USDA Natural Resources Conservation Service

Ecological site F025XY061NV
Pinyon-Mahogany Mountain Slopes

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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 is on mountain side slopes on all aspects above 7,500 feet or on northerly aspects at lower elevations; 7000 to 7,500 feet. Slopes range from 15 to over 75 percent but are typically 30 to 50 percent. Elevations range from 7,000 to 8,500 feet. The average growing season is 50 to 70 days.

The reference plant community is dominated by singleleaf pinyon with curlleaf mountain mahogany occurring sporadically in the tree canopy. Mountain big sagebrush is the principal understory shrub. Antelope bitterbrush, snowberry, serviceberry, and curlleaf mountain mahogany are other important shrubs in the understory community. Idaho fescue, bluebunch wheatgrass, basin wildrye and Nevada bluegrass and other bluegrass species are the most prevalent understory grasses. Arrowleaf balsamroot, tapertip hawksbeard, bluebells and phlox are common understory forbs. An overstory canopy of 20 to 35 percent is assumed to be representative of tree dominance on this site in the pristine environment. Overstory tree canopy composition is about 80 to 95 percent singleleaf pinyon, 5 to 15 percent curlleaf mountain mahogany and 10 percent or less Utah juniper.

Soil depth to bedrock is about 14 to 40 inches (35 to 100 cm). The surface layer is typically more than 10 inches (25 cm) thick and is moderately coarse to medium textured. Soil reaction is mildly to moderately alkaline and the soils are often calcareous. Soils are often skeletal with 35 to over 50 percent gravels, cobbles or stones, by volume, distributed throughout the profile.

This site used to be named: PIMO-CELE3/ARTRV/FEID-PSSPS

Associated sites

R025XY071NV	**MAHOGANY SAVANNA 14-16 P.Z.** Mahogany Savanna typically has a lower AWC value. Dominant species are CELE3/ARTRV/FEID-PSSPS.
R025XY012NV	**LOAMY SLOPE 12-16 P.Z.** Loamy Slopes 12-16 typically has a PSC of fine. Dominant species are ARTRV-PUTR2/FEID-PSSPS.

Similar sites

R025XY071NV	**MAHOGANY SAVANNA 14-16 P.Z.** Mahogany Savanna typically has a lower AWC value. Dominant species are CELE3/ARTRV/FEID-PSSPS.

Table 1. Dominant plant species

Tree	(1) *Pinus monophylla*
Shrub	(1) *Cercocarpus ledifolius* (2) *Artemisia tridentata subsp. vaseyana*
Herbaceous	(1) *Festuca idahoensis* (2) *Pseudoroegneria spicata subsp. spicata*

Physiographic features

This site is on mountain side slopes on all aspects at elevations over 7500 feet and on northerly aspects at lower elevations; 7000 to 7500 feet. Slopes range from 15 to over 75 percent but are typically 30 to 50 percent. Elevations are 7000 to 8500 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	7,000–8,500 ft
Slope	30–50%
Water table depth	60 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	15–75%
Water table depth	Not specified

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers.
The average annual precipitation is 14 or more inches (36 cm). Mean annual air temperature is typically less than 45 degrees F. The average growing season is 50 to 70 days.

Mean annual precipitation across the range in which this ES occurs is 15 inches.

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 4. Representative climatic features

Frost-free period (characteristic range)	50-90 days
Freeze-free period (characteristic range)	60-100 days
Precipitation total (characteristic range)	14-16 in
Frost-free period (actual range)	50-90 days
Freeze-free period (actual range)	60-100 days
Precipitation total (actual range)	14-17 in
Frost-free period (average)	70 days
Freeze-free period (average)	80 days
Precipitation total (average)	15 in

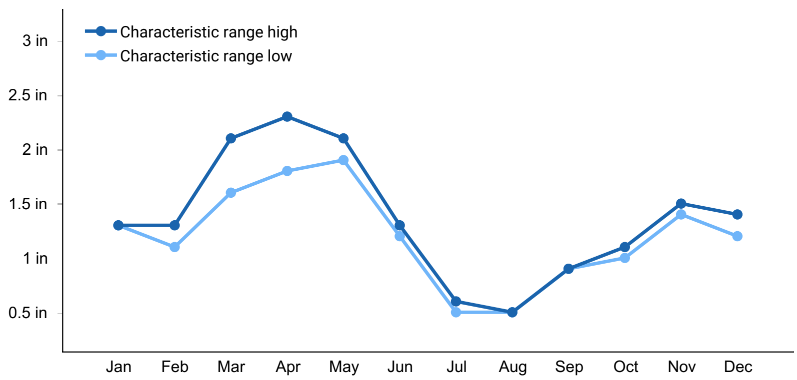


Figure 1. Monthly precipitation range

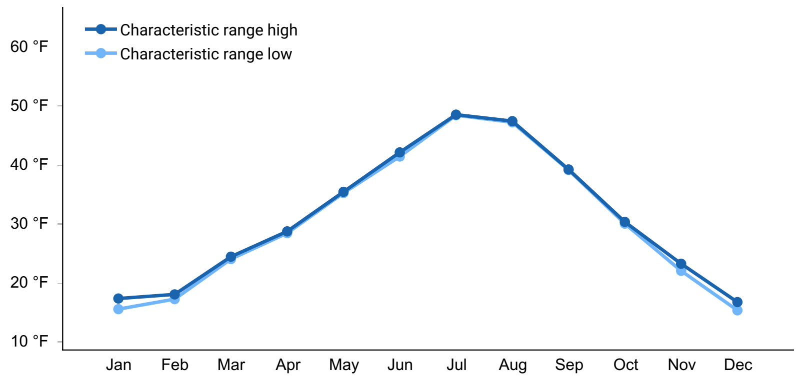


Figure 2. Monthly minimum temperature range

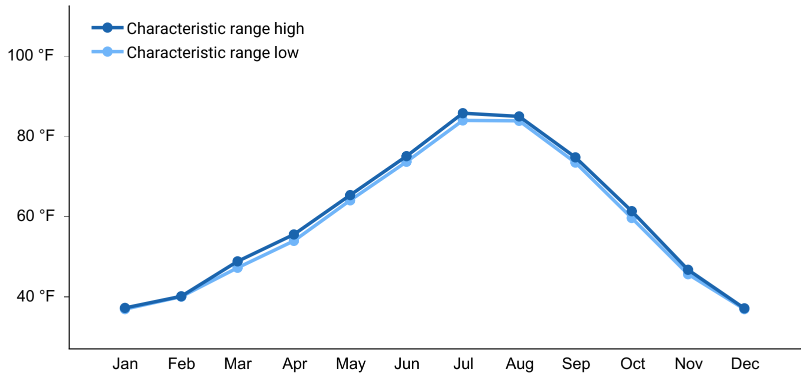


Figure 3. Monthly maximum temperature range

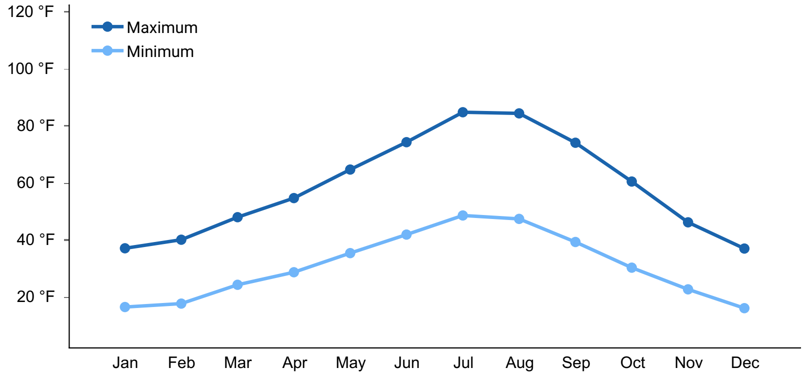


Figure 4. Monthly average minimum and maximum temperature

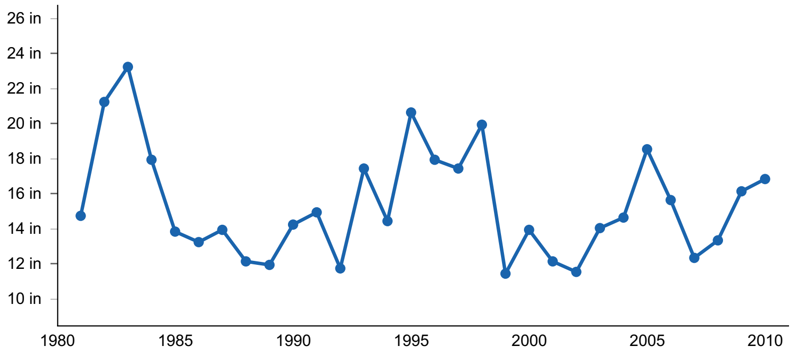


Figure 5. Annual precipitation pattern

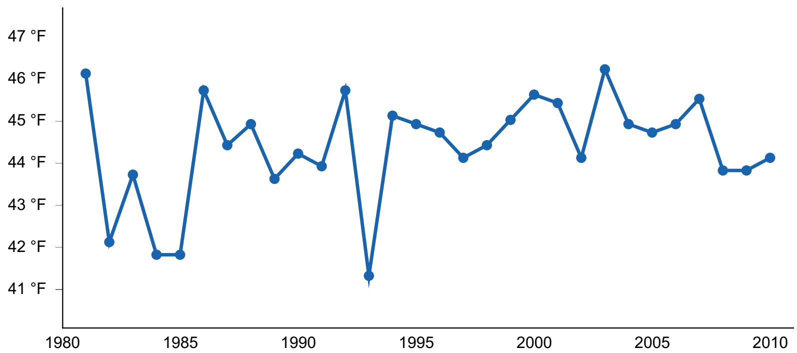


Figure 6. Annual average temperature pattern

Climate stations used

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

Influencing water features

There are no influencing water features associated with this site.

Soil features

Soil depth to bedrock is about 14 to 40 inches (35 to 100 cm). The surface horizon is typically more than 10 inches (25 cm) thick. Soil reaction is mildly to moderately alkaline and the soils are often calcareous. Soils may be skeletal with 35 to over 50 percent gravels, cobbles or stones, by volume, distributed throughout their profile. Available water capacity is low, but trees and shrubs extend their roots into fractures in the bedrock allowing them to utilize deep moisture. Runoff is medium to high and potential for sheet and rill erosion is moderate to severe depending on slope.

The soil series associated with this site are Cavehill, Cropper, Cucamungo, Itca and Ravenswood.

A representative soil series is Cavehill, classified as a loamy-skeletal, carbonatic, frigid Typic Calcixeroll. This soil is moderately deep, well-drained and was formed in residuum and colluvium derived from limestone, calcareous sandstone, and dolomite with surficial deposits of loess. Reaction is moderately to strongly alkaline and effervescence ranges from slightly through violently effervescent. Diagnostic features include a mollic epipedon that occurs from the soil surface to 18 inches and a calcic horizon that occurs from 18 to 29 inches. Rock fragments range from 35 to 60 percent, mainly gravel and cobbles, with stones common in some pedons. Clay content in the particle-size control section is between 18 and 27 percent. Lithology of rock fragments are mainly limestone and dolomite.

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium (3) Residuum
Surface texture	(1) Very gravelly silt loam (2) Very cobbly loam (3) Very stony loam (4) Gravelly loam (5) Cobbly loam
Family particle size	(1) Loamy-skeletal (2) Clayey-skeletal
Drainage class	Well drained
Permeability class	Slow to moderate
Depth to restrictive layer	10–40 in
Soil depth	10–40 in
Surface fragment cover <=3"	10–35%
Surface fragment cover >3"	5–20%
Available water capacity (0-40in)	1–4 in
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	20–35%
Subsurface fragment volume >3" (Depth not specified)	6–25%

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. 2003). 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 (*Bromus tectorum*) 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. The depth of rooting is dependent on the size the plant achieves and in competitive environments, cheatgrass roots were found to penetrate only 15 cm, whereas isolated plants and pure stands were found to root at least 1 m in depth with some plants rooting as deep as 1.5 to 1.7 m.

This ecological site is dominated by long-lived mountain mahogany, deep-rooted cool season perennial bunchgrasses, and long-lived shrubs (50+ years) with high root to shoot ratios. Pinyon pine is present in small amounts. As pinyon pine canopy increases, Idaho fescue and bluebunch wheatgrass decline. The dominant 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. Differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

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 and asserted 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 or no young curl-leaf mahogany (i.e., recruitment) in the understory (Schultz et al. 1990, 1991) despite high seed density beneath trees (Russell and Schupp 1998, Ibanez and Schupp 2002). Intraspecific competition reduces the growth rates of all age classes below the potential growth rates for the species. Competition may also increase mortality in the younger plants.

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).

Mahogany stands are susceptible to drought, frost, and invasion by non-native species, especially cheatgrass. Cheatgrass affects mahogany seedling growth by competing for water resources and nutrients (Ross 1999).

Singleleaf pinyon is a long-lived tree species with wide ecological amplitudes (Tausch et al 1981, Weisberg and Dongwook 2012, West et al 1998). Maximum age of pinyon exceeds 1000 years. Stands with maximum age classes are only found on steep rocky slopes with no evidence of fire (West et al 1975). Singleleaf pinyon is slow-growing and very intolerant to shade with the exception of young plants, usually first year seedlings (Tueller and Clark 1975). Singleleaf pinyon seedling establishment is episodic. Population age structure is affected by drought, which reduces seedling and sapling recruitment more than other age classes. The ecotones between singleleaf pinyon woodlands and adjacent shrublands and grasslands provide favorable microhabitats for singleleaf pinyon seedling establishment since they are active zones for seed dispersal, nurse plants are available, and singleleaf pinyon seedlings are only affected by competition from grass and other herbaceous vegetation for a couple of years.

In pristine conditions, singleleaf pinyon should be subdominant or codominant with curl-leaf mountain mahogany on this site. Historically, the pinyon component would be kept in check by natural disturbance regimes. In the Great Basin, old-growth trees have been found to typically grow on rocky shallow or sandy soils that support little understory vegetation to carry a fire (Holmes et al. 1986, Miller and Rose 1995, West et al. 1998). Increases in pinyon establishment is attributed to a number of factors, the most important being: 1) the cessation of the aboriginal burning (Tausch 1999), 2) the change in climate with rising temperatures (Heyerdahl et al. 2006), 3) the reduced frequency of fire likely driven by the introduction of domestic livestock, 4) a decrease in wildfire frequency along with improved wildfire suppression efforts, and 5) potentially increased CO_2 levels favoring woody plant establishment (Tausch 1999, Bunting 1994). In Utah, Nevada, and Oregon, trees established prior to 1860 accounted for only two percent or less of the total population of pinyon and juniper (Miller et al. 2008). The research strongly suggests that for over 200 years prior to settlement, woodlands in the Great Basin were relatively low density with limited rates of establishment (Miller et al. 2008, Miller and Tausch 2001) and that conifer canopy cover of 10 to 25 percent may be more representative of these sites in pristine condition. Increases in pinyon and juniper densities post-settlement were the result of both infill in mixed age tree communities and expansion into shrub-steppe communities. However, the proportion of old-growth can vary depending on disturbance regimes, soils and climate. Some ecological sites are capable of supporting persistent woodlands, likely due to specific soils and climate resulting in infrequent stand replacement disturbance regimes.

The pinyon jay (Gymnorhinus cyanocephalus) and other members of the seed-caching corvids play an important role in pinyon pine regeneration. These birds cache the seeds in the soil for future use. Those seeds that escape harvesting by the birds and rodents have the opportunity to germinate under favorable soil and climatic conditions (Lanner 1981). A mutualistic relationship exists between the trees that produce food and the animals that disperse the seeds, thereby insuring perpetuation of the trees. Large crops of seeds may stimulate reproduction in birds, especially the pinyon jay (Ligon 1974).

Pinyon growth is dependent mostly upon soil moisture stored from winter precipitation, mainly snow. Much of the summer precipitation is ineffective, being lost in runoff after summer convection storms or by evaporation and interception (Tueller and Clark 1975). Pinyon is highly resistant to drought, which is common in the Great Basin. Tap roots of pinyon have a relatively rapid rate of root elongation and are thus able to persist until precipitation conditions are more favorable (Emerson 1932).

Infilling by younger trees increases canopy cover, causing a decrease in understory perennial vegetation and an increase in bare ground. As pinyon trees increase in density so does their litter. Furthermore, infilling shifts level biomass from ground fuels to canopy fuels which have the potential to significantly impact fire behavior. The more pinyon-dominated this site becomes, the less likely it is to burn under moderate conditions, resulting in frequent high intensity fires (Gruell 1999, Miller et al. 2008). Additionally, as the understory vegetation declines in vigor and density with increased canopy, the seed and propagules of the understory plant community also decrease significantly. The increase in bare ground allows for the invasion of non-native annual species such as cheatgrass. With intensive wildfire, the potential for conversion to annual exotics is a serious threat (Tausch 1999, Miller et al. 2008).

Specific successional pathways after disturbance in this ecological site are dependent on a number of variables, such as plant species present at the time of disturbance and their individual responses to disturbance, past management actions, type and size of disturbance, available seed sources in the soil or adjacent areas, and site and climatic conditions throughout the successional process.

Phillips (1909) recognized that the pinyons are more resistant to disease than most of the conifers with which it associates. Hepting (1971) lists several diseases affecting pinyon including: foliage diseases, a tarspot needle cast, stem diseases such as blister rust and dwarf mistletoe, root diseases and trunk rots, red heart rot, and but rot. The pinyon ips beetle (Ips confuses) and pinyon needle scale (Matsucoccus acalyptus) are both native insects to Nevada that attack pinyon pines throughout their range. The pinyon needle scale weakens trees by killing needles older than one year. Small trees are sometimes killed by repeated feeding and large trees are weakened to the point that they are attacked by the pinyon ips beetle. The beetle typically kills weak and damaged trees (Phillips 2014). During periods of long-term drought, the impact of these two insects on singleleaf pinyon can be substantial.

Mountain big sagebrush, a common component of this site, 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 that are co-dominant with the shrubs include Idaho fescue and bluebunch wheatgrass. Other common grasses include Sandberg bluegrass (*Poa secunda*) and basin wildrye (*Leymus cinereus*). These species 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 m of the soil profile. General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.

Idaho fescue is a perennial cool-season bunchgrass. It produces an extensive fibrous system (Ogle et al. 2008). In a greenhouse study, about 35% of the biomass of Idaho fescue was located within the root system, and between 59-65% of root biomass was located within the top 10 cm of soil (Goodwin et al. 1999). It is fairly drought-tolerant and is moderately shade-tolerant (Ogle et al. 2008). It is capable of persisting under dense canopies of mountain mahogany for longer periods of time than the other bunchgrasses on this site. Idaho fescue has been found to be more capable of suppressing non-native annual species such as cheatgrass than other perennial bunchgrasses, especially when in a mature stand (Borman et al. 1991). This is in part due to its dense, shallow root system that competes well with cheatgrass, but also due to its ability to emerge in the fall and grow at favorable times during the winter (Daubenmire 1975, Borman et al. 1991).

This ecological site has low to moderate resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Four possible alternative stable states have been identified for this site.

Major Successional Stages of Forestland Development:

HERBACEOUS: Vegetation is dominated by grasses and forbs under full sunlight. This stage is experienced after a major disturbance such as crown fire. Skeleton forest (dead trees) remaining after fire or residual trees left following harvest have little or no affect on the composition and production of the herbaceous vegetation.

SHRUB-HERBACEOUS: Herbaceous vegetation and woody shrubs dominate the site. Various amounts of tree seedlings (less than 20 inches in height) may be present up to the point where they are obviously a major component of the vegetal structure.

SAPLING: In the absence of disturbance, the tree seedlings develop into saplings (20 inches to 4.5 feet in height) with a range in canopy cover generally less than 10 percent. Vegetation consists of grasses, forbs and shrubs in association with tree saplings.

IMMATURE FORESTLAND: The visual aspect and vegetal structure are dominated by singleleaf pinyon greater than 4.5 feet in height. The upper crown of dominant and codominant trees are cone or pyramidal shaped. Seedlings and saplings are present in the understory. Understory vegetation is moderately influenced by a tree overstory canopy of about 10 to 20 percent.

MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

OVER-MATURE FORESTLAND: This stage is dominated by singleleaf pinyon that have reached maximal heights for the site. Dominant and codominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically irregularly flat-topped or rounded. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Tree canopy cover is at a maximum for the site and is commonly more than 45 percent.

Fire effects:
The fire return interval in curl-leaf mountain mahogany dominated sites is not well-documented. On this site, fire frequency most likely depends on surrounding vegetation and would generally be rare. Lightning-ignited fires are common but typically do not affect more than a few individual trees. Replacement fires are uncommon to rare (100-600 years) and occur primarily during extreme fire behavior conditions. Spreading, low-intensity surface fires have a very limited role in molding stand structure and dynamics. Surface spread is more likely to occur in higher-density woodlands growing on more productive sites (Romme et al 2007). Pre-settlement fire return intervals in the Great Basin National Park, Nevada were found to have a mean range between 50 to 100 years with north-facing slopes burning every 15 to 20 years and rocky landscapes with sparse understory burning very infrequently (Gruell 1999). Woodland dynamics are largely attributed to long-term climatic shifts (temperature, amounts and distribution of precipitation) and the extent and return intervals of fire (Miller and Tausch 2001). Limited data exists that describes fire histories across woodlands in the Great Basin. The infilling of younger pinyon into the old-growth stands and the expansion of trees into the surrounding sagebrush steppe ecological sites has increased the abundance and landscape level continuity of fuels, which in turn has increased the risk of loss of increased fire severity and size (Miller et al. 2008).

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). Curl-leaf 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). Singleleaf pinyons are most vulnerable to fire when less than four feet tall, however mature trees do not self-prune their dead branches allowing for accumulated fuel in the crowns. This characteristic and the relative flammability of the foliage make individual mature trees susceptible to fire (Bradley et al. 1992). With the low production of the understory vegetation and low density of trees per acre, high severity fires within this plant community were not likely and rarely became crown fires (Bradley et al. 1992, Miller and Tausch 2001). Singleleaf pinyon pines reestablish by seed from nearby seed sources or surviving seeds. Singleleaf pinyon trees have relatively short-lived seeds with little innate dormancy that form only temporary seed banks with most seeds germinating the spring following dispersal (Meewig and Bassett 1983). Density of pinyon seeds in the seed bank is dependent upon the current year’s cone crop. Singleleaf pinyons are known to have favorable cone production every two to three years, thus the potential for a large temporary seed bank is high during mast years and likely low during non-mast years (Chambers et al. 1999). The role of nurse plant requirements between the two tree species is important to post-fire establishment. Chambers et al. (1999) found that singleleaf pinyon seedlings rarely establish in interspaces or open environments.

Initial response of native understory species following fire correlates closely with pinyon canopy cover. In general, research indicates that understory response to disturbance is most productive when crown cover is at or below 20%; beyond 30%, there is a rapid decline in understory species and soil seed reserves (Huber et al. 1999).

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 and can take up to 50 years (Bunting et al. 1987, Ziegenhagen 2003, Miller and Heyerdahl 2008, Ziegenhagen and Miller and Rose 2009).

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 along with seasonality and intensity of the fire all factor into the individual species response. 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). Season and severity of the fire as well as post-fire soil moisture availability will influence plant response.
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.

Idaho fescue 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. 1989). 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 et al. (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. 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 Defossé (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. In addition, given the same fire severity treatment, post-fire culm production was initiated earlier and more rapidly in Idaho fescue (Robberecht and Defossé 1995).

Sandberg bluegrass (*Poa secunda*), a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975). Sandberg bluegrass may retard reestablishment of deeper rooted bunchgrass.

The introduction of annual weedy species like cheatgrass may cause an increase in fire frequency and eventually lead to an annual dominated community. Conversely, without fire, big sagebrush will increase and the potential for re-establishment of pinyon and juniper also increases. Without fire or changes in management, pinyon and juniper will dominate the site and mountain big sagebrush will be severely reduced. The herbaceous understory will also be reduced, though muttongrass and Sandberg bluegrass may be found in trace amounts. The potential for soil erosion increases as the understory plant community declines. Catastrophic wildfire in pinyon-juniper controlled sites may lead to an annual weed dominated state.

State and transition model

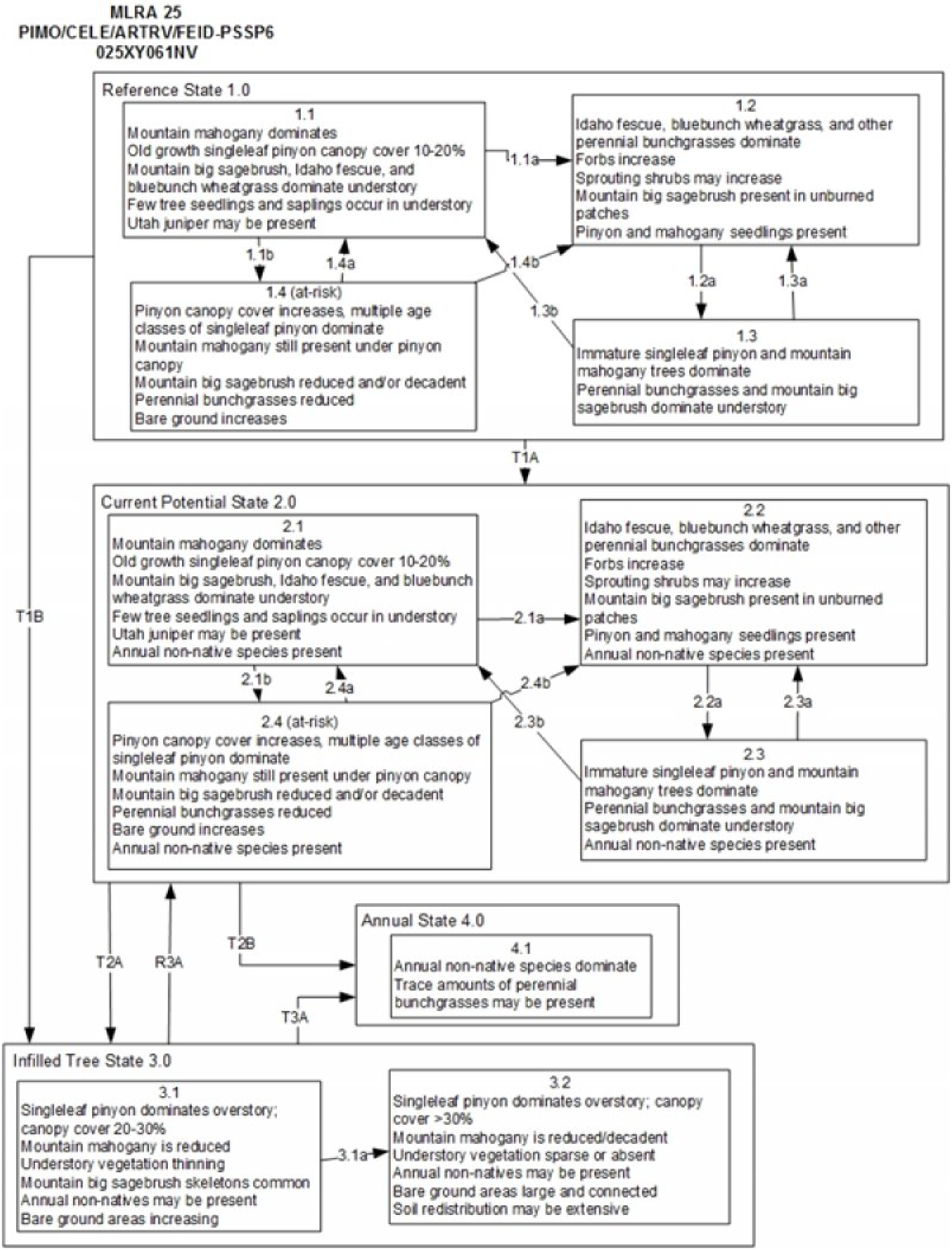


Figure 7. T Stringham 3/2015

MLRA 25
PIMO/CELE/ARTRV/FEID-PSSP6
025XY061NV
Legend

Reference State 1.0 Community Pathways
1.1a: Fire reduces or eliminates mahogany and pinyon cover.
1.1b: Time and lack of disturbance such as fire, disease, or drought allows younger pinyons to infill.
1.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
1.3a: Fire.
1.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
1.4a: Low severity fire, insect infestation, or disease removes individual pinyons and reduces total pinyon cover.
1.4b: High severity crown fire reduces or eliminates pinyon cover.

Transition T1A: Introduction of non-native annual species.
Transition T1B: Time and a lack of disturbance allows for pinyons to dominate site resources; may be coupled with inappropriate herbivory that favors shrub and pinyon dominance.

Current Potential State 1.0 Community Pathways
2.1a: High severity crown fire reduces or eliminates pinyon cover.
2.1b: Time and lack of disturbance such as fire, disease, or drought allows younger pinyons to infill.
2.2a: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory.
2.3a: Fire.
2.3b: Time and lack of disturbance such as fire or drought. Excessive herbivory may also reduce perennial grass understory..
2.4a: Low severity fire, insect infestation, or disease removes individual pinyons and reduces total pinyon cover.
2.4b: High severity crown fire reduces or eliminates pinyon cover.

Transition T2A: Time and a lack of disturbance allows for pinyons to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and pinyon dominance.
Transition T2B: Catastrophic fire.

Infilled Tree State 3.0 Community Pathways
3.1a: Time and lack of disturbance such as fire, disease, or drought allows younger pinyons to infill.

Transition T3A: Catastrophic fire.

Restoration Pathway R3A: Thinning of pinyons coupled with seeding. Success unlikely from phase 3.2.

Annual State 4.0 Community Pathways
None.

Figure 8. Legend

State 1
Reference State

The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree 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 long-term drought, and/or insect or disease attack.

Community 1.1
Community Phase

This phase is characterized by widely dispersed old-growth curl-leaf mountain mahogany and singleleaf pinyon trees, with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by mountain mahogany. Singleleaf pinyon makes up 10-25 percent of the overstory canopy cover. Pinyon pines have reached maximal or near maximal heights for the site and many tree crowns may be flat- or round-topped. Idaho fescue and bluebunch wheatgrass are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*) and tapertip hawksbeard (*Crepis acuminata*), and others are minor components. Fires in this phase are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all/most of the following community phases within this state.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	125	188	250
Shrub/Vine	75	113	150
Tree	38	56	75
Forb	12	19	25
Total	**250**	**376**	**500**

Community 1.2
Community Phase

This community phase is characterized by a post-fire shrub and herbaceous community. Idaho fescue, bluebunch wheatgrass, and other perennial grasses dominate. Forbs may increase post-fire but will likely return to pre-burn levels within a few years. Many mountain mahogany individuals may have survived the fire, but seedlings will be sprouting in open areas. Singleleaf pinyon seedlings up to 20 inches in height may be present. Mountain big sagebrush may be present in unburned patches. Burned tree skeletons may be present; however these have little or no effect on the understory vegetation.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 1.3
Community Phase

This community phase is characterized as an immature woodland with pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedlings and saplings as well as perennial bunchgrasses and sagebrush.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 1.4
Community Phase (at risk)

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes and canopy cover exceeds 20 percent. Pinyon pine overtops mountain mahogany. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs may increase. This community is at risk of crossing a threshold; without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Pathway a
Community 1.1 to 1.2

Fire will eliminate or reduce the mahogany and singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

Pathway b
Community 1.1 to 1.4

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf pinyon. Pinyon begins to overtop the mahogany.

Pathway a
Community 1.2 to 1.3

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory may also reduce perennial grass understory.

Pathway b
Community 1.3 to 1.1

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon.

Pathway a
Community 1.3 to 1.2

Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

Pathway a
Community 1.4 to 1.1

Low intensity fire, insect infestation, or disease kills individual trees within the stand reducing canopy cover to less than 20 percent. Over time younger trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor.

Pathway b
Community 1.4 to 1.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

State 2
Current Potential

This state is similar to the Reference State 1.0, with four general community phases: an old-growth woodland phase, a shrub-herbaceous phase, an immature tree phase, and an infilled tree phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of non-native species. These non-natives, particularly cheatgrass, can be highly flammable and 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. Fires within this community with the small amount of non-native annual species present are likely still small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all/most of the following community phases within this state.

Community 2.1
Community Phase

Figure 10. A sister PIMO-CELE site from MLRA 28 (F028BY058NV) Phase 2.1 T. Stringham, July 2013

Figure 11. PIMO-CELE3/ARTRV/FEID-PSSPS (F025XY061NV) Phase 2.1 T. Stringham, August 2012

This phase is characterized by widely dispersed old-growth curl-leaf mountain mahogany and singleleaf pinyon trees, with an understory of mountain big sagebrush and perennial bunchgrasses. The visual aspect is dominated by mountain mahogany. Singleleaf pinyon, which makes up 10-25 percent of the overstory canopy cover. Pinyon pines have reached maximal or near maximal heights for the site and many tree crowns may be flat- or round-topped. Idaho fescue, bluebunch wheatgrass are the most prevalent grasses in the understory. Mountain big sagebrush is the primary understory shrub. Forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*), tapertip hawksbeard (*Crepis acuminata*), and others are minor components. Fires in this phase are typically small and patchy due to low fuel loads. This fire type will create a plant community mosaic that will include all/most of the following community phases within this state.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 2.2
Community Phase

This community phase is characterized by a post-fire shrub and herbaceous community. Idaho fescue, bluebunch wheatgrass, and other perennial grasses dominate. Forbs may increase post-fire but will likely return to pre-burn levels within a few years. Many mountain mahogany individuals may have survived the fire, but seedlings will be sprouting in open areas. Singleleaf pinyon seedlings up to 20 inches in height may be present. Mountain big sagebrush may be present in unburned patches. Burned tree skeletons may be present; however these have little or no effect on the understory vegetation. Annual non-native species generally respond well after fire and may be stable or increasing within the community.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 2.3
Community Phase

This community phase is characterized as an immature woodland with pinyon trees averaging over 4.5 feet in height. Pinyon canopy cover is between 10 to 20 percent. Tree crowns are typically cone- or pyramidal-shaped. Understory vegetation consists of smaller tree seedlings and saplings as well as perennial bunchgrasses and sagebrush.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 2.4
Community Phase (at risk)

Figure 12. PIMO-CELE3/ARTRV/FEID-PSSPS (F025XY061NV) Phase 2.4 T. Stringham, August 2012

This phase is dominated by singleleaf pinyon. The stand exhibits mixed age classes and canopy cover exceeds 20 percent. Pinyon pine overtops mountain mahogany. The density and vigor of the mountain big sagebrush and perennial bunchgrass understory is decreased. Bare ground areas are likely to increase. Mat-forming forbs may increase. This community is at risk of crossing a threshold; without proper management this phase will transition to the Infilled Tree State 3.0. This community phase is typically described as early Phase II woodland (Miller et al. 2008).

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Pathway a
Community 2.1 to 2.2

Fire will reduce or eliminate the mahogany and singleleaf pinyon overstory and the shrub component. This allows for the perennial bunchgrasses to dominate the site.

Pathway b
Community 2.1 to 2.4

Community Phase

Community Phase (at risk)

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf pinyon. Pinyon begins to overtop the mahogany.

Pathway b
Community 2.1 to 2.4

Community Phase

Community Phase (at risk)

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual infilling of singleleaf pinyon. Pinyon begins to overtop the mahogany.

Pathway a
Community 2.2 to 2.3

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of the singleleaf pinyon component. Mountain big sagebrush reestablishes. Excessive herbivory may also reduce perennial grass understory.

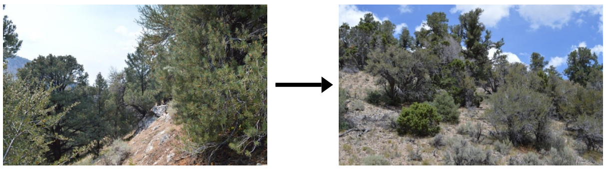
Pathway b
Community 2.3 to 2.1

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon.

Pathway a
Community 2.3 to 2.2

Fire reduces or eliminates tree canopy, allowing perennial grasses to dominate the site.

Pathway a
Community 2.4 to 2.1



Community Phase (at risk) **Community Phase**

Low intensity fire, insect infestation, or disease kills individual trees within the stand reducing canopy cover to less than 20 percent. Over time younger trees mature to replace and maintain the old-growth woodland. The mountain big sagebrush and perennial bunchgrass community increases in density and vigor.

Pathway b
Community 2.4 to 2.2

A high-severity crown fire will eliminate or reduce the singleleaf pinyon overstory and the shrub component which will allow for the perennial bunchgrasses to dominate the site.

State 3
Infilled Tree State

This state has two community phases that are characterized by the dominance of singleleaf pinyon in the overstory. This state is identifiable by 20 to 30 percent canopy cover of singleleaf pinyon. This stand exhibits a mixed age class. Older trees are at maximal height and upper crowns may be flat-topped or rounded. Younger trees are typically cone- or pyramidal-shaped. Mountain mahogany and other understory vegetation is declining due to increasing shade and competition from trees.

Community 3.1
Community Phase

Figure 13. PIMO-CELE3/ARTRV/FEID-PSSPS (F025XY061NV). Phase 3.1 T. Stringham August 2012

Figure 14. PIMO-CELE3/ARTRV/FEID-PSSPS (F025XY061NV). Phase 3.1 T. Stringham August 2012

Singleleaf pinyon dominates the aspect. Mountain mahogany is reduced and lacks recruitment. Understory vegetation is thinning. Perennial bunchgrasses are sparse and mountain big sagebrush skeletons are as common as live shrubs due to tree competition for soil water, overstory shading, and duff accumulation. Pinyon canopy cover is greater than 20 percent. Annual non-native species are present or co-dominate in the understory. Bare ground areas are prevalent and soil redistribution is evident. This community phase is typically described as a Phase II woodland (Miller et al. 2008).

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Community 3.2
Community Phase

Figure 15. PIMO-CELE3/ARTRV/FEID-PSSPS (F025XY061NV). Phase 3.2 T. Stringham August 2012

Singleleaf pinyon dominates the aspect. Tree canopy cover exceeds 30 percent and may be as high as 50 percent. Understory vegetation is sparse to absent. Perennial bunchgrasses, if present, exist in the dripline or under the canopy of trees. Mountain sagebrush skeletons are common or the sagebrush has been extinct long enough that only scattered limbs remain. Mat-forming forbs or Sandberg’s bluegrass may dominate interspaces. Annual non-native species are present and are typically found under the trees. Bare ground areas are large and interconnected. Soil redistribution may be extensive. This community phase is typically described as a Phase III woodland (Miller et al. 2008).

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Pathway a
Community 3.1 to 3.2

Community Phase　　Community Phase

Time without disturbance such as fire, long-term drought, or disease will allow for the gradual maturation of singleleaf pinyon. Infilling by younger trees continues.

State 4
Annual

This state has one community phase and is characterized by the dominance of annual non-native species such as cheatgrass and tansy mustard in the understory. Rabbitbrush may be present. Annual non-native species dominate the understory.

Community 4.1
Community Phase

Cheatgrass, mustards and other non-native annual species dominate the site. Trace amounts of perennial bunchgrasses may be present.

Forest overstory. MATURE FORESTLAND: The visual aspect and vegetal structure is dominated by singleleaf pinyon that have reached or are near maximal heights for the site. Dominant trees average greater than five inches in diameter at one-foot stump height. Upper crowns are typically either irregularly or smoothly flat-topped or rounded. Tree canopy cover ranges from 20 to 35 percent. Understory vegetation is strongly influenced by tree competition, overstory shading, duff accumulation, etc. Infrequent, yet periodic wildfire is a natural factor influencing the understory of mature forestlands. Few seedlings and/or saplings occur in the understory.

Forest understory. Understory vegetative composition is about 50 percent grasses, 5 percent forbs and 45 percent shrubs and young trees when the average overstory canopy is medium (20 to 35 percent). Average understory production ranges from 250 to 500 pounds per acre with a medium canopy cover. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Transition A
State 1 to 2

Trigger: Introduction of non-native annual species. Slow variables: Over time the annual non-native plants will increase within the community. Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Transition B
State 1 to 3

Trigger: Time and a lack of disturbance allow trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Pinyon canopy cover is greater than 20 percent. Little understory vegetation remains due to competition with trees for site resources.

Transition A
State 2 to 3

Trigger: Time and a lack of disturbance allow trees to dominate site resources; may be coupled with inappropriate grazing management that favors shrub and tree dominance. Slow variables: Over time the abundance and size of trees will increase. Threshold: Pinyon canopy cover is greater than 30%. Little understory vegetation remains due to competition with trees for site resources.

Transition B
State 2 to 4

Trigger: Catastrophic crown fire facilitates the establishment of non-native, annual weeds. Slow variables: Increase in tree crown cover, loss of perennial understory and an increase in annual non-native species. Threshold: Cheatgrass or other non-native annuals dominate understory. Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution, and reduces soil organic matter. Increased canopy cover of trees allows severe stand-replacing fire. The increased seed bank of non-native, annual species responds positively to post-fire conditions facilitating the transition to an Annual State.

Restoration pathway A
State 3 to 2

Manual or mechanical thinning of trees coupled with seeding. Probability of success is highest from Community Phase 3.1.

Conservation practices

Brush Management
Range Planting

Transition A
State 3 to 4

Trigger: Fire reduces the tree overstory and allows for the annual non-native species in the understory to dominate the site. Soil disturbing treatments such as slash and burn may also reduce tree canopy and allow for non-native annual species to increase. Slow variables: Over time, cover and production of annual non-native species increases. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size, and spatial variability of fires.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			74–180	
	Idaho fescue	FEID	*Festuca idahoensis*	37–90	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	37–90	–
2	**Secondary Perennial Grasses**			42–87	
	basin wildrye	LECI4	*Leymus cinereus*	19–34	–
	bluegrass	POA	*Poa*	4–19	–
Forb					
3	**Perennial**			8–38	
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	4–19	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	4–19	–
Shrub/Vine					
4	**Primary Shrubs**			37–90	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	37–90	–
5	**Secondary Shrubs**			42–87	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	19–34	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	19–34	–
	snowberry	SYMPH	*Symphoricarpos*	4–19	–
Tree					
6	**Deciduous**			19–34	
	curl-leaf mountain mahogany	CELE3	*Cercocarpus ledifolius*	19–34	–
7	**Evergreen**			21–38	
	singleleaf pinyon	PIMO	*Pinus monophylla*	19–34	–
	Utah juniper	JUOS	*Juniperus osteosperma*	2–4	–

Animal community

Livestock/Wildlife Grazing Interpretations:
This site is suited to cattle and sheep grazing during the summer and fall. Considerations for grazing management include timing, intensity and duration of grazing. Grazing management should be keyed to Idaho fescue and bluebunch wheatgrass production. Idaho fescue and bluebunch wheatgrass provide palatable, nutritious feed during the late spring and summer. New plants of these grasses are established entirely from seed and grazing practices should allow for ample seed production and seedling establishment.
Many areas of this site are not used due to steep slopes, rock outcrops and lack of adequate water. Attentive grazing management is required due to steep slopes and erosion hazards.

Inappropriate grazing management during the growing season will cause a decline in understory plants such as Idaho fescue and bluebunch wheatgrass. Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass, mat forming forbs, and/or cheatgrass and other invasive species to occupy interspaces. 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.

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 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).

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). Idaho fescue is valuable forage for livestock and wildlife. It is an excellent forage grass and can withstand heavy trampling (USDA Forest Service 1937). However, Idaho fescue decreases under heavy grazing by livestock (Eckert and Spencer 1986, Eckert and Spencer 1987) and wildlife (Gaffney 1941).

Bluebunch wheatgrass is considered of of the most important forage grass species on western rangelands for livestock. Although bluebunch wheatgrass can be a crucial source of forage, it is not necessarily the most highly preferred species. 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). Herbage and flower stalk production was shown to be reduced 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 wheatgrass was greatly reduced when drought was coupled with clipping (Busso and Richards 1995). Mueggler (1975) estimated that low-vigor bluebunch wheatgrass may need up to 8 years rest to recover. Bluebunch wheatgrass does not generally provide sufficient cover for ungulates; however, mule deer were frequently found in bluebunch-dominated grasslands.

Stocking rates vary with such factors as kind and class of grazing animal, season of use and fluctuations in climate. Actual use records for individual sites, a determination of the degree to which the sites have been grazed, and an evaluation of trend in site condition offer the most reliable basis for developing initial stocking rates. Selection of initial stocking rates for given grazing units is a planning decision. This decision should be made only after careful consideration of the total resources available, evaluation of alternatives for use and treatment, and establishment of objectives by the decisionmaker.

Wildlife Interpretations:
This ecological site contains two species that are very important for wildlife: curl-leaf mountain mahogany and singleleaf pinyon. This site has high value for mule deer season long, and is also utilized by upland game species including rabbits, sage grouse, blue and ruffed grouse. The pinyon jay is dependent upon sites supporting pinyon pine trees. It is also used by various song birds, rodents, reptiles and associated predators natural to the area. Feral or wild horses will use this site year around.

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 nelson) (Furniss et al 1988, Lanner 1983). Curl-leaf mountain mahogany is excellent browse for deer throughout the year (Sampson and Jesperson 1963, Olsen 1992); 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 use curl-leaf mountain mahogany for cover (Steel et al. 1981). 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.

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. Logan and Irwin (1985) noted that of 52 mountain lion caches, 33 percent were located in curl-leaf mountain mahogany vegetation. 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).

Pinyon pines provide a diversity of habitat for wildlife. Although the foliage of pinyon varies in palatability among fauna, pinyon nuts are preferred by many species. Ungulates will use pinyon trees for cover and graze the foliage. The understory species also provide critical browse for deer. The trees provide important cover for mule deer, elk, wild horses, mountain lion, bobcat (Lynx rufus) and pronghorn (Gottfried and Severson 1994, Coates and Schemnitz 1994, Logan and Irwin 1985, Evans 1988).

Mule deer will eat singleleaf pinyon and juniper foliage, using the foliage moderately in winter, spring, and summer (Kufeld et al. 1973). Deep snows in higher elevation forest zones force mule deer and elk down into pinyon-juniper habitats during winter. This change in habitat allows mule deer and elk to browse the dwarf trees and shrubs (Gottfried and Severson 1994).

The diet of pronghorn antelope varies considerably, though singleleaf pinyon was shown to comprise 1 to 2 percent of their winter diet. Desert bighorn sheep (Ovis nelson) may utilize pinyon-juniper habitat, but only where the terrain is rocky and steep (Gottfried et al. 2000). Gray foxes (Urocyon cinereoargenteus), bobcats, coyotes (Canis latrans), weasels (Mustela frenata), skunks (Mephitis spp.), badgers (Taxidea taxus), and ringtail cats (Bassariscus astutus) search for prey in pinyon-juniper habitat woodlands (Short and McCulloch 1977).

The pinyon mouse (Peromyscus truei) is a pinyon obligate and uses this species for cover and food (Hoffmeister 1981). Other small mammals include the porcupine (Hystricomorph hystricidae), desert cottontail (Sylvilagus audubonii), Nuttall's cottontail (S. nuttallii), deer mouse (Peromyscus maniculatus), Great Basin pocket mouse (Perognathus parvus), chisel-toothed kangaroo rat (Dipodomys microps), and desert woodrat (Neotoma lepida) (Turkowski and Watkins 1976).
Many bird species are associated with pinyon habitat; some are permanent residents, some summer residents, and some winter residents, depending upon location. For birds and bats, the woodland provides structure for nesting and roosting as well as locations for foraging. Singleleaf pinyon provides a number of cavities and the stringy, fibrous bark provides quality nesting material as well as the food provided by the tree's seeds and berries (Short and McCulloch 1977). Several bird species are obligates including the gray flycatcher (Epidonax wrightii), scrub jay (Aphelocoma californica), plain titmouse (Parus inornatus ridgwayi), and gray vireo (Vireo vicinior). Semi-obligates include the black-chinned hummingbird (Archilochus alexandri), ash-throated flycatcher (Myiarchus cinerascens), pinion jay (Gymnorhinus cyanocephalus), American bushtit (Psaltriparus minimus), Bewick's wren (Thryomanes bewickii), Northern mockingbird (Mimus polyglottos), blue-gray gnatcatcher (Polioptila caerulea), black-throated gray warbler (Dendroica nigrescens), house finch (Haemorhous mexicanus), spotted towhee (Pipilo maculatus), lark sparrow (Chondestes grammacus) and black-chinned sparrow (Zonotrichia atricapilla) (Balda and Masters 1980). Ferruginous hawks (Buteo regalis), a conservation priority species due to recent population declines in Nevada, nest in older trees of sufficient size and structure to support their large nest platforms. (Holechek 1981).

Mountain big sagebrush is a highly preferred winter forage for mule deer: In 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. Reliance on the big sagebrush ecosystem by many wild animals for both food and cover has been documented and reviewed extensively. Many wildlife species are dependent on the sagebrush ecosystem including the greater sage grouse (Centrocercus urophasianus), sage sparrow (Amphispiza belli), pygmy rabbit (Brachylagus idahoensis) and the sagebrush vole (Lemmiscus curtatus). Dobkin and Sauder (2004) identified 61 species, including 24 mammals and 37 birds, associated with the shrub-steppe habitats of the Intermountain West. In addition, 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.

Hydrological functions

Runoff is medium to high. Permeability is slow to moderate. The hydrologic cover condition of this site is fair in a representative stand. The average runoff curve is about 80 for group C soils and about 85 for group D soils.

Recreational uses

The trees on this site provide a welcome break in an otherwise open landscape. Steep slopes inhibit many forms of recreation. It has potential for hiking, cross-country skiing, camping and deer and upland game hunting. Off-road vehicles can destroy the fragile soil-vegetation complex causing severe erosion problems.

Wood products

This site has a moderate site quality for tree production. Site index ranges from about 65 to 85 (Howell, 1946).

Productivity Class: 0.5 to 0.7
CMAI*: 6.7 to 10.6 ft3/ac/yr;
0.47 to 0.74 m3/ha/yr.
Culmination is estimated to be 70 years.
*CMAI: is the culmination of mean annual increment or highest average growth rate of the stand in the units specified.

Fuelwood Production: About 8 to 11 cords per acre for stands averaging 5 inches in diameter at 1 foot height. There are about 289,000 gross British Thermal Units (BTUs) heat content per cubic foot of pinyon wood. Firewood is commonly measured by cord, or a stacked unit equivalent to 128 cubic feet. Solid wood volume in a cord varies, but usually ranges from 65 to 90 cubic feet. Assuming an average of 75 cubic feet of solid wood per cord, there are about 22 million BTUs of heat value in a cord of singleleaf pinyon.

Christmas trees: About 15 trees per acre per year in stands of medium canopy and about 25 trees per acre per year in stands of sapling stage.

Pinyon nuts: Production varies year to year, but mature woodland stage can yield 300 pounds per acre in favorable years.

MANAGEMENT GUIDES AND INTERPRETATIONS

1. LIMITATIONS AND CONSIDERATIONS
a. Potential for sheet and rill erosion is moderate to severe depending on slope.
b. Moderate to severe equipment limitations on steeper slopes and on sites having extreme surface stoniness.
c. Proper spacing is the key to a well managed, multiple use and multi-product singleleaf pinyon woodland.

2. ESSENTIAL REQUIREMENTS
a. Adequately protect from uncontolled burning.
b. Protect soils from accelerated erosion.
c. Apply proper grazing management.

3. SILVICULTURAL PRACTICES
a. Harvest cut selectively or in small patches (size dependent upon site conditions) to enhance forage production.
1) Thinning and improvement cutting - Removal of poorly formed, diseased and low vigor trees for fuelwood.
2) Harvest cutting - Selectively harvest surplus trees to achieve desired spacing. Proper spacing improves the health and development of the trees and the overall health of the stand. Save large, healthy, full-crowned pinyon trees for nut producers. Do not select only "high grade" trees during harvest.
3) Slash disposal - broadcasting slash improves reestablishment of native understory species and establishment of seeded grasses and forbs after tree harvest.
4) Spacing Guide - D+9 (a higher spaging guide is required if managing for Christmas trees)
b. Prescription burning program to maintain desired canopy cover and manage site reproduction.
c. Mechanical tree removal (i.e., chaining) - on suitable sites to enhance forage production and manage site reproduction.
d. Pest control - Porcupines can cause extensive damage and populations should be controlled.
e. Fire hazard - Fire usually not a problem in well-managed, mature stands.

Other products

Other important products of this tree include Christmas trees and the pinyon nut which is used as a food source for wildlife and humans.
Pinyon-juniper ecosystems have had subsistence, cultural, spiritual, economic, aesthetic and medicinal value to Native American peoples for centuries and singleleaf pinyon has provided food, fuel, medicine and shelter to Native Americans for thousands of years. The pitch of singleleaf pinyon was used as adhesive, caulking material, and a paint binder. It may also be used medicinally and chewed like gum.

Other information

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

Table 8. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
singleleaf pinyon	*PIMO*	65	85	7	11	–	–	–	

Inventory data references

Physiographic and Soils features are from the NASIS database.

Type locality

Location 1: Elko County, NV	
Township/Range/Section	T38N R63E S26
General legal description	Holburn BLM Allotment in the Windemere Hills, east of Wells, Elko County, Nevada.

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Approval

Kendra Moseley, 4/24/2024

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)	
Contact for lead author	
Date	05/10/2025
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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:**

17. **Perennial plant reproductive capability:**