USDA Natural Resources Conservation Service

Ecological site R035XY236UT
Semidesert Shallow Sandy Loam (Utah Juniper, Blackbrush)

Accessed: 05/16/2024

General information

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

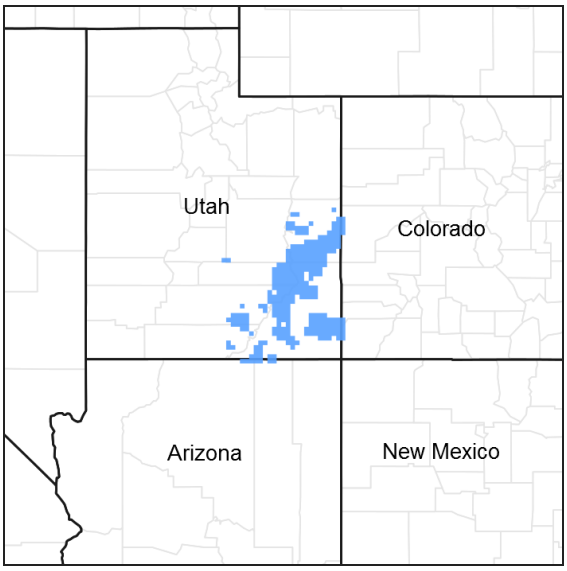


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 035X–Colorado Plateau

This ecological site occurs in the northern portion of MLRA 35, Colorado Plateau Province. It is found principally in the Canyon Lands and High Plateaus of Utah sections within that MLRA. This area has been stucturally uplifted over time while rivers flowing across it were cutting down into its bedrock. Areas of shale, sandstone, limestone, dolomite, and volcanic rock outcrop are found throughout the region.

Classification relationships

Modal Soil: Rizno — loamy, mixed (calc.), mesic Lithic Ustic Torriorthents

Type Location: Consult the San Juan Central Soil Survey

Associated sites

R035XY218UT	**Semidesert Sandy Loam (Blackbrush)**
R035XY230UT	**Semidesert Shallow Sandy Loam (Shadscale)**
R035XY233UT	**Semidesert Shallow Sandy Loam (Blackbrush)**

Similar sites

R035XY233UT	**Semidesert Shallow Sandy Loam (Blackbrush)**

Table 1. Dominant plant species

Tree	(1) *Juniperus osteosperma* (2) *Pinus edulis*
Shrub	(1) *Coleogyne ramosissima*
Herbaceous	(1) *Achnatherum hymenoides*

Physiographic features

This ecological site typically site occurs on foothills, structural benches, mesas, cuestas and hillslopes. Slope, aspect and elevation influence the vegetative floristics of this ecological site. Sites located between 4,600 to 5,800 feet in elevation are described in this description. Where this site is found above 5,800 feet, blackbrush decreases in dominance and Bigelow""s sagebrush increases. Also, sites having north aspects will support a higher amounts of Bigelow""s sagebrush and other shrubs with a relative decrease of blackbrush.

Table 2. Representative physiographic features

Landforms	(1) Cuesta (2) Structural bench (3) Mesa
Flooding frequency	None
Ponding frequency	None
Elevation	1,433–2,073 m
Slope	2–20%
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by hot summers and cool winters which can be slightly modified by local topographic conditions such as aspect. Large fluctuations in daily temperature are common. Mean annual high temperatures range from 63-71 degrees Fahrenheit and mean annual low temperatures range from 35-42 degrees Fahrenheit. Approximately 70-75% of moisture occurs as rain from October-March as convection thunderstorms and snow. Precipitation is variable from month to month and from year to year but averages between 8-12 inches. Snow packs are generally light and not persistent.

Frost Free Period (days) - Expected number of consecutive days where air temperature does not fall below 32 F.

Freeze Free Period (days) - Expected number of consecutive days where air temperature does not fall below 280 F.

Table 3. Representative climatic features

Frost-free period (average)	175 days
Freeze-free period (average)	204 days
Precipitation total (average)	305 mm

Influencing water features

There are no influencing water features.

Soil features

The soils on this site are very shallow to shallow and well to excessively drained. These soils are typically eolian deposits over residuum derived dominantly from sandstone and interbedded shale. The dry surface ranges from dark red to reddish brown and brown. These soils are poorly to moderately developed and runoff is low to high depending on slope. The soil temperature and moisture regimes are mesic and aridic respectively. Surface and sub-surface textures are generally fine sands, fine sandy loams, and loamy sands, which may have channery or gravelly modifiers. When rock fragments are present they generally show evidence of calcium carbonate deposits (small whiteish nodules). Soils are generally nonsaline and the water holding capacity is moderate. Soils occurring on reference state sites typically have low wind and water erosion potential due to biological crust cover which is characterized as a mosaic of lichen pinnacles or moss mounds. This site has been used in the following soils surveys and has been correlated to the following components:

UT624—Grand County—Rizno, Arches,
UT631—Henry Mountains—Rizno, Arches
UT633—Canyonlands Area—Rizno
UT638—San Juan County, Central—Rizno, Arches, Skos
UT643—San Juan County, Navajo Indian Reservation—Piute
UT646—Dixie National Forest—Rizno, Reef, Skos
UT651—Fishlake National Forest—Rizno Skos, Reef
UT685—Capital Reef National Park—Rizno, Moclom;
UT687—Arches National Park—Rizno, Arches, Reef
UT688—Canyonlands National Park—Arches, Reef
UT689—Glen Canyon National Recreation Area—Arches

Table 4. Representative soil features

Parent material	(1) Eolian deposits–sandstone (2) Residuum–sandstone and shale
Surface texture	(1) Fine sandy loam (2) Gravelly fine sandy loam (3) Fine sand
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	10–51 cm
Surface fragment cover <=3"	0–27%
Surface fragment cover >3"	0–3%
Available water capacity (0-101.6cm)	1.27–4.32 cm
Calcium carbonate equivalent (0-101.6cm)	0–40%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–22%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

This site developed under Colorado Plateau ecological conditions and the natural influences of herbivory and climate. Species composition is generally dominated by a sparse layer of Utah juniper and two-needle pinyon. Blackbrush, bigelow sagebrush, and Nevada jointfir are common shrub species. Perennial herbaceous species occurrence is highly variable with Indian ricegrass, needle-and-thread and Salina wildrye found most often. There is no evidence to indicate that this site historically maintained a short burn cycle. Until further research indicates that fire played a significant role in the ecosystem processes of this site, its State and Transition model will not include fire as a disturbance in the reference state.

Drought and insect damage appear to be the main driving factors in many pinyon/juniper communities. Betancourt et al. (1993), noted that pinyon and juniper woodlands in the southwest appear to be more susceptible to large die-offs during droughts, than at other locations. If a severe drought persists, two-needle pinyon being more susceptible to drought and insect damage than Utah juniper, appears to die out first, while the Utah juniper may survive. This event could allow for an increase in shrubs and herbaceous species during periods when wetter years return.

Pinyon/Juniper communities throughout the West have received a lot of attention because many areas have experienced increases in the spatial extent and density of the trees (Miller and Wigand, 1994). on this site, however, pinyon/juniper do not encroach and become dominant. Rather the blackbrush remains a major component of this site.

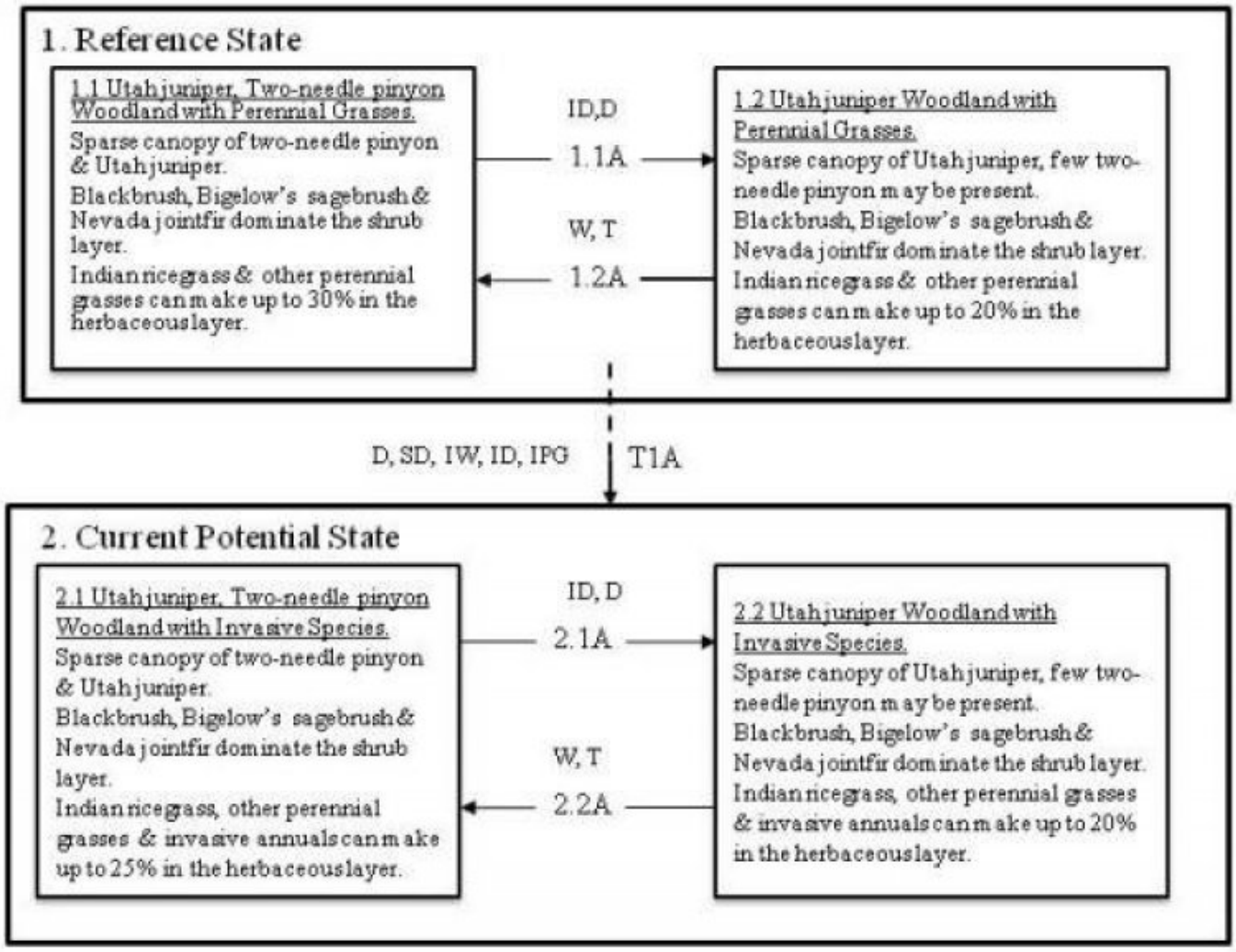
Disturbances that reduce the presence of blackbrush result in an opportunity for invasive annuals to enter into the system and may produce a fuel load for fire to become an ecological driver.

As vegetative communities respond to changes caused by natural occurrences that cause them to cross ecological thresholds, a return to previous states may not be possible without major energy inputs. The amount of energy input needed to affect desired vegetative shifts depends on the 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. Even though these plant communities may not represent every possibility, but they do show the most prevalent and repeatable. As more data are collected, some of these plant communities will be revised or removed, and new ones may be added. The main purpose for including any description of a plant community here is to 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-35- Colorado Plateau
R035XY236UT – Semidesert Shallow Sandy Loam (Utah juniper, Two-needle pinyon, Blackbrush).



Legend:
D = Drought.
W = Wet weather periods.
T = Time
ID = Insect Damage.
SD = Surface Disturbance.
IW = Invasive Weed Source.
IPG = Improper Livestock Grazing

State 1
Reference State

This community has dense diverse biological crusts where the soil has less than 30% surface rock. This state includes the biotic communities that become established on the ecological site if all successional sequences are completed under the natural disturbance regimes. The reference state is generally dominated by blackbrush, Utah juniper, and two-needle-pinyon, however, depending on disturbance history, native grasses, forbs, or other shrubs may occupy significant composition in the plant community. The primary disturbance mechanism is climate fluctuation. The reference state is self sustaining and resistant to change due to high resistance to natural

disturbances and high resilience following natural disturbances. When natural disturbances occur, the rate of recovery is variable. Typically, in the reference state this site will fluctuate between community phases 1.1 and 1.2; however once invasive plants establish, return to these community phases may not be possible. Reference State: Plant communities influenced by insect herbivory, and climate fluctuations. Indicators: A community dominated by Utah juniper and blackbrush where two-needle pinyon and native perennial grasses and forbs may also be present. Feedbacks: Natural fluctuations in weather that allow for a self sustaining Utah juniper-blackbrush and native grass community. Insect herbivory, more frequent fire, 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
Utah juniper, Two-needle pinyon Woodland with Perennial Grasses.

This community phase is characterized by a canopy of sparse Utah juniper, two-needle pinyon, and blackbrush. Commonly occurring grasses include Indian ricegrass, James galleta, needle-and-thread, and six weeks fescue. Other perennial grasses, shrubs, and forbs may also be present and cover is variable. Air dry composition of this site is approximately 10 percent forbs, 15 percent grasses, and 75 percent shrubs and trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-65%) and surface rock fragments (0-60%). 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)
Shrub/Vine	112	151	168
Tree	11	78	151
Grass/Grasslike	22	45	67
Forb	22	34	45
Total	**167**	**308**	**431**

Table 6. Ground cover

Tree foliar cover	0-30%
Shrub/vine/liana foliar cover	5-25%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	0-12%
Non-vascular plants	0%
Biological crusts	1-68%
Litter	2-18%
Surface fragments >0.25" and <=3"	0-27%
Surface fragments >3"	0-3%
Bedrock	4-20%
Water	0%
Bare ground	2-54%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-5%	1-5%
>0.15 <= 0.3	–	10-20%	0-5%	0-5%
>0.3 <= 0.6	–	2-15%	0-5%	0-5%
>0.6 <= 1.4	–	0-5%	–	–
>1.4 <= 4	5-30%	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Utah juniper Woodland with Perennial Grasses.

This community phase is generally represented by a sparse canopy of Utah juniper and blackbrush with few if any two-needle pinyon present. Indian ricegrass and galleta may also be present in limited amounts. Small amounts of other perennial grasses, shrubs, and forbs can also be present and cover is variable. Bare ground is variable (0-55%) depending on biological crust cover, which is also variable (0-50%) and surface rock fragments (3-60%). 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 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	84	118	146
Tree	9	56	101
Grass/Grasslike	11	11	45
Forb	17	22	28
Total	**121**	**207**	**320**

Table 9. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	8-39%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	1-8%
Non-vascular plants	0%
Biological crusts	3-60%
Litter	0-16%
Surface fragments >0.25" and <=3"	0-27%
Surface fragments >3"	0-3%
Bedrock	4-20%
Water	0%
Bare ground	0-54%

Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-5%	1-5%
>0.15 <= 0.3	–	10-20%	0-5%	0-5%
>0.3 <= 0.6	–	5-15%	0-5%	0-5%
>0.6 <= 1.4	–	0-5%	–	–
>1.4 <= 4	5-20%	–	–	–
>4 <= 12	0-15%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 1.1A
Community 1.1 to 1.2

Insect herbivory coupled with long-term drought. During periods of long-term drought, two-needle pinyon trees are susceptible to insect infestations which can cause them to decrease or die out in the community. Drought can also reduce native perennial grass production and eventually eliminate them from the system.

Pathway 1.2A
Community 1.2 to 1.1

During extended periods of average to above average precipitation, two-needle pinyon may recover and/or reestablish themselves on the site. Perennial grasses may increase during this same period.

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, two-needle pinyon, and blackbrush. 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 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. Typically in the current potential state this site will fluctuate between community phases 2.1 and 2.2. Current Potential State: Plant communities influenced by insect herbivory, weather fluctuations, and surface disturbances. Indicators: A community dominated by Utah juniper and blackbrush where two-needle pinyon 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 juniper-blackbrush and grass community.

Community 2.1
Utah juniper, Two-needle pinyon Woodland with Invasive Species.

This community phase is characterized by a sparse canopy of Utah juniper, two-needle pinyon, and blackbrush. Commonly occurring grasses include Indian ricegrass, James galleta, needle-and-thread, and six weeks fescue. Other perennial grasses, shrubs, and forbs may also be present and cover is variable. Some annual grasses and forbs, including invasive species are present. Bare ground is variable (2-55%) depending on biological crust cover, which is also variable (1-68%) and surface rock fragments (0-60%). The following tables provide an example the typical vegetative floristics of a community phase 2.1 plant community.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	112	151	168
Tree	11	78	151
Grass/Grasslike	22	45	67
Forb	22	34	45
Total	**167**	**308**	**431**

Table 12. Ground cover

Tree foliar cover	0-30%
Shrub/vine/liana foliar cover	9-28%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	0-12%
Non-vascular plants	0%
Biological crusts	1-68%
Litter	2-18%
Surface fragments >0.25" and <=3"	0-27%
Surface fragments >3"	0-3%
Bedrock	4-20%
Water	0%
Bare ground	2-54%

Table 13. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-5%	1-5%
>0.15 <= 0.3	–	10-20%	0-5%	0-5%
>0.3 <= 0.6	–	2-12%	0-5%	0-5%
>0.6 <= 1.4	–	0-2%	–	–
>1.4 <= 4	5-25%	–	–	–
>4 <= 12	0-20%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 2.2
Utah juniper Woodland with Invasive Species.

This community phase is generally represented by a sparse canopy of Utah juniper and blackbrush with few if any two-needle pinyon present. Indian ricegrass and galleta may also be present in limited amounts. Small amounts of other perennial grasses, shrubs, and forbs can also be present and cover is variable. Some annual grasses and forbs including invasive species are present. Bare ground is variable Bare ground is variable (0-55%) depending on biological crust cover, which is also variable (0-50%) and surface rock fragments (3-60%). 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. Where excessive surface disturbance has occurred, biological crusts may be damaged or removed. The following tables provide an example the typical vegetative floristics of a community phase 2.2 plant community.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	84	118	146
Tree	9	56	101
Grass/Grasslike	11	11	45
Forb	17	22	28
Total	**121**	**207**	**320**

Table 15. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	8-39%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	1-8%
Non-vascular plants	0%
Biological crusts	3-60%
Litter	0-16%
Surface fragments >0.25" and <=3"	0-27%
Surface fragments >3"	0-3%
Bedrock	4-20%
Water	0%
Bare ground	0-54%

Table 16. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-5%	2-5%	1-5%
>0.15 <= 0.3	–	10-20%	0-5%	0-5%
>0.3 <= 0.6	–	5-15%	0-5%	0-5%
>0.6 <= 1.4	–	0-5%	–	–
>1.4 <= 4	5-20%	–	–	–
>4 <= 12	0-15%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 2.1A
Community 2.1 to 2.2

Insect herbivory coupled with long-term drought. During periods of long-term drought, two-needle pinyon trees are susceptible to insect infestations which can cause them to decrease or die out in the community. Drought can also reduce native perennial grass production and eventually eliminate them from the system.

Pathway 2.2A
Community 2.2 to 2.1

During extended periods of average to above average precipitation, two-needle pinyon may recover and/or reestablish themselves on the site. Both perennial and annual grasses, including invasive species may increase during this same period.

Transition T1A
State 1 to 2

During periods of long-term drought, two-needle pinyon trees are susceptible to insect infestations which can cause them to decrease or die out in the community. Drought can also reduce native perennial grass production and eventually eliminate them from the system as well. Improper livestock grazing, although rare, and/or other surface disturbances can also cause the perennial herbaceous compoment of the plant community to deteriorate. These surface disturbances can also reduce or remove the sites naturally diverse biological crusts thus increase the susceptibility of the soil to erosion by wind and water. Non-native invasive species are more likely to enter the system during these periods. Once non-native species are present, a threshold has been crossed.

Additional community tables

Table 17. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Dominant Trees**			11–151	
	Utah juniper	JUOS	*Juniperus osteosperma*	9–151	–
	twoneedle pinyon	PIED	*Pinus edulis*	4–99	–
Shrub/Vine					
0	**Dominant Shrubs**			67–138	
	blackbrush	CORA	*Coleogyne ramosissima*	6–138	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–27	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	0–15	–
3	**Sub-Dominant Shrubs**			45–101	
	singleleaf ash	FRAN2	*Fraxinus anomala*	0–56	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–34	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	0–31	–
	Havard oak	QUHA3	*Quercus havardii*	0–31	–
	sumac	RHUS	*Rhus*	0–31	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–28	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–28	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–28	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–27	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–27	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–22	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	12–20	–
	Martin's ceanothus	CEMA2	*Ceanothus martinii*	0–18	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–18	–
	mormon tea	EPVI	*Ephedra viridis*	0–15	–
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–15	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–11	–
	shadescale saltbush	ATCO	*Atriplex confertifolia*	0–9	

	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–9	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–8	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–8	–
	roundleaf buffaloberry	SHRO	*Shepherdia rotundifolia*	0–7	–
	brickellbush	BRICK	*Brickellia*	0–7	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–4	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	–
Grass/Grasslike					
0	**Dominant Grasses**			17–45	
	saline wildrye	LESA4	*Leymus salinus*	0–45	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–39	–
	needle and thread	HECO26	*Hesperostipa comata*	0–34	–
1	**Sub-Dominant Grasses**			36–94	
	purple threeawn	ARPU9	*Aristida purpurea*	0–20	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	Grass, annual	2GA	*Grass, annual*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–8	–
	spike dropseed	SPCO4	*Sporobolus contractus*	0–6	–
	squirreltail	ELEL5	*Elymus elymoides*	0–3	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–1	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–1	–
Forb					
2	**Forbs**			22–45	
	pointed gumweed	GRFA	*Grindelia fastigiata*	0–39	–
	mountain pepperweed	LEMO2	*Lepidium montanum*	0–28	–
	Forb, annual	2FA	*Forb, annual*	0–20	–
	Forb, perennial	2FP	*Forb, perennial*	0–20	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–17	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–17	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–15	–
	cryptantha	CRYPT	*Cryptantha*	0–15	–
	desert princesplume	STPI	*Stanleya pinnata*	0–15	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–11	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–10	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	0–10	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–9	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–9	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–9	–
	Newberry's twinpod	PHNE5	*Physaria newberryi*	0–9	–
	longbeak streptanthella	STLO4	*Streptanthella longirostris*	0–6	–
	Fendler's sandmat	CHFE3	*Chamaesyce fendleri*	0–6	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	Utah penstemon	PEUT	*Penstemon utahensis*	0–4	–

	skyblue phacelia	PHCO	*Phacelia coerulea*	0–4	–
	twisted cleomella	CLPL2	*Cleomella plocasperma*	0–4	–
	cleftleaf wildheliotrope	PHCR	*Phacelia crenulata*	0–3	–
	bristle flax	LIAR3	*Linum aristatum*	0–3	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–3	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–3	–
	pale evening primrose	OEPA	*Oenothera pallida*	0–3	–
	wedgeleaf draba	DRCU	*Draba cuneifolia*	0–2	–
	purple springparsley	CYPU2	*Cymopterus purpureus*	0–2	–
	Parry's sandmat	CHPA28	*Chamaesyce parryi*	0–2	–
	northwestern Indian paintbrush	CAAN7	*Castilleja angustifolia*	0–2	–
	Pacific reedgrass	CANU	*Calamagrostis nutkaensis*	0–1	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–1	–
	Crescent milkvetch	ASAM5	*Astragalus amphioxys*	0–1	–
	twolobe larkspur	DENU2	*Delphinium nuttallianum*	0–1	–
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–1	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–1	–
	red dome blanketflower	GAPI	*Gaillardia pinnatifida*	0–1	–
	gilia	GILIA	*Gilia*	0–1	–
	flaxflowered ipomopsis	IPLO2	*Ipomopsis longiflora*	0–1	–
	manybranched ipomopsis	IPPO2	*Ipomopsis polycladon*	0–1	–
	Drummond's goldenbush	ISDR	*Isocoma drummondii*	0–1	–
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0–1	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–1	–
	Pacific aster	SYCHC	*Symphyotrichum chilense var. chilense*	0–1	–

Table 18. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Dominant Trees**			9–101	
	Utah juniper	JUOS	*Juniperus osteosperma*	9–101	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–22	–
Shrub/Vine					
0	**Dominant Shruba**			56–101	
	blackbrush	CORA	*Coleogyne ramosissima*	56–101	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–15	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	0–10	–
3	**Sub-dominant Shrubs**			28–45	
	mormon tea	EPVI	*Ephedra viridis*	0–54	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–36	–
	Havard oak	QUHA3	*Quercus havardii*	0–31	–

	Havard oak	QUHA3	*Quercus havardii*	0–31	–
	sumac	RHUS	*Rhus*	0–31	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	–
	villous lipfern	CHVI	*Cheilanthes villosa*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–22	–
	singleleaf ash	FRAN2	*Fraxinus anomala*	0–20	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–20	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–18	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–17	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–17	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–15	–
	maritime ceanothus	CEMA	*Ceanothus maritimus*	0–11	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	0–8	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–8	–
	roundleaf buffaloberry	SHRO	*Shepherdia rotundifolia*	0–7	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–6	–
	brickellbush	BRICK	*Brickellia*	0–6	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–4	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–3	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–3	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	–
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–1	–
Grass/Grasslike					
0	**Dominant Grass**			11–28	
	James' galleta	PLJA	*Pleuraphis jamesii*	0–15	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–9	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–6	–
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	0–2	–
1	**Sub-dominant Grass**			0–17	
	Grass, annual	2GA	*Grass, annual*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–3	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–2	–
	spike dropseed	SPCO4	*Sporobolus contractus*	0–1	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–1	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–1	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–1	–
	squirreltail	ELEL5	*Elymus elymoides*	0–1	–
Forb					
1	**Forbs**			17–28	
	pointed gumweed	GRFA	*Grindelia fastigiata*	0–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–22	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–15	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–11	–

	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–11	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–11	–
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	Fendler's sandmat	CHFE3	*Chamaesyce fendleri*	0–9	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–7	–
	northwestern Indian paintbrush	CAAN7	*Castilleja angustifolia*	2–7	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	cleftleaf wildheliotrope	PHCR	*Phacelia crenulata*	0–6	–
	longbeak streptanthella	STLO4	*Streptanthella longirostris*	0–6	–
	pale evening primrose	OEPA	*Oenothera pallida*	0–4	–
	springparsley	CYMOP2	*Cymopterus*	0–4	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–3	–
	Jones' pepperweed	LEMOJ	*Lepidium montanum var. jonesii*	0–3	–
	cryptantha	CRYPT	*Cryptantha*	0–2	–
	wedgeleaf draba	DRCU	*Draba cuneifolia*	0–2	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–2	–
	Newberry's twinpod	PHNE5	*Physaria newberryi*	0–2	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–2	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–1	–
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–1	–
	bristle flax	LIAR3	*Linum aristatum*	0–1	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–1	–
	twolobe larkspur	DENU2	*Delphinium nuttallianum*	0–1	–
	Parry's sandmat	CHPA28	*Chamaesyce parryi*	0–1	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	0–1	–
	red dome blanketflower	GAPI	*Gaillardia pinnatifida*	0–1	–
	gilia	GILIA	*Gilia*	0–1	–
	Pacific reedgrass	CANU	*Calamagrostis nutkaensis*	0–1	–
	sego lily	CANU3	*Calochortus nuttallii*	0–1	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–1	–
	Crescent milkvetch	ASAM5	*Astragalus amphioxys*	0–1	–

Table 19. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Trees**			11–151	
	Utah juniper	JUOS	*Juniperus osteosperma*	9–151	–
	twoneedle pinyon	PIED	*Pinus edulis*	4–99	–
Shrub/Vine					
0	**Dominant Shrubs**			67–101	
	blackbrush	CORA	*Coleogyne ramosissima*	67–101	–
	biennial wormwood	ARBI2	*Artemisia biennis*	0–27	–

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Torrey's jointfir	EPTO	*Ephedra torreyana*	0–15	–
3	**Sub-dominant Shrubs**			34–67	
	singleleaf ash	FRAN2	*Fraxinus anomala*	0–56	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–34	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	0–31	–
	Havard oak	QUHA3	*Quercus havardii*	0–31	–
	sumac	RHUS	*Rhus*	0–31	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–28	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–28	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–28	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–27	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–27	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–22	–
	Martin's ceanothus	CEMA2	*Ceanothus martinii*	0–18	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–18	–
	mormon tea	EPVI	*Ephedra viridis*	0–15	–
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–15	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–11	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–9	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–8	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–8	–
	roundleaf buffaloberry	SHRO	*Shepherdia rotundifolia*	0–7	–
	brickellbush	BRICK	*Brickellia*	0–7	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–4	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	–
Grass/Grasslike					
0	**Domintant Grass**			17–45	
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	0–45	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–34	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–34	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–28	–
	cheatgrass	BRTE	*Bromus tectorum*	1–10	–
1	**Sub-dominant Grass**			6–22	
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	Grass, annual	2GA	*Grass, annual*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–8	–
	spike dropseed	SPCO4	*Sporobolus contractus*	0–6	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–4	–
	squirreltail	ELEL5	*Elymus elymoides*	0–3	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–1	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–1	–
Forb					

2	**Forbs**			22–45	
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–17	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–17	–
	desert princesplume	STPI	*Stanleya pinnata*	0–15	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–15	–
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–11	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–10	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–9	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–9	–
	Newberry's twinpod	PHNE5	*Physaria newberryi*	0–9	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–9	–
	longbeak streptanthella	STLO4	*Streptanthella longirostris*	0–6	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	Utah penstemon	PEUT	*Penstemon utahensis*	0–4	–
	skyblue phacelia	PHCO	*Phacelia coerulea*	0–4	–
	cleftleaf wildheliotrope	PHCR	*Phacelia crenulata*	0–4	–
	twisted cleomella	CLPL2	*Cleomella plocasperma*	0–4	–
	bristle flax	LIAR3	*Linum aristatum*	0–3	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–3	–
	pale evening primrose	OEPA	*Oenothera pallida*	0–3	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–3	–
	wedgeleaf draba	DRCU	*Draba cuneifolia*	0–2	–
	northwestern Indian paintbrush	CAAN7	*Castilleja angustifolia*	0–2	–
	Pacific reedgrass	CANU	*Calamagrostis nutkaensis*	0–1	–
	twolobe larkspur	DENU2	*Delphinium nuttallianum*	0–1	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–1	–
	Crescent milkvetch	ASAM5	*Astragalus amphioxys*	0–1	–
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–1	–
	flaxflowered ipomopsis	IPLO2	*Ipomopsis longiflora*	0–1	–
	manybranched ipomopsis	IPPO2	*Ipomopsis polycladon*	0–1	–
	Drummond's goldenbush	ISDR	*Isocoma drummondii*	0–1	–
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0–1	–
	Pacific aster	SYCH4	*Symphyotrichum chilense*	0–1	–
	red dome blanketflower	GAPI	*Gaillardia pinnatifida*	0–1	–

Table 20. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					

0	**Trees**			9–101	
	Utah juniper	JUOS	*Juniperus osteosperma*	9–101	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–22	–
Shrub/Vine					
0	**Dominant Shrubs**			56–101	
	blackbrush	CORA	*Coleogyne ramosissima*	56–101	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–15	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	0–10	–
3	**Sub-dominant Shrubs**			28–45	
	mormon tea	EPVI	*Ephedra viridis*	0–54	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–34	–
	Havard oak	QUHA3	*Quercus havardii*	0–31	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–22	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–20	–
	singleleaf ash	FRAN2	*Fraxinus anomala*	0–20	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	0–18	–
	Cutler's jointfir	EPCU	*Ephedra cutleri*	0–17	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–17	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–15	–
	Martin's ceanothus	CEMA2	*Ceanothus martinii*	0–11	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	0–8	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–8	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–8	–
	roundleaf buffaloberry	SHRO	*Shepherdia rotundifolia*	0–7	–
	sumac	RHUS	*Rhus*	0–6	–
	brickellbush	BRICK	*Brickellia*	0–6	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–4	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	0–3	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–3	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–2	–
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–1	–
Grass/Grasslike					
0	**Dominant Grass**			11–28	
	James' galleta	PLJA	*Pleuraphis jamesii*	0–15	–
	cheatgrass	BRTE	*Bromus tectorum*	0–10	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–9	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–6	–
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	0–2	–
1	**Sub-dominate Grass**			0–17	
	Grass, annual	2GA	*Grass, annual*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–

	sixweeks fescue	VUOC	*Vulpia octoflora*	0–3	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	0–2	–
	spike dropseed	SPCO4	*Sporobolus contractus*	0–1	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–1	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–1	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–1	–
	squirreltail	ELEL5	*Elymus elymoides*	0–1	–
Forb					
2	**Forbs**			11–28	
	pointed gumweed	GRFA	*Grindelia fastigiata*	0–28	–
	Jones' pepperweed	LEMOJ	*Lepidium montanum var. jonesii*	0–28	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	0–28	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–15	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–11	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–11	–
	tansymustard	DESCU	*Descurainia*	0–11	–
	redstem stork's bill	ERCI6	*Erodium cicutarium*	0–9	–
	Fendler's sandmat	CHFE3	*Chamaesyce fendleri*	0–9	–
	Newberry's twinpod	PHNE5	*Physaria newberryi*	0–9	–
	desert princesplume	STPI	*Stanleya pinnata*	0–9	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–7	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–6	–
	cleftleaf wildheliotrope	PHCR	*Phacelia crenulata*	0–6	–
	longbeak streptanthella	STLO4	*Streptanthella longirostris*	0–6	–
	pale evening primrose	OEPA	*Oenothera pallida*	0–3	–
	bristle flax	LIAR3	*Linum aristatum*	0–3	–
	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–3	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–3	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–3	–
	cryptantha	CRYPT	*Cryptantha*	0–2	–
	purple springparsley	CYPU2	*Cymopterus purpureus*	0–2	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–2	–
	northwestern Indian paintbrush	CAAN7	*Castilleja angustifolia*	0–2	–
	buckwheat	ERIOG	*Eriogonum*	0–2	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	0–2	–
	Pacific aster	SYCH4	*Symphyotrichum chilense*	0–1	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–1	–
	flaxflowered ipomopsis	IPLO2	*Ipomopsis longiflora*	0–1	–
	manybranched ipomopsis	IPPO2	*Ipomopsis polycladon*	0–1	–
	Drummond's goldenbush	ISDR	*Isocoma drummondii*	0–1	–
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–1	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–1	–
	Pacific reedgrass	CANU	*Calamagrostis nutkaensis*	0–1	–

	sego lily	CANU3	*Calochortus nuttallii*	0–1	–
	Parry's sandmat	CHPA28	*Chamaesyce parryi*	0–1	–
	twisted cleomella	CLPL2	*Cleomella plocasperma*	0–1	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–1	–
	Crescent milkvetch	ASAM5	*Astragalus amphioxys*	0–1	–
	wedgeleaf draba	DRCU	*Draba cuneifolia*	0–1	–
	twolobe larkspur	DENU2	*Delphinium nuttallianum*	0–1	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	0–1	–

Animal community

--Wildlife Interpretation--
The scarcity of water on these sites limits the species richness and the abundance of large mammals. This site provides some thermal cover and limited forage opportunities for mule deer. Birds, Bats, lizards, snakes and rodents are common. Birds from several families from hawks to sparrows are typical. Golden eagles and red-tailed hawks are common as well as the great horned-owl. Species typical of pinyon/juniper areas, such as black-chinned and rufous hummingbirds, several fly catchers, wood peckers, and corvids will use this site for nesting and foraging. Several species of rodents forage and occupy this site including desert cottontail, black tailed jack rabbit, Colorado chipmunk, white–tailed antelope squirrel, Apache pocket mouse, and several species of Peromyscus. Coyotes and kit foxes will also forage in the area. Dens are probably located in other ecological sites due to the shallow soils and/or the presence rocks or rock out crops. Bats (Myotis, Pipisturellus, and others) can be observed in this ecological site, but are likely limited to areas near water or canyons.

--Grazing Interpretations--
This site provides very limited grazing for livestock. Blackbrush contains high levels of tannins, and has low available nutrition. When present, grasses, primarily Indian ricegrass and James galleta, provide good forage for livestock; however, these species are not always abundant enough to support many livestock. The site does provide fairly good browse for goats. Forage composition and annual production depend largely on yearly precipitation amounts and thus provide challenges for those making livestock grazing management decisions. Regardless of class of livestock, this sites carrying capacity is always low. A lack of available drinking water, can also influence its suitability for livestock grazing. Care should be taken to maintain the native perennial grasses and shrubs present on this site because they are hard to restore once gone.

Livestock grazing should be based on a science based management plan that includes an onsite resource inventory.

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.

Surface disturbance and compaction caused by ATV off-road vehicles tracks, and dirt roads can affect this sites hydrology. Any resulting compaction increases bulk density and breaks down soil aggregates. This results in decreased infiltration rates and increased runoff. The actual removal of the plants due to the tire tracks can alter the hydrology by decreasing plant cover and increasing bare ground. In the rare event that fire occurs on this site, can also affect its hydrology, but these affects are highly 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)

Different plant communities affect hydrology in different ways.

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.

In certain areas, this ecological site is experiencing heavy use from ATVS and other off-road vehicles. This relatively new recreation use is having an impact on soil stability and species composition. At this time the impacts are not clearly quantified and more research is needed to determine the impacts from these linear disturbances.

Wood products

Potential wood products include firewood and fenceposts; however, harvesting such products may be difficult due to steep slopes and sparse stands. This sites site index is 30.
Percent canopy cover by trees is 25.
Average density trees per acre = 50-JUOS, 20-PIED.
Wood production averages about about 3 cords per acre.

Other information

--Poisonous and Toxic Plant Communities--
Toxic plants associated with this site include woolly locoweed, broom snakeweed, wavy leaf (Havard) oak 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).

Havard oak is thought to contain tannins that can be detrimental to cattle, sheep, and occasionally horses if grazed as more than 50% of the diet. Oak is highly toxic during the budding stage, leafing stage, and when acorns are available. Symptoms include lack of appetite, weakness, excessive thirst, edema, reluctance to follow the herd, and emaciation.

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.

Other potentially toxic plants associated with this site include four-wing saltbush and some buckwheat species, which may accumulate selenium, but only when growing on selenium enriched soils. These plants, when consumed will cause alkali disease or chronic selenosis, which affects all classes of livestock (excluding goats). Typically animals consuming 5-50 ppm selenium will develop chronic selenosis and animals consuming greater than 50 ppm

selenium will develop acute selenosis. Clinical signs include lameness, soughing of the hoof, hair loss, blindness, and aimless wondering. Horses tend to develop what is called a “bob” tail or “roached” main due to breakage of the long hairs.

--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, kochia, halogeton, and annual mustards. The presence of these species will depend on soil properties and moisture availability; however these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult, but suppression may be possible.

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

--Fire Ecology--
The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content. Sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Many semi-desert communities in the Colorado Plateau may have evolved without a significient influence of fire. However, a year of exceptionally heavy winter rains can generate enough fuels by producing heavy stands of annual forbs and grasses to carry fire. The two-needle pinyon and Utah juniper communities in the Colorado Plateau growing on shallow soils quite are 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 community dynamics. Fires are more common when trees are stressed or dead due to drought and/or beetle infestations. Pinyon-juniper stands reestablish either by seeds dispersed from adjacent unburned patches or by unburned seeds found at the burn site. Continuous (every 20-40 years) burning of these ecological sites can result in shrub dominated communities, due to the relatively fast recovery of shrubs when compared to trees. If invasive annual grasses are allowed to establish fires may become more frequent, inhibiting the site’s ability to recover.

Inventory data references

The data collected in 2005-2009 were in conjunction with the soil survey update for Arches and Canyonlands National Park. The vegetation data was collected in associated with a soil pit and geo-referenced. All the data is stored as hard copy files and in electronic format in the NRCS Utah State Office.

Type locality

Location 1: San Juan County, UT	
UTM zone	N
UTM northing	597525
UTM easting	425180
General legal description	Canyonlands National Park

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Robert Stager (BLM), Randy Beckstrand (BLM), V. Keith Wadman (NRCS Ret.), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS). Contributors to 2/2008 revisions included Shane Green and Dana Truman (NRCS), Kim Allison, Ann Marie Aubrey, Lynn Jackson, Pam Riddle, Daryl Trotter and David Williams (BLM), Mike Duniway and Jeff Herrick (ARS).

Contact for lead author	shane.green@ut.usda.gov Supporting data: USGS (Mark Miller) 2006-2007 data from Canyonlands and Dugout Ranch. NRCS (Dana Truman) 2006-2007 ESD data from Canyonlands and Arches.
Date	02/08/2008
Approved by	Shane A. Green
Approval date	
Composition (Indicators 10 and 12) based on	Foliar Cover

Indicators

1. **Number and extent of rills:** Rills increase immediately following large storm events but should not persist more than one or two winters due to frost-heave recovery. 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.

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2. **Presence of water flow patterns:** Interspaces between vegetation and/or well developed biological soil crusts can serve as somewhat stable water flow patterns below run-off generating areas (exposed bedrock, areas with very shallow soils). If present, these waterflow patterns should be narrow (<1-1½') but can be very long. These waterflow patterns should be widely spaced (15-20 yrds) on low slopes (< 6%), increasing in frequency (every 10-15yrds) with slope. Otherwise, there should be none to few and short (3-6') water flow patterns on low slopes (< 6%), increasing in frequency and length (up to 5-10') with slope. Waterflow patterns should dissipate where the slope flattens.

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 25-35%, in non-bedrock areas. Most 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%.

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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.

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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 at the base of shrubs and trees is 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 low 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.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have a soil stability rating of 5-6 throughout the site. Surface texture varies from fine sand to gravelly fine sandy loam to channery loam.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface (A horizon) is 1 ½ to 2 inches deep. Structure is weak fine platy parting to moderate fine and medium granular. Color is brown (7.5YR5/4) to light red (2.5YR6/6). 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.

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 (except on clay loam soils where biological soil crust development is minimal). Shrubs, trees, and bunchgrasses and associated plant litter provide barriers to flow.

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.

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 UT juniper) and non-sprouting, drought-deciduous shrubs (e.g. Blackbrush). Blackbrush 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 (deer) use of the palatable sub dominant shrubs and forbs.; drought and insects (though these have minimal direct impacts on the dominant plants (blackbrush and juniper)) Factors contributing to spatial variability include texture, depth and coarse fragment (rock/gravel) content,

slope, aspect, and degree of topographic heterogeneity (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 to 1/2 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 blackbrush stems may die. 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, juniper (especially older trees) and blackbrush will normally have dead stems within the plant canopy. Blackbrush will drop its leaves when water stressed.

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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 ¼ to 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):** 200-300 #/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:** None currently known; however cheatgrass, Russian thistle, and other introduced annual forbs have future potential. This reference should be revised if any of these species become invasive in this ecological site.

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17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce sexually or asexually in most years, except in drought years. Blackbrush reproduction is naturally very episodic and no young plants may be apparent.
