USDA Natural Resources Conservation Service

Ecological site F048AY330UT
Upland Shallow Stony Loam (Two-Needle Pinyon /Douglas Fir)

Last updated: 3/05/2024
Accessed: 05/03/2024

General information

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

MLRA notes

Major Land Resource Area (MLRA): 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.

LRU notes

This ecological site occurs in the Uintah Basin Section of the Southern Rocky Mountain Provence which extends westward into Utah. Mountains in this area are mostly crustal uplifts that formed in the Cretaceous and Tertiary periods. Alluvial fans at the base of these mountains are recharge zones for local aquifers.

Ecological site concept

This site developed under the Uintah Basin Section of the Southern Rocky Mountain Provence ecological conditions and the natural influences of herbivory, fire and climate. This ecological site typically occurs on hills, mountain slopes, and dissected plateaus, on shallow soils over sandstone and/or shale bedrock. Species composition is generally dominated by an overstory canopy of two-needle pinyon and Douglas fir.

Associated sites

R048AY322UT	**Upland Shallow Loam (Two-Needle Pinyon / Utah Juniper)**
R048AY366UT	**Upland Very Steep Loam (Salina Wildrye)**
R048AY443UT	**Mountain Shallow Loam (Mixed Conifer)**

Similar sites

R048AY322UT	**Upland Shallow Loam (Two-Needle Pinyon / Utah Juniper)**

Table 1. Dominant plant species

Tree	(1) *Pinus edulis* (2) *Pseudotsuga menziesii*
Shrub	(1) *Cercocarpus montanus*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Carex geyeri*

Physiographic features

This ecological site typically occurs on hills, mountain slopes, and dissected plateaus. Slope, aspect and elevation influence the vegetative floristics of this ecological site. Sites are located from 6,000 to over 8,500 feet in elevation. Slopes normally range from 2 to 55 percent but may ccasionally be steeper.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain slope (3) Plateau
Flooding frequency	None
Ponding frequency	None
Elevation	6,000–8,500 ft
Slope	2–55%
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 15 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 (average)	116 days
Freeze-free period (average)	142 days
Precipitation total (average)	15 in

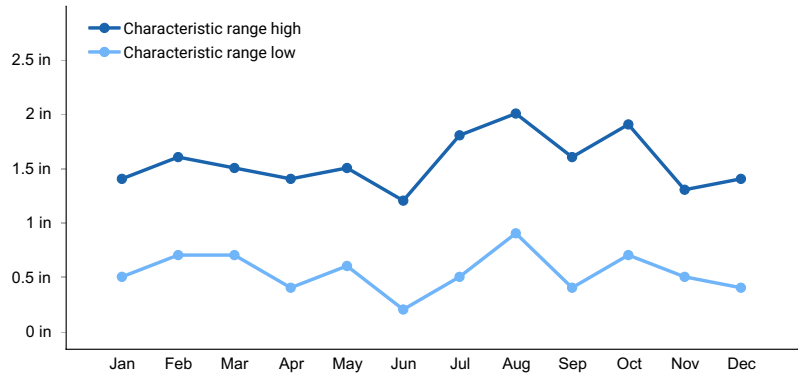


Figure 1. Monthly precipitation range

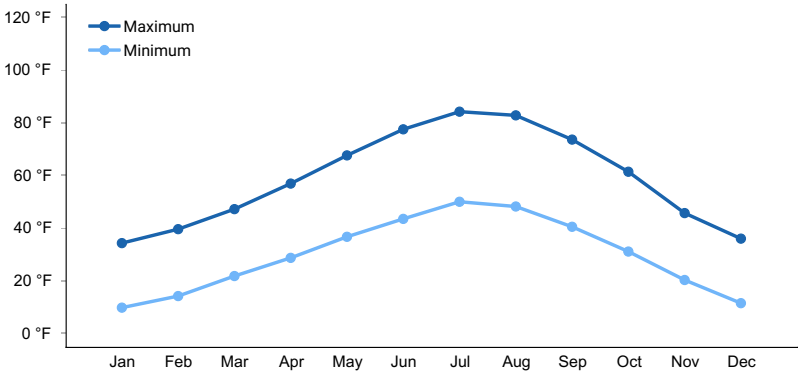


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

There are no influencing water features on this site.

Soil features

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

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

UT013—Duchesne: Jagon, Toddhill, Tyzut.
UT653-Uintah and Ouray Indian Reservation: Jagon, Toddhill, Tyzut.

Typical Soil Profile: (Tyzut).
A—0-4 inches; very channery silt loam; moderately alkaline.
Bk1—4-7 inches; channery silt loam; slightly effervescent; disseminated calconates; moderately alkaline.
Bk2-7-11 inches; extremely channery loam; strongly effervescent; disseminated calconates; moderately alkaline.
Bk3-11-17 inches; extremely channery loam; violently effervescent; disseminated calconates; moderately alkaline.
R—17 inches; unweathered sandstone bedrock.

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and shale (2) Eolian deposits–calcareous sandstone
Surface texture	(1) Very channery fine sandy loam (2) Channery fine sandy loam (3) Channery loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	10–20 in
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	25–50%
Available water capacity (Depth not specified)	0.8–2.1 in
Calcium carbonate equivalent (Depth not specified)	0–30%
Electrical conductivity (Depth not specified)	0–12 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	6.6–8.6
Subsurface fragment volume <=3" (Depth not specified)	1–20%
Subsurface fragment volume >3" (Depth not specified)	9–17%

Ecological dynamics

This site developed under the Uintah Basin Section of the Southern Rocky Mountain Provence 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 Douglas fir. Alderleaf mountain mahogany dominates the shrub layer with lesser amounts Utah serviceberry and mountian snowberry commonly present. Perennial herbaceous species occurrence is directly related to canopy density with bluebunch wheatgrass, Salina wildyre and geyer sedge found

most often.

Evidence indicates that this site historically maintained a fairly long burn cycle (100 years or more). Very old Douglas fir 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.

The Douglas fir on this site appear to be self sustaining with young seedlings and saplings found in most understories. Growth rate is very slow with a typical tree of 60 feet in height being well over 200 years old. Where old trees have been harvested, younger growth is slowly replacing them.

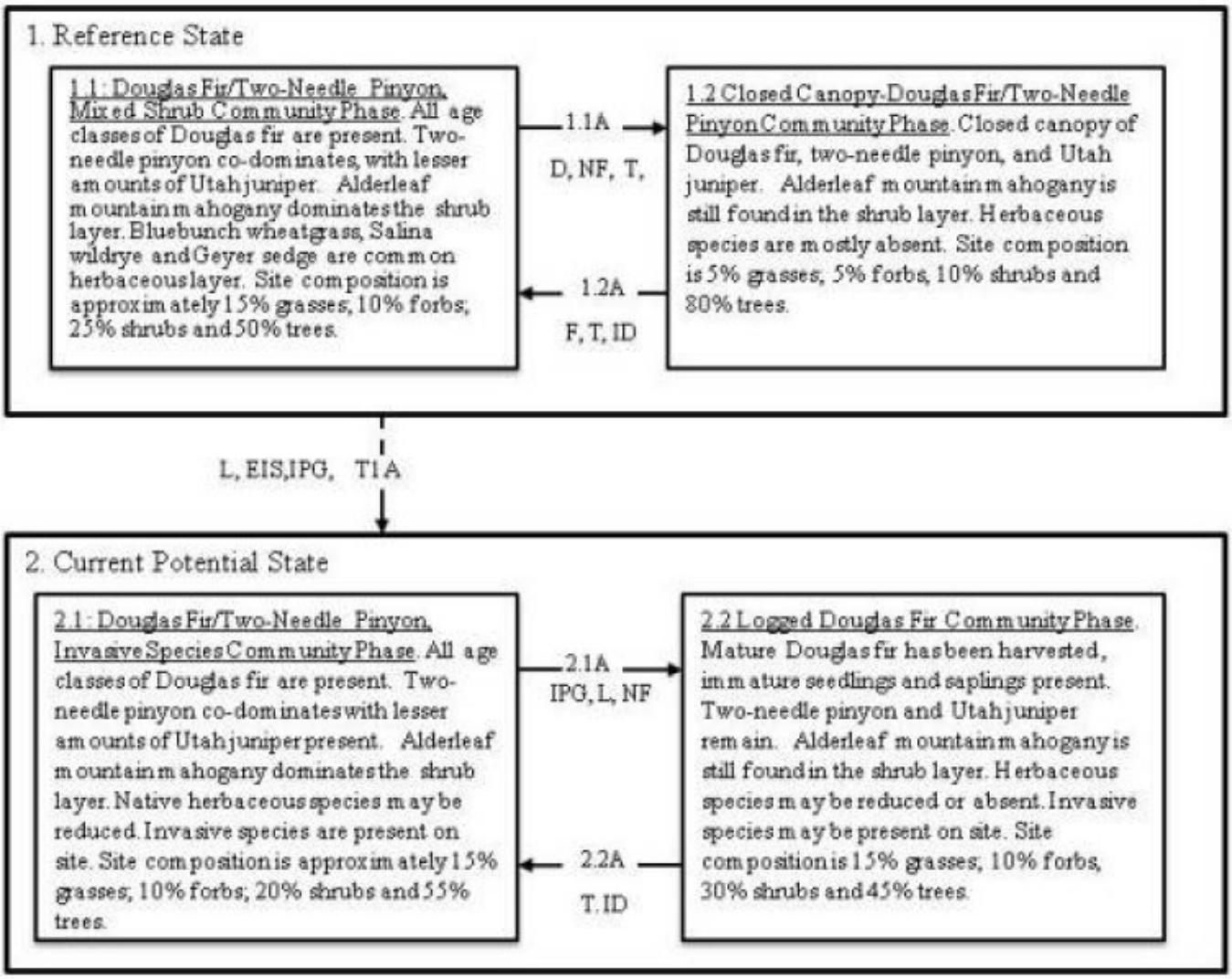
Severe drought and insect damage can affect two-needle pinyon in some locations, causing it to die out. This event can allow for an increase in shrubs and herbaceous species during periods when wetter years return.

As vegetative communities respond to changes caused by natural or manmade events that cause them to cross ecological thresholds, a return to previous state may not be possible. The amount of effort needed to affect desired vegetative shifts depends on a site's 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.
R048AY330UT – Upland Shallow Stony Loam (Douglas Fir, Two-Needle Pinyon).



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.
L=Logging

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 Douglas fir. Two-needle-pinyon often acts as a co-dominate species, lesser amounts of Utah juniper may also be present. All age classes of Douglas fir are present in the reference state. Alderleaf mountain mahogany is the dominate shrub species. Bluebunch wheatgrass, Salina wildrye and Geyer sedge are the most common grass or grasslike species. Other native grasses, forbs, and shrubs may produce significant composition in the plant community. The primary disturbance mechanisms are overstory canopy density, weather fluctuations, and fire or lack of 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 naturally 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 Douglas fir, two-needle pinyon, Utah juniper and alderleaf mountain mahogany. The density of the overstory canopy determines the amount and composition of the other native perennial grasses, grasslikes and forbs that may be present. Feedbacks: Natural fluctuations in weather patterns that allow for a self sustaining Douglas fir, two-needle pinyon, Utah juniper, alderleaf mountain mahogany and native grass and grasslike 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
Douglas Fir, Two-needle Pinyon, Mixed Shrub Community Phase.

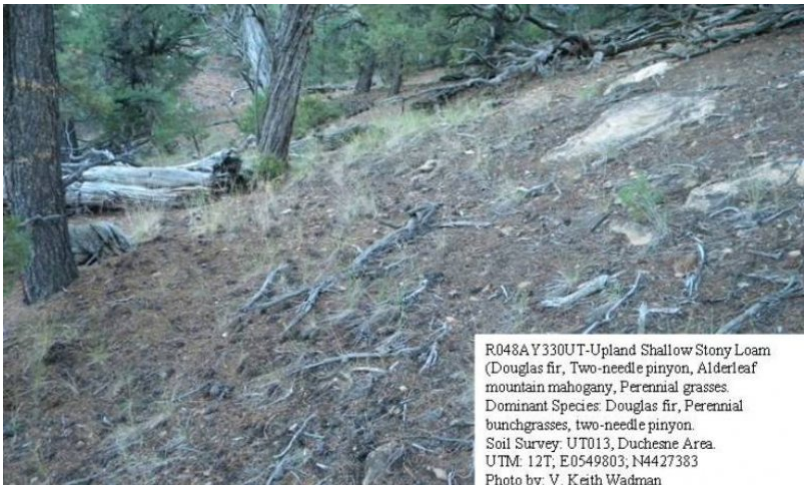


Figure 3. Community Phase 1.1

This community phase is characterized by an overstory canopy of Douglas fir and two-needle pinyon, lesser amounts of Utah juniper are also present. Alderleaf mountain mahogany, Utah serviceberry and mountain snowberry are the most common understory shrubs. Commonly occurring grasses and grasslikes include bluebunch wheatgrass, Salina wildrye and Geyer sedge. Other perennial grasses, shrubs, and forbs are also often present. Air dry composition of this site is approximately 15 percent grasses, 10 percent forbs, 25 percent shrubs and 50 percent trees. Bare ground is variable (5-30%) depending on litter and biological crust cover, which are also variable (10-40%) and surface rock fragments (0-50%). 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	150	225	325
Shrub/Vine	125	150	175
Grass/Grasslike	75	100	150
Forb	50	75	100
Total	**400**	**550**	**750**

Table 6. Ground cover

Tree foliar cover	30-50%
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	5-15%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-40%

Community 1.2
Closed Canopy-Douglas Fir, Two-Needle Pinyon Community Phase.

Figure 5. Community Phase 1.2

This community phase is characterized by an dense overstory canopy of Douglas fir and two-needle pinyon, lesser amounts of Utah juniper are also present. Alderleaf mountain mahogany, Utah serviceberry and mountain snowberry are the most common understory shrubs. Grasses and grasslikes are much reduced or missing. There present they may include bluebunch wheatgrass, Salina wildrye and Geyer sedge. Other perennial grasses, shrubs, and forbs may also be present in small amounts. Air dry composition of this site is approximately 5 percent grasses, 5 percent forbs, 10 percent shrubs and 80 percent trees. Bare ground is variable (5-30%) depending on litter and biological crust cover, which are also variable (10-40%) and surface rock fragments (0-50%). 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	210	290	420
Shrub/Vine	100	125	150
Grass/Grasslike	50	75	100
Forb	40	60	80
Total	**400**	**550**	**750**

Table 8. Ground cover

Tree foliar cover	50-70%
Shrub/vine/liana foliar cover	15-20%
Grass/grasslike foliar cover	5-10%
Forb foliar cover	5-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-30%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	15-20%

Pathway 1.1A
Community 1.1 to 1.2

Douglas Fir, Two-needle Pinyon, Mixed Shrub Community Phase.

Closed Canopy-Douglas Fir, Two-Needle Pinyon Community Phase.

This community pathway occurs when long-term drought and/or extended periods without fire allows canopies of Douglas fir, 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-Douglas Fir, Two-Needle Pinyon Community Phase.

Douglas Fir, Two-needle Pinyon, Mixed Shrub Community Phase.

This community pathway occurs when weather patterns return to within normal ranges and fire reduces or removes Douglas fir, 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 describes the biotic communities that may become established on this ecological site if all successional sequences are completed under natural disturbance conditions. The current potential state is generally dominated by an overstory canopy of Douglas fir where logging has not occurred. Two-needle-pinyon often acts as a co-dominate species, lesser amounts of Utah juniper may also be present. All age classes of Douglas fir are present in the non-logged current potential state. Alderleaf mountain mahogany is the dominate shrub species. Bluebunch wheatgrass, Salina wildrye, cheatgrass and Geyer sedge are the most common grass or grasslike species. Other introduced and native grasses, forbs, and shrubs may produce significant composition in the plant community. The primary disturbance mechanisms are overstory canopy density, weather fluctuations, livestock grazing use, logging and fire or lack of fire. The current potential state is still self sustaining but has a lower resistant to change due to a reduced resistance to disturbances. When disturbances do occur, the rate of recovery can be highly variable. Current Potential State: Plant communities influenced by livestock grazing, logging, wildlife browsing, insect herbivory, weather fluctuations, fire periods and surface disturbances. Indicators: A community dominated by Douglas fir, two-needle pinyon, Utah juniper and alderleaf mountain mahogany. The density of the overstory canopy determines the amount and composition of the other introduced and native grasses, grasslikes and forbs that may be present. Feedbacks: Natural fluctuations in weather patterns that allow for a self sustaining Douglas fir, two-needle pinyon, Utah juniper, alderleaf mountain mahogany and native grass and grasslike community. Insect herbivory, more frequent fires, or other disturbances that may allow for the increase 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.

Community 2.1
Douglas Fir, Two-needle Pinyon, Invasive Species Community Phase.

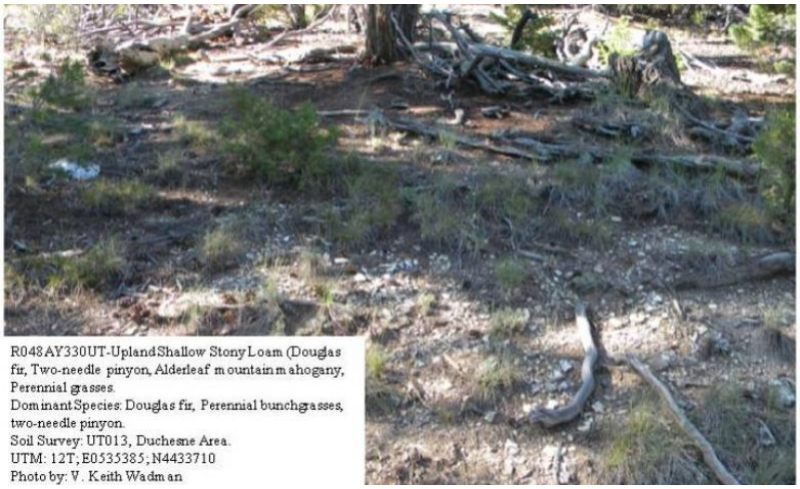


Figure 7. Community Phase 2.1

This community phase is characterized by an overstory canopy of Douglas fir and two-needle pinyon, lesser amounts of Utah juniper are also present. Alderleaf mountain mahogany, Utah serviceberry and mountain snowberry are the most common understory shrubs. Invasive species are now present in the understory community. Commonly occurring grasses and grasslikes include bluebunch wheatgrass, Salina wildrye cheatgrass and Geyer sedge. Other annual and perennial grasses, shrubs, and forbs may also be present. Air dry composition of this site is approximately 15 percent grasses, 10 percent forbs, 20 percent shrubs and 55 percent trees. Bare ground is variable (5-30%) depending on litter and biological crust cover, which are also variable (10-40%) and surface rock fragments (0-50%). 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	150	225	325
Shrub/Vine	125	150	175
Grass/Grasslike	75	100	150
Forb	50	75	100
Total	**400**	**550**	**750**

Table 10. Ground cover

Tree foliar cover	30-50%
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	5-15%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-40%

Community 2.2
Logged Douglas Fir Community Phase.

Figure 9. Community Phase 2.2

This community phase occurs when the mature Douglas fir and, at times, two-needle pinyon are harvested from the site. Immature trees of both species are still present, as well as, any Utah juniper found on the site. Alderleaf mountain mahogany, Utah serviceberry and mountain snowberry are the most common understory shrubs. Invasive species are present in the understory community and may increase following logging. Commonly occurring grasses and grasslikes include bluebunch wheatgrass, Salina wildrye cheatgrass and Geyer sedge. Other annual and perennial grasses, shrubs, and forbs may also be present. Air dry composition of this site is approximately 15 percent grasses, 10 percent forbs, 30 percent shrubs and 45 percent trees. Bare ground is variable (5-30%)

depending on litter and biological crust cover, which are also variable (10-40%) and surface rock fragments (0-50%). 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.

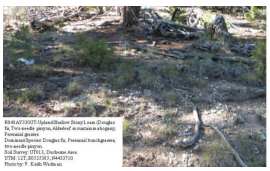
Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Tree	100	175	275
Shrub/Vine	175	200	225
Grass/Grasslike	75	100	150
Forb	50	75	100
Total	**400**	**550**	**750**

Table 12. Ground cover

Tree foliar cover	20-30%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	15-20%
Forb foliar cover	10-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	10-25%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-50%

Pathway 2.1A
Community 2.1 to 2.2



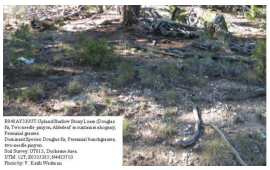
Douglas Fir, Two-needle Pinyon, Invasive Species Community Phase.

Logged Douglas Fir Community Phase.

This community pathway occurs when the site is logged, removing mature Douglas fir and,at times, two-needle pinyon. This harvest when in combination with improper livestock grazing and/or the lack fire can cause the understory vegetation to be highly variable. Under some circumstances understory vegetation can be reduced or nearly eliminated from the site.

Pathway 2.2A
Community 2.2 to 2.1

Logged Douglas Fir Community Phase.



Douglas Fir, Two-needle Pinyon, Invasive Species Community Phase.

This community pathway occurs when time combined with normal weather patterns allow Douglas fir and two-needle pinyon slowly increase, eventually restoring their dominance in the community. Insect damage on two-needle pinyon can slow its recovery on this site.

Transition T1A
State 1 to 2

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

Additional community tables

Table 13. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grass/Grasslikes**			50–75	
	saline wildrye	LESA4	*Leymus salinus*	40–60	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	40–60	–
	Geyer's sedge	CAGE2	*Carex geyeri*	20–40	–
2	**Sub-Dominant**			30–60	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	10–20	–
	blue grama	BOGR2	*Bouteloua gracilis*	10–20	–
	squirreltail	ELEL5	*Elymus elymoides*	10–20	–
	James' galleta	PLJA	*Pleuraphis jamesii*	10–20	–
	muttongrass	POFE	*Poa fendleriana*	10–20	–
	Sandberg bluegrass	POSE	*Poa secunda*	10–20	–
Forb					
3	**Forbs**			60–100	
	low pussytoes	ANDI2	*Antennaria dimorpha*	10–20	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	10–20	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	10–20	–
	aridland goosefoot	CHDE	*Chenopodium desiccatum*	10–20	–
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	10–20	–
	narrowstem cryptantha	CRGR3	*Cryptantha gracilis*	10–20	–
	roundspike cryptantha	CRHU2	*Cryptantha humilis*	10–20	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	10–20	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	10–20	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	10–20	–
	rock goldenrod	PEPU7	*Petradoria pumila*	10–20	

	rock goldenrod	PEPU7	*Petradoria pumila*	10–20	–
	Whipple's penstemon	PEWH	*Penstemon whippleanus*	10–20	–
	spiny phlox	PHHO	*Phlox hoodii*	10–20	–
	longleaf phlox	PHLO2	*Phlox longifolia*	10–20	–
	basindaisy	PLIN7	*Platyschkuhria integrifolia*	10–20	–
	woolly plantain	PLPA2	*Plantago patagonica*	10–20	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	10–20	–
	longstalk clover	TRLO	*Trifolium longipes*	10–20	–
	American vetch	VIAM	*Vicia americana*	10–20	–
Shrub/Vine					
4	**Dominant Shrubs**			80–120	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	80–120	–
5	**Sub-Dominant Shrubs**			60–100	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	20–30	–
	blue elderberry	SANIC5	*Sambucus nigra ssp. cerulea*	10–20	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	10–20	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	10–20	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	10–20	–
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	10–20	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	10–20	–
	mormon tea	EPVI	*Ephedra viridis*	10–20	–
	bastardsage	ERWR	*Eriogonum wrightii*	10–20	–
	spiny hopsage	GRSP	*Grayia spinosa*	10–20	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	10–20	–
	Mexican cliffrose	PUME	*Purshia mexicana*	10–20	–
Tree					
6	**Dominant Trees**			150–300	
	twoneedle pinyon	PIED	*Pinus edulis*	75–150	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	75–150	–
	Utah juniper	JUOS	*Juniperus osteosperma*	25–50	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	25–50	–

Table 14. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grass/Grasslikes**			30–60	
	saline wildrye	LESA4	*Leymus salinus*	20–40	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	20–40	–
	Geyer's sedge	CAGE2	*Carex geyeri*	10–20	–
2	**Sub-Dominant Grasses/Grasslikes**			20–40	
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	5–10	–
	blue grama	BOGR2	*Bouteloua gracilis*	5–10	–
	squirreltail	ELEL5	*Elymus elymoides*	5–10	

	squirreltail	ELELJ	*Elymus elymoides*	5–10	–
	James' galleta	PLJA	*Pleuraphis jamesii*	5–10	–
	muttongrass	POFE	*Poa fendleriana*	5–10	–
	Sandberg bluegrass	POSE	*Poa secunda*	5–10	–
Forb					
3	**Forbs**			40–80	
	low pussytoes	ANDI2	*Antennaria dimorpha*	5–10	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	5–10	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	5–10	–
	aridland goosefoot	CHDE	*Chenopodium desiccatum*	5–10	–
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	5–10	–
	narrowstem cryptantha	CRGR3	*Cryptantha gracilis*	5–10	–
	roundspike cryptantha	CRHU2	*Cryptantha humilis*	5–10	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	5–10	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	5–10	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	5–10	–
	rock goldenrod	PEPU7	*Petradoria pumila*	5–10	–
	Whipple's penstemon	PEWH	*Penstemon whippleanus*	5–10	–
	spiny phlox	PHHO	*Phlox hoodii*	5–10	–
	longleaf phlox	PHLO2	*Phlox longifolia*	5–10	–
	basindaisy	PLIN7	*Platyschkuhria integrifolia*	5–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	5–10	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	5–10	–
	longstalk clover	TRLO	*Trifolium longipes*	5–10	–
	American vetch	VIAM	*Vicia americana*	5–10	–
Shrub/Vine					
4	**Dominant Shrub**			60–80	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	60–80	–
5	**Sub-Dominant Shrubs**			40–80	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	5–10	–
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	5–10	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	5–10	–
	mormon tea	EPVI	*Ephedra viridis*	5–10	–
	bastardsage	ERWR	*Eriogonum wrightii*	5–10	–
	spiny hopsage	GRSP	*Grayia spinosa*	5–10	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–10	–
	Mexican cliffrose	PUME	*Purshia mexicana*	5–10	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	5–10	–
	blue elderberry	SANIC5	*Sambucus nigra ssp. cerulea*	5–10	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	5–10	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	5–10	–
Tree					
6	**Dominant Trees**			250–400	

	twoneedle pinyon	PIED	*Pinus edulis*	125–200	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	125–200	–
	Utah juniper	JUOS	*Juniperus osteosperma*	50–75	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	50–75	–

Table 15. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grass/Grasslikes**			50–75	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	40–60	–
	Geyer's sedge	CAGE2	*Carex geyeri*	20–40	–
	saline wildrye	LESA4	*Leymus salinus*	20–40	–
2	**Sub-Domanent Grasses/Grasslikes**			30–60	
	cheatgrass	BRTE	*Bromus tectorum*	60–90	–
	squirreltail	ELEL5	*Elymus elymoides*	10–20	–
	James' galleta	PLJA	*Pleuraphis jamesii*	10–20	–
	muttongrass	POFE	*Poa fendleriana*	10–20	–
	Sandberg bluegrass	POSE	*Poa secunda*	10–20	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	10–20	–
	blue grama	BOGR2	*Bouteloua gracilis*	10–20	–
Forb					
3	**Forbs**			60–100	
	desert madwort	ALDE	*Alyssum desertorum*	10–20	–
	annual ragweed	AMAR2	*Ambrosia artemisiifolia*	10–20	–
	low pussytoes	ANDI2	*Antennaria dimorpha*	10–20	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	10–20	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	10–20	–
	aridland goosefoot	CHDE	*Chenopodium desiccatum*	10–20	–
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	10–20	–
	narrowstem cryptantha	CRGR3	*Cryptantha gracilis*	10–20	–
	roundspike cryptantha	CRHU2	*Cryptantha humilis*	10–20	–
	herb sophia	DESO2	*Descurainia sophia*	10–20	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	10–20	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	10–20	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	10–20	–
	rock goldenrod	PEPU7	*Petradoria pumila*	10–20	–
	Whipple's penstemon	PEWH	*Penstemon whippleanus*	10–20	–
	spiny phlox	PHHO	*Phlox hoodii*	10–20	–
	longleaf phlox	PHLO2	*Phlox longifolia*	10–20	–
	basindaisy	PLIN7	*Platyschkuhria integrifolia*	10–20	–
	woolly plantain	PLPA2	*Plantago patagonica*	10–20	–
	Russian thistle	SAKA	*Salsola kali*	10–20	–
	tall tumblemustard	SIAL2	*Sisymbrium altissimum*	10–20	–

	stemless mock goldenweed	STAC	*Stenotus acaulis*	10–20	–
	longstalk clover	TRLO	*Trifolium longipes*	10–20	–
	American vetch	VIAM	*Vicia americana*	10–20	–
Shrub/Vine					
4	**Dominant Shrub**			80–120	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	80–120	–
5	**Sub-Dominant Shrubs**			60–100	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	20–40	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	20–40	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	20–30	–
	blue elderberry	SANIC5	*Sambucus nigra ssp. cerulea*	10–20	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	10–20	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	10–20	–
	Mexican cliffrose	PUME	*Purshia mexicana*	10–20	–
	bastardsage	ERWR	*Eriogonum wrightii*	10–20	–
	spiny hopsage	GRSP	*Grayia spinosa*	10–20	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	10–20	–
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	10–20	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	10–20	–
	mormon tea	EPVI	*Ephedra viridis*	10–20	–
Tree					
6	**Dominant Trees**			150–300	
	twoneedle pinyon	PIED	*Pinus edulis*	75–150	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	75–150	–
	Utah juniper	JUOS	*Juniperus osteosperma*	25–50	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	25–50	–

Table 16. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grass/Grasslikes**			60–100	
	Geyer's sedge	CAGE2	*Carex geyeri*	20–40	–
	saline wildrye	LESA4	*Leymus salinus*	20–40	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	20–40	–
2	**Sub-Dominant Grass/Grasslikes**			30–60	
	cheatgrass	BRTE	*Bromus tectorum*	30–90	–
	squirreltail	ELEL5	*Elymus elymoides*	0–10	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–10	–
	muttongrass	POFE	*Poa fendleriana*	0–10	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–10	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	0–10	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–10	–

Forb					
3	**Forbs**			60–100	
	Russian thistle	SAKA	*Salsola kali*	10–20	–
	tall tumblemustard	SIAL2	*Sisymbrium altissimum*	5–10	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	5–10	–
	longstalk clover	TRLO	*Trifolium longipes*	5–10	–
	American vetch	VIAM	*Vicia americana*	5–10	–
	desert madwort	ALDE	*Alyssum desertorum*	5–10	–
	low pussytoes	ANDI2	*Antennaria dimorpha*	5–10	–
	clasping arnica	ARAM2	*Arnica amplexicaulis*	5–10	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	5–10	–
	woollypod milkvetch	ASPU9	*Astragalus purshii*	5–10	–
	aridland goosefoot	CHDE	*Chenopodium desiccatum*	5–10	–
	Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	5–10	–
	narrowstem cryptantha	CRGR3	*Cryptantha gracilis*	5–10	–
	roundspike cryptantha	CRHU2	*Cryptantha humilis*	5–10	–
	herb sophia	DESO2	*Descurainia sophia*	5–10	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	5–10	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	5–10	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	5–10	–
	rock goldenrod	PEPU7	*Petradoria pumila*	5–10	–
	Whipple's penstemon	PEWH	*Penstemon whippleanus*	5–10	–
	spiny phlox	PHHO	*Phlox hoodii*	5–10	–
	longleaf phlox	PHLO2	*Phlox longifolia*	5–10	–
	basindaisy	PLIN7	*Platyschkuhria integrifolia*	5–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	5–10	–
Shrub/Vine					
4	**Shrubs**			80–120	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	80–120	–
5	**Sub-Dominant Shrubs**			60–100	
	basin big sagebrush	ARTRT	*Artemisia tridentata ssp. tridentata*	10–30	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	5–10	–
	mormon tea	EPVI	*Ephedra viridis*	5–10	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	5–10	–
	bastardsage	ERWR	*Eriogonum wrightii*	5–10	–
	spiny hopsage	GRSP	*Grayia spinosa*	5–10	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–10	–
	Mexican cliffrose	PUME	*Purshia mexicana*	5–10	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	5–10	–
	blue elderberry	SANIC5	*Sambucus nigra ssp. cerulea*	5–10	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	5–10	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	5–10	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	5–10	–

Tree					
6	**Dominant Trees**			100–175	
	twoneedle pinyon	PIED	*Pinus edulis*	75–100	–
	Douglas-fir	PSME	*Pseudotsuga menziesii*	50–75	–
	Utah juniper	JUOS	*Juniperus osteosperma*	50–75	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	50–75	–

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 Douglas fir, two-needle pinyon and Utah juniper with an understory of perennial grasses, with bluebunch wheatgrass, Salina wildrye, and Geyer sedge occurring most often. Shrubs, including birchleaf mountain mahogany, and Utah serviceberry 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 occurence 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 good opportunities for hiking and hunting. Trees can provide excellent 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

Douglas fir has a Site Index of 40 to 60 on this site and its wood can be can be harvested for many types of building materials. All age classes of fir trees are present in healthy communities but a return to a mature forest is very slow because of its slow growth habit. Two-needle pinyon and Utah juniper can provide firewood and fence posts 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 (indolizdine 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 Douglas fir, 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. These Douglas fir, 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.

Other references

Baily, R.G. 1995. Description of the ecoregions of the United Sates. Available http://www.fs.fed.us/land/ecosysmgmt/ecoreg1_home.html. Accessed February 27, 2008.

Belnap, J. and S.L. Phillips. 2001. Soil biota in an ungrazed grassland: response to annual grass (Bromus tectorum) invasion. Ecological Applications. 11:1261-1275

Chapin, S.F., B.H. Walker, R.J. Hobbs, D.U. Hooper, J.H. Lawton, O.E. Sala, and D. Tilman. 1997. Biotic control over the functioning of ecosystems. Science. 277:500-504

Cox R.D. and V.J. Anderson. 2004. Increasing native diversity of cheatgrass-dominated rangeland through assisted succession. Journal of Range Management. 57:203-210,

Howard, Janet L. 2003. Atriplex canescens. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/. Accessed on February 25, 2008.

Knight, A.P. and R.G. Walter. 2001. A guide to plant poisoning of animals in North America. Teton NewMedia. Jackson, WY.

National Engineering Handbook. US Department of Agriculture, Natural Resources Conservation Service. Available: http://www.info.usda.gov/CED/Default.cfm#National%20Engineering%20Handbook. Accessed February 25, 2008.

NRCS Grazing Lands Technology Institute. 2003. National Range and Pasture Handbook. Fort Worth, TX, USA: US Department of Agriculture, Natural Resources Conservation Service, 190-VI-NRPH.

Tilley, D.J. 2007. Reintroducing native plants to the American West. Aberdeen Plant Materials Center, Aberdeen, ID, USA: US Department of Agriculture. Available: http://plant-materials.nrcs.usda.gov/idpmc/publications.html. Accessed February 22, 2008.

Utah Climate Summaries. 2008. Available: http://www.wrcc.dri.edu/summary/climsmut.html. Accessed on February 25, 2008.

Utah Division of Wildlife Resources. 2007.
Woods, A.J., D.A. Lammers, S.A. Bryce, J.M. Omernik, R.L. Denton, M. Domeier, and J.A. Comstock. 2001. Ecoregions of Utah (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,175,000).

Contributors

Keith Wadman

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.

Author(s)/participant(s)	Robert Stager (BLM), F.E. Busby (USU), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS), adapted to this site by V. Keith Wadman, (NRCS Retired).
Contact for lead author	shane.green@ut.usda.gov
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).

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%).

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.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 30 – 50 %. (Soil surface is typically covered 0-50 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%.

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.

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.

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.

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.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface horizon is typically 4 inches deep. Structure is typically moderate thin platy parting to moderate very fine granular. Color is typically dark brown (10YR3/2). Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

---

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 Douglas fir-Pinyon-juniper canopy (beyond the reference state) reduces understory vegetation causing an associated increase in runoff.

---

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.

---

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 (Douglas fir/pinyon/juniper) > non-sprouting shrubs (birchleaf mountain mahogany)> cool season perennial grasses & grasslikes (bluebunch wheatgrass, Salina wildrye, Geyer sedge).

    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.

---

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, older trees will normally have dead stems within the plant canopy.

---

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.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 400-750 #/acre on an average year

---

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.

---

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