USDA Natural Resources Conservation Service

Ecological site R036XY142CO
Loamy Mesa Top (pinyon-Utah juniper)

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): 036X–Southwestern Plateaus, Mesas, and Foothills

Loamy Mesa Top - (Pinyon-Juniper) ecological site is found on dipslopes on cuestas, and mesas in MLRA 36 (Southwestern Plateaus Mesas and Foothills). The MLRA 36 is illustrated orange color on the map. The ecological site locations as assigned in soil survey map units are shown in pink color.

The site concept was established within the MLRA 36 Foothill/Upland regions. This zone is 12 to 16 inches of precipitation and has a mesic temperature regime. This site has bimodal precipitation that is dominated by Pinyon and Utah Juniper with shrubs and grasses in the understory.

Classification relationships

NRCS & BLM: Major Land Resource Area 36, Southwestern Plateaus Mesas and Foothills (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
313Aa - San Juan Basin-Mesa Verde and 313Ab - Canyon of Ancients-Blanding Basin Subsections <313A Grand Canyon Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

313Bc - Chuska Valley Cold Desert Shrubland Subsection <313B Navaho Canyonlands Section < 313 Colorado

Plateau Semi-Desert (Cleland, et al., 2007).

EPA:
20a Monticello-Cortez Uplands, 20b Shale Deserts and Sedimentary Basins, and 20c Semiarid Benchlands and Canyonlands, < 20 Colorado Plateau < 10.l Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS: Colorado Plateau Province (Canyonlands and Navajo Sections)

Ecological site concept

The 36X Loamy Mesa Top - (Pinyon-Juniper) ecological site was drafted from the existing Loamy Mesa Top - (Pinyon-Juniper) range site - MLRA 39 and 48X (NRCS, March, 1995). This site was written prior to MLRA 36 being recognized in Colorado and this area was called MLRA 39 when it was written. This site occurs on dipslopes on cuestas, and mesas. The soils are coarse-loamy in the particle control section. The most common surface soil texture are loam or gravelly fine sandy loam. Soils are derived from eolian deposits derived from sandstone. It is a grass community with Pinyon and Utah Juniper community. It has an aridic ustic moisture regime and mesic temperature regime. The effective precipitation ranges from 12 to 16 inches.

Associated sites

R036XY110CO	**Shallow Clay Loam (pinyon-Utah juniper)** Shallow Clay Loam Pinyon-Juniper is a gentle sloped (<25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY111CO	**Steep Shallow Clay Loam (pinyon-Utah juniper)** Steep Shallow Clay Loam Pinyon-Juniper is a very steep sloped (> 25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY141CO	**Shallow Loamy Mesa Top (pinyon-Utah juniper)** Shallow Loamy Mesa Top is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy in texture. This site is dominated by Pinyon, Utah Juniper, muttongrass and Indian ricegrass. This site is in the 15 to 18 inch precipitation zone of foothills/upland.
R036XY284CO	**Loamy Foothills** Loamy Foothills occurs on hills, benches and mesas on moderately deep to deep loamy textured soils derived from alluvium, slope alluvium eolian deposits, and colluvium. It is a Wyoming big sagebrush – Muttongrass community. It has an aridic ustic moisture regime and mesic temperature regime. The effective precipitation ranges from 12 to 16 inches.
R036XY289CO	**Clayey Foothills** Clayey Foothills occurs on benches, foot-slopes, fans, and valley. Soils are moderately deep to deep and have marine shale as parent materials. The soil textures are clay loam to clay. Dominant plants are Wyoming Big Sagebrush and western wheatgrass. This site has a high potential for shrink swell.
R036XY445CO	**Steep Colluvial Slopes** Steep Colluvial Slopes is a very steep (>25% slope) sloped site with very shallow to shallow soils that are clayey in texture. This site is dominated by Utah Juniper and pinyon. This site may have Wyoming big sagebrush in the understory. This site has higher precipitation (12 to 16") than Semidesert Loam (8 to 12"). The temperature is slightly cooler than the semidesert site. Foothill site will be found at elevations above the semidesert site. The soils are similar in nature.

Similar sites

R036XY114CO	**Mountain Pinyon** Mountain Pinyon is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy in texture. This site is dominated by Pinyon, Utah Juniper. This site may have oakbrush in the understory. This site is in the 12 to 16 inch precipitation zone of foothills/upland.
R036XY113CO	**Semidesert Juniper Loam** Semidesert Juniper Loam is a gentle sloped (<25-30% slope) site with shallow soils that are loamy in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.

R036XY287CO	**Stony Foothills** Stony Foothill is a gentle sloped (<25% slope) site with moderately deep to deep soils that are loamy-skeletal in texture. This site is dominated by Pinyon, Utah Juniper. This site may have oakbrush in the understory. This site is in the 12 to 16 inch precipitation zone of foothills/upland.
R036XY111CO	**Steep Shallow Clay Loam (pinyon-Utah juniper)** Steep Shallow Clay Loam Pinyon-Juniper is a very steep sloped (> 25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY445CO	**Steep Colluvial Slopes** Steep Colluvial Slopes is a very steep (>25% slope) sloped site with very shallow to shallow soils that are clayey in texture. This site is dominated by Utah Juniper and pinyon. This site may have Wyoming big sagebrush in the understory. This site has higher precipitation (12 to 16") than Semidesert Loam (8 to 12"). The temperature is slightly cooler than the semidesert site. Foothill site will be found at elevations above the semidesert site. The soils are similar in nature.
R036XY446CO	**Southwestern Mountain (pinyon-Utah juniper)** Southwestern Mountain (Pinyon-Juniper) is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy or loamy-skeletal in texture. This site is dominated by Pinyon, Utah Juniper, Wyoming big sagebrush, muttongrass and Indian ricegrass. This site may have oakbrush in the understory. This site is in the 12 to 16 inch precipitation zone of foothills/upland
R036XY141CO	**Shallow Loamy Mesa Top (pinyon-Utah juniper)** Shallow Loamy Mesa Top is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy in texture. This site is dominated by Pinyon, Utah Juniper, muttongrass and Indian ricegrass. This site is in the 15 to 18 inch precipitation zone of foothills/upland.
R036XY346CO	**Cobbly Foothills** Cobbly Foothill is a gentle sloped (<20% slope) site with moderately deep to deep soils that are loamy-skeletal in texture. Common surface textures are cobbly or gravelly loam. This site is dominated by Big sagebrush, western wheatgrass, Pinyon, and Utah Juniper. This site is in the 12 to 16 inch precipitation zone of foothills/upland.
R036XY110CO	**Shallow Clay Loam (pinyon-Utah juniper)** Shallow Clay Loam Pinyon-Juniper is a gentle sloped (<25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.

Table 1. Dominant plant species

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

Physiographic features

This site occurs on dissected dipslopes on cuestas, and mesas. Slopes typically range from 1-15%, and elevations are generally 6200-7800 ft.

Table 2. Representative physiographic features

Landforms	(1) Mesa (2) Cuesta (3) Dip slope
Flooding frequency	None
Ponding frequency	None
Elevation	1,890–2,377 m
Slope	1–15%
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation is about 15 to 18 inches. Of this, approximately 45-50% falls as snow, and 50-60% falls as rain between April 1 and November 1. Summer moisture is mostly from thundershowers in July, August, September, and October. The driest period is usually from May to June; and June is normally the driest month. There is fall growth from late summer rains on this site during July, August and September, usually from the warm season plants. The average annual total snowfall is 80 inches. The snow depth usually ranges from 1 to 8 inches. The highest winter snowfall record in this area is 152 inches which occurred in 1972-1973. The lowest snowfall record is 30.5 inches during the 1966-1967 winter. The frost-free period typically ranges from 135 to 165 days. The last spring frost is the first of May to the end of May. The first fall frost is the end of September to the end of October. Mean daily annual air temperature is about 37ºF to 62ºF, averaging about 31ºF for the winter and 69ºF in the summer. Summer temperatures of mid-90ºF to low 100ºF are not unusual. The coldest winter temperature recorded was -20ºF on January 13, 1963 and the warmest winter temperature recorded was 68ºF on February 4, 19343. The coldest summer temperature recorded was 27ºF on June 5, 1999. The hottest day on record is 102ºF on July 24, 1936. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2017) for Mesa Verde National Park, Colorado Climate Station. Most Climate station in this LRU (Land Resource Unit) are high end (17 to 18”) of the precipitation range.

Table 3. Representative climatic features

Frost-free period (average)	105 days
Freeze-free period (average)	134 days
Precipitation total (average)	457 mm

Climate stations used

- (1) FT LEWIS [USC00053016], Hesperus, CO
- (2) YELLOW JACKET 2 W [USC00059275], Yellow Jacket, CO
- (3) MANCOS [USC00055327], Mancos, CO
- (4) MESA VERDE NP [USC00055531], Mancos, CO

Influencing water features

None.

Soil features

The soils in this site are moderately deep to very deep (40 to 60+ inches). They soils are coarse loamy in the particle control section. They formed from calcareous eolian material. The soil surface is most commonly loam or gravelly sandy loam with 15-20% clay. The subsoils are loamy textured. The subsurface is usually a sandy clay loam or clay loam with approximately 18-30% clay. The most common parent materials are eolian deposits derived from sandstone or eolian deposits and/or residuum and/or slope alluvium derived from sandstone and siltstone. The soil moisture and temperature regimes are ustic aridic and mesic respectively.

This ecological site has been used in the following Soil Surveys: CO670 (Cortez Area) and CO671 (Ute Mountain Area).

The fine silty soils of Morefield and Roubideau need to be evaluated to see if they belong to a different ecological site. Roubideau soils have no carbonates, rock fragments or shallow in depth claypan. Morefield soils have no hard calcic or claypan that is shallow in depth, layer, and rock fragments.

Typical soils assigned to this ecological site are:

Coarse-Loamy Soils

Atlatl

Atlatl soils are carbonatic with calcic starting between 2 to 4 inches. Atlatl also has 10-40% channers and soft rock fragments that begin at approximately 8 inches in depth. This will decrease the soils available water capacity and cause this soil to act shallow.

Table 4. Representative soil features

Parent material	(1) Eolian deposits–sandstone (2) Residuum–sandstone and siltstone (3) Slope alluvium–sandstone and siltstone
Surface texture	(1) Loam (2) Gravelly fine sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	51–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	9.14–19.81 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–1 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–1
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–20%

Ecological dynamics

This area has a long history of past prehistoric human use for thousands of years. They used pinyon-juniper woodlands for hunting, fuelwood, for food, such as pinon nuts. MLRA 36 have archaeological evidence indicating pinyon-juniper woodlands where modified by prehistoric humans and not pristine and thus where altered at the time of European settlement (Cartledge & Propper, 1993). This area is characterize by broken topography, and lack of perennial water sources. Most pinyon-juniper Northern half of MLRA 36 (Colorado and Utah) can be describe as a persistent woodland type. There is a winter-summer bimodal precipitation pattern on the Colorado Plateau. Meaning that this site developed under climatic conditions that include wet, cold winters, and hot, dry summers with summer rains. This area so included natural influences of herbivory, fire, and climate. This area rarely served as habitat for large herds of native herbivores or large frequent historic fires due to the broken topography. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, and sagebrush complexes.

Pinyon-Juniper expansion began during the late 1800s into deeper well drained soils. (Tausch et al. 1981, Miller and Tausch, 2001). The causes of woodland expansion are often attributed to an reduction in fires, introduction of livestock grazing, shifts in climate, and increases in atmospheric CO2 (Miller and Rose 1999). Prior to European settlement, PJ woodland species were primarily found on shallow soils and rocky ridges. Few fire history studies and pinyon-juniper chronologies have been done in the southwest. It appears that woodland on the Colorado Plateau are more susceptible to die off from severe drought (Miller and Tausch, 2001). Historically, fires before

European settlement in the southwest occurred late spring to mid-summer (Miller and Tausch, 2001).

Historic fire return intervals (300-1000 years) are long, possibly indicating that fire did not play a frequent role in community dynamics. Pinyon and Juniper communities near Mesa Verde were established before European settlement with a fire return interval approximately 400 years (Floyd et al., 2000). Shinneman and Baker (2009) estimated the FRI on the Uncompahgre Plateau to be 400 to 600 years. Mesa Verde (Floyd et al., 2000) and Uncompahgre (Shinneman and Baker, 2009) are in the foothills/upland zone (12 to 16 inches annual precipitation) in MLRA 36. One other known study in the Colorado National Monument on the north eastern part of the Uncompahgre Plateau suggest that lower ecological site zone (semi-desert) (9 to 12 inches of annual precipitation) have a fire return interval of 300 to 1,000 years (Kennard and Moore, 2013). One other difference is that in the semi-desert zone smaller fire of only a few trees maybe more common than the infrequent larger fires found in other studies.

In lower elevations and lower precipitation areas, Utah Juniper maybe dominant over Pinyon. As the precipitation increase and effect moisture increase so will pinyon. The lower end of the pinyon-juniper woodland would be almost entirely Utah Juniper with the reverse happening and pinyon being dominant in the upper end of the pinyon-juniper belt.

The driving factors in Pinyon Juniper woodlands seem to be weather patterns. Drought and insects outbreaks appear to be the main driving factors for mortality in many of the Pinyon/Juniper communities. (Shinneman and Baker, 2009, Floyd et al., 2004) Wet periods seem to enhance and promote pinyon and juniper establishment. Betancourt (1993), noted that Pinyon and Juniper woodlands in the southwest appear to be more susceptible to large die offs during droughts, than in other locations. As severe droughts persist, the Pinyon trees, being more susceptible to drought and insects, seem to die out, while the Utah juniper trees survive. This action could open the canopy for a few years and with sufficient moisture, grasses and forbs would be expected to respond favorably. Two studies illustrated this on the Uncompahgre Plateau found that pinyon began increasing in the 1700s, during a wet period that followed a long dry period. So, tree infill and expansion began before European settlement. Associated fire reduction and livestock grazing effect of European settlers can after the trees started the current expansion. Since the 1900s there has been 2 very wet period in the southwest, during 1900s to 1920s and 1970s to 1990s. These periods saw an increase in Pinon establishment. During the drought of the 1950s and the drought mid-1990s to early 2000s, Pinyon mortality was extensive. (Romme, et al. 2009)

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

PJ fire intervals can be influences by the landscape it occurs on. PJ that is complexed with sagebrush site would burn more frequently do to the fine fuels in the sagebrush sites to start the fires. So, the more rough broken terrain would burn less frequently than the gentler and broader landscapes. PJ sites on the Colorado Plateau generally don’t have enough fine fuels to start large scale fires. The exception would be several wet years in a row that would create the fine fuels necessary for a fire to start.

As vegetation communities respond to changes in management or natural occurrences, thresholds can be crossed, which usually means that a return to the previous state may not be possible without major energy inputs. The amount of energy input needed to affect vegetative shifts depends on the present biotic and abiotic features and the desired results.

Pinyon-juniper sites were treated as one vegetation dynamic type when developing the provision ecological site initiative for MLRA 36. These sites will need to be altered as more data and knowledge in the future becomes available. Variability in climate, soils, aspect and complex biological processes will cause the plant communities to differ. These factors contributing to annual production variability include wildlife use, drought, and insects. Factors contributing to special variability include soil texture, depth, rock fragments, slope, aspect, and micro-topography. The species lists are representative and not a complete list of all occurring or potentially occurring species on this

site. The species lists are not intended to cover the full range of conditions, species and responses of the site. The State & Transition model depicted for this site is based on available research, field observations and interpretations by experts and could change as knowledge increases. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. The following diagram does not necessarily depict all the transitions and states that this site may exhibit, but it does show some of the most common plant communities.

State and transition model

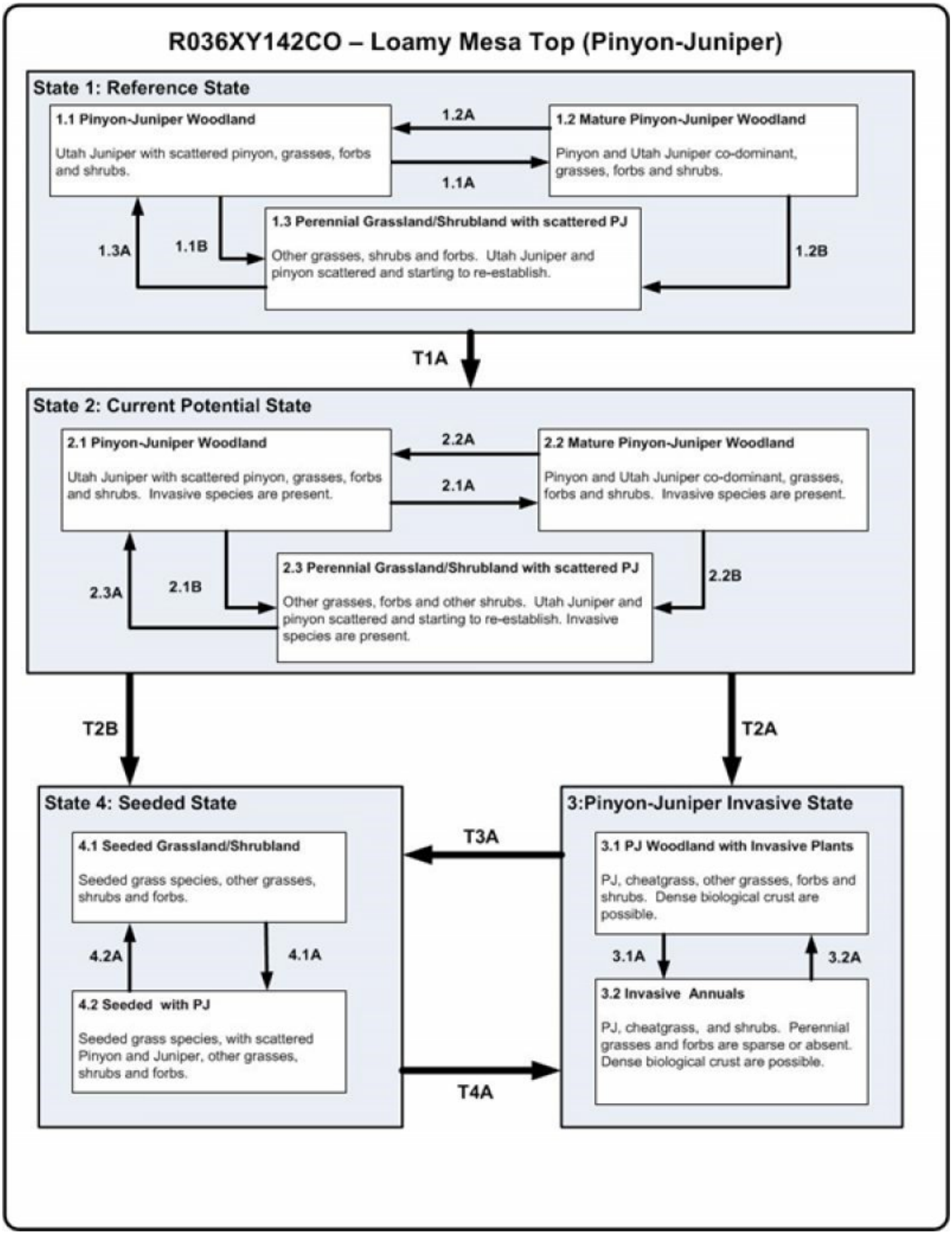
R036XY142CO – Loamy Mesa Top (Pinyon-Juniper)
State 1: Reference State
1.1 Pinyon-Juniper Woodland
Utah Juniper with scattered pinyon, grasses, forbs and shrubs.
1.2A
1.1A
1.2 Mature Pinyon-Juniper Woodland
Pinyon and Utah Juniper co-dominant, grasses, forbs and shrubs.
1.3A
1.1B
1.3 Perennial Grassland/Shrubland with scattered PJ
Other grasses, shrubs and forbs. Utah Juniper and pinyon scattered and starting to re-establish.
1.2B
T1A
State 2: Current Potential State
2.1 Pinyon-Juniper Woodland
Utah Juniper with scattered pinyon, grasses, forbs and shrubs. Invasive species are present.
2.2A
2.1A
2.2 Mature Pinyon-Juniper Woodland
Pinyon and Utah Juniper co-dominant, grasses, forbs and shrubs. Invasive species are present.
2.3A
2.1B
2.3 Perennial Grassland/Shrubland with scattered PJ
Other grasses, forbs and other shrubs. Utah Juniper and pinyon scattered and starting to re-establish. Invasive species are present.
2.2B
T2B
T2A
State 4: Seeded State
4.1 Seeded Grassland/Shrubland
Seeded grass species, other grasses, shrubs and forbs.
4.2A
4.1A
4.2 Seeded with PJ
Seeded grass species, with scattered Pinyon and Juniper, other grasses, shrubs and forbs.
T3A
T4A
3:Pinyon-Juniper Invasive State
3.1 PJ Woodland with Invasive Plants
PJ, cheatgrass, other grasses, forbs and shrubs. Dense biological crust are possible.
3.1A
3.2A
3.2 Invasive Annuals
PJ, cheatgrass, and shrubs. Perennial grasses and forbs are sparse or absent. Dense biological crust are possible.

Figure 6. STM

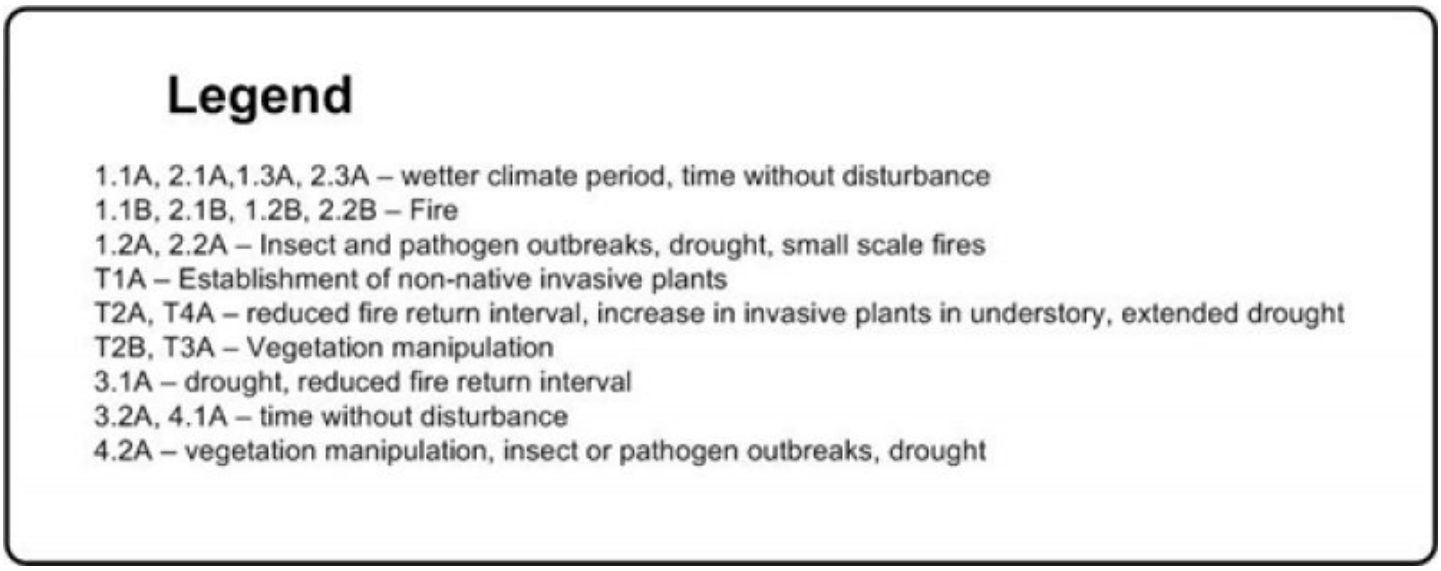

Figure 7. Legend

State 1
Reference State

This state represents the natural variability and dynamics of this site that occurred naturally. This state includes the dominant biotic communities that would have occurred on this ecological site prior to European Settlement. The dominant aspect of this site is Pinyon and Utah Juniper with an understory of shrubs and associated grasses. Fluctuations in species compositions and relative production may change from year to year dependent upon abnormal precipitation or other climatic factors. The primary disturbance mechanisms for this site in reference condition include drought, insects, and infrequent fire. Because catastrophic disturbances like a crown fire or drought happen with long intervals, these communities have long periods of succession, (i.e. long periods of dense Pinyon and Juniper)—300-600 years in upland/foothills ecological site zone and 300 to 1,000 in semi-desert ecological site zone. According to Shinneman (2006), the pinon-juniper zone on the Uncompahgre Plateau typically burns in high-intensity, stand-replacing fires with a 400–600 years rotation (Shinneman, 2006). In the semi-arid environment of this ecological site, fine fuels are typically not continuous, reducing the likelihood of short fire return intervals. Typically, fires occurred in late spring through mid-summer following several wet years that allowed the fine fuels to become more contiguous (Baisan and Swetnam, 1990, and Swetnam and Baisan, 1996). The higher in elevation and higher precipitation area would burn more frequently as they would have more fine fuels in the understory. The timing of drought, and fire, coupled with surface disturbance can dictate whether the community can stay within the reference state or if the community transitions into another state. The following is from the 1995 range site: Vegetation factors: When this site is at or near it's potential, pinyon pine and Utah juniper dominate the site and make up over 80 percent of the plant community. Understory production is very limited and provides marginal amounts of forage for livestock and or wildlife. It does provide good escape cover and thermal cover for deer. When the tree canopy cover exceeds 40 percent, diversity, both plant and animal drops to its lowest level.

Community 1.1
Pinyon-Juniper Woodland

A well-developed understory with a canopy of younger pinyon and Utah juniper. At this stage Utah juniper may be dominant over pinyon. Pinyon trees are more susceptible to drought, insects, and disease than Utah Juniper trees. In fact, it is difficult to identify methods beside fire that naturally reduce Utah juniper. After long periods of drought weaken the Pinyon trees, beetle kills can become quite extensive, especially after the droughts. Drought periods can also weaken and reduce the understory. Plant establishment is mainly limited by the available moisture. Biological crusts can be highly developed and diversified in the large interspaces between trees. The following is from the 1995 range site: Vegetation factors: When the tree canopy ranges from 15 to 30 percent, a wide variety of grasses, forbs, and shrubs will also be present in addition to the pinyon pine and Utah juniper. Muttongrass, needle-and-thread, Indian ricegrass, and bottlebrush squirreltail are the principal grasses. Forbs usually present include Wrights birdbeak, silvery lupine, rocky mountain penstemon, Crandall penstemon, and sulphur buckwheat. Shrubs usually present include mountain big sagebrush, black sagebrush, low rabbitbrush, datil yucca, antelope bitterbrush, and mountain mahogany. During this tree canopy stage, diversity of plant and animal species will reach its peak.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	336	392	448
Tree	280	336	392
Forb	140	168	196
Shrub/Vine	140	168	196
Total	**896**	**1064**	**1232**

Figure 9. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 1.2
Mature Pinyon-Juniper Woodland

Mature pinyon and Utah juniper woodland characterized this community phase. When weather patterns favor an increase of pinyon and Utah juniper canopy with the associated understory of shrubs, grasses and forbs. Depending on the timing of precipitation, cool season grasses, like Indian ricegrass or warm season grasses like galleta could be dominant. Interspaces supporting highly developed biological crusts are common.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	448	476	504
Forb	84	112	140
Grass/Grasslike	84	112	140
Shrub/Vine	56	84	112
Total	**672**	**784**	**896**

Figure 11. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 1.3
Perennial Grassland/Shrubland with scattered PJ

The overall aspect of this community phase is grasses and shrubs with scattered pinyon and Utah juniper. The herbaceous understory has a mix of grasses and forbs. This community phase is a result of a crown fire or sufficiently large and hot ground fire that will kill many of the trees, combined with sufficient seed-banks and moisture for reestablishment of grasses and forbs. It is common that after a crown fire many patches of trees will remain unburned, because of fire’s unpredictability and broken topography. This leaves a seed bank for the burned areas. This community phase is very short lived in comparison to the other community phases in this state. The following is from the 1995 range site: When the tree canopy ranges from 0 - 15 percent, the previously mentioned species will be present with the grasses and forbs producing 80 to 90 percent of the total production. When the tree canopy level is reduced by fire, chaining and/or application of herbicides, forage production will be at its highest level for big game animals as well as domestic livestock.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	616	673	729
Forb	168	224	280
Shrub/Vine	112	140	168
Tree	112	140	168
Total	**1008**	**1177**	**1345**

Figure 13. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Pathway 1.1A
Community 1.1 to 1.2

This pathway occurs when events create a wetter climate cycle, favor pinyon and perennial bunch grass establishment. Following several favorable precipitation years and lack of surface disturbances, native perennial plants will reestablish.

Pathway 1.1B
Community 1.1 to 1.3

This pathway is very unlikely, but can occur when a fire is able to move through the community. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires.

Pathway 1.2A
Community 1.2 to 1.1

This pathway occurs during and after events such as drought or insect/pathogen outbreaks. Droughts and insects can kill the trees, increasing nutrient availability in the system. Due to the natural conditions of drought, grasses typically do not take up the extra nutrients in the long term. In the short term, grasses and forbs may increase for a few years until juniper and pinyon recover.

Pathway 1.2B
Community 1.2 to 1.3

This pathway is very unlikely but can occur when a fire is able to move through the community phase. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires.

Pathway 1.3A
Community 1.3 to 1.1

This pathway occurs when the climate favors the establishment and growth of trees. More energy is taken-up and stored in the trees as the length between fires and droughts increase. In addition, when shrubs establish on the site they can provide safe-sites for tree establishment furthering the presence of trees.

State 2
Current Potential State

This state is very similar to the reference state, except that non-native grasses and/or forbs are now present in all community phases. The current potential state may include introduced (seeded) or invasive nonnative species. The invasive plants are present in sparse amounts in this state. Natural disturbance are still drought, insects, and infrequent fires still influence the community shifts. The human caused disturbance drivers (i.e. domestic livestock grazing, vegetation manipulation, and recreational activities (i.e. OHV use)) are now present. This shift in species composition could affect nutrient cycling, hydrology and soil stability. At this time there is no known way to effectively remove the non-native plants from the site once they have become established. State 2 is in jeopardy of moving to State 3 (Pinyon-Juniper Invasive State) when remaining native understory plants are stressed and invasive species have increased till they are dominant.

Community 2.1
Pinyon-Juniper Woodland

A well-developed understory with a canopy of younger Pinyon and Utah juniper. At this stage Utah juniper may be dominant over Pinyon. Pinyon trees are more susceptible to drought, insects, and disease than Utah Juniper trees. In fact, it is difficult to identify methods beside fire that naturally reduce Utah juniper. After long periods of drought weaken the Pinyon trees, beetle kills can become quite extensive, especially after the droughts. Drought periods can also weaken and reduce the understory. Plant establishment is mainly limited by the available moisture. Biological crusts can be highly developed and diversified in the large interspaces between trees. Sparse invasive introduced plants species would be present in this phase.

Figure 14. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 2.2
Mature Pinyon-Juniper Woodland

Mature pinyon and Utah juniper woodland with a well-developed understory would characterized this community phase. This phase supports a diverse understory of grasses, forbs and shrubs. Depending on the timing of precipitation, cool season grasses, like Indian ricegrass or warm season grasses like galleta could be dominant. Interspaces supporting highly developed biological crusts are common. Sparse invasive introduced plants species would be present in this phase.

Figure 15. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 2.3
Perennial Grassland/Shrubland with Scattered PJ

The overall aspect of this community phase is grassland with scattered pinyon and Utah juniper. The herbaceous understory has a mix of grasses and forbs. This community phase is a result of a crown fire or sufficiently large and hot ground fire that will kill many of the trees, combined with sufficient seed-banks and moisture for reestablishment of grasses and forbs. It is common that after a crown fire many patches of trees will remain unburned, because of fire’s unpredictability and broken topography. This leaves a seed bank for the burned areas. This community phase is very short lived in comparison to the other community phases in this state. Sparse invasive introduced plants species would be present in this phase.

Figure 16. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Pathway 2.1A
Community 2.1 to 2.1

This pathway occurs when events create a wetter climate cycle, favor Pinyon and perennial bunch grass establishment. Following several favorable precipitation years and lack of surface disturbances, native perennial bunch grasses and forbs will reestablish.

Pathway 2.1B
Community 2.1 to 2.2

This pathway is very unlikely, but can occur when a fire or vegetation manipulation happens to the trees. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires. Seeding after the tree removal may be necessary to help facilitate the return of understory species. Seeding depending on the species may take this community phase into state 4 (Seeded State).

Pathway 2.2A
Community 2.2 to 2.1

This pathway occurs during and after events such as drought or beetle infestations. Droughts and insects can kill pinyon trees, increasing nutrient availability in the system. Due to the natural conditions of drought, grasses typically do not take up the extra nutrients in the long term. In the short term, grasses and forbs may increase for a few years until Juniper recover. Utah Juniper are more able to compete for these nutrients and became the dominant overstory tree over time.

Pathway 2.2B
Community 2.2 to 2.3

This pathway is very unlikely to occur naturally with fire. But, vegetation manipulation can be used to remove trees. Two situations occur naturally: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires. Seeding after the tree removal may be necessary to help facilitate the return of understory species. Seeding depending on the species may take this community phase into state 4 (Seeded State).

Pathway 2.3A
Community 2.3 to 2.1

This pathway occurs when the climate favors the establishment and growth of trees. More energy is taken-up and stored in the trees as the length between fires and droughts increase. In addition, when shrubs establish on the site they can provide safe-sites for tree establishment furthering the presence of trees.

State 3
Pinyon-Juniper Invasive State

This state occurs when there is an absence of natural disturbance (i.e. Insects and drought and/or fire) over long time frames (Zlatnik, 1999). Also, management actions could have allowed trees to become very mature and have effectively closed out the understory. Invasive plants have increased in abundance. This state has the lowest resiliency and resistance of any state in this model. There may be no practicable way back to the Current Potential State (State 2), due to the large amounts of energy and monetary inputs that are needed. Seeding, with either natural disturbance and/or vegetation management to transition it to State 3 (Seeded State) may be the best long term option for this site.

Community 3.1
PJ Woodland With Invasive Plants

A lack of understory with a canopy of older Pinyon and Juniper, where plant interspaces very large and connected. This community phase occurs when natural or management actions allow for the increase in Pinyon and Utah juniper and a decrease in the grass and forb understory. Invasive introduced plants species would be present in this phase and are increasing.

Figure 17. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 3.2
Invasive Annuals

This state is characterized by annual grasses like cheatgrass, annual wheatgrass dominating the understory. Also, invasive forbs like storkbill, halogeton and others may be present. This community phase has active erosion under the pinyon and Utah juniper canopy. Utah Juniper has allelopathic effects on some plant (i.e. Sandberg bluegrass, blue grama), which cheatgrass does not appear to suffer this effect when growing under juniper canopies (Zlatnik, 1999).

Figure 18. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Pathway 3.1A
Community 3.1 to 3.2

This pathway occurs when events such as frequent fire or drought remove the trees and shrubs, and facilitate the continued establishment of cheatgrass or other invasive annuals. Cheatgrass will typically invade/increase in tree/shrub interspaces when PJ communities are degraded. Once the cheatgrass establishes the amount and continuity of fine fuels increases. This can reduce the fire return interval and shorten the time between fires. When fire eliminates the tree/shrub/native grass component, it completes the conversion to annual dominant community phase. Cheatgrass and other invasive annuals can persist for long periods of time. Once a fire or a drought removes the trees/shrubs, it is difficult to reestablish because, not only has the fire return interval been shortened to a time that will not allow seedling establish, the soil and other abiotic factors have been altered.

Pathway 3.2A
Community 3.2 to 3.1

This pathway is when there is a lack of fire and/or disturbance. The fire return interval lengthens. This could be done by having firebreaks and/or fire suppression which will allow the perennial species a chance to establish with natural processes or with vegetation manipulation.

State 4
Seeded State

This state is a result seeding plants species. Vegetation manipulation may or may not have been done depending on disturbance history of the location. The trees were removed and adapted grasses, forbs and shrubs are established. Plants can be native or introduced depending on the desired management goals. If grazing tolerant species were established these communities can better withstand grazing and other disturbances. Due to the shallow or rocky soils and unpredictable precipitations patterns, it is difficult to establish grasses from seed, so this state may be hard to achieve and require large energy inputs.

Community 4.1
Seeded Grassland/Shrubland

This community phase appears as a grassland with scattered shrubs and trees. The vegetative production is typically higher than in the current potential state, depending on grass species seeded; however the grass is still sparse due to the low water holding capacity of soils associated with pinyon and juniper.

Figure 19. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Community 4.2
Seeded with PJ

This community phase has a dense under story of introduced grasses and forbs, but a canopy of pinyon and Utah juniper are establishing. Native perennial grasses, forbs, and shrubs may also be starting to establish. Interspaces are filled with biological crusts and herbaceous plants.

Figure 20. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

Pathway 4.1A
Community 4.1 to 4.2

This pathway occurs when events favor the establishment of shrubs and trees, including long periods without disturbances.

Pathway 4.2A
Community 4.2 to 4.1

This pathway occurs as trees and shrubs are removed from the community, either naturally through insect herbivory or through vegetation manipulation by man.

Transition T1A
State 1 to 2

This transition from the native perennial bunchgrass and shrub understory in the reference state to a state that has been invaded by naturalized species such as crested wheatgrass (blown in or seeded), cheatgrass, annual wheatgrass and other introduced or exotic plants. This transition occurs as natural and/or management actions favor an increase in non-native grasses and forbs, especially annuals. Possible events include the presence of invasive species, improper livestock grazing, extended droughts, and fire combined with an available seed source of non-native species.

Transition T2A
State 2 to 3

When this transition to state 3 occurs the site has lost much of its expected resistance and resilience. At this point natural and/or management actions have decreased the understory to a point where erosion increases. Reduced influence from fire, insects, and drought could cause the tree canopy to close, effectively reducing the herbaceous understory thus facilitating the transition. Improper grazing and or increase surface disturbance combined with periods of drought can facilitate this transition because soil stability is lost and susceptibility to soil loss increases.

Transition T2B
State 2 to 4

This transition is from tree canopy reduction and re-establishment of grasses and forbs. If the community is approaching state 3 (pinyon-juniper invasive state), due to a loss of understory and increase invasive plants this pathway of seeding could be preferable to doing nothing. This pathway may facilitate the recovery of the soils. The infrequent naturally occurring fires could also cause this transition. Reseeding after a fire may be the only way to successfully restore the ecological dynamics to a site. Either way this pathway involves large energy and monetary inputs by man.

Transition T3A
State 3 to 4

Vegetation treatment can transition it to a seeded state. Because of the soils (shallow and/or rocky) and the unpredictable precipitation, this pathway should be used cautiously. This pathway involves large energy and monetary inputs by man.

Transition T4A
State 4 to 3

This transition occurs when events favor the establishment and dominance of invasive annuals. Events may include an extended drought, surface disturbance such as off road vehicle use, and/or a shortened fire return interval, all of which can stress the native perennial bunchgrasses.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			252–476	
	muttongrass	POFE	*Poa fendleriana*	168–308	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	45–123	–
	squirreltail	ELEL5	*Elymus elymoides*	0–45	–
	needle and thread	HECO26	*Hesperostipa comata*	0–45	–
Forb					
2	**Forbs**			112–224	
	silvery lupine	LUAR3	*Lupinus argenteus*	11–62	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	11–34	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	11–34	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	11–22	–
	bastard toadflax	COUM	*Comandra umbellata*	0–22	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	11–22	–
	Rocky Mountain penstemon	PEST2	*Penstemon strictus*	11–22	–
	spiny phlox	PHHO	*Phlox hoodii*	0–22	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
Shrub/Vine					
3	**Shrubs**			112–224	
	black sagebrush	ARNO4	*Artemisia nova*	0–62	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–62	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–62	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–62	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–62	–
	banana yucca	YUBA	*Yucca baccata*	0–62	–
Tree					
4	**Trees**			224–448	
	Utah juniper	JUOS	*Juniperus osteosperma*	84–308	–
	twoneedle pinyon	PIED	*Pinus edulis*	56–252	–

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			56–168	
	muttongrass	POFE	*Poa fendleriana*	34–90	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	–
	needle and thread	HECO26	*Hesperostipa comata*	0–11	–
Forb					
2	**Forbs**			28–168	
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	bastard toadflax	COUM	*Comandra umbellata*	0–11	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–11	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–11	–
	silvery lupine	LUAR3	*Lupinus argenteus*	0–11	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	0–11	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–11	–
	Rocky Mountain penstemon	PEST2	*Penstemon strictus*	0–11	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–11	–
Shrub/Vine					
3	**Shrubs**			28–112	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–22	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–11	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–11	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–11	–
	banana yucca	YUBA	*Yucca baccata*	0–11	–
	black sagebrush	ARNO4	*Artemisia nova*	0–11	–
Tree					
4	**Trees**			336–616	
	Utah juniper	JUOS	*Juniperus osteosperma*	168–504	–
	twoneedle pinyon	PIED	*Pinus edulis*	168–504	–

Table 10. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			504–729	
	muttongrass	POFE	*Poa fendleriana*	280–448	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	101–202	–
	needle and thread	HECO26	*Hesperostipa comata*	56–140	–
	squirreltail	ELEL5	*Elymus elymoides*	0–67	–
Forb					
2	**Forbs**			112–336	
	silvery lupine	LUAR3	*Lupinus argenteus*	11–67	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	11–39	–
	Rocky Mountain penstemon	PEST2	*Penstemon strictus*	11–39	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	11–39	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	11–39	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–11	–
	Forb, perennial	2FP	*Forb, perennial*	0–11	–
	bastard toadflax	COUM	*Comandra umbellata*	0–11	–
	Wright's bird's beak	COWR2	*Cordylanthus wrightii*	0–11	–
Shrub/Vine					
3	**Shrubs**			28–196	
	black sagebrush	ARNO4	*Artemisia nova*	0–39	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–39	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–39	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–39	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–39	–
	banana yucca	YUBA	*Yucca baccata*	0–39	–
Tree					
4	**Trees**			28–224	
	Utah juniper	JUOS	*Juniperus osteosperma*	0–168	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–84	–

Animal community

The following is from 1995 Range Site:

Response to grazing:

This site can provide good grazing for sheep and cattle when the canopy cover is 30 percent or less. It also provides good habitat and grazing for big game animals in this stage of development. Once the canopy cover exceeds 30 percent, the understory production decreases rapidly and then this site provides primarily escape cover and thermal cover for wildlife species that are present.

Muttongrass, needle-and-thread, Indian ricegrass, and bottlebrush squirreltail are very palatable during the spring

and early summer. Antelope bitterbrush and mountain mahogany are used primarily in the fall and into the winter. If the overstory is not excessive, this site responds well to spring, summer, and early fall deferment.

Overgrazing with cattle and, or sheep will result in muttongrass, needle-and-thread, Indian ricegrass, bottlebrush squirreltail, antelope bitterbrush, and mountain mahogany to decrease in the plant community. Continued severe overgrazing will result in mountain big sagebrush, low rabbitbrush, silvery lupine, and Wright's birdbeak dominating this site. This will also result in Utah juniper and pinyon pine becoming established more rapidly and moving this site to a closed canopy with very little understory production.

Major plants poisonous to livestock:

Plant Name	Livestock Affected	Type of Poisoning	Season Serious
silvery lupine	cattle and sheep can cause spring abortions and congenital deformities.	Cumulative, Early during and seed set	

The following is from 1995 Range Site:

Wildlife values:

When this site has less than 30 percent canopy cover caused by a mechanical manipulation, herbicides or fire, adequate forage is produced to support herbivores such as deer and elk. As the canopy is allowed to close in through natural regeneration of the juniper and pinyon pine, forage production becomes very limited. Then these areas become primarily escape cover for deer and elk as well as other wildlife. Wildlife species that depend on high canopy densities on this site are the white-breasted nuthatch and plains titmouse. To create the greatest diversity for wildlife using this site, a variety of canopy covers should be maintained. Another limiting factor for wildlife on this site is the lack of dependable water. Where feasible, water facilities designed for use by wildlife can enhance these areas for wildlife habitat.

Hydrological functions

Soils were originally assigned to hydrologic soil groups based on measured rainfall, runoff, and infiltrometer data (Musgrave 1955). Since the initial work was done to establish these groupings, assignment of soils to hydrologic soil groups has been based on the judgment of soil scientists. Assignments are made based on comparison of the characteristics of unclassified soil profiles with profiles of soils already placed into hydrologic soil groups. Most of the groupings are based on the premise that soils found within a climatic region that are similar in depth to a restrictive layer or water table, transmission rate of water, texture, structure, and degree of swelling when saturated, will have similar runoff responses. Four (4) Hydrologic Soil Groups are recognized (A-D). For specific definitions of each hydrologic soil group see the National Engineering Handbook, Chapter 7, Part 630 Hydrology, or visit:http://policy.nrcs.usda.gov/OpenNonWebContent.aspx? content=22526.wba The hydrologic soil groups are based on the following factors:

-intake and transmission of water under the conditions of maximum yearly wetness (thoroughly wet)
- soil not frozen
- bare soil surface
- maximum swelling of expansive clays

The slope of the soil surface is not considered when assigning hydrologic soil groups. In its simplest form, the hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present) (Caudle, et. al, 2013). The runoff curve numbers are determined by field investigations using hydrologic cover conditions and hydrologic soil groups.

Soils Hydrologic Group

Coarse-Loamy Soils

Atlatl - D

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms (Soil Survey Staff, 2015).

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission (Soil Survey Staff, 2015).

Recreational uses

The following is from 1995 Range Site:

This site had good aesthetic appeal and natural beauty. The adjacent steep, rough mountainous terrain from these mesa tops provides any number of scenic panoramas and also provides many opportunities for photography, bird watching and other activities. This site can also provide hunting opportunities for big game species.

Wood products

The following is from 1995 Range Site:

This site has limited potential for fuel wood and some potential for post and pole production. Because of the shallow nature of the soils there is little or no potential for harvesting young trees for use in the nursery trade as ornamentals. Average wood production when this site exceeds 40 percent canopy is 8 to 10 cords of fuel wood per acre.

Marketable posts and poles are somewhat limited because the growth forms of available trees are short (less than 14 ft.) and frequently grow in a twisted pattern.

Other information

The following is from 1995 Range Site:

Endangered plants and animals:
The following endangered plant species may be dependent on this site. Cliff palace milkvetch (Astragalus deterior), Schmoll milkvetch (Astragalus schmolliae), and Mesa Verde stickseed (Hackellia gracilenta).

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--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 36 must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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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Approved by	Rachel Murph, State Rangeland Management Spec., USDA NRCS Colorado
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Some rills are inherent to the site. Rills will frequently start the ends of water flow patterns or below exposed bedrock where the water can accumulate to cause erosion. The number of rills will depend on the slope. The higher the slope the greater the number of rills that will be associated with it.

2. **Presence of water flow patterns:** Water flow patterns are expected. They frequently form around exposed bedrock where the water flows. Usually not enough water flows, they tend to be short and disconnected with debris dams. As slopes get steeper, flow paths are more frequent and evident, runoff is more rapid. Intense summer storms can cause water flow patterns to be more evident after storms.

3. **Number and height of erosional pedestals or terracettes:** Short pedestals are expected at the base of the plants, there should not be exposed roots. When a large amount of well-developed biological crusts present, they can give the appearance of being pedestals. Terracettes and/or debris dams can form in the smaller water flow patterns.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Expect 15-30% bare ground. This site does have biological crusts present and they should not be counted as bare ground.

5. **Number of gullies and erosion associated with gullies:** Gullies usually do not occur on this site in the reference state. There may be rare gullies present caused by run on water from adjacent sites such as exposed bed rock, small watersheds or dissected slopes.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. The trees on this site generally intercept the wind and prevent most wind generated soil erosion.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter for the most part stays in place. There can be some redistribution by water movement of the fine litter in the rills and water patterns. Most litter accumulates at the base of the plants on this site. Woody litter movement on this site is unusual. Litter movement is more evident on the steeper slopes and also, may be greater following intensive rainstorms.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating anticipated to be 3-5 in the interspaces at soil surface. Aggregate stability can be quite variable depending on soil texture, biological crusts and organic matter.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** SOM ranges from 0.5-3%. Surface texture ranges from fine sandy loam to loam. The A-horizon (soil surface) ranges from 1-6 inches in depth. It is typically described as moderate medium platy structure parting to moderate fine granular structure. The A horizon is expected to be more developed under the plant canopies. Use the specific information for the soil you are assessing in the published soil survey to supplement this description.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The presence of trees, perennial grasses and forbs, and shrubs will breakup raindrop impact and splash erosion. The spatial distribution of the plants, biological crusts and interspaces will provide small pockets for water storage and surface roughness that slows down runoff, allowing time for infiltration. The tree and shrub canopy is effective in intercepting rain drops and preventing splash erosion on the reference state. But, with increased tree canopy, understory canopy is reduced, increased bare soil and litter accumulates under trees, it can forms micro-topography that can help water accumulate which can cause more rapid runoff.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A compaction layer is not expected on this site. Naturally occurring layers of hard calcium carbonate may also be found in the soils, but should not be considered a compaction layer.

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

    Dominant: trees (Pinyon pine, Utah juniper,)>= cool season bunchgrass (muttongrass, Indian ricegrass, squirreltail, needle-and-thread) >

    Sub-dominant: shrubs (Mountain big sagebrush, black sagebrush, yellow rabbitbrush, Yucca, Bitterbrush, true mountain mahogany) > forbs (buckwheat, locoweeds, cryptantha, Hood's phlox, scarlet globemallow, skyrocket gilia, arrowleaf balsamroot, hairy goldaster, penstemons, asters, daisy, stemless goldenweed) >

    Other: > forbs (lupine, scarlet globemallow, rocky mountain penstemon, Crandall penstemon, sulfur buckwheat) > cryptogams

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** A mix of young, middle aged and old pinyon and Utah juniper are expected to be found on this site. In years with average or above average precipitation, shrubs, grasses and forbs should have little mortality or decadence. Tree mortality, especially pinyon, can be expected under severe and/or extended drought and subsequent insect infestations. Under a dense tree canopy, understory has increased decadence and mortality.

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14. **Average percent litter cover (%) and depth (in):** 5-15% litter cover at 0.25-1.0 inch depth, depending upon tree canopy. Most litter is at the base and under the canopy of the plants.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Tree canopy cover 0-15%: 900-1200 lbs./ac.; Tree canopy cover 15-30%: 800-1100 lbs./ac.; Tree canopy cover > 30%: 600-800 lbs./ac. Production figures are for total annual vegetation.

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, annual weeds, other noxious weeds

17. **Perennial plant reproductive capability:** All plants have the ability to reproduce in most years. Limitations are weather related, wildfire, natural disease, inter-species competition, and insects may temporarily reduce reproductive capability. Increased tree canopy will result in decreased understory reproductive capability.