

Ecological site group R023XY910NV

Very Shallow Mesic Plateaus Low Production Wyoming and Lahontan Sagebrush sites with Sparse Juniper

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Key Characteristics

- Site does not pond or flood
- Landform other than dunes
- Soil surface is clayey
- MAP \leq 10"

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.

Physiography

This group is on plateaus and hills at elevations between 4,400 and 6,200 feet. Slopes are 5 to 40 percent.

Climate

The climate is classified as Cold Semi-Arid in the Koppen Classification System.

The area receives 8 to 12 inches of annual precipitation as snow in the winter and rain in spring and fall. Summers are generally dry.

The frost-free period is 90 to 110 days. The mean annual air temperature is 45 to 52 °F.

Soil features

The soils in this group have a root restrictive layer at 5 to 40 inches below the surface. The textures vary, but surfaces are gravelly or cobbly.

The soils are Entisols or Aridisols and the soil temperature regime is mesic. Common soil series in this group are Rocconda, Skedaddle, and Jaybee.

Vegetation dynamics

Ecological Dynamics and Disturbance Response:

An ecological site is the product of all the environmental factors responsible for its development. Each site has a set of key characteristics that influence its resilience to disturbance and resistance to invasives. According to Caudle et al. (2013), key characteristics include:

1. Climate factors such as precipitation and temperature.
2. Topographic characteristics such as aspect, slope, elevation, and landform.
3. Hydrologic processes such as infiltration and runoff.
4. Soil characteristics such as depth, texture, structure, and organic matter.
5. Plant communities and their functional groups and productivity.
6. Natural disturbance (fire, herbivory, etc.) regime.

Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al., 2013).

The ecological sites in this group are dominated by deep-rooted, cool-season, perennial bunchgrasses and long-lived shrubs (at least 50 years old) 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 (Dobrowolski et al., 1990). However, community types with low sagebrush (*Artemisia arbuscula*) as the dominant shrub may only have available rooting depths of 71 to 81 centimeters due to a restrictive horizon (Jensen, 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock & Ehleringer, 1992).

In the Great Basin, most of the annual precipitation is received during the winter and early spring. This continental semiarid climate regime favors growth and development of deep-rooted shrubs and herbaceous, cool-season plants using the C3 photosynthetic pathway (Comstock & Ehleringer, 1992). Winter precipitation and slow melting of snow results in deeper percolation of moisture into the soil profile. Herbaceous plants, more shallow-rooted than shrubs, grow earlier in the growing season and thrive on spring rains, while the deeper-rooted shrubs lag in phenological development because they draw from deeply infiltrating moisture from the preceding winter's snowmelt. Periodic drought regularly influences sagebrush ecosystems, and drought duration and severity have increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability within the soil profile (Bates et al., 2006).

The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons (MacMahon, 1980). Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The invasibility of plant communities is often linked to resource availability. Disturbance changes resource uptake and increases nutrient availability, often to the benefit of non-native species; native species are often damaged and their ability to use resources is depressed for a time, but resource pools may increase from lack of use and/or the decomposition of dead plant material following disturbance (Whisenant, 1999; Miller et al., 2013). The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that result in fluctuations in resources (Beckstead & Augspurger, 2004; Chambers et al., 2007; Johnson et al., 2011).

Lahontan sagebrush was only recently identified as a unique species of sagebrush (Winward & McArthur, 1995). Lahontan sagebrush is a cross between low sagebrush and Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and is typically found near the old shorelines of Lake Lahontan from the Pleistocene epoch. This subspecies grows on soils similar to low sagebrush, i.e., soils with shallow depths and low water holding capabilities (Winward & McArthur, 1995).

Wyoming big sagebrush is the most drought-tolerant of the big sagebrushes. It is generally long-lived. Therefore, it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent, large recruitment events and simultaneous low, continuous recruitment are the foundation of population maintenance (Noy-Meir, 1973). Survival of the seedlings depends on adequate moisture conditions.

The perennial bunchgrasses that are dominant include Thurber's needlegrass (*Achnatherum thurberianum*), Indian ricegrass (*Achnatherum hymenoides*), and squirreltail (*Elymus elymoides*). These grass species generally have somewhat shallower root systems than the shrubs on these sites; root densities of these grasses are often as high as or higher than those of shrubs in the upper 0.5 meters of the soil profile. The general differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

Native insect outbreaks are also important drivers of ecosystem dynamics in sagebrush communities. Climate is generally believed to influence the timing of insect outbreaks, especially outbreaks of a sagebrush defoliator called Aroga moth (*Aroga websteri*). Aroga moth infestations occurred in the Great Basin in the 1960s, the early 1970s, and have been ongoing in Nevada since 2004 (Longland & Young, 1995; Bentz et al., 2008). Thousands of acres of big sagebrush (*Artemisia tridentata*) have been impacted, with partial to complete die-off observed. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss & Barr, 1975). When sagebrush stands are decadent and even-aged, Aroga moth infestations are more likely to be stand-replacing events (Longland & Young, 1995).

The ecological sites in this group have low to moderate resilience to disturbance and resistance to invasion. Resilience increases with elevation, northerly aspect, precipitation, and nutrient availability. Four possible states have been identified for this group.

Annual Invasive Grasses:

High elevations in the Great Basin remain relatively uninvaded by cheatgrass (Bradley & Mustard, 2006) and exhibit low risk of invasion (Suring et al., 2005). However, climate changes and local adaptations of cheatgrass at the "invasion edge" are creating more opportunities for invasion in areas previously undisturbed by these plants (Leger et al., 2009; Bradley, 2009). Cheatgrass invasions are being recorded at higher elevations (Mealor et al., 2012; Bradley, 2009) and risk of invasion should be considered in post-fire rehabilitation planning. Across a variety of elevations healthy, native, perennial, herbaceous communities coupled with management practices that reduce litter and seed banks, are the most effective tool to reduce cheatgrass invasions (Chambers et al., 2007; Jones et al., 2015).

Cheatgrass is a cool-season annual grass that maintains an advantage over native plants, in part because it is a prolific seed producer, able to germinate in the autumn or spring, tolerant of grazing, and increases with frequent fire (Klemmedson & Smith, 1964; Miller et al., 1999). Cheatgrass originated from Eurasia and was first reported in North America in the late 1800s (Mack & Pyke, 1983; Furbush, 1953).

Recent modeling and empirical work by Bradford and Lauenroth (2006) suggest that seasonal patterns of precipitation input and temperature are also key factors determining regional variation in the growth, seed production, and spread of invasive annual grasses.

Methods to control cheatgrass include herbicide, fire, grazing, and seeding of primarily non-native wheatgrasses. Mapping potential or current invasion vectors is a management method designed to increase the cost effectiveness of control methods. Spraying with herbicide (Imazapic or Imazapic + glyphosate) and seeding with crested wheatgrass (*Agropyron cristatum*) and Sandberg bluegrass (*Poa secunda*) have been more successful at combating medusahead (*Taeniatherum*) and cheatgrass than spraying alone (Sheley et al., 2012). Where native bunchgrasses are missing from the site, revegetation of medusahead- or cheatgrass-invaded rangelands has shown a higher likelihood of success when using introduced perennial bunchgrasses such as crested wheatgrass (Davies et al., 2015). Butler et al. (2011) tested four herbicides (Imazapic, Imazapic + glyphosate, rimsulfuron, and sulfometuron + Chlorsulfuron), using herbicide-only treatments, for suppression of cheatgrass, medusahead, and ventenata (*Ventenata dubia*) within residual stands of native bunchgrass. Additionally, they tested the same four herbicides followed by seeding of six bunchgrasses (native and non-native) with varying success. Herbicide-only treatments appeared to remove competition for established bluebunch wheatgrass (*Pseudoroegneria spicata*) by providing 100 percent control of ventenata and medusahead and greater than 95 percent control of cheatgrass (Butler et al., 2011). However, caution in using these results is advised, as only one year of data was reported.

Prescribed fire has also been utilized in combination with the application of pre-emergent herbicide to control medusahead and cheatgrass (J. L. Vollmer & J. G. Vollmer, 2008). Both mature medusahead and cheatgrass are very flammable and fire can be used to remove the thatch layer, consume standing vegetation, and even reduce seed levels.

In considering the combination of pre-emergent herbicide and prescribed fire for invasive annual grass control, it is important to assess the tolerance of desirable brush species to the herbicide being applied. Vollmer and Vollmer (2008) tested the tolerance of mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), and multiple sagebrush species to three rates of Imazapic and the same rates with methylated seed oil as a surfactant. They found a cheatgrass control program in an antelope bitterbrush community should not exceed Imazapic at 8 ounces per acre with or without surfactant. Sagebrush, regardless of species or rate of application, was not affected. However, many environmental variables were not reported in this study and managers should install test plots before broad scale herbicide application is initiated.

Fire Ecology:

To date, we have not been able to find specific research on the fire response of Lahontan sagebrush. It likely behaves similarly to low sagebrush.

Low sagebrush is killed by fire and does not sprout (Tisdale & Hironaka, 1981). Fire risk is greatest following a wet, productive year when there is greater production of fine fuels (Beardall & Sylvester, 1976). Fire return intervals are not well understood because these ecosystems rarely coincide with fire-scarred conifers, but a wide range of 20 to well over 100 years has been estimated (Miller & Rose, 1995, 1999; Baker, 2006; Knick et al., 2005). Historically, fires were probably patchy due to the low productivity of these sites (Beardall & Sylvester, 1976; Ralphs & Busby, 1979; Wright et al., 1979; Smith & Busby, 1981). Recovery time of low sagebrush following fire is variable (Young, 1983). After fire, if regeneration conditions are favorable, low sagebrush recovers in 2 to 5 years, but on harsh sites where cover is low to begin with and/or erosion occurs after fire, recovery may require more than 10 years (Young, 1983). Slow regeneration may subsequently worsen erosion (Blaisdell et al., 1982).

Wyoming big sagebrush communities historically had low fuel loads. Patchy fires that burned in a mosaic pattern were common at 10- to 70-year fire return intervals (Young et al., 1979; West & Hassan, 1985; Bunting et al., 1987). Davies et al. (2006) suggest fire return intervals in Wyoming big sagebrush communities were around 50 to 100 years. Wyoming big sagebrush is killed by fire and only regenerates from seed. Recovery time for Wyoming big sagebrush may require 50 to 120 or more years (Baker, 2006). However, the introduction and expansion of cheatgrass has dramatically altered the fire regime (Balch et al., 2013) and restoration potential of Wyoming big sagebrush communities.

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses on a site and 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. This provides relative protection from disturbances that decrease aboveground 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).

Burning has been found to decrease the vegetative and reproductive vigor of Thurber's needlegrass (Uresk et al., 1976). Fire can cause high mortality and reduce basal area and yield of Thurber's needlegrass (Britton et al., 1990). The fine leaves and densely tufted growth form make this grass susceptible to subsurface charring of the crowns (Wright & Klemmedson, 1965). Although timing of fire highly influences the response and mortality of Thurber's needlegrass, smaller bunch sizes are less likely to be damaged by fire (Wright & Klemmedson, 1965). Thurber's needlegrass often survives fire and continues growth or regenerates from tillers when conditions are favorable (Koniak, 1985; Britton et al., 1990). Reestablishment on burned sites is relatively slow due to low germination and competitive ability (Koniak, 1985). Cheatgrass is a highly successful competitor with seedlings of this needlegrass and may preclude reestablishment (Evans & Young, 1978).

Fire will remove aboveground biomass from bluebunch wheatgrass, but plant mortality is generally low (Robberecht & Defossé, 1995) because the buds are underground (Conrad & Poulton, 1966) or protected by foliage. Uresk et al. (1976) reported burning increased vegetative and reproductive vigor of bluebunch wheatgrass. Thus, bluebunch wheatgrass experiences slight damage from fire but is more susceptible to fire damage in drought years (Young, 1983). Plant response varies depending on season, fire severity, fire intensity, and post-fire soil moisture availability.

Indian ricegrass is fairly fire-tolerant (Wright, 1985), which is likely due to its low culm density and below ground plant crowns. Indian ricegrass has reestablishes on burned sites via seed dispersed from adjacent unburned areas (Young, 1983; West, 1994). Thus, the presence of surviving, seed-producing plants is necessary for reestablishment of Indian ricegrass. It is important to manage grazing following fire to promote seed production and establishment of seedlings.

Sandberg bluegrass, a minor component of the sites of this group, can increase following fire likely due to its low stature and productivity (Daubenmire, 1975). Sandberg bluegrass may inhibit reestablishment of deep-rooted bunchgrasses. 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.

Invasive grasses, such as cheatgrass, displace desirable perennial grasses, reduce livestock forage, and accumulate large fuel loads that foster frequent fires (Davies & Svejcar, 2008). Invasion by annual grasses can alter the fire cycle by increasing fire size, fire season length, rate of spread, numbers of individual fires, and likelihood of fires spreading into native or managed ecosystems (D'Antonio & Vitousek, 1992; Brooks et al., 2004). While historical fire return intervals are estimated at 15 to 100 years, areas dominated with cheatgrass are estimated to

have a fire return interval of 3 to 5 years (Whisenant, 1990). The mechanisms by which invasive annual grasses alter fire regimes likely interact with climate. For example, cheatgrass cover and biomass vary with climate (Chambers et al., 2007) and are promoted by wet and warm conditions during the fall and spring. Invasive annual species can take advantage of high nitrogen availability following fire because of their higher growth rates and increased seedling establishment relative to native perennial grasses (Monaco et al., 2003).

Livestock/Wildlife Grazing Interpretations:

Throughout two years of site visits, Lahontan sagebrush was observed in a heavily-browsed state on several ecological sites in this group. This recently differentiated subspecies of low sagebrush (Winward & McArthur, 1995) is moderately to highly palatable to browse species (McArthur, 2005; Rosentreter, 2005). Dwarf sagebrush species such as Lahontan sagebrush, low sagebrush, and black sagebrush (*Artemisia nova*) are preferred by mule deer for browse among the sagebrush species.

The literature is unclear as to the palatability of Wyoming big sagebrush. Generally, Wyoming big sagebrush is the least palatable of the big sagebrush taxa (Bray et al., 1991; Sheehy & Winward, 1981). However, it may receive light or moderate use depending upon the amount of understory herbaceous cover (Tweit & Houston, 1980). Personius et al. (1987) found Wyoming big sagebrush and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) to be intermediately palatable to mule deer compared to mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), the most palatable, and black sagebrush, the least palatable.

Needlegrasses, in general, are valuable forage for both livestock and wildlife. They are grazed closely when the leaves are green in early spring but are usually avoided once seed has matured (Sampson et al., 1951). Thurber's needlegrass is an important forage source for livestock and wildlife in the arid regions of the West (Ganskopp, 1988). The seeds are apparently not injurious, but grazing animals avoid them when the seeds begin to mature. Heavy grazing during the growing season has been shown to reduce the basal area of Thurber's needlegrass (Eckert & Spencer, 1987). This suggests that seasonality and utilization are important factors in management of this plant. A single defoliation, particularly during the boot stage, can reduce herbage production and root mass thus potentially lowering the competitive ability of Thurber's needlegrass (Ganskopp, 1988).

Bluebunch wheatgrass is moderately tolerant of grazing and is very sensitive to defoliation during the active growth period (Blaisdell & Pechanec, 1949; Laycock, 1967; Anderson & Scherzinger, 1975). In studies, herbage and flower stalk production were reduced with clipping at all times during the growing season; clipping was most harmful, however, during the boot stage (Blaisdell & Pechanec, 1949; Britton et al., 1990). Tiller production and growth of bluebunch wheatgrass can be greatly reduced when clipping is coupled with drought (Busso & 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.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species—saltlover (*Halogeton glomeratus*), curvseed butterwort (*Ceratocephala testiculata*), and annual mustards—to occupy interspaces. Sandberg bluegrass increases under grazing pressure (Tisdale & 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 type of grazing animal, and site conditions, either Sandberg bluegrass or cheatgrass may become the dominant understory species with inappropriate grazing management.

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Major Land Resource Area

MLRA 023X
Malheur High Plateau

Subclasses

- R023XY030NV—SOUTH SLOPE 8-12 P.Z.
- R023XY047NV—GRAVELLY CLAY 8-10 P.Z.
- R023XY063NV—SHALLOW GRANITIC HILL 10-14 P.Z.
- R023XY075NV—SHALLOW HILL 10-12 P.Z.
- R023XY076NV—LOAMY HILL 10-14 P.Z.
- R023XY077NV—SHALLOW LOAM 10-14 P.Z.
- R023XY088NV—CHALKY KNOLL

Correlated Map Unit Components

21500908, 21500909, 21501375, 21501365, 21501029, 21501214, 21500261, 21500767, 21500640, 21501211, 21500404, 21501161, 21501025, 21501008, 21500799, 21500383, 21501218, 21501188, 21501216, 21501361, 21589550, 21589559, 21590112, 21589731, 21589904, 21589548, 21590828, 21590735, 21590777, 21590360, 21590930, 21590657, 21590660, 21590898, 21590817, 21590833, 21590677, 21590812, 21604371, 21604379, 21604127, 21604129, 21604533, 21604215, 21604673, 21605136, 21604512, 21605113, 21604214, 21605108, 21604209, 21604822, 21604813, 21604806, 21604503, 21604499, 21604484, 21605015, 21604110, 21604391, 21605034, 21604216, 21605115, 21604235, 21604477, 21604487, 21604877, 21729293, 21729294

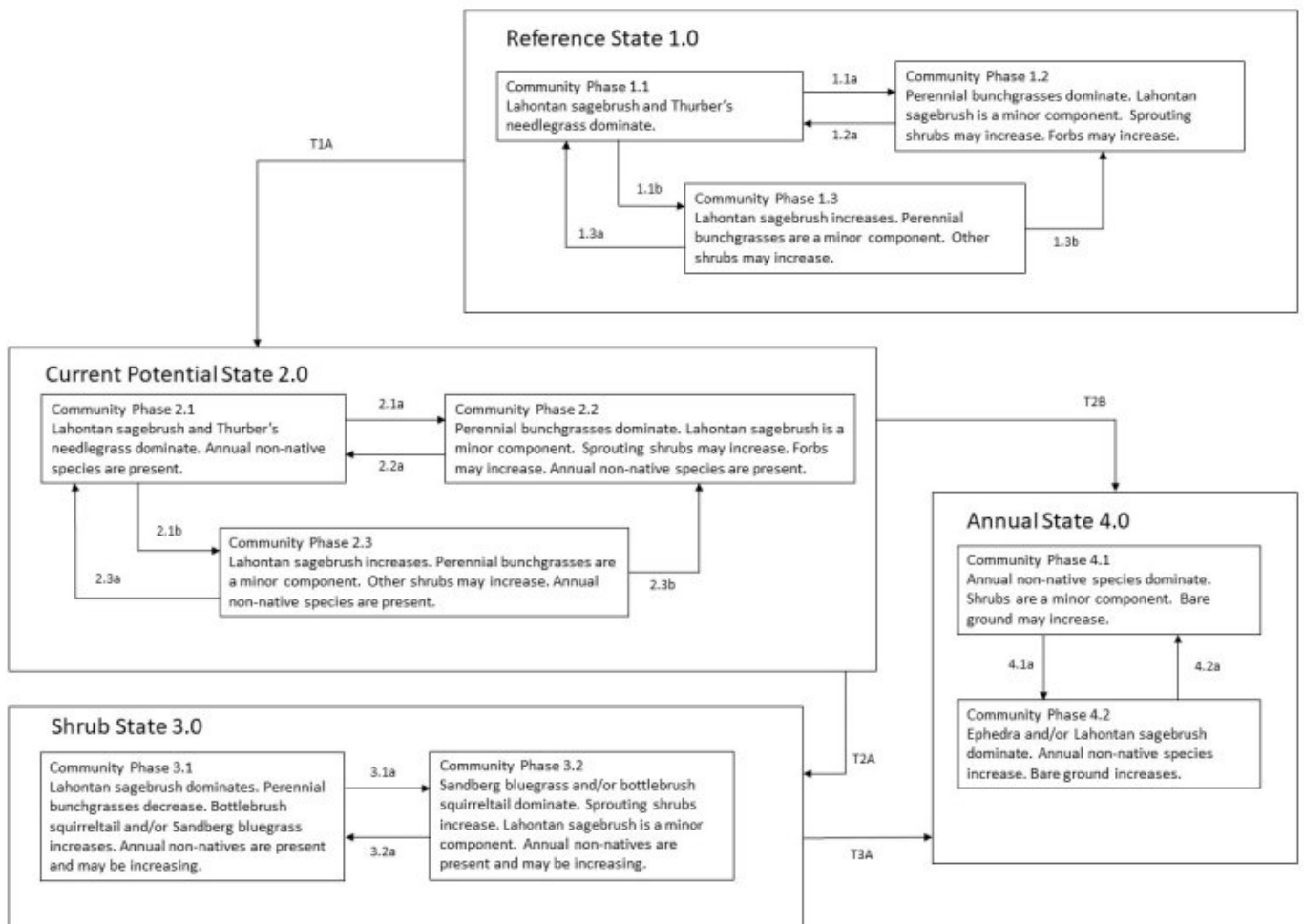
Stage

Provisional

Contributors

T Stringham (UNR under contract with BLM)
DMP

State and transition model



Reference State 1.0 Community Phase Pathways

1.1a: Low-severity fire or Aroga moth infestation creates a grass/sagebrush mosaic. High-severity fire significantly reduces sagebrush cover and leads to an early or mid-seral community dominated by grasses and forbs.

1.1b: Time and lack of disturbance, such as fire or drought, facilitate this pathway. Excessive herbivory may also facilitate this pathway by decreasing the perennial understory.

1.2a: Time and lack of disturbance allow shrubs to regenerate.

1.3a: Low-severity fire or Aroga moth infestation results in a mosaic pattern.

1.3b: High-severity fire significantly reduces sagebrush cover and leads to an early or mid-seral community.

Transition T1A: This transition occurs following the introduction of non-native species such as cheatgrass and mustards.

Current Potential State 2.0 Community Phase Pathways

2.1a: Low-severity fire or Aroga moth infestation creates a grass/sagebrush mosaic. High-severity fire significantly reduces sagebrush cover and leads to an early or mid-seral community dominated by grasses and forbs. Non-native annual species are present.

2.1b: Time and lack of disturbance, such as fire or drought, facilitate this pathway. Inappropriate grazing management may also facilitate this pathway by reducing the perennial understory.

2.2a: Time and lack of disturbance allow sagebrush to regenerate.

2.3a: Low-severity fire or Aroga moth infestation creates a sagebrush/grass mosaic. This pathway may also be facilitated by brush management that minimally disturbs the soil and late fall/winter grazing that causes mechanical damage to sagebrush.

2.3b: High-severity fire significantly reduces sagebrush cover and leads to an early or mid-seral community.

Transition T2A: A transition to Community Phase 3.1 is facilitated by time and lack of disturbance and/or inappropriate grazing management.

Transition T2B: A transition to Community Phase 4.1 is caused by high-severity fire and/or soil disturbance.

Shrub State 3.0 Community Phase Pathways

3.1a: High-severity fire causes this pathway.

3.2a: Time and lack of disturbance facilitate this pathway.

Transition T3A: Catastrophic fire, soil disturbance, and/or concentrated use (ex: livestock gathering area) triggers a transition to Community Phase 4.1. Inappropriate grazing management in the presence of non-native annual species triggers a transition to Community Phase 4.2.

Annual State 4.0 Community Phase Pathways

4.1a: Time and lack of fire facilitate this pathway. This pathway is unlikely to occur.

4.2a: Fire causes this pathway.

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