USDA Natural Resources Conservation Service

Ecological site DX034A02X112
Gravelly Pinedale Plateau (Gr PP)

Last updated: 9/28/2023
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): 034A–Cool Central Desertic Basins and Plateaus

Major Land Resource Area (MLRA) 34A, Cool Central Desertic Basins and Plateaus, consists of approximately 21 million acres in Wyoming, Colorado and Utah, it consists of 10 Land Resource Units (LRU). These units are divisions of the MLRA based on geology, landscape, common soils, water resources and plant community potentials. The elevation ranges from approximately 5600 feet (1700 m) along the Green River in UT and CO to approximately 9500 feet (2900 m) near Jeffrey City, WY. Annual precipitation ranges from 7 to 16 inches (177 to 406 mm), with the driest areas in the Green River and Great Divide Basins and the wettest areas in northern Carbon County, Southeast Fremont County and Albany County. There is a seasonal weather pattern that trends west to east, with more winter precipitation in the west and more spring/summer in the east, illustrated by diminishing amounts of Big Sagebrush in the eastern part of the MLRA.

LRU notes

The Pinedale Plateau LRU is in the upper Green River Drainage from Pinedale, Wyoming at the north working southward to Farson, Wyoming and easterly to South Pass, Wyoming. It is situated between the Wyoming Range and Wind River Range largely in Sublette County with some areas in Lincoln County, northern Sweetwater County, and a small portion of Fremont County. The total area of this LRU is approximately 1,210,000 acres. It shares a boundary with MLRA 46-Northern Rocky Mountain Foothills (proposed for the foothills of western Wyoming).
This LRU is dominated by the New Fork Tongue of the Wasatch formation, a large artesian aquifer that is estimated to hold large amounts of water with relatively quick recharge (Martin, 1997). It is also home to the Lance Formation, a cretaceous strata that is part of the Mesaverde Group, which holds large amounts of hydrocarbons, giving way to one of the largest on shore natural gas fields (Jonah Field) (Bowker et al 2000). The soils in the Pinedale Plateau are dominated by older Alfisols with thick argillic and calcic horizons and younger deep alluvial soils along drainage ways and in river bottoms. Salts are not a major influence in the Pinedale Plateau compared to the adjacent Green River Basin LRU but do occur, including sodium, calcium carbonate, and other soluble salts. Soils are tied closely to their parent geology but are more developed and older so typically do not have bedrock contact within 6 feet.
This LRU has an aridic ustic soil moisture regime and frigid (bordering on cryic) soil temperature regime. The precipitation pattern is bimodal with a slight spikes in the spring and fall. Winter temperatures are cold allowing snow to accumulated and stay until spring. This lends perfectly to cool season grasses and forbs to flourish, also allowing Big Sagebrush to establish and dominate the landscape. The mean annual soil temperatures are between 36 to 40 degrees Fahrenheit (2.2 to 4.4 degrees Celsius) and average precipitation is between 9 and 12 inches (230 to 305 mm) annually. Elevations of this LRU range between 6500 and 7500 feet (1980 to 2280 m).

Classification relationships

Relationship to Other Established Classification Systems
National Vegetation Classification System (NVC):
3 Desert & Semi-Desert 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
M171 Great Basin-Intermountain Dry Shrubland & Grassland Macrogroup
G311 Intermountain Semi-Desert Grassland Group
A1262 Indian Ricegrass-Bluebunch Wheatgrass-Sandhill Muhly Grassland Alliance
CEGL001666 Bluebunch Wheatgrass/Cushion Plants Grassland Association

Ecoregions (EPA):
Level I: 10 North American Deserts
Level II: 10.1 Cold Deserts
Level III: 10.1.4 Wyoming Basin

Ecological site concept

• This site not does receive any additional water.
• These soils:
o are not saline or saline-sodic
o are moderately deep to deep
o are skeletal within 20 inches (50 cm) of the soil surface; they have greater than 35 percent rock fragments by volume in the top 20 inches (50 cm)
o have surface textures that usually range from sandy loam to loam in surface mineral layer (4 inches; 10 cm)
• have slopes 15 to 45%
• clay content is not greater than 35% in mineral soil surface layer (6 inches; 15 cm)
Climate:
aridic ustic moisture regime (ustic bordering on aridic)
frigid (bordering on cryic) temperature regime

Associated sites

DX034A02X162	**Shallow Loamy Pinedale Plateau (SwLy PP)** Soils are shallow (10-20 inches) or rock fragment skeletal (greater than 35% rock fragment by volume) within top 20 inches and rock fragment increases with depth whereas the Gravelly site rock fragments are high at the surface.

Similar sites

R034AY212WY	**Gravelly Foothills and Basins West (Gr)** Previous version of this site, but applied to a larger geographic area.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pseudoroegneria spicata*

Legacy ID

R034AC112WY

Physiographic features

The Gravelly Pinedale Plateau (Gr-PP) ecological site occurs in intermontane basin landscapes on hillslope, mesa, and escarpment landforms (see following definitions). It is typically found on summit and shoulder positions and on all exposures. Slopes are typically from 15 to 45 percent, but can occur on any slope, and at elevations mostly above 7000 feet.

Landscape:

intermontane basin - A generic term for wide structural depressions between mountain ranges that are partly filled with alluvium and called "valleys" in the vernacular. Intermontane basins may be drained internally (bolsons) or externally (semi-bolson).

Landform:
escarpment - A relatively continuous and steep slope or cliff produced by erosion or faulting and that topographically interrupts or breaks the general continuity of more gently sloping land surfaces . The term is most commonly applied to cliffs produced by differential erosion.

hill - A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill.

mesa - An isolated, flat-topped, landform that stands distinctly above the adjacent land area and is bounded by steep slopes or cliffs; and is generally capped by erosion-resistant, nearly horizontal rock (often lava). Mesas and buttes have similar forms and isolated occurrence. A mesa has a summit area broader than the bounding cliff height. Mesas are most common in arid and semi-arid regions, but are not climatically restricted.

summit - (a) The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. Compare - shoulder, backslope, footslope, and toeslope, crest. (b) A general term for the top, or highest area of a landform such as a hill, mountain, or tableland. It usually refers to a high interfluve area of relatively gentle slope that is flanked by steeper slopes, e.g., mountain fronts or tableland escarpments.

shoulder - The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. If present, it comprises the transition zone from summit to backslope. Compare - summit, crest, backslope, footslope, and toeslope.

Table 2. Representative physiographic features

Landforms	(1) Intermontane basin > Hillslope (2) Mesa (3) Escarpment
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	1,981–2,286 m
Slope	15–45%
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 9 to 12 inches per year. Wide fluctuations may occur in yearly precipitation and result in more below average years than those with above average precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Much of the precipitation accumulation (45 percent) comes in the winter in the form of snow (October to April). The wettest month is May (1.69 inches). The dominant plants (sagebrush and cool season grasses) are well adapted to these conditions. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour. The growing season is short (less than 60 day) and cool (critical growth period): primary growth typically occurs between May and June.
Growth of native cool-season plants begins about mid-April and continues to approximately early July. Some green-up of cool-season plants usually occurs in September with adequate fall moisture.

All data is based on the 30-year average from 1981-2010.

Table 3. Representative climatic features

Frost-free period (characteristic range)	30-70 days
Freeze-free period (characteristic range)	50-80 days
Precipitation total (characteristic range)	229-305 mm
Frost-free period (actual range)	15-70 days
Freeze-free period (actual range)	45-90 days
Precipitation total (actual range)	229-330 mm
Frost-free period (average)	36 days
Freeze-free period (average)	64 days
Precipitation total (average)	279 mm

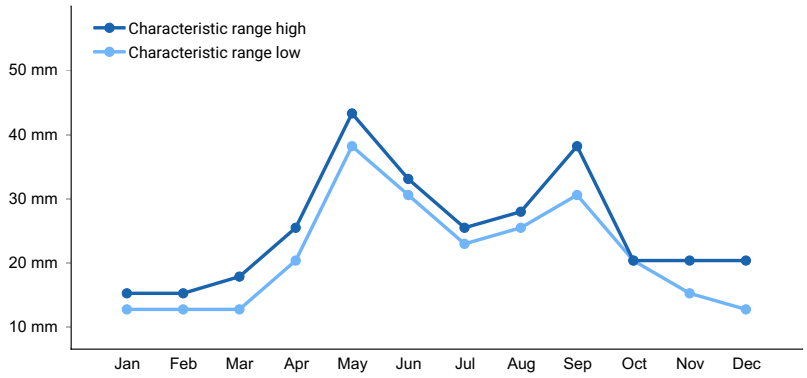


Figure 1. Monthly precipitation range

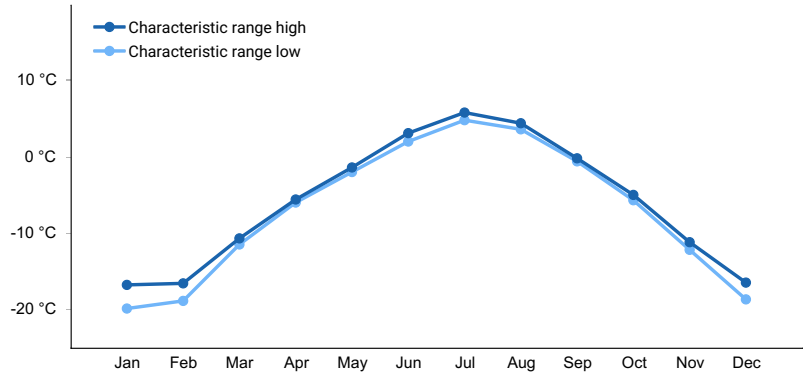


Figure 2. Monthly minimum temperature range

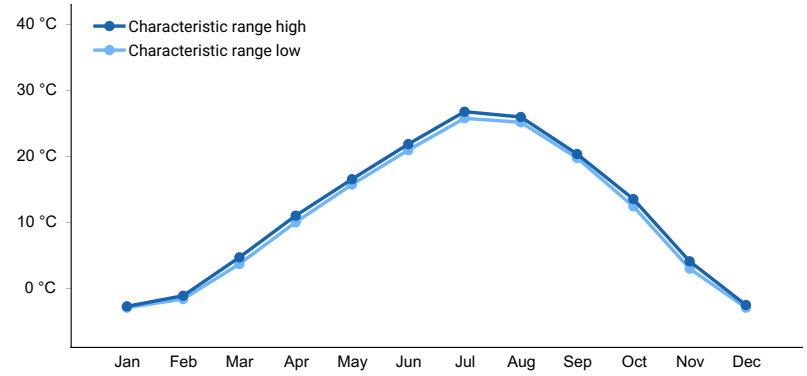


Figure 3. Monthly maximum temperature range

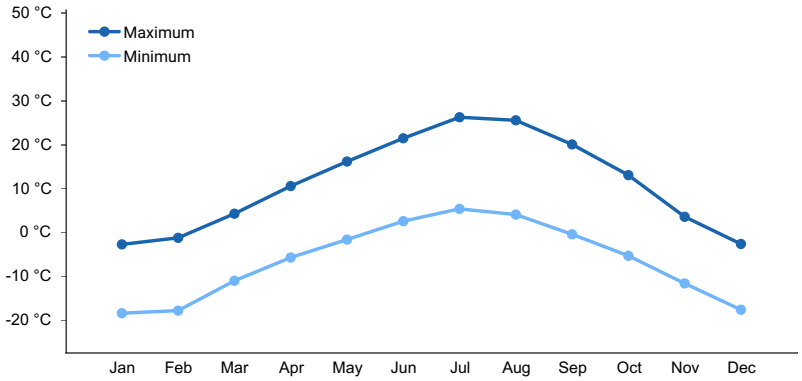


Figure 4. Monthly average minimum and maximum temperature

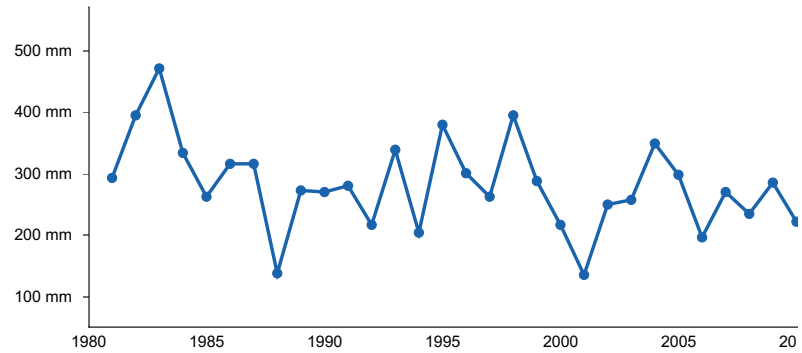


Figure 5. Annual precipitation pattern

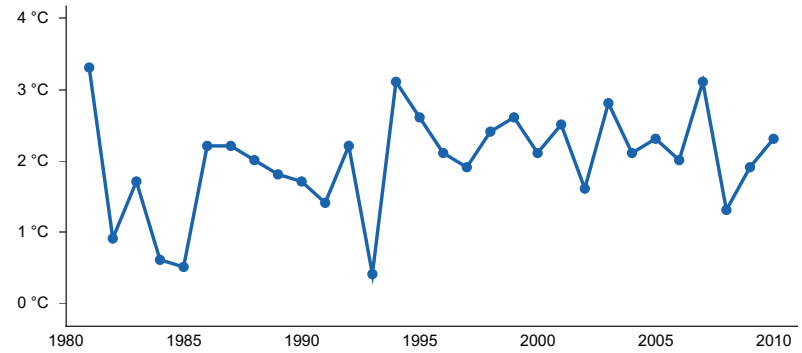


Figure 6. Annual average temperature pattern

Climate stations used

- (1) PINEDALE [USC00487260], Pinedale, WY
- (2) CORA [USC00482054], Cora, WY
- (3) BOULDER REARING STN [USC00480951], Boulder, WY

Influencing water features

There are no influencing water features in the Gravelly Pinedale Plateau ecological site.

Wetland description

N/A

Soil features

The soils of this site are moderately deep to deep, well-drained soils formed in colluvium and slope alluvium. These soils are usually sandy loam to loam. This site usually occurs on steep slopes, but may be on any slope. Surface modifiers are typically very gravelly or very cobbly (rounded) with the volume either maintained or decreasing

throughout the soil profile. A common scenario is a cobbly surface cap with less rock fragments in the subsoil.

Major Soil Series correlated to this site include: Foursees and Roto
Representative soil taxonomy: Loamy-skeletal, carbonatic, frigid Aridic Calciustepts or Loamy-skeletal, mixed, superactive, frigid Aridic Calciustepts

Table 4. Representative soil features

Parent material	(1) Colluvium–sandstone and shale (2) Metamorphic and sedimentary rock (3) Slope alluvium–metamorphic and sedimentary rock
Surface texture	(1) Very gravelly, extremely gravelly sandy loam (2) Gravelly, very cobbly loam
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to moderate
Soil depth	51–152 cm
Surface fragment cover <=3"	30–60%
Surface fragment cover >3"	10–25%
Available water capacity (0-101.6cm)	7.11–14.22 cm
Calcium carbonate equivalent (0-50.8cm)	0–20%
Clay content (0-15.2cm)	10–32%
Electrical conductivity (0-25.4cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-25.4cm)	0–7
Soil reaction (1:1 water) (0-25.4cm)	7–8.6
Subsurface fragment volume <=3" (25.4-50.8cm)	15–60%
Subsurface fragment volume >3" (12.7-50.8cm)	10–30%

Ecological dynamics

A State-and-Transition Model (STM)diagram is depicted below. Thorough descriptions of each state, transition, plant community phase, and pathway are found after the model in this document. This diagram is based on available experimental research, field observations, professional consensus, and interpretations. While based on the best available information, the STM will change over time as knowledge of ecological processes increases.

Plant community composition within the same ecological site has a natural range of variability across the LRU due to the naturally occurring variability in weather, soils, and aspect. Not all managers will choose the Reference Plant Community as the management goal. Other plant communities may be desired to meet land management objectives. This is valid as long as the rangeland health attributes assessment departures are none to slight or slight to moderate from the Reference State. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent cover are used in this ESD. Most observers find it easier to visualize or estimate percent cover for woody species (trees and shrubs). Foliar cover is used to define plant community phases and states in the State-and-Transition Model. Cover drives the transitions between communities

and states because of the influence of shade and interception of rainfall.

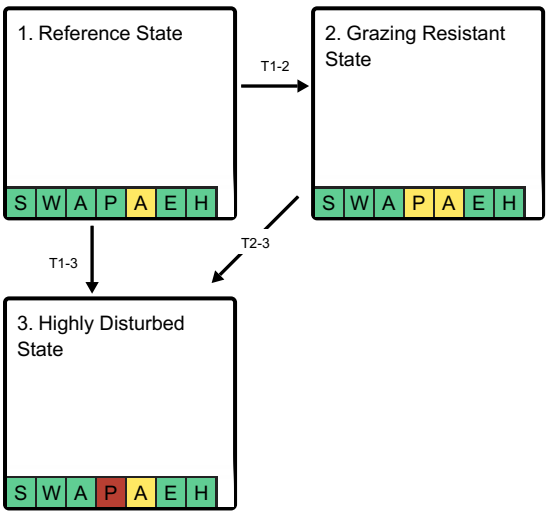
Species composition by dry weight remains an important descriptor of the herbaceous community and of site productivity as a whole and includes both herbaceous and woody species. Calculating similarity index requires data on species composition by dry weight.

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

A resource concern risk assessment and dominant resource concerns are provided for each Land Use, State, and/or Plant Community Phase based on NRCS resource concern and planning criteria used to determine resource treatment levels during the conservation planning process. A resource concern is the resource condition that does not meet the minimum accepted levels established by planning criteria as shown in Section III of the NRCS Field Office Technical Guide (https://efotg.sc.egov.usda.gov/#/).
• Low risk means a low probability for the category of resource concerns and additional assessment is typically not necessary.
• Medium risk means that the category of resource concerns could occur, and additional assessment is recommended if the identified resource is a client concern and/or objective.
• High risk means that a resource concern in that category is likely to occur.
The resource categories are: S (soil), W (water), A (air), P (plant), A (animal), E (energy), and H (human). The dominant resource concerns further refine the resource category to a specific resource concern within that category.

State and transition model

Ecosystem states

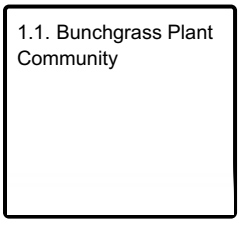


T1-2 - Herbivory (continuous or season-long, low to moderate stocking)

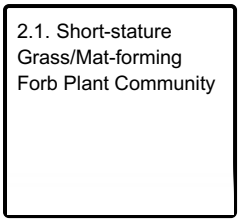
T1-3 - Extreme soil-disturbance (e.g. oil and gas development, road construction, gravel pits, heavy use areas)

T2-3 - Extreme soil-disturbance (e.g. oil and gas development, road construction, gravel pits, heavy use areas)

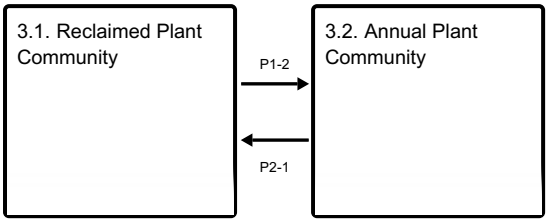
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



P1-2 - Extreme soil disturbance (oil and gas development, road construction, gravel pit, heavy use areas)

P2-1 - Reclamation (contouring, deep ripping, re-seeding, prescribed grazing)

State 1
Reference State

The Reference State is comprised of one plant community, the Bunchgrass Plant community. The dominant grass is Bluebunch wheatgrass (Pseudoroegnaria spicata). Shrubs are sub-dominant and predominantly include fringed sagewort (*Artemisia frigida*), winterfat (*Krascheninnikovia lanata*), and Wyoming big sagebrush (*Artemisia tridentata* ssp. wyomingensis). Wyoming big sagebrush is typically absent on windward aspects (westerly) and present on leeward aspects (easterly). Forbs are sub-dominant and predominantly include pussytoes (Antennaria spp.), buckwheat (Eriogonum spp.), and Hood's phlox (*Phlox hoodii*). Because this site is grass dominated, reference conditions do not result in disturbances that shift plant community phases.

Characteristics and indicators. This site occurs mostly on summits and shoulders, and often on windblown slopes. It is characterized by large rock fragments on the surface, typically alluvium (gravels and cobbles). Due to its landscape position, bunchgrasses dominate in the reference state, predominantly bluebunch wheatgrass, with scattered Wyoming big sagebrush on leeward and north-facing slopes. A common scenario is a one to three inch sandy loam cap over loamy or sandy clay loam. When that cap is thicker (3 inches), needle and thread can replace bluebunch wheatgrass as the the dominant mid-stature bunchgrass.

Resilience management. This site has moderate to moderately high resilience due to its aridic ustic (ustic bordering on aridic) soil moisture regime and frigid bordering on cryic temperature regime (Chambers et.al. 2014). Precipitation is typically low, but more effective with cooler temperatures and present when needed during the critical growth period (May through June). The site can usually recover after disturbance but is susceptible to delays in recovery during extreme climatic events such as drought. The site has moderately high resistance to invasion by annual grasses because of climate limitations (dry and cold). The site is more susceptible to invasion after extreme

disturbance during warmer climatic periods and on southeast aspects and concave micro-topography. At the LRU scale, this site is less resilient than Sandy, Loamy, or Clayey sites and is also less resistant to invasion by annual invasive grasses. Lower resilience and resistance is caused by lower production potential, low available water-holding capacity (AWC), coarser soil textures, and high amounts of rock fragment at the surface, making this site more susceptible to hot and dry drought conditions and harder for perennial plants to become established.

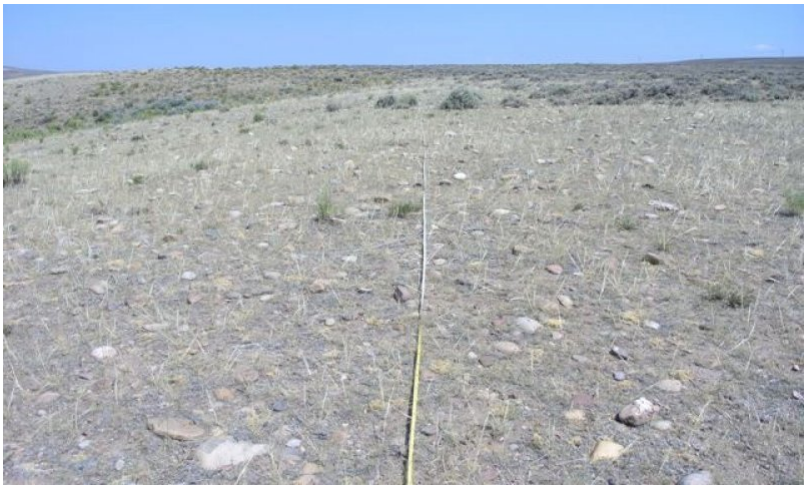
Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass

Dominant resource concerns

- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Community 1.1
Bunchgrass Plant Community



This plant community is well adapted to the climatic conditions of the Cool Central Desertic Basins and Plateaus. The Bunchgrass Plant Community is characterized by the dominance of assorted native perennial bunchgrasses, primarily bluebunch wheatgrass, and a scattering of Wyoming big sagebrush if on leeward aspects. There are generally few canopy gaps and most are generally small (1 to 2 feet). Rock cover on the soil surface is common and armors the site from soil erosion. Although overall productivity potential is low, there is abundant litter cover due to grass dominance.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	235	353	432
Forb	50	76	93
Shrub/Vine	50	76	93
Total	**335**	**505**	**618**

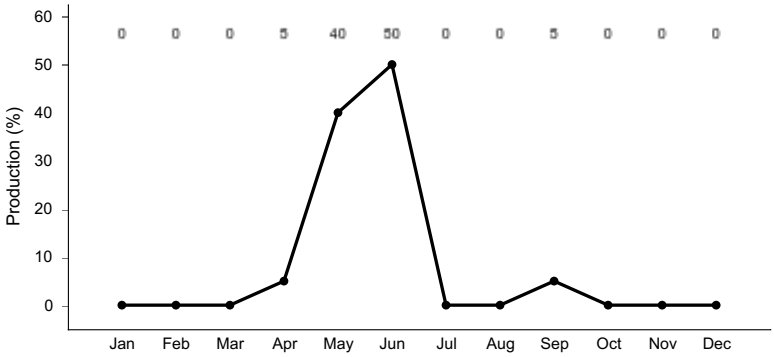


Figure 8. Plant community growth curve (percent production by month). WY0301, 34AC, Upland Sites. All Upland Sites.

State 2
Grazing Resistant State

The Grazing Resistant State is characterized by dominance of Sandberg bluegrass and mat-forming forbs. Mid-size cool-season bunchgrasses have become scarce or absent, and an adequate seedbank does not exist for recovery to the Reference State. This state has one plant community, the Short-stature Grass/Mat-forming Forb Plant Community.

Characteristics and indicators. The site crosses the threshold to the Grazing Resistant State from the Reference State when desirable mid-stature bunchgrasses lose dominance. Once bluebunch wheatgrass becomes scarce for a longer time period, it is unlikely to have a sufficient seedbank to recover dominance in a reasonable time frame without extra energy being added to the system. It is characterized by decreased productivity, increased short-stature grasses, and high foliar cover of mat-forming forbs. The Grazing Resistant State is very resistant to change, and therefore common on the landscape. In many cases, the transition to the Grazing Resistant State may have occurred many decades ago during an era of high stocking rates and continuous grazing. Sandberg bluegrass and rhizomatous wheatgrasses are low in stature and highly grazing tolerant. Rhizomatous species can form mats that provide soil protection by protecting the soil from raindrop impact, decreasing the risk of further soil erosion. High amounts of surface rock fragments can further armor this site from soil erosion.

Resilience management. Site resilience is lower than the Reference State. Site hydrology has been modified due to moisture being utilized by shallower rooting species. Therefore, the site is drier earlier in the season, lower in diversity, and unable to recover as quickly after a disturbances such as drought. This state is more drought-prone, and therefore sees wider productivity swings during dry versus wet years. Site resistance to invasion by annual grasses is similar to the reference state, although there are more niches for undesirable annual forbs such as desert alyssum or annual invasive grasses such as cheatgrass to become established during warmer climatic periods and on southeast aspects and concave micro-topography.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- Sandberg bluegrass (*Poa secunda*), grass
- thickspike wheatgrass (*Elymus lanceolatus ssp. lanceolatus*), grass

Dominant resource concerns

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

Community 2.1
Short-stature Grass/Mat-forming Forb Plant Community

This plant community is characterized by a dominance of short-stature grasses such as Sandberg bluegrass,

rhizomatous grasses and grass-likes, and mat-forming forbs such as pussytoes and Hood's phlox. Total annual production ranges from 150 to 450 pounds per acre with a Representative Value (RV) of 300 pounds per acre. Biotic integrity is affected by the change in functional/structural group dominance. This plant community is at-risk of transitioning to the Highly Disturbed State with additional disturbance such as heavy use by livestock or recreation, extreme drought, or ground-disturbing activity.

State 3
Highly Disturbed State

The Disturbed State is a result of extreme soil-disturbing activities outside of the normal disturbance regime expected for this site. Primary examples include road construction, oil and gas exploration, as well as livestock and recreation heavy use areas.

Characteristics and indicators. Primary indicators of this state are extreme soil disturbance associate with anthropogenic activities. Depending on the time since disturbance, recent climatic events, and reclamation efforts, the plant community could be dominated by annual weeds or it could be reclaimed to a variety of introduced or native species.

Resilience management. Site resilience is lower than the Reference State, but potentially higher than the Grazing Resistant. Site stability and hydrology modifications exist, but may be temporary if proper reclamation occurs. Site resistance to invasion by annual forbs and annual invasive grasses (cheatgrass) is lower due to an increase in soil disturbance allowing niches in the understory for establishment. Common annuals to invade this site include kochia, Russian thistle, and halogeton. Cheatgrass may be present and has the potential to dominate the site when it occurs on southeast aspects and on concave micro-topography.

Dominant resource concerns

- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Terrestrial habitat for wildlife and invertebrates
- Inadequate livestock water quantity, quality, and distribution

Community 3.1
Reclaimed Plant Community

This plant community is highly variable based on weather conditions during restoration activities, the management practices used, the seed mix, and how soil was stockpiled during the disturbance. Total annual production ranges from 300 to 550 pounds per acre with a Representative Value (RV) of 450 pounds per acre. The soil is is typically adequately protected, but erosion can occur during high runoff events. The biotic integrity is dependent on the seed mix used to reclaim the site. There is high variability in watershed function depending on reclamation success.

Community 3.2
Annual Plant Community

As part of succession, all sites that are severely disturbed will go through this plant community as part of their restoration. Weather is the largest determining factor in how long a site will be in this plant community phase, but is approximately two to five years on sites that use Best Management Practices for site restoration (http://www.uwyo.edu/wrrc/). The site has low potential for recovery. Seeding is needed to restore functional structural groups. Productivity in this plant community phase is highly variable based on current year's weather. Total annual production ranges from 100 to 300 pounds per acre with a Representative Value (RV) of 200 pounds per acre.

Pathway P1-2
Community 3.1 to 3.2

Extreme soil disturbance, typically soil removal from anthropogenic sources (road construction, gravel pits, oil and gas exploration, livestock and recreation heavy use areas etc.).

Context dependence. Soils have high rock fragments at the surface, making soil disturbance difficult without machinery. This pathway could occur from one severe disturbance or multiple consecutive disturbances (e.g. livestock salting areas or recreational heavy use) or extreme conditions such as hot temperatures, extreme drought, or high intensity/long duration grazing.

Pathway P2-1
Community 3.2 to 3.1

Reclamation efforts include re-seeding. In cases where heavy equipment caused the disturbance, contouring or deep ripping may be necessary to provide a suitable site for re-seeding. Prescribed grazing is necessary to facilitate successful seeding of perennial species.

Context dependence. Drought conditions and herbivory pressure may hinder restoration efforts, and multiple seeding efforts may be necessary if failure is caused by drought. Mulch can be effective for soil moisture retention and erosion control on slopes greater than eight percent.

Conservation practices

Critical Area Planting
Prescribed Grazing
Range Planting

Transition T1-2
State 1 to 2

Herbivory pressure in excess of normal Reference State conditions. A typical scenario is continuous spring or season-long grazing with low to moderate stocking intensity.

Constraints to recovery. Recovery is inhibited by continued herbivory pressure, reduced seedbank, and drought conditions. Annual grasses may occur ion southeastern aspects and concave micro-topography.

Context dependence. Transition to the Grazing Resistant State is a result of intense herbivory pressure every year during the critical growth period (May through June) for very long period of time to deplete the seedbank of long-lived mid-stature perennial grasses.

Transition T1-3
State 1 to 3

Extreme soil-disturbance from anthropogenic activity such as oil and gas development, road construction, and heavy use areas for livestock production or recreation.

Constraints to recovery. Recovery is inhibited by drought, herbivory pressure, and risk of annual invasion on southeastern aspects and concave micro-topography.

Context dependence. This transition is typically sudden after a mechanical disturbance, but can also occur with multiple consecutive disturbances (e.g. livestock or recreation heavy use areas) and can be exacerbated by hot temperatures and extreme drought.

Transition T2-3
State 2 to 3

Extreme soil-disturbance from anthropogenic activity such as oil and gas development, gravel pits, road construction, and heavy use areas for livestock production or recreation.

Constraints to recovery. Recovery is inhibited by drought, herbivory pressure, and risk of annual invasion.

Context dependence. This transition is typically sudden after a mechanical disturbance, but can also occur with

multiple consecutive disturbances (e.g. livestock or recreation heavy use areas) and can be exacerbated by hot temperatures and extreme drought.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			121–224	
	needle and thread	HECO26	*Hesperostipa comata*	22–224	5–50
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	45–224	25–50
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–90	0–10
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	4–90	1–10
	Sandberg bluegrass	POSE	*Poa secunda*	4–45	1–10
	muttongrass	POFE	*Poa fendleriana*	0–45	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–45	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–22	0–5
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–22	0–5
2	**Rhizomatous Grasses**			27–45	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	22–45	1–5
	western wheatgrass	PASM	*Pascopyrum smithii*	22–45	1–5
3	**Misc Grasses/Grasslikes**			27–45	
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–22	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–22	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–22	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	4–22	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–22	0–5
Forb					
4	**Perennial Forbs**			31–63	
	pussytoes	ANTEN	*Antennaria*	4–22	1–5
	buckwheat	ERIOG	*Eriogonum*	4–22	1–5
	spiny phlox	PHHO	*Phlox hoodii*	4–22	1–5
	longleaf phlox	PHLO2	*Phlox longifolia*	0–13	0–3
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–13	0–3
	rayless tansyaster	MAGR2	*Machaeranthera grindelioides*	0–13	0–3
	beardtongue	PENST	*Penstemon*	0–13	0–3
	flaxleaf plainsmustard	SCLI	*Schoenocrambe linifolia*	0–13	0–3
	fleabane	ERIGE2	*Erigeron*	0–13	0–3
	sandwort	ARENA	*Arenaria*	0–13	0–3
	milkvetch	ASTRA	*Astragalus*	0–13	0–3
	Wyoming besseya	BEWY	*Besseya wyomingensis*	0–13	0–3
	ragwort	SENEC	*Senecio*	0–13	0–3
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	0–3
	stemless mock	STAC	*Stenotus acaulis*	0–13	0–3

	goldenweed				
	stemless four-nerve daisy	TEAC	*Tetraneuris acaulis*	0–13	0–3
	agoseris	AGOSE	*Agoseris*	0–13	0–3
	onion	ALLIU	*Allium*	0–4	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–4	0–1
	violet	VIOLA	*Viola*	0–4	0–1
	deathcamas	ZIGAD	*Zigadenus*	0–4	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–4	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–4	0–1
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–4	0–1
	cryptantha	CRYPT	*Cryptantha*	0–4	0–1
	larkspur	DELPH	*Delphinium*	0–4	0–1
	ipomopsis	IPOMO2	*Ipomopsis*	0–4	0–1
	desertparsley	LOMAT	*Lomatium*	0–4	0–1
	rockcress	ARABI2	*Arabis*	0–4	0–1
	stonecrop	SEDUM	*Sedum*	0–4	0–1
	sagebrush buttercup	RAGL	*Ranunculus glaberrimus*	0–4	0–1
5	**Annual Forbs**			0–4	
	rockjasmine	ANDRO3	*Androsace*	0–4	0–1
	cryptantha	CRYPT	*Cryptantha*	0–4	0–1
	bushy blazingstar	MEDI	*Mentzelia dispersa*	0–4	0–1
	wirelettuce	STEPH	*Stephanomeria*	0–4	0–1
	Forb, annual	2FA	*Forb, annual*	0–4	0–1
Shrub/Vine					
6	**Sagebrush**			22–45	
	prairie sagewort	ARFR4	*Artemisia frigida*	4–45	1–10
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–45	0–5
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	0–13	0–3
7	**Misc Shrubs**			9–22	
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–22	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	4–22	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	4–22	1–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–22	0–5
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–13	0–3
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–13	0–3
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–13	0–3
	shortspine horsebrush	TESP2	*Tetradymia spinosa*	0–13	0–3
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–4	0–1
	bud sagebrush	PIDE4	*Picrothamnus desertorum*	0–4	0–1

Animal community

Livestock:
The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal

growing conditions with a harvest efficiency (HE) of 25 percent. 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). A field visit is required to document actual plant composition and production. More precise carrying capacity estimates, considering forage preference and accessibility (slope, distance to water, etc.), should be calculated using field data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies (up to 35 percent) can result in an increased carrying capacity, but recovery time for upland sites is much longer. If distribution problems occur, stocking rates should be reduced or facilitating conservation practices (i.e., cross-fencing, water development) implemented to maintain plant health and vigor.

Stocking rates are expressed in Animal Unit Months (AUMs) which is defined as the amount of forage consumed by a 1,000 lb. cow with a less than 4 month old calf at her side.

Initial Suggested Stocking Rate:
Plant Community Production (lbs./ac.) (AUMs/ac.)* Ac./AUM
1.1 Bunchgrass 300-450-550 0.08 13
2.1 Short-stature Grass/Mat-forming Forb 150-300-450 0.05 20
3.1 Reclaimed 300-450-550 0.1 10
3.2 Annual 100-200-300 0.02 50

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

Calculation for stocking rates are as follows: Using RV values for production, take forage palatable to grazing cattle and multiply by 0.25 HE and divide by 912.5 pounds per AUM air-dry weight (ADW) to arrive at the initial suggested stocking rate in AUMs per acre.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage, but is typically used in the spring. During the dormant period, the forage for livestock must be supplemented with protein because the quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect grazing capacity within a management unit. Accessibility adjustments should be made for the planning area as necessary. For example, 30 percent of a management unit may have 25 percent slopes and distances of greater than one mile from water, resulting in a 50 percent reduction in grazing access; therefore, the adjustment is 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 grazing access within a management unit. Adjustments should be made that incorporate these factors when calculating the carrying capacity of a management unit.

Wildlife:
Reference State
1.1 Bunchgrass Community: This community phase provides great habitat for elk, pronghorn, mule deer, and sage grouse throughout various times of the year. Value is lower for species dependent on shrubs, however, during winter months these sites are prone to being windblown allowing better access to forage especially for big game species. In addition, given the diverse suite of herbaceous species, this phase also provides important micronutrient requirements for big game species throughout the year as well as during the spring green up for migrating animals. Numerous small mammals and songbirds benefit from this state as well, providing foraging opportunities near nesting and cover habitats.

Grazing Resistant State
2.1 Short-stature Grass/Mat-forming Forb Plant Community: This community phase is variable in its value to wildlife. Value is low for species dependent on shrubs similar to the reference state, unless in close proximity to areas with a more dominant shrub community. This phase still provides winter forage access similar to the reference state, however, with a reduction in grass species, especially the mid-size cool season bunchgrasses, the value to wildlife has been reduced.

Highly Disturbed State

3.1 Reclaimed Plant Community: This community phase is highly variable in its value to wildlife. Reclamation success, size and configuration of the reclaimed area, the species planted, and the time it takes for plants to establish will determine the value of the site for wildlife. A fully reclaimed site containing a diversity of herbaceous and woody native plants can eventually provide the same wildlife habitat benefits as the reference state. In most cases, grasses and forbs establish early in the reclamation process, whereas shrubs take significantly longer to establish. Wildlife species dependent on herbaceous plant communities for forage (such as elk) will benefit from reclamation sooner than those species dependent on communities with a shrub component.
3.2 Annual Plant Community: This plant community exhibits a low level of plant species diversity, and thus, is less apt to meet the seasonal needs of most wildlife who frequent this community. Small mammals and songbirds will still utilize this phase, although not to the capacity as the above states.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is highly variable and is dominated by soils in hydrologic groups B and C. Infiltration ranges from moderately slow to moderate. Runoff potential for this site varies from moderate to high depending on soil hydrologic group, slope 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 are not typically present due to rock fragments on the surface that armor the site. Water flow patterns should be barely distinguishable. Pedestals are only slightly present in association with bunchgrasses . Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Biological crusts are present, but only cover one to two percent of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom in the spring have an aesthetic value that appeals to recreationists and combined with landscape position attract pollinators such as butterflies.

Wood products

No wood products are present on the site.

Inventory data references

Information was derived from 1988 Range Site Descriptions, NRCS clipping data, literature, field observations (based on two sampled sites and observations from numerous others), and personal contacts with range-trained personnel (i.e., agency specialists, landowners, land managers, and scientists).

References

Bestelmeyer, B., J.R. Brown, K.M. Havstad, B. Alexander, G. Chavez, and J.E. Herrick. 2003. Development and Use of State and Transition Models for Rangelands. Jornal of Range Management 56:114–126.

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.

Bowker, K.A. 2000. Jonah Field: A Shallow Sweetspot in the Basin-Centered Gas Accumulation of the Northern Green River Basin, Wyoming..

Chambers, J.C., J.L. Beck, T.J. Christiansen, K.J. Clause, J.B. Dinkins, K.E. Doherty, K.A. Griffin, D.W. Havlina, K.F. Henke, L.L. Kurth, J.D. Maestas, M. Manning, K.E. Mayer, B.A. Mealor, C. McCarthy, M.A. Perea, and D.A. Pyke. 2016. Using resilience and resistance concepts to manage threats to sagebrush ecosystems, Gunnison sage-grouse, and Greater sage-grouse in their eastern range: A strategic multi-scale approach.. Gen. Tech. Rep. RMRS-GTR-356.. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 1–143.

Chambers, J.C., D.A. Pyke, J.D. Maestas, M. Pellant, C.S. Boyd, S.B. Campbell, S. Esipinosa, D.W. Havlina, K.E. Mayer, and A. Wuenschel. 2014. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: A strategic multi-scale approach.. Gen. Tech. Rep. RMRS-GTR-326.. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station., Fort Collins, CO. 73.

Clause, K. and J. Randall. 2014. Wyoming Sagebrush Die-Off Report. Unpublished.

Martin, J.L. 1996. Geohydrology of Tertiary Rocks in the Green River Structural Basin in Wyoming, Utah, and Colorado.. Water-Resources Investigations Report 92-4164. US Geological Survey.

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. “Precipitation-Frequency Atlas of the United States” NOAA Atlas 2, Volume 2 (Wyoming). National Weather Service, Silver Spring, Maryland.

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.

U. S. Environmental Protection Agency. 2010. Level III and IV ecoregions of the continental United States. U.S. EPA, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, U.S..

Winward, A. 2007. Boulder, Squaretop Area Field Notes. Field Notes. Unpublished.

Contributors

Bryan Christensen
Karen J. Clause

Approval

Kirt Walstad, 9/28/2023

Acknowledgments

Shari Meeks, SCCD
Troy Fieseler, WGFD
Justin Feeman, BLM

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)	
Contact for lead author	
Date	05/19/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-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:**

17. **Perennial plant reproductive capability:**