

## Ecological site R048AY322UT Upland Shallow Loam (Two-Needle Pinyon / Utah Juniper)

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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.

### MLRA notes

Major Land Resource Area (MLRA): 048A–Southern Rocky Mountains

MLRA 48A makes up about 45,920 square miles (119,000 square kilometers) and is the southern part of the Rocky Mountains. The Southern Rocky Mountains lies east of the Colorado Plateau, south of the Wyoming Basin, west of the Great Plains, and north of the Rio Grande Rift. It is in western and central Colorado, southeastern Wyoming, eastern Utah, and northern New Mexico. The headwaters of major rivers such as the Colorado, Yampa, Arkansas, Rio Grande, North Platte and South Plate rivers are located here. This MLRA has numerous national forests, including the Medicine Bow National Forest in Wyoming; the Routt, Arapaho, Roosevelt, Pike, San Isabel, White River, Gunnison, Grand Mesa, Uncompahgre, Rio Grande, and San Juan National Forests in Colorado; the Carson National Forest and part of the Santa Fe National Forest in New Mexico. Rocky Mountain National Park also is in this MLRA.

MLRA 48A is the southern Rocky Mountains physiographic region. The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. Several basins, or parks, are between the belts. Some high mesas and plateaus are included. It is characterized by mountain ranges that were uplifted during the Laramide Orogeny and then had periods of glaciation. The ranges include the Sangre de Cristo Mountains, the Laramie Mountains, and the Front Range in the east and the San Juan Mountains and the Sawatch and Park Ranges in the west. The ranges are dissected by many narrow stream valleys having steep gradients. In some areas the upper mountain slopes and broad crests are covered by snowfields and glaciers. Elevation typically ranges from 6,500 to 14,400 feet (1,980 to 4,390 meters) in this area. The part of this MLRA in central Colorado includes the highest point in the Rockies, Mount Elbert, which reaches an elevation of 14,433 feet (4,400 meters). More than 50 peaks in the part of the MLRA in Colorado are at an elevation of more than 14,000 feet (4,270 meters). Many small glacial lakes are in the high mountains.

The mountains in this area were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. This large MLRA can be subdivided into at least 4 large general divisions. First is the Rockies on the east side of this area are called the "Front Range," which is a fault block that has been tilted up on edge and uplifted and is largely igneous and metamorphic geology. It was tilted up on the east edge, so there is a steep front on the east and the west side is more gently sloping and in the south east there are rocks exposed in the mountains are mostly Precambrian igneous and metamorphic rocks. Second is the tertiary rocks, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are throughout this area (San Juan Mountains Area). The third division is Northwest part of the MLRA is dominantly sedimentary rock from the cretaceous/tertiary and Permian/Pennsylvanian periods. The fourth subset is the long and narrow Sangre de Cristos mountains uplifted in the Cenozoic are between the Rio Grande rift and the great plains. Many of the highest mountain ranges were reshaped by glaciation during the Pleistocene. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. They also are important sources of sand and gravel.

The average annual precipitation ranges predominantly from 12 to 63 inches. Summer rainfall commonly occurs as high-intensity, convective thunderstorms. About half of the annual precipitation occurs as snow in winter; this proportion increases with elevation. In the mountains, deep snowpacks accumulate throughout the winter and

generally persist into spring or early summer, depending on elevation. Some permanent snowfields and small glaciers are on the highest mountain peaks. In the valleys at the lower elevations, snowfall is lighter and snowpacks can be intermittent. The average annual temperature is 26 to 54 degrees F (-3 to 12 degrees C). The freeze-free period averages 135 days and ranges from 45 to 230 days, decreasing in length with elevation. The climate of this area is strongly dependent upon elevation; precipitation is greater, and temperatures are cooler at the higher elevations. The plant communities vary with elevation, aspect and change in latitudes due to changing in precipitation kind and timing and temperature.

The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an ustic or udic soil moisture regime. Mineralogy is typically mixed, smectitic, or paramicaceous. In areas with granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on mountain slopes. Dystrocryepts (Leighcan and Mummy series) formed on mountain slopes and summits at the higher elevations. In areas of andesite and rhyolite bedrock, Dystrocryepts (Endlich and Whitecross series) formed in colluvium on mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on mountain slopes at low elevations and with low precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on mountain slopes at high elevations.

### Ecological site concept

This site occurs on very shallow to shallow soils over lithic bedrock. The dry surface layer color is typically a dark reddish brown or a light yellowish brown and the surface soil textures range from channery loams to flaggy fine sandy loams. These soils are moderately well developed, well drained, and have moderate water holding capacities. Soil temperature regime is frigid and moisture regime is aridic bordering on ustic.

### Associated sites

F048AY330UT	<b>Upland Shallow Stony Loam (Two-Needle Pinyon /Douglas Fir)</b>
R048AY366UT	<b>Upland Very Steep Loam (Salina Wildrye)</b>
R048AY443UT	<b>Mountain Shallow Loam (Mixed Conifer)</b>

### Similar sites

F048AY330UT	<b>Upland Shallow Stony Loam (Two-Needle Pinyon /Douglas Fir)</b>
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Table 1. Dominant plant species

Tree	(1) <i>Pinus edulis</i> (2) <i>Juniperus osteosperma</i>
Shrub	(1) <i>Artemisia nova</i>
Herbaceous	(1) <i>Achnatherum hymenoides</i>

### Physiographic features

This ecological site typically occurs on hills, hillslopes, structural benches, and on escarpments, ledges and mesas. Slope, aspect and elevation influence the vegetative floristics of this ecological site. Sites are located between 6,200 to 7,800 feet in elevation. Slopes normally range from 3 to 40 percent but may occasionally be steeper.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mesa (3) Structural bench
Flooding frequency	None
Ponding frequency	None

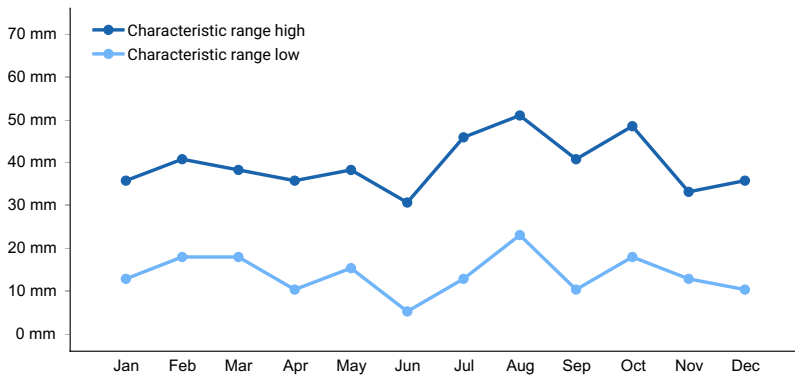
Elevation	1,890–2,377 m
Slope	3–40%
Aspect	Aspect is not a significant factor

## Climatic features

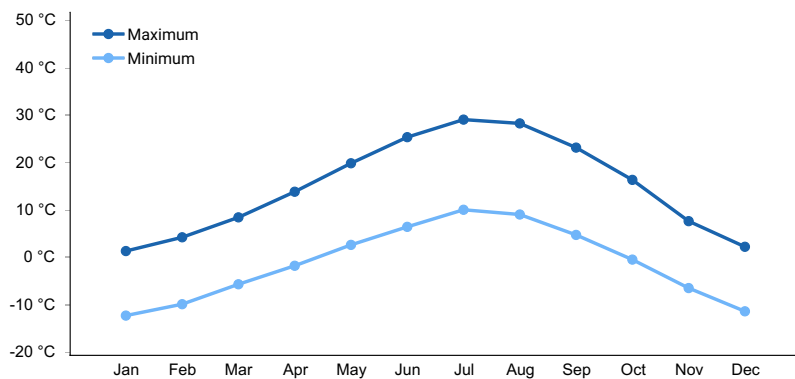
The climate of this site is dry subhumid and semiarid. It is characterized by cold, snowy winters and warm, dry summers. The average annual precipitation ranges from 12 to 16 inches. July, August, and October are typically the wettest months with June being the driest. The most reliable sources of moisture for plant growth are the snow that accumulates over the winter and spring rains. Summer thunderstorms are intermittent and sporadic in nature, and thus, are not reliable sources of moisture to support vegetative growth on this site. The mean annual air temperature ranges from 42 to 45 degrees and averages 44 degrees.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	305-406 mm



**Figure 1. Monthly precipitation range**



**Figure 2. Monthly average minimum and maximum temperature**

## Influencing water features

There are no influencing water features on this site.

## Soil features

This site occurs on very shallow to shallow soils over lithic bedrock. The dry surface layer color is typically a dark reddish brown or a light yellowish brown and the surface soil textures range from channery loams to flaggy fine sandy loams. These soils are moderately well developed, well drained, and have moderate water holding capacities. Soil temperature regime is frigid and moisture regime is aridic bordering on ustic.

This site has been used in the following soils surveys and has been correlated to the following components:

UT013—Duchesne: Benlow, Cedarknoll, Gompers, Moonshine.

UT653-Uintah and Ouray Indian Reservation: Benlow, Cedarknoll, Gompers, Moonshine.

Typical Soil Profile: (Moonshine).

A—0-3 inches; flaggy fine sandy loam; disseminated calconates; moderately alkaline.

C1—3-15 inches; fine sandy loam; disseminated calconates; moderately alkaline.

C2-15-19 inches; fine sandy loam; disseminated calconates; moderately alkaline.

R—19 inches; unweathered sandstone bedrock.

**Table 4. Representative soil features**

Parent material	(1) Alluvium—sandstone and shale (2) Residuum—calcareous sandstone
Surface texture	(1) Channery loam (2) Flaggy fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Soil depth	15–51 cm
Surface fragment cover ≤3"	0–20%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	1.02–3.81 cm
Calcium carbonate equivalent (Depth not specified)	1–10%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–2
Soil reaction (1:1 water) (Depth not specified)	7.4–8.4
Subsurface fragment volume ≤3" (Depth not specified)	0–8%
Subsurface fragment volume >3" (Depth not specified)	0%

## Ecological dynamics

This site developed under the Uintah Basin Section of the Southern Rocky Mountain Province ecological conditions and the natural influences of herbivory, fire and climate. Species composition is generally dominated by an overstory canopy of two-needle pinyon and Utah juniper. Black sagebrush and alderleaf mountain mahogany are common shrub species. Perennial herbaceous species occurrence is directly related to canopy density with Indian ricegrass, Letterman needlegrass and geyer sedge found most often.

Evidence indicates that this site historically maintained a fairly long burn cycle (100 years or more). Very old two-needle pinyon and Utah juniper are common on most undisturbed sites. Over time, their canopies increase in density, reducing understory vegetation dramatically. Following stand removing fire, the understory vegetation flourishes, but over time is again reduced.

Severe drought and insect damage can affect two-needle pinyon in some locations, causing it die out, often allowing

Utah juniper to increase. This event can also allow for an increase in shrubs and herbaceous species during periods when wetter years return.

As vegetative communities respond to changes caused by natural or manmade events that cause them to cross ecological thresholds, a return to previous states may not be possible. The amount of effort needed to affect desired vegetative shifts depends on a sites present biotic and abiotic features and the desired results.

The following State and Transition diagram depicts the most common plant communities found on this ecological site. It does not necessarily depict all the plant communities that can occur, but does show the most prevalent and repeatable. As more data are collected, some of these plant communities may be revised or removed, and new ones added. These descriptions capture the current knowledge and experience at the time of this revision.

## **State and transition model**

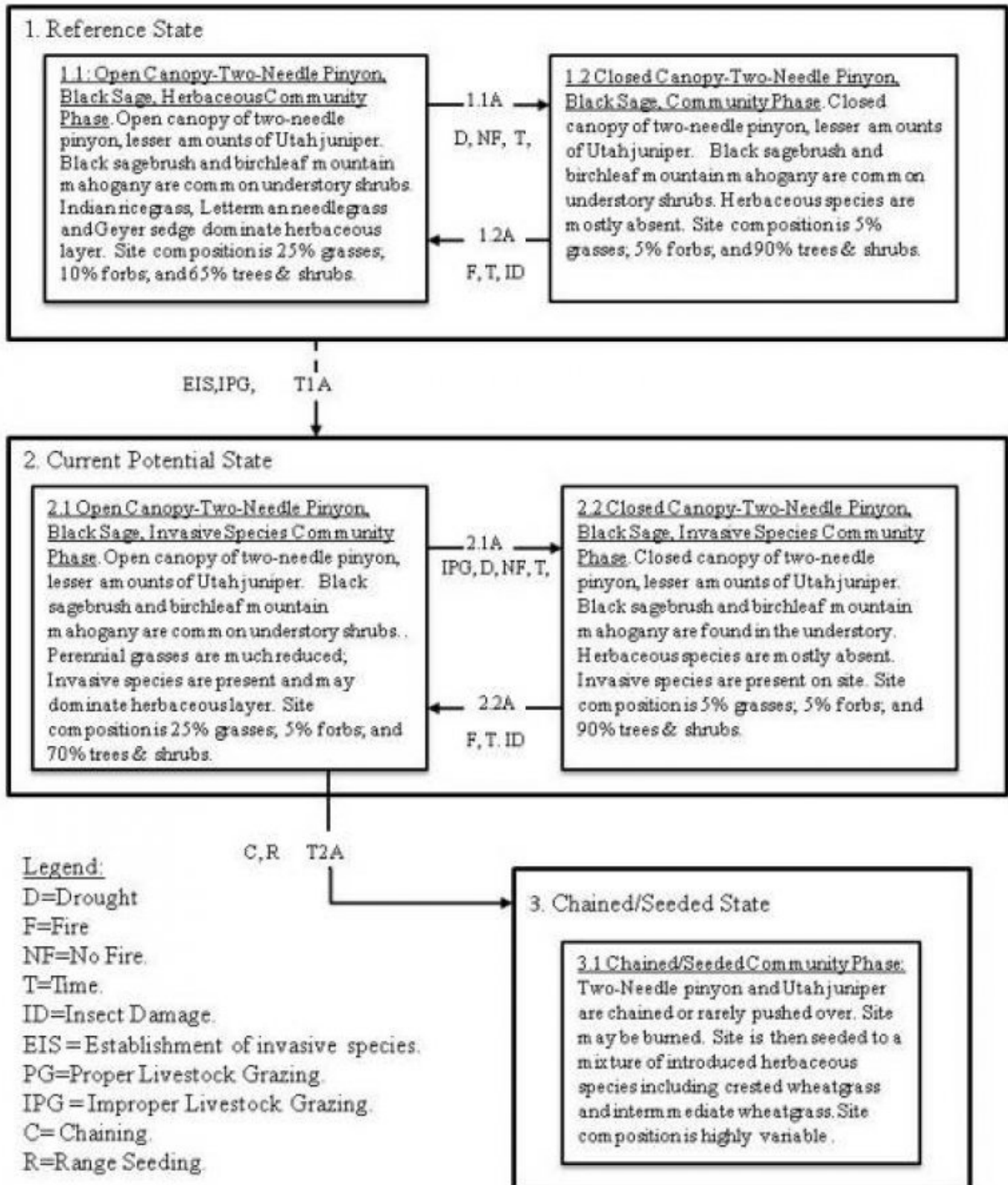
State and Transition Model

State: Utah

Site Type: Rangeland

MLRA: D-48A- Southern Rocky Mountain Province, Uintah Basin Extension.

R048AY322UT – Upland Shallow Loam (Two-Needle Pinyon, Black Sage, Indian Ricegrass).



## State 1

### Reference State

This state describes the biotic communities that may become established on this ecological site if all successional sequences are completed under natural disturbance conditions. The reference state is generally dominated by an overstory canopy of two-needle-pinyon with lesser amounts of Utah juniper. Black sagebrush is the dominate shrub. Indian ricegrass and Letterman needlegrass are the most common grasses. Other native grasses, forbs, and shrubs may produce significant composition in the plant community. The primary disturbance mechanisms are overstory canopy density, weather fluctuation, and fire. The reference state is self sustaining and resistant to change due to a high resistance to natural disturbances and a high resilience following those disturbances. When natural disturbances occur, the rate of recovery can be quite variable. Typically in the reference state, this ecological site will fluctuate between community phases 1.1 and 1.2. Reference State: Plant communities influenced by canopy density, long term weather fluctuations, and periodic fire. Indicators: A community dominated by two-needle pinyon, Utah juniper and black sagebrush. The density of the overstory canopy determines the amount and composition of the other native perennial grasses and forbs that may be present. Feedbacks: Natural fluctuations in weather patterns that allow for a self sustaining two-needle pinyon, Utah juniper, black sagebrush and native grass community. Insect herbivory, more frequent fires, or other disturbances that may allow for the establishment of invasive species. At-risk Community Phase: All communities are at risk when native plants are stressed and nutrients become available for invasive plants to establish. Trigger: The establishment of invasive plant species.

### Community 1.1

#### Open Canopy-Two-needle Pinyon, Black Sage, Herbaceous Community Phase.



Figure 3. Community Phase 1.1

This community phase is characterized by an open canopy of two-needle pinyon and Utah juniper. Black sagebrush and alderleaf mountain mahogany are the most common understory shrubs. Commonly occurring grasses and grasslikes include Indian ricegrass, Letterman needlegrass and Geyer sedge. Other perennial grasses, shrubs, and forbs are also often present. Air dry composition of this site is approximately 10 percent forbs, 25 percent grasses, and 65 percent shrubs and trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-20%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example the typical vegetative floristics of a community phase 1.1 plant community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	112	196	247
Grass/Grasslike	67	112	135
Shrub/Vine	73	95	123
Forb	28	45	56
<b>Total</b>	<b>280</b>	<b>448</b>	<b>561</b>

**Table 6. Ground cover**

Tree foliar cover	20-30%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	20-25%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	2-5%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

## Community 1.2 Closed Canopy-Two-needle Pinyon, Black Sage Community Phase.

Soil Survey: UT013, Duchesne Area  
UTM: 12T, E0555290, N4429190  
Photo by: V. Keith Wadman  
Date: 9/24/2010

This photo provides an example of a community phase 1.2 site.



**Figure 5. Community Phase 1.2**

This community phase is characterized by a dense canopy of two-needle pinyon and Utah juniper. Black sagebrush and alderleaf mountain mahogany, where present, are the most common understory shrubs. Herbaceous vegetation is significantly reduced because of shading by the overstory canopy. Where herbaceous species do remain, Indian ricegrass, Letterman needlegrass and Geyer sedge are found most often. Other perennial grasses, shrubs, and forbs may also occasionally be present. Air dry composition of this site is approximately 5 percent forbs, 5 percent grasses, and 90 percent shrubs and trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-20%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example the typical vegetative floristics of a community phase 1.2 plant community.



**Table 7. Annual production by plant type**

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	179	303	370
Shrub/Vine	45	67	90
Forb	34	45	56
Grass/Grasslike	22	34	45
<b>Total</b>	<b>280</b>	<b>449</b>	<b>561</b>

**Table 8. Ground cover**

Tree foliar cover	40-60%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	2-5%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

### Pathway 1.1A Community 1.1 to 1.2



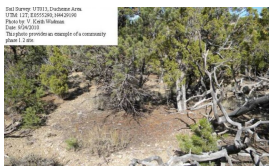
**Open Canopy-Two-needle Pinyon, Black Sage, Herbaceous Community Phase.**



**Closed Canopy-Two-needle Pinyon, Black Sage Community Phase.**

This community pathway occurs when long-term drought and/or extended periods without fire allows canopies of two-needle pinyon and Utah juniper to significantly increase. This closed canopy causes understory vegetation to be reduced or nearly eliminated from the site. Drought alone can also reduce native perennial grass production and eventually eliminate them from the system.

### Pathway 1.2A Community 1.2 to 1.1



**Closed Canopy-Two-needle Pinyon, Black Sage Community Phase.**



**Open Canopy-Two-needle Pinyon, Black Sage, Herbaceous Community Phase.**

This community pathway occurs when weather patterns return to within normal ranges and fire reduces two-needle pinyon and Utah juniper, significantly opening the sites canopy. Insect damage on two-needle pinyon can also cause it to be reduced on this site. This more open canopy allows understory vegetation to increase and under some circumstances, flourish on the site.

## State 2

### Current Potential State

The current potential state is similar to the reference state, however invasive species are now present in all community phases. This state is generally dominated by two-needle pinyon, with lesser amounts of Utah juniper present. Black sagebrush and alderleaf mountain mahogany are the most common shrubs. Depending on the sites disturbance history, native perennial grasses, forbs, or other shrubs may be common in the sites understory. Primary disturbance mechanisms are thought to include long-term weather fluctuations, insect herbivory, improper livestock grazing, fire interval and surface disturbances such as road and pipeline development and off road vehicle (OHV) use. Few disturbed sites have been located to date and so little data exists regarding them. The current potential state is still self sustaining but has less resistance to change due to lower resistance to disturbances and lower resilience following disturbances. This state will typically fluctuate between community phases 2.1 and 2.2. Current Potential State: Plant communities influenced by livestock grazing, wildlife browsing, insect herbivory, weather fluctuations, fire periods and surface disturbances. Indicators: A community dominated by two-needle pinyon and black sagebrush where other shrubs and native perennial grasses and forbs may also be present. Invasive grasses and forbs are present. Feedbacks: Natural fluctuations in weather that allow for a self sustaining two-needle pinyon, black sagebrush and grass community.

## Community 2.1

### Open Canopy-Two-needle Pinyon, Black Sage, Invasive Species Community Phase.

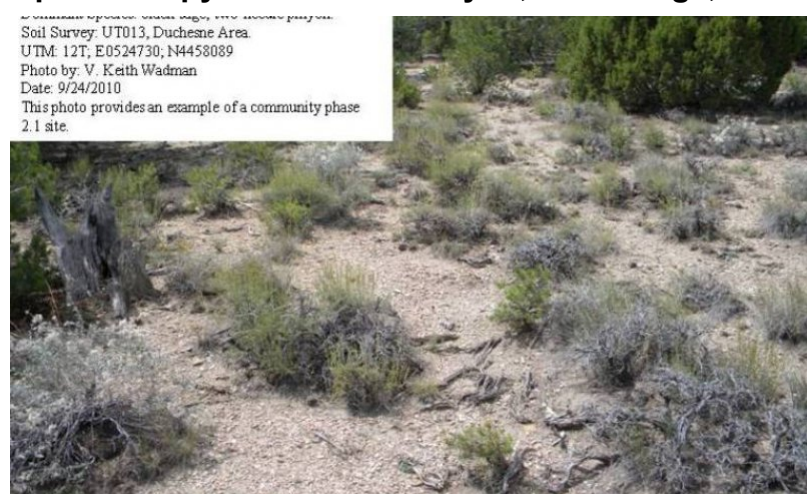


Figure 7. Community Phase 2.1

This community phase is characterized by an open canopy of two-needle pinyon and Utah juniper. Black sagebrush and alderleaf mountain mahogany are the most common understory shrubs. Commonly occurring grasses and grasslikes include Cheatgrass, Indian ricegrass, Letterman needlegrass and Geyer sedge. Other annual and perennial grasses and forbs and various other shrubs are also present. Air dry composition of this site is approximately 10 percent forbs, 25 percent grasses, and 65 percent shrubs and trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-20%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example the typical vegetative floristics of a community phase 2.1 plant community.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	112	196	247
Grass/Grasslike	67	112	135
Shrub/Vine	56	84	112
Forb	45	56	67
<b>Total</b>	<b>280</b>	<b>448</b>	<b>561</b>

Table 10. Ground cover

Tree foliar cover	20-30%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	20-25%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	2-5%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

## Community 2.2

### Closed Canopy-Two-needle Pinyon, Black Sage Invasive Species Community Phase.



R048AY322UT-Upland Shallow Loam (Two-needle pinyon, Black Sage, Indian Ricegrass)  
 Dominant Species: black sage, two-needle pinyon.  
 Soil Survey: UT013, Duchesne Area.  
 UTM: 12T, E0536076, N4433394  
 Photo by: V. Keith Wadman  
 Date: 8/31/2010

Figure 9. Community Phase 2.2

This community phase is characterized by a dense canopy of two-needle pinyon and Utah juniper. Black sagebrush and alderleaf mountain mahogany, where present, are the most common understory shrubs. Herbaceous vegetation is significantly reduced because of shading by the overstory canopy. Where herbaceous species do remain, cheatgrass, Indian ricegrass, Letterman needlegrass and Geyer sedge are found most often. Other perennial grasses, shrubs, and forbs may also occasionally be present. Air dry composition of this site is approximately 5 percent forbs, 5 percent grasses, and 90 percent shrubs and trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-20%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example the typical vegetative floristics of a community phase 2.2 plant

community.

**Table 11. Annual production by plant type**

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	179	303	370
Shrub/Vine	45	67	90
Forb	34	45	56
Grass/Grasslike	22	34	45
<b>Total</b>	<b>280</b>	<b>449</b>	<b>561</b>

**Table 12. Ground cover**

Tree foliar cover	40-60%
Shrub/vine/liana foliar cover	5-15%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	2-5%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

### Pathway 2.1A Community 2.1 to 2.2



**Open Canopy-Two-needle Pinyon, Black Sage, Invasive Species Community Phase.**

**Closed Canopy-Two-needle Pinyon, Black Sage Invasive Species Community Phase.**

This community pathway occurs when long-term drought and/or extended periods without fire allows canopies of two-needle pinyon and Utah juniper to significantly increase. This closed canopy causes understory vegetation to be reduced or nearly eliminated from the site. Drought and/or improper livestock alone can also reduce native perennial grass production and eventually eliminate them from the system.

### Pathway 2.2A Community 2.2 to 2.1



**Closed Canopy-Two-needle Pinyon, Black Sage Invasive Species Community Phase.**

**Open Canopy-Two-needle Pinyon, Black Sage, Invasive Species Community Phase.**

This community pathway occurs when weather patterns return to within normal ranges and fire reduces two-needle pinyon and Utah juniper, significantly opening the sites canopy. Insect damage on two-needle pinyon can also cause it to be reduced on this site. This more open canopy allows understory vegetation to increase and under some circumstances, flourish on the site.

### State 3 Chained and Seeded State

This state occurs when the site is chained to remove two-needle pinyon and juniper trees. Following the chaining this area may or may not be burned and then seeded to introduced species such as crested wheatgrass. Where sufficient understory species are present, the site might be allowed to recover naturally following the chaining.

#### Community 3.1 Chained and seeded Community Phase.

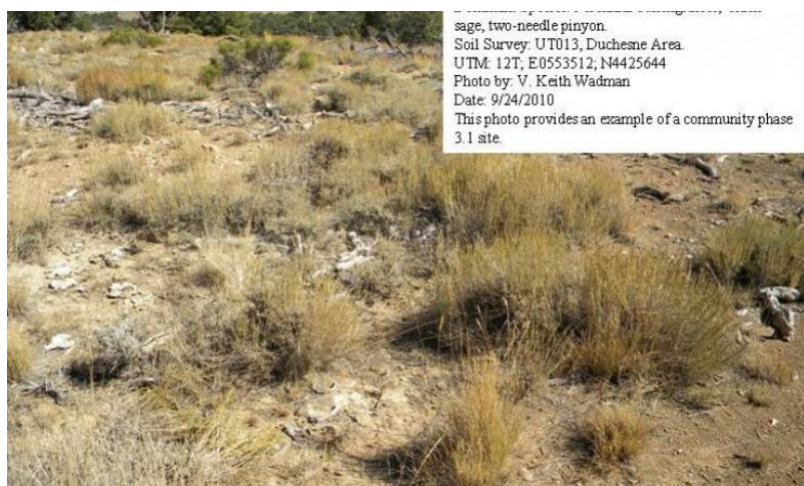


Figure 11. Community Phase 3.1

This community phase is created when overstory canopies of two-needle pinyon and Utah juniper are chained. This action releases understory species, allowing them to increase. Black sagebrush and alderleaf mountain mahogany, where present, are the most likely to increase in the shrub layer. Other shrubs such as broom snakeweed and green rabbitbrush may also increase. Where herbaceous species do remain, cheatgrass, Indian ricegrass, Letterman needlegrass and Geyer sedge are most likely to increase. Other annual and perennial grasses and forbs present may also increase following chaining. This site is often aerial seeded to introduced species with crested wheatgrass and intermediate wheatgrass seeded most often. Air dry composition of this site following chaining is highly variable but a typical result is approximately 15 percent forbs, 35 percent grasses, and 50 percent shrubs. A few remaining trees are also normally present. Bare ground is variable (2-60%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-20%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example the typical vegetative floristics of a community phase 3.1 plant community.

Table 13. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	179	224	336
Grass/Grasslike	56	112	168
Forb	45	78	112
Tree	22	34	56
<b>Total</b>	<b>302</b>	<b>448</b>	<b>672</b>

Table 14. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	15-35%
Grass/grasslike foliar cover	10-30%
Forb foliar cover	10-20%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-20%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	40-60%

### Transition T1A State 1 to 2

This transitional pathway occurs when improper livestock grazing causes the perennial herbaceous community to become significantly reduced allowing non-native species such as cheatgrass, Russian thistle and other invasive weeds to become established. Broom snakeweed may also increase during this time. Once invasive species occupy the site, a threshold has been crossed. Cheatgrass has been known to become established in healthy communities on this site, however.

### Transition T2A State 2 to 3

This transitional pathway occurs when the site is chained and seeded to introduced species including crested wheatgrass and intermediate wheatgrass. During seeding establishment non-native species such as cheatgrass, Russian thistle and ragweed species may also become established. Broom snakeweed may increase during this time. Once introduced and invasive species occupy the site, a threshold has been crossed.

### Additional community tables

Table 15. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Dominant Grasses</b>			56–112	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	34–67	–
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	34–67	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	22–45	–
2	<b>Sub-Dominant Grasses</b>			34–67	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	11–22	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	11–22	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–22	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	11–22	–
<b>Forb</b>					

3	<b>Forbs</b>			45–90	
	low pussytoes	ANDI2	<i>Antennaria dimorpha</i>	11–22	–
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	11–22	–
	woollypod milkvetch	ASPU9	<i>Astragalus purshii</i>	11–22	–
	aridland goosefoot	CHDE	<i>Chenopodium desiccatum</i>	11–22	–
	narrowstem cryptantha	CRGR3	<i>Cryptantha gracilis</i>	11–22	–
	roundspike cryptantha	CRHU2	<i>Cryptantha humilis</i>	11–22	–
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	11–22	–
	scarlet gilia	IPAG	<i>Ipomopsis aggregata</i>	11–22	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	11–22	–
	rock goldenrod	PEPU7	<i>Petroradia pumila</i>	11–22	–
	Whipple's penstemon	PEWH	<i>Penstemon whippleanus</i>	11–22	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	11–22	–
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	11–22	–
	basindaisy	PLIN7	<i>Platyschkuhria integrifolia</i>	11–22	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	11–22	–
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	11–22	–
	longstalk clover	TRLO	<i>Trifolium longipes</i>	11–22	–
	American vetch	VIAM	<i>Vicia americana</i>	11–22	–
<b>Shrub/Vine</b>					
4	<b>Dominant Shrubs</b>			56–112	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	56–90	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	34–67	–
5	<b>Sub-Dominant Shrubs</b>			34–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra ssp. cerulea</i>	11–22	–
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	11–22	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	11–22	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	11–22	–
	bastardsage	ERWR	<i>Eriogonum wrightii</i>	11–22	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	11–22	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	11–22	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	11–22	–
<b>Tree</b>					
6	<b>Dominant Trees</b>			112–224	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	84–168	–
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28–56	–

Table 16. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Dominant Grasses</b>			22–45	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–22	–

	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	0–22	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	0–22	–
2	<b>Sub-Dominant Grasses</b>			11–34	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–11	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	0–11	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–11	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–11	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0–11	–
<b>Forb</b>					
3	<b>Forbs</b>			34–56	
	low pussytoes	ANDI2	<i>Antennaria dimorpha</i>	6–11	–
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	6–11	–
	woollypod milkvetch	ASPU9	<i>Astragalus purshii</i>	6–11	–
	aridland goosefoot	CHDE	<i>Chenopodium desiccatum</i>	6–11	–
	narrowstem cryptantha	CRGR3	<i>Cryptantha gracilis</i>	6–11	–
	roundspike cryptantha	CRHU2	<i>Cryptantha humilis</i>	6–11	–
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	6–11	–
	scarlet gilia	IPAG	<i>Ipomopsis aggregata</i>	6–11	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	6–11	–
	rock goldenrod	PEPU7	<i>Petradoria pumila</i>	6–11	–
	Whipple's penstemon	PEWH	<i>Penstemon whippleanus</i>	6–11	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	6–11	–
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	6–11	–
	basindaisy	PLIN7	<i>Platyschukhria integrifolia</i>	6–11	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	6–11	–
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	6–11	–
	longstalk clover	TRLO	<i>Trifolium longipes</i>	6–11	–
	American vetch	VIAM	<i>Vicia americana</i>	6–11	–
<b>Shrub/Vine</b>					
4	<b>Dominant Shrubs</b>			45–90	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	22–56	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	22–45	–
5	<b>Sub-Dominant Shrubs</b>			22–45	
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	6–11	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	6–11	–
	bastardsage	ERWR	<i>Eriogonum wrightii</i>	6–11	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6–11	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	6–11	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	6–11	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	6–11	–
	blue elderberry	SANIC5	<i>Sambucus nigra ssp. cerulea</i>	6–11	–
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	6–11	–



Tree					
6	<b>Dominant Trees</b>			280–420	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	196–308	–
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	84–112	–

Table 17. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Dominant Grasses</b>			56–112	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	34–67	–
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	34–67	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	22–45	–
2	<b>Sub-Dominant Grasses</b>			67–112	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	67–101	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	11–22	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	11–22	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–22	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	11–22	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–22	–
<b>Forb</b>					
3	<b>Forbs</b>			45–90	
	desert madwort	ALDE	<i>Alyssum desertorum</i>	11–22	–
	annual ragweed	AMAR2	<i>Ambrosia artemisiifolia</i>	11–22	–
	low pussytoes	ANDI2	<i>Antennaria dimorpha</i>	11–22	–
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	11–22	–
	woollypod milkvetch	ASPU9	<i>Astragalus purshii</i>	11–22	–
	aridland goosefoot	CHDE	<i>Chenopodium desiccatum</i>	11–22	–
	narrowstem cryptantha	CRGR3	<i>Cryptantha gracilis</i>	11–22	–
	roundspike cryptantha	CRHU2	<i>Cryptantha humilis</i>	11–22	–
	herb sophia	DESO2	<i>Descurainia sophia</i>	11–22	–
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	11–22	–
	scarlet gilia	IPAG	<i>Ipomopsis aggregata</i>	11–22	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	11–22	–
	rock goldenrod	PEPU7	<i>Petroradia pumila</i>	11–22	–
	Whipple's penstemon	PEWH	<i>Penstemon whippleanus</i>	11–22	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	11–22	–
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	11–22	–
	basindaisy	PLIN7	<i>Platyschkuhria integrifolia</i>	11–22	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	11–22	–
	Russian thistle	SAKA	<i>Salsola kali</i>	11–22	–
	tall tumbled mustard	SIAL2	<i>Sisymbrium altissimum</i>	11–22	–
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	11–22	–

	longstalk clover	TRLO	<i>Trifolium longipes</i>	11–22	–
	American vetch	VIAM	<i>Vicia americana</i>	11–22	–
<b>Shrub/Vine</b>					
4	<b>Dominant Shrubs</b>			90–157	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	56–90	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	34–67	–
5	<b>Sub-Dominant Shrubs</b>			67–135	
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	22–45	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	22–45	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra ssp. cerulea</i>	11–22	–
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	11–22	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	11–22	–
	bastardsage	ERWR	<i>Eriogonum wrightii</i>	11–22	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	11–22	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	11–22	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	11–22	–
<b>Tree</b>					
6	<b>Dominant Trees</b>			112–224	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	84–168	–
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28–56	–

Table 18. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					
1	<b>Dominant Grasses</b>			22–45	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–22	–
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	0–22	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	0–22	–
2	<b>Sub-Dominant Grasses</b>			11–34	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	0–11	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–11	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–11	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0–11	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–11	–
<b>Forb</b>					
3	<b>Forbs</b>			34–56	
	Russian thistle	SAKA	<i>Salsola kali</i>	11–22	–
	tall tumbled mustard	SIAL2	<i>Sisymbrium altissimum</i>	6–11	–
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	6–11	–

	longstalk clover	IRLU	<i>Liriodium longipes</i>	6–11	–
	American vetch	VIAM	<i>Vicia americana</i>	6–11	–
	desert madwort	ALDE	<i>Alyssum desertorum</i>	6–11	–
	low pussytoes	ANDI2	<i>Antennaria dimorpha</i>	6–11	–
	clasping arnica	ARAM2	<i>Arnica amplexicaulis</i>	6–11	–
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	6–11	–
	woollypod milkvetch	ASPU9	<i>Astragalus purshii</i>	6–11	–
	aridland goosefoot	CHDE	<i>Chenopodium desiccatum</i>	6–11	–
	narrowstem cryptantha	CRGR3	<i>Cryptantha gracilis</i>	6–11	–
	roundspike cryptantha	CRHU2	<i>Cryptantha humilis</i>	6–11	–
	herb sophia	DESO2	<i>Descurainia sophia</i>	6–11	–
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	6–11	–
	scarlet gilia	IPAG	<i>Ipomopsis aggregata</i>	6–11	–
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	6–11	–
	rock goldenrod	PEPU7	<i>Petrorhiza pumila</i>	6–11	–
	Whipple's penstemon	PEWH	<i>Penstemon whippleanus</i>	6–11	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	6–11	–
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	6–11	–
	basindaisy	PLIN7	<i>Platyschekuhria integrifolia</i>	6–11	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	6–11	–
<b>Shrub/Vine</b>					
4	<b>Dominant Shrubs</b>			90–135	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	22–56	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	22–45	–
5	<b>Sub-Dominant Shrubs</b>			22–45	
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	6–11	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	6–11	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	6–11	–
	bastardsage	ERWR	<i>Eriogonum wrightii</i>	6–11	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6–11	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	6–11	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	6–11	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	6–11	–
	blue elderberry	SANIC5	<i>Sambucus nigra ssp. cerulea</i>	6–11	–
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	6–11	–
<b>Tree</b>					
6	<b>Dominant Trees</b>			280–420	
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	196–308	–
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	84–112	–

Table 19. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Grass/Grasslike</b>					

**Grass/Grasslike**

1	<b>Dominant Grasses</b>			112-673	
	crested wheatgrass	AGCR	<i>Agropyron cristatum</i>	112-560	-
	intermediate wheatgrass	THIN6	<i>Thinopyrum intermedium</i>	112-560	-
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	0-22	-
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-22	-
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	0-22	-
2	<b>Sub-Dominant Grasses</b>			56-112	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	56-112	-
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-11	-
	saline wildrye	LESA4	<i>Leymus salinus</i>	0-11	-
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-11	-
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0-11	-
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0-11	-
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-11	-

**Forb**

3	<b>Forbs</b>			34-56	
	Russian thistle	SAKA	<i>Salsola kali</i>	11-22	-
	tall tumbled mustard	SIAL2	<i>Sisymbrium altissimum</i>	6-11	-
	stemless mock goldenweed	STAC	<i>Stenotus acaulis</i>	6-11	-
	longstalk clover	TRLO	<i>Trifolium longipes</i>	6-11	-
	American vetch	VIAM	<i>Vicia americana</i>	6-11	-
	desert madwort	ALDE	<i>Alyssum desertorum</i>	6-11	-
	low pussytoes	ANDI2	<i>Antennaria dimorpha</i>	6-11	-
	clasping arnica	ARAM2	<i>Arnica amplexicaulis</i>	6-11	-
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	6-11	-
	woollypod milkvetch	ASPU9	<i>Astragalus purshii</i>	6-11	-
	aridland goosefoot	CHDE	<i>Chenopodium desiccatum</i>	6-11	-
	narrowstem cryptantha	CRGR3	<i>Cryptantha gracilis</i>	6-11	-
	roundspike cryptantha	CRHU2	<i>Cryptantha humilis</i>	6-11	-
	herb sophia	DESO2	<i>Descurainia sophia</i>	6-11	-
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	6-11	-
	scarlet gilia	IPAG	<i>Ipomopsis aggregata</i>	6-11	-
	hoary tansyaster	MACA2	<i>Machaeranthera canescens</i>	6-11	-
	rock goldenrod	PEPU7	<i>Petradoria pumila</i>	6-11	-
	Whipple's penstemon	PEWH	<i>Penstemon whippleanus</i>	6-11	-
	spiny phlox	PHHO	<i>Phlox hoodii</i>	6-11	-
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	6-11	-
	basindaisy	PLIN7	<i>Platyschukuhria integrifolia</i>	6-11	-
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	6-11	-

**Shrub/Vine**

4	<b>Dominant Shrubs</b>			90-135	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	22-56	-
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	22-45	-

	manogany				
5	<b>Sub-Dominant Shrubs</b>			22–45	
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	6–11	–
	mormon tea	EPVI	<i>Ephedra viridis</i>	6–11	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	6–11	–
	bastardsage	ERWR	<i>Eriogonum wrightii</i>	6–11	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	6–11	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	6–11	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	6–11	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	6–11	–
	blue elderberry	SANIC5	<i>Sambucus nigra ssp. cerulea</i>	6–11	–
	narrowleaf yucca	YUAN2	<i>Yucca angustissima</i>	6–11	–
<b>Tree</b>					
6	<b>Dominant Trees</b>			56–112	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	34–67	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	45–67	–

## Animal community

### --Wildlife Interpretation--

Small herds of mule deer, pronghorn antelope, and elk can be seen grazing/browsing on these sites, especially when near water sources and in the winter. The hot summers and lack of water favors small mammals, which have an easier time finding shelter, food, and water. Many species of rats, mice, squirrels, bats, and chipmunks can be observed, along with coyotes and foxes. Utah juniper provides good habitat for several bird species including juniper titmice, scrub jays, pinyon jays, and black throated gray warblers, and sparrows. Lizards are the most visible and can be observed during the day. (NPS.gov, 2008).

### --Grazing Interpretations--

The open canopy community phases of this site can provide fair spring, fall, and winter grazing conditions for livestock because of its accessible but somewhat limited nutritious forage. This site may lack natural perennial water sources, however, which can influence its suitability for livestock grazing. The plant community is primarily composed of an overstory canopy of two-needle pinyon and Utah juniper with an understory of perennial grasses, with Indian ricegrass, Letterman needlegrass, and Geyer sedge occurring most often. Shrubs, including black sagebrush, birchleaf mountain mahogany, and bitterbrush can provide some winter browse for cattle, sheep, and goats. Forb composition and annual production depends primarily on precipitation amounts, and thus, is challenging to use in making livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as the occurrence of poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, a science based grazing management plan should be developed.

## Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group D due to the shallow depth (NRCS National Engineering Handbook). These soils are saturated quickly due to high infiltration rates and shallow depth; once soils are saturated, run off potential is high. Hydrological groups are used in equations that estimate runoff from rainfall. These estimates are needed for solving hydrologic problems that arise in planning watershed-protection and flood-prevention projects and for designing structures for the use, control and disposal of water. Heavy grazing can alter the hydrology by decreasing plant cover and increasing bare ground. Fire can also affect hydrology, but its affect is variable. Fire intensity, fuel type, soil, climate, and topography can each have different influences. Fires can increase areas of bare ground and hydrophobic layers that reduce infiltration and increase runoff (National Range and Pasture Handbook, 2003).

## Recreational uses

Recreation activities include aesthetic value and fair opportunities for hiking and hunting. Trees can provide some screening values for camping and picnicking. In good condition there are several forbs and shrubs that bloom in the spring. Shallow soils limit this site's ability to be used for vacation homes, other residences, or deep ponds.

## Wood products

Two-needle pinyon and Utah juniper can provide firewood and fence post where growth is sufficient and regulations allow for such use.

## Other information

--Poisonous and Toxic Plant Communities--

Toxic plants associated with this site include woolly locoweed, broom snakeweed, and Russian thistle.

Woolly locoweed is toxic to all classes of livestock and wildlife. Locoweed is palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. Locoweed contains swainsonine (indolizidine alkaloid) and is poisonous at all stages of growth. Poisoning will become evident after 2-3 weeks of continuous grazing and is associated with 4 major symptoms: 1) neurological damage, 2) emaciation, 3) reproductive failure and abortion, and 4) congestive heart failure linked with "high mountain disease".

Broom snakeweed 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 (Knight and Walter, 2001).

Russian thistle is an invasive toxic plant, causing nitrate and to a lesser extent oxalate poisoning, which affects all classes of livestock. The buildup of nitrates in these plants is highly dependent upon environmental factors such as after a rain storm, during a drought, during periods with cool/cloudy days, and when growing on soils high in nitrogen and low in sulfur and phosphorus. Nitrate collects in the stems and can persist throughout the growing season. Clinical signs of nitrate poisoning include drowsiness, weakness, muscular tremors, increased heart and respiratory rates, staggering gait, and death. Conversely, oxalate poisoning causes kidney failure; clinical signs include muscle tremors, tetany, weakness, and depression. Poisoning generally occurs when livestock consume and are not accustomed to grazing oxalate-containing plants. Animals with prior exposure to oxalates have increased numbers of oxalate-degrading rumen microflora, and thus, are able to degrade the toxin before clinical poisoning can occur.

--Invasive Plant Communities--

Generally, as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses may invade the site. Of particular concern in semi-arid environments are annual invaders including cheatgrass, Russian thistle, alyssum 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.

On well developed Utah juniper and two-needle pinyon communities, soils are often completely occupied by lateral roots which can inhibit the herbaceous understory as well as limit annual invasive species. Once these sites are disturbed and pinyon-juniper communities begin to decline, their increase or invasion is possible.

--Fire Ecology--

The ability for an ecological site to carry fire depends primarily on its' 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. The two-needle pinyon and Utah juniper communities growing on shallow soils are quite unique. These trees can support stand-replacing fires, though historically, fires were likely a mixture of surface and crown fires with intensities and frequencies dependent on site productivity. Most research agrees that historic fire return intervals are at a minimum 100 years, indicating that fire may have not played an important role in short term community dynamics. Fires are

more common when trees are stressed or dead due to drought and/or beetle infestations. Pinyon-juniper stands reestablish either by seeds dispersed from adjacent unburned patches or by unburned seeds found at the burn site. Continuous (every 20-40 years) burning of these ecological sites can result in shrub dominated communities, due to the relatively fast recovery of shrubs when compared to trees. If invasive annual grasses are allowed to establish, fires may become more frequent, inhibiting the site's ability to recover.

## **Inventory data references**

Data to support this ecological site originated from historic inventories collected by USDA Range professionals.

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## **Contributors**

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## **Approval**

Kirt Walstad, 3/05/2024

## 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.

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Date	09/12/2008
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

- 1. Number and extent of rills:** A. On more gentle slopes (< 15 %): None to Rare. Rills are most likely to form below adjacent exposed bedrock or from converging water flow patterns where sufficient water accumulates to cause erosion. B. On steep slopes (> 15 %): Rills are rarely present. Where they occur, rills are short (up to 10 feet long).

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- 2. Presence of water flow patterns:** Very few sinuous flow patterns wind around perennial plants and surface rock. Evidence of flow patterns is expected to increase somewhat with slopes greater than 15%. Water flow patterns are long (15-20 feet), narrow (<1 foot wide), and spaced widely (10-20 yards) on gentle slopes (<15%) and more closely (<10 yards) on steeper slopes (>15%).

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- 3. Number and height of erosional pedestals or terracettes:** Small pedestals may form at the base of plants that occur on the edge of water flow patterns, but should not show any exposed roots. Terracettes are fairly common, forming behind debris dams of small to medium sized litter (up to 2 inches in diameter) in water flow patterns. These debris dams may accumulate smaller litter (leaves, grass and forb stems) and sediment.

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- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 30 – 60 %. (Soil surface is typically covered 0-20 percent surface fragments). Most bare ground is associated with water flow patterns, rills, and gullies. 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 rare on gentle slopes (< 15%). On steeper slopes and areas below adjacent exposed bedrock, gullies may occur. Length often extends from exposed bedrock until gully reaches a stream or an area where water and sediment accumulate. Gullies may show slightly more indication of erosion as slope increases, or as the site occurs adjacent to steep sites/watershed with concentrated flow patterns.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None to very few. Trees break the wind and reduce the potential for wind erosion. The channers on the soil surface help armor it and reduce the potential for wind erosion.
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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter accumulates at the base of plants. Woody litter is usually not moved unless present in water flow patterns, rills, or gullies.
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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 an erosion rating of 4 or 5 under the plant canopies, and a rating 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):** Soil surface horizon is typically 3 inches deep. Structure is typically medium and fine sugangular blocky. Color is typically dark yellowish brownish (10YR4/4). 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 from 6 to 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: trees (pinyon/juniper) > non-sprouting shrubs (black sagebrush, birchleaf mountain mahogany) > cool season perennial grasses (Indian ricegrass, Letterman needlegrass).
- Sub-dominant: warm season perennial grasses (Galleta, Blue grama) > forbs (woolypod locoweed, cusion phlox) > biological soil crusts.
- 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, and siberian wheatgrass) Biological soil crust is variable in its expression where present on this site and is measured as a component of ground cover. Forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.
- Additional: Factors contributing to temporal variability include insects and other pathogens (mistletoe), drought, extreme precipitation events, etc. Factors contributing to spatial variability include slope, amount of rock fragments, aspect, etc. Following a recent disturbance such as fire, drought or insects that may remove the woody vegetation, forbs and

perennial grasses (herbaceous species) may become more dominate in the community. These conditions may 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):** During years with average to above-average precipitation, there should be very little recent mortality or decadence apparent in trees, shrubs, or grasses. During severe (multi-year) drought up to 20% of the pinyons and junipers may die, either from drought, insect damage or pathogens such as mistletoe. There may be partial mortality of individual bunchgrasses and other shrubs during drought. Some bunchgrass and shrub mortality may occur during severe droughts, particularly on the shallower and coarser soils associated with this site. Because woody stems may persist for many years, both pinyons and junipers (especially older trees) will normally have dead stems within the plant canopy.
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14. **Average percent litter cover (%) and depth ( in):** Litter cover (including under plants) nearly all of which should be fine litter. Depth should be 1 leaf thickness in the interspaces and up to ¼” under canopies, and up to ¾” under tree canopies. Litter cover may increase to 30% on some years due to increased production of plants.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 350-500 #/acre on an average year
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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:** Few invasive species are capable of dominating this site. When invasion does occur, cheatgrass, broom snakeweed, and mustard species are the most likely species to invade.
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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.
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