Ecological site R025XY031NV
STONY MAHOGANY SAVANNA

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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.

MLRA notes

Major Land Resource Area (MLRA): 025X–Owyhee High Plateau

MLRA Notes 25—Owyhee High Plateau This area is in Nevada (56 percent), Idaho (30 percent), Oregon (12 percent), and Utah (2 percent). It makes up about 27,443 square miles. MLRA 25 is characteristically cooler and wetter than the neighboring MLRAs of the Great Basin. The western boundary is marked by a gradual transition to the lower and warmer basins of MLRA 24. The boundary to the south-southeast, with MLRA 28B, is marked by gradual changes in geology marked by an increased dominance of singleleaf pinyon and Utah juniper and a reduced presence of Idaho fescue. The boundary to the north, with MLRA 11, is a rapid transition from the lava plateau topography to the lower elevation Snake River Plain. Physiography: All of this area lies within the Intermontane Plateaus. The southern half is in the Great Basin section of the Basin and Range province. This part of the MLRA is characterized by isolated, uplifted fault-block mountain ranges separated by narrow, aggraded desert plains. This geologically older terrain has been dissected by numerous streams draining to the Humboldt River. The northern half of the area lies within the Columbia Plateaus province. This part of the MLRA forms the southern boundary of the extensive Columbia Plateau basalt flows. Most of the northern half is in the Payette section, but the northeast corner is in the Snake River Plain section. Deep, narrow canyons draining into the Snake River have been incised into this broad basalt plain. Elevation ranges from 3,000 to 7,550 feet on rolling plateaus and in gently sloping basins. It is more than 9,840 feet on some steep mountains. The Humboldt River crosses the southern half of this area Geology: The dominant rock types in this MLRA are volcanic. They include andesite, basalt, tuff, and rhyolite. In the north and west parts of the area, Cretaceous granitic rocks are exposed among Miocene volcanic rocks in mountains. A Mesozoic igneous and metamorphic rock complex dominates the south and east parts of the area. Upper and Lower Paleozoic calcareous sediments, including oceanic deposits, are exposed with limited extent in the mountains. Alluvial fan and basin fill sediments occur in the valleys. Climate: The average annual precipitation in most of this area is typically 11 to 22 inches. It increases to as much as 49 inches at the higher elevations. Rainfall occurs in spring and sporadically in summer. Precipitation occurs mainly as snow in winter. The precipitation is distributed fairly evenly throughout fall, winter, and spring. The amount of precipitation is lowest from midsummer to early autumn. The average annual temperature is 33 to 51 degrees F. The freeze-free period averages 130 days and ranges from 65 to 190 days, decreasing in length with elevation. It is typically less than 70 days in the mountains. Water: The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow in the mountains. Surface water from mountain runoff is generally of excellent quality and suitable for all uses. The basin fill sediments in the narrow alluvial valleys between the mountain ranges provide some ground water for irrigation. The alluvial deposits along the large streams have the most ground water. Based on measurements of water quality in similar deposits in adjacent areas, the basin fill deposits probably contain moderately hard water. The water is suitable for almost all uses. The carbonate rocks in this area are considered aquifers, but they are little used. Springs are common along the edges of the limestone outcrops. Soils: The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic or frigid temperature regime and an aridic, aridic bordering on xeric, or xeric moisture regime. Soils with aquic moisture regimes are limited to drainage or spring areas, where moisture originates or runs on and through. These soils are of a very limited extent throughout the MLRA. They generally are well drained, clayey or loamy, and shallow or moderately deep. Most of the soils formed in mixed parent material. Volcanic ash and loess mantle the landscape. Surface soil textures are loam and silt loam with ashy texture modifiers in some areas. Argillic horizons occur on the more stable landforms. They are exposed nearer the soil surface on convex landforms, where ash and loess deposits are more likely to erode. Soils that formed in carbonatic parent material in areas that receive less than 12 inches of precipitation are characterized by calcic horizons throughout the profile, while soils in areas that receive more than 12 inches of precipitation do not have calcic horizons in the upper part of the profile. Soils that formed on stable landforms at the lower elevations are dominated by ochric horizons. Soils that formed at the middle and upper elevations are characterized by mollic epipedons. Soils in drainage areas at all elevations that receive moisture running on or through them are characterized by thicker mollic epipedons. Biological Resources: This MLRA supports shrub-grass vegetation. Lower elevations are characterized by Wyoming big sagebrush associated with bluebunch wheatgrass, western wheatgrass, and Thurber’s needlegrass. Other important plants include bluegrass, squirreltail, penstemon, phlox, milkvetch, lupine, Indian paintbrush, aster, and rabbitbrush. Black sagebrush occurs but is less extensive. Singleleaf pinyon and Utah juniper occur in limited areas. With increasing elevation and precipitation, vast areas characterized by mountain big sagebrush or low sagebrush/early sagebrush in association with Idaho fescue, bluebunch wheatgrass, needlegrasses, and bluegrass become common. Snowberry, curl-leaf mountain mahogany, ceanothus, and juniper also occur. Mountains at the highest elevations support whitebark pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, aspen, and curl-leaf mountain mahogany. Major wildlife species include mule deer, bighorn sheep, pronghorn, mountain lion, coyote, bobcat, badger, river otter, mink, weasel, golden eagle, red-tailed hawk, ferruginous hawk, Swainson's hawk, northern harrier, prairie falcon, kestrel, great horned owl, short-eared owl, long-eared owl, burrowing owl, pheasant, sage grouse, chukar, gray partridge, and California quail. Reptiles and amphibians include western racer, gopher snake, western rattlesnake, side-blotched lizard, western toad, and spotted frog. Fish species include bull, red band, and rainbow trout.

Ecological site concept

This site occurs in assosiation with bedrock outcroppings on summits and sideslopes of hills and mountains on all exposures. Slopes range from 4 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations range from 7,000 to 8,500 feet. The soils associated with this site are shallow to very shallow to bedrock and are well drained. These soils are modified by high volumes of rock fragments throughout the profile, and there is a surface cover of cobbles, stones or boulders. The reference plant community is dominated by curlleaf mountainmahogany. Mountain big sagebrush is the principal understory shrub. Bluebunch wheatgrass, Idaho fescue and needlegrass are the most prevalent understory grasses. Total overstory canopy cover is less than 25 percent (±15%). Understory vegetation comprises about 25% of the total site production. Potential vegetative composition for the understory is about 50% grasses, 5% forbs and 45% shrubs. Total annual air-dry production for all trees, shrubs, and herbaceous plants in the understory to a height of 4.5 feet is 150 pounds for unfavorable years, 250 pounds for normal years, and 400 pounds for favorable yeras. Overstory of curlleaf mountainmahogany represents about 80% of the total site production. Approximate ground cover (basal and crown) is 15 to 35 percent.

Associated sites

R025XY004NV	**LOAMY SLOPE 16+ P.Z.**
R025XY012NV	**LOAMY SLOPE 12-16 P.Z.**
R025XY016NV	**SOUTH SLOPE 14-18 P.Z.**
R025XY042NV	**SHALLOW LOAM 14-16 P.Z.**

Similar sites

R025XY030NV	**MAHOGANY THICKET** CELE3 overstory canopy cover greater than 50 percent; more productive site
R025XY071NV	**MAHOGANY SAVANNA 14-16 P.Z.** Overstory canopy of CELE3 averages 35 to less than 50 percent; more productive understory; more productive site
R025XY075NV	**MAHOGANY SAVANNA 16+ P.Z.** Overstory canopy of CELE3 averages 35 to less than 50 percent; FEID dominant grass; LECI4 and BRMA4 other important grasses

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Cercocarpus ledifolius* (2) *Artemisia tridentata subsp. vaseyana*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Festuca idahoensis*

Physiographic features

This site occurs in assosiation with bedrock outcroppings on summits and sideslopes of hills and mountains on all exposures. Slopes range from 4 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations are 7000 to 8500 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill
Runoff class	Low to very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,130 – 2,590 m
Slope	0 – 80 %
Water table depth	180 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.
The average annual precipitation ranges from 14 or more inches. Mean annual air temperature is typically <45 degrees F.

Mean annual precipitation across the range in which this ES occurs is 18.58".

Monthly mean precipitation: January 1.65”; February 1.68”; March 1.98”; April 2.43”; May 2.41”; June 1.62”; July 0.61”; August 0.63”; September 0.84”; October 1.41”; November 1.51”; December 1.79”.

*The above data is averaged from the Jarbridge 4N and Lamoille PH WRCC climate stations.

Table 3 Representative climatic features

Frost-free period (average)	80 days
Freeze-free period (average)	110 days
Precipitation total (average)	480 mm

- (1) LAMOILLE YOST [USC00264394], Spring Creek, NV
- (2) JARBIDGE 7 N [USC00264039], Jackpot, NV

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are shallow to very shallow to bedrock and are well drained. These soils are modified by high volumes of rock fragments throughout the profile, and there is a surface cover of cobbles, stones or boulders. Available water capacity is low. Runoff is medium to high.

The soil series associated with this site include Mahogee, Rozara, Pernog and Udelope.

A representative soil series is Mahogee, classified as a loamy, mixed, superactive, Lithic Argicryoll. This soil is shallow, well drained and was formed in residuum and colluvium derived from rhyolite. Reaction is neutral. Dianostic horizons include a mollic epipedon that occurs from the soil surface to 17 inches and an argillic horizon that occurs from 2 inches to 17 inches. Clay content in the particle-size control section is 18 to 25 percent. Rock fragments range from 15 to 35 percent, mainly fine gravel. Lithology of fragments are rhyolite.

Table 4. Representative soil features

Parent material	(1) Residuum (2) Colluvium
Surface texture	(1) Extremely stony sandy loam (2) Very stony loam (3) Very bouldery sandy loam
Family particle size	(1) Loamy (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow
Depth to restrictive layer	50 – 100 cm

Soil depth	50 – 100 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0 – 10 %
Available water capacity (0-101.6cm)	13.94 – 13.97 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	7.4 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	10 – 20 %
Subsurface fragment volume >3" (Depth not specified)	0 – 30 %

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation and temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration and runoff), 4) soils (depth, texture, structure, and organic matter), 5) plant communities (functional groups and 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. It can also increase resource uptake via 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 of the plant, and in competitive environments, cheatgrass roots were found to penetrate only 15 centimeters whereas isolated plants and pure stands were found to root at least 1 meter in depth, with some plants rooting as deep as 1.5 to 1.7 m.

This ecological site is dominated by the long-lived curl-leaf 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 meters. (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 typically have 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.

Curl-leaf 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.

Curl-leaf 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 to 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.

Curl-leaf 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 retards 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 canopy gaps where a tree has died and an increase exposure of bare ground occurs, or around the perimeter of the stand under sagebrush plants where there is less, typically shallow litter cover (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 that facilitates mahogany recruitment (Gruell 1985, Ibáñez et al. 1998).

Mountain big sagebrush is generally long-lived; therefore it is unnecessary for new individuals to recruit every year for perpetuation of the stand. Simultaneous low, continuous recruitment and infrequent large recruitment events are 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 generally have 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 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, 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).

In western and central Nevada communities in which curlleaf mountain-mahogany occurs, large-scale disturbance was infrequent in presettlement times. However, evidence of small-scale disturbance from lightning, low-severity fire, insects, wind, and snow is abundant. Small disturbances often create canopy gaps in dense stands of curlleafmountain-mahogany. Gaps allow for the release of young curlleaf mountain-mahogany.

The successional role of curlleaf mountain-mahogany varies with community type. Mountain brush communities in which curlleafmountain-mahogany is either dominant or codominant are generally stable. Changes in relative abundance of codominant species may occur; however, succession rates are extremely slow because vegetation changes depend on soil development which is also slow.

As ecological condition declines, understory grasses and forbs are reduced as mountain big sagebrush, snowberry, and rabbitbrush increase. Heavy utilization by livestock and wildlife will result in most of the foliage of the mountain-mahogany growing above the reach of browsing animals and will severely limit production. Cheatgrass is the species most likely to invade this site.

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. Three possible alternative stable states have been identified for this site.

Fire Ecology:
The presettlement fire regime of curlleaf mountainmahogany communities probably varied with community type and structure. The fire return interval in curl-leaf mountain mahogany-dominated sites is not well documented, however Arno and Wilson (1986) suggested sites of curl-leaf mountain mahogany with ponderosa pine (Pinus ponderosa) had fire return intervals of 13-22 years before 1900. Curlleaf mountainmahogany may depend on fire to reduce conifer competition and produce favorable soil conditions for seedling establishment Most often curl-leaf mountain mahogany stands occur on warm, dry, rocky ridges or outcrops where fire would be an infrequent occurrence (USDA Forest Service 1937). Dealy (1974) 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. 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). Individual curlleaf mountainmahogany are severely damaged by fire. Because many dead branches persist in the crown and leaves are slightly resinous, curlleaf mountainmahogany is probably very flammable. Curl-leaf mountain mahogany is considered a weak sprouter after fire and is usually moderately to severely damaged by severe fires. 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 highly susceptible to injury from fire. It is often top-killed by fire and will not resprout. 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). It 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).

Antelope bitterbrush is moderately fire-tolerant (McConnell and Smith 1977). If cheatgrass is present, bitterbrush seedling success is much lower. The factor that most limits establishment of bitterbrush seedlings is competition for water resources with cheatgrass, an invasive species (Clements and Young 2002). Bitterbrush regenerates by seed and resprouting (Blaisdell and Mueggler 1956, McArthur et al. 1982), though sprouting ability is highly variable (Blaisdell et al. 1982). Bitterbrush sprouts from a region on the stem approximately 1.5 inches above and below the soil surface; the plant rarely sprouts if the root crown is killed by fire (Blaisdell and Mueggler 1956). Low-intensity fires may allow bitterbrush to sprout; however, community response also depends on soil moisture levels at time of fire (Murray 1983). Lower soil moisture allows more charring of the stem below ground level (Blaisdell and Mueggler 1956), thus sprouting will usually be more successful after a spring fire than after a fire in summer or fall (Murray 1983, Busse et al. 2000, Kerns et al. 2006).

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site, coupled with seasonality and intensity of the fire factor into individual species' responses. For most forbs and grasses, the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Wright 1971, Young 1983).

Idaho fescue's response to fire varies with condition and size of the plant, season and severity of fire, and ecological conditions. Mature Idaho fescue plants are commonly reported to be severely damaged by fire in all seasons (Wright et al. 1979). Initial mortality may be high (in excess of 75%) on severe burns, but usually varies from 20 to 50% (Barrington et al 1988). Rapid burns have been found to leave little damage to root crowns, and new tillers are produced with onset of fall moisture (Johnson et al. 1994). However, Wright and others (1979) found the dense, fine leaves of Idaho fescue provided enough fuel to burn for hours after a fire had passed, thereby killing or seriously injuring the plant regardless of the intensity of the fire (Wright et al. 1979). Idaho fescue is commonly reported to be more sensitive to fire than the other prominent grass on this site, bluebunch wheatgrass (Conrad and Poulton 1966). Robberecht and Defosse (1995) suggested the latter was more sensitive, however. They observed culm and biomass reduction with moderate fire severity in bluebunch wheatgrass, whereas a high fire severity was required for this reduction in Idaho fescue. Given the same fire severity treatment, post-fire culm production was initiated earlier and more rapidly in Idaho fescue (Robberecht and Defosse 1995).

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. Bluebunch wheatgrass is generally favored by burning. Burning stimulates flowering and seed production. However, season and severity of the fire will influence plant response. Plant regeneration will vary depending on post-fire soil moisture availability.

Sandberg bluegrass, a minor component of this ecological site, has been found to increase following fire, likely due to its low stature and productivity (Daubenmire 1975, Rau et al. 2008). 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. Repeated frequent fire in this community will facilitate the establishment of an annual weed community with varying amounts of Sandberg bluegrass and rabbitbrush.

Depending on fire severity, rabbitbrush and snowberry (Symphoricarpos spp.) may increase after fire. Rubber rabbitbrush is top-killed by fire, but can resprout after fire and can also establish from seed (Young 1983). Yellow rabbitbrush (Chrysothamnus viscidiflorus) 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). Snowberry has been noted to regenerate well and can exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982). If balsamroot (Balsamorhiza spp.) is common before fire, these plants will increase following a fire or with heavy grazing (Wright 1985). As cheatgrass increases, fire frequencies also increase to frequencies between 0.23 and 0.43 times a year; then, even sprouting shrubs such as rabbitbrush will not survive (Whisenant 1990).

State and transition model

Figure 5. T. Stringham 3/2015

Figure 6. Legend

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			77-197	
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	43-84	–
	Idaho fescue	FEID	*Festuca idahoensis*	15-43	–
	bluegrass	POA	*Poa*	6-28	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	8-21	–
	western needlegrass	ACOC3	*Achnatherum occidentale*	7-21	–
2	**Secondary Perennial Grasses**			6-28	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6-30	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	6-30	–
	squirreltail	ELEL5	*Elymus elymoides*	6-30	–
	needle and thread	HECO26	*Hesperostipa comata*	6-30	–
	basin wildrye	LECI4	*Leymus cinereus*	6-30	–
Forb					
3	**Perennial Forbs**			6-28	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	6-30	–
	phlox	PHLOX	*Phlox*	6-30	–
	goldenweed	PYRRO	*Pyrrocoma*	6-30	–
Shrub/Vine					
4	**Primary Shrubs**			90-135	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	84-112	–
	snowberry	SYMPH	*Symphoricarpos*	6-22	–
5	**Secondary Shrubs**			6-28	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	6-50	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	6-50	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	6-50	–
Tree					
6	**Evergreen**			6-50	
	curl-leaf mountain mahogany	CELE3	*Cercocarpus ledifolius*	6-50	–
	Utah juniper	JUOS	*Juniperus osteosperma*	6-10	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	6-10	–

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 12. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

Livestock Interpretations: This site is suited for livestock grazing. Considerations for grazing management include timing, intensity and duration of grazing. Overgrazing by livestock and/or wildlife will cause a reduction in deep-rooted perennial bunchgrasses in the understory. Bluebunch wheatgrass and needlegrasses may be particularly affected. As perennial grass cover declines, the potential for invasion by annual non-native species is increased. Reduction in competition from these grasses allows shallower rooted grasses such as Sandberg bluegrass and forbs to increase (Smoliak et al. 1972). Bare ground also increases in this scenario. With annuals present in the understory, a fire in this community can cause a transition to a state dominated by annuals and Sandberg bluegrass with some sprouting shrubs such as rabbitbrush and snowberry in the overstory. Sandberg bluegrass increases under grazing pressure (Tisdale and Hironaka 1981) and is capable of co-existing with cheatgrass. Excessive sheep grazing favors Sandberg bluegrass; however, where cattle are the dominant grazers, cheatgrass often dominates (Daubenmire 1970). 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. Columbia needlegrass provides valuable forage for all classes of livestock and many species of wildlife. 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. As with most needlegrasses, Columbia needlegrass is most palatable early in the season before the foliage becomes coarse and wiry. Palatability to cows and horses is increased because large amounts of fine leafage remain green throughout the growing season and is described as "fair to good" for cattle and horses, becoming nearly unpalatable at maturity. Serviceberry branches and leaves are consumed by both domestic livestock and wildlife, particularly in late winter and early spring. Serviceberry can tolerate moderate to heaving browsing when adequate precipitation is received. Mountain big sagebrush is eaten by domestic livestock but has long been considered to be of low palatability, and a competitor to more desirable species. Despite low palatability, mountain big sagebrush is eaten in small amounts by sheep, cattle, goats, and horses. Antelope bitterbrush is an important shrub species to domestic livestock (Wood 1995). Antelope bitterbrush is most commonly found on soils which provide minimal restriction to deep root penetration such as coarse textured soil, or finer textured soil with high stone content (Driscoll 1964, Clements and Young 2002). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953). Idaho fescue provides important forage for many types of domestic livestock. The foliage cures well and is preferred by livestock in the late fall and winter. Idaho fescue tolerates light to moderate grazing (Ganskopp and Bedell 1980) and is moderately resistant to trampling (Cole 1987). Heavy grazing may lead to replacement of Idaho fescue with non-native species such as cheatgrass (Mueggler 1984). Mountain brome is ranked as excellent forage for both cattle and horses and good for domestic sheep, though domestic animals will graze mountain brome only when it is fairly succulent. 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). 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 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. In a study conducted by Logan and Irwin (1985), 33 percent of noted lion caches (52 total) were located in curl-leaf mountain mahogany vegetation. 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). Curl-leaf mountain mahogany is an important cover and browse species for big game such as elk (Cervus canadensis), mule deer (Odocoileus heminous), pronghorn antelope (Antilocarpra americana), and bighorn sheep (Ovis canadensis) (Lanner 1983, Furniss 1988, Sabo et al. 2005). Sampson and Jespersen (1963) state that curl-leaf mountain mahogany is excellent browse for mule 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. Curl-leaf mountain mahogany is consumed widely by mule deer throughout the year (Olsen 1992); 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 also utilize curl-leaf mountain mahogany for cover (Steele et al. 1981). 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). Serviceberry berries provide excellent forage for small animals and birds. Birds also utilize the shrub for nesting and cover. Antelope bitterbrush is critical browse for mule deer, antelope, and elk (Wood 1995). Common snowberry is considered important browse for many types of wildlife. Bighorn sheep use common snowberry regularly during the summer. Forage value to elk is 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. Mountain big sagebrush is a highly preferred winter forage for mule deer: In a study by Personius et al. (1987), mountain big sagebrush was the most preferred sagebrush species. Fecal samples from ungulates in Montana showed that bighorn sheep, mule deer, and elk all consumed mountain big sagebrush in small amounts in winter, while cattle showed no sign of sagebrush use. . 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). Reliance on the big sagebrush ecosystem by many wild animals for both food and cover has been documented and reviewed extensively. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Meadows surrounded by sagebrush may be used as feeding and strutting grounds. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities. Idaho fescue is an important source of forage for pronghorn and deer in ranges of northern Nevada. Mountain brome seedheads and seeds provide food for many birds and small mammals. Pronghorn antelope will consume mountain brome primarily in the spring. The palatability of mountain brome is excellent for deer, particularly during the late spring and early summer.

Recreational uses

Aesthetic value is derived from the lush verdure of native grasses in the spring and early summer on this site. This site has potential for upland game hunting. Nature study and photography also have recreational potential.

Wood products

No known potential

Other products

Native peoples 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 mountainmahogany may be planted to help stabilize soil in disturbed areas such as roadcuts and mine spoils.

Inventory data references

NV-ECS-1 - 1 record Soils and Physiographic features were gathered from NASIS.

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Approval

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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	03/21/2011
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 on this site. Rock fragments armor the site. If rills are present, they occur on slopes >20%.

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2. **Presence of water flow patterns:** Water flow patterns are rare on this site due to short slope lengths. They occur on steeper slopes (20% gradient) in areas recently subjected to intense summer convection storms or rapid snowmelt.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. A few may occur in water flow patterns.

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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 ± 15-30%.

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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 catastrophic events.

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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 3 to 6 on most soil textures found on this site. (To be field tested.)

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is fine granular or weak, medium subangular blocky. Soil surface colors are very dark and soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1 to 3 percent. 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:** The tree-like canopy of curlleaf mountain mahogany and tall shrubs break raindrop impact and provide opportunity for snow catch and accumulation on site. Deep-rooted perennial bunchgrasses (i.e. bluebunch wheatgrass) slow runoff and increase infiltration.

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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. Subsoil subangular blocky structure or argillic horizons 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: Tree-like shrubs

    Sub-dominant: deep-rooted, cool season, perennial bunchgrasses > tall shrubs (mountain big sagebrush) > shallow-rooted, cool season, perennial grasses>deep-rooted, cool season, perennial forbs > fibrous, shallow-rooted, cool season, perennial and annual forbs

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs not uncommon and standing dead shrub canopy material may be as much as 15% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers. Mortality of mountain mahogany is usually the result of insect infestation or fire.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (10-20%) and litter depth is ± 1/2 inch.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through June) ± 900 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: **Singleleaf pinyon and Utah juniper are increasers on this site. Cheatgrass and bulbous bluegrass are invaders on this site.**

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