

Ecological site R035XY216UT Semidesert Sandy Loam (Wyoming Big Sagebrush)

Accessed: 04/30/2024

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.

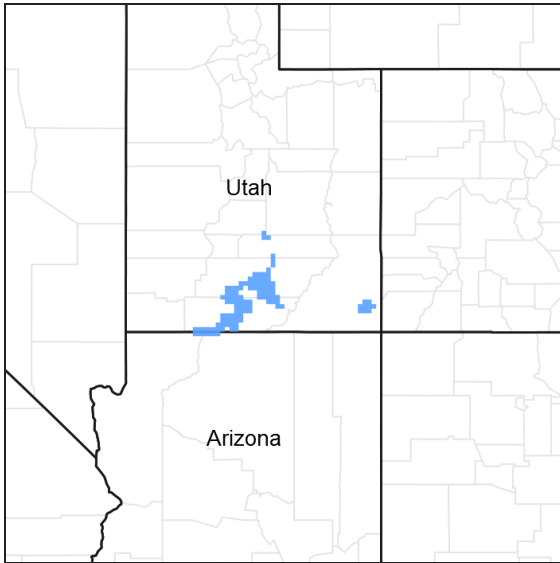


Figure 1. Mapped extent

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

Site concept: The Semidesert Loam (Wyoming big sagebrush) ecological site occurs in the semidesert climate zone of the Colorado and Green River Plateaus region (MLRA 35), at elevations between 5,100 to 7,200 feet. Average annual precipitation is 8 to 13 inches. This site occurs on gently-sloping alluvial flats, sandy hills and plains. The soils are deep with very few rock fragments. Surface textures are range from fine sands to fine sandy loams. The soil moisture regime is ustic aridic and the soil temperature regime is mesic. The reference plant community is dominated by Wyoming big sagebrush, blue grama, needle-and-thread, and a variety of other perennial grasses. Cheatgrass and redstem storksbill are common invaders of the understory, and Utah juniper is capable of dominating this site when fire is suppressed well beyond the natural fire return interval of 40-50 years.

Classification relationships

Modal Soil: Palma Family FSL — coarse-loamy, mixed, mesic Ustollic Haplargids

Similar sites

R035XY209UT	Semidesert Loam (Wyoming Big Sagebrush) This site has deep loamy soils and produces more grass. Perennial grass is also more resilient following grazing or drought on this loam soil.
R035XY215UT	Semidesert Sandy Loam (4-Wing Saltbush) This site has very similar soils, but supports a fourwing saltbush/perennial grass community.
R035XY011UT	Loamy Bottom (Basin Big Sagebrush) This site has very similar soils, but is always found on stream terraces next to a wash or a stream. It receives extra moisture from run-in and/or a seasonally high water table. This site is susceptible to tamarisk invasion as opposed to juniper.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Artemisia tridentata var. wyomingensis</i>
Herbaceous	(1) <i>Bouteloua gracilis</i> (2) <i>Hesperostipa comata</i>

Physiographic features

This site is found on sandy landforms that occur on top of structural benches; particularly on dunes, plains, and alluvial flats. When not on structural benches, this site can occur on alluvial flats and sandy hills and plains. Slopes are mostly 2 to 15 percent and elevations range from 5,100 feet to 7,200 feet.

Table 2. Representative physiographic features

Landforms	(1) Structural bench (2) Alluvial flat (3) Stream terrace
Flooding frequency	None
Ponding frequency	None
Elevation	1,554–2,195 m
Slope	2–15%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this site is characterized by hot summers and cold winters. Large fluctuations in daily temperature are common, and precipitation varies greatly from month to month and from year to year. Average annual precipitation is 8 to 13 inches. Approximately 25 percent occurs as snow from December through February. On the average, May and June are the driest months and August is the wettest month.

Table 3. Representative climatic features

Frost-free period (average)	137 days
Freeze-free period (average)	162 days
Precipitation total (average)	330 mm

Influencing water features

Due to its landscape position, this site is not typically influenced by streams or wetlands.

Soil features

The soils of this site are moderately deep to deep, sandy loams and loamy sands. They formed in alluvial and eolian material derived mainly from sandstone parent materials. Surface layers are fine sand, loamy fine sand and fine sandy loams and are usually 3 to 10 inches thick. The subsoil is fine sandy loam and/or loamy fine sand. Rock fragments are uncommon on the soil surface and throughout the soil profile. The soil moisture regime is ustic aridic and the soil temperature regime is mesic. Water holding capacity ranges from 1.2 inches (in coarser, shallower soils) to 4.3 inches (in finer, deeper soils) of water in the upper 40 inches of soil. These soils are well to excessively well drained, with moderate to rapid permeability. Carbonates may be found throughout the soil profile, but are not always present.

This site has been used in the following soil surveys:

UT686 Escalante Grand Staircase--Soil components: Henrieville, Mivida, Progresso, Santrick, and Yarts.

UT685 Capitol Reef National Park - Begay;

Table 4. Representative soil features

Parent material	(1) Alluvium--sandstone
Surface texture	(1) Sandy loam (2) Fine sand (3) Fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Moderate to rapid
Soil depth	51 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.05-10.92 cm
Calcium carbonate equivalent (0-101.6cm)	0-30%
Electrical conductivity (0-101.6cm)	0-2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6-8.4
Subsurface fragment volume <=3" (Depth not specified)	0-3%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site was historically dominated by Wyoming big sagebrush and a diverse perennial understory, including needle and thread, Blue grama, and James' galleta. The historic fire return interval is presumed to be about 40-50 years, possibly up to 70 years (Howard 1999). Native grasses dominate for several years following fire, with sprouting shrubs increasing in the community. Sagebrush will most commonly re-establish in the community within 10 years after the fire and increase steadily for 10-20 years until it dominates the overstory. In addition to fire, sagebrush may decrease due to heavy winter browsing, drought or aroga moth.

Today this site often burns less frequently due to fire suppression efforts and reduced fine fuel loads from improper livestock grazing. Improper livestock grazing can cause native grasses and forbs to lose vigor or disappear from the

community completely. Cheatgrass is known to establish on this site, but is not documented to gain dominance. It may co-dominate the understory during wet years, but does not persist during average or dry periods while perennial grasses are still present.

Utah juniper is naturally a minor component of the reference state. However, fire suppression may allow it to become dominant when the natural fire return interval of 40-50 years is greatly exceeded.

When the ecological processes are altered due to improper grazing, prolonged drought, altered fire regime, invasive species dominance, or other disturbances, alternative states can occur that differ from the historic reference state in both plant community structure and ecological function.

State and transition model

R035XY216UT Semidesert Sandy Loam (Wyoming Big Sagebrush)

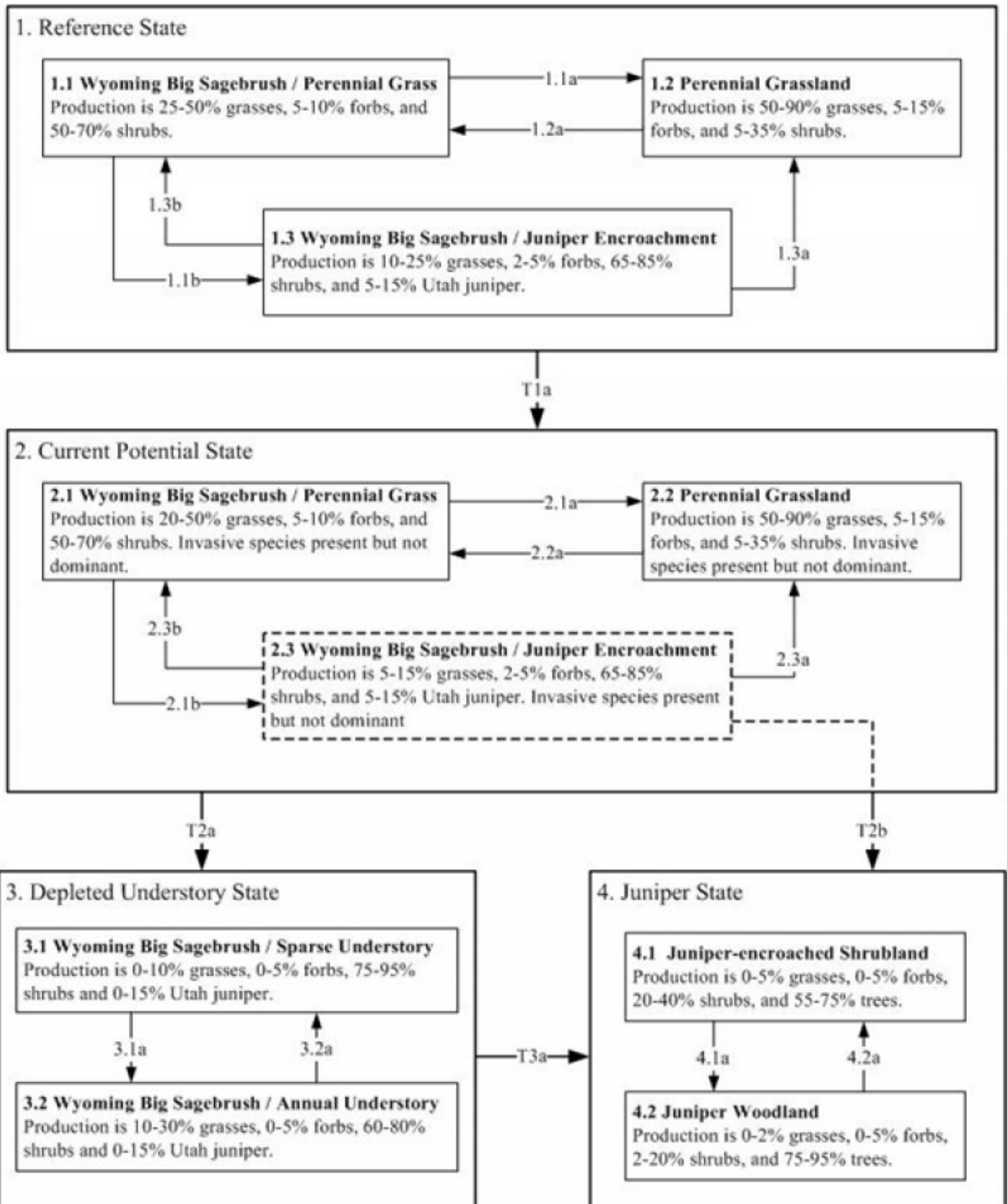


Figure 4. State-and-Transition Model

**State 1
Reference State**

The reference state contains plant communities presumed to occur prior to the introduction of non-native plants, livestock grazing, and other modern disturbances. Wyoming big sagebrush dominance depends on time since fire,

winter browsing, aroga moth, and/or extended drought. Utah juniper may occur as a minor component of the plant community and is removed by fire prior to maturity.

Community 1.1 Wyoming Big Sagebrush / Perennial Grass

4202455 N. Photo by Jamin Johanson, March 30, 2011.



Figure 5. Phase 1.1

Phase 1.1 is dominated by Wyoming big sagebrush and perennial grasses. Percent composition by air-dry weight is 25-50% perennial grasses, 5-10% forbs, and 50-70% shrubs. In the reference state, this is the most common community phase.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	336	420	504
Grass/Grasslike	224	308	392
Forb	11	28	84
Tree	–	28	84
Total	571	784	1064

Table 6. Ground cover

Tree foliar cover	0-2%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	25-35%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	10-20%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	15-30%

Table 7. Canopy structure (% cover)

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

Community 1.2 Perennial Grassland

4174069 N. Photo by the Southwest Regional GAP project, May 07, 2003.



Figure 7. Phase 1.2

Phase 1.2 is dominated by perennial grasses. Percent composition by air-dry weight is 50-90% perennial grasses, 5-15% forbs, and 5-35% shrubs. Sprouting shrubs make up most of the shrub component. This phase is usually the result of stand-replacing fire that eliminates Wyoming big sagebrush for the space of several years. Sagebrush may begin to re-establish in the community within 10 years following fire, and will steadily increase in the community until it becomes co-dominant with the perennial grass.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	560	673
Shrub/Vine	56	140	224
Forb	11	56	112
Total	515	756	1009

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	15-35%
Forb foliar cover	0-15%
Non-vascular plants	0%

Biological crusts	15-30%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

Table 10. Canopy structure (% cover)

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

Community 1.3 Wyoming Big Sagebrush / Juniper Encroachment

0100000000000000 Wyoming big sagebrush and juniper grassland dominated. Capital Hill soil survey, Biggby soil component. NAD83 0485167 E. 4221751 N. Photo by Jamin Johanson, September 28, 2011.



Figure 9. Phase 1.3

Phase 1.3 is dominated by Wyoming big sagebrush, with abundant perennial grasses in the understory and the presence, but not dominance, of Utah juniper. Percent composition by air-dry weight is 10-25% grasses, 2-5% forbs, 65-85% shrubs, and 5-15% Utah juniper.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	448	504	560
Grass/Grasslike	140	224	308
Tree	28	84	140
Forb	11	28	84
Total	627	840	1092

Table 12. Ground cover

Tree foliar cover	2-10%
Shrub/vine/liana foliar cover	25-35%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-45%

Table 13. Canopy structure (% cover)

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

Pathway 1.1a Community 1.1 to 1.2



Wyoming Big Sagebrush /
Perennial Grass



Perennial Grassland

Stand-replacing fire is the most common cause of this community pathway. The fire return interval is highly variable but usually occurs every 40-50 years. Sagebrush decreases while perennial grasses, forbs, and sprouting shrubs

increase and dominate the site. Aroga moth, low-intensity fires, and prolonged drought may also result in a substantial decrease in sagbrush, but do not necessarily eliminate it from the community. Prolonged heavy browsing in the winter by wildlife has also been documented to drive this pathway in the Beef Basin area of San Juan county, Utah.

Pathway 1.1b Community 1.1 to 1.3



Wyoming Big Sagebrush /
Perennial Grass



Wyoming Big Sagebrush /
Juniper Encroachment

Pathway 1.1b results when the average fire return interval of 40-50 years is exceeded. Shrubs and Utah juniper increase, while perennial grasses decrease. However, due to the reproductive capabilities of perennial grasses, they are resilient to this phase and will regain dominance in the event of a wildfire.

Pathway 1.2a Community 1.2 to 1.1



Perennial Grassland



Wyoming Big Sagebrush /
Perennial Grass

This pathway results from the establishment and natural increase of Wyoming big sagebrush into the plant community 10-30 years following a fire.

Pathway 1.3a Community 1.3 to 1.1



Wyoming Big Sagebrush /
Juniper Encroachment



Wyoming Big Sagebrush /
Perennial Grass

Stand-replacing fire is the most common cause of this community pathway. The fire return interval is highly variable but usually occurs every 40-50 years. Sagebrush and juniper decrease while perennial grasses, forbs, and sprouting shrubs increase and dominate the site. Prolonged heavy browsing of sagebrush by wildlife in the winter has also been documented as a driver of this transition in the Beef Basin area in San Juan County, Utah.

Pathway 1.3b Community 1.3 to 1.2



Wyoming Big Sagebrush /
Juniper Encroachment



Perennial Grassland

Pathway 1.3b results from low intensity fires, aroga moth, drought, or heavy wildlife browsing that reduces

sagebrush, but does not eliminate it from the community.

State 2 Current Potential

The Current Potential state is similar to the Reference state in composition and ecological function, but allows for non-native species to be present. During wet periods, non-native invasive annuals, particularly cheatgrass, may increase temporarily in the community, but they decrease in abundance during average or dry periods. This state also includes an at-risk plant community with juniper encroachment that occurs when lack of fire extends beyond the 40-50 year fire return interval. When juniper approaches co-dominance with Wyoming big sagebrush, phase 2.3 is at-risk of transitioning to the Juniper state. Similarly, when perennial grasses are losing vigor and the ability to propagate themselves, this state is at risk of transitioning to the depleted understory state, which is incapable of recovering perennial grasses without significant management inputs. Phases 2.1 and 2.3 are both susceptible to this transition.

Community 2.1 Wyoming Big Sagebrush / Perennial Grass

Wyoming big sagebrush, needle and thread, and blue grama dominate. Cheatgrass is present. South from (plot 2000 area) Range Trend Plot. NAD83 0594698 E. 4200481 N. Photo credits to UDWR, June 16, 2004.



Figure 11. Phase 2.1

Phase 2.1 is dominated by Wyoming big sagebrush and perennial grasses. Cheatgrass and/or other invasive species are present. Percent composition by air-dry weight is 25-50% perennial grasses, 5-10% forbs, and 50-70% shrubs.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	336	420	504
Grass/Grasslike	224	308	392
Forb	11	28	84
Tree	—	28	84
Total	571	784	1064

Table 15. Ground cover

Tree foliar cover	0-2%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	25-35%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0-10%

Litter	10-20%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	15-30%

Table 16. Canopy structure (% cover)

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

Community 2.2 Perennial Grassland

Photo by Jake Owens, March 30, 2011.



Figure 13. Phase 2.2

Phase 2.2 is dominated by perennial grasses. Cheatgrass and/or other invasive species are present. Percent composition by air-dry weight is 50-90% perennial grasses, 5-15% forbs, and 5-35% shrubs. Sprouting shrubs make up most of the shrub component. This phase is usually the result of stand-replacing fire that eliminates Wyoming big sagebrush for the space of several years. Sagebrush may begin to re-establish in the community within 10 years following fire, and will steadily increase in the community until it becomes co-dominant with the perennial grass.

Table 17. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	560	673
Shrub/Vine	56	140	224
Forb	11	56	112
Total	515	756	1009

Table 18. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	15-35%
Forb foliar cover	0-15%
Non-vascular plants	0%
Biological crusts	15-30%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-50%

Table 19. Canopy structure (% cover)

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

Community 2.3

At risk: Wyoming Big Sagebrush / Juniper Encroachment

Phase 2.3 is dominated by Wyoming big sagebrush, with somewhat reduced perennial grasses in the understory. Utah juniper is increasing in dominance. Cheatgrass and/or other invasive species are present. Percent composition by air-dry weight is 5-15% grasses, 2-5% forbs, 65-85% shrubs, and 5-15% Utah juniper.

Table 20. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	448	504	560
Grass/Grasslike	140	224	308
Tree	28	84	140
Forb	11	28	84
Total	627	840	1092

Table 21. Ground cover

Tree foliar cover	2-10%
Shrub/vine/liana foliar cover	25-35%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	30-45%

Table 22. Canopy structure (% cover)

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

Pathway 2.1a Community 2.1 to 2.2



Wyoming Big Sagebrush /
Perennial Grass



Perennial Grassland

Stand-replacing fire is the most common cause of this community pathway. The fire return interval is highly variable but usually occurs every 40-50 years. Sagebrush decreases while perennial grasses, forbs, and sprouting shrubs

increase and dominate the site. Cheatgrass and/or other invasive annuals may increase as well. Aroga moth, low-intensity fires, and prolonged drought may also result in a substantial decrease in sagbrush, but do not necessarily eliminate it from the community. Prolonged heavy browsing in the winter by wildlife has also been documented to drive this pathway in the Beef Basin area of San Juan county, Utah.

Pathway 2.1b **Community 2.1 to 2.3**

Pathway 2.1b results when the average fire return interval of 40-50 years is exceeded. Shrubs and Utah juniper increase, while perennial grasses decrease. Improper grazing that reduces the vigor of perennial grasses may accelerate this pathway. The resiliency of perennial grasses is reduced due to decreased seed production and the presence of non-native invasive species, particularly cheatgrass.

Pathway 2.2a **Community 2.2 to 2.1**



Perennial Grassland

Wyoming Big Sagebrush /
Perennial Grass

This pathway results from the establishment and natural increase of Wyoming big sagebrush into the plant community 10-30 years following a fire.

Pathway 2.3b **Community 2.3 to 2.1**

Pathway 2.3b results from low intensity fires, aroga moth, drought, or heavy wildlife browsing that reduces sagebrush, but does not eliminate it from the community.

Pathway 2.3a **Community 2.3 to 2.2**

Stand-replacing fire is the most common cause of this community pathway. The fire return interval is highly variable but usually occurs every 40-50 years. Sagebrush and juniper decrease while perennial grasses, forbs, and sprouting shrubs increase and dominate the site. Cheatgrass and/or other invasive annuals may increase as well. Prolonged heavy browsing of sagebrush by wildlife in the winter has also been documented as a driver of this transition in the Beef Basin area in San Juan County, Utah.

State 3 **Depleted Understory State**

The depleted understory state occurs when perennial grasses lose vigor and are unable to reproduce—they are essentially absent from the understory. Improper livestock grazing can accelerate this transition. Perennial forbs may also be reduced. This state is not as capable of carrying a stand replacing fire that removes big sagebrush due to a reduction in fine fuels. As a result, sagebrush continues to increase and the understory continues to be reduced.

Community 3.1 **Wyoming Big Sagebrush / Sparse Understory**



Figure 16. Phase 3.1

Phase 3.1 is dominated by Wyoming big sagebrush and has very little perennial grasses in the understory. Cheatgrass and/or other invasive species may be present but not dominant. Percent composition by air-dry weight is 0-10% grasses, 2-5% forbs, 75-95% shrubs, and 0-15% Utah juniper.

Table 23. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	448	588	729
Tree	—	28	84
Grass/Grasslike	—	39	84
Forb	6	17	28
Total	454	672	925

Table 24. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	30-40%
Grass/grasslike foliar cover	0-5%
Forb foliar cover	0-2%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	5-25%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-50%

Table 25. Canopy structure (% cover)

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

Community 3.2

Wyoming Big Sagebrush / Annual Understory

Phase 3.2 is dominated by Wyoming big sagebrush and has cheatgrass, redstem storksbill, and/or other invasive species dominating the understory. Percent composition by air-dry weight is 10-30% grasses, 0-5% forbs, 60-80% shrubs, and 0-15% Utah juniper.

Table 26. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	448	588	729
Grass/Grasslike	28	84	140
Forb	6	45	84
Tree	–	28	84
Total	482	745	1037

Table 27. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	25-35%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	0-15%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	5-20%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	35-50%

Table 28. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0%	0-5%	0-10%
>0.15 <= 0.3	–	0-5%	0-10%	0-2%
>0.3 <= 0.6	0-2%	5-15%	0-25%	0-2%
>0.6 <= 1.4	0-5%	5-15%	–	–
>1.4 <= 4	0-2%	0-5%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Pathway 3.1a Community 3.1 to 3.2

This pathway occurs during wet periods that facilitate a flush of annuals that dominate the understory.

Pathway 3.2a Community 3.2 to 3.1

This pathway occurs during dry periods when invasive annuals do not produce much biomass. It may occur in as short a timeframe as one year.

State 4 Juniper State

This state occurs when perennial grasses become too sparse to produce sufficient seed to regain dominance after fire or tree removal. Shrubs also decrease or disappear from the community and are unable to return naturally following tree removal. It is unknown whether this state accelerates erosion, but soil fertility is expected to decline as this state persists, due to a lack of fine root turnover and other organic matter inputs usually associated with sagebrush grasslands.

Community 4.1 Juniper-encroached Shrubland

Encroachment and Utah juniper in community 3.1 to 3.2. Photo by Jake Owens, July 21, 2010.
NAD83 0488694 E. 4213956 N. Photo by Jake Owens, July 21, 2010.



Figure 19. Phase 4.1

This community phase is characterized by a Utah juniper/ Pinyon woodland with an understory of Wyoming big sagebrush and sparse perennial grasses. Composition by air-dry weight is 0-5% grasses, 0-5% forbs, 20-40% shrubs, and 55-75% trees.

Table 29. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	224	308	392
Shrub/Vine	112	168	224
Forb	–	17	28
Grass/Grasslike	–	17	28
Total	336	510	672

Table 30. Ground cover

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

Table 31. Canopy structure (% cover)

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

Community 4.2 Juniper Woodland



Figure 21. Phase 4.2

This community phase is characterized by a Utah juniper/ Pinyon woodland with a sparse understory. Composition by air-dry weight is 0-2% grasses, 0-5% forbs, 2-20% shrubs, and 75-95% trees.

Table 32. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	280	392	504
Shrub/Vine	28	56	84
Forb	–	17	28
Grass/Grasslike	–	17	28
Total	308	482	644

Table 33. Ground cover

Tree foliar cover	15-25%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	0-5%
Forb foliar cover	0-5%
Non-vascular plants	0%
Biological crusts	40-60%
Litter	5-15%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	15-30%

Table 34. Canopy structure (% cover)

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

Pathway 4.1a Community 4.1 to 4.2



Juniper-encroached Shrubland



Juniper Woodland

This pathway occurs when lack of fire or mechanical removal of juniper allows the invasive trees to dominate the site.

Pathway 4.2a Community 4.2 to 4.1



Juniper Woodland



Juniper-encroached Shrubland

This pathway occurs when Utah juniper is mechanically thinned. It can only be successful given a seed source for sagebrush.

Transition T1a State 1 to 2

This transition is the result of establishment by invasive species. Modern disturbances such as recreation and livestock grazing may accelerate this transition by providing seed sources and germination sites for non-native species. However, the two primary invaders on this site, cheatgrass and redstem storksbill, can establish in the absence of major disturbance.

Transition T2a State 2 to 3

This transition occurs when perennial grasses are reduced by improper grazing to the point that they can no longer self-propagate. Few remnant plants may still persist under shrubs, but re-establishment and dominance by perennial grasses will not occur following a fire, or with the removal of livestock grazing.

Transition T2b State 2 to 4

This transition occurs when juniper and shrub co-dominate. They may preclude sufficient reproduction by perennial grasses. Fire suppression, improper livestock grazing, or other disturbances that reduce the vigor of perennial grasses can accelerate this transition. The threshold is the point where perennial grasses can no longer re-establish themselves following fire, herbicide, or other disturbance that removes woody species. Utah juniper is increasing in the community and becomes co-dominant with sagebrush.

Transition T3a State 3 to 4

This transition occurs when Utah juniper increases in the community to become co-dominant with sagebrush. Annual grasses, if present, may be reduced as Utah juniper increases.

Additional community tables

Table 35. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			336–476	
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata ssp. wyomingensis</i>	336–476	20–30
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–90	0–5
3	Subdominant Shrubs			0–56	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–56	0–3
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–28	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–28	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–17	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–17	0–1
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–17	0–1
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–11	0–1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0–11	0–1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grasses			168–364	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–364	0–26
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–112	0–8
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–112	0–8
1	Subdominant Grasses			28–168	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–56	1–4
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–56	0–4
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–56	0–4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–45	0–3
	Grass, annual	2GA	<i>Grass, annual</i>	0–28	0–2

	Grass, annual	Symbol	Grass, annual	0-28	0-1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0-11	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-11	0-1
Forb					
2	Forbs			11-84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-34	0-2
	Forb, annual	2FA	<i>Forb, annual</i>	0-28	0-2
	buckwheat	ERIOG	<i>Eriogonum</i>	0-22	0-1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0-22	0-1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0-17	0-1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0-17	0-1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-17	0-1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0-17	0-1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0-17	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-17	0-1
	hoary Townsend daisy	TOIN	<i>Townsendia incana</i>	0-11	0-1
	stemless four-nerve daisy	TEACA2	<i>Tetraneuris acaulis var. acaulis</i>	0-6	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-6	0-1
	flax	LINUM	<i>Linum</i>	0-6	0-1
	desertparsley	LOMAT	<i>Lomatium</i>	0-6	0-1
Tree					
4	Trees			0-84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	0-84	0-4
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0-28	0-1

Table 36. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	Dominant Grasses			392-616	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	224-448	15-25
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0-168	0-10
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-168	0-10
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-112	0-8
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-112	0-8
1	Sub-dominant Grass			0-168	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-84	0-5
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-56	0-4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-45	0-3
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-45	0-3
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-22	0-1

	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0–22	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–22	0–1
	Grass, annual	2GA	<i>Grass, annual</i>	0–3	0–2
Shrub/Vine					
2	Shrubs			56–224	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–140	0–10
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–56	0–4
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–34	0–2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–22	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–22	0–2
	dwarf fleabane	ERNA5	<i>Erigeron nanus</i>	0–22	0–2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–22	0–2
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–22	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–11	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
Forb					
3	Forbs			11–112	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–45	0–3
	Forb, annual	2FA	<i>Forb, annual</i>	0–34	0–2
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–22	0–2
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0–22	0–2
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–22	0–2
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–22	0–2
	buckwheat	ERIOG	<i>Eriogonum</i>	0–22	0–2
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0–22	0–2
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0–22	0–2
	flax	LINUM	<i>Linum</i>	0–22	0–2
	desertparsley	LOMAT	<i>Lomatium</i>	0–22	0–2
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–22	0–2
	hoary Townsend daisy	TOIN	<i>Townsendia incana</i>	0–17	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–11	0–1

Table 37. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			448–560	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–84	0–6
2	Sub-dominant Shrubs			0–56	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–56	0–4

	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–28	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–28	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–17	0–2
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–17	0–2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–17	0–2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–11	0–1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0–11	0–1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grasses			112–280	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–168	4–12
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–112	0–8
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–112	0–8
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–84	0–6
1	Sub-dominant Grasses			28–84	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–56	0–4
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–56	0–4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–45	0–3
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	0–2
	Grass, annual	2GA	<i>Grass, annual</i>	0–22	0–2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–11	0–1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0–11	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–11	0–1
Tree					
3	Trees			28–84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28–84	2–6
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–28	0–2
Forb					
4	Forbs			11–84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Forb, annual	2FA	<i>Forb, annual</i>	0–28	0–2
	buckwheat	ERIOG	<i>Eriogonum</i>	0–22	0–1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0–22	0–1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0–17	0–1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0–17	0–1
	spreading asphed	ASLO7	<i>Aspicarpa longipes</i>	0–17	0–1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–17	0–1

	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis var. acaulis</i>	0–6	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–6	0–1
	flax	LINUM	<i>Linum</i>	0–6	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–6	0–1

Table 38. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			336–476	
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata ssp. wyomingensis</i>	336–476	20–30
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–90	0–5
3	Subdominant Shrubs			0–56	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–56	0–3
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–28	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–28	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–17	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–17	0–1
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–17	0–1
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–11	0–1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0–11	0–1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
0	Dominant Grasses			168–364	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	11–364	0–26
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–112	0–8
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–112	0–8
1	Subdominant Grasses			28–168	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	6–140	1–10
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–56	0–4
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–56	1–4
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–56	0–4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–45	0–3
	Grass, annual	2GA	<i>Grass, annual</i>	0–28	0–2
	purple threeawn	ARPI19	<i>Aristida purpurea</i>	0–11	0–1

	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0–11	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–11	0–1
Forb					
2	Forbs			11–84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	0–2
	Forb, annual	2FA	<i>Forb, annual</i>	0–28	0–2
	buckwheat	ERIOG	<i>Eriogonum</i>	0–22	0–1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0–22	0–1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0–17	0–1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0–17	0–1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–17	0–1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–17	0–1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	hoary Townsend daisy	TOIN	<i>Townsendia incana</i>	0–11	0–1
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0–11	0–1
	flax	LINUM	<i>Linum</i>	0–6	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–6	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetrandeureis acaulis var. acaulis</i>	0–6	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–6	0–1
Tree					
4	Trees			0–84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	0–84	0–4
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–28	0–1

Table 39. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	Dominant Grasses			392–616	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	224–448	15–25
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–168	0–10
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–168	0–10
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–112	0–8
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–112	0–8
1	Sub-dominant Grass			0–168	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	6–140	1–10
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–84	0–5
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–56	0–4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–45	0–3
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–45	0–3

	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–22	0–1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0–22	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–22	0–1
	Grass, annual	2GA	<i>Grass, annual</i>	0–3	0–2
Shrub/Vine					
2	Shrubs			56–224	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–140	0–10
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–56	0–4
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–34	0–2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–22	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–22	0–2
	dwarf fleabane	ERNA5	<i>Erigeron nanus</i>	0–22	0–2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–22	0–2
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–22	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–11	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
Forb					
3	Forbs			11–112	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–45	0–3
	Forb, annual	2FA	<i>Forb, annual</i>	0–34	0–2
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–22	0–2
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0–22	0–2
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0–22	0–2
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–22	0–2
	buckwheat	ERIOG	<i>Eriogonum</i>	0–22	0–2
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0–22	0–2
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0–22	0–2
	flax	LINUM	<i>Linum</i>	0–22	0–2
	desertparsley	LOMAT	<i>Lomatium</i>	0–22	0–2
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–22	0–2
	hoary Townsend daisy	TOIN	<i>Townsendia incana</i>	0–17	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetraneuris acaulis var. acaulis</i>	0–11	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–11	0–1
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0–11	0–1

Table 40. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			448–560	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–84	0–6

2	Sub-dominant Shrubs			0-56	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0-56	0-4
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-28	0-2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0-28	0-2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-28	0-2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0-17	0-2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0-17	0-2
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-17	0-2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0-17	0-2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0-11	0-1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0-11	0-1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0-11	0-1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0-6	0-1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-6	0-1
Grass/Grasslike					
0	Dominant Grasses			112-280	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56-168	4-12
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0-112	0-8
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-112	0-8
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-84	0-6
1	Sub-dominant Grasses			28-84	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	6-140	1-10
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-56	0-4
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-56	0-4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-45	0-3
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-34	0-2
	Grass, annual	2GA	<i>Grass, annual</i>	0-22	0-2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0-11	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-11	0-1
Tree					
3	Trees			28-84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28-84	2-6
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0-28	0-2
Forb					
4	Forbs			11-84	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-34	0-2
	Forb, annual	2FA	<i>Forb, annual</i>	0-28	0-2
	buckwheat	ERIOG	<i>Eriogonum</i>	0-22	0-1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0-22	0-1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0-17	0-1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0-17	0-1

	spreading asphed	ASLO7	<i>Aspicarpa longipes</i>	0–17	0–1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–17	0–1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0–11	0–1
	flax	LINUM	<i>Linum</i>	0–6	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–6	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis var. acaulis</i>	0–6	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–6	0–1

Table 41. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			448–729	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–224	0–15
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	56–168	4–12
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–112	0–8
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–112	0–8
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–84	0–6
2	Sub-dominant Shrubs			0–84	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–56	0–4
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–28	0–2
	mormon tea	EPVI	<i>Ephedra viridis</i>	0–28	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–17	0–2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–17	0–2
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–17	0–2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–17	0–2
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–11	0–1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0–11	0–1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0–11	0–1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0–6	0–1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–6	0–1
Grass/Grasslike					
1	Grasses			0–84	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	0–2
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–28	0–2
	cheatgrass	BRTE	<i>Bromus tectorum</i>	0–28	0–2
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–28	0–2

	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–28	0–2
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–28	0–2
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–22	0–2
	Grass, annual	2GA	<i>Grass, annual</i>	0–22	0–2
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–22	0–2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–11	0–1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–11	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–11	0–1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0–11	0–1
Tree					
3	Trees			0–84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28–84	2–6
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–28	0–2
Forb					
4	Forbs			6–28	
	Forb, annual	2FA	<i>Forb, annual</i>	0–28	0–2
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–28	0–2
	buckwheat	ERIOG	<i>Eriogonum</i>	0–22	0–1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0–22	0–1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0–17	0–1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0–17	0–1
	spreading asphed	ASLO7	<i>Aspicarpa longipes</i>	0–17	0–1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0–17	0–1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0–11	0–1
	flax	LINUM	<i>Linum</i>	0–6	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–6	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis var. acaulis</i>	0–6	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–6	0–1

Table 42. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	Dominant Shrubs			448–729	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–224	0–15
2	Sub-dominant Shrubs			0–84	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–56	0–4
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–28	0–2
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–28	0–2

	mormon tea	EPVI	<i>Ephedra viridis</i>	0-28	0-2
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-17	0-2
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0-17	0-2
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0-17	0-2
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0-17	0-2
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0-11	0-1
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	0-11	0-1
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i> var. <i>nauseosa</i>	0-11	0-1
	Wright's fishhook cactus	SCWR	<i>Sclerocactus wrightiae</i>	0-6	0-1
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-6	0-1
Grass/Grasslike					
0	Dominant Grasses			28-140	
	cheatgrass	BRTE	<i>Bromus tectorum</i>	28-140	2-10
1	Sub-dominant Grasses			0-28	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-28	0-2
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-28	0-2
	cheatgrass	BRTE	<i>Bromus tectorum</i>	0-28	0-2
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0-28	0-2
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-28	0-2
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-28	0-2
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-22	0-2
	Grass, annual	2GA	<i>Grass, annual</i>	0-22	0-2
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-22	0-2
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-11	0-1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-11	0-1
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	0-11	0-1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-11	0-1
Tree					
3	Trees			0-84	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	28-84	2-6
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0-28	0-2
Forb					
4	Forbs			6-84	
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	6-84	1-6
	Forb, annual	2FA	<i>Forb, annual</i>	0-28	0-2
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-28	0-2
	buckwheat	ERIOG	<i>Eriogonum</i>	0-22	0-1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0-22	0-1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0-17	0-1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0-17	0-1
	spreading asphed	ASLO7	<i>Aspicarpa longipes</i>	0-17	0-1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0-17	0-1

	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0–17	0–1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0–17	0–1
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis var. acaulis</i>	0–6	0–1
	beardtongue	PENST	<i>Penstemon</i>	0–6	0–1
	flax	LINUM	<i>Linum</i>	0–6	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–6	0–1

Table 43. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	Dominant Trees			224–392	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	224–392	12–18
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0–90	0–5
Shrub/Vine					
0	Dominant Shrubs			112–224	
1	Sub-dominant Shrubs			0–56	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0–34	0–3
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–11	0–1
	Torrey's jointfir	EPTO	<i>Ephedra torreyana</i>	0–11	0–1
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0–11	0–1
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–6	0–1
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0–6	0–1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–6	0–1
	roundleaf buffaloberry	SHRO	<i>Shepherdia rotundifolia</i>	0–6	0–1
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0–6	0–1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0–6	0–1
Grass/Grasslike					
2	Grasses			0–28	
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–17	0–1
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0–17	0–1
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–17	0–1
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–17	0–1
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–17	0–1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–6	0–1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0–6	0–1
	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0–6	0–1
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0–6	0–1
Forb					
3	Forbs			0–28	
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0–11	0–1

	snaggy tieabane	ERPU2	<i>Erigeron pumilus</i>	0-6	0-1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0-6	0-1
	flax	LINUM	<i>Linum</i>	0-6	0-1
	desertparsley	LOMAT	<i>Lomatium</i>	0-6	0-1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0-6	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-6	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-6	0-1
	stemless four-nerve daisy	TEACA2	<i>Tetranneuris acaulis var. acaulis</i>	0-6	0-1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0-6	0-1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-6	0-1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-6	0-1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0-6	0-1

Table 44. Community 4.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	Dominant Trees			280-504	
	Utah juniper	JUOS	<i>Juniperus osteosperma</i>	280-476	12-20
	twoneedle pinyon	PIED	<i>Pinus edulis</i>	0-112	0-8
Shrub/Vine					
1	Shrubs			28-84	
	fourwing saltbush	ATCA2	<i>Atriplex canescens</i>	0-34	0-3
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-11	0-1
	Torrey's jointfir	EPTO	<i>Ephedra torreyana</i>	0-11	0-1
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa ssp. nauseosa var. nauseosa</i>	0-11	0-1
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-6	0-1
	Fremont's mahonia	MAFR3	<i>Mahonia fremontii</i>	0-6	0-1
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0-6	0-1
	roundleaf buffaloberry	SHRO	<i>Shepherdia rotundifolia</i>	0-6	0-1
	Cutler's jointfir	EPCU	<i>Ephedra cutleri</i>	0-6	0-1
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	0-6	0-1
Grass/Grasslike					
2	Grasses			0-28	
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0-17	0-1
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	0-17	0-1
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0-17	0-1
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0-17	0-1
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-17	0-1
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-6	0-1
	purple threeawn	ARPU9	<i>Aristida purpurea</i>	0-6	0-1

	sixweeks fescue	VUOC	<i>Vulpia octoflora</i>	0-6	0-1
	spike dropseed	SPCO4	<i>Sporobolus contractus</i>	0-6	0-1
Forb					
3	Forbs			0-28	
	redstem stork's bill	ERCI6	<i>Erodium cicutarium</i>	0-11	0-1
	shaggy fleabane	ERPU2	<i>Erigeron pumilus</i>	0-6	0-1
	fineleaf hymenopappus	HYFI	<i>Hymenopappus filifolius</i>	0-6	0-1
	flax	LINUM	<i>Linum</i>	0-6	0-1
	desertparsley	LOMAT	<i>Lomatium</i>	0-6	0-1
	tufted evening primrose	OECA10	<i>Oenothera caespitosa</i>	0-6	0-1
	beardtongue	PENST	<i>Penstemon</i>	0-6	0-1
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	0-6	0-1
	stemless four-nerve daisy	TEACA2	<i>Tetraeneuris acaulis var. acaulis</i>	0-6	0-1
	flatspine bur ragweed	AMAC2	<i>Ambrosia acanthicarpa</i>	0-6	0-1
	woolly locoweed	ASMO7	<i>Astragalus mollissimus</i>	0-6	0-1
	Wright's bird's beak	COWR2	<i>Cordylanthus wrightii</i>	0-6	0-1
	Brenda's yellow cryptantha	CRFL5	<i>Cryptantha flava</i>	0-6	0-1

Animal community

--Livestock and Wildlife Grazing--

This site provides good year round grazing conditions for livestock and wildlife due to the high availability of nutritious forage. Yet, this site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. The suitability for re-seeding or restoring this site is fair due to the extreme temperatures and variability in time and amount of precipitation. This site may occur in desert bighorn sheep, mule deer and pronghorn antelope ranges, and can be important winter areas for these wildlife species. However, in many places the populations will be small and have little grazing impact on the site.

The plant community is primarily grasses, with 30% cover coming from Indian ricegrass, needleandthread, and galleta. These grasses provide good grazing conditions for horses, cattle, sheep, elk, and bighorn sheep. The presence of shrubs, primarily Wyoming big sagebrush, mountain big sagebrush, four-wing saltbush, mormontea, and winterfat, provide year round browse for all classes of livestock and wildlife. Wyoming and mountain big sagebrush provides good wintering browse due to its high protein content; however is used sparingly by livestock when other herbaceous forages are available. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation must be made.

--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.

Hydrological functions

The soil is in hydrologic group b. The runoff curve numbers are 61 through 79 depending on the condition of the watershed.

Recreational uses

Recreation values are hiking and hunting.

Wood products

None

Other information

--Poisonous/Toxic Plant Communities--

Toxic plants associated with this site include woolly locoweed and broom snakeweed. Woolly locoweed is toxic to all classes of livestock and wildlife. Locoweed is palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. Locoweed contains swainsonine (indolizidine alkaloid) and is poisonous at all stages of growth. Poisoning will become evident after 2-3 weeks of continuous grazing and is associated with 4 major symptoms: 1) neurological damage, 2) emaciation, 3) reproductive failure and abortion, and 4) congestive heart failure linked with "high mountain disease". Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep will generally only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest.

Potentially toxic plants associated with this site include four-wing saltbush and big sagebrush. Four-wing saltbush may accumulate selenium, but only when growing on selenium enriched soils. These plants, when consumed will cause alkali disease or chronic selenosis, which affects all classes of livestock (excluding goats). Typically animals consuming 5-50 ppm selenium will develop chronic selenosis and animals consuming greater than 50 ppm selenium will develop acute selenosis. Clinical signs include lameness, souging of the hoof, hair loss, blindness, and aimless wondering. Horses tend to develop what is called a "bob" tail or "roached" main due to breakage of the long hairs. Big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of $\frac{3}{4}$ lbs of big sagebrush fed to sheep for three days was found to be lethal.

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

--Invasive Plant Communities--

Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over

grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. Of particular concern in semi-arid environments are the non-native annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and annual mustards. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible. Pinyon pine and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site.

--Fire Ecology--

The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content—sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Many semi-desert plant communities in the Colorado Plateau may have evolved without the 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.

Fire is an important aspect of Wyoming big sagebrush dominated ecological sites. Fire intervals are historically 10-70 years and fires are typically patchy, forming mosaics. Shrub vegetation is able to reestablish from seed dispersal from the adjacent non burned sagebrush stands; however the process is relatively slow. Fire also decreases the extent of Utah juniper/pinyon pine invasions, which allows the historic plant community to maintain integrity. When the plant community is burned shrubs will decrease, while perennial and annual grasses increase. The perennial shrubs associated with this site are able to recover at a faster rate than the invading trees. When the site is degraded by the presence of invasive annuals, the fire return interval is shortened due to increased flashy fuels. The shortened fire return interval is often sufficient to suppress the native plant community.

--References--

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

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Rangeland health reference sheet

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

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Date	09/11/2008
Approved by	Shane A. Green
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None on flatter slopes (0-5%), none to rare on sites with steeper slopes (>5%). Rills are expected on sites that are adjacent to landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such rill development should usually be limited to slopes exceeding 5% and adjacent to sites where runoff accumulation occurs (i.e. exposed bedrock, small watersheds, steep sites, etc.) Rills heal rapidly due to the coarse soil textures and frost heaving action over a couple of winters. Any rills present should be somewhat short in length. An increase in rill formation may be seen after recent large thunderstorms.

2. **Presence of water flow patterns:** Flow patterns wind around perennial plant bases and show little to slight evidence of erosion. They are short and stable and there is minor evidence of deposition. On gently sloping (< 5 % slopes) locations within the site, water flow patterns are infrequent and usually less than 3 feet in length. Longer (>3 feet) water flow patterns may be found on steeper slopes (>5%). They are narrow (<1 foot wide) and widely spaced (10-20 yards)

3. **Number and height of erosional pedestals or terracettes:** Plants may show little pedestalling, but there should not be any exposed roots. Shrubs normally have coppice mounding up to 4 inches caused by deposition of wind borne sediments, do not misinterpret these as pedestals. Terracettes should be rare to few, occurring in waterflow patterns obstructed by woody litter. Any rare pedestals that occur are usually associated with natural wind erosion, and should not have exposed roots. Interspaces between well developed biological soil crusts may resemble pedestals but they are actually a characteristic of the crust formation.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 35-55% bare ground. Ground cover is based on the first raindrop impact, and bare ground is the opposite of ground cover. Any well developed biological crusts present should not be recorded as bare ground. 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.

5. **Number of gullies and erosion associated with gullies:** None to rare. Some gullies may be present in landscape settings where increased runoff may accumulate (such as areas below exposed bedrock). Such gully development is expected to be limited to steeper slopes adjacent to sites where runoff accumulation occurs. Any gullies present should show little sign of accelerated erosion and should be stabilized with perennial vegetation.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Very minor wind generated soil movement is normal. Wind caused blowouts and deposition are generally stable or have healed over. Coppice mounding around Mormontea and other shrubs is common. Increased wind generated soil movement can occur during severe 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 and wind movement. Very minor litter removal may occur in flow patterns and rills with deposition occurring 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.

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 or 5 under the plant canopies and a rating of 4 in the interspaces using the soil stability kit test. The average should be a 4. Surface texture varies from loamy fine sand to fine sandy loam. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface typically varies from 3 to 4 inches. Structure typically weak platy. Color typically varies from reddish yellow (5YR4/6) to brown (7.5YR5/4). An ochric horizon extends to a depth of 3 to 7 inches. An ochric horizon typically extends to a depth of 2 to 10 inches. The ochric horizon is a surface horizon lacking fine stratification and which is either light colored, or thin, or has a low organic carbon content, or is massive and (very) hard when dry. 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. Refer to soil survey for more detailed information about your specific site.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Vascular plants and any well developed biological soil crusts will break raindrop impact and splash erosion. Spatial distribution of vascular plants and interspaces between well developed biological soil crusts (where present) provide detention storage and surface roughness that slows runoff allowing time for infiltration. Interspaces between plants and any well developed biological soil crusts (where present) may serve as water flow patterns during episodic runoff events, with natural erosion expected in severe storms. When perennial grasses decrease, reducing ground cover and increasing bare ground, runoff is expected to increase and any associated 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. A few soils have bedrock at about 30+ inches. Naturally occurring soil horizons may be harder than the surface because of an accumulation of clay or calcium carbonate and should not be considered as 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: cool season perennial grasses (Indian ricegrass, Needle and Thread) > non sprouting shrubs (Big sagebrush, Fourwing saltbush, Winterfat)

Sub-dominant: warm season perennial grasses (Galleta, Sand dropseed) > sprouting shrubs (Moromtea) > 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. Crested wheatgrass and Russian wildrye 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: Temporal variability factors include insects, drought, and infrequent fire. Spatial variability factors include soil texture, slope, etc.

Following a recent disturbance such as fire or drought that removes the woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community. If a disturbance has not occurred for an extended period of time,

woody species may continue to increase crowding out the perennial herbaceous understory species. In either case, 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 recent mortality or decadence apparent in either the shrubs or grasses. Some mortality of bunchgrass and other shrubs may occur during very severe (long term) droughts.

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 1/2" under canopies. Litter cover may increase to 10-15% on some years due to increased grass plant production.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 450 - 500 #/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:** Cheatgrass, Broom snakeweed & introduced annual forbs (Filarie, Russian thistle).

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