Ecological site R028AY059NV
MAHOGANY SAVANNA

Accessed: 05/16/2024

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.

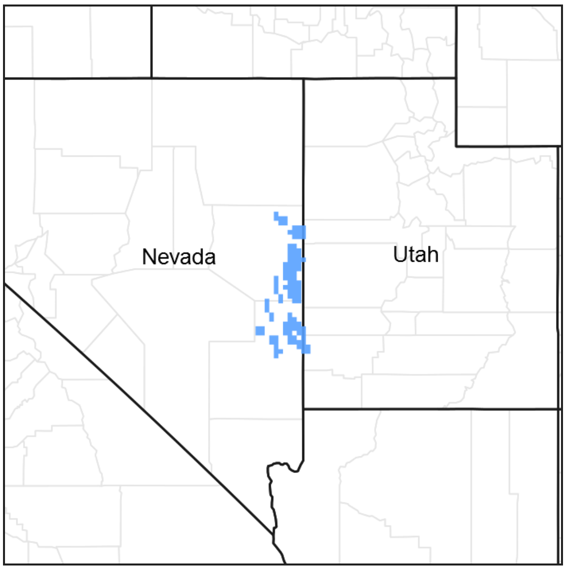


Figure 1. Mapped extent

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): 028A–Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

Ecological site concept

This site occurs on sideslopes of mountains and moraines on all aspects. Slope gradients of 30 to 50 percent are most typical. Elevations are 6300 to over 10000 feet.

Average annual precipitation is 13 to 22 inches. Mean annual air temperature is 41 to 44 degrees F. The average growing season is about 60 to 90 days.

The soils associated with this site are shallow to deep and well to excessively drained. The soils are formed in residuum and colluvium from limestone or from till derived from quartzite. These soils are modified by high volumes of rock fragments throughout the profile.

The reference state is dominated by curlleaf mountain mahogany. Mountain big sagebrush is the principal understory shrub. Bluebunch wheatgrass and muttongrass are the most prevalent understory grasses. Total overstory canopy cover is less than 50 percent (±35%). Understory vegetation comprises about 50% of the total site production. Total annual production for all trees, shrubs, and herbaceous plants in the understory to a height of 4.5 feet ranges from 600 to 1300 pounds per acre. Total production of all trees, shrubs and herbaceous plants irrespective of height ranges from 1200 to 2500 pounds per acre.

Associated sites

F028AY077NV	**PIMO-CELE3/ARTRV/PSSPS-POFE**
R028AY058NV	**STONY MAHOGANY SAVANNA**
R028AY060NV	**MAHOGANY THICKET**
R028AY065NV	**SHALLOW LOAM 14+ P.Z.**
R028AY067NV	**CALCAREOUS LOAM 14+ P.Z.**

Similar sites

R028AY060NV	**MAHOGANY THICKET** Total site productivity is greater; CELE3 canopy cover greater than 35%, usually at least 50%
R028AY058NV	**STONY MAHOGANY SAVANNA** Less productive understory; total site productivity is less; CELE3 canopy cover is less than 25% (±15%)

Table 1. Dominant plant species

Tree	(1) *Cercocarpus ledifolius*
Shrub	(1) *Artemisia tridentata subsp. vaseyana*
Herbaceous	(1) *Pseudoroegneria spicata subsp. inermis* (2) *Poa fendleriana*

Physiographic features

This site occurs on sideslopes of mountains and moraines on all aspects. Slope gradients range from 15 to 50, but slopes of 30 to 50 percent are most typical. Elevations are 6300 to over 10000 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Moraine
Elevation	1,920–3,048 m
Slope	15–50%
Aspect	Aspect is not a significant factor

Climatic features

Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.
Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Average annual precipitation is 13 to 22 inches. Mean annual air temperature is 41 to 44 degrees F. The average growing season is about 60 to 90 days.

Mean annual precipitation at the Great Basin National Park climate station (263340) is 13.33 inches.
Monthly mean precipitation is:
January 1.05; February 1.18; March 1.37; April 1.21; May 1.24; June .87; July .97; August 1.18; September 1.08; October .96; December .96

Table 3. Representative climatic features

Frost-free period (average)	70 days
Freeze-free period (average)	85 days
Precipitation total (average)	432 mm

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are typically shallow to deep and well to excessively drained. The soils are formed in residuum and colluvium from limestone or till derived dominantly from quartzite. These soils are modified by high volumes of rock fragments throughout the profile. Available water holding capacity is very low to low. Runoff is medium to very high. The soil moisture regime is xeric and the soil temperature regime is frigid or cryic. The soil series associated with this site include: Canyoung, Cropper, Denpark, Gaia, Highup, Kious, Topeki, Wambolt, and Zarark.

The representative soil series is Gaia, classified as a Loamy-skeletal, mixed, superactive Xeric Haplocryolls. Diagnostic horizons include a mollic epipedon from the soil surface to 11 inches. Clay content in the particle control sections average 8 to 18 percent. Rock fragments range from 65 to 90 percent, mainly gravel and cobbles. Reaction is slightly acid to neutral. The soils are formed in till derived dominantly from quartzite with local admixtures of granitic rocks.

Table 4. Representative soil features

Parent material	(1) Colluvium–limestone (2) Residuum–calcareous sandstone (3) Till–quartzite
Surface texture	(1) Very gravelly loam (2) Very stony loam (3) Extremely gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Very slow to moderately rapid
Soil depth	51–152 cm
Surface fragment cover <=3"	20–60%
Surface fragment cover >3"	1–23%
Available water capacity (0-101.6cm)	2.29–8.89 cm
Calcium carbonate equivalent (0-101.6cm)	0–50%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	12–74%
Subsurface fragment volume >3" (Depth not specified)	0–23%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al. 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The Great Basin vegetative communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource uptake by the decomposition of dead plant material following disturbance. The invasion of cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al 2007). Dobrowolski et al. (1990) cite multiple authors on the extent of the soil profile exploited by the competitive exotic annual cheatgrass. Specifically, the depth of rooting is dependent on the size the plant achieves and in competitive environments cheatgrass roots were found to penetrate only 15 cm whereas isolated plants and pure stands were found to root at least 1 m in depth with some plants rooting as deep as 1.5 to 1.7 m.

This ecological site is dominated by the long-lived curlleaf mountain mahogany, deep-rooted cool season perennial bunchgrasses, and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 m. (Comstock and Ehleringer 1992). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992). The perennial bunchgrasses generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 meters. General differences in root depth distributions between grasses and shrubs results in resource partitioning in this system.

Curlleaf mountain mahogany is a multi-branched, evergreen shrub or tree extending from 3 to over 20 feet in height. The rooting of mountain mahogany is spreading and limited by the depth to bedrock. Youngberg and Hu (1972) reported in an Oregon study that curl-leaf mountain mahogany produces nitrogen-fixing root nodules. They also reported that nodulated plants had the highest amounts of nitrogen in the leaves. It is the most widely distributed species of Cercocarpus and is the only species of the genus that extends as far north and west as Washington. Most often curlleaf mountain mahogany stands occur on warm, dry, rocky ridges or outcrops where fire would be an infrequent occurrence (USDA 1937). Dealy (1975) and Scheldt (1969) found that mahogany trees were larger and older on fire-resistant rocky sites and were the seed source if fire destroyed the non-rocky portion of the site.

Curlleaf mahogany plants are long-lived and can reach 1,300+ years of age (Schultz 1987, Schultz et al. 1990). As mahogany stands increase in average age, average canopy volume and height of the individuals present also increases. As average canopy height and volume increase, stand density declines (Schultz et al 1991). Stands with a closed, or nearly closed canopy often have few or no young curl-leaf mahogany (i.e., recruitment) in the understory (Schultz et al. 1990, 1991), despite high seed density beneath trees (Russell and Schupp 1998, Ibanez and Schupp 2002). Intraspecific competition reduces the growth rates of all age classes below the potential growth rates for the species. Competition may also increase mortality in the younger plants.
Curlleaf mahogany plants are very self-compatible for pollination and most developing seed matures and is viable (Russell et al. 1998). The deep litter throughout stands with high canopy cover appears to facilitate seed germination but retard seedling survival due to poor contact between the root and the soil (Schultz et al. 1996, Ibanez and Schupp 2001). Reproduction in large stands with high canopy cover occurs most often in either canopy gaps where a tree has died and increased exposure of bare ground or around the perimeter of the stand under sagebrush plants, where litter cover is less and seldom deep (Schultz 1987, Schultz et al. 1991).
Mahogany seeds require bare mineral soil to germinate; litter depths over 0.25 inches can impede recruitment (Gruell 1985, Schultz et al. 1991, Ibáñez et al. 1998, Ibáñez 2002). Once germination occurs, the seedlings exhibit rapid growth in relation to top growth, providing some resistance to drought and competition with invasive species (Dealy 1975). Dealy (1975) reported that curl-leaf mahogany seedlings have a mean taproot length of 0.97 m after 120 days. The mean top height was slightly less than 2.5 cm. Multiple sources (Schultz et al. 1996, Ibáñez et al. 1998) found that mahogany seedlings germinate abundantly under the canopy of adult plants but rarely successfully establish there due to shading and higher litter amounts. In addition, Schultz et al. (1996) found that seedlings had significantly higher long term success in areas dominated by sagebrush canopy than in areas under mahogany canopy or in interspaces. Some hypothesize that the light shading and hydraulic lift provided by sagebrush may create a microsite facilitating mahogany recruitment (Gruell 1985, Ibáñez et al. 1998).

Mountain big sagebrush is generally long-lived; therefore it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent large recruitment events and simultaneous low, continuous recruitment is the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent on adequate moisture conditions.

The perennial bunchgrasses that are co-dominant with the shrubs include bluebunch wheatgrass, needlegrasses (Achnatherum spp.) and muttongrass (*Poa fendleriana* ssp. longiligula). These species generally have somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. Differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.
Mahogany stands are susceptible to drought, frost, insect attack, and invasion by non-native species, especially cheatgrass (*Bromus tectorum*). Cheatgrass affects mahogany seedling growth by competing for water resources and nutrients in an area (Ross 1999).

Infilling by singleleaf pinyon (*Pinus monophylla*) may also occur with an extended fire return interval. Eventually, singleleaf pinyon will dominate the site and the understory of mountain big sagebrush and grasses will be severely reduced. Muttongrass may remain underneath trees on north-facing slopes.

This ecological site has moderate to high resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, precipitation, and nutrient availability. Long-term disturbance response may be influenced by small differences in landscape topography. North slopes are more resilient than south slopes because lower soil surface temperatures operate to keep moisture content higher on northern exposures. Four possible alternative stable states have been identified for this site.

Fire Ecology:
The historic fire return interval in curlleaf mountain mahogany stands is not well documented, however a study by Arno and Wilson (1986) suggested sites of curlleaf mountain mahogany with ponderosa pine had fire return intervals of 13 to 22 years before 1900. Fire frequency most likely depends on surrounding vegetation. Mahogany will persist longest on rocky sites where it is protected from fire. Because of their thicker bark, mature trees can often survive low-severity fires (Gruell 1985). Curlleaf mountain mahogany is considered a weak sprouter after fire. It is usually moderately to severely damaged by severe fires and the recovery time of these sites is variable; some measurements show that stands lack recruitment for up to 30 years post-fire (Gruell 1985). Curlleaf mountain mahogany produces seed crops at very irregular intervals and is difficult to reestablish after fire. Seedlings are sensitive to drought and frost (Plummer et al 1968, Dealy 1975).

Mountain big sagebrush is killed by fire (Neuenschwander 1980, Blaisdell et al. 1982), and does not resprout (Blaisdell 1953). Post fire regeneration occurs from seed and will vary depending on site characteristics, seed source, and fire characteristics. Mountain big sagebrush seedlings can grow rapidly and may reach reproductive maturity within 3 to 5 years (Bunting et al. 1987). Mountain big sagebrush may return to pre-burn density and cover within 15 to 20 years following fire, but establishment after severe fires may proceed more slowly (Bunting et al. 1987).

Depending on fire severity, rabbitbrush (Chrysothamnus spp.), Utah serviceberry (*Amelanchier utahensis*), manzanitas (Ceanothus spp.), and mountain snowberry (*Symphoricarpos oreophilus*) may increase after fire. The majority of research concerning rabbitbrush has been conducted on yellow rabbitbrush. Yellow rabbitbrush has a large taproot root system and is known to be shorter lived and less competitive than sagebrush. Seedling density, flower production, and shoot growth decline as competition from other species increases (McKell and Chilcote 1957, Miller et al. 2013). Yellow rabbitbrush is top-killed by fire, but sprouts vigorously after fire (Kuntz 1982, Akinsoji 1988). Snowberry is also top-killed by fire, but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Mountain snowberry has been noted to regenerate well and exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982). Fire will remove aboveground biomass from bluebunch wheatgrass but plant mortality is generally low (Robberecht and Defossé 1995) because the buds are underground (Conrad and Poulton 1966) or protected by foliage. However, season and severity of the fire will influence plant response. Plant response will vary depending on post-fire soil moisture availability.

Muttongrass, a minor component on this site, is top killed by fire but will resprout after low to moderate severity fires. A study by Vose and White (1991) in an open sawtimber site, found minimal difference in overall effect of burning on muttongrass.

State and transition model

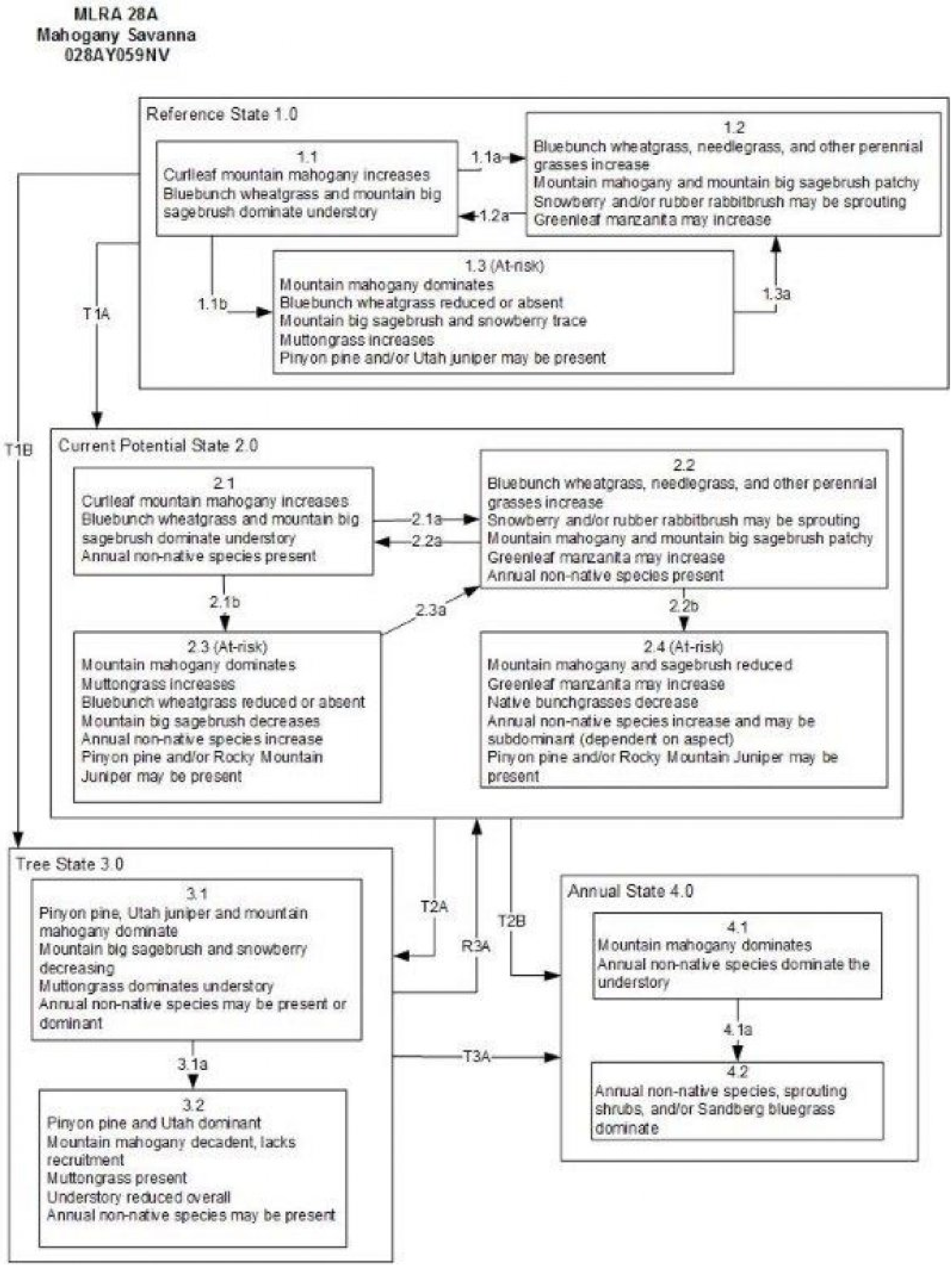


Figure 6. State and Transition Model

MLRA 28A
Mahogany Savanna
028AY059NV

Reference State 1.0 Community Pathways
1.1a: Low severity fire creates mosaic pattern of shrubs and grasses.
1.1b: Time and lack of disturbance or fire, long-term drought, herbivory, or combinations of these. Muttongrass increases with more shade.
1.2a: Time and lack of disturbance or fire, long-term drought, herbivory, or combinations of these.
1.3a: Low severity fire creates mosaic pattern. Greenleaf manzanita will increase after fire.

Transition T1A: Introduction of non-native annual species.
Transition T1B: Time and lack of disturbance allows pinyon and/or juniper to increase and overtop mahogany. Litter increases while understory plants decrease.

Current Potential State 2.0 Community Pathways
2.1a: Low severity fire.
2.1b: Time and lack of disturbance or fire, long-term drought, inappropriate grazing management, or combinations of these. Muttongrass increases because of increased shade from pinyon/juniper trees.
2.2a: Time and lack of disturbance or fire, long-term drought, inappropriate grazing management, or combinations of these.
2.2b: Fire in the presence of non-native annuals. Annual species may increase in a year with heavy spring precipitation.
2.3a: Fire. Greenleaf manzanita will increase after fire.

Transition T2A: Time and lack of disturbance allows pinyon and/or juniper to increase and overtop mahogany. Litter increases while understory plants decrease.

Transition T2B: Inappropriate grazing in the presence of non-native annual species (4.1) Catastrophic fire (4.2).

Tree State 3.0 Community Pathways
3.1a: Time and lack of disturbance or fire, drought, inappropriate grazing management, or combinations of these allows for maturation of the pinyon/juniper community.

Restoration Pathway R3A: Removal of pinyon/juniper from site will allow mountain mahogany to again become the dominant overstory.

Annual State 4.0 Community Pathways
4.1a: Catastrophic fire.

Figure 7. Legend

State 1
Reference State

The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. The Reference State has three general community phases; a tree-shrub dominant phase, a sprouting shrub and perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect attack.

Community 1.1
Community Phase

The plant community is dominated by curlleaf mountain mahogany. Mountain big sagebrush is the principal understory shrub. Bluebunch wheatgrass and muttongrass are the most prevalent understory grasses. Total overstory canopy cover is less than 50 percent (±35%). Understory vegetation comprises about 50% of the total site production. Total annual production for all trees, shrubs, and herbaceous plants in the understory to a height of 4.5 feet ranges from 600 to 1300 pounds per acre. Total production of all trees, shrubs and herbaceous plants irrespective of height ranges from 1200 to 2500 pounds per acre. Potential vegetative composition for the understory is about 50% grasses, 10% forbs and 40% shrubs. Overstory trees and tree-like shrub composition is about 50% of the total site production. Approximate ground cover (basal and crown) is 30 to 50 percent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	760	1040	1430
Grass/Grasslike	293	490	686
Shrub/Vine	242	387	535
Forb	50	101	151
Total	**1345**	**2018**	**2802**

Community 1.2
Community Phase

Figure 9. P. Novak-Echenique, 9/2014, NV713, MU2042

This community phase is characteristic of a post-disturbance, early-seral community. If resulting from fire, mountain mahogany will be present in patches. Mountain snowberry, Utah serviceberry, greenleaf manzanita and rabbitbrush are sprouting or increasing in burned areas. Perennial bunchgrasses may dominate.

Community 1.3
Community Phase (At Risk)

Figure 10. T. Stringham July 2014, NV784, MU 1485

Figure 11. P. Novak-Echenique, 9/2014, NV713, MU2042

Mahogany density will increase in the absence of disturbance. Shrubs and deep-rooted perennial bunchgrasses will be shaded out by the dense mahogany. Muttongrass is more shade tolerant, however, and will still be found in the understory. Mahogany in dense stands will lose lower branches due to shading and/or herbivory, resulting in a more tree-like appearance. Scattered pinyon trees may be present and increasing on the site, however the mahogany and shrub understory is intact and is dominating site resources (Miller et al 2008).

Pathway a
Community 1.1 to 1.2

Low-severity fire (primarily from lightning strikes) can reduce the mahogany overstory and release the understory species including sprouting shrubs and perennial bunchgrasses. Due to low fuel loads, fires will typically be low severity, resulting in a mosaic pattern.

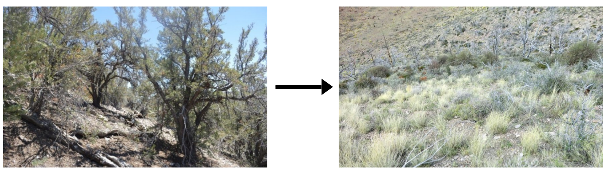
Pathway b
Community 1.1 to 1.3

Time and lack of disturbance such as fire allows the mountain mahogany to regenerate. The shrub and herbaceous understory components decline due to increased shading from the trees.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance such as fire allows the mountain mahogany to increase. The shrub and herbaceous understory components decline due to increased shading from the trees.

Pathway a
Community 1.3 to 1.2



Community Phase (At Risk) → Community Phase

A low-severity or spot fire, snow loading, or insect damage will decrease the overstory and allow for the herbaceous plants in the understory to increase.

State 2
Current Potential State

This state is similar to the Reference State 1.0. It has similar community phases with the addition of the 2.4 at-risk community phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. These non-natives can be highly flammable, and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community 2.1
Community Phase

Figure 12. P Novak-Echenique 7/2012, NV 708, MU5420

Figure 13. P Novak-Echenique, 7/2012, NV 708, MU 5420

This community phase is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. This community is dominated by curlleaf mountain mahogany. Mountain big sagebrush and mountain snowberry dominate the shrub component. Bluebunch wheatgrass and needlegrasses are the dominant perennial bunchgrasses. Forbs and other grasses are a small component of the understory. Utah juniper and singleleaf pinyon may be present.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early seral community where annual non-native species are present. Mountain mahogany and sagebrush are present in trace amounts. Snowberry, greenleaf and Martin's manzanita, Utah serviceberry and rabbitbrush are sprouting or increasing; perennial bunchgrasses may dominate the site. Annual non-native species are stable or increasing within the community.

Community 2.3
Community Phase (At Risk)

Figure 14. T. Stringham NV 708, MU 5420, July 2012

Curlleaf mountain mahogany dominates the overstory. Mountain big sagebrush, mountain snowberry, Utah serviceberry and other understory shrubs decrease. Perennial bunchgrass understory is reduced. Muttongrass will likely increase in the understory and may be the dominant grass on the site. Mountain mahogany may have a “hedged” or tree-like appearance from many years of browsing by deer. Annual non-native plants are increasing in the understory. Scattered pinyon trees may be present and increasing on the site, however the mahogany and shrub understory is intact and is dominating site resources (Miller et al 2008).

Community 2.4
Community Phase (At Risk)

This community is at risk of crossing into an annual state. Native bunchgrasses dominate the understory; however, annual non-native species such as cheatgrass may be sub-dominant. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Mountain big sagebrush and mountain snowberry are minor components. Singleleaf pinyon may be present to increasing. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway a
Community 2.1 to 2.2

Wildfire reduces the overstory and allows for the understory species to dominate the site. Due to low fuel loads, fires are typically low severity or spotting resulting in a mosaic pattern. A fire may be more severe following an unusually wet spring or a change in management favoring an increase in fine fuels. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Pathway b
Community 2.1 to 2.3

Community Phase

Community Phase (At Risk)

Time and lack of disturbance allows the mountain mahogany component to increase. The shrub and herbaceous understory components decline due to increased shading from the trees.

Pathway a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of woody species allows curlleaf mountain mahogany and understory shrubs to re-establish.

Pathway b
Community 2.2 to 2.4

Tree/shrub removal treatment or prescribed burning in the presence of the non-native annual cheatgrass will reduce shrub canopy and cause a shift to Phase 2.4. A year with heavy spring precipitation in the presence of cheatgrass will accelerate this pathway.

Pathway a
Community 2.3 to 2.2

Low-severity or spotty fire, damage from snow loading, or insects will reduce the overstory and allow for the perennial bunchgrasses in the understory to increase. A fire may be more severe following an unusually wet spring or a change in management favoring an increase in fine fuels. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

State 3
Tree State

This state has two community phases and is characterized by singleleaf pinyon pine and juniper trees dominating site resources. Pinyon and juniper trees outcompete and overtop the mountain mahogany overstory. The understory is reduced due to shading and competition with tree overstory. This state may be compounded by grazing of livestock and wildlife further reducing perennial understory species. Annual non-native species may be increasing. This state will not occur where this site extends above the pinyon/juniper tree zone (>9000 ft.)

Community 3.1
Community Phase

Figure 15. T. Stringham July 2014, NV 784, MU1485

Singleleaf pinyon and curlleaf mountain mahogany co-dominate the site. The understory of shrubs and grasses is nearly intact but shows signs of thinning (Miller et al 2008). Mountain big sagebrush and snowberry and are starting to show signs of increased competition from tree canopy and are decreasing in the understory. Muttongrass increases with shading and may be the dominant bunchgrass in the understory. Annual non-native species are present and may be increasing.

Community 3.2
Community Phase

Singleleaf pinyon pine dominates the site. Trees dominate site resources and the understory is reduced (Miller at al 2008.) Mountain mahogany is decadent and lack recruitment. Muttongrass is present but reduced in density. The shrub component of the understory is reduced, mountain big sagebrush skeletons may be present. Annual non-native species are present to increasing.

Pathway a
Community 3.1 to 3.2

Time and lack of disturbance allows for increased cover and shading of pinyon pine trees.

State 4
Annual State

The primary characteristic of this state is a dominance of non-native annual grasses like cheatgrass. The community may be dominated by sprouting shrubs, annual non-native grasses and forbs. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses, and/or severe wildfire or repeated fires. Non-native annuals and sprouting shrubs dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community 4.1
Community Phase

Mountain mahogany dominates the overstory and annual non-native species such as cheatgrass dominate the understory. Perennial bunchgrasses are present in trace amounts. This phase is very at risk of fire and converting to annual grassland.

Community 4.2
Community Phase

Annual non-native species dominate the site. Perennial bunchgrasses may be present in trace amounts. Mountain mahogany and mountain big sagebrush may present in trace amounts. Rabbitbrush and other sprouting shrubs may be sprouting.

Pathway a
Community 4.1 to 4.2

Catastrophic fire eliminates the mountain mahogany overstory and allows for annual non-native species to dominate.

Transition A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, and thistle. Slow variables: Over time annual non-native species increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition B
State 1 to 3

Trigger: Time and lack of disturbance such as fire allows for pinyon trees to dominate. Slow variables: Over time abundance and size of pinyon will increase. Threshold: Pinyon pine dominates ecological processes. Trees overtop and outcompete mountain mahogany and shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

Transition A
State 2 to 3

Trigger: Time and lack of disturbance such as fire allows for singleleaf pinyon pine trees to dominate. Slow variables: Over time abundance and size of pinyon pine will increase. Threshold: Pinyon pine dominates ecological processes. Trees overtop and outcompete mountain mahogany and shrubs for water and sunlight. Shrub skeletons exceed live shrubs with minimal recruitment of new cohorts.

Transition B
State 2 to 4

Trigger: High-severity or stand-replacing fire that significantly reduces or eliminates Mountain mahogany and sagebrush. Perennial bunchgrasses significantly damaged by the fire may be further reduced or eliminated with inappropriate post-fire grazing management. Cheatgrass becomes the dominant grass. Slow variable: Cover and production of annual non-native grasses and forbs will increase. Threshold: Loss of mahogany overstory, sagebrush, and deep-rooted perennial bunchgrasses alters nutrient cycling, nutrient redistribution, and reduces soil organic matter and soil moisture. Increased continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires.

Restoration pathway A
State 3 to 2

Removal of singleleaf pinyon and juniper trees from the site may allow mountain mahogany to reestablish and become dominant in the overstory.

Conservation practices

Brush Management

Transition A
State 3 to 4

Trigger: To community phase 4.1: Overgrazing in the presence of non-native annual species can cause a decrease in perennial bunchgrasses and an increase in annual species. Spring and/or fall moisture may also increase annual species. To community phase 4.2: Catastrophic fire. Slow variables: Cover and production of annual non-native species increase in the understory. Threshold: Loss of mahogany overstory, mountain big sagebrush, and deep-rooted perennial bunchgrasses alters nutrient cycling, nutrient redistribution, and reduces soil organic matter and soil moisture. Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			272–585	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	202–353	–
	muttongrass	POFE	*Poa fendleriana*	50–151	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	7–27	–
	Dore's needlegrass	ACNED	*Achnatherum nelsonii ssp. dorei*	7–27	–
	western needlegrass	ACOCO	*Achnatherum occidentale ssp. occidentale*	7–27	–
2	**Secondary Perennial Grasses**			20–101	
	blue grama	BOGR2	*Bouteloua gracilis*	6–30	–
	mountain brome	BRMA4	*Bromus marginatus*	6–30	–
	sedge	CAREX	*Carex*	6–30	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	6–30	–
	needle and thread	HECO26	*Hesperostipa comata*	6–30	–
	basin wildrye	LECI4	*Leymus cinereus*	6–30	–
Forb					
3	**Perennial**			50–151	
Shrub/Vine					
4	**Primary Shrubs**			222–434	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	202–353	–
	snowberry	SYMPH	*Symphoricarpos*	20–81	–
5	**Secondary Shrubs**			20–101	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	10–30	–
	greenleaf manzanita	ARPA6	*Arctostaphylos patula*	10–30	–
	Martin's ceanothus	CEMA2	*Ceanothus martinii*	0–30	–
	birchleaf mountain mahogany	CEMOG	*Cercocarpus montanus var. glaber*	0–30	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–30	–
	slender buckwheat	ERMI4	*Eriogonum microthecum*	0–17	–
Tree					
6	**Evergreen**			760–1430	
	curl-leaf mountain mahogany	CELE3	*Cercocarpus ledifolius*	908–1130	–
	Utah juniper	JUOS	*Juniperus osteosperma*	10–40	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	10–40	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	10–40	–

Animal community

Livestock Interpretations:
This site has limited value for livestock grazing due to steep slopes and stony surfaces. Despite low palatability, mountain big sagebrush is eaten by sheep, cattle, goats, and horses. Chemical analysis indicates that the leaves of big sagebrush equal alfalfa meal in protein, have a higher carbohydrate content, and yield twelvefold more fat (USDA-Forest Service 1937). Bluebunch wheatgrass is moderately grazing tolerant and is very sensitive to

defoliation during the active growth period (Blaisdell and Pechanec 1949, Laycock 1967, Anderson and Scherzinger 1975 Britton et al. 1990). Herbage and flower stalk production was reduced with clipping at all times during the growing season; however, clipping was most harmful during the boot stage (Blaisdell and Pechanec 1949, Britton et al. 1990). Tiller production and growth of bluebunch was greatly reduced when clipping was coupled with drought (Busso and Richards 1995). Mueggler (1975) estimated that low vigor bluebunch wheatgrass may need up to 8 years rest to recover. Although an important forage species, it is not always the preferred species by livestock and wildlife (Anderson and Scherzinger 1975, Britton et al. 1990).

Muttongrass is excellent forage for domestic livestock especially in the early spring. Muttongrass begins growth in late winter and early spring, which makes it available before many other forage plants. Columbia needlegrass provides valuable forage for all classes of livestock. Overall production is generally low in the upper sagebrush and mountain brush zones and at the limits of its range where Columbia needlegrass grows only in scattered patches. It is especially valuable to cattle and horses on summer ranges and to domestic sheep on lambing grounds. It is more often cropped closely by cattle and horses than by sheep. Western needlegrass has a spreading and deeply penetrating root system, which makes it resistant to trampling. Letterman's needlegrass begins growth early in the year and remains green throughout the relatively long growing season, thus, making it valuable forage for livestock..

Common snowberry is considered important browse for many types of livestock. It is especially important to domestic sheep and cattle. Common snowberry was found to be highly palatable to cattle. It plays a critical role in permitting cattle to meet their protein requirements during the latter half of the growing season. Domestic sheep also utilize common snowberry for browse and it is considered fair to good forage. It is has no forage value for horses. Some livestock (domestic goats, sheep, and cattle) use it in spring, fall, and/or winter but rarely in the summer.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine-tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:

This site provides valuable habitat for a variety of wildlife species. Curlleaf mountain mahogany is an important cover and browse species for big game such as elk, mule deer, and bighorn sheep (Furniss et al 1988, Lanner 1983). Sampson and Jesperson (1963) states that curlleaf mountain mahogany is excellent browse for mule deer (Odocoileus heminous), and domestic livestock will browse this plant to varying degrees in all seasons except summer. It is not uncommon for these trees to develop a "hedged" appearance after years of regular browsing by wildlife.

According to Olsen (1992) curlleaf mountain mahogany is consumed widely by mule deer throughout the year. In fact, mule deer fecal pellets were observed to contain curl-leaf mountain mahogany year-round, with the highest frequency of leaves found in winter (Gucker 2006). Mule deer will use curlleaf mountain mahogany for cover as well (Steel et al. 1981).

Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer and elk. Common snowberry is considered important browse for many types of wildlife. Bighorn sheep use common snowberry regularly during the summer. Forage value to elk as fair. Common snowberry is important as both cover and food for bird and small mammal populations. These include sharp-tailed, ruffed, and blue grouse, wild turkey and, several non-game species of bird including the kingbird, western flycatcher, and western bluebird. Among small mammals that rely on common snowberry are fox squirrels, desert cottontails, and pocket gopher. Bluebunch wheatgrass is considered one of the most important forage grass species on western rangelands for wildlife. Bluebunch wheatgrass does not generally provide sufficient cover for ungulates, however, mule deer are frequently found in bluebunch-dominated grasslands. Deer and elk make heavy use of muttongrass, especially in early spring when other green forage is scarce. Depending upon availability of other nutritious forage, deer may use mutton grass in all seasons. Muttongrass cures well and is an important fall and winter deer food in some areas. Columbia needlegrass provides valuable forage for many species of wildlife. It is also consumed by mule deer and other wildlife species throughout the growing season. Needlegrasses are a significant component in the diet of pocket gophers. Columbia needlegrass is palatable to many species of wildlife throughout its range. As with most needlegrasses, it is most palatable early in the season before the foliage becomes coarse and wiry. Palatability of Columbia needlegrass is described as "fair" for wildlife overall, becoming nearly unpalatable at maturity. Western needlegrass and Letterman's needlegrass are important forage species for many wildlife species.

Overgrazing by livestock and/or wildlife will cause a reduction in deep-rooted perennial bunchgrasses in the understory with bluebunch wheatgrass and needlegrasses particularly affected. As perennial grass cover declines, the potential for invasion by annual non-native species is increased. With the reduction in competition from these grasses bunchgrasses, shallower rooted grasses such as Sandberg bluegrass and forbs may increase (Smoliak et al. 1972). Bare ground also increases in this scenario.

This site also provides breeding and hunting grounds for mountain lions, Puma concolor (Steele et al. 1981,

(Gucker 2006). Lions used curl-leaf mountain mahogany vegetation as an important site for caching kills. Loagan and Irwin (1985) noted of 52 mountain lion caches, 33 percent were located in curl-leaf mountain mahogany vegetation (Gucker 2006 and ref. therein).
A variety of small mammals consume curlleaf mountain mahogany seeds (Gucker 2006, Wildlife Action Plan Team 2012). Curl-leaf mountain mahogany leaves and fruits have also been found in bushy-tailed woodrat (Neotoma cinerea) middens (Gucker 2006).
Bird species utilize mountain mahogany habitat types heavily. Virginia's warblers (Oreothylypis virginae) were recorded in their second highest densities in the state in mountain mahogany habitats. This habitat type also provides important nesting sites for dusky flycatchers (Empidonax oberholseri), rock wrens (Salpinctes obsoletus), and American kestrels (Falco sparverius) (Wildlife Action Plan Team 2012).

Hydrological functions

Permeability is very slow to moderately rapid. Runoff is medium to very high. Hydrologic soil groups are A, B, C, and D. Rills are none to rare. Rill development may increase after summer convection storms due to runoff from adjacent rock outcrops. Water flow patterns are none to rare with occurrence increasing as canopy cover increases. Pedestals are none to rare with small pedastals occurring only in water flow paths. Perennial herbaceous plants (especially deep-rooted bunchgrasses [bluebunch wheatgrass] slow runoff and increase infiltration. Curlleaf mountain mahogany and understory shrubs break raindrop impact and provide opportunity for snow catch and accumulation on site.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition and the colorful flowering of wild flowers and shrubs during the spring and early summer. This site offers rewarding opportunities to photographers and for nature study. This site is used for hiking and has potential for upland and big game hunting.

Other products

Common snowberry fruit was eaten fresh but was not favored by Native Americans in Washington and Oregon. The fruits were also dried for winter use. Common snowberry was used on hair as soap, and the fruits and leaves mashed and applied to cuts or skin sores as a poultice and to soothe sore, runny eyes. Tea from the bark was used as a remedy for tuberculosis and sexually transmitted diseases. A brew made from the entire plant was used as a physic tonic. Arrowshafts and pipestems were made from the stems. Native Americans used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing.

Other information

Curlleaf mountain mahogany may be planted to help stabilize soil in disturbed areas such as roadcuts and mine spoils.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T12N R69E S7
Latitude	38° 55′ 37″
Longitude	114° 16′ 14″
General legal description	About 2 miles below Wheeler Peak Campground on Lehman Creek, Great Basin National Park, Snake Range, White Pine County, Nevada. Also occurs in Lincoln County, Nevada.

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Rangeland health reference sheet

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

Author(s)/participant(s)	P NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist.
Date	04/02/2014
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. Rill development may increase after summer convection storms due to runoff from adjacent rock outcrops.

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2. **Presence of water flow patterns:** Water flow patterns are none to rare with occurrence increasing as canopy cover increases.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare with small pedastals occurring only in water flow paths.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 20%; surface rock fragments ±35%

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5. **Number of gullies and erosion associated with gullies:** None.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events. Mat of accumulating litter under mountain mahogany is very stable and shows no obvious movement.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 5 to 6 on most soil textures found on this site.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically subangular blocky. Soil surface colors are dark browns and soils are typified by a thick mollic epipedon. Surface textures are loams, silt loams, or loamy coarse sands. Some pedons have an O horizon above the mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 2 to 4 percent, dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [bluebunch wheatgrass, needlegrasses] slow runoff and increase infiltration. Curlleaf mountain mahogany and understory shrubs break raindrop impact and provide opportunity for snow catch and accumulation on site.

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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): Compacted layers are none. Sub-surface horizons with subangular blocky structure are not to be interpreted as compacted layers.

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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: Reference State: Curlleaf mountain mahogany

    Sub-dominant: understory shrubs > deep-rooted, cool season, perennial bunchgrasses > deep-rooted, cool season, perennial forbs > shallow-rooted, cool season, perennial grasses = fibrous, shallow-rooted, cool season, perennial forbs > annual forbs

    Other: evergreen trees

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Overstory shrubs have little mortality. Dead branches within understory shrubs are common and standing dead shrub canopy material may be as much as 35% of total shrub canopy; mature bunchgrasses (<25%) may have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Herbaceous, or non-persistent, litter within curlleaf mountain mahogany canopy interspaces (± 30-40%) and litter depth is ± 1 inch. Leaf litter forms a mat 1 to 2 inches thick under the drip line of mature mountain mahogany. Large, persistent, litter from trees (limbs, etc.) variable to 5%.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For understory vegetation to 4½ feet and normal or average growing season (through June) = ±900 lbs/ac; Favorable years: 1300 lbs/ac Unfavorable years: 600 lbs/ac

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Potential invaders include cheatgrass. Singleleaf pinyon pine may increase on this site and eventually dominate it.

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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Reduced growth and reproduction occur during drought years.
