USDA Natural Resources
Conservation Service

Ecological site R036XY316UT
Upland Shallow Loam (littleleaf mountain mahogany)

Accessed: 05/19/2024

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.

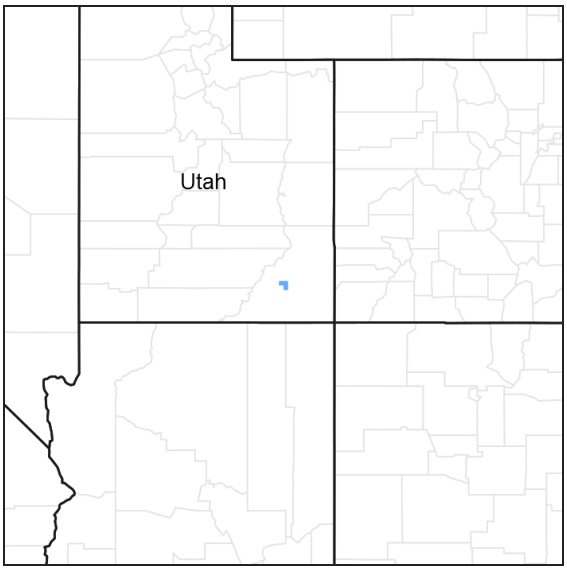


Figure 1. Mapped extent

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.

Classification relationships

Semiarid Benchlands and Canyonlands Ecoregion (Woods, et. al, 2001)
Intermountain Semidesert and Desert Province, 341 (Bailey, 1995)

Associated sites

R036XC302UT	**Upland Dissected Slope (pinyon-Utah juniper)**
R036XY307UT	**Upland Loam (pinyon-Utah juniper)**

Similar sites

R035XY315UT	**Upland Shallow Loam (Pinyon-Utah Juniper) AWC <3** THis site is very similar to the MLRA 36 site, however there is less rock outcrop, less littleleaf mountain mahogany, and it occurs in MLRA 35.
R035XY019UT	**Shallow Sand Rock Pocket (Utah Juniper/Two-Needle Pinyon)** This site is very similar to the Rock Pocket site of MLRA 35. The look and plant species are very similar. R036XY316UT, however may have higher production in some instances.
R036XY315UT	**Upland Shallow Loam (pinyon-Utah juniper)** This site differs in species present. Little leaf moutain mahogany is not a dominant plant species. There is also likely less rock outcrop in this site.

Table 1. Dominant plant species

Tree	(1) *Pinus edulis* (2) *Juniperus osteosperma*
Shrub	(1) *Cercocarpus intricatus*
Herbaceous	Not specified

Physiographic features

This site occurs on structural benches and cuestas. This site is usually found in a complex with exposed bedrock or rock outcrop. Run-off is variable, and is greatly influenced by micro-topography. Typically slopes range from 2-20% however; sites may occur on sites with up to 35% slope.

Table 2. Representative physiographic features

Landforms	(1) Structural bench (2) Cuesta
Flooding frequency	None
Ponding frequency	None
Elevation	1,798–2,316 m
Slope	2–20%
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by warm summers, cool winters. The climate is modified by local topographic conditions, such as aspect. Mean annual high temperatures range from 62-65 degrees Fahrenheit and mean annual low temperatures range from 35-40 degrees Fahrenheit. Much of the rainfall occurs as convective storms in late summer and early fall; about 20-30% percent of the total precipitation fall in July and August. Snow packs are generally light and not persistent, about 15 to 20 percent of the total precipitation falls as snow. May and June are typically the driest months, with average annual precipitation ranging from 12-14 inches.

Table 3. Representative climatic features

Frost-free period (average)	175 days
Freeze-free period (average)	178 days
Precipitation total (average)	356 mm

Influencing water features

There are no water features influencing this site.

Soil features

The soils are shallow to very shallow and well drained. Typically the surface layer is a yellowish red. Runoff is moderate, but does depend slightly on slope. These soils typically have a moderately rapid permeability. The soils temperature and moisture regimes are mesic and aridic ustic, respectively. Surface textures and subsurface textures are generally fine sandy loams to very fine sandy loams, are nonsaline, and moderately alkaline. Biological soil crust cover varies by plant community phase, soil, aspect, elevation, etc. This site has been used in the following soil surveys and has been correlated to the following components:

UT638—Natural Bridges National Monument, UT – Nizhoni

Typical Soil Profile:
A—0-3 inches; yellowish red; very fine sandy loam; moderately alkaline (pH=8.2)
2C1—2-6 inches; red; fine sandy loam; moderately alkaline (pH=8.2)
2C2—6-7 inches; dark reddish gray; fine sandy loam; moderately alkaline (pH=8.4)
3R—7 inches; sandstone (typically Cedar Mesa)

Table 4. Representative soil features

Surface texture	(1) Fine sandy loam (2) Very fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	3–51 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Calcium carbonate equivalent (0-101.6cm)	1–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	1–5
Soil reaction (1:1 water) (0-101.6cm)	8.2–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

This site developed under Colorado Plateau climatic conditions and included natural influences of herbivory and climate. Due to the remote location, broken topography, and lack of perennial water sources this area rarely served as habitat for herds of native herbivores or large historic fires. This ecological site occurs on the shallow to very shallow, moderately developed soils found on structural benches and cuestas in Major Land Resource Area (MLRA) 36—Southwestern Plateaus, Mesas, and Foothills. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, sagebrush, and grassland complexes.

Pinyon and Juniper communities throughout the West have received a lot of attention because many areas have experienced increases in the spatial extent and density of trees (Miller and Wigand 1994). In MLRA 36, the woodland expansion began during the late 1800s (Tausch et al. 1981). The causes of woodland expansion are being studied, and are often attributed to an increase in the fire return interval, introduction of livestock grazing, shifts in climate, and increases in atmospheric CO2 (Miller and Rose 1999). The natural disturbance regime on shallow soils historically dominated by Pinyon and Utah juniper in the Colorado Plateau area is unique and little is understood (Miller and Tausch 2001; Floyd et al. 2004). Historic fire return intervals are long, possibly indicating that fire did not play a role in community dynamics. Pinyon and Juniper communities near Mesa Verde were established before European settlement with a fire return interval of greater than 400 years (Floyd et al. 2000).

The major disturbance factors affecting this shallow loam site is erosional events that expose the underlying bedrock, allowing for decreases in biological crust and grass and forb productivity. This differs from the disturbance pattern of the other shallow loam site in MLRA 36. Reasoning could include landscape position. This site is likely

influenced by climate as well as insect herbivory, but this has not been proven in the field.

The communities of mature Pinyon and Juniper are stable, but fragile. Disturbances such as improper grazing (continuous season long grazing, heavy stocking rates, etc.), recreation activities, etc., can remove herbaceous vegetation and compact the soils. The unpredictability of the annual growing conditions and the shallow soils make these communities susceptible to the loss of understory and the resulting accelerated erosion. This ecological site has been grazed by domestic livestock since they were introduced into the area, though grazing has been light due to the lack of water and difficult terrain. The introduction of domestic livestock and the use of fencing and reliable water sources have influenced the disturbance regime of this site. As of this date, invasive annual grasslands that are so common in the Great Basin after a severe disturbance are not as prevalent on this ecological site in MLRA 36, potentially due to the remote location, the climate, and/or the soils.

As vegetation communities respond to changes in management or natural occurrences, thresholds can be crossed, which usually means that a return to the previous state may not be possible without major energy inputs. The amount of energy input needed to affect vegetative shifts depends on the present biotic and abiotic features and the desired results. The following diagram does not necessarily depict all the transition and states that this site may exhibit, but it does show some of the most common plant communities that can occur on the site and the transition pathways among the communities. These plant communities may not represent every possibility, but they are the most prevalent and repeatable. As more data is collected, some of these plant communities will be revised or removed, and new ones may be added. None of these plant communities should necessarily be thought of as the “desired plant community. 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.

--Reference State (State 1)--
The Reference State has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under influences such as grazing and recreational uses. Through literature review, historical accounts and observations of trends in plant community dynamics under a variety of uses have been considered. Community phases, community pathways, states, transitions, thresholds, and restoration pathways have been determined through similar studies and experience.

This state represents the natural range of variability that historically dominated the dynamics of this ecological site. This state includes the biotic communities that would have been expressed on the ecological site if all successional sequences were completed without interferences by man under the present environmental conditions; natural disturbances are inherent in its development. This state is dominated by older Pinyon and Utah juniper with a medium to sparse understory of native perennial grasses and native perennial and annual forbs. The primary disturbance mechanisms for this site in reference condition include erosional events. Erosion exposes the underlying bedrock and decrease the productivity of biological soil crusts and the native grasses and forbs. Typically shrub and tree production remains relatively similar between plant community phases.

Reference state: Community phases influenced by erosional events.
Indicators: A developed understory co-existing with a canopy of older Pinyon and Utah juniper.

Feedbacks: An increase in erosions that exposes the underlying bedrock and decreases the productivity of biological soil crusts, grasses, and forbs. The establishment of non-native plant species in the understory.

At-risk Community Phase: All communities are at risk when native plants in the understory are stressed, and nutrients become available for non-natives to establish.

Trigger: The introduction of non-native plants to fill the available niches.

--Transition from Reference State (State 1) to Current Potential State (State 2)--
T1a– This transition from the native perennial bunchgrass understory in the reference state to a state that has been invaded by naturalized species such as Crested wheatgrass (blown in), cheatgrass, and annual wheatgrass. This transition occurs as natural and/or management actions favor an increase in non-native grasses and forbs, especially annuals. Possible events include the mere presence of invasive species, improper livestock grazing, seeding introduced species nearby, and extended droughts, combined with an available seed source of non-native species.

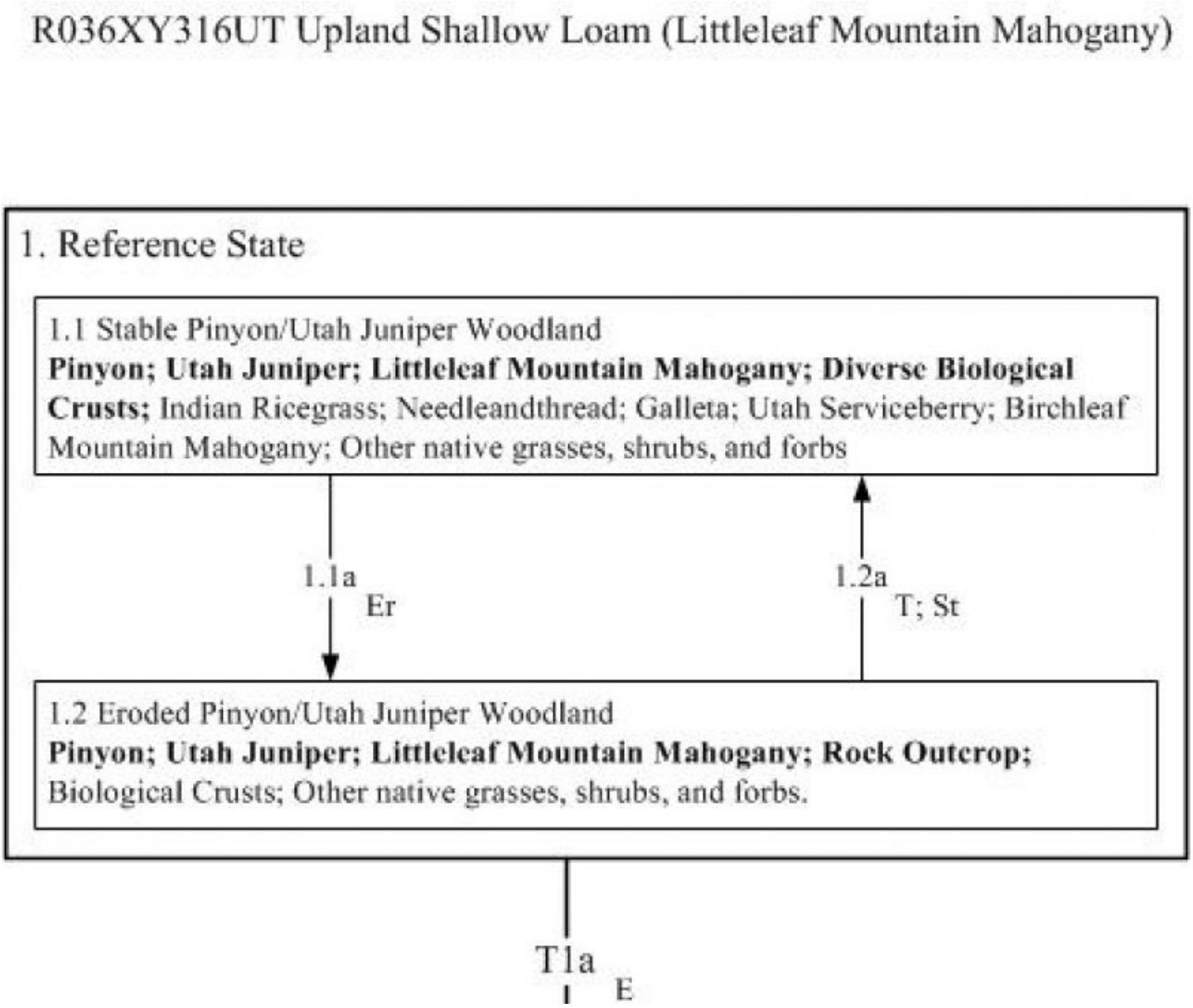
--Current Potential State (State 2)--
This state is very similar to the reference state, except that non-native grasses and/or forbs are now present in all phases. The current potential state may include naturalized or invasive nonnative species. The primary disturbance mechanisms for this state include natural and human caused disturbances. Natural erosional events still influence the community shifts; however, domestic livestock grazing, recreational activities, and other man caused disturbances now present. Plant communities within the current potential state are more likely managed and used for various purposes by man, with out significant alteration in plant community composition or production. In time, continuous surface disturbances (i.e. improper grazing, off highway vehicles (OHV) use, recreational activities, etc.) will likely stress the native perennial grasses and allow for non-natives species to increase. This shift in species composition could affect nutrient cycling, hydrology and soil stability. At this time there is no known way to effectively remove the non-native plants from the site once they have become established. Therefore, this site is often irreversibly altered from the reference state

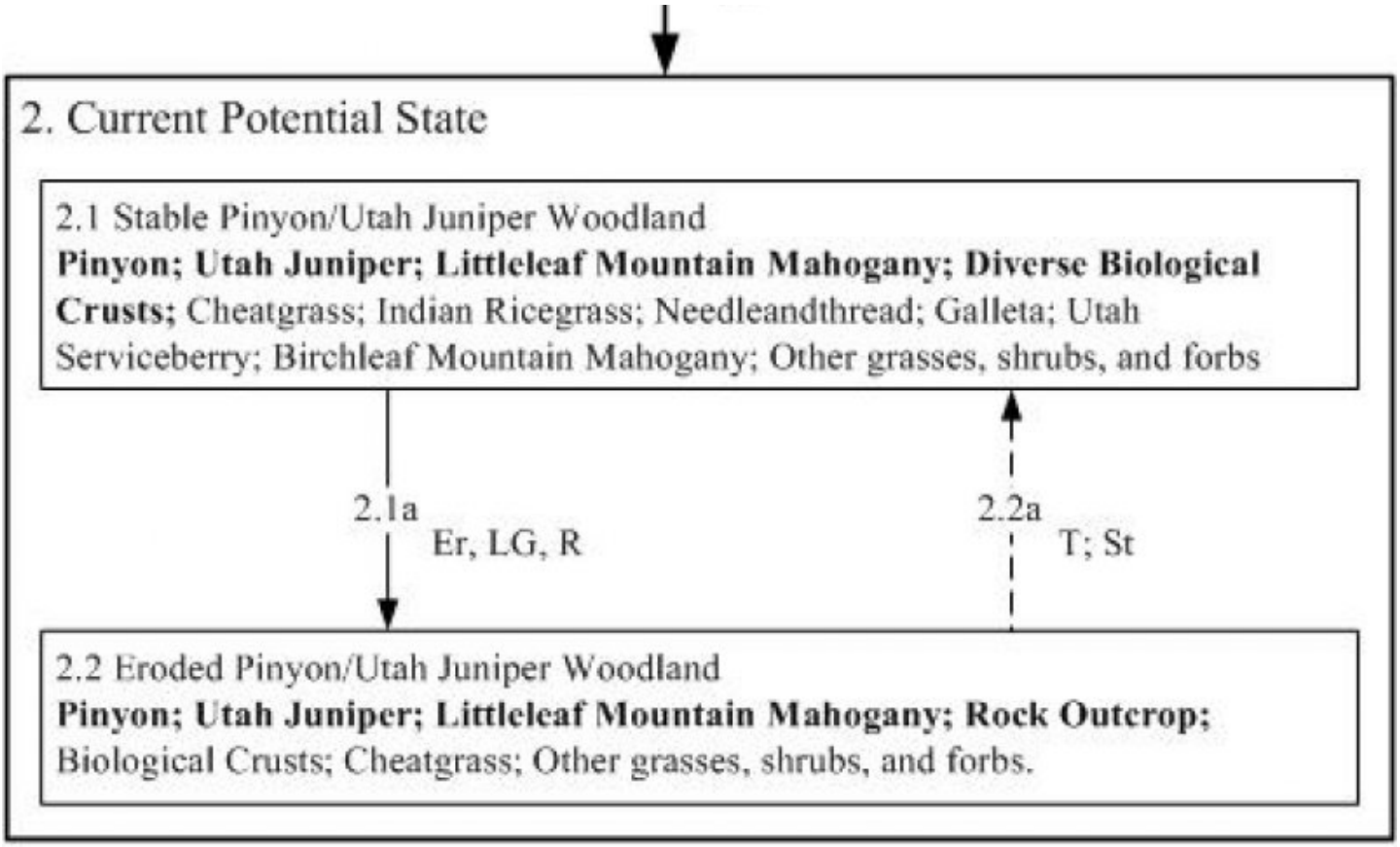
Current Potential State: Community phases maintained by natural and manmade erosional events and domestic livestock grazing.

Indicators: A developed shrub understory co-existing with a canopy of older Pinyon and Utah Juniper.

Feedbacks: An increase in erosion that exposes the underlying bedrock and decreases the productivity of biological soil crusts, grasses, and forbs.

State and transition model





Legend:
Er = Soil erosion
St = Soil stabilization, deposition, and/or formation
T = Time
E = Establishment of non-native plant species
LG = Improper livestock grazing
R = Improperly managed recreational activities that may cause erosion

State 1
Reference State--Stable Pinyon/Utah Juniper Woodland--1.1

Community 1.1
Reference State--Stable Pinyon/Utah Juniper Woodland--1.1

This community phase is dominated by Utah Juniper, Pinyon, Littleleaf mountain mahogany, and diverse biological crusts including lichen, moss, and cyanobacteria. This phase also has a well developed understory of Indian ricegrass, Needleandthread, Galleta, and native annual and perennial forbs. Bare ground (3-5% measured by first raindrop impact) is fairly uncommon due to the diverse biological crust cover (45-75% cover measured by first raindrop impact), while rock outcrop (10-25%) is variable depending on the site. --Community Pathway-- 1.1a – This pathway occurs when erosional events favor the decrease in biological crust, grass, and forb productivity and an increase in the amount of exposed bedrock. Utah juniper, pinyon, and shrub productivity is expected to remain similar throughout the transition. Erosional events could include anything from water to wind, caused by increased trampling from native wildlife, rodent activity, drought (reduction in the herbaceous understory), etc.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	392
Tree	56	112	168
Forb	112	140	168
Grass/Grasslike	90	112	135
Total	**426**	**644**	**863**

Table 6. Ground cover

Tree foliar cover	15-25%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	5-20%
Forb foliar cover	5-20%
Non-vascular plants	0%
Biological crusts	45-75%
Litter	1-5%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	10-25%
Water	0%
Bare ground	3-5%

Table 7. Canopy structure (% cover)

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

State 2
Reference State--Eroded Pinyon/Utah Juniper Woodland--1.2

Community 2.1
Reference State--Eroded Pinyon/Utah Juniper Woodland--1.2

This community phase is characterized by a mature Pinyon and Utah juniper woodland with Littleleaf mountain mahogany in the understory. Other shrubs present typically include, Utah serviceberry, Green mormontea, Birchleaf mountain mahogany, and Broom snakeweed. The herbaceous understory is sparse and the productivity of soil biological crusts has decreased. Forbs are typically still present; however grasses may or may not be found on this site. Bare ground (10-15%) and exposed bedrock (30-50%) has increased. --Community Pathway-- 1.2a – This pathway occurs as events favor the reestablishment of perennial grasses and the increased productivity of

biological soil crusts, soil deposition and formation. While the presence of rock outcrop typically does not decrease once it reaches this level of exposure, the site is still able to stabilize and return to a community similar to plant community 1.1, just with more exposed bedrock.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	392
Tree	56	112	168
Forb	22	90	135
Grass/Grasslike	–	56	112
Total	**246**	**538**	**807**

Table 9. Ground cover

Tree foliar cover	15-25%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	5-20%
Non-vascular plants	0%
Biological crusts	10-40%
Litter	1-5%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	20-50%
Water	0%
Bare ground	10-15%

Table 10. Canopy structure (% cover)

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

State 3
Current Potential State--Stable Pinyon/Utah Juniper Woodland--2.1

Community 3.1
Current Potential State--Stable Pinyon/Utah Juniper Woodland--2.1

This community phase is dominated by Utah Juniper, Pinyon, Littleleaf mountain mahogany, and diverse biological

crusts including lichen, moss, and cyanobacteria. This phase also has a well developed understory of Indian ricegrass, needleandthread, galleta, and native annual and perennial forbs. Cheatgrass or other non-native grass species are present. Bare ground (3-5% measured by first raindrop impact) is fairly uncommon due to the diverse biological crust cover (45-75%), while rock outcrop (10-25%) is variable depending on the site. --Community Pathway-- 2.1a – This pathway occurs when erosional events favor the decrease in biological crust, grass, and forb productivity and an increase in the amount of exposed bedrock. Utah juniper, pinyon, and shrub productivity is expected to remain similar throughout the transition. Erosional events could include anything from water to wind, caused by increased trampling from native wildlife, rodent activity, drought (reduction in the herbaceous understory), etc.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	392
Tree	56	112	168
Forb	112	140	168
Grass/Grasslike	90	112	135
Total	**426**	**644**	**863**

Table 12. Ground cover

Tree foliar cover	15-25%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	5-20%
Forb foliar cover	5-20%
Non-vascular plants	0%
Biological crusts	45-75%
Litter	1-5%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	10-25%
Water	0%
Bare ground	3-5%

Table 13. Canopy structure (% cover)

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

State 4

Current Potential State--Eroded Pinyon/Utah Juniper Woodland--2.2

Community 4.1
Current Potential State--Eroded Pinyon/Utah Juniper Woodland--2.2

This community phase is characterized by a mature Pinyon and Utah juniper woodland with littleleaf mountain mahogany in the understory. Other shrubs present typically include, Utah serviceberry, green mormontea, birchleaf mountain mahogany, and broom snakeweed. The herbaceous understory is sparse and the productivity of soil biological crusts has decreased. Forbs are typically still present; however grasses may or may not be found on this site. Bare ground (10-15%) and exposed bedrock (30-50%) has increased. --Community Pathway-- 2.2a – This pathway occurs as events favor the reestablishment of perennial grasses and the increased productivity of biological soil crusts, soil deposition and formation. While the presence of rock outcrop typically does not decrease once it reaches this level of exposure, the site is still able to stabilize and return to a community similar to plant community 2.1, just with more exposed bedrock.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	168	280	392
Tree	56	112	168
Forb	22	90	135
Grass/Grasslike	–	56	112
Total	**246**	**538**	**807**

Table 15. Ground cover

Tree foliar cover	15-25%
Shrub/vine/liana foliar cover	10-20%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	5-20%
Non-vascular plants	0%
Biological crusts	10-40%
Litter	1-5%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	30-50%
Water	0%
Bare ground	10-15%

Table 16. Canopy structure (% cover)

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

Additional community tables

Table 17. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Dominant Shrubs**			73–224	
	Utah serviceberry	AMUTU	*Amelanchier utahensis var. utahensis*	22–90	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	34–90	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	11–90	–
	mormon tea	EPVI	*Ephedra viridis*	6–17	–
3	**Sub-Dominant Shrubs**			0–84	
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–22	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–17	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–11	–
	Utah fendlerbush	FEUT	*Fendlerella utahensis*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–6	–
Grass/Grasslike					
0	**Dominant Grasses**			90–112	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	56–84	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	6–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	28–39	–
1	**Sub-Dominant Grasses**			0–17	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–11	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	

	squirreltail	ELELE	*Elymus elymoides*	0–11	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–6	–
	Grass, perennial	2GP	*Grass, perennial*	0–6	–
Forb					
0	**Dominant Frobs**			62–112	
	rock goldenrod	PEPUP	*Petradoria pumila ssp. pumila*	28–56	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	28–39	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–28	–
2	**Sub-Dominant Forbs**			0–28	
	Forb, annual	2FA	*Forb, annual*	0–6	–
	Forb, perennial	2FP	*Forb, perennial*	0–6	–
	milkvetch	ASTRA	*Astragalus*	0–6	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–6	–
	bristle flax	LIAR3	*Linum aristatum*	0–6	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–6	–
Tree					
4	**Trees**			101–123	
	twoneedle pinyon	PIED	*Pinus edulis*	56–67	–
	Utah juniper	JUOS	*Juniperus osteosperma*	45–56	–

Table 18. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Dominant Shrubs**			73–224	
	Utah serviceberry	AMUTU	*Amelanchier utahensis var. utahensis*	22–90	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	34–90	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	11–90	–
	mormon tea	EPVI	*Ephedra viridis*	6–17	–
3	**Sub-Dominant Shrubs**			0–84	
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–22	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–17	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–11	–
	Utah fendlerbush	FEUT	*Fendlerella utahensis*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–6	–
Forb					
0	**Dominant Forbs**			56–90	

	rock goldenrod	PEPUP	*Petradoria pumila ssp. pumila*	56–90	–
2	**Sub-Dominant Forbs**			0–34	
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	0–11	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–11	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–6	–
	bristle flax	LIAR3	*Linum aristatum*	0–6	–
	Forb, annual	2FA	*Forb, annual*	0–6	–
	Forb, perennial	2FP	*Forb, perennial*	0–6	–
	milkvetch	ASTRA	*Astragalus*	0–6	–
Grass/Grasslike					
1	**Grasses**			0–112	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–22	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–22	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–11	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	–
Tree					
4	**Trees**			101–123	
	twoneedle pinyon	PIED	*Pinus edulis*	56–67	–
	Utah juniper	JUOS	*Juniperus osteosperma*	45–56	–

Table 19. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Dominant Shrubs**			73–224	
	Utah serviceberry	AMUTU	*Amelanchier utahensis var. utahensis*	22–90	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	34–90	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	11–90	–
	mormon tea	EPVI	*Ephedra viridis*	6–17	–
3	**Sub-Dominant Shrubs**			0–84	
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–22	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–17	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–11	–

	Utah fendlerbush	FEUT	*Fendlerella utahensis*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–6	–
Grass/Grasslike					
0	**Dominant Grasses**			90–112	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	56–84	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	6–56	–
	James' galleta	PLJA	*Pleuraphis jamesii*	28–39	–
	cheatgrass	BRTE	*Bromus tectorum*	6–11	–
1	**Sub-Dominant Grasses**			0–17	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–11	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–11	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–6	–
	Grass, annual	2GA	*Grass, annual*	0–6	–
	Grass, perennial	2GP	*Grass, perennial*	0–6	–
Forb					
0	**Dominant Forbs**			62–112	
	rock goldenrod	PEPUP	*Petradoria pumila ssp. pumila*	28–56	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	28–39	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	2–28	–
2	**Sub-Dominant Forbs**			0–28	
	Forb, annual	2FA	*Forb, annual*	0–6	–
	Forb, perennial	2FP	*Forb, perennial*	0–6	–
	milkvetch	ASTRA	*Astragalus*	0–6	–
	tansymustard	DESCU	*Descurainia*	0–6	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–6	–
	bristle flax	LIAR3	*Linum aristatum*	0–6	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–6	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–6	–
Tree					
4	**Trees**			101–123	
	twoneedle pinyon	PIED	*Pinus edulis*	56–67	–
	Utah juniper	JUOS	*Juniperus osteosperma*	45–56	–

Table 20. Community 4.1 plant community composition

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

Shrub/Vine					
0	**Dominant Shrubs**			73–224	
	Utah serviceberry	AMUTU	*Amelanchier utahensis var. utahensis*	22–90	–
	littleleaf mountain mahogany	CEIN7	*Cercocarpus intricatus*	34–90	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	11–90	–
	mormon tea	EPVI	*Ephedra viridis*	6–17	–
3	**Sub-Dominant Shrubs**			0–84	
	Fremont's mahonia	MAFR3	*Mahonia fremontii*	0–22	–
	desert snowberry	SYLO	*Symphoricarpos longiflorus*	0–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0–17	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	–
	Bigelow sage	ARBI3	*Artemisia bigelovii*	0–11	–
	Utah fendlerbush	FEUT	*Fendlerella utahensis*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
	Stansbury cliffrose	PUST	*Purshia stansburiana*	0–6	–
Forb					
0	**Dominant Forbs**			56–90	
	rock goldenrod	PEPUP	*Petradoria pumila ssp. pumila*	56–90	–
2	**Sub-Dominant Forbs**			0–34	
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	0–11	–
	lobeleaf groundsel	PAMU11	*Packera multilobata*	0–11	–
	Forb, annual	2FA	*Forb, annual*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	winged buckwheat	ERAL4	*Eriogonum alatum*	0–11	–
	buckwheat	ERIOG	*Eriogonum*	0–6	–
	fineleaf hymenopappus	HYFI	*Hymenopappus filifolius*	0–6	–
	bristle flax	LIAR3	*Linum aristatum*	0–6	–
	milkvetch	ASTRA	*Astragalus*	0–6	–
	prickly Russian thistle	SATR12	*Salsola tragus*	0–6	–
	tansymustard	DESCU	*Descurainia*	0–6	–
Grass/Grasslike					
1	**Grasses**			0–112	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–22	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–22	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–11	–
	Grass, annual	2GA	*Grass, annual*	0–11	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–11	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–11	–

	purple threeawn	ARPU9	*Aristida purpurea*	0–11	
	blue grama	BOGR2	*Bouteloua gracilis*	0–11	–
	cheatgrass	BRTE	*Bromus tectorum*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	–
Tree					
4	**Trees**			101–123	
	twoneedle pinyon	PIED	*Pinus edulis*	56–67	–
	Utah juniper	JUOS	*Juniperus osteosperma*	45–56	–

Animal community

--Threatened and Endangered Species--
This section will be populated as more information becomes available.

--Wildlife Interpretations--
The scarcity of water up on the mesas limits the species richness and the abundance of large mammals. This site provides thermal cover and limited forage opportunities for mule deer and elk. Birds, bats, lizards, snakes and rodents are more common. Birds from several families are common, from hawks to sparrows. Golden eagles and red-tailed hawks are common as well as the great horned-owl. Species typical of pinyon juniper areas including black-chinned and rufous hummingbirds, and several fly catchers, wood peckers. 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; however dens are likely to be located in other ecological sites due to shallow soils and/or presence rocks fragments and rock outcrop. 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 fair grazing conditions for livestock during spring, summer, and fall when in good ecological condition due to accessibility and nutritious forage. However, this site often lacks natural perennial water sources, which can influence the suitability grazing. Care should be taken to maintain the native perennial grasses and shrubs due to the poor suitability for re-seeding or restoring this site. The suitability for reseeding and/or restoration is poor due to the lack of precipitation at critical times and shallow soil characteristics.

The plant community is primarily shrubs, including Littleleaf mountain mahogany, mormontea, Utah serviceberry, long flower snowberry, and birchleaf mountain mahogany, which provide browse for cattle, sheep, and goats. Cattle will typically only use mormontea in the late fall and winter when nutrient needs can not be met by palatable shrubs and dormant grasses alone. The presence of grasses, including Indian ricegrass, galleta, and needleandthread provide grazing habitat for all classes of livestock. Utah juniper and pinyon pine provide good cover for livestock. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation must be made.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group D. Here runoff potential is high and infiltrations rates are relatively slow when the profile is wet, depending on slope and ground cover/health. This is explained by the shallow nature of the soils (NRCS National Engineering Handbook). 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. In areas similar to the reference state where ground cover is adequate infiltration is increase and runoff potential is decreased. In areas where ground cover is less than 50%, infiltration is reduced and run-off potential is increased. Heavy used by livestock affects hydrology in two ways. Trampling increased bulk density and breaks down soil aggregates. This results in decreased infiltration rates and increased runoff. Heavy grazing can alter the hydrology by decreasing plant cover and increasing bare ground. Fire can also affect hydrology, but it is variable. Fire intensity, fuel type, soil, climate, and topography can each have different

influences. Fire can increase areas of bare ground and hydrophobic layer that reduce infiltration and increase runoff.

Recreational uses

Recreation activities include aesthetic value and opportunities for camping, hiking and hunting. The more open canopy, gentle slopes, and proximity of this site to the canyon walls, makes this site popular for hiking trails. The tall trees and opens understory creates camp sites that provide shade and protection from the wind. Trees provide screening values for camping and picnicking. In addition, during certain years, this site provides good opportunities for pinyon nut collection.

Wood products

This site is a good site for gathering fence posts or firewood.

Other information

--Poisonous/Toxic Plant Communities--
Toxic plants associated with this site include woolly locoweed and broom snakeweed. 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 will typically only graze broom snakeweed when other forage is unavailable and generally 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, cool/cloudy days, and soils high in nitrogen and low in sulfur and phosphorus, all which cause increased nitrate accumulation. 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. (Knight and Walter, 2001)

--Invasive Plant Communities--
Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in semi-arid environments are the non-native 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.

Inventory data references

Data used to develop this site was collected in Natural Bridges National Monument and was associated with a soil survey update. All points where georeferenced and typically correlated to a soil observation. Data was collected in 2005-2007.

Type locality

Location 1: San Juan County, UT

UTM zone	N
UTM northing	4159500
UTM easting	587217
General legal description	Located in Natural Bridges National Monument; near histrock vistors' center; in the Mossback Butte USGS Quad.

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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)	Ashley Garrelts (NRCS) and Shane A. Green (NRCS)
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Date	11/17/2008
Approved by	Shane A. Green
Approval date	
Composition (Indicators 10 and 12) based on	Foliar Cover

Indicators

1. **Number and extent of rills:** Some rills are found throughout the site. Rills often begin at lower end of a water flow

pattern or below exposed bedrock where water has accumulated sufficiently to cause erosion. Several rills may connect. Rills may be actively eroding with sharp sides as much as 2 inches high. Most rills will be 6 inches or less wide. Rills may extend 20 or more feet in length. Number of rills will be greater on the steeper slopes (>20 %) associated with this site but length of rills may be less on these slopes (as gullies are more likely to form on steep slopes).

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2. **Presence of water flow patterns:** Water flow patterns frequently form on soil surface as water flows from exposed bedrock and from undisturbed areas of biological crusts but not at sufficient quantity to cause erosion. The spaces between biological crusts seem to serve as water storage and flow patterns. Water flow patterns are often connected forming a branching pattern. Water flow patterns may exceed 30 feet in length on gentle (<10 %) sloping land, growing longer on steeper slopes.

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3. **Number and height of erosional pedestals or terracettes:** Short pedestals are often found at plant bases growing along sides of rills, but there should be no exposed roots. The interspaces between well formed biological crusts give the appearance of pedestals. A few small (<1 sq ft.) teracettes form behind debris dams of small to medium sized branches in water flow patterns.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground in the reference state is expected to range from 5-10%. Except where covered by plant canopy cover, the primary areas of bare ground are in water flow patterns and rills. Note that much of the area is covered with biological crusts which should not be recorded as bare ground; however there are some areas of weakly developed crust that may function as bare ground (raindrop splash, runoff, etc.) and should be recorded as bare ground.

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5. **Number of gullies and erosion associated with gullies:** A few gullies are found throughout the site and begin where several rills converge or below exposed bedrock where sufficient water has accumulated to cause erosion. Gullies will deepen until bedrock is reached. Once bedrock is reached, a gully will continue to erode soil from the edges and become wider. Gullies will seldom be deeper than 20 inches because of shallow soil (<20 inches) depth. Gullies may be 4 or more feet wide.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** The occurrence of wind scoured, blowouts, and/or depositional areas are rare. Trees intercept wind and prevent wind generated soil movement.

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7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water movement and wind. Fine litter (<¼ inch in diameter) may be moved in water flow patterns and rills, with deposition occurring at obstruction. Sites with well developed crust cover, may exhibit litter being trapped by the crust pinnacles. The majority of litter accumulates at the base of plants or in soil depression adjacent to the plant. Woody stems (those greater than ¼ inch in diameter) are not likely to move under normal conditions. In areas below exposed bedrock, it is possible that gullies may remove litter from base of juniper and pinyon trees.

---

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 textures range from fine sandy loams to sandy loams.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface is 1-3 inches deep and structure is typically described as moderate very coarse platy parting to weak fine granular. The A-horizon color is a yellowish red (5YR5/6). 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.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The presence of perennial grasses, shrubs, trees and any well developed biological soil crusts (moss, pinnacled lichen, and light cyanobacteria) will break raindrop impact and splash erosion. The spatial distribution of vascular plants, non-vascular communities (when present), and interspaces provide detention storage and surface roughness that slows down runoff, allowing time for infiltration. The tree canopy is effective in intercepting rain drops and preventing splash erosion but configuration of crowns and litter accumulation under crowns forms micro-topography that may help accumulate water for more rapid runoff, particularly if bare soil lies below the outer edge of the canopy.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A compaction layer is not expected on this site; however, sandstone bedrock lies within 20 inches or less of the soil surface. Naturally occurring layers of hard calcium carbonate and/or unweathered parent material may also be found in the soil, but should not be considered a compaction layer.

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: 15-30% trees (e.g. Two Needle Pinyon and Utah Juniper)
    25-50% various species of biological crusts (e.g. moss, lichen, and cyanobacteria)
    5-10% evergreen shrubs (e.g. Littleleaf Mountain Mahogany)

    Sub-dominant: 10-20% deciduous shrubs (e.g. Utah Serviceberry; Birchleaf Mountain Mahogany; Long Flower Snowberry)
    15-20% perennial grasses (e.g. Indian Ricegrass, Galleta, and needleandthread)

    Other: Other forbs, shrubs, and grasses

    Additional: Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Mix of young, medium aged, and old pinyon and Utah juniper are expected to be found on this site. During years with average to above average precipitation, there should be very little mortality or decadence apparent in either shrubs or grasses. Old and young tree mortality and decadence naturally occurs during severe droughts. Insects and droughts may combine to increase death of pinyon. Insects may also cause some death and decadence of sagebrush during natural cycles.

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14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 1-5%. Most litter accumulates at below and

to the side of live plants, and thus percent litter will be just slightly above percent of canopy cover. Litter associated with forbs is less than .10 inches deep, while litter under shrubs is .25 to .5 inches deep and litter under trees is 100% and .5 to 1 inches deep. Bare interspaces of water flow patterns, rill, and gullies do not have litter except where debris dams occur. Very little litter is found on areas of biological crusts

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 350 to 450 pounds per acre in 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:** Known invasive species include cheatgrass (Bromus tectorum), broom snakeweed (Gutierrezia sarothrae), tansy mustard (Descurainia pinnata), annual stickseed (Lappula sp.), annual Cryptantha (Cryptantha sp.), and Russian thistle (Salsola tragus).

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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 during drought.

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18. **Supporting Data:** NRCS (Dana Truman) 2006 ESD data from Natural Bridges National Monument.
