USDA Natural Resources
Conservation Service

# Ecological site R028AY060NV
# MAHOGANY THICKET

Accessed: 05/09/2024

## 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.

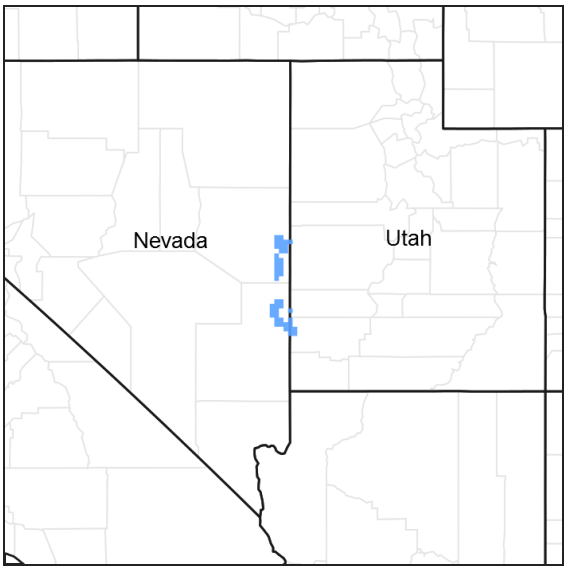


**Figure 1. Mapped extent**

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 mountain backslopes. Slope gradients of 15 to 75 percent are typical. Elevations range from 7500 to over 11,000 feet.

Average annual precipitation is 14 to 22 inches. Mean annual air temperature is 40 to 43 degrees F. The average growing season is about 40 to 70 days.

The soils associated with this site are typically shallow to moderately deep and well drained. The soils have formed in residuum and colluvium from quartzite, limestone, dolomite, welded tuff or mixed tuffaceous rocks. These soils are normally neutral to slightly acid in reaction and often modified by high volumes of rock fragments throughout the profile.

The reference state is dominated by curlleaf mountain mahogany, but other trees such as singleleaf pinyon, quaking aspen, white fir and limber pine may occur sporadically in the tree canopy. Mountain snowberry is the principal understory shrub and needlegrasses are the most prevalent understory grass species. Total overstory canopy cover exceeds 45 percent (=50%). Understory vegetation comprises about 10% of the total site production. Production ranges from 75 to 300 pounds per acre understory.

## Associated sites

| | |
|---|---|
| F028AY077NV | **PIMO-CELE3/ARTRV/PSSPS-POFE** |
| R028AY059NV | **MAHOGANY SAVANNA** |
| R028AY062NV | **MOUNTAIN RIDGE** |
| R028AY065NV | **SHALLOW LOAM 14+ P.Z.** |
| R028AY067NV | **CALCAREOUS LOAM 14+ P.Z.** |

## Similar sites

| | |
|---|---|
| R028AY058NV | **STONY MAHOGANY SAVANNA**<br>Total site productivity is less; CELE3 canopy cover is less than 25% (±15%) |
| R028AY059NV | **MAHOGANY SAVANNA**<br>Total site productivity is less; understory production is greater; CELE3 canopy cover less than 40% |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Cercocarpus ledifolius* |
| Shrub | (1) *Symphoricarpos oreophilus* |
| Herbaceous | (1) *Achnatherum* |

## Physiographic features

This site typically occurs on mountain backslopes on all aspects. Slope gradients of 15 to 75 percent are typical. Elevations range from 6000 to over 11,000 feet.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Mountain slope |
| Elevation | 1,829–3,353 m |
| Slope | 15–75% |
| 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 14 to 22 inches. Mean annual air temperature is 40 to 43 degrees F. The average growing season is about 40 to 70 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) | 50 days |
| Freeze-free period (average) | 75 days |
| Precipitation total (average) | 457 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 moderately deep and well drained. The soils have formed in residuum and colluvium from granite, limestone, dolomite, welded tuff or mixed tuffaceous rocks. The soils have a thick mollic epipedon. Some soils have an argillic or calcic horizon. These soils are normally neutral to slightly acid in reaction and often modified by high volumes of rock fragments throughout the profile. Available water holding capacity is low. the soil moisture regime is xeric and the soil temperature regime is cryic. The soil series associated with this site include Denpark, Hardol and Kious.

The representative soil component is Kious, classified as a Loamy-skeletal, mixed superactive, shallow Pachic Haplocryolls. Diagnostic horizons include a mollic epipedon from the soil surface to 19 inches. Paralithic contact is from 16 to 20 inches. Clay content in the particle control sections average 50 to 80 percent. Rock fragments range from 12 to 18 percent. Reaction is slightly acid or neutral, usually increasing with depth. Effervescence is none. Lithology consists of quartz monzonite.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Colluvium–dolomite<br>(2) Residuum–limestone<br>(3) Colluvium–quartz-monzonite |
| Surface texture | (1) Very gravelly silt loam<br>(2) Extremely gravelly silt loam<br>(3) Very cobbly loamy coarse sand |
| Family particle size | (1) Loamy |
| Drainage class | Well drained |
| Permeability class | Very slow |
| Soil depth | 51–152 cm |
| Surface fragment cover <=3" | 15–20% |
| Surface fragment cover >3" | 5–25% |
| Available water capacity (0-101.6cm) | 9.91–10.16 cm |
| Calcium carbonate equivalent (0-101.6cm) | 1–50% |
| Electrical conductivity (0-101.6cm) | 0 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 0 |
| Soil reaction (1:1 water) (0-101.6cm) | 6.4–8 |
| Subsurface fragment volume <=3" (Depth not specified) | 15–75% |
| Subsurface fragment volume >3" (Depth not specified) | 10–25% |

## 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).

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. As tree canopy increases, bluebunch wheatgrass and needlegrasses will decline while muttongrass – the more shade tolerant grass – will increase. 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 curl-leaf 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 mountain mahogany plants 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 curlleaf 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). Cheatgrass thus affects mahogany growth by competing for water resources and reducing the amount of bare soil in an area (Ross 1999). 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 present on this site include needlegrasses (Achnatherum spp.), muttongrass (*Poa fendleriana*) and several other species. These grasses 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. Muttongrass may be more shade tolerant than other perennial bunchgrasses and will persist in the understory as the canopy closes (Erdman 1970).
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*) and Utah juniper (*Juniperus osteosperma*) may also occur with an extended fire return interval.
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. Concave areas receive run-in from adjacent landscapes and consequently retain more moisture to support the growth of deep-rooted perennial grasses (i.e. needlegrasses) whereas convex areas where runoff occurs are slightly less resilient and may have more shallow-rooted perennial grasses (i.e. muttongrass). North slopes are also more resilient than south slopes because lower soil surface temperatures operate to keep moisture content higher on northern exposures. Two possible alternative stable states have been identified for this site.
Fire Ecology:
The fire return interval of curlleaf mountain mahogany dominated sites is not well documented, however a study by Arno and Wilson (1986) suggested sites of curl-leaf mountain mahogany with ponderosa pine had fire return intervals of 13-22 years before 1900. Fire frequency most likely depends on surrounding vegetation. Mahogany will persist longest in rocky areas 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).
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 15-20 years following fire, but establishment after severe fires may proceed more slowly (Bunting et al. 1987). Depending on fire severity, mountain snowberry may increase after fire. Snowberry is top-killed by fire but resprouts after fire from rhizomes (Leege and Hickey 1971, Noste and Bushey 1987). Snowberry has been noted to be fire tolerant (Miller et al 2013); it regenerates well and may exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982). Creeping barberry is resistant to low-intensity fire (Armour et al 1984). Creeping barberry is rhizomatous, thus it is capable of sprouting after fire and increasing in abundance after fire (Brown and Norbert 1989).

Perennial needlegrasses tend to be among the least fire resistant bunchgrasses because of their densely tufted stems. Columbia needlegrass is, however, only slightly to moderately damaged by fire, probably because it has relatively few culms per clump which may help to minimize the amount of subsurface heat transfer and subsequent damage.
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. Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass. Thus, bluebunch wheatgrass is considered to experience slight damage to fire but is more susceptible in drought years (Young 1983). Plant response will vary depending on season, fire severity, fire intensity and 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 a minimal effect of burning on muttongrass.

## State and transition model

MLRA 28A
Mahogany Thicket
028AY060NV

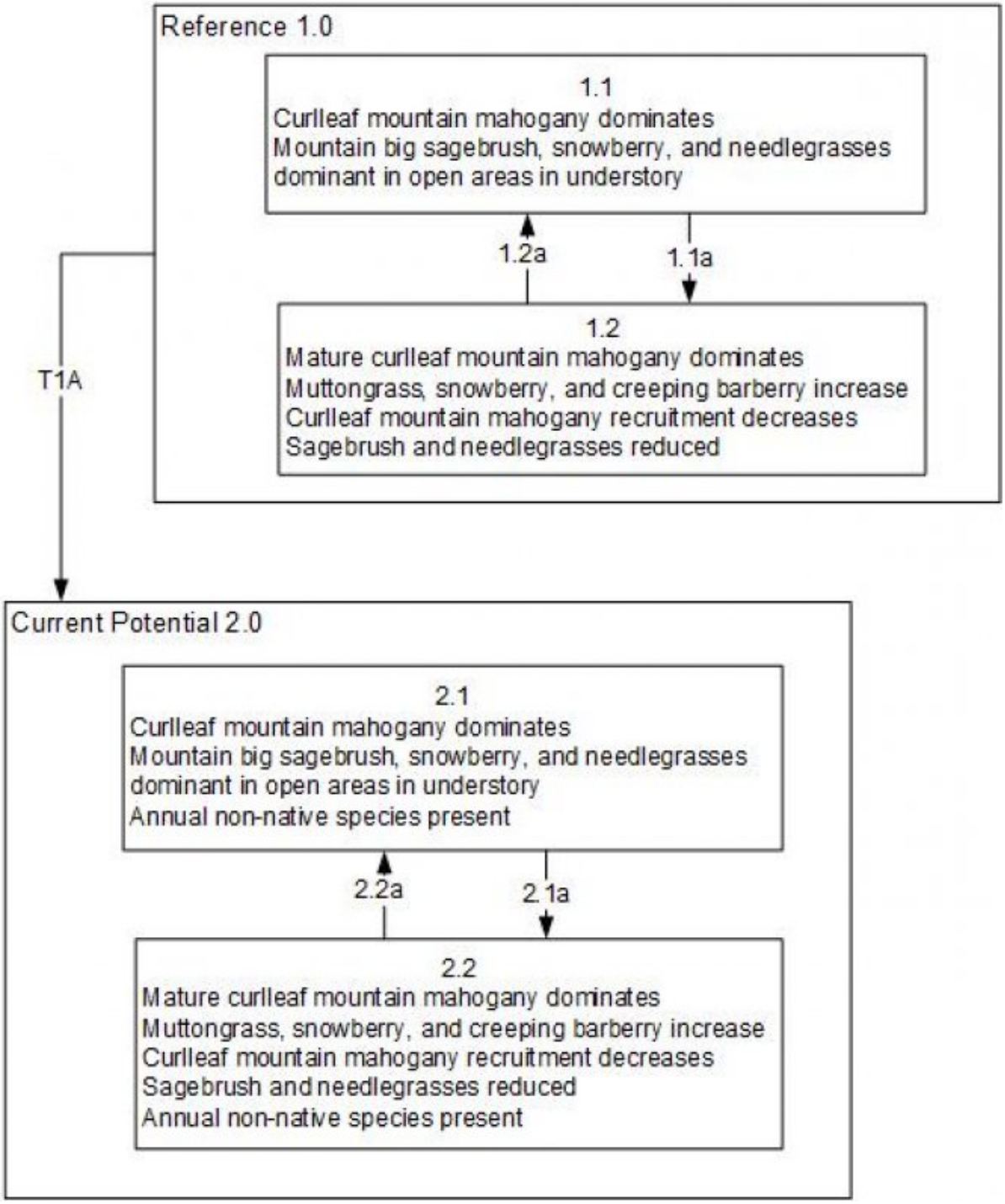


**Figure 6. State and Transition Model**

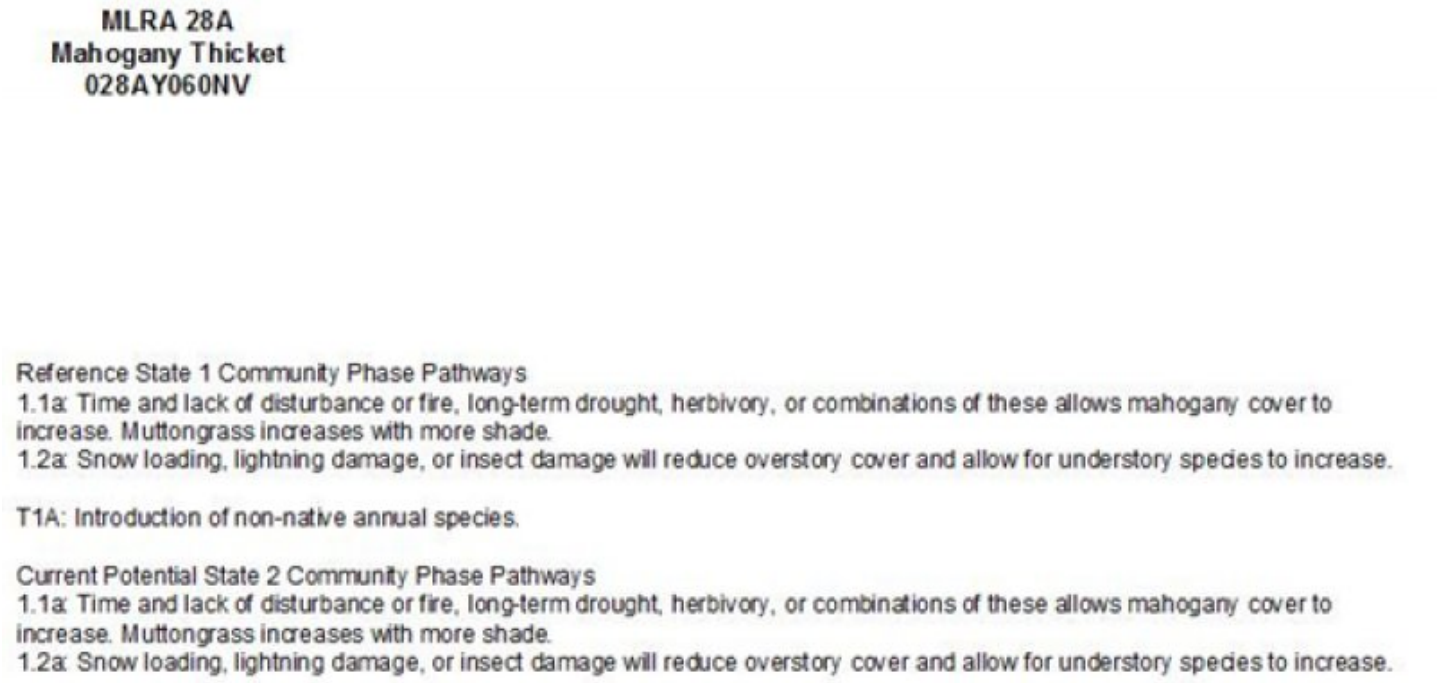


**Figure 7. Legend**

## 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 two general community phases; a tree-shrub 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, but other trees such as singleleaf pinyon, quaking aspen, white fir and limber pine may occur sporadically in the tree canopy. Mountain snowberry is the principal understory shrub and needlegrasses are the most prevalent understory grass species. Total overstory canopy cover exceeds 45 percent (=50%). Understory vegetation comprises about 10% of the total site production. Potential vegetative composition for the understory is about 55% grasses, 15% forbs and 30% shrubs. Overstory trees and tree-like shrub composition is about 90% of the total site production. Approximate ground cover (basal and crown) is 50 to about 75 percent. Mountain mahogany canopy is not closed in this phase. Small disturbances that damage or kill individual trees open up areas in the canopy. Mountain big sagebrush and snowberry make up the shrub components of the understory.

**Table 5. Annual production by plant type**

| Plant Type | Low (Kg/Hectare) | Representative Value (Kg/Hectare) | High (Kg/Hectare) |
|---|---|---|---|
| Tree | 1844 | 2569 | 3183 |
| Shrub/Vine | 26 | 50 | 76 |
| Grass/Grasslike | 19 | 45 | 69 |
| Forb | 17 | 26 | 34 |
| **Total** | **1906** | **2690** | **3362** |

### Community 1.2
### Community Phase

Mahogany density increases in the absence of disturbance. Shrubs and deep-rooted perennial bunchgrasses are shaded out by the dense mahogany. Muttongrass is more shade tolerant, however, and is still found in the understory. Mountain big sagebrush is reduced or eliminated. Snowberry and creeping barberry are the dominant shrubs in the understory. Mahogany in dense stands will lose lower branches due to shading and/or herbivory, resulting in a more tree-like appearance. Singleleaf pinyon, Utah juniper, white fir, and/or limber pine are described in the site concept and may or may not be present.

### Pathway a
### Community 1.1 to 1.2

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. Muttongrass and other shade-tolerant species increase.

### Pathway a
### Community 1.2 to 1.1

Snow loading, lightning, or insect damage will decrease the overstory and allow for the shrubs and herbaceous plants in the understory to increase.

## State 2
## Current Potential

This state is similar to the Reference State 1.0. This state has the same two general community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. 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

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 curl-leaf mountain mahogany. Small disturbances that damage or kill individual trees open up areas in the canopy. Mountain big sagebrush and mountain snowberry make up the shrub components of the understory. Bluebunch wheatgrass and Thurber's needlegrass make up the perennial bunchgrasses. Forbs and other grasses are a small component of the understory. Singleleaf pinyon, Utah juniper, white fir, and/or limber pine may be present.

### Community 2.2
### Community Phase

**Figure 9. T.Stringham August 2013, NV708, MU5350, Kious soil series**

Curlleaf mountain mahogany dominates the overstory. Mountain big sagebrush is reduced or eliminated. Snowberry and creeping barberry are the dominant shrubs in the understory. The understory of bluebunch wheatgrass and needlegrasses is reduced while the shade-tolerant muttongrass increases in the understory and may be the dominant grass on the site. Annual non-native species are stable to increasing. Bare ground may be increasing. Mahogany in dense stands will lose lower branches due to shading and/or herbivory, resulting in a more tree-like appearance Singleleaf pinyon, Utah juniper, white fir, and/or limber pine may be present.

### Pathway a
### Community 2.1 to 2.2

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

Snow loading, lightning, or insect damage will reduce the overstory and allow for the shrubs and herbaceous plants in the understory to increase. Fires may be likely 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.

### Transition A
### State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, and thistles. 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.

## 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** | | | 16–53 | |
| | slender wheatgrass | ELTR7 | *Elymus trachycaulus* | 3–13 | – |
| | muttongrass | POFE | *Poa fendleriana* | 3–13 | – |
| | Dore's needlegrass | ACNED | *Achnatherum nelsonii ssp. dorei* | 3–9 | – |
| | western needlegrass | ACOCO | *Achnatherum occidentale ssp. occidentale* | 2–9 | – |
| | Letterman's needlegrass | ACLE9 | *Achnatherum lettermanii* | 3–8 | – |
| 2 | **Secondary Perennial Grasses** | | | 3–17 | |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 1–6 | – |
| | blue grama | BOGR2 | *Bouteloua gracilis* | 1–6 | – |
| | mountain brome | BRMA4 | *Bromus marginatus* | 1–6 | – |
| | Ross' sedge | CARO5 | *Carex rossii* | 1–6 | – |
| | basin wildrye | LECI4 | *Leymus cinereus* | 1–6 | – |
| | bluebunch wheatgrass | PSSPS | *Pseudoroegneria spicata ssp. spicata* | 1–6 | – |
| **Forb** | | | | | |
| 3 | **Perennial** | | | 17–34 | |
| | yarrow | ACHIL | *Achillea* | 1–9 | – |
| | aster | ASTER | *Aster* | 1–9 | – |
| | lupine | LUPIN | *Lupinus* | 1–9 | – |
| | beardtongue | PENST | *Penstemon* | 0–9 | – |
| | rockcress | ARABI | *Arabidopsis* | 0–6 | – |
| **Shrub/Vine** | | | | | |
| 4 | **Primary Shrubs** | | | 9–26 | |
| | mountain snowberry | SYOR2 | *Symphoricarpos oreophilus* | 9–26 | – |
| 5 | **Secondary Shrubs** | | | 17–50 | |
| | Utah serviceberry | AMUT | *Amelanchier utahensis* | 2–9 | – |
| | greenleaf manzanita | ARPA6 | *Arctostaphylos patula* | 2–9 | – |
| | mountain big sagebrush | ARTRV | *Artemisia tridentata ssp. vaseyana* | 2–9 | – |
| | slender buckwheat | ERMI4 | *Eriogonum microthecum* | 2–9 | – |
| **Tree** | | | | | |
| 6 | **Evergreen** | | | 1905–3363 | |
| | curl-leaf mountain mahogany | CELE3 | *Cercocarpus ledifolius* | 2287–2556 | – |
| | Utah juniper | JUOS | *Juniperus osteosperma* | 13–54 | – |
| | Rocky Mountain juniper | JUSC2 | *Juniperus scopulorum* | 13–54 | – |
| | singleleaf pinyon | PIMO | *Pinus monophylla* | 13–54 | – |
| | quaking aspen | POTR5 | *Populus tremuloides* | 13–54 | – |

## Animal community

Livestock Interpretations:
This site has limited value for livestock grazing due to steep slopes and stony surfaces. 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. 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. Slender wheatgrass is grazed by all classes of livestock. Snowberry is readily eaten by all classes of livestock, particularly domestic sheep. 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:
Curlleaf mountainmahogany provides food and cover for a variety of wildlife species. Curlleaf mountainmahogany is highly palatable to deer. A variety of small mammals consume curlleaf mountainmahogany seeds. Snowberry is an important forage species for deer and elk on high elevation summer ranges. Snowberry is frequently one of the first species to leaf out, making it a highly sought after food in the early spring. 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. 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. Mutton grass cures well and is an important fall and winter deer food in some areas. Slender wheatgrass is grazed by sage grouse, deer, elk, moose, and bighorn sheep, mountain goat, pronghorn, various rodents, and all classes of livestock. The seeds are eaten by various seed predators. Slender wheatgrass provides hiding and thermal cover for songbirds, upland game birds, waterfowl, and small mammals.
Livestock/Wildlife Grazing Interpretations:
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) state that curl-leaf mountain mahogany is excellent browse for deer, 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.
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). Many wildlife species are dependent on the sagebrush ecosystem including the greater sage grouse, sage sparrow, pygmy rabbit and the sagebrush vole. Dobkin and Sauder (2004) identified 61 species, including 24 mammals and 37 birds, associated with the shrub-steppe habitats of the Intermountain West.
Creeping barberry is an important browse plant for sheep and deer even though it is mildly poisonous (Noste and Bushey 1987, Guillon 1964). Snowberry is an important forage plant for sheep, deer, elk and bighorn sheep (Guillon 1964). Snowberry is poor to fair browse for cattle but may be heavily used by domestic livestock on overgrazed ranges (Morris et al 1962).

The Thurber’s needlegrass component of this plant community is an important forage source for livestock and wildlife in the arid regions of the West (Ganskopp 1988). Although the seeds are apparently not injurious, grazing animals avoid them when they begin to mature. Sheep, however, have been observed to graze the leaves closely, leaving stems untouched (Eckert and Spencer 1987). Heavy grazing during the growing season has been shown to reduce the basal area of Thurber’s needlegrass (Eckert and Spencer 1987), suggesting that both seasonality and utilization are important factors in management of this plant. A single defoliation, particularly during the boot stage, was found to reduce herbage production and root mass thus potentially lowering the competitive ability of this needlegrass (Ganskopp 1988).
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). 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.
Muttongrass, a minor component on this ecological site, is relatively grazing tolerant. It is palatable and nutritional forage for livestock and wildlife when it is in the early stages of growth. It rates as excellent forage for cattle and horses, and good for sheep, elk and deer (Dayton 1937). Muttongrass persists well in open areas and under canopies of oak and other shrubs (Monsen et al. 2004).
Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces, leading to increased fire frequency and potentially an annual plant community. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. Thus, depending on the season of use, the grazer and site conditions, either Sandberg bluegrass or cheatgrass may become the dominant understory with inappropriate grazing management.
Curl-leaf mountain mahogany habitat provides food and cover for a variety of wildlife. Curl-leaf mountain mahogany habitat type has been documented as important browse and cover for elk (Cervus canadensis), pronghorn antelope (Antilocarpra americana) and even feral horses.
Wildlife Interpretations:
According to Olsen (1992) curl-leaf 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 curl-leaf mountain mahogany for cover as well (Steel et al. 1981).
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 curl-leaf 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. Runoff is very high. Hydrologic soil groups are B and C. Rills are rare to few. Occurrence of rills may be more frequent as canopy cover increases and on steeper slopes. Water flow patterns are none to rare with occurrence increasing as canopy cover increases. These are typically short (<1m) and meandering. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., needlegrasses] slow runoff and increase infiltration. Curlleaf mountainmahogany 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 information

Curlleaf mountainmahogany may be planted to help stabilize soil in disturbed areas such as roadcuts and mine spoils. Mountain snowberry is useful for establishing cover on bare sites and has done well when planted onto roadbanks. Letterman’s needlegrass has been used successfully in revegetating mine spoils. This species also has good potential for erosion control. Slender wheatgrass is widely used for revegetating disturbed lands. Slender wheatgrass is a short-lived perennial with good seedling vigor. It germinates and establishes quickly when seeded

making it a good choice for quick cover on disturbed sites. It persists long enough for other, slower developing species to establish. It is especially valuable for use in saline soils. It has been used for rehabilitating mine spoils, livestock ranges, and wildlife habitat and watershed areas.

## Type locality

| Location 1: White Pine County, NV | |
|---|---|
| Township/Range/Section | T13N R68E S36 |
| Latitude | 38° 56′ 49″ |
| Longitude | 114° 17′ 27″ |
| General legal description | North of Wheeler Peak road, Great Basin National Park, Snake Range, White Pine County, Nevada. Also occurs in Lincoln County, Nevada. |

## Other references


Anderson, E. W. and R. J. Scherzinger. 1975. Improving quality of winter forage for elk by cattle grazing. Journal of Range Management:120-125.

Armour, Charles D.; Bunting, Stephen C.; Neuenschwander, Leon F. 1984. Fire intensity effects on the understory in ponderosa pine forests. Journal of Range Management. 37(1): 44-48.

Arno, S. F. and A. E. Wilson. 1986. Dating past fires in curlleaf mountain-mahogany communities. Journal of Range Management:241-243.

Blaisdell, J. P. 1953. Ecological effects of planned burning of sagebrush-grass range on the upper Snake River Plains. US Dept. of Agriculture.

Blaisdell, J. P. and J. F. Pechanec. 1949. Effects of Herbage Removal at Various Dates on Vigor of Bluebunch Wheatgrass and Arrowleaf Balsamroot. Ecology 30:298-305.

Blaisdell, J. P., R. B. Murray, and E. D. McArthur. 1982. Managing intermountain rangelands-sagebrush-grass ranges. USDA Forest Serv. Intermountain Forest and Range Exp. Sta. Gen. Tech. Rep. INT-134.

Britton, C. M., G. R. McPherson, and F. A. Sneva. 1990. Effects of burning and clipping on five bunchgrasses in eastern Oregon. Great Basin Naturalist 50:115-120.

Brown, J. K., and N. V. DeByle. 1989. Effects of prescribed fire on biomass and plant succession in western aspen. Res. Pap. INT-412. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 16 p.

Bunting, S. C., B. M. Kilgore, and C. L. Bushey. 1987. Guidelines for prescribed burning sagebrush-grass rangelands in the northern Great Basin. US Department of Agriculture, Forest Service, Intermountain Research Station Ogden, UT, USA.

Busso, C. A. and J. H. Richards. 1995. Drought and clipping effects on tiller demography andgrowth of two tussock grasses in Utah. Journal of Arid Environments 29:239-251.

Caudle, D., J. DiBenedetto, M. Karl, H. Sanchez, and C. Talbot. 2013. Interagency ecological site handbook for rangelands. Available at: http://jornada.nmsu.edu/sites/jornada.nmsu.edu/files/InteragencyEcolSiteHandbook.pdf. Accessed 4 October 2013.

Chambers, J., B. Bradley, C. Brown, C. D'Antonio, M. Germino, J. Grace, S. Hardegree, R. Miller, and D. Pyke. 2013. Resilience to Stress and Disturbance, and Resistance to *Bromus tectorum* L. Invasion in Cold Desert Shrublands of Western North America. Ecosystems:1-16.

Conrad, C. E. and C. E. Poulton. 1966. Effect of a wildfire on Idaho fescue and bluebunch wheatgrass. Journal of

Range Management:138-141.

Dayton, W. 1937. Range plant handbook. USDA, Forest Service. Bull.
Dealy, E.J. 1975. Ecology of curlleaf mountain-mahogany (Cercocarpus ledifolius Nutt) in eastern Oregon and adjacent areas. Unpublished dissertation, Oregon State University, Corvallis.

Dobkin, D.S. and J.D. Sauder. 2004. Shrub steppe landscapes in jeopardy. Distributions, abundances, and the uncertain future of birds and small mammals in the Intermountain West. High Desert Ecological Research Institute, Bend, Oregon. USA.

Eckert, R. E., Jr. and J. S. Spencer. 1987. Growth and reproduction of grasses heavily grazed under rest-rotation management. Journal of Range Management 40:156-159.

Erdman, J. A. 1970. Pinyon-juniper succession after natural fires on residual soils of Mesa Verde, Colorado. Brigham Young University Science Bulletin-Biological Series 11:1-26.

Evans, R. A. and J. A. Young. 1978. Effectiveness of Rehabilitation Practices following Wildfire in a Degraded Big Sagebrush-Downy Brome Community. Journal of Range Management 31:185-188.

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

Furniss, M. M., D. C Ferguson, K. W Voget, J. W. Burkhardt, A.R. Tiedemann, J. L. Oldemeyer. 1988. Taxonomy, life history, and ecology of a mountain-mahogany defoliator, Stamnodes animata (Pearsall), in Nevada. Fish and Wildlife Research 3. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. 26 p.

Ganskopp, D. 1988. Defoliation of Thurber Needlegrass: Herbage and Root Responses. Journal of Range Management 41:472-476.

Gruell, G., S. C. Bunting, and L. Neuenschwander. 1985. Influence of fire on curlleaf mountain-mahogany in the Intermountain West. Pages 58-72 in Fire's Effects on Wildlife Habitat - symposium proceedings. General Technical Report INT-186. USDA Forest Service, Intermountain Research Station, Missoula, Montana. .

Gucker, Corey L. 2006. Cercocarpus ledifolius. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/

Guillon, G.W. 1964. Wildlife use of Nevada plants. Contributions toward a flora of Nevada No. 49. Beltsville, MD: U.S. Department of Agriculture, Agriculture Research Service, Plant Industry Station, Crops Research Division. 161 p.

Houghton, J.G., C.M. Sakamoto, and R.O. Gifford. 1975. Nevada’s Weather and Climate, Special Publication 2. Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada, Reno, NV.

Ibáñez, I., and Eugene W. Schupp. 2002. Effects of litter, soil surface conditions, and microhabitat on Cercocarpus ledifolius Nutt. Seedling emergence and establishment. Journal of Arid Environments 52:209-222.
Ibáñez, I., E. W. Schupp, and J. L. Boettinger. 1998. Successional history of a curlleaf mountain mahogany stand: a hypothesis. McArthur ED, Ostler WK, Wambolt CL (comps) Proceedings: Shrubland Ecotones:12-14.

Koniak, S. 1985. Succession in pinyon-juniper woodlands following wildfire in the Great Basin. The Great Basin Naturalist 45:556-566.

Lanner, Ronald M. 1983. Trees of the Great Basin: A natural history. Reno, NV: University of Nevada Press. 215 p.

Laycock, W. A. 1967. How heavy grazing and protection affect sagebrush-grass ranges. Journal of Range Management:206-213.

Leege, T. A. and W. O. Hickey. 1971. Sprouting of northern Idaho shrubs after prescribed burning. The Journal of Wildlife Management:508-515.

Logan, Kenneth A. and L. Irwin. 1985. Mountain lion habitats in the Big Horn Mountains, Wyoming. Wildlife Society Bulletin. 13: 257-262.
Merrill, E. H., H. Mayland, and J. Peek. 1982. Shrub responses after fire in an idaho ponderosa pine community. The Journal of Wildlife Management 46:496-502.
Miller, R. F., J. C. Chambers, D. A. Pyke, F. B. Pierson, and C. J. Williams. 2013. A review of fire effects on vegetation and soils in the Great Basin Region: response and ecological site characteristics. Gen. Tech. Rep. RMRS-GTR-308. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 126 p.

Monsen, S. B., R. Stevens, and N. L. Shaw. 2004. Grasses. Pages 295-424 in Restoring western ranges and wildlands, vol. 2. Gen. Tech. Rep. RMRS-GTR-136-vol-2. USDA: Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Morris, M.S., Shmautz, J.E., Stickney, P.F. 1962. Winter field key to the native shrubs of Montana. Bull. 23. Bozeman, MT: Montana State University, Forest and Conservation Experiment Station; U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 70 p.

Mueggler, W. F. 1975. Rate and Pattern of Vigor Recovery in Idaho Fescue and Bluebunch Wheatgrass. Journal of Range Management 28:198-204.

National Oceanic and Atmospheric Administration. 2004. The North American Monsoon. Reports to the Nation. National Weather Service, Climate Prediction Center. Available online: http://www.weather.gov/.

Neuenschwander, L. 1980. Broadcast burning of sagebrush in the winter. Journal of Range Management:233-236.

Noste, N. V. and C. L. Bushey. 1987. Fire response of shrubs of dry forest habitat types in Montana and Idaho. General technical report INT.

Noy-Meir, I. 1973. Desert Ecosystems: Environment and Producers. Annual Review of Ecology and Systematics 4:25-51.

Olsen, Rich. 1992. Mule deer habitat requirements and management in Wyoming. B-965. Laramie, WY: University of Wyoming, Cooperative Extension Service.
Robberecht, R. and G. Defossé. 1995. The relative sensitivity of two bunchgrass species to fire. International Journal of Wildland Fire 5:127-134.

Ross, C. 1999. Population dynamics and changes in Curlleaf Mountain Mahogany in two adjacent Sierran and Great Basin mountain ranges. University of Nevada, Reno.

Sampson, A.W., B.S. Jespersen. 1963. California range brushlands and browse plants. Berkeley, CA: University of California, Division of Agricultural Sciences, California Agricultural Experiment Station, Extension Service. 162 p.

Scheldt, R.S. 1969. Ecology and utilization of curlleaf mountain mahogany in Idaho. Unpublished thesis, University of Idaho, Moscow.

Schultz, B. W., R. J. Tausch, and P. T. Tueller. 1996. Spatial relationships among young Cercogarpus ledifolius (curlleaf mountain mahogany). Western North American Naturalist 56:261-266.

Schultz, B. W., R. Tausch, and P. T. Tueller. 1991. Size, age, and density relationships to curlleaf mahogany (Cercocarpus ledifolus) populations in western and central Nevada: competitive implications. Western North American Naturalist 51:183-191.

Stringham, T.K., P. Novak-Echenique, P. Blackburn, C. Coombs, D. Snyder and A. Wartgow. 2015. Final Report for USDA Ecological Site Description State-and-Transition Models, Major Land Resource Area 28A and 28B Nevada. University of Nevada Reno, Nevada Agricultural Experiment Station Research Report 2015-01. p. 1524.

Tisdale, E. W. and M. Hironaka. 1981. The sagebrush-grass region: A review of the ecological literature. University of Idaho, Forest, Wildlife and Range Experiment Station.

Uresk, D. W., J. F. Cline, and W. H. Rickard. 1976. Impact of wildfire on three perennial grasses in south-central Washington. Journal of Range Management 29:309-310.

USDA–Forest Service. 1937. Range Plant Handbook. Dover Publications, New York. 816 p.

USDA-NRCS Plants Database (Online; http://www.plants.usda.gov).

Vose, J. M. and A. S. White. 1991. Biomass response mechanisms of understory species the first year after prescribed burning in an Arizona ponderosa-pine community. Forest Ecology and Management 40:175-187.

Wildlife Action Plan Team. 2012. Nevada Wildlife Action Plan. Nevada Department of Wildlife. Reno, Nevada.

Wright, H. A. and J. O. Klemmedson. 1965. Effect of Fire on Bunchgrasses of the Sagebrush-Grass Region in Southern Idaho. Ecology 46:680-688.

Young, R. P. 1983. Fire as a vegetation management tool in rangelands of the intermountain region. Pages 18-31 in Managing intermountain rangelands - improvement of range and wildlife habitats. USDA, Forest Service. Gen. Tech Rept. INT-GTR-157. Odgen, UT.

Youngberg, C.T. and L. Hu. 1972. Root nodules on mountain mahogany. Forest Science 18: 211-212.

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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 | 01/12/2016 |
| Approved by | |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:** Rills are rare to few. Occurrence of rills may be more frequent as canopy cover increases and on steeper slopes.

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2. **Presence of water flow patterns:** Water flow patterns are none to rare with occurrence increasing as canopy cover increases. These are typically short (<1m) and meandering.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Terracettes are non-existent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 10-25% depending on amount of surface rock fragments.

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

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

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 leaf litter under mature trees is very stable and shows no obvious movement.

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 3 to 6 on most soil textures found on this site.

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 grayish browns and soils are typified by a thick mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1 to 4 percent, dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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 [i.e., needlegrasses] slow runoff and increase infiltration. Curlleaf mountainmahogany and understory shrubs break raindrop impact and provide opportunity for snow catch and accumulation on site.

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. Subangular blocky or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted layers.

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

    Dominant: Curlleaf mountainmahogany >>

    Sub-dominant: deep-rooted, cool season, perennial bunchgrasses > deep-rooted, cool season, perennial grasses > understory shrubs > shallow-rooted, cool season, perennial forbs = 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 trees 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 mountainmahogany canopy interspaces (± 25%) and litter depth is ± ½ inch. Leaf litter forms a mat 1 to 2 inches thick under the drip line of mature mountainmahogany. 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):** Total for all trees, shrubs and herbaceous plants, irrespective of plant height for normal or average growing season (through June) = ± 2400 lbs/ac Favorable years + 3000 lbs/ac and unfavorable years + 1700 lbs/ac. For understory vegetation to 4½ feet and normal or average growing season (through June) = ± 150 lbs/ac. Favorable years + 300 lbs/ac and unfavorable years + 75 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 and annual mustards.

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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 occurs during extended or extreme drought conditions

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