Ecological site EX044B01A093
Saline Upland (SU) LRU 01 Subset A

Last updated: 9/11/2023
Accessed: 05/19/2024

General information

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

MLRA notes

Major Land Resource Area (MLRA): 044B–Central Rocky Mountain Valleys

Major Land Resource Area (MLRA) 44B, Central Rocky Mountain Valleys, is nearly 3.7 million acres of southwest Montana and borders two MLRAs: 43B Central Rocky Mountains and Foothills and 46 Northern and Central Rocky Mountain Foothills.

The major watersheds of this MLRA are those of the Missouri and Yellowstone Rivers and their associated headwaters such as the Beaverhead, Big Hole, Jefferson, Ruby, Madison, Gallatin, and Shields Rivers. These waters allow for extensive irrigation for crop production in an area that would generally only be compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs that supply irrigation water, hydroelectric power, and municipal water. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River.

The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay), but there is some limited mining. Urban development is high with large expanses of rangeland converted to subdivisions for a rapidly growing population.

The MLRA consists of one Land Resource Unit (LRU) and seven climate based LRU subsets. These subsets are based on a combination of Relative Effective Annual Precipitation (REAP) and frost free days. Each subset expresses a distinct set of plants that differentiate it from other LRU subsets. Annual precipitation ranges from a low of 9 inches to a high near 24 inches. The driest areas tend to be in the valley bottoms of southwest Montana in the rain shadow of the mountains. The wettest portions tend to be near the edge of the MLRA at the border with MLRA 43B. Frost free days also vary widely from less than 30 days in the Big Hole Valley to around 110 days in the warm valleys along the Yellowstone and Missouri Rivers.

The plant communities of the MRLA are highly variable, but the dominant community is a cool-season grass and shrub-steppe community. Warm-season grasses have an extremely limited extent in this MLRA. Most subspecies of big sagebrush are present, to some degree, across the MLRA.

LRU notes

MLRA 44B has one LRU that covers the entire MLRA. The LRU has been broken into seven climate subsets based on a combination of Relative Effective Annual Precipitation (REAP) and frost free days. Each combination of REAP and frost free days results in a common plant community that is shared across the subset. Each subset is giving a letter designation of A through F for sites that do not receive additional water and Y for sites that receive additional water.

LRU 01 Subset A has a REAP of nine to 14 inches (228.6-355.6mm) with a frost free days range of 70 to 110 days. This combination of REAP and frost free days results in a nearly treeless sagebrush steppe landscape.

The soil moisture regime is Ustic, dry that borders on Aridic and has a Frigid soil temperature regime.

Classification relationships

Mueggler and Stewart. 1980. Grassland and Shrubland habitat types of Western Montana
1. *Sarcobatus vermiculatus*/Elymus cinereus h.t.
2. *Sarcobatus vermiculatus*/Agropyron smithii h.t.
3. Agropyron spicatum/Agropyron smithii h.t.

EPA Ecoregions of Montana, Second Edition:
Level I: Northwestern Forested Mountains
Level II: Western Cordillera
Level III: Middle Rockies & Northern Great Plains
Level IV: Paradise Valley
Townsend Basin
Dry Intermontane Sagebrush Valleys
Shield-Smith Valleys

National Hierarchical Framework of Ecological Units:
Domain: Dry
Division: M330 – Temperate Steppe Division – Mountain Provinces
Province: M332 –Middle Rocky Mountain Steppe – Coniferous Forest – Alpine Meadow
Section: M332D – Belt Mountains Section
M332E – Beaverhead Mountains Section
Subsection: M332Ej – Southwest Montana Intermontane Basins and Valleys
M332Dk – Central Montana Broad Valleys

Ecological site concept

The Saline Upland ecological site is an upland site formed from alluvium or slope alluvium. The site does not receive additional moisture from a water table or flooding. It is moderately deep to very deep and has no root-restrictive layers within 20 inches (50cm). The surface of the site has less than five percent stone cover. The site has saline or saline-sodic influence within four inches of the mineral surface. The Saline Upland ecological site is dominated by salt tolerant plants.

Associated sites

EX044B01A006	**Claypan (Cp) LRU 01 Subset A** The Claypan ecological site may express a similar plant community and may be on the landscape position either immediately above or immediately below the Saline Upland ecological site.
EX044B01A030	**Limy (Ly) LRU 01 Subset A** The Limy ecological site can be found on the landscape immediately above the Saline Upland site.

Similar sites

EX044B01A006	**Claypan (Cp) LRU 01 Subset A** The Claypan ecological site has a similar plant community presence, but it has a highly sodic influenced soil, which affects the ecological processes as well as the state and transition model.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus* (2) *Artemisia tridentata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Pascopyrum smithii*

Legacy ID

R044BA093MT

Physiographic features

The Saline Upland ecological site primarily exists at the toe slope position on fan remnants, hillslopes, and stream terrace risers. Slopes are variable, ranging from nearly level to 30 percent.

Local vernacular describes the site as a "bathtub ring" of the valleys, as the soil may appear slightly white. Despite the fact that the saline upland site is not associated with ground water, capillary fringe from soil moisture flow through pulls salts to the soil surface, turning the bare ground white at the discharge.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Landforms	(1) Intermontane basin > Fan remnant (2) Intermontane basin > Eroded fan remnant (3) Intermontane basin > Stream terrace (4) Intermontane basin > Hillslope
Flooding frequency	None to rare
Elevation	1,219–1,981 m
Slope	0–30%
Water table depth	102 cm
Aspect	Aspect is not a significant factor

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. Fifty to sixty percent of the annual long-term average total precipitation falls between May and August. Snow on frozen ground makes up the majority of winter precipitation. The average precipitation for LRU 01 Subset A is 12 inches (305mm), and the frost-free period averages 78 days. Precipitation is highest in May and June. Some of Montana’s driest areas are located in sheltered mountain valleys because of the rain-shadow effects on the leeside of some ranges.

Table 3. Representative climatic features

Frost-free period (characteristic range)	70-110 days
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	229-356 mm
Frost-free period (actual range)	70-110 days
Freeze-free period (actual range)	110-140 days
Precipitation total (actual range)	229-356 mm
Frost-free period (average)	78 days
Freeze-free period (average)	125 days
Precipitation total (average)	305 mm

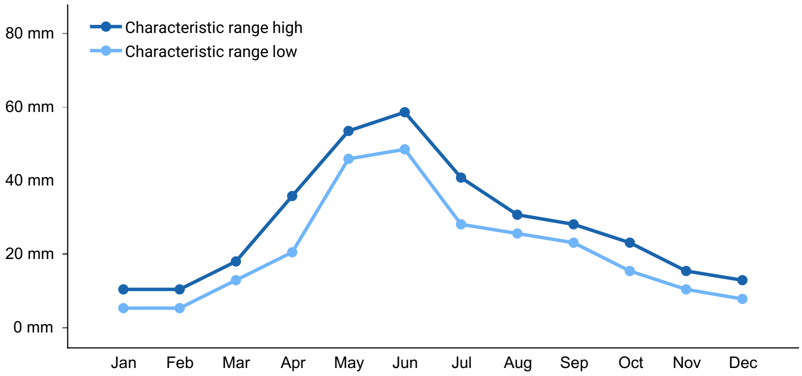


Figure 1. Monthly precipitation range

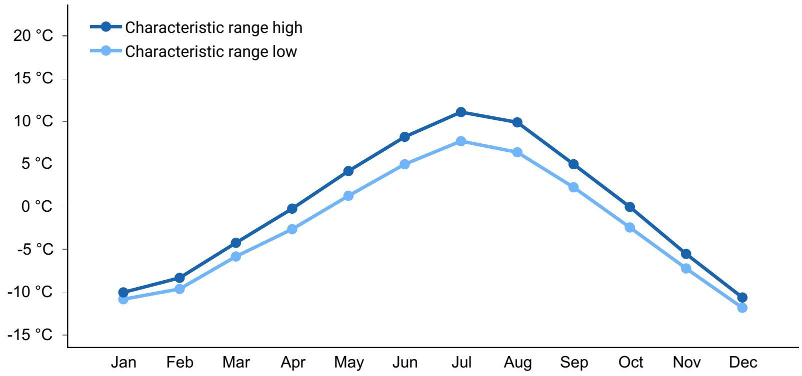


Figure 2. Monthly minimum temperature range

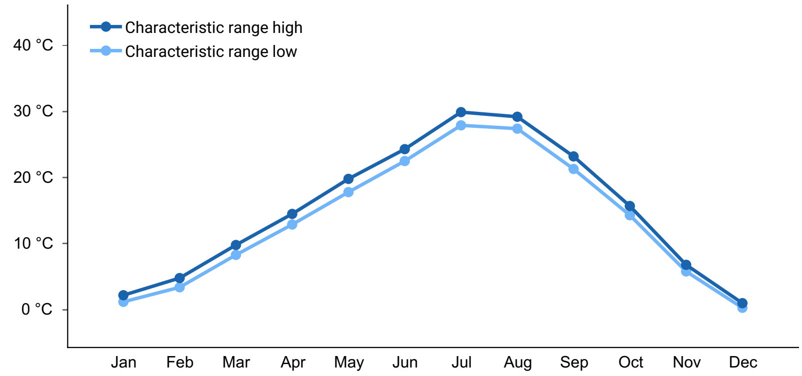


Figure 3. Monthly maximum temperature range

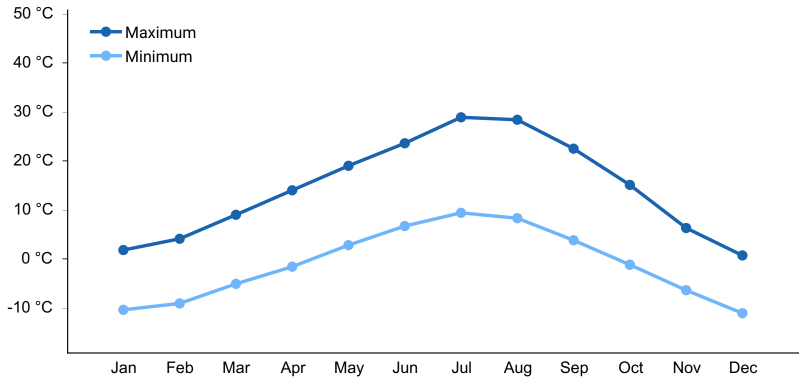


Figure 4. Monthly average minimum and maximum temperature

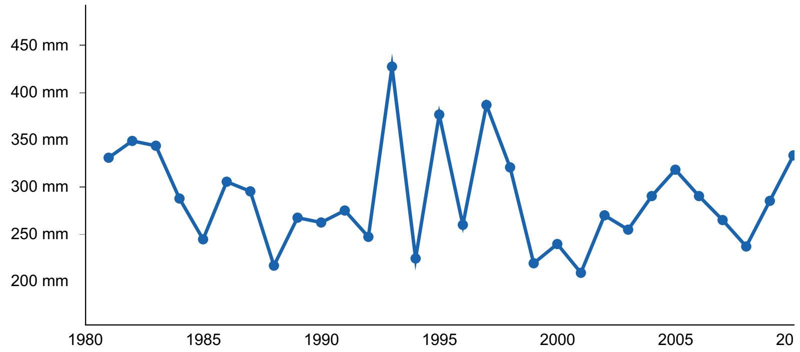


Figure 5. Annual precipitation pattern

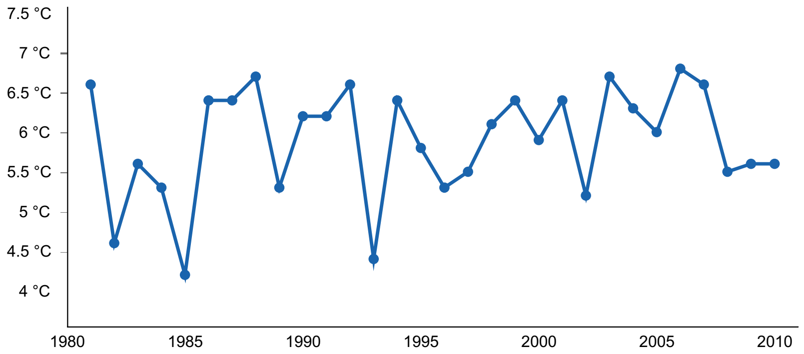


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DEER LODGE 3 W [USC00242275], Deer Lodge, MT
- (2) DILLION U OF MONTANA WESTERN [USC00242409], Dillon, MT
- (3) GLEN 2 E [USC00243570], Dillon, MT
- (4) ENNIS [USC00242793], Ennis, MT
- (5) BOULDER [USC00241008], Boulder, MT
- (6) GARDINER [USC00243378], Gardiner, MT
- (7) TOWNSEND [USC00248324], Townsend, MT
- (8) TRIDENT [USC00248363], Three Forks, MT
- (9) TWIN BRIDGES [USC00248430], Sheridan, MT
- (10) WHITE SULPHUR SPRNGS 2 [USC00248930], White Sulphur Springs, MT
- (11) DILLON AP [USW00024138], Dillon, MT
- (12) HELENA RGNL AP [USW00024144], Helena, MT

Influencing water features

The site does not have a water table; however, capillary fringe, evapotranspiration, and soil moisture throughflow bring salts toward the surface.

Wetland description

This site is not associated with wetland characteristics.

Soil features

These soils are moderately deep to very deep, have moderately slow to moderately rapid permeability, and are well drained. These soils are formed from alluvium. Typically, soil surface textures consist of loam, silt loam, and clay loam textures. The common soil series in this ecological site includes Littletable and Trudau. These soils may exist across multiple ecological sites due to natural variations in slope, texture, rock fragments, and pH.

Table 4. Representative soil features

Parent material	(1) Alluvium–sedimentary rock
Surface texture	(1) Loam (2) Silt loam (3) Clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderately rapid
Soil depth	51–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.84–18.54 cm
Calcium carbonate equivalent (0-101.6cm)	3–40%
Electrical conductivity (0-101.6cm)	4–25 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–30
Soil reaction (1:1 water) (0-101.6cm)	7.4–9.6
Subsurface fragment volume <=3" (0-50.8cm)	0–20%
Subsurface fragment volume >3" (0-50.8cm)	0–5%

Ecological dynamics

The Saline Upland (SU) ecological site reference plant community is dominated by basin wildrye (*Leymus cinereus*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needle and thread (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), and thickspike wheatgrass (*Elymus lanceolatus*). Subdominant species may include black greasewood (*Sarcobatus vermiculatus*), basin big sage (*Artemisia tridentata* ssp. tridentata), and Gardner's saltbush (*Atriplex gardneri*i).

As the community changes away from reference, cool-season shortgrasses tend to increase. If allowed to continue, non-native grasses such as cheatgrass, field brome, and ventenata tend to take over the site. The amount of bare ground can increase exponentially during this time. The short-rooted nature of these grasses means erosion can occur rapidly.

Due to the saline nature of the soil on this site, it remains largely intact as a native rangeland system. Conversion to cropland is rarely successful and is extremely limited in extent.

Historical records indicate that, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Because of the nomadic nature and herd structure of bison, grazed areas received periodic, high-intensity, short-duration grazing pressure. Livestock forage was noted as being minimal in areas recently grazed by bison (Lesica and Cooper 1997). Meriwether Lewis documented that he was met by 60 Shoshone warriors on horseback in August 1805, and the Corps of Discovery was later supplied with horses by the same band of Shoshone. This suggests that the areas near the modern-day Montana towns of Twin Bridges, Dillon, Grant, and Dell were grazed by an untold number of horses for nearly 50 years prior to the large introduction of cattle and sheep. The gold boom of the 1860s brought the first herds of livestock overland from Texas, and homesteaders began settling the area. During this time, cattle were the primary domestic grazers in the area. In the 1890s, sheep production increased by more than 400 percent and dominated the livestock industry until the 1930s.

Since then, cattle production has dominated the region's livestock industry (Wyckoff and Hansen 2001).

Natural fire was a frequent ecological driver of this ecological site; however, due to the relatively low plant density and fire-resistant nature of the plants (saltbush and greasewood), stand replacement was rare. The reference community with a high amount of herbaceous growth as a result of favorable growing conditions has the highest susceptibility to extreme fire. A herbaceous invaded community that contains high amounts of exotic annual grasses can greatly increase the risk of fire frequency and intensity, resulting in the potential removal of native species.

Some of the major invasive species that can occur on this site include (but are not limited to) spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), cheatgrass (*Bromus tectorum*), Canada thistle (*Cirsium arvense*), dandelion (Taraxicum spp.), and Kentucky bluegrass (*Poa pratensis*). Invasive weeds have a high impact on this ecological site, and cheatgrass poses the highest risk of invasion.

Plant Communities and Transitions
A state and transition model for this ecological site is depicted below. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field data, field observations, and interpretations by experts. It is likely to change as knowledge increases.

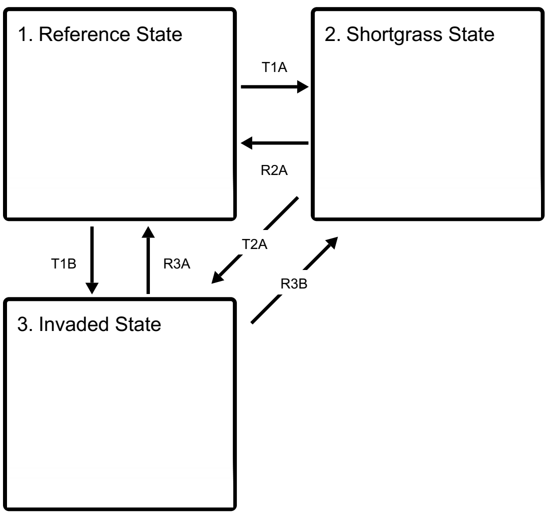
The plant communities within the same ecological site will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are intended to cover the core species and the known range of conditions and responses.

Both percent species composition by weight and percent canopy cover are referenced in this document. Canopy cover drives the transitions between communities and states because of the influence of shade, the interception of rainfall, and the competition for available water. Species composition by dry weight remains an important descriptor of the herbaceous community and of the community as a whole. Woody species are included in the species composition for the site. Calculating the similarity index requires species composition by dry weight.

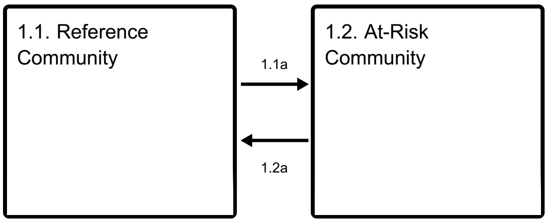
Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), no quantitative information exists that specifically identifies threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer et al. (2003), Bestelmeyer et al. (2004), Bestelmeyer and Brown (2005), and Stringham et al. (2003).

State and transition model

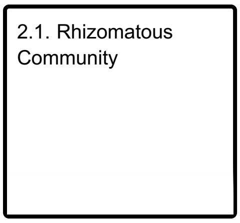
Ecosystem states



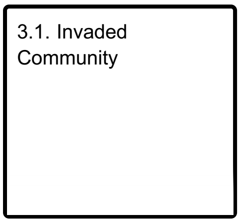
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The Reference State of this ecological site consists of two known potential plant communities, the Reference Community (1.1) and the Wheatgrass Community (1.2). These are described below but are generally characterized by a mid-statured, cool-season grass community with limited shrub production. Community 1.1 is dominated by basin wildrye and bluebunch wheatgrass and is considered the reference, while Community 1.2 has a codominance of basin wildrye, bluebunch wheatgrass, and western wheatgrass with an increase in basin big sagebrush. These communities may meld into each other due to the varying conditions that occur in southwest Montana, particularly during dry cycles.

Community 1.1
Reference Community

In the Reference Community, basin wildrye, bluebunch wheatgrass, and western wheatgrass are dominant. On the driest of sites, basin wildrye is often reduced to small patches as a subdominant species. Sandberg bluegrass, inland saltgrass, and prairie Junegrass are also components of the reference state. Basin big sagebrush, Wyoming big sagebrush, and black greasewood are the dominant shrubs. Gardner's saltbush, winterfat, and low sagebrush (*Artemisia arbuscula*) are minor components.

Dominant plant species

- big sagebrush (*Artemisia tridentata*), shrub
- greasewood (*Sarcobatus vermiculatus*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- basin wildrye (*Leymus cinereus*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- saltgrass (*Distichlis spicata*), grass
- scarlet globemallow (*Sphaeralcea coccinea*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- curlycup gumweed (*Grindelia squarrosa*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	404	538	628
Shrub/Vine	76	101	118
Forb	25	34	39
Total	**505**	**673**	**785**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-3%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	0-1%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-3%
Bedrock	0%
Water	0%
Bare ground	10-20%

Table 7. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	10-20%
Grass/grasslike basal cover	30-45%
Forb basal cover	3-10%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-3%
Bedrock	0%
Water	0%
Bare ground	10-20%

Community 1.2
At-Risk Community

The At-Risk Community is distinguished by a plant community dominated by midstatured bunchgrasses and rhizomatous grasses, with an increase in forbs and shrubs. This is typically a result of non-prescribed grazing removing some of the basin wildrye and bluebunch wheatgrass. In fact, basin wildrye may be at such a low density that it no longer contributes to the structural integrity of the community. This community is extremely susceptible to invasive non-native species due to an increase in bare ground expected due to a reduction of basal area occupied by the larger bunchgrasses. In this community, cheatgrass possibly exists in a trace amount, which poses a risk to the hydrologic function, biotic integrity, and site stability due to its shallow root structure and ability to overtake areas.

Pathway 1.1a
Community 1.1 to 1.2

The community pathway from the Reference Community (1.1) to the At-Risk Community (1.2) is primarily driven by improper grazing. When vigor declines enough for plants to die or become smaller, species with higher grazing tolerance (in this ecological site, that would be western wheatgrass) increase in vigor and production as they access the resources previously used by basin wildrye. The decrease in species composition by weight of basin wildrye to be equal to that of rhizomatous grasses, specifically inland saltgrass, western wheatgrass, and thickspike wheatgrass, indicates that the reference plant community has shifted to the At-Risk Community (1.2). The driver for community shift 1.1A is improper grazing management or prolonged drought. This shift is triggered by the loss of vigor of basin wildrye, soil erosion, or prolonged drought coupled with improper grazing. Blaisdell (1958) stated that drought and warmer-than-normal temperatures are known to advance plant phenology by as much as one month. During drought years, plants may be especially sensitive or reach a critical stage of development earlier than expected.

Pathway 1.2a
Community 1.2 to 1.1

The At-Risk Community (1.2) will return to the Reference Community (1.1) with proper grazing management and appropriate grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. It may take several years of favorable conditions for the community to transition back to a wildrye-dominated state. The driver for this community shift (1.2a) is the increased vigor of basin wildrye, resulting in increased biomass production and dominance of the plant community. The trigger for this shift is the change in grazing management favoring basin wildrye. These triggers are generally conservative grazing management styles such as deferred or rest rotations utilizing light to moderate grazing (less than 50 percent use) combined with favorable growing conditions such as cool, wet springs. These systems tend to promote increases in soil organic matter, which promotes microfauna and can increase infiltration rates. Inversely, long periods of rest at a time when this state is considered stable may not result in an increase in native bunchgrasses, and it has been suggested (Noy-Meir 1975) that these long periods of rest or underutilization may actually drive the system to a lower level of stability by creating large amounts of standing biomass, dead plant caudex centers, and gaps in the plant canopy.

State 2
Shortgrass State

State 2, Shortgrass State, has been altered by long-term unmanaged, heavy grazing. In this State, drought conditions may speed the departure from reference.

Community 2.1
Rhizomatous Community

This plant community is primarily dominated by rhizomatous grasses such as western wheatgrass and thickspike wheatgrass, with limited amounts of mid-statured bunchgrasses. This community often has an increased presence of basin big sagebrush. Native "increaser" forbs will begin to dominate the forb community (western yarrow, goldenrod), with potentially invasive species such as common dandelion also present. Overall, production is reduced, as is litter cover. Because of the lower organic matter and shallower rooting depth of existing plants, the Rhizomatous Community has more bare ground than the reference, which may affect site stability. Hydrologic function is impaired as a response to reduced deep-rooted bunchgrasses and increased evapotranspiration. The transition from reference is in response to long-term drought, unmanaged grazing, or, in limited cases, increased fire frequency.

State 3
Invaded State

The site is invaded when more than five percent of the total production is from non-native exotic species, such as cheatgrass and any occurrence of ventenata. Due to the complex relationships between plants and soil biota and their influence on site stability, hydrology, and biotic integrity, restoration from the invaded state will never return to the reference state. To restore an invaded state would require a considerable input of energy and capital to match the reference plant community, but the hydrology and soil biota would not be those of the reference state. Often, the invasive species seedbank is not eliminated, which will allow for a fast conversion back to the invaded state.

Community 3.1
Invaded Community

The Invaded Community consists primarily of non-native grasses and forbs. The primary species is cheatgrass however ventenata is known to be present in this MLRA allowing for rapid invasion. There tends to be an increase in sagebrush and greasewood cover. Native grasses are often limited to short bunchgrasses although some taller grasses may exist in the protective bases of shrubs. The increase of annual grasses can increase the intensity and severity of wildfire. The transition to this community is driven by two likely disturbances. The first being repeated heavy, unmanaged grazing and the other is intense fire. These often occur in combination which creates bare ground, depletes organic matter, and increases evapotranspiration. Extensive restoration practices are needed to make this community resemble the reference state however it will never return to reference due to the severe departure and often loss of soil resources needed to maintain reference. Restoration to a community that resembles reference will require extensive and expensive inputs such as pest management, brush management and range seeding; however, removal of existing species may actually accelerate erosion of the soil surface if not properly managed.

Resilience management. Prescribed grazing will not return this community to Reference however it may maintain the community to prevent complete removal of native vegetation.

Transition T1A
State 1 to 2

The Reference State (1) transitions to the Altered State (2) if basin wildrye, by dry weight, decreases to below 10% or if bare ground cover is increased beyond 20%. The driver for this transition is loss of taller bunchgrasses, which creates open areas in the plant canopy with bare soil. Soil erosion results in decreased soil fertility, driving transitions to the Altered State. There are several other key factors signaling the approach of transition T1A: increases in soil physical crusting, increase of rhizomatous grasses, decreases in cover of cryptogamic crusts, decreases in soil surface aggregate stability and/or evidence of erosion including water flow patterns, development of plant pedestals, and litter movement. The trigger for this transition is improper grazing management and/or long-term drought leading to a decrease in basin wildrye composition to <15% and reduction in total plant canopy cover.

Transition T1B
State 1 to 3

Rapid invasion of the Reference State is often a result of repeated heavy disturbance from non-managed grazing (often combined with prolonged drought), stressing native bunchgrasses. Seeds of non-native grasses and forbs readily germinated in the bare ground between bunchgrass culms.

Restoration pathway R2A
State 2 to 1

The Shortgrass State (2) has lost soil or vegetation attributes to the point that recovery to the Reference State (1) will require reclamation efforts such as soil rebuilding, intensive mechanical and cultural treatments, and/or revegetation (via seeding or sprig planting in the case of basin wildrye). Examples of mechanical treatment may be brush control, while cultural treatments may include prescribed grazing, targeted brush browsing, or prescribed burning. Low-intensity prescribed fires can be used to reduce competitive increasers like needle and thread and Sandberg bluegrass. A low-intensity fire will also reduce big sagebrush densities. In areas prone to annual grass infestation, fire should be carefully planned or avoided. The drivers for this restoration pathway are reclamation efforts along with proper grazing management.

Transition T2A
State 2 to 3

With continued disturbance, the Shortgrass State can degrade, losing the majority of the native bunchgrasses as well as reducing the native rhizomatous grasses. Invasive species take advantage of these plant gaps. The trigger is the presence of invasive species such as cheatgrass, ventenata, and leafy spurge.

Restoration pathway R3A
State 3 to 1

Restoration of the Invaded State (3) to the Reference State (1) requires substantial energy input. The drivers for the restoration pathway are the removal of invasive species, restoration of native bunchgrass species, persistent management of invasive species, and proper grazing management. Without continued control, invasive species are likely to return (probably rapidly) due to the presence of seeds and/or other viable material in the soil and management related practices that increase soil disturbance. If invaded by conifer encroachment, treatment depends on the condition of the rangeland. Sites that have transitioned from the Rhizomatous State (2) to the Invaded State (3) may be severely lacking in soil and vegetative properties that will allow for restoration to the Reference State. Hydrologic function damage may be irreversible, especially with accelerated gully erosion.

Restoration pathway R3B
State 3 to 2

If invasive species are removed before remnant populations of bunchgrass are drastically reduced, the Invaded State (3) can revert to the Rhizomatous state. The driver for the reclamation pathway is weed management without reseeding. Continued Integrated Pest Management (IPM) will be required as many of the invasive species that can occupy the Invaded State have extended dormant seed life. The trigger is invasive species control.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Mid and Rhizomatous Grasses**			336–504	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	168–224	10–35
	basin wildrye	LECI4	*Leymus cinereus*	0–168	0–5
	thickspike wheatgrass	ELLA3	*Elymus lanceolatus*	67–101	5–15
	western wheatgrass	PASM	*Pascopyrum smithii*	67–101	5–15
	saltgrass	DISP	*Distichlis spicata*	11–34	1–5
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–34	0–5
4	**Shortgrass**			56–112	
	Sandberg bluegrass	POSE	*Poa secunda*	0–101	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	–
	foxtail barley	HOJU	*Hordeum jubatum*	0–50	–
	squirreltail	ELEL5	*Elymus elymoides*	0–50	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–50	–
	sedge	CAREX	*Carex*	0–34	–
Forb					
2	**Forbs**			25–39	
	desertparsley	LOMAT	*Lomatium*	0–34	0–3
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–34	0–3
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–17	0–1
	onion	ALLIU	*Allium*	0–11	0–1
	spiny phlox	PHHO	*Phlox hoodii*	0–11	0–1
	Forb, dicot, perennial	2FDP	*Forb, dicot, perennial*	0–11	0–1
Shrub/Vine					
3	**Shrubs**			76–118	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	11–101	5–10
	greasewood	SAVE4	*Sarcobatus vermiculatus*	11–101	5–10
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–56	3–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	11–50	1–3
	Gardner's saltbush	ATGA	*Atriplex gardneri*	11–50	1–3
	little sagebrush	ARAR8	*Artemisia arbuscula*	0–34	0–2
	prairie sagewort	ARFR4	*Artemisia frigida*	0–34	0–2

Animal community

The Saline Upland ecological site provides a variety of wildlife habitats for an array of species. Prior to the settlement of this area, large herds of antelope, elk, and bison roamed. Though the bison have been replaced, mostly with domesticated livestock, elk and antelope still frequently utilize this largely intact landscape for winter habitat in areas adjacent to forests.

The high bunchgrass component of the Reference State provides excellent nesting cover for multiple neotropical migratory birds that select for open grasslands, such as the long-billed curlew and McCown’s longspur.

Greater sage grouse may be present on sites with suitable habitat, typically requiring a minimum of 15 percent sagebrush canopy cover (Wallestad 1975). The Bunchgrass-Shrub Community (1.1) is likely to have optimal sage grouse presence given its high sagebrush canopy cover. The potentially diverse forb component of the Reference State may also provide important early-season (spring) foraging habitat for the greater sage grouse and their broods. Other communities on the site with sufficient sagebrush cover may harbor sage grouse populations, specifically Rhizomatous Community 2.1, where big sagebrush populations are under a reduced fire regime. Also, as sagebrush canopy cover increases under the Rhizomatous Community and, to a limited extent, under Shortgrass-Shrub State 3.1, pygmy rabbit, Brewer's sparrow, and Mule deer use may also increase.

Managed livestock grazing is suitable on this site due to the potential to produce an abundance of high-quality forage. This is often not a preferred site for grazing by livestock, though it may be utilized by grazing animals in or near reference conditions. In order to maintain the productivity of the site, grazing on this site must be managed carefully to make sure utilization is not excessive. Management objectives should include maintenance or improvement of the native plant community. Careful management of the timing and duration of grazing is important. Short grazing periods and adequate deferment during the growing season are recommended for plant maintenance, health, and recovery. According to McLean et al., early-season defoliation of bluebunch wheatgrass can result in high mortality and reduced vigor in plants. They also suggest, based on prior studies, that regrowth is necessary before dormancy to reduce injury of bluebunch.

The grazing season has a greater impact on winterfat than the intensity of grazing. Late winter or early spring grazing is detrimental. However, early winter grazing may actually be beneficial (Blaisdell 1984).

Continual non-prescribed grazing of this site will be detrimental, will alter the plant composition and production over time, and will result in the transition to the Rhizomatous State. The transition to other states will depend on the duration of poorly managed grazing as well as other circumstances such as weather conditions and fire frequency.

The Rhizomatous State is subject to further degradation to the Shortgrass-Shrub State or Invaded State. Management should focus on grazing management strategies that will prevent further degradation, such as rest rotation, seasonal grazing deferment, or winter grazing where feasible. Communities within this state are still stable under proper management. Forage quantity and quality may be substantially decreased from the Reference State.

In the Shortgrass-Shrub State, grazing may be possible but is generally not economically and/or environmentally sustainable.

Grazing is possible in the Invaded State. Invasive species are generally less palatable than native grasses. Forage production is typically greatly reduced in this state. Due to the aggressive nature of invasive species, sites in the Invaded State face an increased risk of further degradation by invasive-dominant communities. Grazing must be carefully managed to avoid further soil loss and degradation. Prescriptive grazing can be used to manage invasive species. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or maintain the species composition of invasive species.

Hydrological functions

The hydrologic cycle functions best in the Reference State (1) with good infiltration and deep percolation of rainfall; however, the cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high bunchgrass canopy cover. High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sedimentation transport low. Water leaving the site will have minimal sediment load, which allows for high water quality in associated streams. High rates of infiltration will allow water to move below the rooting zone during periods of heavy rainfall. The Reference Community (1.1) should have no rills or gullies present and drainage ways should be vegetated and stable. Water flow patterns, if present, will be barely observable. Plant pedestals are essentially non-existent. Plant litter remains in place and is not moved by wind or water.

Improper grazing management results in a community shift to the Bunchgrass Community (1.2). This plant community has a similar canopy cover, but only slightly higher bare ground. Therefore, the hydrologic cycle is functioning at a level similar to the water cycle in the Reference Community (1.1).

In the Invaded State (3) canopy and ground cover are greatly reduced compared to the Reference State (1), which impedes the hydrologic cycle. Infiltration will decrease and runoff will increase due to reduced ground cover, presence of shallow-rooted species, rainfall splash, soil capping, reduced organic matter, and poor structure. Sparse ground cover and decreased infiltration can combine to increase frequency and severity of flooding within a watershed. Soil erosion is accelerated, quality of surface runoff is poor, and sedimentation increases.

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, big game and upland bird hunting. The forbs have flowers that appeal to photographers. This site provides valuable open space.

References

Masters, R. and R. Sheley. 2001. Principles and practices for managing rangeland invasive plants. Journal of Range Management 38:21–26.

McCalla, G.R., W.H. Blackburn, and L.B. Merrill. 1984. Effects of Livestock Grazing on Infiltration Rates of the Edwards Plateau of Texas. Journal of Range Management 37:265–269.

McLean, A. and S. Wikeem. 1985. Influence of season and intensity of defoliation on bluebunch wheatgrass survival and vigor in southern British Columbia. Journal of Range Management 38:21–26.

Miller, R.F., T.J. Svejcar, and J.A. Rose. 2000. Impacts of western juniper on plant community composition and structure. Journal of Range Management 53:574–585.

Moulton, G.E. and T.W. Dunlay. 1988. The Journals of the Lewis and Clark Expedition. Pages in University of Nebraska Press.

Mueggler, W.F. and W.L. Stewart. 1980. Grassland and Shrubland Habitat Types of Western Montana.

Pelant, M., P. Shaver, D.A. Pyke, and J.E. Herrick. 2005. Interpreting Indicators of Rangeland Health.

Pellant, M. and L. Reichert. 1984. Management and Rehabilitation of a burned winterfat community in Southwestern Idaho. Proceedings--Symposium on the biology of Atriplex and related Chenopods. 1983 May 2-6; Provo UT General Technical Report INT-172.. USDA Forest Service Intermountain Forest and Range Experiment Station. 281–285.

Pitt, M.D. and B.M. Wikeem. 1990. Phenological patterns and adaptations in an Artemisia/Agropyron plant community. Journal of Range Management 43:350–357.

. 1990. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

Arno, S.F. and G.E. Gruell. 1982. Fire History at the Forest-Grassland Ecotone in Southwestern Montana. Journal of Range Management 36:332–336.

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

Bestelmeyer, B. and J. Brown. 2005. State-and-Transition Models 101: A Fresh look at vegetation change.

Blaisdell, J.P. 1958. Seasonal development and yield of native plants on the Upper Snake River Plains and their relation to certain climate factors.

Blaisdell, J.P. and R.C. Holmgren. 1984. Managing Intermountain Rangelands--Salt-Desert Shrub Ranges. General Tech Report INT-163. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 52.

Bunting, S.C., B.M. Kilgore, and C.L. Bushey. 1987. Guidelines for Prescribe burning sagebrush-grass rangelands in the Northern Great Basin. General Technical Report INT-231. USDA Forest Service Intermountain Research Station, Ogden, UT. 33.

Colberg, T.J. and J.T. Romo. 2003. Clubmoss effects on plant water status and standing crop. Journal of Range Management 56:489–495.

Daubenmire, R. 1970. Steppe vegetation of Washington.

DiTomaso, J.M. 2000. Invasive weeds in Rangelands: Species, Impacts, and Management. Weed Science 48:255–265.

Dormaar, J.F., B.W. Adams, and W.D. Willms. 1997. Impacts of rotational grazing on mixed prairie soils and vegetation. Journal of Range Management 50:647–651.

Hobbs, J.R. and S.E. Humphries. 1995. An integrated approach to the ecology and management of plant invasions. Conservation Biology 9:761–770.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States.

Lacey, J.R., C.B. Marlow, and J.R. Lane. 1989. Influence of Spotted knapweed (Centaurea maculosa) on surface runoff and sediment yield.. Weed Technology 3:627–630.

Lesica, P. and S.V. Cooper. 1997. Presettlement vegetation of Southern Beaverhead County, MT.

Manske, L.L. 1980. Habitat, phenology, and growth of selected sandhills range plants.

Pokorny, M.L., R. Sheley, C.A. Zabinski, R. Engel, T.J. Svejcar, and J.J. Borkowski. 2005. Plant Functional Group Diversity as a Mechanism for Invasion Resistance.

Ross, R.L., E.P. Murray, and J.G. Haigh. July 1973. Soil and Vegetation of Near-pristine sites in Montana.

Schoeneberger, P.J. and D.A. Wysocki. 2017. Geomorphic Description System, Version 5.0..

Smoliak, S., R.L. Ditterlin, J.D. Scheetz, L.K. Holzworth, J.R. Sims, L.E. Wiesner, D.E. Baldridge, and G.L. Tibke.

2006. Montana Interagency Plant Materials Handbook.

Stavi, I. 2012. The potential use of biochar in reclaiming degraded rangelands. Journal of Environmental Planning and Management 55:1–9.

Stringham, T.K., W.C. Kreuger, and P.L. Shaver. 2003. State and Transition Modeling: an ecological process approach. Journal of Range Management 56:106–113.

Stringham, T.K. and W.C. Krueger. 2001. States, Transitions, and Thresholds: Further refinement fro rangeland applications.

Sturm, J.J. 1954. A study of a relict area in Northern Montana. University of Wyoming, Laramie 37.

Thurow, T.L., Blackburn W. H., and L.B. Merrill. 1986. Impacts of Livestock Grazing Systems on Watershed. Page in Rangelands: A Resource Under Siege: Proceedings of the Second International Rangeland Congress.

Various NRCS Staff. 2013. National Range and Pasture Handbook.

Walker, L.R. and S.D. Smith. 1997. Impacts of invasive plants on community and ecosystem properties. Pages 69–86 in Assessment and management of plant invasions. Springer, New York, NY.

Wambolt, C. and G. Payne. 1986. An 18-Year Comparison of Control Methods for Wyoming Big Sagebrush in Southwestern Montana. Journal of Range Management 39:314–319.

West, N.E. 1994. Effects of Fire on Salt-Desert shrub rangelands. Proceedings--Ecology and Management of Annual Rangelands: 1992 May 18-22. Boise ID General Technical Report INT-GTR-313.. USDA Forest Service Intermountain Research Station. 71–74.

Whitford, W.G., E.F. Aldon, D.W. Freckman, Y. Steinberger, and L.W. Parker. 1989. Effects of Organic Amendments on Soil Biota on a Degraded Rangeland. Journal of Range Management 41:56–60.

Wilson, A.M., G.A. Harris, and D.H. Gates. 1966. Cumulative Effects of Clipping on Yield of Bluebunch wheatgrass. Journal of Range Management 19:90–91.

Approval

Kirt Walstad, 9/11/2023

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)	Grant Petersen

Contact for lead author	grant.petersen@usda.gov
Date	04/23/2019
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 evident in the reference state.

2. **Presence of water flow patterns:** Water flow patterns are not present in the reference condition on gentle slopes. If present, they are most likely to occur on steep slopes and are inconspicuous, disconnected, and very short in length.

3. **Number and height of erosional pedestals or terracettes:** Wind and water erosion should not be evident in the reference state.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is less than 20 percent in the reference state.

5. **Number of gullies and erosion associated with gullies:** Not evident in Reference State.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Not evident

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is minimal and should not be more than a few inches (less than 12) from where it originated. If movement is noticed, it will be smaller leaves and stems from smaller grasses and forbs.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Site Stability ratings often 3-4 in interspaces and 4-6 under plant canopy.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Very weak platy to moderately fine granular structure. Structure will be friable indicated lower soil organic matter. Typical A horzion is less than 4 inches thick with colors from Munsell Color Book with Value 7 or less and Chroma 2 or less. Local geology may affect color in which is important to reference the Official Series Description (OSD) for characteristic range.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The Saline upland ecological site is well drained but has a slow to moderate infiltration rates. An even distribution of mid stature grasses (60-70% of site production), cool season rhizomatous

grasses along with a mix of shortgrass, forbs and shrubs optimizes infiltration rates for this site.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Not Present in Reference State

---

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

    Dominant: Mid statured, cool season bunchgrasses

    Sub-dominant: salt tolerant shrubs ≥ cool season bunchgrass ≥ Rhizomatous grasses ≥ forbs = subshrubs

    Other: native annual forbs may be present

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Mortality of native perennial grasses and shrubs is low. Some seasonal decadence of shrubs may be noticed after extended drought however this will be limited.

---

14. **Average percent litter cover (%) and depth (in):** This site has limited litter cover typically around 20% though it may vary slightly based on current growing conditions and natural site variability. Litter is fairly fine herbaceous with minimal woody litter and often in a depth too thin to measure.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Production of this site is relatively low due to chemical limitations of the site. Average annual production is 600. Low: 450 High 700. Production varies based on effective precipitation and natural variability of soil properties for this ecological site.

---

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:** Non-native species that may occur (but not limited to) include: Leafy spurge, Spotted knapweed, Cheatgrass, Field brome (aka Japanese brome), Ventenata, and Crested wheatgrass

    Native species that may indicate degraded states (presence alone does not necessarily indicate a degraded): Blue grama, Rocky Mountain Juniper, Sandberg bluegrass, pricklypear, Greasewood

---

17. **Perennial plant reproductive capability:** In the reference condition, all plants are vigorous enough for reproduction either by seed or rhizomes in order to balance natural mortality with species recruitment.
