USDA Natural Resources Conservation Service

Ecological site R035XY226UT
Semidesert Shallow Loam (Black Sagebrush/Indian Ricegrass)

Accessed: 05/18/2024

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 north western portion of MLRA 35, Colorado Plateau Province. It is found principally in the High Plateaus of Utah section 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.

Associated sites

R035XY209UT	**Semidesert Loam (Wyoming Big Sagebrush)**

Similar sites

R034BY227UT	**Semidesert Shallow Loam (Black Sagebrush)**
R028AY236UT	**Semidesert Shallow Loam (Black Sagebrush)**

Table 1. Dominant plant species

Tree	(1) *Juniperus osteosperma* (2) *Pinus edulis*
Shrub	(1) *artemisia nova* (2) *Purshia mexicana*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Pleuraphis jamesii*

Physiographic features

This ecological site typically occurs on dip slopes on cuestas, and on hillslopes on structural benches. Slope and aspect have only a minor influence the vegetative floristics of this ecological site. Runoff is typically medium to very rapid. Flooding and ponding are rare due to local landscape positions and the dry nature of the ecosystem. Slopes generally range from 2% to 30% but can range to 60%. Elevations range from 5000 to 5800 feet.

Table 2. Representative physiographic features

Landforms	(1) Cuesta (2) Structural bench (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	1,524–1,768 m
Slope	2–60%
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation is 9 to 13 inches. Approximately 75 percent occurs as rain from March through October. On the average, February, March and August are the wettest months and April, May and June are the driest. The mean annual air temperature is 45-48 degrees Fahrenheit. The average frost-free period is 155 to 176 days. Precipitation is extremely variable from month to month and from year to year. Much of the summer precipitation occurs as convection thunder storms.

Table 3. Representative climatic features

Frost-free period (average)	176 days
Freeze-free period (average)	205 days
Precipitation total (average)	330 mm

Influencing water features

There are no influencing water features associated with this site.

Soil features

This site occurs on very shallow to shallow soils. The dry surface layer color is typically reddish brown or brown and the surface soil textures range from flaggy loams to very stony fine sandy loams. These soils are moderatly well developed, well drained, and have moderate water holding capacities. Soil temperature regime is mesic and moisture regime is ustic aridic (torric). Erosion potential of soils on reference state sites typically depends on surface rock fragments. Sites with greater than 50% rock fragments have lower wind and water erosion potentials

than sites with less than 50% surface rock fragments. Biological crust cover is characterized as crustless with the possible occurrence of light cyanobacteria and/or isolated lichen and moss pinnacles. This site has been used in the following soils surveys and has been correlated to the following components:

UT685 - Capitol Reef - Mellenthin moist;
UT686—Escalante Grand Staircase National Monument— Mellenthin moist.

Typical Soil Profile: (Mellenthin, moist).
A—0-4 inches; very stony fine sandy loam; reddish brown (5YR 5/4); moderately calcareous; moderately alkaline.
Bk1—4-11 inches; very stony loam; reddish brown (5YR 5/4); very strongly calcareous; moderately alkaline.
Bk2-11-15 inches; very stony loam; pink (5YR 8/3);very strongly calcareous; moderately alkaline.
R—15 inches; sandstone.

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and shale (2) Colluvium–limestone
Surface texture	(1) Very cobbly loam (2) Extremely channery sandy loam (3) Extremely gravelly clay loam
Drainage class	Well drained
Permeability class	Moderate
Soil depth	10–51 cm
Surface fragment cover <=3"	35–40%
Surface fragment cover >3"	27–30%
Available water capacity (0-101.6cm)	1.02–3.56 cm
Calcium carbonate equivalent (0-101.6cm)	1–5%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–7.8
Subsurface fragment volume <=3" (Depth not specified)	15–28%
Subsurface fragment volume >3" (Depth not specified)	20–23%

Ecological dynamics

This site developed under Colorado Plateau ecological conditions and the natural influences of native herbivory, occasional fire and climate. Species composition is generally composed of an open canopy of Utah juniper, a few scattered two-needle pinyon may also be present. Shrub composition is mainly black sagebrush, Mexican cliffrose and both Utah and Nevada jointfir occurring most often. Perennial cool and warm season grasses dominate the herbaceous layer with Indian ricegrass, James galleta and blue grama most common.

This site is very resistant to disturbance. Fire is an integral part of the natural cycle of the plant community. Periodic fire decreases the abundance of Utah juniper and increases perennial grasses. Improper livestock grazing, (i.e., heavy grazing in late winter and early spring) decreases cool season grasses allowing warm season grasses to dominance. Further disturbance can allow for the invasion of undesirable introduced species (i.e., Russian thistle, cheatgrass and storksbill geranium) and for green rabbitbrush and broom snakeweed to increase.

Drought and insect damage appear to be a 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, which is 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. During periods with an absence of fire, Utah juniper will increase in dominance, reducing understory herbaceous species.

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 sites 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, they are 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

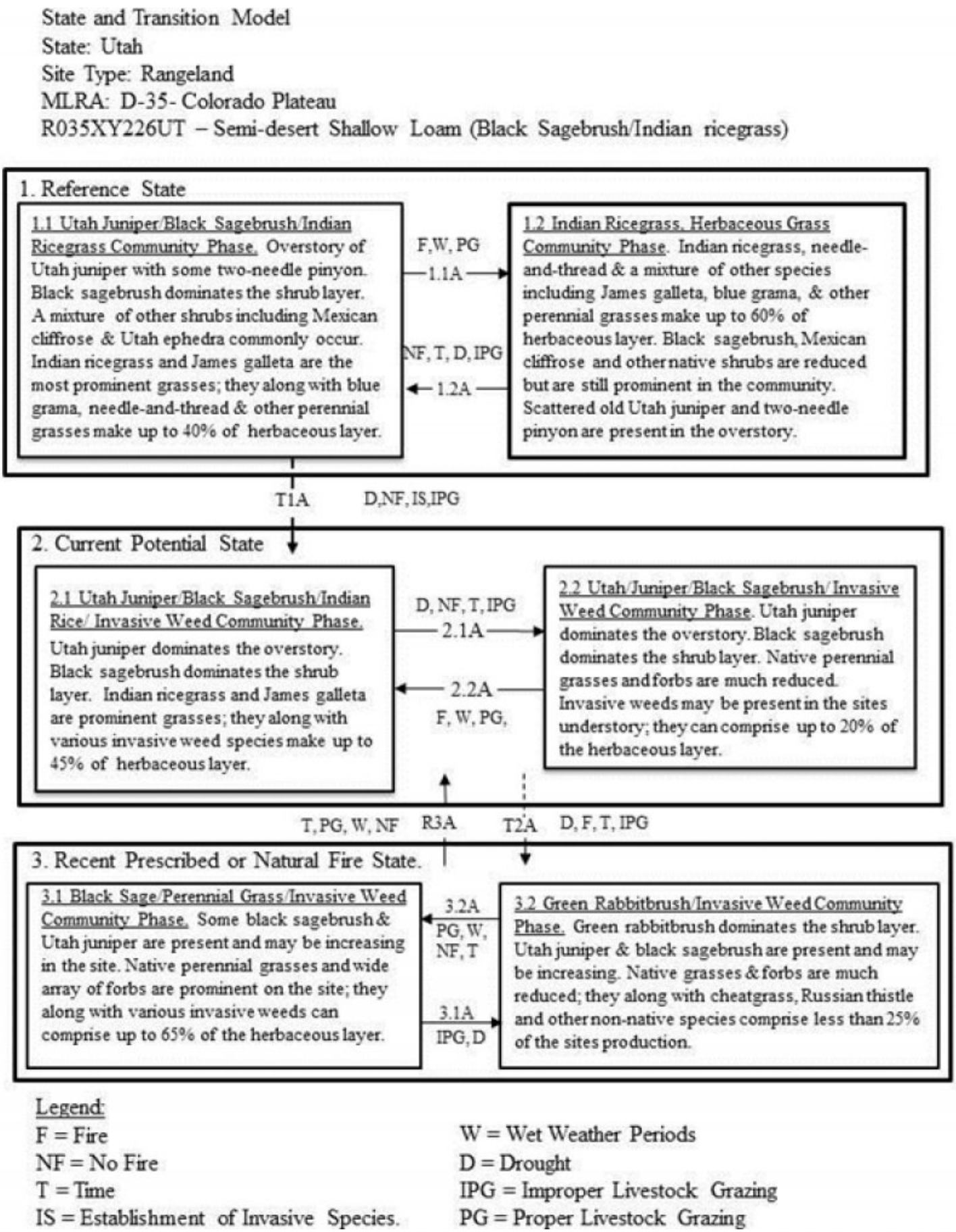


Figure 3. R035XY226UT

State 1
Reference State

This state describes the various biotic communities that are expected to be found on this ecological site under

natural conditions. This reference state has an overstory of scattered Utah juniper with a few two-needle pinyon present. There is a well developed shrub layer with black sagebrush dominating. Mexican cliffrose and Nevada jointfir are other common shrub species. Indian ricegrass is the dominant herbaceous species with James galleta and blue grama commonly occurring. Other native grasses, forbs, and shrubs will often produce a significant portion of vegetative composition in the plant community. This site occurs on 2 to 30% slopes (occasionally 60%) on all aspects. It is usually found on more cuestas and structural benches. Its soils are shallow to very shallow, well drained and typically gravelly loams in texture. The reference state is self-sustaining and resistant to change due to a good natural resilience to its natural disturbances. The primary natural disturbance mechanisms are wildlife population densities which can affect the shrub layer composition, weather fluctuations, and fire period. Definitions: Reference State: Natural plant communities as influenced by shrub canopy density, long term weather fluctuations, and periodic fire. Indicators: These communities are dominated by Utah juniper, black sagebrush and Indian ricegrass. The density of the tree and shrub canopy determines the amount and composition of the other native species present in the community. Feedbacks: Natural fluctuations in weather patterns that allow for a self-sustaining tree and shrub and native grass community. Prolonged drought, an increase in fire frequency, or other disturbances may allow for the establishment of invasive species. At-risk Community Phase: All communities are at risk when native plants are stressed and conditions are created that may allow invasive plants to establish. Trigger: The establishment of invasive plant species.

Community 1.1
Utah Juniper/Black Sagebrush/Indian Ricegrass

Figure 4. Community Phase 1.1

This community phase is characterized by an open canopy of Utah juniper with a few scattered two-needle pinyon. Black sagebrush and Mexican cliffrose are the most common understory shrubs. Commonly occurring grasses include Indian ricegrass, James galleta and blue grama. Other perennial grasses, shrubs, and forbs are also often present. Air dry composition of this site is approximately 10 percent forbs, 30 percent grasses, and 55 percent shrubs and 5% trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-50%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example of 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	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 6. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

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

Community 1.2
Indian Ricegrass Herbaceous Grass Community Phase.

Figure 6. Community Phase 1.2

The visual aspect of this reference community phase is dominated by Indian ricegrass and James galleta. Significant trees and shrubs are present and typically include Utah juniper, black sagebrush, Mexican cliffrose and Utah jointfir. Other commonly occurring grasses include needle and thread and blue grama. This site is early in its natural fire cycle and a slow transition from herbaceous species to woody species is occurring. The sites vegetative composition by air-dry weight is approximately 50 percent perennial grasses, 10 percent forbs, 30 percent shrubs

and 5% trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-50%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example of the typical vegetative floristics of a community phase 2.1 plant community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 9. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 10. Canopy structure (% cover)

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

Pathway 1.1A
Community 1.1 to 1.2

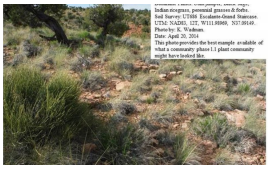
Utah Juniper/Black Sagebrush/Indian Ricegrass

Indian Ricegrass Herbaceous Grass Community Phase.

This pathway occurs when any combination of fire, wet weather cycles and good livestock management allow the perennial grasses to increase and Utah juniper, two-needle pinyon, black sagebrush and other shrubs to decrease.

Pathway 1.2A
Community 1.2 to 1.1

Indian Ricegrass Herbaceous Grass Community Phase.



Utah Juniper/Black Sagebrush/Indian Ricegrass

This community pathway occurs when any combination of extended drought, long periods without fire, and improper livestock grazing cause the perennial herbaceous community to become significantly reduced and Utah juniper and perennial shrubs to increase.

State 2
Current Potential State

The Current Potential State is similar to the Reference Sate except that non-native species are now present. This state describes the plant communities that may or have become established on this ecological site under various successional sequences and disturbance conditions. This state typically has a scattered overstory of Utah juniper with a few two-needle pinyon also present. Black sagebrush dominates the shrub layer. Mexican cliffrose and Nevada and/or Utah jointfir are other common shrub species. Indian ricegrass is the dominant herbaceous species with James galleta and other perennial grasses and forbs commonly found in abundance also. These other native grasses, forbs, and shrubs may produce significant composition in the plant community. Cheatgrass, Russian thistle, redstem storksbill, various mustard species and other non-native species are present on the site and under certain circumstances, may visually dominate the sites aspect. The primary disturbance mechanisms are the shrub layer density; the amount of invasive species present; weather fluctuations; and fire. The current potential state is still self-sustaining but may be losing its resistance to change due to the impact of disturbances with less resilience following those disturbances. Definitions: Current Potential State: Plant communities influenced by shrub canopy density, long term weather fluctuations, and periodic fire. Invasive species are present in various amounts. Indicators: A community dominated by Utah juniper, black sagebrush and Indian ricegrass. The density of the tree and shrub canopies determines the amount and composition of the other native and introduced grasses and forbs that may be present. Feedbacks: Natural fluctuations in weather patterns that allow for a self sustaining shrub and native grass community. Prolonged drought, more frequent fires, and/or other disturbances that may allow for the increase of invasive species. At-risk Community Phase: All communities are at risk when native plants are stressed and nutrients become available for invasive plants to increase. Trigger: A reduction of perennial grass and forb species combined with an increase of invasive plant species.

Community 2.1
Utah Juniper/Black Sagebrush/Indian Ricegrass/Invasive Weed Community Phase.

Figure 8. Community Phase 2.1

This community phase is characterized by an open canopy of Utah juniper with a few scattered two-needle pinyon. Black sagebrush and Mexican cliffrose are the most common understory shrubs. Commonly occurring grasses include Indian ricegrass, James galleta and blue grama. Other perennial grasses, shrubs, and forbs are also often present. Invasive weed species are now present in the community and may dominate the herbaceous layer. Air dry composition of this site is approximately 15 percent forbs, 30 percent grasses, and 55 percent shrubs and 5% trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-50%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example of 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	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 12. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 13. Canopy structure (% cover)

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

Community 2.2
Utah Juniper/Black Sagebrush/Invasive Weed Community Phase.

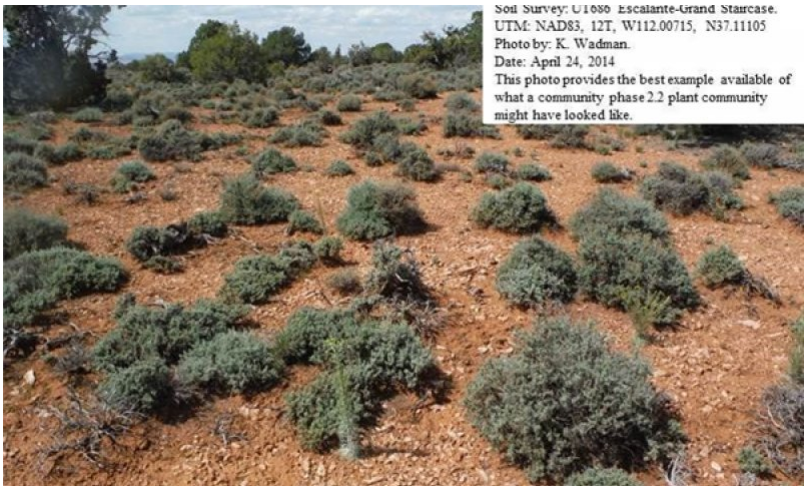


Figure 10. Community Phase 2.2

This community phase is characterized by a canopy of Utah juniper with a few scattered two-needle pinyon. Black sagebrush and Mexican cliffrose are the most common understory shrubs. Perennial grasses including Indian ricegrass, James galleta and blue grama are much reduced. Invasive weed species are present in the community and may dominate the herbaceous layer. Air dry composition of this site is approximately 25 percent forbs, 10 percent grasses, and 60 percent shrubs and 5% trees. Bare ground is variable (2-50%) depending on biological crust cover, which is also variable (1-25%) and surface rock fragments (0-50%). Biological crusts can vary from sites dominated by light cyanobacteria in the plant interspaces, with occasional moss and lichen pinnacles under shrub canopies, to those dominated by lichen and moss pinnacles as well as cyanobacteria in the site interspaces. The following tables provide an example of 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	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 15. Ground cover

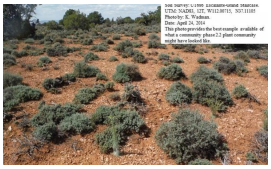
Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 16. Canopy structure (% cover)

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

Pathway 2.1A
Community 2.1 to 2.2

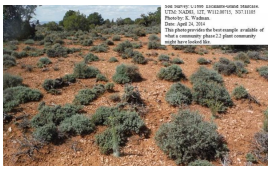
Utah Juniper/Black Sagebrush/Indian Ricegrass/Invasive Weed Community Phase.



Utah Juniper/Black Sagebrush/Invasive Weed Community Phase.

This community pathway occurs when any combination of extended drought, long periods without fire, and improper livestock grazing cause the perennial herbaceous community to become significantly reduced and Utah juniper and perennial shrubs to increase. Annual invasive species such as cheatgrass, Russian thistle, and ragweed species may increase during this time.

Pathway 2.2A
Community 2.2 to 2.1



Utah Juniper/Black Sagebrush/Invasive Weed Community Phase.

Utah Juniper/Black Sagebrush/Indian Ricegrass/Invasive Weed Community Phase.

This pathway occurs when any combination of fire, wet weather cycles and good livestock management cause the perennial grasses to increase and Utah juniper and black sagebrush to decrease. Invasive species, although still present, are reduced as a percentage of the herbaceous layer.

State 3
Recent Prescribed or Natural Fire State.

Natural or prescribed fire (rarely chaining)has removed the sites overstory Utah juniper and much the sites shrub layer. This state is now dominated by native and/or introduced herbaceous species for grass and/or forbs. Indian ricegrass and other native perennial grass species range from abundant to nearly missing depending on the site pre-fire condition. A wide array of native and/or invasive forbs may also be present. Invasive weedy species may include cheatgrass, Russian thistle, red-stem storksbill, various mustard species. The primary disturbance mechanisms include fire which removes or reduces the overstory Utah juniper and black sagebrush; amounts of invasive herbaceous species present; weather fluctuations, and fire patterns. This state is losing its resistance to change due to the impact of these disturbances and has less resilience following those disturbances. Definitions: Natural or prescribed fire state: Plant communities dominated by herbaceous grass and/or grass or forbs; long term weather fluctuations; and periodic fire timeframes. Indicators: The post-fire density of the tree and shrub canopies determines the amount and composition of the other native and introduced grasses and forbs that may be present. Feedbacks: Natural fluctuations in weather patterns that allow Utah juniper and black sagebrush to become reestablished and their impact the native or introduced herbaceous communities. Prolonged drought, more frequent reburns, and/or other disturbances that allow for the increase of all invasive species. At-risk Community Phase: All communities are at risk when native plants are stressed and nutrients become available for invasive plants to increase. Trigger: A reduction of perennial grass and forb species combined with an increase of invasive plant species.

Community 3.1
Black Sage/Perennial Grass/Invasive Weed Community Phase.

Figure 12. Community Phase 3.1

Site has been burned, removing much of the overstory Utah juniper. Black sagebrush is present in varying amounts and may be increasing. Mexican cliffrose and other shrubs may or may not be present. Native perennial grasses maybe abundant or may be much reduced depending on pre-fire conditions. The site is typically seeded to crested or intermediate wheatgrass. Non-native species are present on the site and will be present in the seeded community. Utah juniper seedlings are also typically present in the post-fire community and may need follow-up treatment. The sites vegetative composition by air-dry weight is approximately 65 percent grasses and introduced

weedy species, 10 percent forbs, 20 percent shrubs and 5% trees. The following tables provide an example of the typical vegetative floristics of a community phase 3.1 plant community.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 18. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 19. Canopy structure (% cover)

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

Community 3.2
Green Rabbitbrush/Invasive Weed Community Phase.

Figure 14. Community Phase 3.2

Site has been burned, removing much of the old Utah juniper overstory. Green rabbitbrush and/or broom snakeweed have been released by the fire and dominate the sites aspect. Utah juniper and Black sagebrush seedlings are present in varying amounts and may be increasing. Mexican cliffrose and other shrubs may or may not be present. Native perennial grasses are much reduced. The site is often seeded to crested or intermediate wheatgrass. Non-native species are present on the site and will be present in the seeded community. Utah juniper seedlings are also typically present in the post-fire community and may need follow-up treatment. The sites vegetative composition by air-dry weight is approximately 25 percent grasses and introduced weedy species, 10 percent forbs, 60 percent shrubs and 5% trees. The following tables provide an example of the typical vegetative floristics of a community phase 3.2 plant community.

Table 20. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	185	247	308
Grass/Grasslike	101	135	168
Tree	34	45	56
Forb	17	22	28
Total	**337**	**449**	**560**

Table 21. Ground cover

Tree foliar cover	5-10%
Shrub/vine/liana foliar cover	30-35%
Grass/grasslike foliar cover	10-15%
Forb foliar cover	5-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 22. Canopy structure (% cover)

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

Pathway 3.1A
Community 3.1 to 3.2

Black Sage/Perennial Grass/Invasive Weed Community Phase.

Green Rabbitbrush/Invasive Weed Community Phase.

This community pathway occurs when any combination of extended drought, long periods without additional fire, and improper livestock grazing cause the perennial herbaceous community to become significantly reduced and Utah juniper, green rabbitbrush and other perennial shrubs to increase.

Pathway 3.2A
Community 3.2 to 3.1

Green Rabbitbrush/Invasive Weed Community Phase.

Black Sage/Perennial Grass/Invasive Weed Community Phase.

This pathway occurs when any combination of no fire, wet weather cycles and good livestock management cause the perennial grasses to increase and Utah juniper and green rabbitbrush to decrease. Invasive species, although still present, are reduced as a percentage of the herbaceous layer.

Transition T1A
State 1 to 2

This transitional pathway occurs when any combination of extended drought, fire, and improper livestock grazing cause the perennial herbaceous community to become significantly reduced and non-native species such as cheatgrass, russian thistle and ragweed species to become established. Broom snakeweed may also increase during this time. Once invasive species occupy the site, a threshold has been crossed.

Transition T2A
State 2 to 3

This transitional pathway occurs when any combination of extended drought, fire, and improper livestock grazing, over long periods of time, cause the perennial herbaceous community to become significantly reduced and non-

native species such as cheatgrass, Russian thistle and ragweed species to increase. Green rabbitbrush may also increase during this time and dominate the shrub layer. Utah juniper is removed or much reduced in the overstory. Once invasive species and/or green rabbitbrush dominate, a threshold has been crossed.

Restoration pathway R3A
State 3 to 2

This restoration pathway occurs when any combination of no fire, wet weather cycles and good livestock management cause the perennial grasses to increase. Utah juniper and black sagebrush also increase while green rabbitbrush decreases. Invasive species, although still present, are reduced as a percentage of the herbaceous layer.

Additional community tables

Table 23. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			84–168	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	34–101	–
	James' galleta	PLJA	*Pleuraphis jamesii*	28–56	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–34	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
Forb					
3	**Sub-Dominant Forbs**			56–90	
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–

	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–
Shrub/Vine					
4	**Dominant Shribs**			168–280	
	black sagebrush	ARNO4	*Artemisia nova*	112–202	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5				56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Table 24. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			140–252	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	101–135	–
	James' galleta	PLJA	*Pleuraphis jamesii*	56–78	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–34	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
Forb					

3	**Sub-Dominant Forbs**			56–90	
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–
	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–
Shrub/Vine					
4	**Dominant Shribs**			84–140	
	black sagebrush	ARNO4	*Artemisia nova*	56–84	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5				56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Table 25. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			84–168	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	34–101	–
	cheatgrass	BRTE	*Bromus tectorum*	34–67	–
	James' galleta	PLJA	*Pleuraphis jamesii*	28–56	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–34	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
Forb					
3	**Sub-Dominant Forbs**			84–140	
	Russian thistle	SAKA	*Salsola kali*	22–45	–
	western tansymustard	DEPI	*Descurainia pinnata*	22–45	–
	herb sophia	DESO2	*Descurainia sophia*	22–45	–
	redstem stork's bill	ERCI6	*Erodium cicutarium*	22–45	–
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–
	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–

Shrub/Vine					
4	**Dominant Shribs**			168–280	
	black sagebrush	ARNO4	*Artemisia nova*	112–202	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5				56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Table 26. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			28–84	
	cheatgrass	BRTE	*Bromus tectorum*	34–67	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	11–34	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–22	–
	James' galleta	PLJA	*Pleuraphis jamesii*	11–22	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
Forb					
3	**Sub-Dominant Forbs**			84–140	
	Russian thistle	SAKA	*Salsola kali*	22–45	–
	western tansymustard	DEPI	*Descurainia pinnata*	22–45	–
	herb sophia	DESO2	*Descurainia sophia*	22–45	–

	redstem stork's bill	ERCI6	*Erodium cicutarium*	22–45	–
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–
	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–
Shrub/Vine					
4	**Dominant Shribs**			196–336	
	black sagebrush	ARNO4	*Artemisia nova*	168–258	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5				56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Table 27. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			252–364	
	crested wheatgrass	AGCR	*Agropyron cristatum*	112–224	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	112–224	–
	intermediate wheatgrass	THIN6	*Thinopyrum intermedium*	112–224	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	101–135	–
	James' galleta	PLJA	*Pleuraphis jamesii*	56–78	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–34	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
Forb					
3	**Sub-Dominant Forbs**			56–90	
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–
	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–
Shrub/Vine					
4	**Dominant Shribs**			84–140	

	black sagebrush	ARNO4	*Artemisia nova*	56–84	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5				56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Table 28. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Dominant Grasses**			140–252	
	crested wheatgrass	AGCR	*Agropyron cristatum*	56–84	–
	Russian wildrye	PSJU3	*Psathyrostachys juncea*	56–84	–
	intermediate wheatgrass	THIN6	*Thinopyrum intermedium*	56–84	–
	James' galleta	PLJA	*Pleuraphis jamesii*	56–78	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	34–67	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–34	–
	squirreltail	ELEL5	*Elymus elymoides*	11–34	–
2	**Sub-Dominant Grasses**			56–112	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–45	–
	Grass, perennial	2GP	*Grass, perennial*	11–34	–
	purple threeawn	ARPU9	*Aristida purpurea*	11–22	–
	Grass, annual	2GA	*Grass, annual*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–22	–
Forb					
3	**Sub-Dominant Forbs**			56–90	
	Forb, perennial	2FP	*Forb, perennial*	11–17	–
	Holboell's rockcress	ARHO2	*Arabis holboellii*	6–11	–
	freckled milkvetch	ASLE8	*Astragalus lentiginosus*	6–11	–

	woolly locoweed	ASMO7	*Astragalus mollissimus*	6–11	–
	winding mariposa lily	CAFL	*Calochortus flexuosus*	6–11	–
	splitleaf Indian paintbrush	CARH4	*Castilleja rhexiifolia*	6–11	–
	maiden blue eyed Mary	COPA3	*Collinsia parviflora*	6–11	–
	Brenda's yellow cryptantha	CRFL5	*Cryptantha flava*	6–11	–
	cushion buckwheat	EROV	*Eriogonum ovalifolium*	6–11	–
	shaggy fleabane	ERPU2	*Erigeron pumilus*	6–11	–
	ballhead ipomopsis	IPCOC3	*Ipomopsis congesta ssp. congesta*	6–11	–
	Utah desertparsley	LOPA	*Lomatium parryi*	6–11	–
	woolly groundsel	PACA15	*Packera cana*	6–11	–
	cleftleaf wildheliotrope	PHCRC	*Phacelia crenulata var. corrugata*	6–11	–
	spiny phlox	PHHO	*Phlox hoodii*	6–11	–
	longleaf phlox	PHLO2	*Phlox longifolia*	6–11	–
	gooseberryleaf globemallow	SPGR2	*Sphaeralcea grossulariifolia*	6–11	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	6–11	–
	Forb, annual	2FA	*Forb, annual*	6–11	–
Shrub/Vine					
4	**Dominant Shribs**			196–252	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	168–224	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	56–112	–
	black sagebrush	ARNO4	*Artemisia nova*	56–84	–
	Mexican cliffrose	PUME	*Purshia mexicana*	34–67	–
	mormon tea	EPVI	*Ephedra viridis*	22–34	–
5	**Sub-Dominant Shrubs**			56–112	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	11–22	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	11–22	–
	crispleaf buckwheat	ERCO14	*Eriogonum corymbosum*	11–22	–
	spiny hopsage	GRSP	*Grayia spinosa*	11–22	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	11–22	–
	Great Basin fishhook cactus	SCPU6	*Sclerocactus pubispinus*	11–22	–
	narrowleaf yucca	YUAN2	*Yucca angustissima*	11–22	–
Tree					
6	**Dominant Trees**			34–67	
	Utah juniper	JUOS	*Juniperus osteosperma*	28–50	–
	twoneedle pinyon	PIED	*Pinus edulis*	11–22	–

Animal community

--Grazing Interpretations--

This site provides good spring, fall, and winter grazing conditions for domestic livestock due to its accessibility and

its supply of nutritious forage. The herbaceous plant community is primarily grasses, with the majority of canopy cover being attributed to Indian ricegrass and James galleta. Improper livestock grazing can cause these species to decrease while annual forbs, black sagebrush and rabbitbrush species increase.

When this site is stressed, cheatgrass, alyssum, Russian thistle and halogeton are likely to invade.

--Wildlife Interpretation--

This ecological site, in its reference state, produces significant amounts of nutritious forage that was utilized by native herbivores including Rocky Mountain elk, mule deer and pronghorn antelope who lived here along their associated predators. Although much of this site is presently different from the reference state, it is still very important as wildlife habitat. Other wildlife commonly observed using this site include mountain lions, rabbits, coyotes, badgers, and red fox"s.

This site also provides habitat to raptors and other bird species including golden eagles, red-tailed hawks, ferruginous hawks, and several species of owls. Ringneck pheasant, sage grouse, chukars, and California quail are also commonly found.

Hydrological functions

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

Recreational uses

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

Wood products

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

Other information

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

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

Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however, cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep generally will only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest (Knight and Walter, 2001).

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

--Invasive Plant Communities--
Generally, as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses may invade the site. Of particular concern in semi-arid environments are annual invaders including cheatgrass, Russian thistle, redstem storksbill and annual mustards. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult, but suppression may be possible.

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

--Fire Ecology--
The ability for an ecological site to carry fire depends primarily on its" present fuel load and plant moisture content. Sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. The two-needle pinyon and Utah juniper communities growing on shallow soils are quite unique. These trees can support stand-replacing fires, though historically, fires were likely a mixture of surface and crown fires with intensities and frequencies dependent on site productivity. Most research agrees that historic fire return intervals are at a minimum 100 years, indicating that fire may have not played an important role in short term community dynamics. Fires are more common when trees are stressed or dead due to drought and/or beetle infestations. Pinyon-juniper stands reestablish either by seeds dispersed from adjacent unburned patches or by unburned seeds found at the burn site. Continuous (every 20-40 years) burning of these ecological sites can result in shrub dominated communities, due to the relatively fast recovery of shrubs when compared to trees. If invasive annual grasses are allowed to establish, fires may become more frequent, inhibiting the site’s ability to recover.

Other references

Relative Forage Preference of Plants for Grazing Use by Season: Plants commonly found in Major Land Resource Area D35 --The Colorado Plateau. 2007

Stubbendieck, J., S. L. Hatch, and C. H. Butterfield. 1997. North American range plants. Lincoln, NE: University of Nebraska Press. 501p.

USDA, Forest Service. 2007. Fire effects information: plant species life form. Available at http://www.fs.fed.us/database/feis/plants/index.html. Accessed 7 August 2007.

Knight, A. P. and R. G. Walter. 2001. A guide to plant poisoning of animals in North America. Jackson, WY: Teton NewMedia. 367p.

USDA, Forest Service. 2007. Fire effects information: plant species life form. Available at http://www.fs.fed.us/database/feis/plants/index.html. Accessed 7 August 2007.

Contributors

Susanne Mayne
V. Keith Wadman

Rangeland health reference sheet

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

Author(s)/participant(s)	Robert Stager (BLM), F.E. Busby (USU), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS), adapted to this site and revised to include updated terminology and concepts by V. Keith Wadman (NRCS Retired).
Contact for lead author	shane.green@ut.usda.gov
Date	05/03/2014
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Very few rills present. Some very minor rill development may occur on steeper slopes or on areas located below exposed bedrock or other water shedding areas where increased runoff may occur. Any rills present should be <1 inch deep, fairly short (<8 feet long) and somewhat widely spaced (6-8 feet). Minor rill development may be observed following major thunderstorm or spring runoff events but should heal during the next growing season.

---

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

---

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

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 15–30%. (Soil surface is typically covered 0-20% surface fragments). Most bare ground is associated with water flow patterns, rills, and gullies. Poorly developed biological soil crusts that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover.

---

5. **Number of gullies and erosion associated with gullies:** None to rare on gentle slopes (< 15%). On steeper slopes and areas below adjacent exposed bedrock, gullies may occur. Length often extends from exposed bedrock until gully reaches a stream or an area where water and sediment accumulate. Gullies may show slightly more indication of erosion

as slope increases, or as the site occurs adjacent to steep sites/watershed with concentrated flow patterns.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Trees break the wind and reduce the potential for wind erosion. The gravel on the soil surface help armor it and reduce the potential for wind erosion.

---

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water movement. Minor litter removal may occur in flow channels with deposition occurring within 1 to 2 feet at points of obstruction. The majority of litter accumulates at the base of plants. Some grass leaves and small twigs (grass stems) may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes >15% and/or increased runoff resulting from heavy thunderstorms.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have an erosion rating of 4 or 5 under the plant canopies, and a rating of 3 to 4 in the interspaces. The average should be a 4. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** (Mellenthin, moist). Soil surface horizon is typically 0 to 4 inches deep. Structure is typically weak medium platy. Color is typically dark reddish brown (5YR 5/4). Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Spatial distribution of well developed biological soil crusts (where present) intercept raindrops reducing splash erosion and provide areas of surface detention to store water allowing additional time for infiltration. Crowns of trees and accumulating litter at base of trees appear to create a micro-topography that may enhance development of water flow patterns below the drip line of the canopy. Significant increases in Pinyon-juniper canopy (beyond the reference state) reduces understory vegetation causing an associated increase in runoff.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None, although bedrock is typically found from 6 to 15 inches of soil surface. In addition, there may be layers of calcium carbonate or other naturally occurring hard layers found in the soil subsurface. These should not be considered to be compaction layers.

---

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

    Dominant: Trees (two-needle pinyon/Utah juniper) > Sprouting shrubs (black sage)> cool season perennial grasses (Indian ricegrass).

    Sub-dominant: warm season perennial grasses (James galleta, blue grama) > forbs (woolypod locoweed, cushion phlox) > biological soil crusts.

    Other: Functional/structural groups may appropriately contain non-native species if their ecological function is the same

as the native species in the reference state (e.g. crested wheatgrass, intermediate wheatgrass, and siberian wheatgrass) Biological soil crust is variable in its expression where present on this site and is measured as a component of ground cover. Forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.

Additional: Factors contributing to temporal variability include insects and other pathogens (mistletoe), drought, extreme precipitation events, etc. Factors contributing to spatial variability include slope, amount of rock fragments, aspect, etc. Following a recent disturbance such as fire, drought or insects that may remove the woody vegetation, forbs and perennial grasses (herbaceous species) may become more dominate in the community. These conditions may reflect a functional community phase within the reference state.

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** During years with average to above-average precipitation, there should be very little recent mortality or decadence apparent in trees, shrubs, or grasses. During severe (multi-year) drought up to 20% of the pinyons and junipers may die, either from drought, insect damage or pathogens such as mistletoe. There may be partial mortality of individual bunchgrasses and other shrubs during drought. Some bunchgrass and shrub mortality may occur during severe droughts, particularly on the shallower and coarser soils associated with this site. Because woody stems may persist for many years, both pinyons and junipers (especially older trees) will normally have dead stems within the plant canopy.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover (including under plants) nearly all of which should be fine litter. Depth should be 1 leaf thickness in the interspaces and up to ¼" under canopies, and up to ¾" under tree canopies. Litter cover may increase to 30% on some years due to increased production of plants.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production in air-dry herbage should be approximately 400 - 500#/acre on an average year, but could range from 300 to 600#/acre during periods of prolonged drought or above average precipitation.

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Few invasive species are capable of dominating this site. When invasion does occur, cheatgrass, and mustard species are the most likely species to invade.

---

17. **Perennial plant reproductive capability:** All perennial plants should have the ability to reproduce in all years, except in extreme drought years. There are no restrictions on either seed or vegetative reproduction. Some seedling recruitment of major species is present during average and above average growing years.
