USDA Natural Resources
Conservation Service

Ecological site R035XY313UT
Upland Shallow Loam (Cliffrose)

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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.

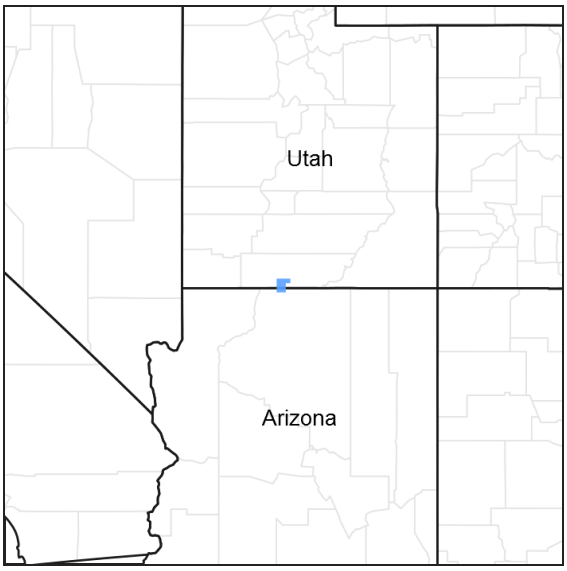

Figure 1. Mapped extent

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.

Classification relationships

Purshia mexicana shrubland alliance (NVC 2004).

Ecological site concept

This site occurs in the upland zone of the Colorado and Green River Plateaus Region (MLRA 35) in southeastern Utah, on the north Kaibab Plateau. It occurs on cuestas and structural benches at elevations from approximately 5800 to 6300 feet and slopes ranging from 2 to 15%. Soils are very shallow to shallow, loamy skeletal and well-drained, and formed in residuum derived from limestone. The soil moisture regime is aridic ustic and the soil temperature regime is mesic. The plant community is a shrubland characterized by a high cover of mountain big sage (*Artemisia tridentata* ssp. vaseyana) and cliffrose (*Purshia mexicana*), with a sparse overstory of Utah juniper (*Juniperus osteosperma*) and twoneedle pinyon (*Pinus edulis*). The natural disturbance regime includes infrequent stand-clearing fire, light grazing by native wildlife, and a fluctuating climate with significant dry and wet periods. The current interpretive state is impacted by invasive annual grasses, which may increase fire severity and frequency, fire suppression, livestock grazing, and overbrowse by wildlife.

Associated sites

R035XY308UT	**Upland Loam (Mountain Big Sagebrush)** This site occurs on adjacent gently sloping deep alluvial soils at slightly lower elevations. Mountain big sagebrush is strongly dominant, cliffrose is not an important species, and blue grama (Bouteloua gracilis) and needle and thread grass (Hesterostipa comata) are important species.
R035XY315UT	**Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3** This site occurs at higher elevations. This site is a woodland, and twoneedle pinyon is the dominant species. Black sagebrush (Artemisia nova) is an important shrub.

Similar sites

R035XY315UT	**Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3** This site is a twoneedle pinyon - Utah juniper woodland that typically occurs on very shallow to shallow soils derived from sandstone. Cliffrose is a component of the understory, but is not considered a dominant species.

Table 1. Dominant plant species

Tree	(1) *Juniperus osteosperma* (2) *Pinus edulis*
Shrub	(1) *Artemisia tridentata subsp. vaseyana* (2) *Purshia mexicana*
Herbaceous	Not specified

Physiographic features

This site occurs on dipslopes of cuestas and structural benches. Elevations range from 5790 to 6300 feet, and slopes range from 2 to 15%. Runoff class is very high.

Table 2. Representative physiographic features

Landforms	(1) Cuesta (2) Structural bench
Elevation	5,790–6,300 ft
Slope	2–15%

Climatic features

The climate is characterized by hot summers and cool winters. Large fluctuations in daily temperature are common. Precipitation is bimodal, with summer monsoons from July through October and winter rains from January through March. Precipitation is variable from month to month and from year to year and typically ranges between 11 and 16 inches (the below climate data is from the nearest weather station to this site). Snow packs are generally light and not persistent.

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	153 days
Precipitation total (average)	15 in

Climate stations used

- (1) KANAB [USC00424508], Kanab, UT

Influencing water features

Soil features

The soils associated with this ecological site are very shallow to shallow over lithic limestone bedrock. These soils are derived from residuum weathered from limestone parent material. The dry surface color is strong brown. Soils are well drained with moderately rapid permeability. The soil moisture regime is ustic aridic and the soil temperature regime is mesic. Surface texture is gravelly fine sandy loam, and surface rock fragments smaller than 3 inches in diameter average 55 percent while larger fragments average 10 percent. Soils on the sites in the reference state generally have low wind and water erosion potential due to high cover of gravels and vegetation. Biological crust cover is characterized as low, with patchy lichen, moss, and cyanobacteria cover. Subsurface textures are loamy. Subsurface rock fragments smaller than 3 mm in diameter average 20 percent by volume, and larger fragments average 22 percent. The Timpoweap soils (Loamy-skeletal, mixed, super active, mesic Lithic Haplustalfs) are correlated to this ecological site.

This ecological site has been correlated to the following mapunits and soil components:

UT686 - Grand Staircase-Escalante National Monument - M5160 - Timpoweap (45%)

Typical Soil Profile:
A--0-5 inches; gravelly fine sandy loam; not calcareous; neutral
Bt--5-13 inches; very cobbly clay loam; slightly calcareous; slightly alkaline
R--13 inches; Moenkopi Formation limestone bedrock

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Gravelly fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	4–20 in
Surface fragment cover <=3"	55%
Surface fragment cover >3"	10%
Available water capacity (0-40in)	1.2–1.5 in
Calcium carbonate equivalent (0-40in)	1–3%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	7.4–7.8
Subsurface fragment volume <=3" (Depth not specified)	20%
Subsurface fragment volume >3" (Depth not specified)	22%

Ecological dynamics

This ecological site occurs in the upland zone of the Colorado and Green River Plateaus Region (MLRA 35) in southeastern Utah, on the north Kaibab Plateau. The plant community is a shrubland characterized by a high cover of mountain big sage (*Artemisia tridentata* ssp. vaseyana) and cliffrose (*Purshia mexicana*), with a sparse overstory of Utah juniper (*Juniperus osteosperma*) and twoneedle pinyon (*Pinus edulis*). This site occurs above basin and

Wyoming big sagebrush steppe, and below pinyon-juniper woodland. This site developed with a natural disturbance regime that included infrequent stand-clearing fire (Howard 1995), decadal level variation in precipitation with alternating wet and dry periods, including severe drought (Swetnam and Betancourt 1998, Hereford et al. 2002, Miller 2004, Schwinning et al. 2008), and light grazing by native ungulates (Mack and Thompson 1982, Cole et al. 1997, Neff et al. 2005, Schwinning et al. 2008). Current disturbances impacting this site include invasive annual grasses, which may increase fire severity and frequency, livestock grazing, and overbrowse by wildlife.

Historically the Colorado Plateau experienced only light grazing by native ungulates (Mack and Thompson 1982, Cole et al. 1997, Schwinning et al. 2008). The Kaibab Plateau, including the Buckskin Mountain area where this site occurs, has been heavily impacted by wildlife management and by livestock grazing (Rasmussen 1941, BLM 2004). Historically the vegetation communities of this ecological site were browsed primarily by mule deer, whose populations were kept in check by Native Americans, mountain lion, wolf, bobcats and coyote. In 1906 a federal game preserve was created, which prohibited deer hunting and sought to reduce or eliminate predators (Rasmussen 1941). This allowed the deer population to grow from approximately 4000 to 100,000 in 18 years, and caused severe depletion of shrublands with extensive areas of cliffrose mortality (Rasmussen 1941). Cliffrose individuals that survived were typically taller than browseline. The deer population crashed, but the herd has remained much larger than the historical population size. In addition to the heavy browse pressure, this area has been grazed by livestock since the 1880s (Rasmussen 1941). Grazing intensity was highest when grazing was first introduced, and today is relatively light with only minimal winter use (Evangelista et al. 2004).

Settlement also brought invasive species, and cheatgrass (*Bromus tectorum*) is now pervasive in this area (BLM 2004, Evangelista et al. 2004). Cheatgrass may provide a continuous, persistent fine fuel layer that increases fire frequency, severity, and extends the fire season (e.g. Stohlgren et al. 2001, Evangelista et al. 2004, Reid et al. 2006). Exploitative grazing reduced vegetation densities and understory production, which increased soil erosion and reduced microsite suitability for shrub recruitment and recovery (BLM 2004).

The historic role of fire in these sparse woodlands is poorly understood (e.g. Romme et al. 2009). Low severity understory fires are generally accepted to have never been a significant process in pinyon-juniper systems on the Colorado Plateau (e.g. Floyd et al. 2004, Floyd et al. 2008, Romme et al. 2009, Shinneman and Baker 2009). Very long fire rotations (400-600 years) with stand-initiating fire events when fire does occur is likely the natural dynamic. Increases in tree density and cover over long periods of time may shade out the shrub component, but is not necessarily unnatural. Livestock grazing and overbrowse impacts may have contributed to the development of decadent stands of dying shrubs with little recruitment in much of the current extent of this site. Land managers have employed chaining and tree thinning treatments, with and without seeding, to try to increase recruitment opportunities for decadent shrublands in areas where tree density is considered too high to improve habitat for wildlife. Estimates of historic fire rotation in mountain big sagebrush and cliffrose communities are variable, and there is little specific information for these communities in Utah. Baker (2006) estimates a rotation of 75 to 100 years for mountain big sagebrush. Fire return intervals of 30 to 70 years for cliffrose are reported in Howard (1995). In Nevada and northern Utah, cheatgrass invasion has shortened the FRI in cliffrose communities to 5.5 years (Howard 1995). In other areas a lack of fire and recruitment opportunities is preventing rejuvenation of cliffrose communities (Howard 1995, BLM 2004).

Decadal scale variation in precipitation due to the Pacific Decadal Oscillation (PDO) has characterized the climate of the Colorado Plateau over the last century, with a wet period from 1905-1941, a dry period between 1942-1977, a wet period from 1978-1998, and a dry period from 1999 to the present, with a particularly catastrophic drought in 2002 (Ehleringer et al. 2000, Hereford et al. 2002, Miller 2004, Schwinning et al. 2008). These fluctuations can change plant community composition, cover and production (Swetnam and Betancourt 1998, Illius and O'Connor 1999, Ehleringer et al. 2000, Briske et al. 2003, Neff et al. 2005). In this ecological site drought impacts severe enough to cause a shift to a new community phase have not been observed; however fluctuations in precipitation are certainly important in the community dynamics of this site. Drought has caused mortality of twoneedle pinyon in the area (BLM 2004), and precipitation determines herbaceous fuel loads, recovery trajectories after disturbance, and annual productivity which interacts with browse impacts.

Global climate change predictions for the Colorado Plateau include an increase in both average and extreme temperatures, which will increase the impacts of drought even if precipitation patterns remain relatively unchanged (Schwinning et al. 2008). The Colorado Plateau may be particularly sensitive to global climate change due to a transitional climatic position between strong monsoon dominated systems to the south and cool season precipitation dominance to the north (Ehleringer et al. 2000, Miller 2004). Evidence for global climate change so far

shows an increase in minimum temperatures since the 1960s, a weak trend towards increasing winter precipitation and no change in the summer monsoon (Spence 2001).

The following State-and-Transition Model describes the most commonly occurring plant communities found on this ecological site. Separations between states and community phases are based on professional consensus. Tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in modal communities within the community phase, except for Community Phase 1.1, which was inferred from Community Phase 2.1 because no data were available. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), they do not represent the absolute range of characteristics or an exhaustive listing of all species that may occur in that phase over the geographic range of the ecological site.

State and transition model

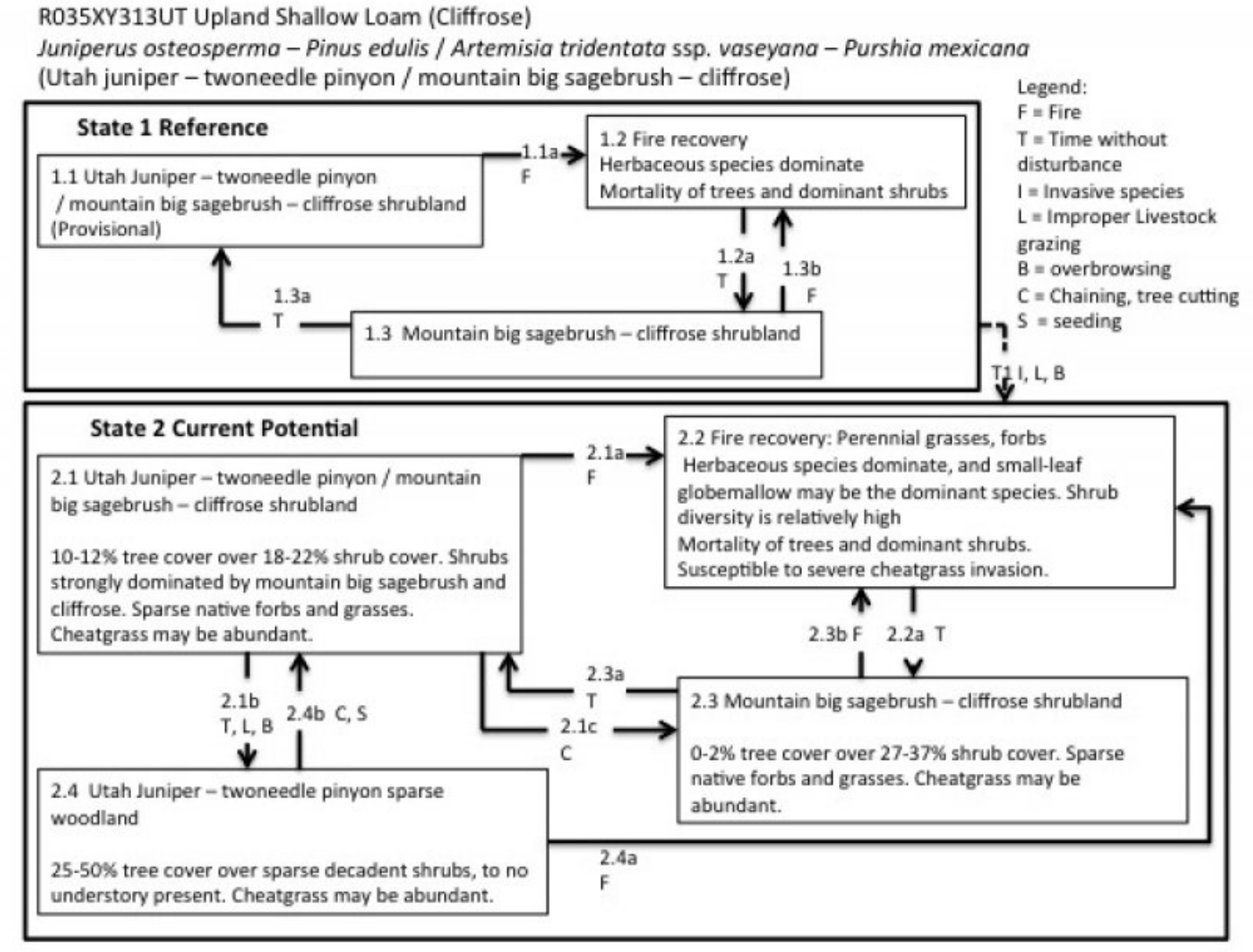

Figure 6. R035XY313UT

State 1
Reference

The reference state was determined by literature review, historical accounts, reports, and observations of trends in plant community dynamics. The reference state represents the plant communities and ecological dynamics of this ecological site under pre-settlement conditions and a natural disturbance regime. The plant communities of the reference state were similar to those of the current potential state (State 2), and were characterized by a shrubland dominated by mountain big sagebrush and cliffrose, with a sparse overstory of Utah juniper and twoneedle pinyon.

Infrequent stand clearing fires would have created mosaics of shrublands in different phases of succession with longer fire return intervals characterized by higher tree cover, and early fire recovery communities dominated by herbaceous species. Cheatgrass was not present in the reference state, and extensive stands of decadent shrubs would likely have been rare without overbrowse and grazing pressures. The primary disturbances included infrequent stand-clearing fire, fluctuations in climate and native ungulate browsing. Reference State: Plant communities influenced by infrequent fire, light browse and climate fluctuations between wet and dry periods. Indicators: Dominance by mountain big sagebrush and cliffrose, with a mosaic of plant communities present over the landscape and healthy shrub population structure. Feedbacks: Infrequent fire and light browse pressure allowed for a self-sustaining shrubland community. At-risk Community Phase: Community 1.2 is particularly susceptible to invasion by cheatgrass due to a lack of competition and extensive bare soil; however all phases are susceptible to invasion, especially with heavy grazing, browse or other disturbances that remove vegetative cover and disturb soils. Trigger: Improper livestock grazing, invasive species, and severe overbrowse due to wildlife mismanagement.

Community 1.1
Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.1, except with no cheatgrass, a higher proportion of native grasses and forbs, more BSC cover, and a healthy population structure for dominant shrubs. Community composition data in the below table was inferred from Community Phase 2.1.

Community 1.2
Fire recovery

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.2, except with no cheatgrass, and dominance by native perennials.

Community 1.3
Mountain big sagebrush - cliffrose shrubland

Data for this community phase does not exist, but the community composition was likely similar to Community Phase 2.3, except with no cheatgrass, a higher proportion of native grasses and forbs, more BSC cover, and a healthy population structure for dominant shrubs.

Pathway 1.1a
Community 1.1 to 1.2

This pathway occurs with fire. Fire is generally stand-clearing in the historic state, and may occur at 15 to 70 year intervals. Fire is more likely in the summer months during wet precipitation cycles when fine fuel biomass is highest.

Pathway 1.2a
Community 1.2 to 1.3

This pathway occurs with time without further disturbance, allowing mountain big sagebrush and cliffrose to recruit and regain dominance. This may take between 5 and 15 years.

Pathway 1.3a
Community 1.3 to 1.1

This pathway occurs with time without further disturbance, allowing Utah juniper and twoneedle pinyon to establish and grow.

Pathway 1.3b
Community 1.3 to 1.2

This pathway occurs with fire, which may occur at 15 to 70 or greater year intervals and is more likely in the summer months during wet precipitation cycles when fine fuel biomass is highest.

State 2
Current Potential

This state represents the current potential of this ecological site, and the dynamics include disturbance by livestock, invasive species, overbrowse, and possibly altered fire regimes. This state will naturally fluctuate between all community phases, though Community phase 2.4 is more likely with abusive livestock or overbrowse. Cheatgrass invasion may result in a shortened FRI; many examples exist from other ecological systems where a grass-fire cycle is created (e.g. D'Antonio and Vitousek 1992), but since this has not been observed in this site a grass state is not included in the state and transition model. Current Potential State: Plant communities influenced by fire, overbrowse and overgrazing, invasive species, and climate fluctuations between wet and dry periods. Indicators: Decadent shrub communities without recruitment are prevalent, especially cliffrose. A woodland community phase where the understory is largely gone is also present. Cheatgrass may be abundant, and is generally present at least trace levels. Sparse native understory cover. Feedbacks: A fire regime or manual treatments that allow for shrub recruitment and self-sustaining shrub populations. Improper livestock grazing and/or overbrowse that depletes the understory and prevents shrub, especially cliffrose, recruitment. At-risk Community Phase: Community 2.2 is especially at risk of cheatgrass invasion.

Community 2.1
Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

Figure 8. Community Phase 2.1

Figure 9. Decadent cliffrose, community phase 2.1

This community phase is characterized by 8-12% canopy cover of short-statured Utah juniper and twoneedle pinyon over 18-22% shrub canopy, with mountain big sagebrush dominant and cliffrose an important co-dominant. Shrubs are typically decadent, with little recruitment and tall cliffrose with branches above browseline. Recruitment of Utah juniper and twoneedle pinyon is evident with 1-2% cover of regenerating juniper and up to 1% cover regenerating pine. Total canopy cover averages 36%. Secondary shrubs have low cover and production, and common species include Mormon tea (*Ephedra viridis*), broom snakeweed (*Gutierrezia sarothrae*), narrowleaf yucca (*Yucca angustissima*), plains pricklypear (*Opuntia polyacantha*), Gambel’s oak (*Quercus gambelii*), whipple

cholla (*Cylindropuntia whipplei*), cushion buckwheat (*Eriogonum ovalifolium*), and kingcup cactus (*Echinocereus triglochidiatus*). Perennial grass cover is low, at 2-4% cover. Common species include Indian ricegrass (*Achnatherum hymenoides*) and squirreltail (*Elymus elymoides*). The native annual grass sixweeks fescue (*Vulpia octoflora*) may be present. Forb cover is also low, ranging from 0-2%. Common species include rock goldenrod (*Petradoria pumila*), thicksepal cryptantha (*Cryptantha crassisepala*), small-leaf globemallow (*Sphaeralcea parvifolia*), Brewer's navarettia (*Navarretia breweri*), longleaf phlox (*Phlox longifolia*), thymeleaf sandmat (*Chamaesyce serpyllifolia*), and sago lily (*Calochortus nuttallii*), although many other species could be present at a given location, and cover and production is highly dependent on precipitation. Perennial grass cover averages 3%, and ranges from trace to 7%. James' galleta is the dominant species, while Indian ricegrass typically present at up to 1% cover. Purple needlegrass may also be present at trace amounts. The soil surface is dominated by rock fragments, with 3-6% BSC, 9-13% litter, 4-18% woody debris, 6-10% bare ground, and at least trace exposed bedrock. Cheatgrass cover and production may be high, and the nonnative forb redstem stork's bill (*Erodium cicutarium*) may be present. Crested wheatgrass (*Agropyron cristatum*) has been seeded into the area and may be present, although it was not recorded in any plots.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	100	200	380
Grass/Grasslike	10	20	235
Tree	2	6	20
Forb	0	5	15
Total	**112**	**231**	**650**

Table 6. Ground cover

Tree foliar cover	8-12%
Shrub/vine/liana foliar cover	18-22%
Grass/grasslike foliar cover	2-30%
Forb foliar cover	0-4%
Non-vascular plants	0-2%
Biological crusts	3-6%
Litter	13-31%
Surface fragments >0.25" and <=3"	10-38%
Surface fragments >3"	2-6%
Bedrock	0.1-7.0%
Water	0%
Bare ground	6-10%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	1-5%	0-5%	0-4%
>0.5 <= 1	0-2%	1-5%	2-4%	0-4%
>1 <= 2	1-3%	3-10%	0-4%	0-2%
>2 <= 4.5	1-3%	10-20%	0-1%	0-1%
>4.5 <= 13	1-3%	2-9%	–	–
>13 <= 40	8-12%	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 2.2
Fire recovery (provisional)

This community phase was not observed for this site, and the following description is based on a fire recovery study conducted within the area where this site occurs, as well as other literature. Mountain big sagebrush, cliffrose, Utah juniper and twoneedle pinyon are killed by fire. Herbaceous species will dominate in the early years after fire, and will continue to be an important component of the community for up to 15 years (Blaisdell et al. 1982, Johnson 2000, Evangelista et al. 2004). Small-leaf globemallow is likely to be abundant, and may be the dominant species for at least 8 years post-fire (Evangelista et al. 2004). Cheatgrass may also be an abundant species, and may remain so given adequate precipitation (Evangelista et al. 2004). Dense cheatgrass cover may delay recovery of cliffrose (Price and Brotherson 1987), and mountain big sagebrush, and may facilitate repeat burning, which will further delay recovery (e.g. D'Antonio and Vitousek 1992). Shrubs capable of resprouting after fire, such as Gambel’s oak, Mormon tea, narrowleaf yucca, and kingcup cactus will quickly resprout, unless drought conditions prevail, and will be more prominent in this community phase. Species capable of rapidly colonizing after disturbance, such as broom snakeweed, will also increase. Cliffrose seedlings will likely establish in the bare mineral soil and open ground after fire. Mountain big sagebrush recruitment may be abundant in the spring following fire, but may also be sparse (Johnson 2000). With time without disturbance (15 plus years) mountain big sagebrush and cliffrose will regain dominance and the community will shift to a shrubland community phase. Seeding native species and minimizing soil disturbance in the recovery phase may help prevent cheatgrass dominance (Evangelista et al. 2004).

Community 2.3
Mountain big sagebrush - cliffrose shrubland

Figure 11. Community Phase 2.3

Figure 12. Community Phase 2.3, treated juniper

A natural example of this community phase was not observed; however, data was collected in areas treated by tree thinning and clearing with slash left in place to improve the structure of the shrubland community and improve wildlife habitat (BLM 2004). This community phase is characterized by strong shrub dominance with only 0-2% tree cover. Total canopy cover averages 38%. Mountain big sagebrush cover ranges from 18-23% and cliffbrush cover ranges from 3-5%. Abundant mountain big sagebrush recruitment was observed in this phase, but no recruitment of cliffrose was seen. Secondary shrub and herbaceous species composition remain similar to community phase 2.1, although broom snakeweed and Mormon tea are typically more abundant in this community phase. Cheatgrass may be abundant, and redstem stork's bill may be present. Bare ground ranges from 6-20%, litter 8-17%, woody debris 11-15%, gravels 5-22%, cobbles 4-5%, and BSC 0-6%. With a lack of recruitment, no fire or seeding, cliffrose may eventually be extirpated from this community, leading to an altered state. This is not included in the state and transition model, but managers should be aware of the potential.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	155	230	350
Grass/Grasslike	0	4	130
Forb	0	3	6
Tree	0	1	5
Total	**155**	**238**	**491**

Table 9. Ground cover

Tree foliar cover	0-2%
Shrub/vine/liana foliar cover	27-37%
Grass/grasslike foliar cover	1-11%
Forb foliar cover	0-3%
Non-vascular plants	0-1%
Biological crusts	0-6%
Litter	19-32%
Surface fragments >0.25" and <=3"	5-22%
Surface fragments >3"	4-5%
Bedrock	1-7%
Water	0%
Bare ground	6-20%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	1-3%	0-10%	0-3%
>0.5 <= 1	0-1%	1-10%	1-11%	0-3%
>1 <= 2	0-1%	10-20%	0-3%	0-3%
>2 <= 4.5	0-1%	11-35%	0-1%	0-1%
>4.5 <= 13	0-1%	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 2.4
Utah juniper - twoneedle pinyon sparse woodland

Figure 14. Community Phase 2.4

Data was not collected for this community phase, but it was observed and documented. This community phase is characterized by tree dominance, and a loss or significant decline in the understory. Dominant shrubs are shaded out and die, with a lack of recruitment opportunities, do not re-establish. This community phase may naturally return to a mountain big sagebrush – cliffrose shrubland through fire, which clears the tree canopy and provides open ground for shrub recruitment. Alternatively manual treatment such as chaining or otherwise thinning or removing trees may shift the community to C.P. 2.3.

Pathway 2.1a
Community 2.1 to 2.2

This pathway occurs with fire, which is more likely in the summer months during wet precipitation cycles when fine fuel biomass is highest. Cheatgrass invasion has increased fire severity and size in some areas.

Pathway 2.1c
Community 2.1 to 2.3

Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

Mountain big sagebrush - cliffrose shrubland

This pathway occurs with chaining and/or tree removal that targets established Utah juniper and twoneedle pinyon pine to return the community to a shrub dominated phase. Land managers have treated large areas of this ecological site to improve habitat for wildlife. The effectiveness of this treatment is unknown; however, cliffrose recruitment was not observed in any treated areas.

Pathway 2.1b
Community 2.1 to 2.4

Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

Utah juniper - twoneedle pinyon sparse woodland

This pathway occurs with a very long period of time between fire events (perhaps naturally occurring at the latter stages of the fire return interval), and is accelerated and maintained by overbrowse or overgrazing that prevents recruitment of dominant shrub species.

Pathway 2.2a
Community 2.2 to 2.3

This pathway occurs with time without further disturbance, allowing mountain big sagebrush and cliffrose to recruit and regain dominance. This may take between 5 and 15 years. Cheatgrass abundance following fire may compete with shrubs and delay recovery, and/or may shorten the fire return interval, preventing complete recovery.

Pathway 2.3a
Community 2.3 to 2.1

Mountain big sagebrush - cliffrose shrubland

Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

This pathway occurs with time without further disturbance, allowing Utah juniper and twoneedle pinyon to establish and grow.

Pathway 2.3b
Community 2.3 to 2.2

This pathway occurs with fire, which is more likely in the summer months during wet precipitation cycles when fine fuel biomass is highest. Cheatgrass invasion may accelerate this pathway.

Pathway 2.4b
Community 2.4 to 2.1

Utah juniper - twoneedle pinyon sparse woodland

Utah juniper - twoneedle pinyon / mountain big sagebrush - cliffrose shrubland

This restoration pathway occurs with chaining and/or tree removal that targets established Utah juniper and twoneedle pinyon pine to return the community to a shrub dominated phase. Seeding may be necessary to re-establish mountain big sagebrush and cliffrose, and fire may be more effective to return this community to a desired phase.

Pathway 2.4a
Community 2.4 to 2.2

This pathway occurs with fire, which is likely to be catastrophic and stand clearing. Cheatgrass invasion will facilitate this pathway. Fire is likely to be stand clearing due to high tree densities; however, when tree densities are relatively low and there is no understory this community phase is self-maintaining.

Transition T1
State 1 to 2

Transition from reference state (State 1) to current potential state (State 2). This transition may occur with improper livestock grazing, invasive species introduction, and severe overbrowse.

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			160–450	
	Mexican cliffrose	PUME	*Purshia mexicana*	80–240	4–16
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	70–210	8–16
	Shrub, other	2S	*Shrub, other*	0–20	0–4
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–5	0–2
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	0–1
	mormon tea	EPVI	*Ephedra viridis*	0–5	0–1
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–5	0–1
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	1–3	1–2
	kingcup cactus	ECTR	*Echinocereus triglochidiatus*	0–1	0–1
	Gambel oak	QUGA	*Quercus gambelii*	0–1	0–1
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–1	0–1
Tree					
2	**Trees**			2–20	
	Utah juniper	JUOS	*Juniperus osteosperma*	2–20	6–13
	twoneedle pinyon	PIED	*Pinus edulis*	0–15	0–1
Grass/Grasslike					
3	**Grasses**			30–125	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	30–75	5–20
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–30	0–3
	squirreltail	ELEL5	*Elymus elymoides*	5–20	2–4
	Grass, perennial	2GP	*Grass, perennial*	0–5	0–2
Forb					
4	**Forbs**			0–15	
	thicksepal cryptantha	CRCR3	*Cryptantha crassisepala*	0–15	0–1
	Forb, annual	2FA	*Forb, annual*	0–10	0–3
	Forb, perennial	2FP	*Forb, perennial*	0–10	0–3
	sego lily	CANU3	*Calochortus nuttallii*	0–5	0–1
	Brewer's navarretia	NABR	*Navarretia breweri*	0–5	0–1
	rock goldenrod	PEPU7	*Petradoria pumila*	0–5	0–1
	longleaf phlox	PHLO2	*Phlox longifolia*	0–5	0–1
	small-leaf globemallow	SPPA2	*Sphaeralcea parvifolia*	0–5	0–1
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–1	0–1

Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			100–380	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	70–210	8–17
	Mexican cliffrose	PUME	*Purshia mexicana*	40–160	2–8
	Shrub, other	2S	*Shrub, other*	0–20	0–4
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–15	1–2
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	0–1
	Gambel oak	QUGA	*Quercus gambelii*	0–5	0–1
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–5	0–1
	kingcup cactus	ECTR	*Echinocereus triglochidiatus*	0–5	0–1
	mormon tea	EPVI	*Ephedra viridis*	0–5	0–1
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–5	0–1
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	1–3	1–2
Tree					
2	**Trees**			2–20	
	Utah juniper	JUOS	*Juniperus osteosperma*	2–20	6–13
	twoneedle pinyon	PIED	*Pinus edulis*	0–15	0–1
Grass/Grasslike					
3	**Native Grasses**			5–30	
	squirreltail	ELEL5	*Elymus elymoides*	5–20	2–4
	Grass, perennial	2GP	*Grass, perennial*	0–5	0–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–5	0–2
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–5	0–1
5	**Non-native annual grasses**			0–235	
	cheatgrass	BRTE	*Bromus tectorum*	0–235	0–25
Forb					
4	**Native Forbs**			0–15	
	Forb, perennial	2FP	*Forb, perennial*	0–20	0–5
	thicksepal cryptantha	CRCR3	*Cryptantha crassisepala*	0–10	0–1
	Forb, annual	2FA	*Forb, annual*	0–5	0–2
	Brewer's navarretia	NABR	*Navarretia breweri*	0–5	0–1
	rock goldenrod	PEPU7	*Petradoria pumila*	0–5	0–1
	longleaf phlox	PHLO2	*Phlox longifolia*	0–5	0–1
	small-leaf globemallow	SPPA2	*Sphaeralcea parvifolia*	0–5	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–5	0–1
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–5	0–1
6	**Non-native annual forbs**			0–5	
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–5	0–1

Table 13. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs**			155–350	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	100–325	18–23
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–55	1–3
	Mexican cliffrose	PUME	*Purshia mexicana*	10–45	3–5
	mormon tea	EPVI	*Ephedra viridis*	0–15	0–1
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	0–5	0–1
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–5	0–1
	Gambel oak	QUGA	*Quercus gambelii*	0–5	0–1
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	0–5	0–1
Tree					
2	**Trees**			0–5	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–5	0–1
	twoneedle pinyon	PIED	*Pinus edulis*	0–5	0–1
Grass/Grasslike					
3	**Native Grasses**			0–75	
	squirreltail	ELEL5	*Elymus elymoides*	3–75	1–2
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–5	0–1
5	**Non-native annual grasses**			0–55	
	cheatgrass	BRTE	*Bromus tectorum*	0–55	0–10
Forb					
4	**Native Forbs**			0–6	
	rock goldenrod	PEPU7	*Petradoria pumila*	0–5	0–1
	small-leaf globemallow	SPPA2	*Sphaeralcea parvifolia*	0–5	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–1	0–1
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–1	0–1
	thicksepal cryptantha	CRCR3	*Cryptantha crassisepala*	0–1	0–1
6	**Non-native annual forbs**			0–5	
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–5	0–2

Animal community

--Livestock and Wildlife Grazing--

This site provides fair-good grazing conditions for livestock and wildlife during spring, summer, and fall when in good ecological condition due to accessibility and nutritious forage. However, this site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. Care should be taken to maintain the native perennial grasses and shrubs due to the poor suitability for re-seeding or restoring this site. The suitability for reseeding and/or restoration is poor due to the lack of precipitation at critical times and shallow soil characteristics. This site may occur in mule deer and desert bighorn sheep habitat; however in many places the populations will be small and have little grazing impact on the site.

The plant community is primarily shrubs, including mountain big sagebrush, cliffrose, and broom snakeweed, which provide browse for cattle, sheep, goats, mule deer, and bighorn sheep. Cliffrose, the dominant shrub species is readily used by livestock and wildlife in the winter months and only lightly in the spring and summer unless other deciduous shrub species are absent. The presence of grasses, including bottlebrush squirreltail and Indian ricegrass provide desirable grazing conditions for all classes of livestock and wildlife, though these grasses are

sparse. Utah juniper and pinyon pine provide good cover for livestock and wildlife. Mule deer and goats may utilize these trees as forage. 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 must be made.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group D due to their shallow depth (NRCS National Engineering Handbook). These soils become saturated quickly due to their high infiltration rates and shallow depths; once these soils are saturated run off potential is high. (National Range and Pasture Handbook, 2003).

Recreational uses

This ecological site is used for hunting and camping.

Wood products

Wood product uses are fenceposts and firewood. Cliffrose has a unique usage as an ornamental woodworking, as it grows to exceptional sizes on this site.

Other information

--Poisonous/Toxic Plant Communities--

Broom snakeweed is the only known toxic plant associated with this site. This plant contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep generally will only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest.

Potentially toxic plants associated with this site include some buckwheat species and mountain big sagebrush. Some buckwheat species may accumulate selenium, but only when growing on selenium enriched soils. These plants, when consumed will cause alkali disease or chronic selenosis, which affects all classes of livestock (excluding goats). Typically animals consuming 5-50 ppm selenium will develop chronic selenosis and animals consuming greater than 50 ppm selenium will develop acute selenosis. Clinical signs include lameness, soughing of the hoof, hair loss, blindness, and aimless wondering. Horses tend to develop what is called a “bob” tail or “roached” main due to breakage of the long hairs. Mountain big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of ¾ lbs of big sagebrush fed to sheep for three days was found to be lethal.

--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. Cheatgrass is already well-established in undisturbed areas of this site.

--Fire Ecology--

The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content—sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Many plant communities in the Colorado Plateau may have evolved without the influence of fire. However a year of exceptionally heavy winter rains can generate fuels by producing heavy stands of annual forbs and grasses. When fires do occur, the effect on the plant community may be extreme due to the harsh environment and slow rate of recovery.

Inventory data references

Data collected to develop this ecological site were part of a contract to update draft MLRA35 Ecological Sites. The vegetation data was collected on representative soil components, and was geo-referenced. All data is stored as hard copy files and in an electronic format in the NRCS Utah State Office.

High intensity sampling (Caudle et al. 2013) was used to describe this ecological site. Site characteristics such as aspect, slope, elevation and UTMS were recorded for each plot, along with complete species inventory by ocular percent cover. The line-point intercept method was used to measure foliar cover, groundcover, and vegetation structure. At 100 points along a 200 foot transect, ground cover and intercepted plant species were recorded by height. The first hit method (Herrick et al. 2009) was used to generate the foliar cover values entered in the community phase composition tables. Annual production was estimated using the double-weight sampling method outlined in the National Range and Pasture Handbook and in Sampling Vegetation Attributes (NRCS 2003 and Interagency Technical Reference 1999 pgs. 102 - 115). For herbaceous vegetation, ten 9.6 square foot circular sub-plots were evenly distributed along a 200 foot transect. For woody and larger herbaceous species, production was estimated in four 21x21 foot square plots along the same transect. Weight units were collected for each species encountered in the production plots. The number of weight units for each species is then estimated for all plots.

Type locality

Location 1: Kane County, UT	
UTM zone	N
UTM northing	4101513
UTM easting	402642
General legal description	The type location occurs in the Buckskin Mountain Area of Escalante-Grand Staircase National Monument, approximately 20 miles east of Kanab along highway 89.

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Contributors

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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)	Robert Stager (BLM), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS), Randy Beckstrand (BLM), Alice Miller (Pyramid Botanical Consultants)
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Date	02/16/2016
Approved by	Shane A. Green
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Few, but occur throughout site. Rills may be 6 to 10 feet in length. Sides of rills may be up to 3 inches high. Rills are most likely to form below adjacent exposed bedrock or water flow patterns where sufficient water accumulates to cause erosion.

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2. **Presence of water flow patterns:** Frequent and occur throughout area. Interspaces between well developed biological soil crusts appear to be water depression storage areas but can serve as water flow patterns across areas covered with biological soil crust during episodic precipitation events. Evidence of flow patterns will increase somewhat with slope.

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3. **Number and height of erosional pedestals or terracettes:** Few, throughout site. Pedestals up to 3 inches form at the base of plants that occur on the edge of rills. On steep slopes (>12%), gullies may remove soil from the base of trees exposing roots that resemble pedestals. Interspaces between well developed biological soil crusts resemble pedestals. Terracettes are present, but debris dams are also present. Some debris dams of small to medium sized litter (up to 2 inches in diameter) may form in water flow patterns, rills, and gullies. These debris dams may accumulate smaller litter (leaves, grass and forb stems).

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 6 to 10 %. Most bare ground is associated with water flow patterns, rills, and gullies. The soil surface is covered by up to 12-44% rock fragments. Areas with well developed biological soil crusts should not be counted 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. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

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5. **Number of gullies and erosion associated with gullies:** None to few on gentle slopes (< 10 %). On steep slopes and areas below adjacent exposed bedrock, gullies may be numerous but limited by depth to bedrock. Length often extends from exposed bedrock until gully reaches a stream or an area where water and sediment accumulate. Gullies may remove soil from base of trees exposing roots.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None to very few. Tall shrubs break the wind and reduce the potential for wind erosion.

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7. **Amount of litter movement (describe size and distance expected to travel):** On gentle slopes (< 10 %) most litter accumulates at base of plants. Woody litter not typically moved unless located in a water flow pattern, rill, or gully.

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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 or 6 under the plant canopies, and a rating of 4 to 6 in the interspaces. The average should be a 4 or 5. Surface texture is gravelly fine sandy loam. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

---

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

surface horizon is approximately 5 inches deep. Structure is weak fine granular. Color is strong brown (7.5YR4/6). There is little if any difference under canopy or in interspaces and a recognizable A horizon is expected to be present throughout. Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Spatial distribution of well developed biological soil crusts (where present) intercept raindrops reducing splash erosion and provide areas of surface detention to store water allowing additional time for infiltration. Crowns of trees and accumulating litter at base of trees appear to create a micro-topography that may enhance development of water flow patterns below the drip line of the canopy. Significant increases in Pinyon-juniper canopy (beyond the reference state) reduces understory vegetation causing an associated increase in runoff.

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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, although bedrock is found within 20 inches of soil surface. In addition, there may be layers of calcium carbonate or other naturally occurring hard layers found in the soil subsurface. These should not be considered to be 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: Tall sprouting shrubs > Perennial Grasses > Forbs = Trees (Juniper > Pinyon)

    Sub-dominant:

    Other: 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, Intermediate wheatgrass, etc.) (Assumin g that Cliffrose is a non-sprouter)
    Biological soil crust is variable in its expression where present on this site and is measured as a component of ground cover.

    Additional: Disturbance regime includes drought, insects, fire, and parasites. Following a recent disturbance such as fire, drought, or insects 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.
    This site has unique cliffrose which are 8 to 12 feet tall. This area can be overused by deer which is evidenced by the hedging on the cliffrose.
    Dominants—Cliffrose, Mountain big sagebrush, Utah Juniper. Sub Dominants—Pinion, Broom snakeweed, Squirreltail, Indian ricegrass, Muttongrass. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** In drought tree mortality may increase with the first sign being a yellowish to reddish leaf color. Decadence in the principle shrubs, especially cliffrose, are likely to occur near the end of the fire cycle. 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):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 112 - 645 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:** Cheatgrass and introduced annual forbs are likely to invade this site.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce sexually or asexually in most years, except in drought years.
