times the gypsum accumulations were not fully captured in the assigned series.

Major soil series correlated to this site include Winnett, Winnett-like, Spyglass-like, Ravine, Renohill-like, Deertrail-like, Zigweid, Bunkwater-like, Ulm, Silhouette-like, Diamonkit-like, Worfka, Pultney-like, Lonebear-like, and Savageton-like.

Figure 8. Soil pit excavated in a Saline Upland Clayey ecological site.

Table 4. Representative soil features

Parent material	(1) Residuum–shale
Surface texture	(1) Loam (2) Silty clay loam (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to well drained
Permeability class	Slow to moderate
Soil depth	10–60 in
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	0.8–8.3 in
Calcium carbonate equivalent (0-40in)	0–14%

Electrical conductivity (0-40in)	4–16 mmhos/cm
Sodium adsorption ratio (0-40in)	13–40
Soil reaction (1:1 water) (0-40in)	7.4–10
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The Saline Upland Clayey ecological site presents as a sparsely vegetated landscape, dominated by salt-tolerant plant species, especially woody species. The expected potential is low with composition consisting of 15 percent grasses, 10 percent forbs, and 75 percent shrubs (woody species). The grasses tend be "patchy" in nature, finding depressions or concave landscape positions to occupy where the forbs are more evenly dispersed. The sporadic timing and quantity/intensity of storm events/precipitation with the fine textures of this site create a natural variation in production and composition.

Historic perception of these sites as "wastelands" and the lack of management on these sites has led to a shift in community vigor and composition. Fire is not a factor in these communities because of the lack of fine fuels to carry a fire, a stark contrast to the associated sagebrush communities.

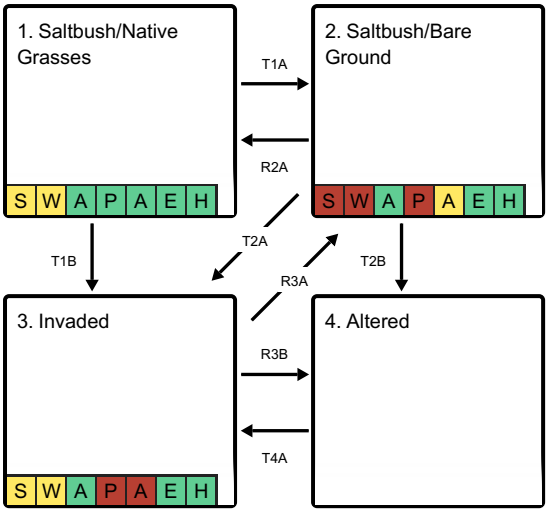
Deterioration of this site is not as acute on the landscape as many communities. Species such as halogeton, Russian thistle, and weedy annuals will become dominant as the grass and native forbs are reduced or completely removed from the site. The Reference Plant Community (description follows the State-and-Transition diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed to lightly grazed, seasonal use pastures, and historical accounts also have 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 (CP). 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) and is illustrated by "R" in the legend (R2-1).

State and transition model

Ecosystem states



T1A - Use with no recovery removes or reduces the mid-stature cool-season grasses; which is further exacerbated with prolonged drought.

T1B - Drought or disturbance with a seed source starts the conversion to the Invaded State.

R2A - Long-term prescribed grazing with seeding will aid in the recovery of perennial grasses.

T2A - Disturbance with a seed source for invasive species, especially with drought, starts the transition to an invaded State.

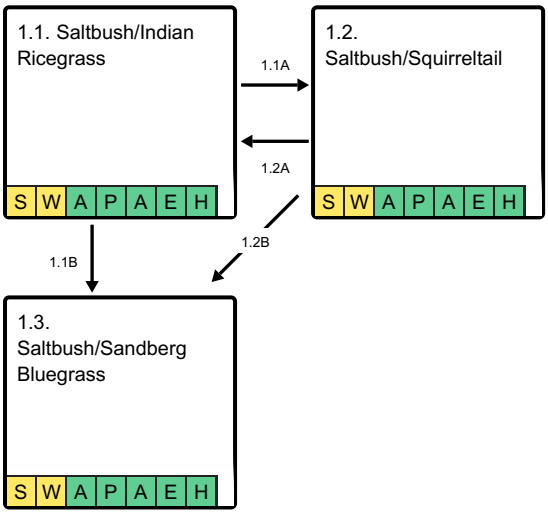
T2B - Use of mechanical treatment and seeding aids in recovering disturbed sites.

R3A - Integrated pest management or weed control and grazing management aid in the recovery to a Gardner's saltbush state.

R3B - Intensive weed control with mechanical treatment and seeding, the community can be improved.

T4A - Continued disturbance or lack of management with a seed source present will allow even a reclaimed site to transition back to the Invaded State.

State 1 submodel, plant communities



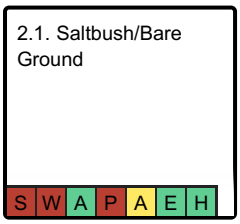
1.1A - Prolonged drought especially when conditions are exacerbated by moderate, continuous season-long grazing.

1.1B - Drought in conjunction with heavy, continuous season-long grazing reduces the vigor and composition of Indian ricegrass in this community.

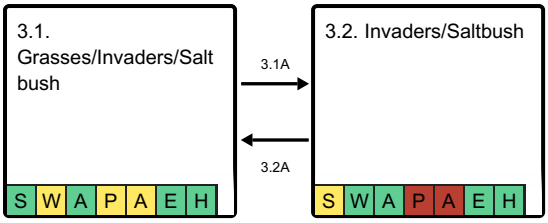
1.2A - Long-term prescribed grazing with rest rotation is the main approach to allow Indian ricegrass to recover on a site.

1.2B - Heavy, continuous season-long or year-long grazing with drought limits the community to Sandberg bluegrass and Gardner's saltbush.

State 2 submodel, plant communities



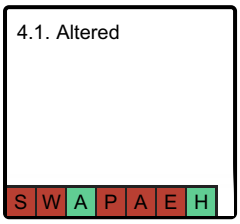
State 3 submodel, plant communities



3.1A - Drought with soil disturbance and either over use or no use allows invasive species to increase in composition on this site.

3.2A - Integrated pest management with grazing management will help control invasive species and allow some recovery of this community.

State 4 submodel, plant communities



State 1
Saltbush/Native Grasses

The Reference Communities (1.1., 1.2, and 1.3) for this state have developed under moderate use throughout the year by large ungulates. Although these sites do not provide a large quantity of forage, the value of the saltbush and the interspersed grasses provides a food source for spring and fall grazing when other sites are sensitive.

Characteristics and indicators. This State is characterized by a dominance of Gardner's saltbush and a mixture of mid-stature bunchgrasses and some rhizomatous species. A variety of low-growing forbs are present in these communities.

Resilience management. The Saltbush/Native Grasses State is easily shifted when disturbance occurs, but is well adapted to the climatic conditions. The Saltbush/Native Grasses State can quickly recover from drought, making it sustainable, but hard to reestablish once disturbed.

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
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- desertparsley (*Lomatium*), other herbaceous
- textile onion (*Allium textile*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Aggregate instability
- Feed and forage imbalance
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Community 1.1
Saltbush/Indian Ricegrass

Figure 9. Indian ricegrass and Gardner's saltbush are the key species within the Reference Community Phase 1.1 (Saltbush/Indian Ricegrass).

This community phase, Saltbush/Indian Ricegrass, is described as the Reference Plant Community. This community evolved under moderate grazing by large ungulates and with very droughty soil conditions due to the slower infiltration rates and salt content of the soil. The salt-tolerant, drought-resistant plants that dominate this site are Gardner's saltbush and Indian ricegrass. Bottlebrush squirreltail and birdfoot sagebrush are minor components. A small variety of forbs are found on this site, and are listed on the following plant community tables . The total annual production (air-dry weight) of this state is about 350 pounds per acre, but it can range from about 125 lbs./acre in unfavorable years, to about 500 lbs./acre in above average years.

Resilience management. The Saline Upland Clayey ecological site is extremely stable and well adapted to the climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community in relation to soil stability, watershed function, and biologic integrity.

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
- desertparsley (*Lomatium*), other herbaceous
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- shortspine horsebrush (*Tetradymia spinosa*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Wind erosion
- Concentration of salts or other chemicals
- Aggregate instability
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	100	225	300
Grass/Grasslike	25	100	150
Forb	0	25	50
Total	**125**	**350**	**500**

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	0-5%
Litter	10-30%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	30-40%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	10-20%	0-2%	0-5%
>0.5 <= 1	–	0-10%	5-10%	0-5%
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

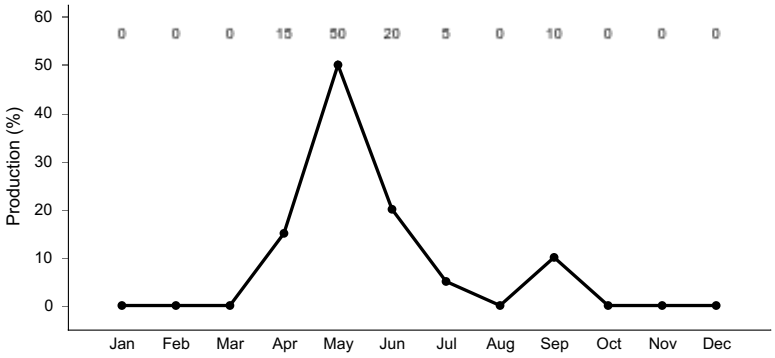


Figure 11. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Community 1.2
Saltbush/Squirreltail

Figure 12. Bottlebrush squirreltail will maintain cover as Indian ricegrass decreases, leaving a Saltbush/Squirreltail community.

The bottlebrush squirreltail begins to be the dominant species under moderate, season-long grazing by large ungulates. Prolonged drought can play an important role and will exacerbate these conditions. Gardner's saltbush and bottlebrush squirreltail are the major components of this plant community. Other cool-season grasses make up the majority of the understory with miscellaneous forbs. Forbs commonly found on this site are wild onion, biscuitroot, smooth woodyaster, leafy wildparsley, and plains pricklypear. When compared to the Reference Community (1.1), shortspine horsebrush has decreased significantly, Indian ricegrass has decreased and may occur in only trace amounts, birdfoot sagebrush may have increased, and alkali seepweed may have established within the site. The total annual production (air-dry weight) of this state is about 200 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: Community Phase 1.2 is relatively resistant to change. The herbaceous species are well adapted to grazing; however, species composition can be altered through long-term overgrazing. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may occur, but is not extensive. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact, but there is a shift in herbaceous structure.

Dominant plant species

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

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Concentration of salts or other chemicals
- Aggregate instability
- Plant structure and composition
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	50	100	250
Grass/Grasslike	20	75	100
Forb	5	25	50
Total	**75**	**200**	**400**

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	10-30%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-45%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	10-30%	5-10%	2-10%
>0.5 <= 1	–	0-10%	0-10%	–
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

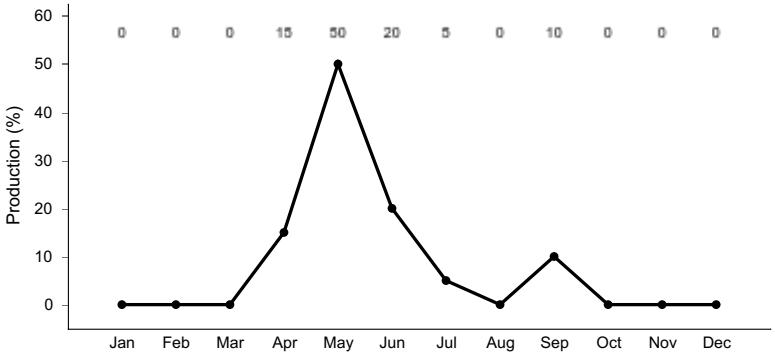


Figure 14. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Community 1.3
Saltbush/Sandberg Bluegrass

Figure 15. The at-risk community within the Reference State is the Saltbush/Sandberg Bluegrass Community (1.3).

Plant Community 1.3, Saltbush/Sandberg Bluegrass, is an at-risk community for the Reference State. As Sandberg bluegrass increases, Indian ricegrass is easily removed from the system. Drought, soil conditions, and seed source can influence the shift between bottlebrush squirreltail and Sandberg bluegrass. Both species are common on the Saline Upland Clayey ecological site as it is degraded. Sandberg bluegrass has higher defenses to tolerate grazing and drought. 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 350 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 overgrazing. The herbaceous component is mostly intact, and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement occur within the basal inter-spaces, but is not extensive. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact. Sandberg bluegrass is a grazing- and drought-tolerant grass that can easily maintain cover and increase with moderate to heavy grazing. Sandberg bluegrass is also tolerant to traffic and other minor surface disturbances, allowing it to maintain cover as other native grasses begin to fall out of the composition. As drought, continued heavy utilization, or ground disturbance increases, Sandberg bluegrass loses vigor and will be removed, making this community prone to invasion or to become dominated by Gardner's saltbush.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- squirreltail (*Elymus elymoides*), grass
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- tansyaster (*Machaeranthera*), other herbaceous
- woolly plantain (*Plantago patagonica*), other herbaceous

Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	50	100	250
Grass/Grasslike	15	50	50
Forb	10	25	50
Total	**75**	**175**	**350**

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	10-20%
Surface fragments >0.25" and <=3"	0-35%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	25-35%

Table 13. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	10-30%	10-20%	0-5%
>0.5 <= 1	–	0-10%	0-5%	0-5%
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

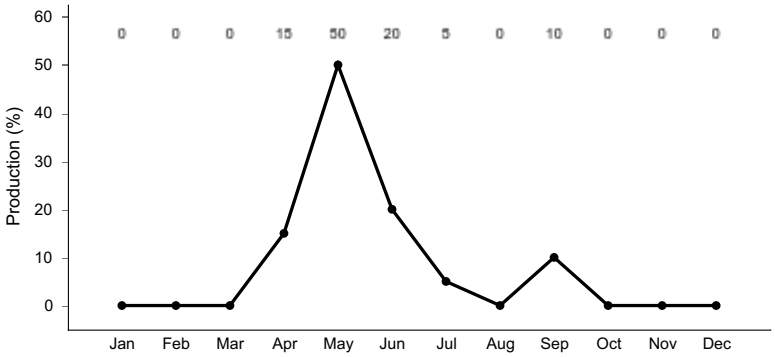
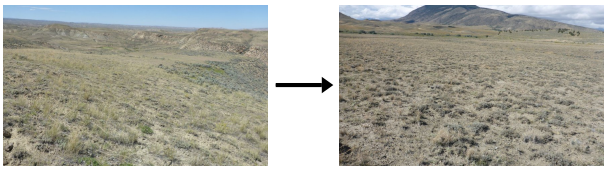


Figure 17. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

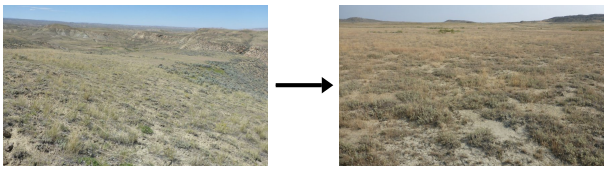
Pathway 1.1A
Community 1.1 to 1.2



Saltbush/Indian Ricegrass | Saltbush/Squirreltail

Drought; moderate, continuous season-long grazing–Prolonged drought will stress Indian ricegrass beyond tolerance, reducing and possibly removing it from the community, especially when conditions are exacerbated by moderate, continuous season-long grazing. The loss of production in Indian ricegrass is initially compensated by bottlebrush squirreltail, and a flush of annual grasses may occur.

Pathway 1.1B
Community 1.1 to 1.3

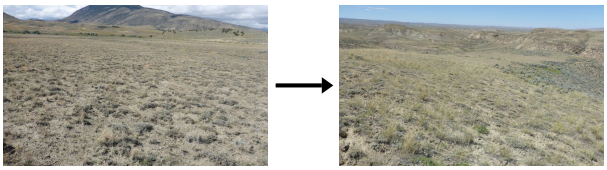


Saltbush/Indian Ricegrass | Saltbush/Sandberg Bluegrass

Drought; heavy, continuous season-long grazing–Prolonged drought will stress Indian ricegrass beyond tolerance, reducing and possibly removing it from the community. Drought loss will be exacerbated by heavy, continuous season-long grazing in removing the more desirable species leading to the dominance of Sandberg bluegrass. The loss of production in Indian ricegrass is initially compensated by Sandberg bluegrass, western wheatgrass, and bottlebrush squirrreltail as well as an assortment of forbs.

Context dependence. Existing herbaceous composition will be a determining factor in the Saltbush/Ricegrass Community (Reference) degrading to Community Phase 1.2 or 1.3. If bottlebrush squirreltail is in good vigor and subdominant on a site to Indian ricegrass, degradation of the Reference Community will transition to Community Phase 1.2 rather than Community Phase 1.3. However, if Sandberg bluegrass is the subdominant, the transition will be to Community Phase 1.3.

Pathway 1.2A
Community 1.2 to 1.1



Saltbush/Squirreltail | Saltbush/Indian Ricegrass

Long-term prescribed grazing; rest–The application of long-term prescribed grazing including rest and rotation of use will allow Indian ricegrass to recover. The small shift in birdfoot sagebrush and alkali seepweed will not disappear, but will be a very minor component on the site.

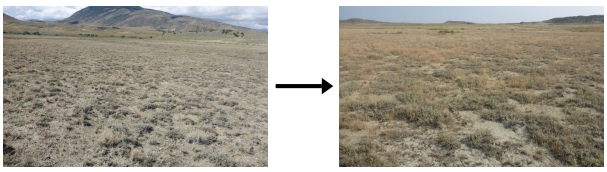
Context dependence. Recovery of this site with grazing management including rest is dependent on having a seed source in the near proximity of the site for Indian ricegrass. Further consideration has to be given to the soil surface conditions and climatic patterns to be favorable for germination for recovery to be possible.

Conservation practices

Prescribed Grazing
Heavy Use Area Protection
Watering Facility
Water Well
Upland Wildlife Habitat Management

Prescribed Grazing

Pathway 1.2B
Community 1.2 to 1.3



Saltbush/Squirreltail | Saltbush/Sandberg Bluegrass

Drought; heavy, continuous year-long grazing–Prolonged drought will continue to reduce the vigor and tolerance of this community. As bottlebrush squirreltail is removed by drought or grazing pressure, Sandberg bluegrass will persist. A flush of annual forbs usually responds to the loss of perennial vegetation. When drought lifts, if grazing pressure is not removed, the ability for the perennial vegetation (bottlebrush squirreltail and Indian ricegrass) are limited in their ability to recover.

Context dependence. This community pathway (1.2-1.3) is dependent on the presence of Sandberg bluegrass, and the level of disturbance. If Sandberg bluegrass is not present in the community, then this pathway will lead to a different community phase not identified, or it may force a transition to State 2.1 Saltbush/*Bare Ground*.

State 2
Saltbush/Bare Ground

The loss of most of the perennial grass species within this state has created an at-risk community that is vulnerable to invasive species, but also is resilient and resistant to change. This creates a difficult scenario, and coupled with the low productivity of the land, many managers do not attempt to improve or manage these landscapes.

Characteristics and indicators. The Saltbush/*Bare Ground* State (State 2) consists predominately of Gardner's saltbush with pricklypear cactus or a few other scattered forbs, but very little other vegetation on the site.

Resilience management. As described before, the protein value of gardner’s saltbush provides an excellent source of feed at specific times of the year. If managed properly, saltbush can be a great spring or fall food source for livestock and wildlife.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

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

Community 2.1
Saltbush/Bare Ground

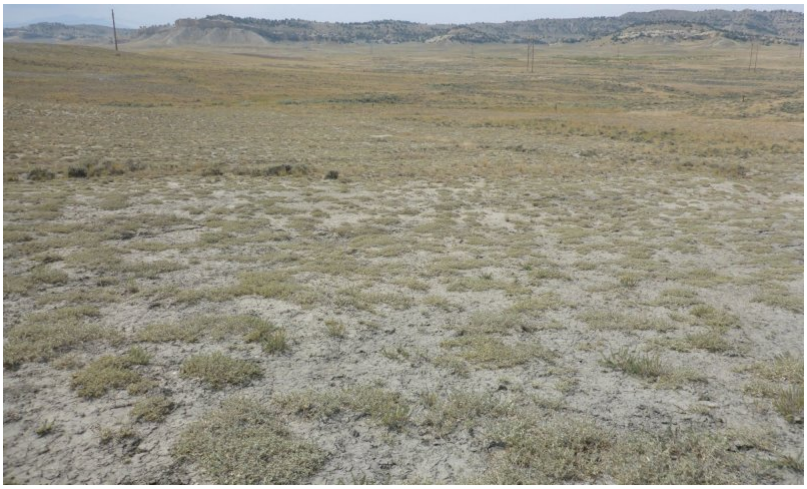


Figure 18. Saline Upland Clayey ecological site transitioned to a Saltbush/Bare Ground community.

The persistence and resilience of Gardner's saltbush helps to create a stable plant community. This community will occur where sites are subjected to continuous year-long grazing. Gardner’s saltbush will dominate this site, and in some cases may comprise 100 percent of the plant community. The interspaces between plants have expanded significantly, leaving the amount of bare ground prevalent and the soil surface exposed to erosional elements. Birdfoot sagebrush will continue to persist with Gardner's saltbush and may help to protect the inter-spaces to a degree, but the site is more prone to erosion. Cool-season grasses have been greatly reduced and commonly are eliminated. With the lack of competition this site is vulnerable to invasion by noxious weed species such as clasping pepperweed and halogeton. When compared to the Reference Community 1.1, plant composition and structure are lacking, and productivity is diminished due to the excessive amount of bare ground. The total annual production (air-dry weight) of this community is about 250 pounds per acre, but it can range from about 50 lbs./acre in unfavorable years, to about 400 lbs./acre in above average years.

Resilience management. Rangeland Health Indicators: The Saltbush/*Bare Ground* community is resistant to change as the stand becomes more decadent. Fire is not a factor with the lack of fine fuels. 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 (Plant Communities 1.1 and 1.2). Continued frequent and severe grazing has minimal effect on the persistent cover of Gardner's saltbush; however, the structure and vigor of the shrub will become stunted. University of Wyoming exclosure studies established in the 1950s were analyzed, and the removal of grazing has not shown any potential improvement for the plant composition or structure once degraded. Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestalling are obvious. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces and gullies may be establishing where rills have concentrated down slope.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- plains pricklypear (*Opuntia polyacantha*), other herbaceous
- smooth woodyaster (*Xylorhiza glabriuscula*), other herbaceous
- alkali seepweed (*Suaeda vera*), other herbaceous

Dominant resource concerns

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

Table 14. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	50	250	350
Forb	0	10	50
Grass/Grasslike	0	0	5
Total	**50**	**260**	**405**

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	5-15%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	30-40%

Table 16. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	10-30%	0-2%	0-5%
>0.5 <= 1	–	0-10%	0-2%	0-5%
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

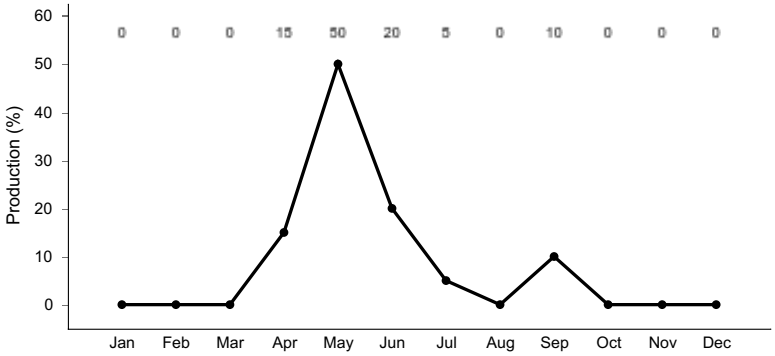


Figure 20. Plant community growth curve (percent production by month).

WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

State 3
Invaded

The major invasive species that are moving into the Big Horn Basin are cheatgrass, halogeton, Russian knapweed, and a variety of thistles. Many of these sites are used frequently by recreationalists for ATV/ORVs, shooting, etc., due to the open, barren nature. The heavy clay soils are attractive for mudding and other 4-wheel drive activities. With the increased “traffic” and the soil surface disturbance, not only is the ground opened to allow establishment, but weed seed sources are readily transported from one area to another.

Characteristics and indicators. The Invaded State will maintain the Gardner's saltbush as well as birdfoot sagebrush, with varying composition of the native herbaceous species. The dominant or significant herbaceous composition will transition to an introduced or invasive species. Halogeton is the major threat to the Saline Upland Clayey ecological site. However, cheatgrass will establish in the barren interspaces.

Resilience management. Preliminary studies completed by the Wyoming Bureau of Land Management (BLM) and University of Wyoming have shown examples of halogeton outcompeting Gardner's saltbush to be the only species on a location. However, no final publication has been found detailing the final outcome. Presentations have suggested that Gardner's saltbush may still be present in the understory, and with the removal or suppression of halogeton, saltbush may be able to recover. With other weedy species, no wide or monoculture stands have been located. The risk of going to a cheatgrass-only composition is minimal, unless intense ground disturbance (tillage, scraping, etc) occurs, removing the persistent saltbush cover. Once these communities have lost the native components, especially Gardner's saltbush, it is extremely difficult to reverse the community. Seeding is difficult due to the heavy-textured, salt-burdened, droughty soils.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- squirreltail (*Elymus elymoides*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- saltlover (*Halogeton glomeratus*), other herbaceous
- clasping pepperweed (*Lepidium perfoliatum*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Concentration of salts or other chemicals
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Community 3.1
Grasses/Invaders/Saltbush

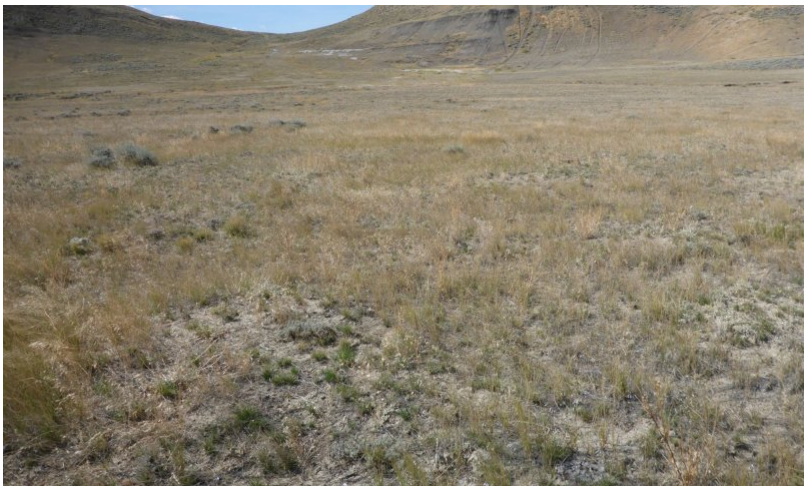


Figure 21. Gardner's saltbush, western wheatgrass, and Sandberg bluegrass community with a cheatgrass component.

Figure 22. Wildfire burn scars in a Saline Upland Clayey site with an component of cheatgrass and black greasewood.

This Community phase will resemble the Reference State communities (1.1, 1.2, and 1.3) but will have the presence of invasive species such as cheatgrass, halogeton, and knapweeds. The herbaceous species structural and functional groups still exist, but are decreasing in vigor and composition. If managed, the weed invasion can be minimal and change of this site may occur very slowly. Degradation of the site could be exacerbated by prolonged drought conditions, fire, or other disturbances. Fire in the Saline Upland Clayey ecological site was said to be not a risk. However, the added fuels of invasive species, namely cheatgrass, can provide the needed conditions to allow a fire to occur. In 2018, a lightening strike within the Oregon Basin of Wyoming, produced a fire the burned several hundred acres, included a sizable patch of Saline Upland Clayey. This community was in the Grasses/Invaded/Saltbush community 3.1. This community had a small cover of black greasewood with an understory component of cheatgrass. The fire burned quickly across the landscape, but the low structure and fuels under the saltbush and greasewood allowed hot spots that created significant burn scars in these areas. The site will be evaluated as healing and succession occurs to determine the long-term effects of a fire. So although it occurs, fire is still rare on these communities and is not considered a major risk overall. The variability in composition between other weedy species that are commonly found with cheatgrass affect the production of these sites, so at this time, sufficient data has not been collected to provide an average production figure. Site specific analysis is recommended for planning.

Resilience management. Rangeland Health Indicators: The plant community is relatively resistant to change; however, the invasive species will continue to increase if not managed. The other herbaceous species are well adapted to grazing and drought conditions. The plant composition is mostly intact and plant vigor and replacement capabilities are reduced but sufficient. Water flow patterns and litter movement may occur, but is not extensive. Instances of pedestalling is minimal. Soils are mostly stable and the surface shows minimal soil loss. The watershed is functioning and the biotic community is intact. The weedy species that encroach into this community determine the benefits or risks associated. Invasive species, in general, are able to colonize in the inter-spaces of the community, reducing bare ground, increasing water infiltration, and ultimately creating a more stable soil. The consequence is an increase in fire risk due to the added bio-fuels. This is especially true with cheatgrass.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- birdfoot sagebrush (*Artemisia pedatifida*), shrub
- squirreltail (*Elymus elymoides*), grass
- Sandberg bluegrass (*Poa secunda*), grass
- cheatgrass (*Bromus tectorum*), grass
- woolly plantain (*Plantago patagonica*), other herbaceous
- field cottonrose (*Logfia arvensis*), other herbaceous
- plains pricklypear (*Opuntia polyacantha*), other herbaceous

Dominant resource concerns

- Compaction
- Aggregate instability
- Naturally available moisture use
- Plant productivity and health
- Plant structure and composition
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

Table 17. 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	10-30%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	20-30%

Table 18. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	20-40%	5-15%	0-5%
>0.5 <= 1	–	0-10%	0-5%	0-10%
>1 <= 2	–	–	–	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

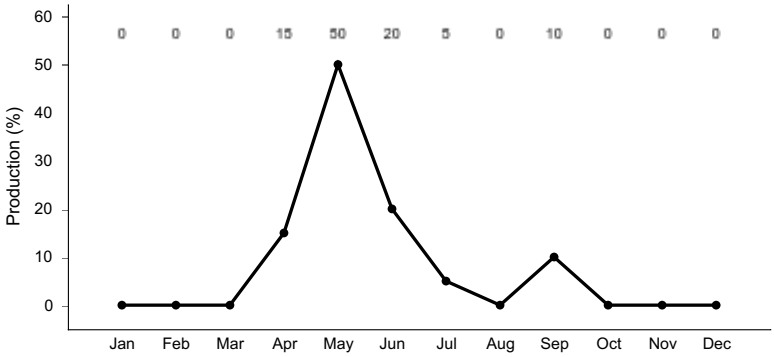


Figure 23. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Community 3.2
Invaders/Saltbush

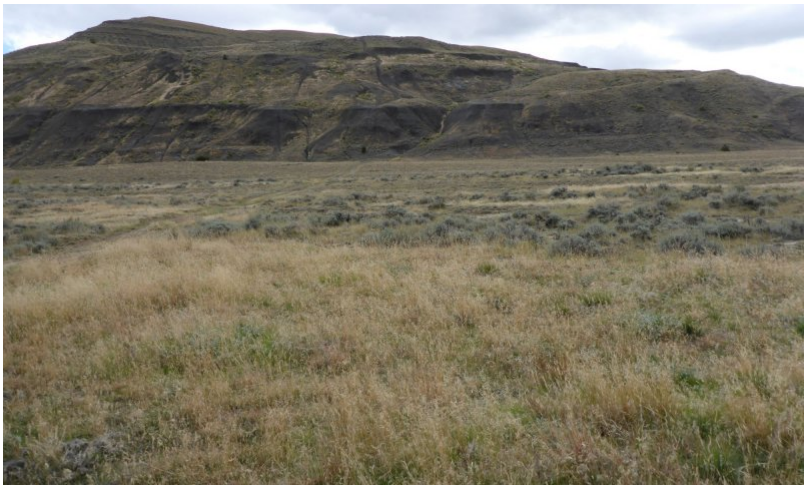


Figure 24. Cheatgrass and saltbush dominated community on the Saline Upland Clayey ecological site.

As annuals or other invasive species increase, the native grasses are weakened and eventually will be removed from the site. This will leave a saltbush community that has a dominant invasive partner. Cheatgrass may be a common threat on this site, but unlike the sagebrush counterpart, the Gardner’s saltbush is able to maintain and prevent the dense monoculture stands of cheatgrass that increases the fire risk, reducing the risk of the loss of Gardner’s saltbush from this community. However, Halogeton has recently been found to take over and slowly remove saltbush from a location, especially in the fine textured soils of this site. As other invasive species are brought into the Basin, the dynamics of this site will vary depending on the specific species. Due to the variable productivity and the extent of interaction with saltbush, it is difficult to identify the potential productivity without completing a site specific evaluation.

Resilience management. Rangeland Health Indicators: This plant community is resistant to change as the stand becomes more decadent. Continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the plant community. Plant diversity is greatly altered and the herbaceous component is not intact. Recruitment of perennial grasses is not occurring and the replacement potential is minimal. The biotic integrity is missing.

Dominant plant species

- Gardner's saltbush (*Atriplex gardneri*), shrub
- cheatgrass (*Bromus tectorum*), grass
- field cottonrose (*Logfia arvensis*), other herbaceous
- clasping pepperweed (*Lepidium perfoliatum*), other herbaceous

Dominant resource concerns

- Sheet and rill erosion
- Compaction
- Concentration of salts or other chemicals
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Feed and forage imbalance
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

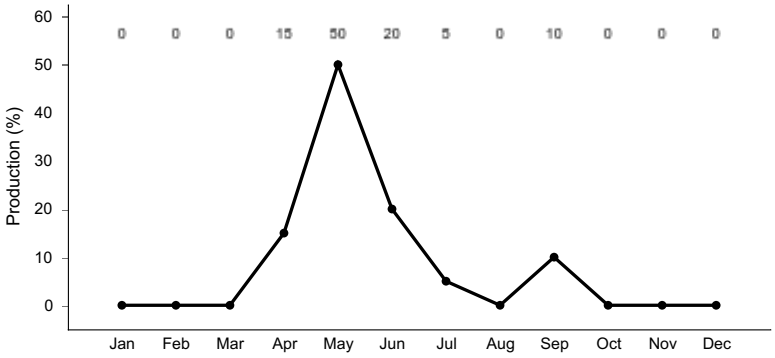
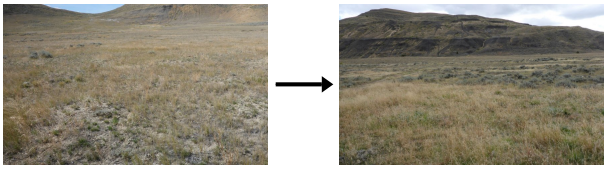


Figure 25. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

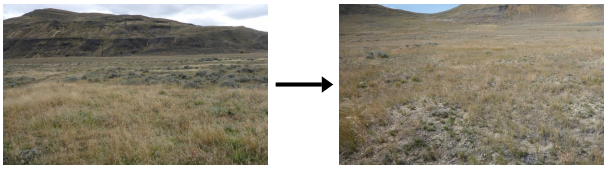
Pathway 3.1A
Community 3.1 to 3.2



Grasses/Invaders/Saltbush **Invaders/Saltbush**

No use/management, persistent drought, frequent and severe grazing, further disturbance–Once invasive species have gained a niche in a community no use is comparable to no management or over use. Drought on its own can force a community to change very quickly. Disturbances such as energy development, mining, or recreation, assist in providing a seed source. Soil disturbance opens the seedbed to initiate the establishment invasive species, allowing the problem to quickly across the landscape.

Pathway 3.2A
Community 3.2 to 3.1



Invaders/Saltbush **Grasses/Invaders/Saltbush**

Integrated pest management or invasive species control with long-term prescribed grazing–In areas where there are still remnant populations of the cool-season perennial grasses, if weed control is put into place and grazing management occurs to protect the perennial grass species, this site has the potential to improve slightly.

Conservation practices

Integrated Pest Management (IPM)

Upland Wildlife Habitat Management
Prescribed Grazing
Invasive Plant Species Control

State 4
Altered

Many of the sites identified have been near areas that are actively mined for bentonite, oil and gas, or have been used for recreational vehicles. The level and extent of disturbance varies greatly between each of these uses. Climate, degree of disturbance, type of disturbance, and the resources surrounding each location must be considered with this state.

Characteristics and indicators. The Altered State is to capture areas where surface disturbance has removed the native vegetation or where the site has been treated to improve or enhance the native community resulting in a non-native composition.

Resilience management. Climatic conditions and soil limitations restrict the feasibility of manipulating the native vegetation or degraded sites with much success. Additional inputs to help improve soil quality as well as artificial watering systems to assist in seedling establishment have been costly, and troublesome. Irrigating these sites has created issues with surface crusting, inhibiting seedling emergence. Intensity and timing of precipitation has proved risky and nearly impossible to achieve a high level of success. However, some areas have had acceptable establishment with introduced or improved varieties of species.

Community 4.1
Altered

Small acreages of abandoned lands have been created over an extended period of time. Changes in irrigation systems, land management or ownership, as well as extended periods of drought have shifted acres of the Saline Upland Clayey ecological site to a degraded state. Irrigation of these sites is difficult, and many times attempts to farm these areas are short lived, but the change to the soil or plants are long-lasting. Once the soil has been tilled or mechanically worked, the structure and function of the site is altered. These changes prevent the site from returning to a true Reference State. Many times the disturbances are due to vehicle traffic from mining, farming, or recreation. Over time the saltbush is degraded and then removed from the site. Oil and gas development remove all vegetation to create pad sites, leaving raw and compacted soils susceptible to weeds. Many times when these locations are left to recover by natural forces, they become weed-dominated or slowly transition through several stages of primary succession, creating a community that is variable with productivity related closer to the disturbance rather than to the communities that exist. In select locations introduced seedings were completed and then were left to adapt to the climate. Many of these sites are still visible on the landscape with a distinctive community or a row pattern in the vegetation. Crested wheatgrasses and Russian wildrye were the primary species utilized in the seedings during the late 1940s to the early 1980s. The persistence of these species and the furrows or drill rows help to quickly identify these locations. In other instances, the edge of the pad site, or edge effect of fields, roads, etc. are still visible on aerial photography. Because of the noted variability, estimation or average production has not been attempted. The selected growth curve is typical for the climate, not taking into consideration the variety of plant species that are present. Site-specific evaluation needs completed to accurately capture the potential productivity and growth curves.

Resilience management. The climatic challenges (low amount, high-intensity, scattered rainfall and variable spring temperatures) with the soil limitations (heavy textures prone to surface sealing and high salt, sodium, or gypsum content) make seeding or reestablishing vegetation challenging. There are new cultivars that will tolerate the conditions, but the cost and risk analysis must be considered in the reclamation process. This community has not been identified to recover to a natural community within a specified time frame.

Dominant resource concerns

- Sheet and rill erosion
- Wind erosion
- Ephemeral gully erosion

- Classic gully erosion
- Compaction
- Concentration of salts or other chemicals
- Aggregate instability
- Sediment transported to surface water
- Plant productivity and health
- Plant structure and composition
- Feed and forage imbalance
- Inadequate livestock shelter
- Inadequate livestock water quantity, quality, and distribution

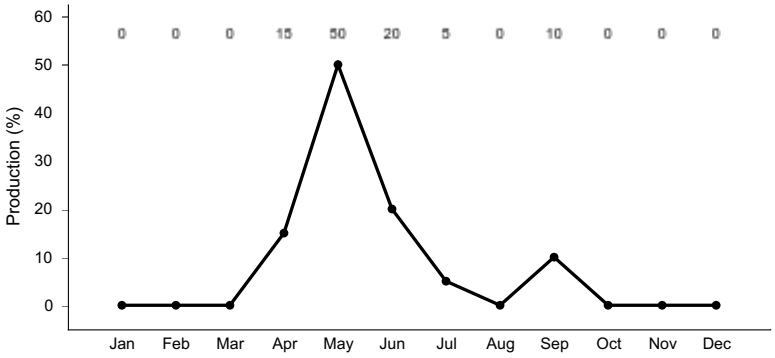


Figure 26. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Transition T1A
State 1 to 2

Frequent, severe grazing and drought–When these communities are used year-long with no recovery and multiple uses per growing season, the mid-stature cool-season grasses will be removed or reduced to a very trace composition on the site. If it is again exacerbated with prolonged drought, the community will become a saltbush-dominant or monoculture stand.

Constraints to recovery. The lack of seed source and the harsh environment created by the heavy clay soils limits the ability for seedling establishment.

Transition T1B
State 1 to 3

Drought, disturbance or overuse with seed source present–When drought or a disturbance such as overuse by grazers occurs, the vulnerability of the state is opened and when there is a seed source present, invasive species can gain a foothold quickly due to the open canopy and low plant density.

Constraints to recovery. The difficulty to eradicate invasive species hinders the ability for the recovery of this State.

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing; seeding with no to only minimal ground disturbance, cultural seeding practices–With extended grazing management, allowing rest and rotation, these sites may be prevented from further degradation, and will see a return to the Reference State composition over very extended periods. Trials have been completed on an informal basis of broadcast seeding sites in the fall and winter, and then feeding hay over them. This works to incorporate organics that will increase infiltration, provide nutrients to the site as well as prevent erosion, and allow for a small amount of establishment of species. Although the scientific studies have not addressed this in the Basin, it has been seen to have a small success in isolated areas.

Conservation practices

Range Planting
Upland Wildlife Habitat Management
Prescribed Grazing

Transition T2A
State 2 to 3

Disturbance with seed source present, drought–Ground disturbance from recreation, energy development, or other activities provides a means to introduce a seed source into an already vulnerable community with the high bare ground and open canopy. Drought provides further stress on the saltbush, reducing vigor, and allowing species such as halogeton and cheatgrass to gain a foothold in the community.

Constraints to recovery. The difficulty to eradicate weeds limits the recovery potential of this community.

Transition T2B
State 2 to 4

Mechanical grazing land treatment (furrowing or pitting), seeding–Several locations throughout the Big Horn Basin have been contour furrowed with a range plow with a 5-foot interval. In some areas non-native seedings were implemented while others had no seedings completed. The furrows assisted in catching and holding more moisture and provided a zone where establishment could take place. Overall improvements were seen to persist on these treated locations for over 20 years; however, the process is quite expensive with low returns (long-term species response).

Constraints to recovery. The limitations of the soil for seedling establishment is the major constraint to recovery. With the use of newer seeding techniques and soil amendments with salt-affected, heavy textured soils, better success rates are being seen.

Conservation practices

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting

Restoration pathway R3A
State 3 to 2

Integrated pest management, invasive weed control, long-term prescribed grazing - As was mentioned previously, it is known that with favorable weather and management, Gardner’s saltbush will respond and gain productivity, if a presence is there before treatments begin. The process is very slow and requires continual maintenance of the site to prevent halogeton from returning.

Context dependence. If cheatgrass is the invasive species of concern, then recovery is not a potential, but halogeton is containable to allow recovery of this State.

Conservation practices

Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Prescribed Grazing
Invasive Plant Species Control

Restoration pathway R3B

State 3 to 4

Integrated pest management or invasive species control, grazing land mechanical treatment, seeding–With the improved varieties of plant materials that are available for salt-affected soils, seeding sites has become a more feasible solution. However, control of the invasive species with long-term grazing management as well as mechanical preparation and seeding will be required to have any level of success. Success will still be minimal due to the limiting climatic conditions that exist within the Big Horn Basin.

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
Invasive Plant Species Control

Transition T4A
State 4 to 3

Continued disturbance or lack of use or management with seed source present –If a site is vulnerable and not established or if it is in a degraded state, many times these sites will be repeatedly misused or abused by vehicle traffic. These at-risk sites are vulnerable to weeds especially the aggressive invasive species that are within the Basin. Knapweed and halogeton, as well as cheatgrass have seed sources readily available and easily transported on tires, undercarriages, animals, and humans themselves.

Additional community tables

Table 19. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature, Cool-season Bunchgrass**			20–100	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	20–100	5–10
2	**Rhizomatous, Cool-season Grass**			0–10	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–10	0–5
3	**Short-stature, Cool-season Bunchgrass**			5–25	
	squirreltail	ELEL5	*Elymus elymoides*	5–20	5–10
	Sandberg bluegrass	POSE	*Poa secunda*	0–5	0–5
4	**Mid-stature, Warm-season Tillering Grass**			0–10	
	alkali sacaton	SPAI	*Sporobolus airoides*	0–10	0–2
Forb					
5	**Perennial Forbs**			0–50	
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–25	0–5
	fleabane	ERIGE2	*Erigeron*	0–25	0–2
	desertparsley	LOMAT	*Lomatium*	0–5	0–5
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–5	0–5
	textile onion	ALTE	*Allium textile*	0–5	0–2
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	0–2
Shrub/Vine					
6	**Dominant Shrubs**			100–300	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	100–300	20–40
7	**Miscellaneous Shrubs**			0–50	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–25	0–20
	seepweed	SUAED	*Suaeda*	0–25	0–10
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–10	0–2

Table 20. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature, Cool-season Bunchgrass**			0–5	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–5	0–2
2	**Rhizomatous, Cool-season Grass**			0–10	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–10	0–5
3	**Short-stature, Cool-season Bunchgrass**			10–75	
	squirreltail	ELEL5	*Elymus elymoides*	10–50	5–15
	Sandberg bluegrass	POSE	*Poa secunda*	0–25	0–5
4	**Miscellaneous Grasses**			0–10	
	Grass, perennial	2GP	*Grass, perennial*	0–10	0–5
Forb					
5	**Perennial Forbs**			5–30	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–20	0–5
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–10	0–5
	tansyaster	MACHA	*Machaeranthera*	0–5	0–5
	textile onion	ALTE	*Allium textile*	0–5	0–2
	Forb, perennial	2FP	*Forb, perennial*	0–5	0–2
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–5	0–2
	desertparsley	LOMAT	*Lomatium*	0–5	0–2
6	**Annual Forbs**			0–20	
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	0–5
	Forb, annual	2FA	*Forb, annual*	0–5	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–5	0–2
Shrub/Vine					
7	**Dominant Shrub**			50–200	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	50–200	20–35
8	**Miscellaneous Shrubs**			0–100	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–100	0–20
	seepweed	SUAED	*Suaeda*	0–10	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–10	0–5
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–10	0–2

Table 21. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid-stature, Cool-season Bunchgrass**			0–5	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–5	0–2
2	**Rhizomatous, Cool-season Grass**			0–5	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–5	0–2
3	**Short-stature, Cool-season Bunchgrass**			10–50	
	Sandberg bluegrass	POSE	*Poa secunda*	10–50	5–10
	squirreltail	ELEL5	*Elymus elymoides*	0–5	0–2
4	**Miscellaneous Grasses**			0–5	
	Grass, perennial	2GP	*Grass, perennial*	0–5	0–5
Forb					
5	**Perennial Forbs**			0–50	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–25	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–5	0–5
	smooth woodyaster	XYGL	*Xylorhiza glabriuscula*	0–5	0–5
	tansyaster	MACHA	*Machaeranthera*	0–5	0–5
	textile onion	ALTE	*Allium textile*	0–5	0–2
	desertparsley	LOMAT	*Lomatium*	0–5	0–2
6	**Annual Forbs**			0–30	
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	0–5
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–10	0–2
	mustard	BRASS2	*Brassica*	0–5	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–5	0–2
	Forb, annual	2FA	*Forb, annual*	0–5	0–2
Shrub/Vine					
7	**Dominant Shrubs**			50–250	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	50–250	20–40
8	**Miscellaneous Shrubs**			0–50	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–50	0–20
	seepweed	SUAED	*Suaeda*	0–25	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–10	0–5

Table 22. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Miscellaneous Grasses**			0–5	
	alkali sacaton	SPAI	*Sporobolus airoides*	0–5	0–2
	Grass, perennial	2GP	*Grass, perennial*	0–5	0–2
Forb					
3	**Perennial Forbs**			0–20	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	0–2
	woodyaster	XYLOR	*Xylorhiza*	0–5	0–2
	Forb, perennial	2FP	*Forb, perennial*	0–5	0–2
	desertparsley	LOMAT	*Lomatium*	0–5	0–2
4	**Annual Forbs**			0–30	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–10	0–5
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	0–5
	Wilcox's woollystar	ERWI	*Eriastrum wilcoxii*	0–5	0–2
	mustard	BRASS2	*Brassica*	0–5	0–2
	Forb, annual	2FA	*Forb, annual*	0–5	0–2
Shrub/Vine					
5	**Dominant Shrubs**			50–350	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	50–350	20–40
6	**Miscellaneous Shrubs**			0–100	
	birdfoot sagebrush	ARPE6	*Artemisia pedatifida*	0–100	0–10
	seepweed	SUAED	*Suaeda*	0–10	0–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–5	0–2

Animal community

Animal Community – Wildlife Interpretations:

1.1 – Indian Ricegrass/Gardner’s Saltbush: Perennial Bunchgrasses/Gardner’s Saltbush: 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 for in wildlife habitat management. 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.

1.2 – Perennial Bunchgrasses/Gardner’s Saltbush: 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 for in wildlife habitat management. 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.

2.1 – Gardner’s 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 for in wildlife habitat management. 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.

3.1 – Invaded/Gardner’s 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.

4.1 – Altered (Disturbed and Restored/Reclaimed): This is not a desirable plant community to select as a wildlife habitat management objective. After establishment, this community exhibits a low level of plant species diversity. However, seeds produced by seeded species may serve as a forage source for sage grouse and other birds as well as grassland obligate small mammals. Depending upon the stage of succession, or selected seed mixture, 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 plant community (as described in this ecological site description). Because of this, a field visit is recommended in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
The carrying capacity is calculated as the production (normal year) X .25 efficiency factor / 912.5 lbs. /AUM (Animal Unit Month, the amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for one month) to calculate the AUMs/Acre.

Plant Community Description/Title lbs./Acre ; AUM/Acre* ; Acres/AUM*
Below Ave.-Normal-Above Ave.
1.1 Saltbush/Indian ricegrass 125 - 350 - 500 0.10 10.43
1.2 Saltbush/Squirreltail 75 - 200 - 400 0.05 18.25
1.3 Saltbush/Sandberg bluegrass 75 - 175 - 350 0.05 20.86
2.1 Saltbush/Bare ground 50 - 250 - 400 0.07 14.60
3.1 Grasses/Invaders/Saltbush ** ** ** ** **
3.2 Invaders/Saltbush ** ** ** ** **
4.1 Disturbed/Degraded ** ** ** ** **

* Carrying capacity is figured for continuous, season-long grazing by cattle under average growing conditions.
** Sufficient data for invaded and reclaimed communities has not yet been collected or evaluated, so no projection of a stocking rate recommendation or production range will be established at this time.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use must be supplemented with protein because the forage quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect carrying capacity (grazing capacity) within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30 percent of the unit (i.e. 50 percent reduction on 30 percent of the management unit).

Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of grazeable acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Hydrological functions

Water and salinity are the principal factors limiting forage production on this site. Soils in the hydrologic group B and C dominate this site, with localized areas of hydrologic group D. Infiltration ranges from slow to moderate. Runoff potential for this site varies from moderate to very high depending upon soil hydrologic group and ground cover. In

many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies typically should not be present. Water flow patterns may be present but should be barely distinguishable. Pedestals are only slightly present in association with bunchgrasses such as bluebunch wheatgrass. 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 limited hunting opportunities for upland game species. Because of the raw nature of these sites, cultural artifacts can be viewed in the area of these sites especially along the drainageways that dissect the area. The locations generally are close or include a diverse geology that offers a chance to explore the unique and varied geology of the area. This ecological site, however, proves to be very 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 must be taken into consideration when crossing the area with trails or roadways. The site generally is rough as well, and provides no soft cover for camping or resting. The extent of this ecological site is found within three different wild horse ranges: Pryor Mountain, McCullough Peaks, and 15 Mile. Wild horse and wildlife excursions are found as recreational venues for BLM lands and State Lands within the Big Horn Basin.

Wood products

No appreciable wood products are present on this site.

Other products

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

Ornamental Species: The flowering forbs of this site have been found useful in landscaping and xeriscaping. The shrub component has been cultivated to serve as a conservation planting 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 also were 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.

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; and 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 two of these estimated points, with two 21 ft. X 21 ft. square extended shrub plots)
• Line Point Intercept (overstory and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect
• Continuous Line Intercept (Woody canopy cover, with minimum gap of 0.2 foot for all woody species and succulents. Intercept height collected at each measurement.)
• Gap Intercept (Basal Gap measured with a minimum gap requirement of 0.7 foot.)
• Sample Point (Ten 1-meter square point photographs taken at set distances on transect. Read using the sample point computer program established by the High Plains Agricultural Research Center, WY.)
• Soil Stability (Slake test: surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

Type locality

Location 1: Big Horn County, WY	
Township/Range/Section	T52N R94W S19
UTM zone	N
UTM northing	4927536
UTM easting	723121
Latitude	44° 28′ 0″
Longitude	108° 11′ 41″
General legal description	647m N, 263m W, NE Corner of sec. 4.1 mi E. of Emblem, WY on Hwy 16, S. 1.5 mi Cty Rd. 14. 6.3 mi E. Bench Canal Rd. 3.75 mi E. Utility Access Rd. 108 m S. of Rd.

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Approval

Kirt Walstad, 3/04/2025

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
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Date	01/24/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present.

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2. **Presence of water flow patterns:** Barely observable. Some minor evidence of water flow patterns may be found winding around perennial plant bases with little evidence of erosion and they are short (< 5 ft).

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3. **Number and height of erosional pedestals or terracettes:** Not evident on slopes less than 5%, Plant roots are covered and most litter remains in place around plant crowns. Erosional pedestals will be present with terracettes at debris dams on slopes greater than 5% (both pedestals and terracettes should be less <1 inch in height).

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** *Bare Ground* is between 45 and 70%, occurring in small openings throughout the site. Canopy gaps comprise up to 45% of the ground surface, and are primarily in the 1-2 foot category (>50% of total gaps). No canopy gaps >6 feet should be present.

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5. **Number of gullies and erosion associated with gullies:** Active gullies restricted to concentrated water flow patterns.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None

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7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Plant litter remains in place and is not moved by erosional forces. As site increases in slope greater than 9% expect movement increase.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and littler average 30% or greater of the soil surface and maintains soil surface integrity. The soil stability class is found to average 3.2 ranging from 1 (interspaces) to 6 (under canopy).

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The soil surface structure is moderate moderate granular (moderate fine subangular or angular blocky parting to granular) with a surface depth of 2 to 7 inches (5- 15 cm). The dry surface Colors are generally in the 10YR to 7.5YR range with a Hue of 6 and a Chroma of 3. Organic matter in the surface ranges from 0.5 to 1.0.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The expected potential is low with composition consisting of 15% grasses, 10% forbs, and 75% shrubs (woody species). The grasses tend be "patchy" in nature finding depressions or concave landscape positions to occupy where the forbs are more evenly dispersed. Basal cover is typically less than 5% for this site and does very little to effect runoff on this site.Sparse plant canopy, the finer soil textures, and the high amount of bare ground contribute to slow to moderate infiltration rates. The amount of bare ground and slow infiltration rates result in a naturally higher runoff rate even in reference state.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be present.

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

    Dominant: 1.1: Shrubs>>Mid-stature grasses>Forbs>Rhizomatous grasses

    Sub-dominant: 1.2: Shrubs>>Short-stature grasses>Forbs>Rhizomatous grasses=Mid-stature grasses

    Other: 1.3: Shrubs>>Short-stature grasses=Forbs>Mid-stature grasses=Rhizomatous grasses

    Additional: 12b. Functional/Structural Groups not expected: Annual Grasses
    12c. Number of Functional/ Structural Groups: 3
    12d. Number of Functional/Structural Species: 2

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very Low, but some plant mortality and decadence is expected. It is common to find dead matter accumulated in bunchgrasses such as Indian ricegrass, but live plant matter quantity should exceed standing dead except for in times of severe drought.

14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 5 to 20% with an average of 10% litter cover between plants; reaching a high of 30 under plants. Herbaceous litter depth typically ranges from 3-10 mm, and woody litter ranges from 2-6 mm.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1.1 Average Annual Production is 200 lbs. (90 kg) ranging from 75 to 400 lbs. (34-181 kg) production.
1.2 Average Annual Production is 350 lbs. (158 kg) ranging from 125 to 500 lbs. (57-227 kg) production.
1.3 Average Annual Production is 175 lbs. (79 kg) ranging from 75 to 350 lbs. (34-158 kg) production.

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, annual false wheatgrass, false buffalograss, Sandberg bluegrass, smooth woodyaster, and a variety of native annual forbs will invade the site as it degrades. Invasive species that are common include but are not limited to: Halogeton, Cheatgrass, Knapweeds and Thistles. For a current and more complete list consult the County and State Weed and Pest Noxious Weed List.

17. **Perennial plant reproductive capability:** May be limited due to effective moisture and seed/soil contact. Western wheatgrass will
commonly reproduce by underground rhizomes and not by seed production.