

Ecological site R034BY239UT

Semidesert Shallow Sandy Loam (Utah Juniper/Two-Needle Pinyon)

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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): 034B—Warm Central Desertic Basins and Plateaus

MLRA 34B occurs in is in Utah (70 percent) and Colorado (30 percent). It makes up about 12,850 square miles (33,290 square kilometers). A small part of the area is in the High Plateaus of Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. The northern part of the MLRA occurs in the Uinta Basin Section, which is bounded by the Uinta Mountains to the north, the Wasatch Range to the west, the Roan Plateau to the south, and the Rabbit Hills to the east. The southern part of the MLRA occurs in the northern third of the Canyon Lands Section. This section is bounded by the Roan Plateau to the north, the Wasatch Plateau to the west, the southern end of the San Rafael Swell to the south, and the western slope of the Rocky Mountains to the east. Elevation ranges from 4,100 feet (1,250 meters) near Green River, Utah, to 7,500 feet (2,285 meters) at the base of the Wasatch Range and the Roan Plateau.

Most of this area is covered by residual basin-floor materials and materials washed in from the surrounding mountains and plateaus. Shale and sandstone are the dominant rock types. The Tertiary-age Green River, Uinta, and Duchesne Formations dominate the northern part of the MLRA. The southern part is dominated by Cretaceous-age materials with lesser amounts of Jurassic and Triassic materials. The dominant Cretaceous formations are Mancos Shale, Dakota Sandstone, and the members of the Mesa Verde Group. The dominant Jurassic formations are the Morrison, Entrada, and Navajo. The dominant Triassic formations are the Chinle and Moenkopi. Quaternary alluvial, eolian, and glacial deposits occur in both parts of the MLRA.

The average annual precipitation in most of this area ranges from 6 to 10 inches (150 to 255 millimeters). A small part of this area receives as much as 24 inches of annual precipitation.

Much of the precipitation occurs as high-intensity, convective thunderstorms during the period July through September. May and June are usually the drier months. Precipitation is more evenly distributed throughout the year in the northern part of the MLRA than in the southern part, where there is a significant peak in late summer. The northern part of the MLRA receives more precipitation as snow during winter than the southern part. The average annual temperature ranges from 41 to 54 degrees F (5 to 12 degrees C). The freeze-free period averages 170 days and ranges from 110 to 235 days.

The dominant soil orders in this MLRA are Aridisols and Entisols. Mollisols occur at the higher elevations, particularly in the northern part of the MLRA. The dominant soil temperature regime is mesic, and the dominant soil moisture regime is aridic. The soils receiving less than 8 inches (205 millimeters) of precipitation annually have an aridic soil moisture regime. The soils receiving 8 to 12 inches (205 to 305 millimeters) have an aridic soil moisture regime that borders on ustic. The soils receiving 12 to 16 inches (305 to 405 millimeters) generally have an ustic soil moisture regime that borders on aridic. The dominant soil mineralogy is mixed and soils are formed in slope alluvium or residuum derived from shale or sandstone. Many of the soils are shallow or moderately deep to shale or sandstone bedrock. The soils at the lower elevations generally have significant amounts of calcium carbonate, salts, and gypsum.

Ecological site concept

The soils of this site formed mostly in eolian deposits and/or slope alluvium over residuum weathered from sandstone. Surface soils are fine sandy loam, channery fine sandy loam, to gravelly fine sandy loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but typically make up less than 35 percent of the soil volume. These soils are shallow, well-drained, and have moderate to moderately rapid permeability. pH is slightly to moderately alkaline.. Available water-holding capacity ranges from 1 to 3 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic aridic and the soil temperature regime is mesic. Precipitation ranges from 8-12 inches annually.

Associated sites

R034BY227UT	Semidesert Shallow Loam (Black Sagebrush)
R034BY230UT	Semidesert Shallow Loam (Salina Wildrye)
R034BY233UT	Semidesert Shallow Loam (Utah Juniper-Pinyon)

Similar sites

R034BY233UT	Semidesert Shallow Loam (Utah Juniper-Pinyon)
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Table 1. Dominant plant species

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

Physiographic features

Site is found on structural benches, outwash terraces, and erosion remnants. Slope gradients are typically 2 to 35 percent. Elevation of this site ranges from 5,200 to 7,000 feet.

Table 2. Representative physiographic features

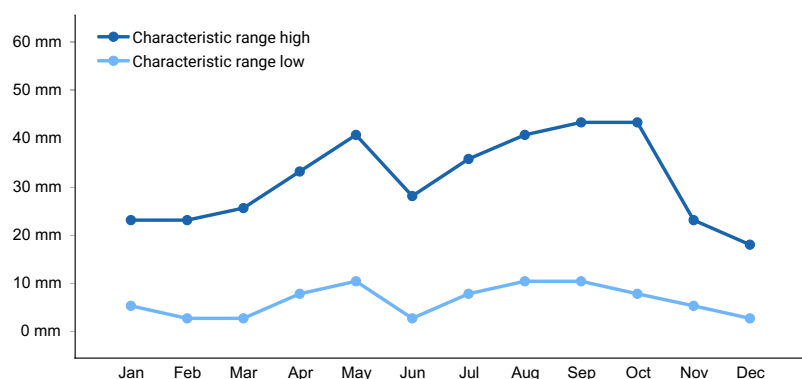
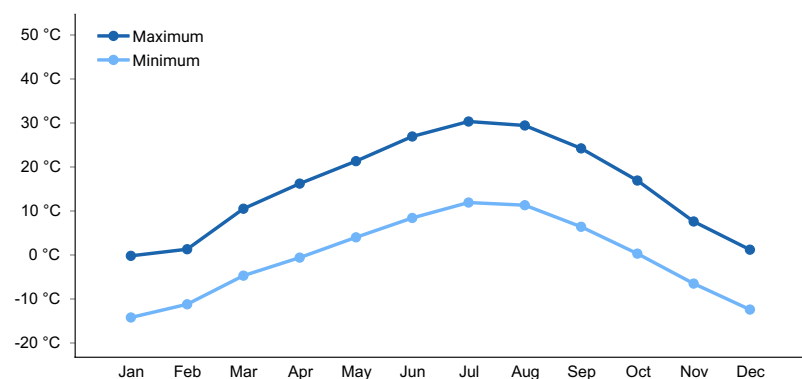
Landforms	(1) Structural bench (2) Outwash terrace (3) Erosion remnant
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	1,585–2,134 m
Slope	2–35%
Ponding depth	0 cm
Aspect	Aspect is not a significant factor

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 8 to 12 inches. May and August thru 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 45 to 49 degrees.

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	203-305 mm
Frost-free period (average)	125 days
Freeze-free period (average)	140 days
Precipitation total (average)	

**Figure 1. Monthly precipitation range****Figure 2. Monthly average minimum and maximum temperature**

Influencing water features

There are no water features influencing this site.

Soil features

The soils of this site formed mostly in eolian deposits and/or slope alluvium over residuum weathered from sandstone. Surface soils are fine sandy loam, channery fine sandy loam, to gravelly fine sandy loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but typically make up less than 35 percent of the soil volume. These soils are shallow, well-drained, and have moderate to moderately rapid permeability. pH is slightly to moderately alkaline.. Available water-holding capacity ranges from 1 to 3 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic aridic and the soil temperature regime is mesic. Precipitation ranges from 8-12 inches annually.

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

UT013—Duchesne: Hideout; Neola.

UT653-Uintah and Ouray Indian Reservation: Hideout; Neola.

Typical Soil Profile: (Hideout).

A—0-2 inches; fine sandy loam; disseminated calconates; slightly effervescent; moderately alkaline.

C1—2-10 inches; fine sandy loam; disseminated calconates; slightly effervescent; moderately alkaline.

R—10 inches; fractured sandstone bedrock.

Table 4. Representative soil features

Parent material	(1) Eolian sands—sandstone (2) Slope alluvium—sandstone (3) Residuum—sandstone
Surface texture	(1) Fine sandy loam (2) Channery fine sandy loam (3) Gravelly fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	13–51 cm
Soil depth	13–51 cm
Surface fragment cover <=3"	2–25%
Surface fragment cover >3"	0–10%
Available water capacity (0-50.8cm)	2.54–7.62 cm
Calcium carbonate equivalent (0-50.8cm)	1–25%
Electrical conductivity (0-50.8cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	0
Soil reaction (1:1 water) (0-50.8cm)	7.4–8.4
Subsurface fragment volume <=3" (0-50.8cm)	5–26%
Subsurface fragment volume >3" (0-50.8cm)	0–4%

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 Utah juniper and two-needle pinyon. Alderleaf mountain mahogany and black sagebrush are common shrub species. Perennial herbaceous species occurrence is directly related to canopy density with Indian ricegrass, James galleta and needle-and-thread found most often.

Evidence indicates that this site historically maintained a fairly long burn cycle (100 years or more). Very old Utah juniper and two-needle pinyon 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-34B - Warm Central Desertic Basins and Plateaus .

R034BY239UT – Upland Shallow Sandy Loam (Utah Juniper, Two-Needle Pinyon, Black Sage, Indian Ricegrass).

1. Reference State

1.1 Open Canopy-Utah Juniper, Two-Needle Pinyon, Herbaceous Understory Community Phase. Open canopy of Utah juniper, lesser amounts of two-needle pinyon. Black sagebrush and alderleaf mountain mahogany are common understory shrubs. Indian ricegrass, James galleta and needle-and-thread dominate herbaceous layer. Site composition is 25% grasses, 10% forbs, and 65% trees & shrubs.

1.1A
D, NF, T,

1.2 Closed Canopy-Utah Juniper, Two-Needle Pinyon, Community Phase. Closed canopy of Utah juniper, lesser amounts of two-needle pinyon. Black sagebrush and alderleaf mountain mahogany are common understory shrubs. Herbaceous species are mostly absent. Site composition is 15% grasses, 10% forbs, and 75% trees & shrubs.

1.2A
F, T, ID

EIS, IPG, T1A

2. Current Potential State

2.1 Open Canopy-Utah Juniper, Two-Needle Pinyon, Invasive Species Community Phase. Open canopy of Utah juniper, lesser amounts of two-needle pinyon. Black sagebrush and alderleaf mountain mahogany are common understory shrubs. Perennial grasses are much reduced; Invasive species are present and may dominate herbaceous layer. Site composition is 25% grasses, 10% forbs, and 65% trees & shrubs.

2.1A
IPG, D, NF, T,

2.2 Closed Canopy-Utah Juniper, Two-Needle Pinyon, Invasive Species Community Phase. Closed canopy of two-needle pinyon, lesser amounts of Utah juniper. Black sagebrush and alderleaf mountain mahogany are found in the understory. Herbaceous species are mostly absent. Invasive species are present on site. Site composition is 10% grasses, 5% forbs, and 85% trees & shrubs.

2.2A
F, T, ID

C, R T2A

Legend:

D=Drought

F=Fire

NF=No Fire.

T=Time.

ID=Insect Damage.

EIS = Establishment of invasive species.

PG=Proper Livestock Grazing.

IPG = Improper Livestock Grazing.

C= Chaining.

R=Range Seeding.

3. Chained/Seeded State

3.1 Chained/Seeded Community Phase: Two-Needle pinyon and Utah juniper are chained or rarely pushed over. Site may be burned. Site is then seeded to a mixture of introduced herbaceous species including crested wheatgrass and intermediate wheatgrass. Site composition is highly variable.

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 Utah juniper with lesser amounts of two-needle-pinyon. Alderleaf mountain mahogany and black sagebrush are the dominate shrubs. Indian ricegrass and James galleta 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 Utah juniper, two-needle-pinyon, alderleaf mountain mahogany 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 Utah juniper, two-needle-pinyon, alderleaf mountain mahogany, 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- Utah Juniper, Two-Needle Pinyon Herbaceous Understory Community Phase



Figure 3. Community Phase 1.1

This community phase is characterized by an open canopy of Utah juniper and two-needle pinyon. Alderleaf mountain mahogany and black sagebrush are the most common understory shrubs. Commonly occurring grasses and grasslikes include Indian ricegrass, James galleta and needle-and-thread. 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 (35-55%) 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

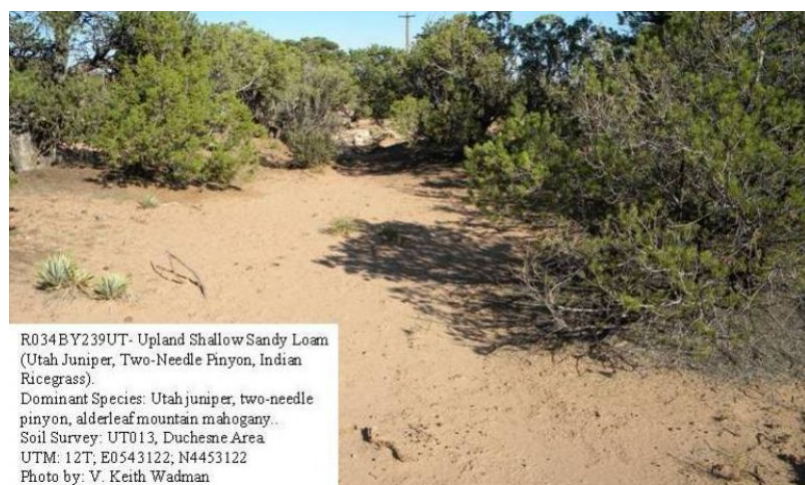
Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	90	140	179
Grass/Grasslike	90	112	146
Shrub/Vine	56	84	112
Forb	45	56	67
Total	281	392	504

Table 6. Ground cover

Tree foliar cover	20-25%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-55%

Community 1.2

Closed Canopy- Utah Juniper, Two-Needle Pinyon Community Phase.

**Figure 5. Community Phase 1.2**

This community phase is characterized by a closed canopy of Utah juniper and two-needle pinyon. Alderleaf mountain mahogany and black sagebrush are the most common understory shrubs. Commonly occurring grasses and grasslikes include Indian ricegrass, James galleta and needle-and-thread. Other perennial grasses, shrubs, and forbs are also often present. Air dry composition of this site is approximately 10 percent forbs, 15 percent grasses, and 75 percent shrubs and trees. Bare ground is variable (35-55%) 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.

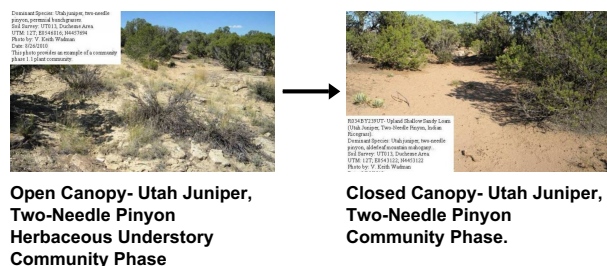
Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	146	185	224
Shrub/Vine	56	84	112
Grass/Grasslike	34	67	101
Forb	45	56	67
Total	281	392	504

Table 8. Ground cover

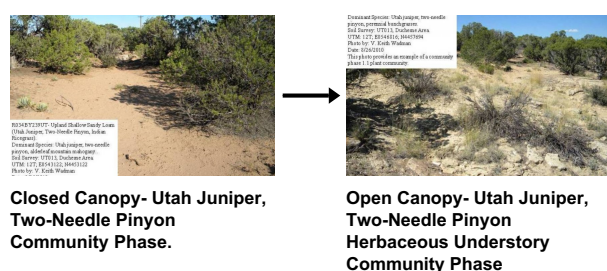
Tree foliar cover	25-30%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-55%

Pathway 1.1A Community 1.1 to 1.2



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



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 Utah juniper with lesser amounts of two-needle pinyon present. Alderleaf mountain mahogany and black sagebrush 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 Utah juniper, 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 Utah juniper, two-needle pinyon, black sagebrush and grass community.

Community 2.1
Open Canopy- Utah Juniper, Two-Needle Pinyon Invasive Species Community Phase



Figure 7. Communith Phase 2.1

This community phase is characterized by an open canopy of Utah juniper and two-needle pinyon. Alderleaf mountain mahogany and black sagebrush are the most common understory shrubs. Commonly occurring grasses include cheatgrass, Indian ricegrass, James galleta and needle-and-thread. Other 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 (35-55%) 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	90	140	179
Grass/Grasslike	90	112	146
Shrub/Vine	56	84	112
Forb	45	56	67
Total	281	392	504

Table 10. Ground cover

Tree foliar cover	20-25%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-55%

Community 2.2

Closed Canopy- Utah Juniper, Two-Needle Pinyon Invasive Species Community Phase.

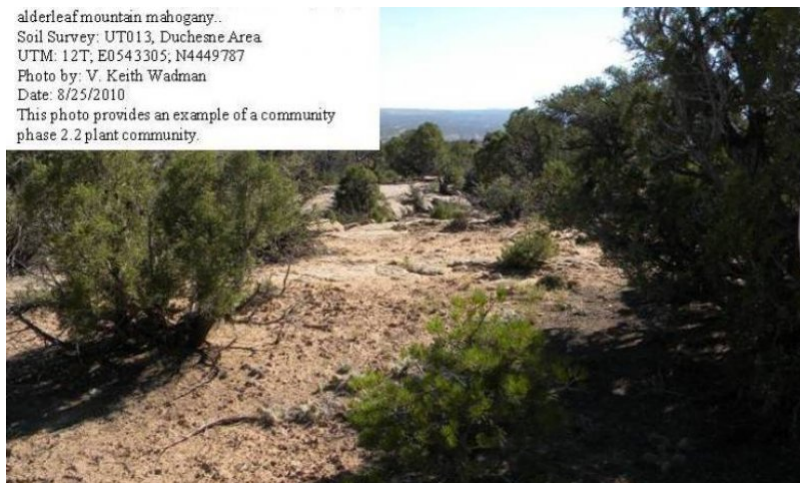


Figure 9. Community Phase 2.2

This community phase is characterized by a closed canopy of Utah juniper and two-needle pinyon. Alderleaf mountain mahogany and black sagebrush are the most common understory shrubs. Commonly occurring grasses and grasslikes include cheatgrass, Indian ricegrass, James galleta and needle-and-thread. Other grasses, shrubs, and forbs are also often present. Air dry composition of this site is approximately 5 percent forbs, 10 percent grasses, and 85 percent shrubs and trees. Bare ground is variable (35-55%) 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	146	185	224
Shrub/Vine	56	84	112
Grass/Grasslike	34	67	101
Forb	45	56	67
Total	281	392	504

Table 12. Ground cover

Tree foliar cover	25-30%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-55%

Pathway 2.1A Community 2.1 to 2.2



**Open Canopy- Utah Juniper,
Two-Needle Pinyon Invasive
Species Community Phase**



**Closed Canopy- Utah Juniper,
Two-Needle Pinyon 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- Utah Juniper,
Two-Needle Pinyon Invasive
Species Community Phase.**



**Open Canopy- Utah Juniper,
Two-Needle Pinyon 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/Seeded State

This state occurs when the site is chained to remove Utah juniper and two-needle pinyon trees. Following the chaining this area may or may not be burned and then seeded to native or introduced species such as Indian ricegrass or 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 Utah juniper and two-needle pinyon are chained or burned. This action releases understory species, allowing them to increase. Alder mountain mahogany and black sagebrush, 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, James galleta and needle-and-thread 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 either native or introduced species with Indian ricegrass and crested 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)
Grass/Grasslike	112	157	202
Shrub/Vine	56	84	112
Tree	22	56	90
Forb	45	56	67
Total	235	353	471

Table 14. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	20-25%
Grass/grasslike foliar cover	20-30%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-10%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-45%

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 (%)
Grass/Grasslike					
1	Dominant Grasses			84–140	
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	34–67	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	34–67	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	22–45	–
2	Sub-Dominant Grasses			34–67	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–22	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	11–22	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–22	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	11–22	–
Forb					

3	Forbs			67–101	
	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>Petradoria 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	–
Shrub/Vine					
4	Dominant Shrubs			90–135	
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	56–90	–
	black sagebrush	ARNO4	<i>Artemisia nova</i>	34–67	–
5	Sub-Dominant Shrubs			45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra</i> ssp. <i>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	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</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	–
Tree					
6	Dominant Trees			90–135	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	90–140	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	34–56	–

Table 16. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Dominant Grasses			56–84	

	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	22–45	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	22–45	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	17–34	–
2	Sub-Dominant Grasses			34–67	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–22	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	11–22	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–22	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	11–22	–
Forb					
3	Forbs			67–101	
	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>Petradoria 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	–
Shrub/Vine					
4	Dominant Shrubs			90–135	
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	56–90	–
	black sagebrush	ARNO4	<i>Artemisia nova</i>	34–67	–
5	Sub-Dominant Shrubs			45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra</i> ssp. <i>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	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</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	–
Tree					
6	Dominant Trees			135–224	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	112–196	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	56–84	–

Table 17. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Dominant Grasses			84–140	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	34–67	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	34–67	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	22–45	–
2	Sub-Dominant Grasses			34–67	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	22–45	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</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	–
Forb					
3	Forbs			67–101	
	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	–
	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>Petradoria 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>Platyschukhria integrifolia</i>	11–22	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	11–22	–
	Russian thistle	SAKA	<i>Salsola kali</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	–
Shrub/Vine					
4	Dominant Shrubs			90–135	
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	56–90	–
	black sagebrush	ARNO4	<i>Artemisia nova</i>	34–67	–
5	Sub-Dominant Shrubs			45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra</i> ssp. <i>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	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</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	–
Tree					
6	Dominant Trees			90–135	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	90–140	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	34–56	–

Table 18. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Dominant Grasses			56–84	
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	22–45	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	22–45	–
	cheatgrass	BRTE	<i>Bromus tectorum</i>	22–45	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	17–34	–
2	Sub-Dominant Grasses			34–67	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–22	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</i>	11–22	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	11–22	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	11–22	–
Forb					
3	Forbs			67–101	
	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	–
	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>Petradoria 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	–
	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	–
Shrub/Vine					
4	Dominant Shrubs			90–135	
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	56–90	–
	black sagebrush	ARNO4	<i>Artemisia nova</i>	34–67	–
5	Sub-Dominant Shrubs			45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra</i> ssp. <i>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	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</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	–
Tree					
6	Dominant Trees			135–224	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	112–196	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	56–84	–

Table 19. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Dominant Grasses			224–280	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	56–224	–
	crested wheatgrass	AGCR	<i>Agropyron cristatum</i>	0–168	–
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	34–67	–

	needle and thread	HECO26	<i>Hesperostipa comata</i>	22–45	–
2	Sub-Dominant Grasses			34–67	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	45–90	–
	Geyer's sedge	CAGE2	<i>Carex geyeri</i>	11–22	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	11–22	–
	saline wildrye	LESA4	<i>Leymus salinus</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	–
Forb					
3	Forbs			67–101	
	desert madwort	ALDE	<i>Alyssum desertorum</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	–
	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>Petradoria 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	–
	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	–
Shrub/Vine					
4	Dominant Shrubs			90–135	
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	56–90	–
	black sagebrush	ARNO4	<i>Artemisia nova</i>	34–67	–
5	Sub-Dominant Shrubs			45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	22–34	–
	blue elderberry	SANIC5	<i>Sambucus nigra</i> ssp. <i>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	–
	slender buckwheat	ERMI4	<i>Eriogonum microthecum</i>	11–22	–
	spiny hopsage	GRSP	<i>Gravia spinosa</i>	11–22	–

	Spring heparage	Shrub	Grass	Tree	
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	11–22	–
	Mexican cliffrose	PUME	<i>Purshia mexicana</i>	11–22	–
Tree					
6	Dominant Trees			22–67	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	17–34	–
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	17–28	–

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 Utah juniper and two-needle pinyon with an understory of perennial grasses, with Indian ricegrass, James galleta, and needle-and-thread occurring most often. Shrubs, including black sagebrush and alderleaf mountain mahogany 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.

Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. All soils with a depth to a water impermeable layer less than 50 centimeters [20 inches]. In this case the shallow soil over bedrock puts this ESD in group D. The runoff curve numbers are 80 to 89 depending on the overall watershed condition. 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. (NRCS National Engineering Handbook). In areas similar to the reference state where ground cover is adequate, infiltration is increased and runoff potential is decreased. In areas where ground cover is less, infiltration is reduced and runoff potential is increased.

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, alysium 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.

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Contributors

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Approval

Kirt Walstad, 3/05/2022

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	02/08/2008
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills may form immediately following large storm events but should not persist more than one or two winters. There should be very few on slopes <6%. On slopes >6%, rills may be 5-10 feet in length. Rills are most likely to form below adjacent exposed bedrock or water flow patterns where sufficient water accumulates to cause erosion.

2. **Presence of water flow patterns:** None to few. If present, they should be short (3-6') on slopes <6%, increasing in frequency and length (up to 5-10') with slope. waterflow patterns located below exposed bedrock should be narrow (<1-1½') but may be long. They should be widely spaced (15-20 yds) on slopes <6%, increasing in frequency (every 10-15yds) with slope. Waterflow patterns should dissipate where the slope flattens.

3. **Number and height of erosional pedestals or terracettes:** Occasional terracettes may be associated with accumulation behind woody Utah juniper litter. Well developed biological crusts may appear pedestalled, but are actually a characteristic of the crust formation.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 35-55%, in non-bedrock areas. Some bare ground is associated with water flow patterns. Areas with well developed biological soil crusts should not be counted as bare ground. Areas with 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. Bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

5. **Number of gullies and erosion associated with gullies:** No active gullies. Some stable gullies may be present in landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such gully development is expected to be limited to slopes exceeding 15%. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation and biological soil crusts.

6. **Extent of wind scoured, blowouts and/or depositional areas:** There should be very little evidence of active wind scoured, blowout or depositional areas. Wind caused deposition found at the base of shrubs and trees should be stabilized by biological soil crusts or litter.

7. **Amount of litter movement (describe size and distance expected to travel):** There may be movement of fine litter outside of the stable waterflow patterns of up to 2-4' on slopes <6% and 5-10' on steeper slopes . Fine litter may be redistributed in the stable waterflow patterns following large storm events, depositing where the slope flattens or behind obstructions. Woody litter should not move from beneath the plant.

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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 4-5 throughout the site. Surface texture varies from fine sandy loams to channery sandy loams.
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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface (A horizon) is 0 to 2 inches deep. Structure is weak fine blocky parting to single grain. Color is brown (7.5YR5/4 or 4/4). The A horizon would be expected to be more strongly developed under plant canopies. It is important, if you are sampling, to observe the A horizon under plant canopies as well as the interspaces. 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:** Distribution of vascular plants and/or biological soil crusts (where present) intercept raindrops preventing, but not eliminating, reduction of infiltration due to physical crusting. Plants and/or biological soil crusts usually have sufficient cover to slow runoff allowing time for infiltration. Shrubs, trees, and perennial grasses and associated plant litter provide barriers to flow.
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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 4 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: Biological soil crusts* codominate with trees (e.g. Utah juniper) and non-sprouting, drought-deciduous shrubs (e.g. alderleaf mountain mahogany, black sagebrush). Black sagebrush cover declines relative to tree cover in areas with more rock outcrop.
- Sub-dominant: Cool-season bunchgrasses (e.g. Indian ricegrass), Warm-season bunchgrasses (e.g. Galleta). Non-drought-deciduous shrubs.
- Other: Annual and perennial forbs.
- Perennial and annual 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 wildlife use of the palatable dominant shrubs and forbs; drought and insects (though these have minimal direct impacts on the dominant plants). Factors contributing to spatial variability include texture, depth and coarse fragment content, slope, aspect, and degree of topographic heterogeneity which may contributing to water redistribution and concentration.
- Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state.

*Biological soil crusts are an important component on many soils of this ecological site except on very fine textured surfaces (clay loams) and where rock fragment cover is high. At least 1/4 of the soil surface not protected by plant litter or rock should support lichens, mosses or dark cyanobacterial crusts.

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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 perennial vegetation may die. Individual bunchgrass and shrub mortality may occur during these severe droughts, particularly on the shallower and coarser soils associated with this site. Because woody stems may persist for many years, Utah juniper (especially older trees) and black sagebrush 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) of the non-bedrock areas, nearly all of which should be fine litter. Depth should be 1 leaf thickness in the interspaces, up to ¼" under shrub canopies and 1½" under trees. Litter cover may increase up to 30% immediately following leaf drop. Litter redistribution following natural extreme runoff events can reduce litter cover by concentrating it in low-lying areas. Litter cover may increase to 20-30% followings seasons with high production of annuals.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 250-450 #/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:** Cheatgrass, Russian thistle, alyssum and other introduced annual forbs have potential.
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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. Blackbrush reproduction is naturally very episodic and no young plants may be apparent.
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