USDA Natural Resources
Conservation Service

# Ecological site R035XY130UT
# Desert Shallow Sandy Loam (Shadscale)

Accessed: 06/30/2024

## General information

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

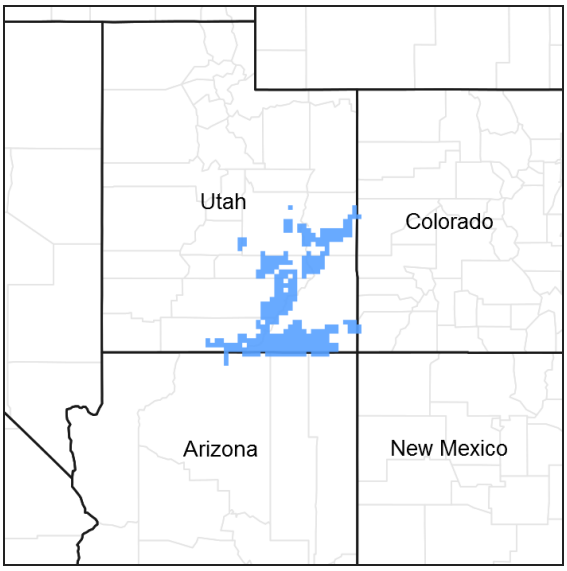



**Figure 1. Mapped extent**

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

## MLRA notes

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

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

## Classification relationships

Modal Soil: Farb FSL — loamy, mixed (calc.), mesic Lithic Torriorthents

Type Location: Lime Ridge, Gooseneck Park.
This was the type location in the old version of the site description authored by George Cook.

## Associated sites

| | |
|---|---|
| R035XY109UT | **Desert Loam (Shadscale)** |
| R035XY121UT | **Desert Sandy Loam (Blackbrush)** |

| | |
|---|---|
| R035XY122UT | **Desert Shallow Loam (Shadscale)** |
| R035XY124UT | **Desert Shallow Clay (Mat Saltbush)** |
| R035XY136UT | **Desert Stony Loam (Shadscale-Bud Sagebrush)** |

## Similar sites

| | |
|---|---|
| R035XY133UT | **Desert Shallow Sandy Loam (Blackbrush)**<br>Many times the desert shallow blackbrush and desert shallow shadscale sites are intermixed and overlap is common. The key difference is the dominant shrub species. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | (1) *Atriplex confertifolia*<br>(2) *Ephedra torreyana* |
| Herbaceous | (1) *Pleuraphis jamesii*<br>(2) *Eriogonum inflatum* |

## Physiographic features

This site occurs on mesas, benches, hillslopes, pediments, valleys, cuestas, and ridges. Run off is medium to high and is often influenced by micro-topography. Typically slopes range from 2-15% however sites have been mapped on slopes up to 50%.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Mesa<br>(2) Cuesta<br>(3) Structural bench |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 3,000–6,800 ft |
| Slope | 2–15% |
| Ponding depth | 0 in |
| Aspect | Aspect is not a significant factor |

## Climatic features

The climate is characterized by hot summers and cool to warm winters, which can be slightly modified by local topographic conditions, such as aspect. Large fluctuations in daily temperatures are common. Mean annual high temperatures range from 67-75 degrees Fahrenheit and mean annual low temperatures range from 35-50 degrees Fahrenheit. Approximately 65-70% of moisture occurs as rain from July-November, mostly as convection thunderstorms and snow. Precipitation is variable from month to month and from year to year but averages between 5-8 inches. Snow packs when present are generally light and not persistent.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 180 days |
| Freeze-free period (average) | 240 days |
| Precipitation total (average) | 8 in |

## Influencing water features

There are no water feature indluencing this site.

## Soil features

The soils are very shallow to shallow, weakly to moderately developed, and well drained. Typically the dry surface is light reddish brown to dark reddish brown. Soils generally have low wind and water erosion potential due to abundant rock fragments that protect the surface soils. Soil surface fragments range from 25-75%. The soil temperature and moisture regimes are mesic and typic aridic respectively. Surface and subsurface textures are generally loamy sands, channery loams, or gravelly sandy loams. Soils are nonsaline and the water holding capacity is low. Biological crust cover is characterized as a weak crust, with light cyanobacteria and/or isolated moss clumps with no continuity. This site has been used in the following soil surveys and has been correlated to the following components:

UT631 – Henry Mountains Area – Moenkopie; Farb;
UT643 – San Juan County, Navajo Indian Reservation – Lithic Torriorthents; Moenkopie; Pickrell;
UT633 – Canyonlands Area – Lithic Torriorthents;
UT638 – San Juan County, Central – Limeridge; Moenkopie;
UT624 – Grand County, Central – Moenkopie;
UT685 – Capital Reef National Park – Moenkopi;

Typical Profile:
A – 0-2 inches; channery/gravelly loamy sand; strongly calcareous; moderately alkaline
C – 2-9 inches; channery/gravelly fine sandy loam; strongly calcareous; moderately alkaline
2R – 9+ inches; sedimentary parent material

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Residuum–sandstone and shale |
| Surface texture | (1) Gravelly fine sandy loam<br>(2) Loamy sand<br>(3) Gravelly sandy loam |
| Family particle size | (1) Sandy |
| Drainage class | Well drained |
| Permeability class | Moderate to moderately rapid |
| Soil depth | 4–20 in |
| Surface fragment cover <=3" | 25–75% |
| Surface fragment cover >3" | 0–20% |
| Available water capacity (0-40in) | 0.6–2.2 in |
| Calcium carbonate equivalent (0-40in) | 5–30% |
| Electrical conductivity (0-40in) | 0–4 mmhos/cm |
| Sodium adsorption ratio (0-40in) | 0–5 |
| Soil reaction (1:1 water) (0-40in) | 7.4–9 |
| Subsurface fragment volume <=3" (Depth not specified) | 5–30% |
| Subsurface fragment volume >3" (Depth not specified) | 0–5% |

## Ecological dynamics

This site developed under the Colorado Plateau climatic conditions and included the natural influences of herbivory and climate. The site is dominated by shadscale, Torrey's jointfir is also commonly present. Cool season grasses, such as Indian ricegrass, are more prevalent in sites found on soils with more structural development. For example sites mapped on Lime Ridge, near Bluff, UT, found on Limeridge soils, which have more development, are dominated by Indian ricegrass, James galleta, and shadscale. Conversely, sites mapped on the White Rim of Canyonlands National Park, near Moab, UT, found on Moenkopie and Tsaya soils, which are very weakly developed, are dominated by James galleta and shadscale. Indian ricegrass may or may not be present. The desert shallow sandy loam shadscale site is exposed to fairly harsh conditions and soils with more development generally have higher water holding capacities, which enable vegetation to be more productive.

The most prominent disturbance regime associated with this site is weather. During periods of drought perennial warm and cool season grasses decrease, while periods of normal and above average precipitation result in an increase in perennial warm and cool season grasses. Shrub cover is generally similar under both climatic conditions; however, annual production decreases during drought. There is little natural herbivory on the site due to the lack of cover available to wildlife species.

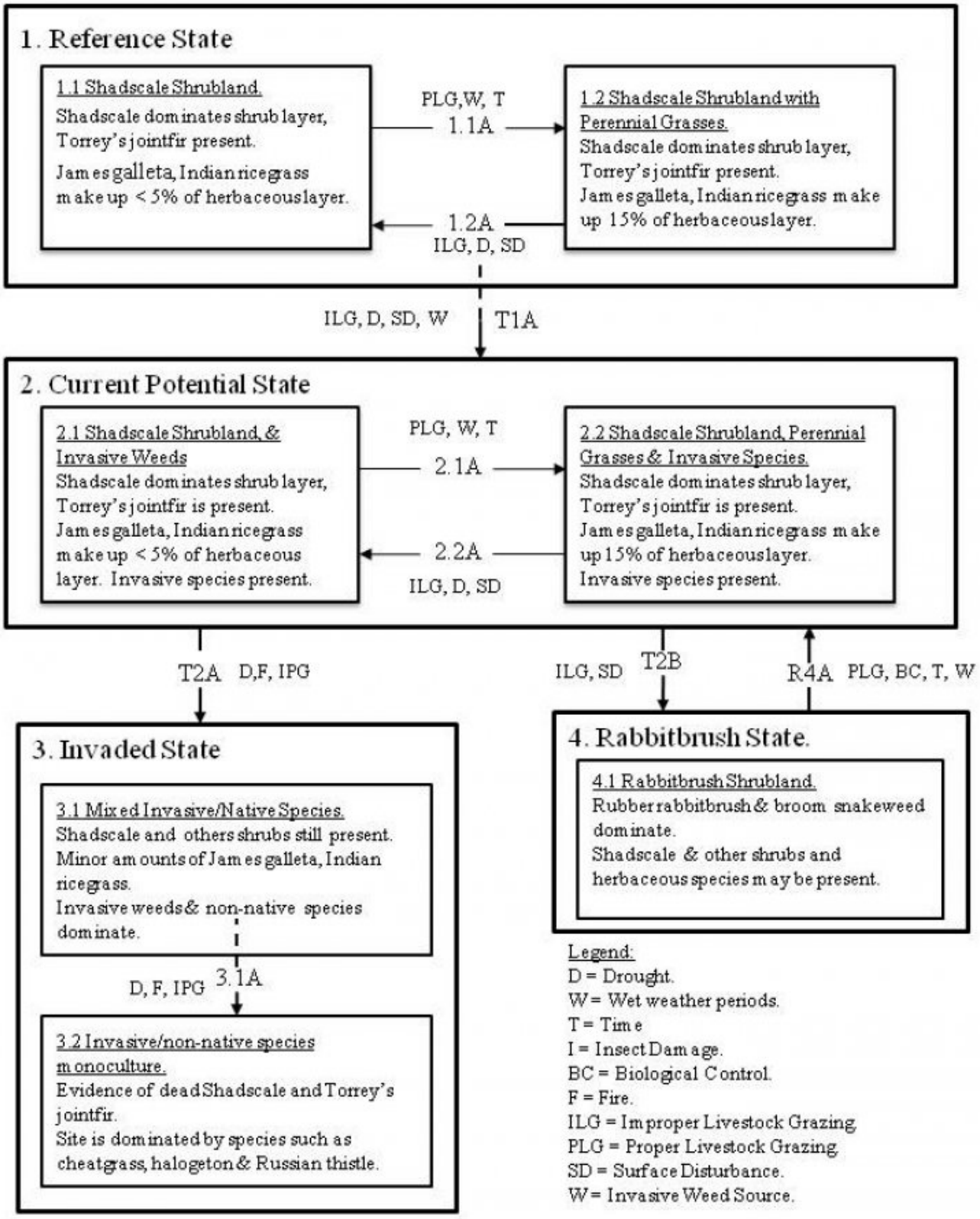
This ecological site has been grazed by domestic livestock since they were first introduced into the area. This livestock introduction, and the use of fencing and reliable water sources, has influenced the disturbance regime historically associated with this ecological site. This site often serves as important wintering pastures for sheep and cattle. Improperly managed livestock grazing (continuous season long grazing, heavy stocking rates, etc.) may cause this site to depart from the reference plant community. When this occurs, any native perennial grasses present can decrease while invasive forbs, annual grasses, rabbitbrush and broom snakeweed can increase. Shadscale, due to its spinescent nature, is resistant to moderate browsing pressures, however, improper grazing may stress this species and allow nutrients to become available for invasive species to utilize (Simonin, 2001). Timing of grazing also affects the sites ecological dynamics, for example, spring grazing can result in a decline of cool season grasses, while heavy summer/early fall grazing can result in a decline of warm season grasses.

When vegetation communities respond to changes in management or to natural influences which move them to different ecological states, a return to previous states may not be possible. The amount of energy needed to affect vegetative shifts depends on present biotic and abiotic features and the desired results.

The following state and transition model diagram depicts most commonly occurring plant community states and phases, and community and transitional pathways identified on this site. These plant communities may not represent every possibility, but they are the most prevalent and repeatable. As more data are collected, some of these plant communities may be revised or removed, and new ones may be added. This model was developed using range data collected in 2006 and 2007 in Canyonlands National Park in Southeastern Utah as part of a national park soil survey update. Both ocular and measured data was collected and utilized. Range data collected by the NRCS (1982) was also used.

## State and transition model

State and Transition Model
State: Utah
Site Type: Rangeland
MLRA: D-35- Colorado Plateau
R035XY130UT – Desert Shallow Sandy Loam (Shadscale).




**State 1**
**Reference State**

The reference state was determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under land use influences, such as grazing and recreation. Literature reviews, trends in plant community dynamics, and historical accounts are also considered. The reference state represents the historic plant communities and natural ecological dynamics of the desert shallow sandy loam, shadscale site. This state includes the biotic communities that become established on the ecological site if all successional sequences are completed under current climatic conditions; natural disturbances are inherent in its development. This state is dominated by warm season perennial grasses and shadscale. Perennial cool season grasses may or may not be present depending on soil development. The primary disturbance mechanism is weather fluctuations. The reference state is self sustaining and resistant to change due to high resistance to natural disturbances and high resilience following natural disturbances. When natural disturbances occur, the rate of recovery is relatively rapid due to niches being filled with highly adapted native vegetation. Reference State: Community phases disturbed by climate fluctuations. Indicators: A site dominated by shadscale and galleta, where Indian ricegrass and sand dropseed may or may not be present. Feedbacks: Extended drought resulting in a reduction of native perennial plant vigor. Normal fluctuations in weather allowing for the maintenance of both shrubs and perennial grasses. At-risk Community Phase: All communities are at risk when nutrients are available for invasive plants to establish. Plant community 1.1 is especially at risk due to limited production and cover of understory grasses. Trigger: Introduction of invasive plants to fill available niches.

## Community 1.1
## Shadscale Shrubland

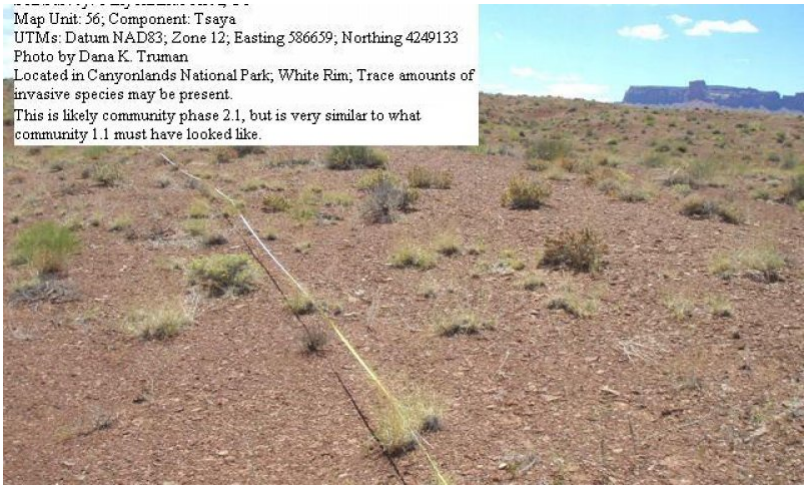



**Figure 4. Shadscale Shrubland**

This plant community phase is dominated by shadscale and Torrey's jointfir, warm and cool season perennial grasses are present in varing amounts. Grasses may include but are not limited to, Indian ricegrass, James galleta, and sand dropseed. James galleta is typically the dominant species in this plant community phase. Desert trumpet is typically the dominant forb present. Other perennial grasses, shrubs, and forbs may also be present and cover is variable. Bare ground is (10-30%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and/or channers. 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 (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 100 | 150 | 200 |
| Grass/Grasslike | 50 | 75 | 100 |
| Forb | 10 | 30 | 50 |
| **Total** | **160** | **255** | **350** |

**Table 6. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |

| | |
|---|---|
| Shrub/vine/liana basal cover | 10-25% |
| Grass/grasslike basal cover | 10-20% |
| Forb basal cover | 2-10% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 1-8% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-5% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-30% |

**Table 7. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 1-5% | 1-5% |
| >0.5 <= 1 | – | 1-10% | 1-10% | 2-10% |
| >1 <= 2 | – | 5-15% | 1-5% | – |
| >2 <= 4.5 | – | 0-5% | 0-5% | – |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

## Community 1.2
## Shadscale Shrubland & Grasses

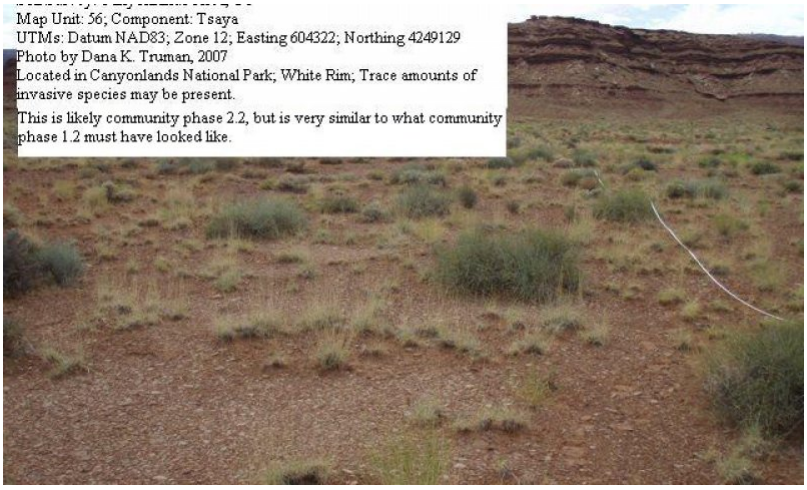



**Figure 6. Shadscale Shrubland with Perennial Grasses**

This plant community phase is dominated by shadscale, Torrey's jointfir, and perennial grasses. Grasses may include, but are not limited to, Indian ricegrass, James galleta, and sand dropseed. James galleta is typically the dominant species in this plant community phase. Other perennial grasses may also be present depending on harshness of the soil conditions. Desert trumpet is typically the dominant forb; however, other perennial shrubs, and forbs may be present and cover is variable. Bare ground is (10-30%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface

rock fragments (20-60%) can be very prevalent and are characterized by gravels, cobbles, and/or channers. The following tables provide an example of the typical vegetative floristics of a community phase 1.2 plant community.

**Table 8. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 100 | 150 | 200 |
| Grass/Grasslike | 50 | 100 | 150 |
| Forb | 10 | 30 | 50 |
| **Total** | **160** | **280** | **400** |

**Table 9. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 10-25% |
| Grass/grasslike basal cover | 15-25% |
| Forb basal cover | 2-10% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 1-8% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-30% |

**Table 10. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 1-5% | 1-5% |
| >0.5 <= 1 | – | 1-10% | 5-15% | 2-10% |
| >1 <= 2 | – | 5-15% | 1-10% | – |
| >2 <= 4.5 | – | 0-5% | 0-5% | – |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

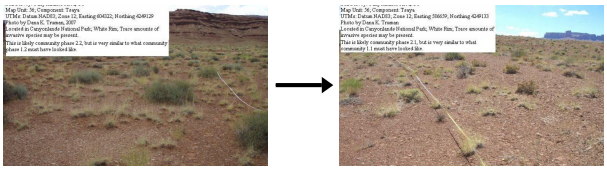
## Pathway 1.1A
## Community 1.1 to 1.2

Shadscale Shrubland

Shadscale Shrubland & Grasses

This pathway occurs on properly managed sites when positive weather events, such as years with normal to above average precipitation favor the establishment of perennial grasses.

### Pathway 1.2A
### Community 1.2 to 1.1



**Shadscale Shrubland & Grasses** **Shadscale Shrubland**

This pathway occurs when drought coupled with improper livestock grazing and/or other surface disturbance reduces the percentage of perennial herbaceous vegetation growing on the site.

## State 2
## Current Potential State

This state is similar to state one, however there are now non-native invasive species established in the understory—cheatgrass and halogeton being the most common. The primary disturbance mechanism is weather fluctuation; however livestock grazing now may influence the ecological dynamics of the site. The current potential state has less ability resist change and less resilience following disturbances. Current Potential State: Plant communities disturbed by fluctuating weather conditions and livestock grazing. Indicators: Site dominated by shadscale and galleta, Indian ricegrass and sand dropseed may also be present. Invasive species are now present. Feedbacks: Extended drought, improper livestock grazing, and fire, resulting in a reduction of native perennial plant vigor. Normal fluctuations in weather and proper livestock grazing, allowing for the maintenance of both shrubs and perennial grasses. At-risk Community Phase: All communities are at risk when nutrients are available for invasive plants to flourish. Community phase 2.1 is particularly at risk due to the decreased native perennial grass understory associated with this phase. Trigger: Increased occurrence of invasive plants to fill available niches.

### Community 2.1
### Shadscale Shrubland & Invasive Weeds


**Figure 8. Shadscale Shrubland & Invasive Weeds**

This plant community phase is dominated by shadscale and Torrey's jointfir, warm and cool season perennial grasses are minimally present. Grasses may include but are not limited to, Indian ricegrass, James galleta, and sand dropseed. James galleta is typically the dominant species in this plant community phase. Cheatgrass is now present. Other perennial or invasive grasses, shrubs, and forbs my also be present and cover is variable. This plant community is very similar to plant community 1.1 in production and cover. The main difference is the non-native invasive species now present. Bare ground is (10-50%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and/or channers. 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 (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 100 | 150 | 200 |
| Grass/Grasslike | 25 | 75 | 125 |
| Forb | 10 | 30 | 50 |
| **Total** | **135** | **255** | **375** |

**Table 12. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 5-25% |
| Grass/grasslike basal cover | 2-10% |
| Forb basal cover | 1-5% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 5-10% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-50% |

**Table 13. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 1-5% | 1-5% |
| >0.5 <= 1 | – | 1-10% | 1-10% | 2-10% |
| >1 <= 2 | – | 5-15% | 1-5% | – |
| >2 <= 4.5 | – | 0-5% | 0-5% | – |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

## Community 2.2
## Perennial Shrubland, Grasses & Invasive Weeds

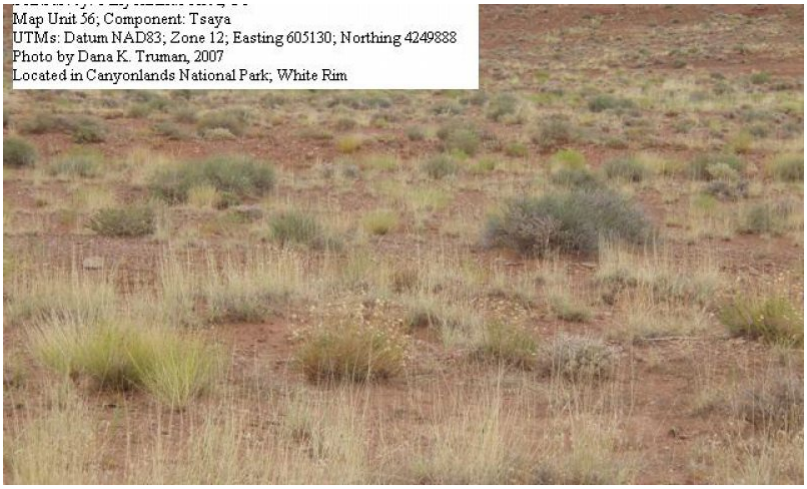



**Figure 10. Shadscale Shrubland, Grasses & Invasive Weeds**

This plant community phase is dominated by shadscale, Torrey's jointfir, and perennial grasses. Grasses may include Indian ricegrass, James galleta, and sand dropseed. James galleta is typically the dominant species in this plant community phase. Cheatgrass is now present. Other perennial or invasive grasses, shrubs, and forbs may also be present and cover is variable. This plant community is very similar to plant community 1.2 in production and cover. The main difference is that there are now non-native, invasive species present. Bare ground is (10-30%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and/or channers. 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 (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 100 | 250 | 300 |
| Shrub/Vine | 100 | 200 | 300 |
| Forb | 25 | 50 | 75 |
| **Total** | **225** | **500** | **675** |

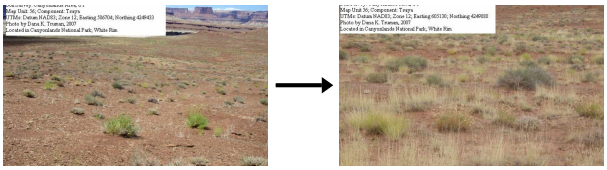
**Table 15. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 10-20% |
| Grass/grasslike basal cover | 10-25% |
| Forb basal cover | 2-5% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 2-5% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-30% |

**Table 16. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 1-5% | 1-5% |
| >0.5 <= 1 | – | 1-10% | 5-15% | 2-10% |
| >1 <= 2 | – | 5-15% | 1-10% | – |
| >2 <= 4.5 | – | 0-5% | 0-5% | – |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

### Pathway 2.1A
### Community 2.1 to 2.2

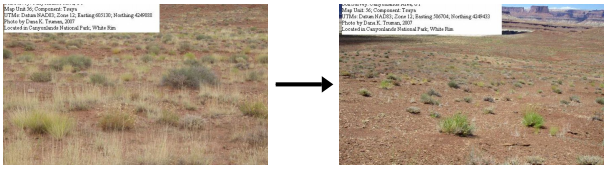


**Shadscale Shrubland & Invasive Weeds**

**Perennial Shrubland, Grasses & Invasive Weeds**

This pathway occurs when events, such as years with normal to above average precipitation, and properly managed livestock grazing favor the establishment of perennial grasses.

### Pathway 2.2A
### Community 2.2 to 2.1



**Perennial Shrubland, Grasses & Invasive Weeds**

**Shadscale Shrubland & Invasive Weeds**

This pathway occurs when events, such as surface disturbance, drought and/or improper livestock grazing, decrease the amount of perennial grasses present on the site.

### State 3
### Invaded State

This state is dominated by invasive species—cheatgrass, halogeton, and Russian thistle being the most common. The primary disturbance mechanisms are fire, improper livestock grazing and drought. One or more invasive species has increased to a point where they influence or drive the disturbance regime and nutrient cycle. Research has shown that plant species differ substantially in the effects on soil water content and temperature, and in their effects on the frequency and intensity of disturbance. After invasive plants have established, a sites fundamental nutrient cycling processes, root pores, mycorrhizal associations, microbial species, and soil organic material changes (Chapin et al. 1997; Belnap and Phillips, 2001). These alterations can eventually create ecologically impoverished sites that are very difficult to restore to functionally diverse perennial herbaceous and woody communities. The competitiveness of the annual forbs and/or grasses, and the ability of these species to quickly establish after a disturbance, make this state extremely resistant to change and resilient after a disturbance. Current Potential State: Plant communities disturbed by improper livestock grazing and drought. Indicators: A site dominated by invasive plant species, such as cheatgrass and halogeton Feedbacks: Time without disturbance which may enable some native vegetation to reestablish. Natural fluctuations in weather and fire if fine fuel

accumulation is adequate, which allow for the continued dominance of invasive plant species. At-risk Community Phase: Plant community 3.1 is most at risk because of declining native perennial vegetation.

## Community 3.1
## Mixed Invasive/Native Species

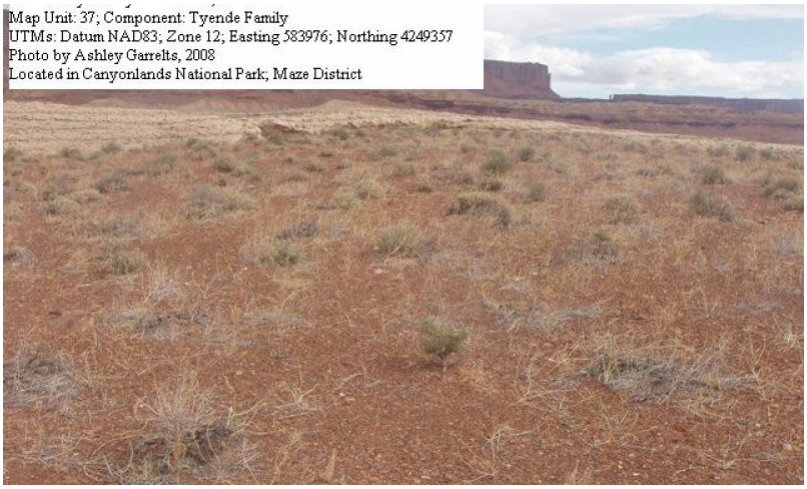



**Figure 12. Mixed Invasive/Native Species**

This plant community phase is characterized by a dominance of invasive species, with a minimal occurrence of shadscale, Torrey's jointfir, James galleta, and other native perennial grasses, shrubs, and forbs. Invasive species include cheatgrass, halogeton, and Russian thistle. Other grasses, forbs, or shrubs may also be present and cover is variable. Bare ground is (10-30%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and/or channers. 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 (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 100 | 200 | 300 |
| Shrub/Vine | 100 | 150 | 200 |
| Forb | 50 | 100 | 150 |
| **Total** | **250** | **450** | **650** |

**Table 18. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 10-20% |
| Grass/grasslike basal cover | 15-25% |
| Forb basal cover | 10-15% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 5-10% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-30% |

**Table 19. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 5-10% | 5-10% |
| >0.5 <= 1 | – | 5-10% | 5-15% | 1-5% |
| >1 <= 2 | – | 1-10% | 1-5% | 5-10% |
| >2 <= 4.5 | – | 0-5% | 0-5% | 1-5% |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

## Community 3.2
## Invasive Species Monoculture


**Figure 14. Invasive Species Monoculture**

This plant community phase is characterized by a monoculture of invasive species, which may include cheatgrass, halogeton, and Russian thistle. Evidence of dead shadscale and Torrey's jointfir can be found in this plant community phase. Bare ground is (20-50%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and channers. 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 (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 100 | 200 | 300 |
| Forb | 50 | 100 | 150 |
| Shrub/Vine | 0 | 5 | 10 |
| **Total** | **150** | **305** | **460** |

**Table 21. Soil surface cover**

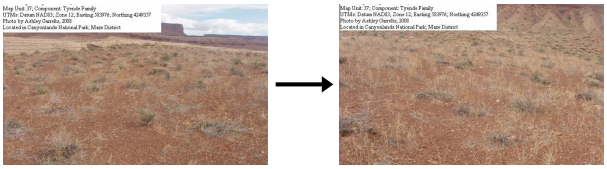
| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 10-20% |
| Grass/grasslike basal cover | 15-25% |
| Forb basal cover | 10-15% |

| | |
|---|---|
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 5-10% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 20-50% |

**Table 22. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | – | 5-10% | 5-10% |
| >0.5 <= 1 | – | 0-5% | 5-15% | 1-5% |
| >1 <= 2 | – | 1-5% | 1-5% | 5-10% |
| >2 <= 4.5 | – | – | 0-5% | 1-5% |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

## Pathway 3.1a
## Community 3.1 to 3.2



**Mixed Invasive/Native Species** **Invasive Species Monoculture**

This pathway occurs when events such as drought and improper livestock grazing further reduce the sites vigor. When this now at-risk community receives sufficient moisture for invasive annuals to flourish, fire can convert site to one dominated by cheatgrass and non-native forbs.

## State 4
## Rabbitbrush State

This state is dominated by rubber rabbitbrush and broom snakeweed, with minimal occurrence of shadscale, Torrey mormontea, galleta, and other native perennial shrubs, grasses, and forbs. The primary disturbance mechanisms are improper livestock grazing, weather fluctuations, and mining or other surface disturbances. Rubber rabbitbrush and broom snakeweed have increased to a point where they influence or drive the disturbance regime and nutrient cycle. These alterations can eventually create ecologically impoverished sites that are very difficult to restore to functionally diverse perennial herbaceous and woody communities. The competitiveness of rubber rabbitbrush and broom snakeweed and the ability of these species to quickly establish after a disturbance make this state extremely resistant to change and resilient after a disturbance. Rabbitbrush State: Plant communities disturbed by improper livestock grazing, mining disturbances, and other continued surface disturbances, such as road development, etc. Indicators: A site dominated by broom snakeweed and rabbitbrush Feedbacks: Time without disturbance which may enable limited native vegetation to reestablish. Natural fluctuations in climate, improper livestock grazing or continued surface disturbances which allow for the continued dominance of broom snakeweed and rubber rabbitbrush. Restoration Pathway: Fall livestock grazing and insects may be used to control the establishment and

dominance of rubber rabbitbrush. Time without surface disturbances and livestock grazing may allow for the reestablishment of native perennial shrubs and grasses without an increase in broom snakeweed; however this may take many years to accomplish.

## Community 4.1
## Rabbitbrush Shrubland


**Figure 16. Rabbitbrush Shrubland**

This plant community phases is characterized by a dominance of rubber rabbitbrush and broom snakeweed, where native grasses shrubs, grasses, and forbs may also be present. Bare ground is (10-30%) and biological crusts (0-5%), when present, are characterized by light cyanobacteria in the interspaces, with an occasional moss or lichen pinnacle. Surface rock fragments (20-60%) are very prevalent and are characterized by gravels, cobbles, and/or channers. The following tables provide an example of the typical vegetative floristics of a community phase 4.1 plant community.

**Table 23. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Shrub/Vine | 100 | 200 | 300 |
| Grass/Grasslike | 50 | 150 | 250 |
| Forb | 50 | 100 | 150 |
| **Total** | **200** | **450** | **700** |

**Table 24. Soil surface cover**

| | |
|---|---|
| Tree basal cover | 0% |
| Shrub/vine/liana basal cover | 5-25% |
| Grass/grasslike basal cover | 0-10% |
| Forb basal cover | 0-10% |
| Non-vascular plants | 0% |
| Biological crusts | 0-5% |
| Litter | 5-10% |
| Surface fragments >0.25" and <=3" | 20-60% |
| Surface fragments >3" | 0-20% |
| Bedrock | 0-5% |
| Water | 0% |
| Bare ground | 10-50% |

**Table 25. Canopy structure (% cover)**

| Height Above Ground (Ft) | Tree | Shrub/Vine | Grass/ Grasslike | Forb |
|---|---|---|---|---|
| <0.5 | – | 0-5% | 0-5% | 0-5% |
| >0.5 <= 1 | – | 1-10% | 0-10% | 0-10% |
| >1 <= 2 | – | 5-15% | 0-5% | – |
| >2 <= 4.5 | – | 0-5% | 0-5% | – |
| >4.5 <= 13 | – | – | – | – |
| >13 <= 40 | – | – | – | – |
| >40 <= 80 | – | – | – | – |
| >80 <= 120 | – | – | – | – |
| >120 | – | – | – | – |

## Transition T1A
## State 1 to 2

Transition from Reference State (State 1) to Current Potential State (State 2). This transition occurs as non-native invasive species become established in the plant community. Common non-native invasive species include cheatgrass, halogeton, and Russian thistle. Disturbances that may accelerate this transition include improper livestock grazing, surface distrubance and/or extended drought. Invasive species such as cheatgrass have also been known to invade an intact perennial plant community, however, where no disturbance has occurred.

## Transition T2A
## State 2 to 3

Transition from Current Potential State (State 2) to Invaded State (State 3). This transition occurs as events favor the dominance of invasives species such as cheatgrass, Russian thistle, and halogeton. Events include drought and possibly fire; if fine fuel accumulation increases to a point where fire can carry through the current potential state. That fire could cause a transition into the invaded state.

## Transition T2B
## State 2 to 4

Transition from Current Potential State (State 2) to Rabbitbrush State (State 4). This transition occurs as events favor the increased dominance of rabbitbrush and broom snakeweed. Events typically include improper livestock grazing, mining or other large surface disturbance.

## Restoration pathway R4a
## State 4 to 2

Restoration from Rabbitbrush State (State 4) to Current Potential State (State 2). This restoration pathway occurs as events favor the reestablishment of native grasses, shrubs, and forbs. Fall livestock grazing and insects may be used to control the establishment and dominance of rubber rabbitbrush (Tirmenstein, 1999a); however care must be taken to allow for the reestablishment of native perennial shrub, grass, and forb species, without an increase in broom snakeweed which is enhanced by grazing pressures (Tirmenstein, 1999b). Time without surface disturbances and livestock grazing may allow for the reestablishment of native perennial shrubs and grasses without an increase in broom snakeweed; however this may take many years to accomplish.

## Additional community tables

**Table 26. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 100–150 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 100–150 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 10–40 | – |
| 3 | **Sub-Dominant** | | | 10–50 | |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–20 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–20 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–10 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–5 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 0 | **Dominant Grasses** | | | 45–55 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 45–55 | – |
| 1 | **Sub-Dominant Grasses** | | | 5–20 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–10 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–10 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–10 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 0–5 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–5 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–5 | – |
| **Forb** | | | | | |
| 0 | **Dominant Forbs** | | | 5–10 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 5–10 | – |
| 2 | **Sub-Dominant Forbs** | | | 20–25 | |
| | larkspur | DELPH | *Delphinium* | 0–10 | – |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–10 | – |
| | Mojave woodyaster | XYTO2 | *Xylorhiza tortifolia* | 0–10 | – |
| | fineleaf hymenopappus | HYFI | *Hymenopappus filifolius* | 0–5 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–5 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–5 | – |

**Table 27. Community 1.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 100–200 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 100–150 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 10–40 | – |
| 3 | **Sub-Dominant Shrubs** | | | 10–50 | |
| | blackbrush | CORA | *Coleogyne ramosissima* | 0–50 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–20 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–20 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–10 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 0 | **Dominant Grasses** | | | 70–100 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 70–100 | – |
| 1 | **Sub-Dominant Grasses** | | | 10–30 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 10–20 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–20 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–10 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–10 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 0–5 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–5 | – |
| | sixweeks fescue | VUOC | *Vulpia octoflora* | 0–3 | – |
| **Forb** | | | | | |
| 0 | **Dominant Forbs** | | | 5–10 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 5–10 | – |
| 2 | **Sub-Dominant Forbs** | | | 20–25 | |
| | larkspur | DELPH | *Delphinium* | 0–10 | – |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–10 | – |
| | Mojave woodyaster | XYTO2 | *Xylorhiza tortifolia* | 0–10 | – |
| | fineleaf hymenopappus | HYFI | *Hymenopappus filifolius* | 0–5 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–5 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–5 | – |

**Table 28. Community 2.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 50–150 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 41–150 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 5–20 | – |
| 3 | **Sub-Dominant Shrubs** | | | 10–100 | |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–50 | – |
| | blackbrush | CORA | *Coleogyne ramosissima* | 0–40 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–15 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–15 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 0 | **Dominant Grasses** | | | 15–50 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 10–50 | – |
| | cheatgrass | BRTE | *Bromus tectorum* | 5–15 | – |
| 1 | **Sub-Domiant Grasses** | | | 5–50 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–30 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 0–15 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–15 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–10 | – |
| | sixweeks fescue | VUOC | *Vulpia octoflora* | 0–5 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–5 | – |
| | Grass, annual | 2GA | *Grass, annual* | 0–5 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–5 | – |
| **Forb** | | | | | |
| 0 | **Dominant Forbs** | | | 5–10 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 5–10 | – |
| 2 | **Sub-Dominant Forbs** | | | 25–35 | |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–25 | – |
| | larkspur | DELPH | *Delphinium* | 0–20 | – |
| | Mojave woodyaster | XYTO2 | *Xylorhiza tortifolia* | 0–15 | – |
| | saltlover | HAGL | *Halogeton glomeratus* | 0–5 | – |
| | fineleaf hymenopappus | HYFI | *Hymenopappus filifolius* | 0–5 | – |
| | prickly Russian thistle | SATR12 | *Salsola tragus* | 0–5 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–5 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–5 | – |

**Table 29. Community 2.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 50–175 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 50–150 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 5–30 | – |
| 3 | **Sub-Dominant Shrubs** | | | 25–75 | |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–40 | – |
| | blackbrush | CORA | *Coleogyne ramosissima* | 0–30 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–15 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–10 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 0 | **Dominant Grasses** | | | 50–150 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 30–150 | – |
| | cheatgrass | BRTE | *Bromus tectorum* | 10–20 | – |
| 1 | **Sub-Dominant Grasses** | | | 10–100 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–50 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–25 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 0–15 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–15 | – |
| | Grass, annual | 2GA | *Grass, annual* | 0–10 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–10 | – |
| | sixweeks fescue | VUOC | *Vulpia octoflora* | 0–5 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–5 | – |
| **Forb** | | | | | |
| 0 | **Dominant Forbs** | | | 5–25 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 2–25 | – |
| 2 | **Sub-Dominant Forbs** | | | 20–40 | |
| | prickly Russian thistle | SATR12 | *Salsola tragus* | 0–20 | – |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–20 | – |
| | saltlover | HAGL | *Halogeton glomeratus* | 0–10 | – |
| | fineleaf hymenopappus | HYFI | *Hymenopappus filifolius* | 0–5 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–5 | – |
| | larkspur | DELPH | *Delphinium* | 0–5 | – |

**Table 30. Community 3.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 5–100 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 5–75 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 5–10 | – |
| 3 | **Sub-Dominant Shrubs** | | | 10–50 | |
| | blackbrush | CORA | *Coleogyne ramosissima* | 0–50 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–15 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–5 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–5 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 0 | **Dominant Grasses** | | | 100–200 | |
| | cheatgrass | BRTE | *Bromus tectorum* | 100–200 | – |
| 1 | **Sub-Dominant Grasses** | | | 0–100 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 0–100 | – |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–50 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–25 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–25 | – |
| | Grass, annual | 2GA | *Grass, annual* | 0–10 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–10 | – |
| **Forb** | | | | | |
| 0 | **Dominant Forbs** | | | 50–100 | |
| | saltlover | HAGL | *Halogeton glomeratus* | 20–100 | – |
| | prickly Russian thistle | SATR12 | *Salsola tragus* | 20–75 | – |
| 2 | **Sub-Dominant Forbs** | | | 0–50 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 0–50 | – |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–25 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–10 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–10 | – |

**Table 31. Community 3.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Grasses** | | | 100–200 | |
| | cheatgrass | BRTE | *Bromus tectorum* | 100–200 | – |
| | Grass, annual | 2GA | *Grass, annual* | 0–5 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–5 | – |
| **Forb** | | | | | |
| 2 | **Forbs** | | | 50–100 | |
| | saltlover | HAGL | *Halogeton glomeratus* | 50–100 | – |
| | prickly Russian thistle | SATR12 | *Salsola tragus* | 20–75 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–10 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| **Shrub/Vine** | | | | | |
| 3 | **Shrubs** | | | 0–10 | |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–5 | – |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 0–5 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 0–5 | – |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 0–5 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–5 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–5 | – |

**Table 32. Community 4.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Shrub/Vine** | | | | | |
| 0 | **Dominant Shrubs** | | | 100–200 | |
| | rubber rabbitbrush | ERNA10 | *Ericameria nauseosa* | 50–150 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 50–100 | – |
| 3 | **Sub-Dominant Shrubs** | | | 0–100 | |
| | shadscale saltbush | ATCO | *Atriplex confertifolia* | 0–50 | – |
| | blackbrush | CORA | *Coleogyne ramosissima* | 0–40 | – |
| | littleleaf horsebrush | TEGL | *Tetradymia glabrata* | 0–15 | – |
| | Torrey's jointfir | EPTO | *Ephedra torreyana* | 0–10 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–5 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–5 | – |
| **Grass/Grasslike** | | | | | |
| 1 | **Grasses** | | | 0–150 | |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 0–100 | – |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 0–50 | – |
| | purple threeawn | ARPU9 | *Aristida purpurea* | 0–15 | – |
| | cheatgrass | BRTE | *Bromus tectorum* | 0–15 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 0–15 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–15 | – |
| | sixweeks fescue | VUOC | *Vulpia octoflora* | 0–5 | – |
| | spike dropseed | SPCO4 | *Sporobolus contractus* | 0–5 | – |
| | Grass, annual | 2GA | *Grass, annual* | 0–5 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 0–5 | – |
| **Forb** | | | | | |
| 2 | **Forbs** | | | 0–100 | |
| | desert trumpet | ERIN4 | *Eriogonum inflatum* | 0–50 | – |
| | gooseberryleaf globemallow | SPGR2 | *Sphaeralcea grossulariifolia* | 0–50 | – |
| | Mojave woodyaster | XYTO2 | *Xylorhiza tortifolia* | 0–15 | – |
| | saltlover | HAGL | *Halogeton glomeratus* | 0–10 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–10 | – |
| | larkspur | DELPH | *Delphinium* | 0–10 | – |
| | prickly Russian thistle | SATR12 | *Salsola tragus* | 0–10 | – |
| | Forb, annual | 2FA | *Forb, annual* | 0–5 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–5 | – |
| | fineleaf hymenopappus | HYFI | *Hymenopappus filifolius* | 0–5 | – |

## Animal community

--Wildlife Interpretation--
Small herds of mule deer and pronghorn antelope can be seen grazing/browsing on these sites, especially when near water sources and in the winter. Desert bighorn sheep may utilize this site, when occurring on steeper slopes. The hot climate and lack of water favors small mammals, which have an easier time finding shelter, food, and water to live. Many species of rats, mice, squirrels, bats, and chipmunks can be observed, along with coyotes and foxes. Lizards are the most visible and can be observed during the day. Species may include the northern whiptail, desert spiny, and the colorful western collard lizard. (NPS.gov, 2008)

--Grazing Interpretations--
This site provides only fair grazing conditions for livestock during fall, winter, and spring due to low availability of nutritious forage. This site also often lacks natural perennial water sources, which can influence the suitability for livestock grazing. The plant community is generally an equal mixture shrubs and grasses. The dominant shrub species, shadscale, provides some browse for domestic sheep and goats in the winter, spring, and fall. Cattle typically will only utilize the fruits/seeds due to the spiny nature of the plant. Subdominant shrubs include winterfat, blackbrush, and Torrey's jointfir, which provide good winter browse for cattle, sheep, and goats. The presence of grasses, including James galleta, Indian ricegrass, and sand dropseed, provide good spring and fall grazing conditions for cattle, horses, and sheep. Forage composition and annual production depend primarily on precipitation amounts and thus creates challenges for those making livestock grazing management decisions. Forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Livestock grazing should be based on a science based grazing management plan that includes an onsite forage evaluation.

## 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 occurrence is variable. Fire intensity, fuel type, soil, climate, and topography can each have different influences. Fires can increase areas of bare ground and hydrophobic layers that reduce infiltration and increase runoff (National Range and Pasture Handbook, 2003)

## Recreational uses

Recreation activities include aesthetic value and good opportunities for hiking, horseback riding, and off-road vehicle use. Camp sites are usually limited due to lack of sheltering trees or rock outcrop.

## Wood products

None

## Other products

--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 had 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 causes 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 period of 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--
As ecological conditions deteriorate and native vegetation decreases due to disturbance (fire, improper livestock grazing, drought, off road vehicle overuse, erosion, etc.) invasive species can establish on the site. Of particular concern in arid environments are the non-native annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and 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. Shadscale ecological sites occur on a wide variety of saline soils and thus invading plants will be tolerant of such conditions.

--Fire Ecology--
Due to the sparse plant cover and lack of fine fuels on this ecological site, shadscale dominated shrub communities were not historically influenced by fire. Fires were rare or non-existent; however increased presence of exotic annual grasses can greatly alter fire regimes due to the increase in fine fuels. The slow recovery period allows for cheatgrass invasions which can subsequently increase the fire regime. When fire does occur, shadscale plants are killed and do not readily recover, except through re-establishment by seeds from adjacent unburned stands. Because shadscale seedlings lack spines, they are highly susceptible to browsing (Simonin, K.A., 2001)

The ability for an ecological site to carry fire depends primarily on a sites present fuel load and plant moisture content. Sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Many desert plant communities in the Colorado Plateau may have evolved without significient influence of fire. However a year of exceptionally heavy winter rains can generate fuels by producing heavy stands of annual forbs and grasses. When fires do occur, the effect on the plant community may be extreme due to the harsh environment and slow rate of recovery.

## Other information

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

## Inventory data references

The data collected in 2005-2007 were in conjunction with the soil survey update for Arches and Canyonlands National Park. The vegetation data was collected in associated with a soil pit and geo-referenced. All the data is stored as hard copy files and in electronic format in the NRCS Utah State Office.

## Other references

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

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

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

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

NPS.gov. 2008. Canyonlands National Park. Nature and Science. Available: http://www.nps.gov/cany/naturescience/. Accessed on January 4, 2008.

Simonin, K, A. 2001. Atriplex confertifolia. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/. Accessed April 1, 2008.

Tirmenstein, D. 1999a. Chrysothamnus nauseosus. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/. Accessed on June 10, 2008.

Tirmenstein, D. 1999b. Gutierrezia sarothrae. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/. Accessed on June 10, 2008.

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

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

Plant.USDA.gov, Natural Resources Conservation Service, Plants Database, accessed at various times.

United States Department of Agriculture Handbook 296, Land resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, Issued 2006.

## Contributors

Ashley Garrelts
George Cook
George S. Cook
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), Randy Beckstrand (BLM), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS). Contributors to 4/2008 revisions included: Ashley Garrelts (NRCS) and Shane A. Green (NRCS) |
| Contact for lead author | shane.green@ut.usda.gov |
| Date | 07/18/2008 |
| Approved by | Shane A. Green |
| Approval date | |

| | |
|---|---|
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:** Rills may be present in the reference state on the gentler slopes (0-2% cover) but are generally masked by the surface rock fragments. Few rills are present on slopes exceeding 10% (1-5% cover) and likely to form below adjacent exposed bedrock or water flow patterns where sufficient water accumulates to cause erosion. Rills present should be small—less than 6 feet in length. The number of rills can increase immediately following large storm events but should not persist more than one or two seasons due to coarse soil textures and frost-heave recovery.

---

2. **Presence of water flow patterns:** The occurrence of water flow patterns is rare (1-3% cover) on all slopes in the reference state, and are typically less than 3 feet long. As slopes increase (>10%) water flow pattern occurrence (3-8% cover) and length (3-5ft) increases. An increase in water flow patterns is also expected after disturbance events such as precipitation events

---

3. **Number and height of erosional pedestals or terracettes:** The occurrence of pedestalling or terracetting in the reference state is rare; however 1 inch pedestalling of shrubs is acceptable.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** In the reference state bare ground is fairly uncommon (10-30) and similar throughout all plant community phases. Bare ground is associated with water flow patterns, rodent activity, and plant interspaces. Areas with poorly developed biological soils crust that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. This site can have up to 25-75% surface rock fragments. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

---

5. **Number of gullies and erosion associated with gullies:** Active gullies are generally nonexistent; however, stable gullies may occur in landscape settings where increased runoff may have accumulated (such as areas below exposed bedrock). Gully development is expected to be limited to steep slopes, show little sign of accelerated erosion, and be stabilized with perennial vegetation and surface rock fragments.

---

6. **Extent of wind scoured, blowouts and/or depositional areas:** Slight wind generated soil movement is normal; however due to the abundance of surface rock fragments wind erosion is typically limited to large wind events.

---

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 up to 2-3 ft and usually occurs in water flow patterns and rills, with deposition occurring at obstruction. 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.

---

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of**

**values):** This site should have a soil stability rating of 4-5 throughout the site. Surface texture varies from channery/gravelly fine sandy loam to channery/gravelly sandy loam.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface horizon is 2 inches deep. Structure is weak medium platy and weak fine granular. Color is reddish brown (5YR4/3). The A horizon would be expected to be more strongly developed under plant canopies. It is important if you are sampling to observe the A horizon under plant canopies as well as the interspaces. Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Distribution of perennial grasses, shrubs, and any biological soil crusts (when present), in conjunction with surface rock fragments intercept raindrops reducing splash erosion. Due to the surface rock fragments, plants and/or biological soil crusts are limited in how much they can effectively slow runoff and allow time for infiltration. When perennial grasses and shrubs decrease and cause an increase in exposed bare ground and rock fragments, runoff is amplified and infiltration reduced.

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None; high percentages of cobbles and gravel are found in all soil horizons and 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: Non-sprouting shrubs (Shadscale, Blackbrush) = Warm season perennial grasses (Galleta, Sand dropseed) = cool season perennial grasses (Indian ricegrass)

    Sub-dominant: Sprouting shrubs (Mormontea) > forbs > 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. Siberian Wheatgrass, Forage kochia etc.)
    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 that contribute to temporal variability include insects, drought, and very infrequent fire. Factors that contribute to spatial variability include soil depth, etc.
    Following a recent disturbance such as drought or insects that removes the woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community. These conditions reflect a 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 mortality or decadence apparent in either shrubs or grasses. During and following drought fourwing saltbush may appear dead, due to leaf drop and many plant may die during a multi-year drought. Some, (up to 20%) perennial bunch grass mortality is

expected during severe drought.

---

14. **Average percent litter cover (%) and depth ( in):** Litter cover (including under plants) ranges from 3-5%, nearly all of which should fine litter. Variability is due to the herbaceous production differences from one year to the next. Depth is generally 1 leaf thickness in the interspaces and up to ¼ inch under plant canopies. Litter can increase up to 20% immediate following leaf drop or after favorable conditions increase native annual forb production.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 200-280 lbs/acre on an average year.

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Known invasive species include cheatgrass (Bromus tectorum), broom snakeweed (Gutierrezia sarothrae), tansy mustard (Descurainia pinnata), Halogeton (Halogeton glomeratus), and Russian thistle (Salsola tragus)

---

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

---

18. **Supporting Data:** NRCS (Dana Truman/Ashley Garrelts) 2006/2007 ESD data from Arches and Canyonlands National Parks

---