USDA Natural Resources Conservation Service

Ecological site R036XY325CO
Semidesert Loam

Accessed: 05/19/2024

General information

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

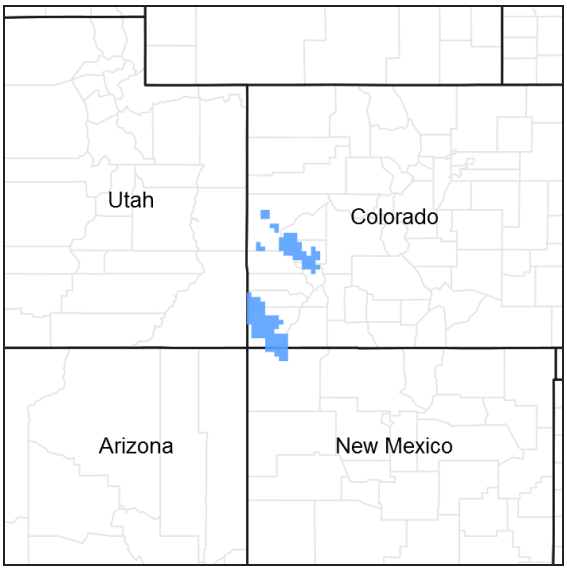


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 036X–Southwestern Plateaus, Mesas, and Foothills

Semi-desert Loam ecological site is found on benches and sloping mesa in MLRA 36. The MLRA 36 is illustrated orange color on the map. The ecological site locations as assigned in soil survey map units are shown in pink color. The site concept was established within the MLRA 36 s regions. This zone is 9 to 12 inches of precipitation and has a mesic temperature regime. This site has bimodal precipitation that is dominated by Wyoming big sagebrush.

Classification relationships

NRCS & BLM:
Major Land Resource Area 36, Southwestern Plateaus Mesas and Foothills (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
341Ba - Mancos Shale Lowlands-Grand Valley, 341Bd -Salt Anticline Benchlands, 341Bg - Northeast Flank, 341Bo - North Uncompahgre Plateau, 341Bp - Uncompahgre Plateau, and 341Bq - South Uncompahgre Plateau subsections <341B Northern Canyonlands Section < 341 Intermountain Semi-desert and Desert (Cleland, et al., 2007).

313Aa - San Juan Basin-Mesa Verde, 313Ab - Canyon of Ancients-Blanding Basin, and 313Ac - Monument Upwarp

subsections <313A Grand Canyons Section < 341 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

313BC - Chuska Valley Cold Desert Shrubland Subsection <313B Navaho Canyonlands Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

EPA: 20a Monticello-Cortez Uplands, 20b Shale Deserts and Sedimentary Basins and 20c Semiarid Benchlands and Canyonlands, < 20 Colorado Plateau < 10.I Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS:
Colorado Plateau Province (Canyonlands and Navajo Section)

Ecological site concept

The 36X Semidesert Loam was drafted from the existing Semidesert Loam Range Site 35X (SCS, April, 1981). This site was written prior to MLRA 36 being mapped in Colorado and this area was in MLRA 34X/35X when it was written. This site occurs on benches, sloping mesas and alluvial fans on moderately deep to deep soils derived mainly from alluvium from sandstone and shale. The soil textures range from fine sandy loam to clay loam. It is a Wyoming big sagebrush – galleta community. It has an ustic aridic moisture regime and mesic temperature regime. The effective precipitation ranges from 9 to 12 inches.

Associated sites

R034BY404CO	**Semidesert Stony Loam (Shadscale)** Stony Saltdesert is found on gentle sloping (0-15%) benches and mesas. Soils are deep and have a loam surface. Subsoil is a loam to clay loam. There are basalt cobbles and gravels on the surface and occasionally in the profile. Dominant vegetation is shadscale, galleta, squirreltail, Indian ricegrass, globemallow and winterfat. Clayey saltdesert is shallow in depth with heavy silty clay loams, silty clay and clay textures with salts and calcareous to the surface.
R035XY413CO	**Alkali Bottom** Alkali Bottom is found on terraces, drainage-ways and alluvial valley floors. This site is in a run-in position on the landscape. Soils are deep from shale and sandstone. Soils are moderate to strongly alkaline. Surface textures are sandy loam, clay loam or silty clay loam. Subsurface textures are silty clay loam. Dominant plants are alkali sacaton, inland saltgrass, basin wildrye, and greasewood.
R036XY110CO	**Shallow Clay Loam (pinyon-Utah juniper)** Shallow Clay Loam Pinyon-Juniper is a gentle sloped (<25-30% slope) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory.
R036XY111CO	**Steep Shallow Clay Loam (pinyon-Utah juniper)** Steep Shallow Clay Loam Pinyon-Juniper is a very steep sloped site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory.
R036XY113CO	**Semidesert Juniper Loam** Semidesert Juniper Loam is a gentle sloped (<25-30% slope) site with shallow soils that are loamy in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory.
R036XY326CO	**Semidesert Sandy Loam** Semidesert Sandy Loam is on coarse texture soils. Clay content is lower in these soils than those found in Semidesert Loam. Both are a Wyoming big sagebrush dominated site. Needle-and-thread is the dominant grass on this site. The soils on this site are moderately deep to very deep.
R036XY328CO	**Semidesert Clay Loam** Semidesert Clay Loam is on clayey texture soils. Clay content is higher in these soils than those found in Semidesert Loam. Both are a Wyoming big sagebrush dominated site. Western wheatgrass/thickspike wheatgrass is the dominant grass on this site. The soils on this site are moderately deep to very deep.
R036XY405CO	**Loamy Bottom** Loamy bottom occurs on drainage-ways, floodplains and alluvial fans. This site is in a run-in position on the landscape. Soils are deep. Soil textures are generally loams. Dominant vegetation is basin wildrye, muttongrass, basin big sagebrush, and western wheatgrass.

R036XY445CO	**Steep Colluvial Slopes** Steep Colluvial Slopes is a very steep (>25% slope) sloped site with very shallow to shallow soils that are clayey in texture. This site is dominated by Utah Juniper and pinyon. This site may have Wyoming big sagebrush in the understory. This site has higher precipitation than Semidesert Loam. The temperature is slightly cooler than the semidesert site. Foothill site will be found at elevations above the semidesert site. The soils are similar in nature.

Similar sites

R036XY326CO	**Semidesert Sandy Loam** Semidesert Sandy Loam is on coarse texture soils. Clay content is lower in these soils than those found in Semidesert Loam. Both are a Wyoming big sagebrush dominated site. Needle-and-thread is the dominant grass on this site. The soils on this site are moderately deep to very deep.
R036XY328CO	**Semidesert Clay Loam** Semidesert Clay Loam is on clayey texture soils. Clay content is higher in these soils than those found in Semidesert Loam. Both are a Wyoming big sagebrush dominated site. Western wheatgrass/thickspike wheatgrass is the dominant grass on this site. The soils on this site are moderately deep to very deep.
R036XY284CO	**Loamy Foothills** Loamy Foothills has higher precipitation than Semidesert Loam. The temperature is slightly cooler than the semidesert site. Foothill site will be found at elevations above the semidesert site. The soils are similar in nature.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. wyomingensis*
Herbaceous	(1) *Pleuraphis jamesii* (2) *Achnatherum hymenoides*

Physiographic features

This site occurs on structural benches, dipslopes, dipslopes on cuestas, alluvial fans, mesas, hills, valley floor and terraces. Slopes typically range from 1-25%, and elevations are generally 5000-6800 ft.

Table 2. Representative physiographic features

Landforms	(1) Structural bench (2) Dip slope (3) Cuesta
Flooding frequency	None
Ponding frequency	None
Elevation	1,524–2,073 m
Slope	1–25%
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation is about 9 to 12 inches. This area is located where there is winter precipitation and summer monsoonal rains meet. Of this, 45-50% falls as snow, and 50-55% falls as rain. Snow usually falls from November to March. Rains are falls April 1 thru October 31. The driest period is usually May to June. Plant growth begins late March and early April. Cool-season plants start a dormancy period during June. Summer thundershowers are common in July to September. The summer moisture will favor growth from the warm season plants. When late summer and fall rains occur, warm-season plants accelerate growth, and some regrowth occurs on cool-season species. Shrub species continue growth through the entire growing season. The average annual total snowfall is 17.8 inches. The highest winter snowfall record in this area is 44.8 inches which occurred in 1972-1973. The lowest snowfall record is zero inches during the 1999-2000 winter. The highest yearly precipitation

recorded was 19.02 in 2015 and the lowest was 5.17 in 1989. Mean daily annual air temperature is about 50ºF to 54ºF, averaging about 33ºF for the winter and 61ºF through the growing season, March through October. Summer temperatures of 100ºF or more are not unusual. The frost-free period typically ranges from 125 to 165 days at Hovenweep NM (national monument). The last spring frost is the first part of May to the end of May. The first fall frost is the end of September to the middle of October. Mean annual temperature ranges from 55 to 49ºF. Average annual temperature is 51.9ºF. The coldest winter temperature recorded was -24ºF on December 24, 1990 and the coldest summer temperature recorded was 26ºF on June 12, 1970. The hottest day on record is 106 ºF on July 15, 1998. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2017) for Hovenweep NM, Utah Climate Station. Hovenweep NM is on the Western edge of the MLRA. Hovenweep NM is the only station occurring in the MLRA in this zone. It is on the upper end of precipitation. There is a need for climate date in the zone.

Typical warm dry weather in late spring and early summer puts warm season plants at a distinct disadvantage compared to plants that grow earlier on stored winter moisture and spring rains. Deep storage of winter moisture allows sagebrush and small trees to compete strongly with shallower rooted grasses during this dry period where other factors encourage their spread.

Table 3. Representative climatic features

Frost-free period (average)	131 days
Freeze-free period (average)	146 days
Precipitation total (average)	279 mm

Climate stations used

- (1) HOVENWEEP NM [USC00424100], Monticello, UT

Influencing water features

There are no water features associated with this site.

Soil features

The soils in this site are moderately deep to deep, and well drained. The soils formed in eolian and alluvial materials derived mainly from sandstone or sandstone and shale. The surface layer is light brown to reddish brown loam, fine sandy loam, very fine sandy loam or gravelly sandy loam, 2 to 10 inches thick. The soil surface ranges from 14 to 24% clay.

The subsoil ranges from 19 to 32% clay at 20 inches in depth (sandy clay loam, loam and clay loam). Subsoils may have pebbles or gravels present. Permeability ranges from moderately slow to moderate.

The major soils associated with this site are:
Barx, Abra, and Blancot.

Moderately deep soils assigned this site: Gapmesa, Progresso and Hagerman

Table 4. Representative soil features

Parent material	(1) Slope alluvium–sandstone (2) Eolian deposits–sandstone and shale
Surface texture	(1) Loam (2) Fine sandy loam (3) Very fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained

Permeability class	Moderately slow to moderate
Soil depth	51 cm
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	10.41–18.8 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–13%
Subsurface fragment volume >3" (Depth not specified)	0–14%

Ecological dynamics

MLRA 36 occurs on the higher elevation portion of the Colorado Plateau. The Colorado Plateau is a physiographic province which exists throughout eastern Utah, western Colorado, western New Mexico and northern Arizona. It is characterized by uplifted plateaus, canyons and eroded features. The Colorado Plateau lies south of the Uintah Mountains, north of the Mogollon transition area, west of the Rocky Mountains, and east of the central Utah highlands. The higher elevation portion of the Colorado Plateau which is represented by MLRA 36 is characterize by broken topography, and lack of perennial water sources. This area has a long history of past prehistoric human use for thousands of years. MLRA 36 shows archaeological evidence indicating that pinyon-juniper woodlands where modified by prehistoric humans and not pristine and thus where altered at the time of European settlement (Cartledge & Propper, 1993). This area also included natural influences of herbivory, fire, and climate. This area rarely served as habitat for large herds of native herbivores or large frequent historic fires due to the broken topography. This site is extremely variable and plant community composition will vary with the water fluctuations on this site.

There is a winter-summer bimodal precipitation pattern on this part of the Colorado Plateau. Meaning that this site developed under climatic conditions that include wet, cold winters, and hot, dry summers with summer rains. This area has climatic fluctuations and prolonged droughts are common occurrences. Between an above average year and a drought year, forbs are the most dynamic (Passey et.al. 1982) and can vary up to 4 fold. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, and sagebrush complexes with high productive sites in the bottoms of the canyons. Predominant species on the Colorado Plateau are Wyoming big sagebrush (*Artemisia tridentata* var. wyomingensis), mountain big sagebrush (*A. tridentata* var. vaseyana), and black sagebrush (*A. nova*), Basin Big Sagebrush (*A. tridentata* var. tridentata), Utah Juniper (Juniperus utahensis) and Pinyon (*Pinus edulis*).

This site is influenced by many of the natural disturbances typical of MLRA 36, particularly by fire. Wyoming big sagebrush typically is the dominant plant species; however, with the removal of big sagebrush following a burn, perennial grasses generally dominate the community. Wyoming big sagebrush will begin to re-establish itself in the community within 2-10 years following a fire, given a seed source and average precipitation (Johnson and Payne, 1968). However, it may take more than 10 years for big sagebrush to re-establish in unfavorable conditions (Howard, 1999). Invasive species, particularly cheatgrass, may reduce the resilience of this site following wildfire or management disturbances. Other plants likely to invade this site are annual sunflower, annual mustards, sticktight, and Russian thistle.

Any disturbance that reduces the vigor or establishment of perennial plants will increase the likelihood of

establishment of invasive annuals in the understory. (Boyle and Reeder, 2005).

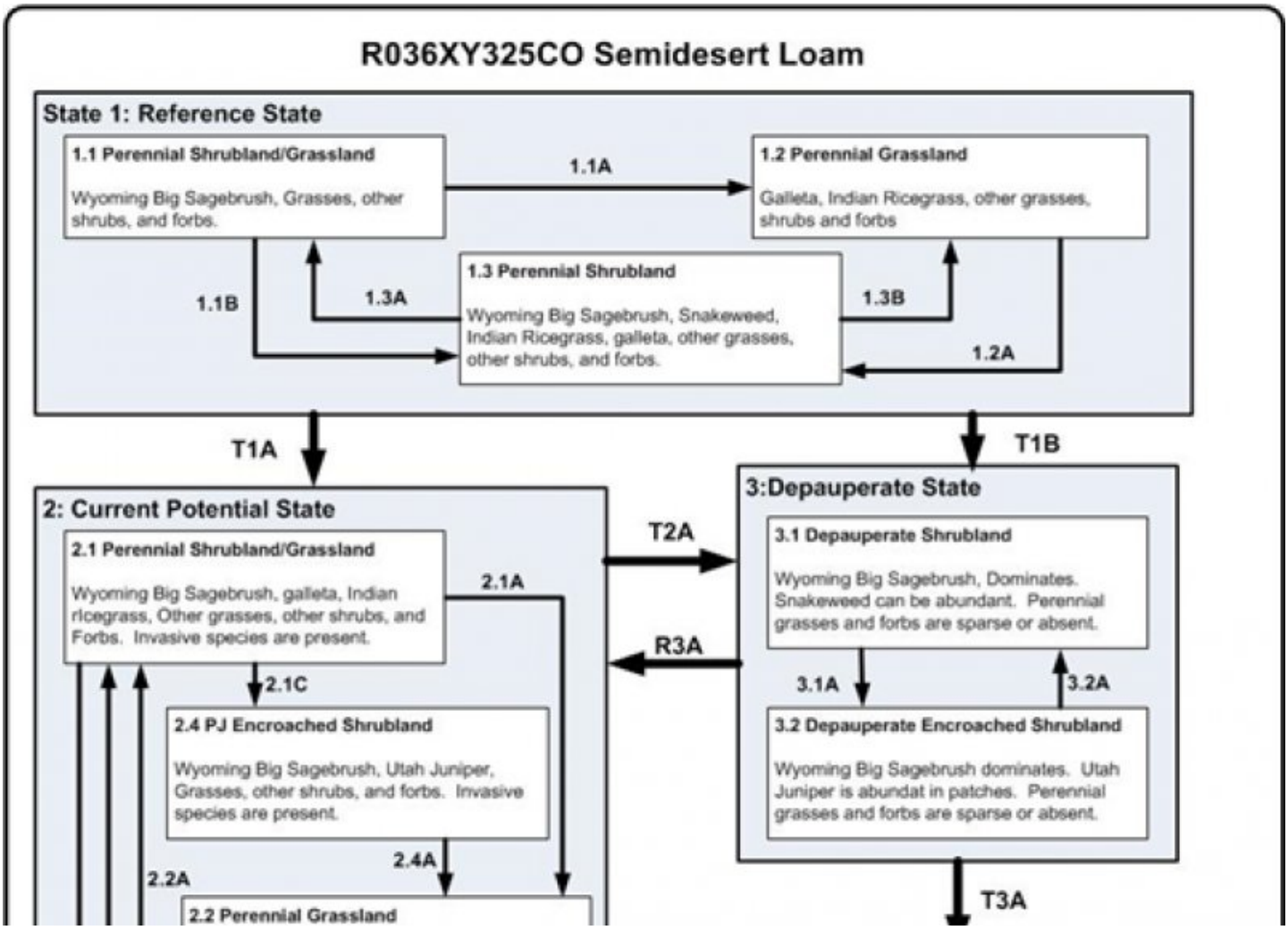
Caution should be used to protect this site from establishment and increased dominance of annual invasive species, particularly cheatgrass, by maintaining or increasing the vigor and establishment of perennial species through proper management. Proximity to roads or other seed vectors will increase the likelihood of invasion by non-native species (Davies and Sheley, 2007). Continuous season-long grazing and/or heavy stocking rates may decrease the vigor and establishment of perennial grass species.

The following is from the 1988 Range site (SCS, 1988):

"If ecological retrogression is cattle induced, blue grama, galleta, and stickyleaf low rabbitbrush, winterfat, Wyoming big sagebrush, and Fendler threeawn increase. Western wheatgrass, bottlebrush squirreltail, and Indian ricegrass would decrease with continuous early spring grazing. Galleta would decrease with continuous summer grazing. If retrogression is caused by sheep, desirable forbs and grasses decrease. Winterfat and Wyoming big sagebrush would decrease with continuous winter and early spring grazing. Plants most likely to invade this site are: cheatgrass, sixweeks fescue, annual sunflower, mustard, sticktight, Russian thistle, and broom snakeweed."

Variability in climate, soils, aspect and complex biological processes will cause the plant communities to differ. These factors contributing to annual production variability include wildlife use, drought, and insects. Factors contributing to special variability include soil texture, depth, rock fragments, slope, aspect, and micro-topography. The species lists are representative and not a complete list of all occurring or potentially occurring species on this site. The species lists are not intended to cover the full range of conditions, species and responses of the site. The State & Transition model depicted for this site is based on available research, field observations and interpretations by experts and could change as knowledge increases. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. The following diagram does not necessarily depict all the transitions and states that this site may exhibit, but it does show some of the most common plant communities.

State and transition model



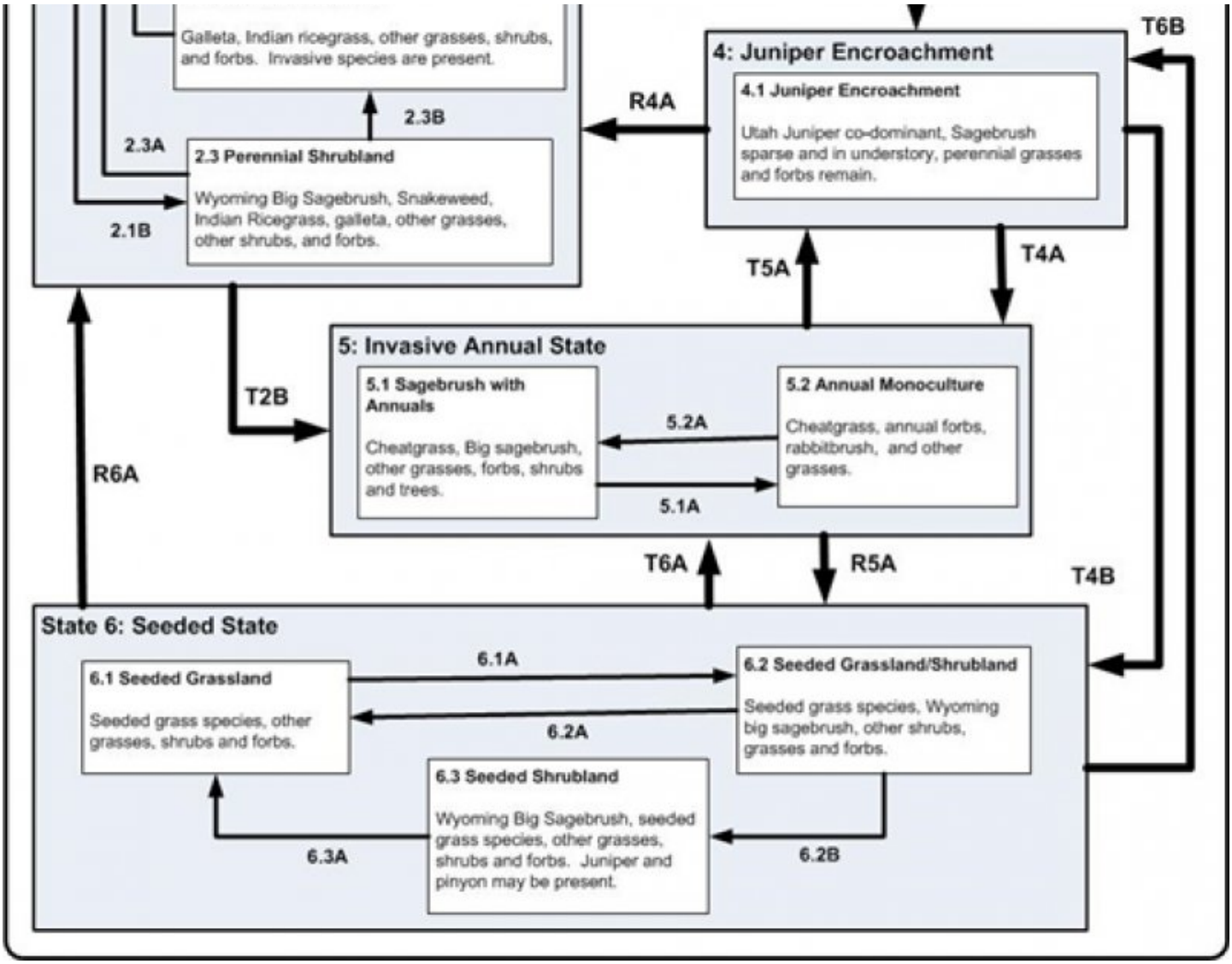


Figure 6. STM

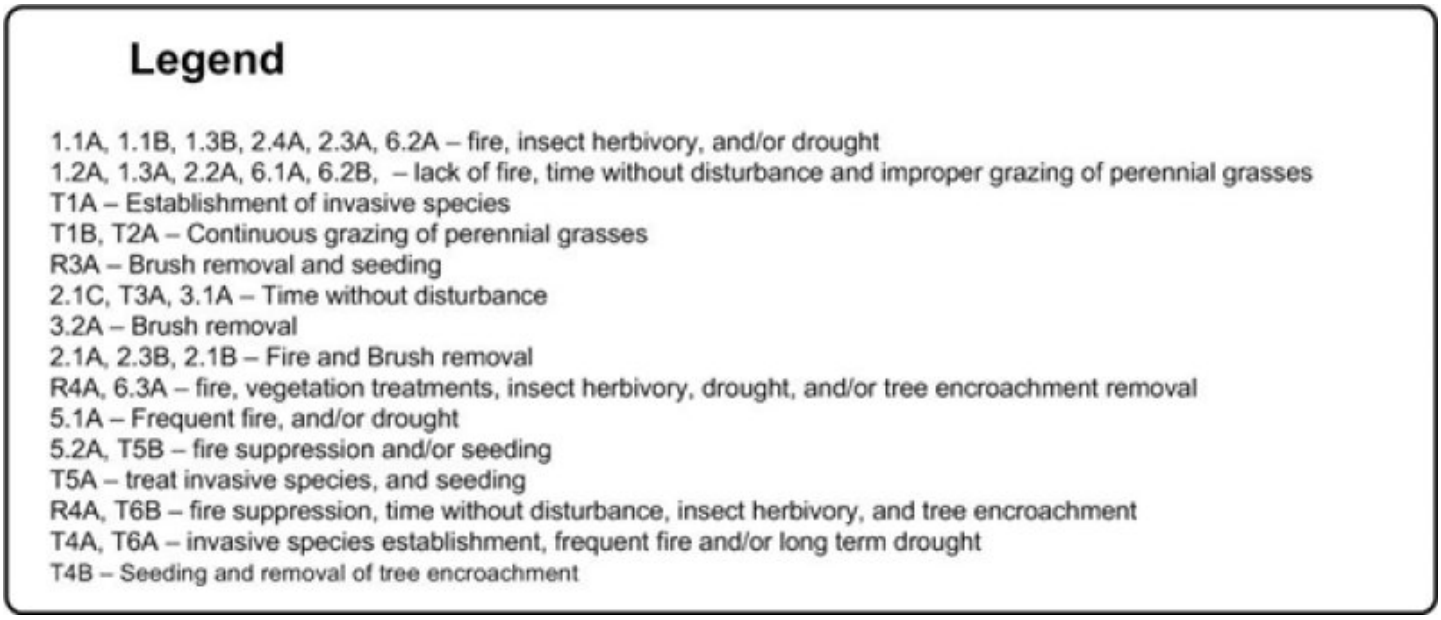


Figure 7. STM Legend

State 1
Reference State

The reference state represents the expected historical plant communities and ecological dynamics of this site, without the effects of improper grazing, altered fire regime, non-native species, or other human disturbances. The reference state is dominated by big sagebrush and/or perennial grasses. The reference state is self-sustaining,

meaning it is resistant to natural disturbances and exhibits high resilience following natural disturbances (Briske et al., 2008). All community phases are at risk of non-native/invasive plant establishment when a seed source and germination sites are available.

Community 1.1
Perennial Shrubland/Grassland

Wyoming big sagebrush is the co-dominant with grasses in this phase. James' galleta and Indian ricegrass dominate the understory, along with a variety of other native perennial grasses. Forbs are a minor component of the plant community. Fourwing saltbush is often present but not dominant. The following is from 1988 range site: The aspect of this site is a mixed grass-shrub community. Grasses make up 50 - 60 percent, while forbs are 5 - 10 percent and shrubs 25 - 35 percent, air-dry weight.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	269	404	538
Shrub/Vine	135	202	269
Forb	45	67	90
Total	**449**	**673**	**897**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	10-25%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	2-5%
Non-vascular plants	0%
Biological crusts	15-35%
Litter	5-25%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	5-15%

Table 7. Canopy structure (% cover)

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

Figure 9. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 1.2
Perennial Grassland

This phase is dominated by perennial native grasses.

Figure 10. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 1.3
Perennial Shrubland

Big sagebrush dominates the plant community with some understory. The following is from 1988 range site: The aspect of this site is a mixed grass-shrub community. Grasses make up 50 - 60 percent, while forbs are 5 - 10 percent and shrubs 25 - 35 percent, air-dry weight.

Figure 11. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 1.1A
Community 1.1 to 1.2

Fire removes big sagebrush and perennial bunchgrasses quickly recover and dominate. The natural fire return interval is highly variable depending on fuel levels and climate, but is expected to range between 10-70 years (Howard, 1999) in areas dominated by Wyoming big sagebrush.

Pathway 1.1B
Community 1.1 to 1.3

Low intensity fire, pathogens, or extended drought thin big sagebrush (Winward, 2004). The natural fire return interval is widely variable depending on fuel levels and climate, and is expected to be between 10-70 years in Wyoming big sagebrush communities (Howard, 1999). Perennial grasses and fourwing saltbush re-sprout, and the grasses dominate the site.

Pathway 1.2A
Community 1.2 to 1.3

Time without disturbance can result in a natural increase in sagebrush dominance (Welch and Criddle, 2003). Grazing of perennial grasses may decrease the time required for this pathway.

Pathway 1.3A
Community 1.3 to 1.1

Time without disturbance can result in a natural increase in sagebrush dominance (Welch and Criddle, 2003). Grazing of perennial grasses may decrease the time required for this pathway.

Pathway 1.3B
Community 1.3 to 1.2

Fire removes big sagebrush, perennial bunchgrasses quickly recover and dominate. The natural fire return interval is highly variable depending on fuel levels and climate, but is expected to range between 10-70 years (Howard, 1999) in areas dominated by Wyoming big sagebrush.

State 2
Current Potential State

The current potential state is similar in structure and function to the reference state, however invasive species are present in all community phases. The current potential state is generally dominated by big sagebrush and perennial grasses, but has an additional phase due to juniper encroachment as a result of fire suppression. The current potential state is less resilient than the reference state due to the presence of non-native/invasive species in the plant community.

Community 2.1
Perennial Shrubland/Grassland

Perennial grasses co-dominate the site with big sagebrush and/or fourwing saltbush. Non-native species are present but not dominant.

Figure 12. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 2.2
Perennial Grassland

This phase is dominated by perennial native grasses. Non-native species are present but not dominant.

Figure 13. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 2.3
Perennial Shrubland

Wyoming big sagebrush is the dominant plant in the perennial shrubland phase. James' galleta and Indian Ricegrass dominate the understory, along with a variety of other native perennial grasses. Forbs are a minor component of the plant community. Fourwing saltbush is often present. Non-native species are present but not dominant.

Figure 14. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 2.4
PJ Encroached Shrubland

This phase is dominated by Wyoming big sagebrush. Pinyon and/or Utah juniper may dominate in patches, and many young trees are scattered throughout the sagebrush-dominated areas. Perennial grasses noticeably

decrease, especially in areas where pinyon and juniper dominate. This reduces the resilience of the site by improving the germination site availability for non-native invasive species, especially following a burn.

Figure 15. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 2.1A
Community 2.1 to 2.2

Fire removes big sagebrush, perennial bunchgrasses quickly recover and dominate. The natural fire return interval is highly variable depending on fuel levels and climate, but is expected to range between 10-70 years (Howard, 1999) in areas dominated by Wyoming big sagebrush.

Pathway 2.1B
Community 2.1 to 2.3

Low intensity fire, pathogens, or extended drought thin big sagebrush (Winward, 2004). The natural fire return interval is widely variable depending on fuel levels and climate, and is expected to be between 10-70 years in Wyoming big sagebrush communities (Howard, 1999). Perennial grasses and fourwing saltbush re-sprout, and the grasses dominate the site.

Pathway 2.1C
Community 2.1 to 2.4

Extended time without disturbance, most commonly fire return intervals greater than about 70 years, promote pinyon and juniper establishment and growth in the community.

Pathway 2.2A
Community 2.2 to 2.1

Time without disturbance can result in a natural increase in sagebrush dominance (Welch and Criddle, 2003). Grazing of perennial grasses may decrease the time required for this pathway.

Pathway 2.3A
Community 2.3 to 2.1

Time without disturbance can result in a natural increase in sagebrush dominance (Welch and Criddle, 2003). Grazing of perennial grasses may decrease the time required for this pathway.

Pathway 2.3B
Community 2.3 to 2.2

Fire removes big sagebrush, perennial bunchgrasses quickly recover and dominate. The natural fire return interval is highly variable depending on fuel levels and climate, but is expected to range between 10-70 years (Howard, 1999) in areas dominated by Wyoming big sagebrush.

Pathway 2.4A
Community 2.4 to 2.2

Fire removes big sagebrush, pinyon and juniper. Perennial grasses resprout quickly and dominate the site, except in patches where they were eliminated by pinyon and juniper dominance. These patches may be more susceptible to invasion by non-native/invasive species.

State 3

Depauperate State

This state occurs when native perennial grasses are removed by excessive grazing. Native forbs are also reduced. The fire return interval is greatly increased due to a lack of fine fuels. The prolonged fire return interval facilitates establishment of Utah juniper.

Community 3.1
Depauperate Shrubland

Figure 16. Phase 3.1

This community phase is the result of excessive grazing or other disturbance that removes perennial grasses and native forbs from the understory. Wyoming big sagebrush dominates and overall production is greatly reduced.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	280	392	504
Grass/Grasslike	–	17	28
Tree	–	6	17
Forb	–	6	11
Total	**280**	**421**	**560**

Figure 18. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 3.2
Depauperate Encroached Shrubland

This community phase occurs when Utah juniper begins to dominate the site in patches due to prolonged time without fire or other shrub-controlling disturbance.

Pathway 3.1A
Community 3.1 to 3.2

Prolonged time without fire or other brush-controlling disturbance promotes establishment and dominance of Utah juniper in patches.

Pathway 3.2A

Community 3.2 to 3.1

Brush management can thin Utah juniper and return the site to phase 3.1.

State 4
Juniper Encroachment

This state occurs due to lack of fire or other brush controlling disturbance. Utah juniper performs well on this ecological site in the absence of disturbance, and eventually outcompetes Wyoming big sagebrush for water and nutrients. The result is a juniper dominated state with little to no Wyoming big sagebrush, perennial grasses, or forbs in the understory.

Community 4.1
Juniper Encroachment

This is the only phase in the fire-resistant, self-perpetuating state dominated by Utah juniper.

State 5
Invasive Annual State

This state is dominated by invasive annual species. Invasive annual species can including cheatgrass, Russian thistle, kochia, halogeton, storksbill geranium, and annual mustards. Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible.

Community 5.1
Sagebrush with Annuals

This state will look big sagebrush with an invasive annual species understory. Frequently, sagebrush canopy cover will be dense due to little to none perennial understory being present. Cheatgrass, and other annual introduced species are now present in the understory. It can function as a plant community this way unless the fire return interval decreases to less than 5 years (Whisenant 1986). Then it will transition to an Annual grasses phase (5.2). This phase is at risk for becoming a cheatgrass-dominated grassland.

Figure 19. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 5.2
Annual Monoculture

This community is characterized by an almost a complete monoculture of cheatgrass and/or other invasive annuals. This community can be long-lasting phase if fires and disturbance continue to be frequent.

Figure 20. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 5.1A
Community 5.1 to 5.2

This pathway occurs when frequent fire or drought remove the big sagebrush, and favor the establishment of

cheatgrass or other invasive annuals. In a degraded sagebrush community, cheatgrass will take advantage of the increased interspaces between plants will typically establish in the interspaces. Once annuals get established it creates a fine fuel load which will decrease the fire return interval. With more frequent fires, sagebrush can be eliminated from the site and a monocultures of invasive annuals can become established. These monocultures can persist for long time periods. Frequent fires also prevent the re-establishment of sagebrush on the site.

Pathway 5.2A
Community 5.2 to 5.1

This pathway occurs when there is a longer fire return interval. Longer fire return intervals can be enabled by using fire suppression and fire breaks to allow perennial vegetation to a change to get established. Along with this seeding and/or proper grazing may allow native perennial plants to return to this community. This pathway has very intensive energy inputs.

State 6
Seeded State

This state results from seeding introduced perennial grasses (i.e. crested wheatgrass and Russian wildrye). Native perennial grasses, forbs and shrubs may be included in the seed mix. This state behave similar community dynamics to the current potential state community. Other vegetation treatments may be necessary to get to this state, they include chaining, mowing, disking, prescribed burning and other techniques which manipulate the plant community. Applying vegetation treatments to plant communities to either the invasive annuals or juniper encroachment states to create a seeded state is often the first step in assisted restoration to plant communities an intermediate step to get to the Current Potential State. The seeded state could persist for long periods of time with proper management. Native grasses and forbs may reestablish over time from nearby seed sources. Big sagebrush will typically reestablish in 30-40 years.

Community 6.1
Seeded Grassland

This community is dominated by seeded plants such as crested wheatgrass, Russian wildrye, smooth brome, and intermediate and pubescent wheatgrasses. Big sagebrush has little to no production in this phase. This site has high production due to the seed grass production. This production typically is higher than the current potential or reference state. This site usually has low species diversity.

Figure 21. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 6.2
Seeded Grassland/Shrubland

This phase has big sagebrush co-dominant with the seeded grass.

Figure 22. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 6.3
Seeded Shrubland

This community consists big sagebrush with sparse understory. Sagebrush canopy cover would typically be greater than 35%. Scattered Utah juniper and maybe two-needle pinyon might have encroached. Two-needle pinyon and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense

stands and eventually dominate the site. Nonnative invasive species, such as cheatgrass are present but in insignificant amounts. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase.

Figure 23. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 6.1A
Community 6.1 to 6.2

Time without disturbance and climatic conditions that favor establishment of sagebrush will assist this pathway. Improper grazing on the grasses species can favor shrub establishment and reduce their competitiveness. Also, several consecutive years of droughts can reduce grass cover.

Pathway 6.2A
Community 6.2 to 6.1

This transition is caused by naturally occurring fires, herbivory of sagebrush, and/or drought that suppresses sagebrush establishment. These events tend to favor grass establishment. With a mature sagebrush community, this pathway can be caused by high intensity fire that burns hot enough to remove big sagebrush and PJ, if it has started to encroach. Low-intensity fire after sagebrush has had a chance to set seed, improper grazing and or browsing by native ungulates, and possible stem-root pathogens will revert a young sagebrush community to a grassland with the potential to become a sagebrush-grass community once again (Winward, 2004). Vegetation treatments (mechanically, prescribed fire, chemically, etc.) can also be employed to imitate the natural disturbances regime.

Pathway 6.2B
Community 6.2 to 6.3

This pathway favors shrub establishment. This pathway is cause by time without disturbance (i.e. fire) and favorable conditions for young sagebrush establishment. Also, Pinyon and juniper will start to encroach under these condition. Improper continuous grazing of perennial grasses will speed up this pathway. This will lead to an old decadent stand of sagebrush with little to no understory.

Pathway 6.3A
Community 6.3 to 6.1

This pathway is caused by naturally occurring fires, vegetation treatments (chemical and mechanical), and/or insect herbivory removes the shrubs and possible trees if they have encroached on this site. It reverts the system back to a grassland phase. Depending on the amount of understory present, grasses and forbs may need to be reseeded to aid reestablishment.

Transition T1A
State 1 to 2

Invasive species are present on the site. The current potential state is less resilient than the reference state due to the presence of non-native/invasive species in the plant community.

Transition T1B
State 1 to 3

Continuous grazing of perennial species and lack of disturbance over a very long time span.

Transition T2A

State 2 to 3

Continuous grazing of perennial species and lack of disturbance over a very long time span.

Transition T2B
State 2 to 5

This transition is from big sagebrush dominated state, to a state that is dominated by invasive species. Events include establishment of invasive species, fire (<5-20 years), continuous season long grazing of perennial grasses, long term drought.

Restoration pathway R3A
State 3 to 2

Brush management and seeding to adapted perennial grasses, forbs and shrubs under favorable climatic conditions may result in a restoration of state 2 from the depauperate state 3.

Transition T3A
State 3 to 4

This transition is expected to occur when fire or other juniper-controlling disturbance has been absent from the site for at least 150 years. Sagebrush becomes very decadent and Utah juniper outcompetes all species for water and other resources.

Restoration pathway R4A
State 4 to 2

Pathways can be one or more of the following: brush treatments, seeding, insect herbivory/pathogen, proper grazing, drought, and/or fire. This pathway requires lots of energy input into the system.

Transition T4A
State 4 to 5

This transition is from big sagebrush dominated state, to a state that is dominated by invasive species. Events include establishment of invasive species, fire (<5-20 years), continuous season long grazing of perennial grasses, long term drought.

Transition T4B
State 4 to 6

Seeding of introduced/native species (grasses and forbs) is the pathway to state 4. Also, trees are usually removed by mechanical or chemical treatments. This transition requires energy input into the system.

Transition T5A
State 5 to 4

This transition requires fire return intervals to length and fire suppression may be necessary to interrupted the shorten fire return intervals that occur when cheatgrass and other annuals invade. Juniper will encroach onto the site with time and lack of fire. Seeding may be necessary to establish perennial plants. This could require significant energy inputs to make this transition happen.

Restoration pathway R5A
State 5 to 6

Invasive annuals will need to be treated and dominance suppress enough to allow desired seeded species the ability to complete so that they can become established. Seeding of introduced species is the pathway to state 4. This transition will be difficult and require substantial inputs and management of the site. It may not be practical on a

large scale. Research is needed for species adapted to compete with annual invasive plants, and seeding techniques to add with successful transition from the invasive annual state.

Restoration pathway R6A
State 6 to 2

This return path could possible occur as a result of long time frames without disturbance. Native plants from adjacent site would slow establish in the seeded state. Proper grazing from livestock and wildlife which would favor the establishment of native plants. Removal of the Utah juniper and Pinyon as they encroach would also be necessary.

Transition T6B
State 6 to 4

This transition is from the big sagebrush-seeded grass state to a state that is dominated by two-needle pinyon and Utah juniper. Events include, fire suppression, time without disturbance, insect herbivory, continuous season long grazing of perennial grasses, and tree invasion. As canopy density increase, bare ground will increase further increasing the fire return interval, accelerating erosion, increasing run-off and further affecting the watershed functionality. This transition also favors the establishment of invasive annual species such as cheatgrass.

Transition T6A
State 6 to 5

This transition is from a seeded state, to a state that is dominated by invasive species. Events include increased of invasive species, shortened fire return interval, and long term drought. Improper continuous season long grazing of perennial grasses can reduce the time needed for this pathway.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				269–538	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	34–135	–
	James' galleta	PLJA	*Pleuraphis jamesii*	67–135	–
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–101	–
	blue grama	BOGR2	*Bouteloua gracilis*	34–67	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	34–67	–
	western wheatgrass	PASM	*Pascopyrum smithii*	13–34	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	13–34	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	13–34	–
Forb					
2				45–90	
	sego lily	CANU3	*Calochortus nuttallii*	0–13	–
	trailing fleabane	ERFL	*Erigeron flagellaris*	0–13	–
	New Mexico groundsel	PANEM	*Packera neomexicana var. mutabilis*	0–13	–
	toadflax penstemon	PELI2	*Penstemon linarioides*	0–13	–
	beardtongue	PENST	*Penstemon*	0–13	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–13	–
	silvery lupine	LUAR3	*Lupinus argenteus*	0–7	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	0–7	–
Shrub/Vine					
3				135–269	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	112–224	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	13–34	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–34	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–17	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–13	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–13	–
	mormon tea	EPVI	*Ephedra viridis*	0–13	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–13	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–13	–

Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				0–34	
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
Forb					
2				0–11	
	Forb, annual	2FA	*Forb, annual*	0–6	–
	Forb, perennial	2FP	*Forb, perennial*	0–6	–
Shrub/Vine					
3				280–504	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	168–392	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–45	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–39	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–28	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–17	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–11	–
Tree					
4				0–17	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–17	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–6	–

Animal community

This section is from the 1988 Range site:

--General wildlife—
This site provides both food and cover for wildlife. There is palatable browse for mule deer and pronghorn, and when present, grasses such as muttongrass and Indian rice grass offer good grazing. When this site occurs near water, the species richness and the abundance of large mammals is increased. Birds, Bats, lizards, snakes and rodents are more common when this site occurs far from water.

--Grazing Interpretations--
This site provides good year round grazing conditions for livestock and wildlife due to the high availability of nutritious forage. Yet, this site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. The suitability for re-seeding or restoring this site is fair due to the extreme temperatures and variability in time and amount of precipitation. This site may occur in desert bighorn sheep, elk, mule deer and pronghorn antelope ranges, and are important wintering areas for these wildlife species. However, in many places the populations will be small and have little grazing impact on the site.

The grasses present provide good grazing conditions for horses, cattle, sheep, elk, and bighorn sheep. The presence of shrubs, primarily Wyoming big sagebrush, fourwing saltbush, winterfat, and rabbitbrush provide year round browse for all classes of livestock and wildlife. Wyoming sagebrush and winterfat provides good wintering browse due to its high protein content; however sagebrush is used sparingly by livestock when other herbaceous forages are available. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation should be made.

The approximate vegetative basal density is 10 to 15 percent.

Vegetation density = basal area, which is the area of ground surface covered by the stem or stems. Usually, this is measured one inch above the soil in contrast to the full spread of foliage

Guide to Initial Stocking Rates:
Stocking rates are based on an average growing season. Based on 1200 pounds of forage (air-dry) per animal unit month. (This figure takes into account the vegetation that disappears through trampling, small herbivores, etc., which amounts to approximately 7.9 pounds per day under normal conditions).

Excellent
AUM/ac = .17 - .15
ac/AUM = 5.7 - 7.1
Good
AUM/ac = .14 - .09
ac/AUM = 7.1 - 12.5
Fair
AUM/ac = .08 - .05
ac/AUM = 12.5 - 25.0
Poor
AUM/ac = .04 - .00
ac/AUM = 25.0 - 50.0

--Major Poisonous Plants to Livestock: --
Silvery lupine (Lupinus argenteus) - dangerous when other forage is scarce and if hay contains immature lupine pods. All livestock are occasionally poisoned. Sheep are the most affected.

Effects Upon Animals:
Lupine seeds are toxic to sheep when 0.25 to 1.5 percent of the animal's body weight is consumed in one feeding. The toxin is not cumulative and small amounts ingested over a period of time create no difficulties. Most characteristic symptom is labored breathing. Animals may vary from depression and coma to extreme activity. Animals my butt objects and other animals or may stand with lowered head pressing against a solid object. Death from respiratory paralysis follows a short period of convulsions.

Broom snakeweed (Xanthocephalum sarothrae)-dangerous when forage is scarce. Cattle and sheep are the most affected.

Effects Upon Animals:
Poisoning is not common but will occur on overgrazed ranges. Causes abortion in cattle or may produce weak underweight calves. Losses are sporadic and will occur when 10 to 20 percent of the body weight of green material is consumed in 1/2 to 20 weeks.

Variable Senecio (Senecio mutabilis) - dangerous when palatable forage is scarce. Cattle and horses are mostly affected. Some sheep are affected also.

Effects Upon Animals:
Symptoms are progressive and effects are cumulative. Weakness, diarrhea and darkly stained urine may be observed. Animals die quickly or wander aimlessly. Adequate feed or supplement during the spring will reduce the hazard.

--Invasive Plant Communities--

Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in this site are the non-native annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and annual mustards. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible. Pinyon pine and Utah juniper are natural invaders if stands are found

adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site.

Hydrological functions

Soils were originally assigned to hydrologic soil groups based on measured rainfall, runoff, and infiltrometer data (Musgrave 1955). Since the initial work was done to establish these groupings, assignment of soils to hydrologic soil groups has been based on the judgment of soil scientists. Assignments are made based on comparison of the characteristics of unclassified soil profiles with profiles of soils already placed into hydrologic soil groups. Most of the groupings are based on the premise that soils found within a climatic region that are similar in depth to a restrictive layer or water table, transmission rate of water, texture, structure, and degree of swelling when saturated, will have similar runoff responses. Four (4) Hydrologic Soil Groups are recognized (A-D). For specific definitions of each hydrologic soil group see the National Engineering Handbook, Chapter 7, Part 630 Hydrology, or visit:http://policy.nrcs.usda.gov/OpenNonWebContent.aspx? content=22526.wba

The hydrologic soil groups are based on the following factors:

-intake and transmission of water under the conditions of maximum yearly wetness (thoroughly wet)
- soil not frozen
- bare soil surface
- maximum swelling of expansive clays

The slope of the soil surface is not considered when assigning hydrologic soil groups. In its simplest form, the hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present) (Caudle, et. al, 2013). The runoff curve numbers are determined by field investigations using hydrologic cover conditions and hydrologic soil groups.

Soils Hydrologic Group

Fine-Loamy Moderately Deep Soils (depth 20 to 40 Inches)
Hagerman C
Gapmesa B & C
Progresso B

Fine-Loamy Deep Soils (soils greater than 40 inches)
Barx B & C
Blancot B
Abra B

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms (Soil Survey Staff, 2015).

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission (Soil Survey Staff, 2015).

Recreational uses

This section is from the 1988 Range site:

This site has fair to poor aesthetic appeal and natural beauty. During exceptional rainfall years, a profusion of flowering plants appear.

Wood products

None

Other information

Plant Preference table is from 1988 range site.

Type locality

Location 1: Montrose County, CO	
Township/Range/Section	T47N R18W S12
General legal description	Highway 90, 3 miles east of Bedrock Store, Paradox Valley

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--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 36 must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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)	Original written by Steve Myers and Scott Woodall (12/15/2004). Revised by Jake Owens (2/12/2012). Owens used R035XY209UT reference sheet and revised it to match this site. The R035XY209UT reference sheet was prepared by V. Keith Wadman (NRCS Ret.), F.E. Busby (USU), Paul Curtis (BLM), Dana Truman (NRCS), Robert Stager (BLM), Shane A. Green (NRCS) Revised and updated by Suzanne Mayne-Kinney on 2/2/2017.
Contact for lead author	
Date	02/02/2017
Approved by	Rachel Murph, State Rangeland Management Spec., USDA NRCS Colorado
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to few. Any rills present should be somewhat short in length (less than 6 feet long) and are very shallow which follow the surface micro-features. An increase in rill formation may be seen after disturbance events such as recent fire or thunderstorms in adjacent landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such rill development should usually be limited to slopes exceeding 20%.

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2. **Presence of water flow patterns:** Flow patterns wind around perennial plant bases and show little to slight evidence of erosion. They are short, stable and usually disconnected. There is minor evidence of deposition. On gently sloping (< 10 % slopes) locations within the site, water flow patterns are infrequent and usually less than 3 feet. Longer water flow patterns may be found on steeper slopes (> 20 %). Numerous small debris dams maybe obvious after rainfall events.

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3. **Number and height of erosional pedestals or terracettes:** Plants should show little or no pedestalling. Terracettes should be absent or few. Pedestals that occur may be found on steeper slopes (> 20 %) and usually associated with water flow patterns. Loss of plant cover can result in well-developed biological soil crust forming. This interspaces between well-developed biological soil crusts may resemble pedestals but they are actually a characteristic of the crust formation.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 10–15% bare ground is common. Ground cover is based on the first raindrop impact, and bare ground is the opposite of ground cover. Well-developed biological soil crusts should not be recorded as bare ground. Poorly developed biological soil crusts that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. Extended drought can cause bare ground to increase.

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5. **Number of gullies and erosion associated with gullies:** None to few. Some gullies may be present in landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such gully development is expected to be limited to slopes exceeding 20% and adjacent to sites where runoff accumulation occurs. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Very minor evidence of wind generated soil movement Wind scoured (blowouts) and depositional areas are rarely present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water movement. Minor litter removal may occur in flow patterns and rills with deposition occurring at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have a soil stability rating of 5 to 6 under vegetation canopies and a ratio of 2 to 4 in the interspaces. The average should be a 4. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The surface layer is light brown to reddish brown fine sandy loams or loam, 2 to 10 inches thick. The A horizon is weakly developed, but the A horizon would be expected to be more strongly developed under plant canopies. It is important if you are sampling to observe the A horizon under plant canopies as well as the interspaces. Refer to soil survey for more detailed information about your specific site.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Vascular plants and well developed biological soil crusts will break raindrop impact and splash erosion. Spatial distribution of vascular plants and interspaces between well-developed biological soil crusts (where present) provide detention storage and surface roughness that slows runoff allowing time for infiltration. Interspaces between plants and well developed biological soil crusts (where present) may serve as water flow patterns during episodic runoff events, with natural erosion expected in severe storms. When perennial grasses decrease, reducing ground cover and increasing bare ground, runoff is expected to increase and any associated infiltration reduced.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Naturally occurring soil horizons may be harder than the surface because of an accumulation of clay (soil texture change) or calcium carbonate and should not be considered as compaction layers.

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

    Dominant: Perennial grasses (Indian ricegrass, Galleta) = non-sprouting shrubs (Wyoming big sagebrush) >

    Sub-dominant: sprouting shrubs (Winterfat, Fourwing saltbush) = annual forbs

    Other:

    Additional: Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state (e.g. Crested wheatgrass and Russian wildrye etc.) The perennial grass/non-sprouting shrub functional groups are expected on this site. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

Disturbance regime includes drought, insects, and fire. Assumed fire cycle of 50-70+ years. Following a recent disturbance such as fire or drought that removes the woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community. If a disturbance has not occurred for an extended period of time, woody species may continue to increase crowding out the perennial herbaceous understory species. In either case, these conditions would reflect a functional community phase within the reference state.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses should be present under average to above average growing conditions with age class expression likely subdued during below average years. Slight decadence in the principle shrubs could occur near the end of the fire cycle or during and following an extended drought. Expect more decadence on bunchgrasses with lack of disturbance. In general, a mix of age classes may be expected with some dead and decadent plants present.

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14. **Average percent litter cover (%) and depth (in):** (10-20%). Variability may occur due to weather. Litter cover declines during and following a drought as the plants are not producing the litter.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 400 lbs./ac, low precipitation years, 600 lbs./ac/ average precipitation years, 800 lbs./ac above average precipitation years. After extended drought or the first growing season following a wildfire, production may be significantly reduced by 200-400 lbs./ac.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Green rabbitbrush, Cheatgrass, Purple Threeawn, Broom snakeweed & introduced annual forbs (Filaree, Russian thistle, sticktight).

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce sexually or asexually in most years. The only limitations are weather-related, wildfire, natural diseases and insects. Low green rabbitbrush sprouts vigorously following fire.
