Ecological site group R023XY904NV
Cobbly Moderately Deep Clay 10-14 PZ Low or Lahontan Sagebrush and Sandberg bluegrass

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Key Characteristics

- Site does not pond or flood
- Landform other than dunes
- Soil surface is clayey
- MAP > 10"
- Soils warmer than frigid.
- Soils weekly reactive or less.

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 at elevations between 5,000 and 6,500 feet. Slopes are 0 to 15 percent.

Climate

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

The area receives between 8 and 13 inches of annual precipitation as snow in the winter and rain in spring and fall. Summers are generally dry.

The frost-free period it 80 to 90 days. The mean annual air temperature is between 45 and 50 °F.

Soil features

The soils in this group are moderately deep Vertisols with cobbly surface textures. As Vertisols, they are subject to mild to extreme swelling whcih can damage the root systems of many plants. Surface cracking of the soil is associated with the eroded state of this group.

Common soil series in this group include Tunnison and Tuledad.

Vegetation dynamics

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 (Jensen, 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock & Ehleringer, 1992).

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).

Low sagebrush is fairly drought tolerant but also tolerates periodic wetness during some portion of the growing season (Fosberg & Hironaka, 1964; Blackburn et al., 1968a, 1968b, 1969a, 1969b). It grows on soils that have a strongly structured B2t (argillic) horizon close to the soil surface (Winward, 1980; Fosberg & Hironaka, 1964; Zamora & Tueller, 1973). Low sagebrush is also susceptible to the sagebrush defoliator known as the Aroga moth (Aroga websteri). While the Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (*Artemisia tridentata*) (Furniss & Barr, 1975), research is inconclusive of the damage sustained by low sagebrush populations.

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). It typically grows near the old shorelines of Lake Lahontan from the Pleistocene Epoch. This subspecies grows on soils similar to low sagebrush with shallow depths and low water holding capabilities (Winward & McArthur, 1995).

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

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. Five possible stable states have been identified for this group.

Annual Invasive Grasses:

The species most likely to invade these sites are cheatgrass and medusahead (Taeniatherum). Both species are cool- season annual grasses that maintain an advantage over native plants in part because they are prolific seed producers, able to germinate in the autumn or spring, tolerant of grazing, and increase with frequent fire (Klemmedson & Smith, 1964; Miller et al., 1999). Medusahead and cheatgrass originated from Eurasia and both were first reported in North America in the late 1800s (Mack & Pyke, 1983; Furbush, 1953). Pellant and Hall (1994) found 3.3 million acres of public lands dominated by cheatgrass and suggested that another 76 million acres were susceptible to invasion by winter annuals including cheatgrass and medusahead. By 2003, medusahead occupied approximately 2.3 million acres in 17 western states (Rice, 2005). In the Intermountain West, the exponential increase in dominance by medusahead has largely been at the expense of cheatgrass (Harris, 1967; Hironaka, 1994). Medusahead matures two to three weeks later than cheatgrass (Harris, 1967). Recently, James et al. (2008) measured leaf biomass over the growing season and found that medusahead maintained vegetative growth later in the growing season than cheatgrass. Mangla et al. (2011) also found medusahead had a longer period of growth and more total biomass than cheatgrass and hypothesized this difference in relative growth rate may be due to the ability of medusahead to maintain water uptake as upper soils dry compared to co-occurring species, especially cheatgrass. Medusahead litter has a slow decomposition rate because of its high silica content, allowing it to accumulate over time and suppress competing vegetation (Bovey et al., 1961; Davies & Johnson, 2008). Harris (1967) reported medusahead roots have thicker cell walls compared to those of cheatgrass, allowing it to more effectively conduct water, even in very dry conditions.

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. Collectively, the body of research suggests that the invasion and dominance of medusahead onto native grasslands and cheatgrass-infested grasslands will continue to increase in severity because conditions that favor native bunchgrasses or cheatgrass over medusahead are rare (Mangla et al., 2011). Medusahead replaces native vegetation and cheatgrass directly by competition and suppression; it replaces native vegetation indirectly by increasing fire frequency.

Methods to control medusahead and 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. A study by Davies et al. (2013) found an increase in medusahead cover near roads. Cover was higher near animal trails than random transects, but the difference was less evident. This implies that vehicles and animals aid the spread of the weed; however, vehicles are the major vector of movement. Spraying with herbicide (Imazapic or Imazapic and glyphosate) and seeding with crested wheatgrass (*Agropyron cristatum*) and Sandberg bluegrass (*Poa secunda*) have been more successful at combating medusahead 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 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. 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). Mature medusahead or cheatgrass is very flammable and fire can be used to remove the thatch layer, consume standing vegetation, and even reduce seed levels. Furbush (1953) reported that timing a burn while the seeds were in the milk stage effectively reduced medusahead the following year. He further reported that adjacent unburned areas became a seed source for reinvasion the following year.

When 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. J. L. Vollmer and J. G. 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:

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). Fine fuel loads generally average 100 to 400 pounds per acre (110 to 450 kilograms per hectare) but are occasionally as high as 600 pounds per acre (680 kilogram per hectare) in low sagebrush habitat types (Bradley et al., 1992). Reestablishment occurs from off-site wind-dispersed seed (Young, 1983). 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). We were unable to find any substantial research on success of seeding low sagebrush after fire. To date, we have not been able to find specific research on the fire response of Lahontan sagebrush.

Thurber's needlegrass is very susceptible to fire-caused mortality. Burning can decrease the vegetative and reproductive vigor of Thurber's needlegrass (Uresk et al., 1976). Fire can cause high mortality, in addition to reducing 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). However, Thurber's needlegrass often survives fire and will continue growth when conditions are favorable (Koniak, 1985). Thus, the initial condition of the bunchgrasses on a site along with seasonality and intensity of the fire all factor into the individual species response.

Sandberg bluegrass, a minor component of these ecological sites, has been found to increase following fire likely due to its low stature and productivity (Daubenmire, 1975) and may slow re-establishment of more deeply rooted bunchgrasses.

Bottlebrush Squirreltail is considered fire tolerant due to its small size, coarse stems, broad leaves, and generally sparse leafy material (Wright, 1971; Britton et al., 1990). Post-fire regeneration originates from surviving root crowns and from on- and off-site seed sources. Bottlebrush squirreltail can produce large numbers of highly germinable seeds with relatively rapid germination (Young & Evans, 1977) when exposed to the correct environmental cues. Early spring growth and ability to grow at low temperatures contribute to the persistence of bottlebrush squirreltail on cheatgrass-dominated ranges (Hironaka & Tisdale, 1973).

The grasses likely to invade the sites in this group are cheatgrass and medusahead. These invasive grasses 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:

Domestic sheep and, to a much lesser degree, cattle consume low sagebrush, particularly during the spring, fall, and winter (Sheehy & Winward, 1981). Heavy dormant season grazing by sheep will reduce sagebrush cover and increase grass production (Laycock, 1967). Trampling damage, particularly from cattle or horses, in low sagebrush habitat types is greatest on areas with highly clayey soils during spring snowmelt when surface soils are saturated. On drier areas with more gravelly soils, trampling is less of a problem (Hironaka et al., 1983). Bunchgrasses, in general, best tolerate light grazing after seed formation. Britton et al. (1990) observed the effects of clipping date on basal area of five bunchgrasses in eastern Oregon and found grazing from August to October (after seed set) has the least impact. Heavy grazing during the growing season will reduce perennial bunchgrasses and increase sagebrush (Laycock, 1967). Abusive grazing by cattle or horses allows unpalatable plants like low sagebrush, rabbitbrush, and some forbs such as arrowleaf balsamroot (*Balsamorhiza sagittata*) to become dominant on the site. Sandberg bluegrass is grazing tolerant due to its short stature. Annual non-native weedy species such as cheatgrass, mustards, and medusahead may invade.

Reduced bunchgrass vigor or density provides an opportunity for Sandberg bluegrass expansion and/or cheatgrass and other invasive species to occupy interspaces. Sandberg bluegrass increases under grazing pressure (Tisdale & Hironaka, 1981). It is capable of co-existing with cheatgrass or other weedy species. 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.

Thurber's needlegrass is an important forage source for livestock and wildlife in the arid regions of the West (Ganskopp, 1988). Although the seeds are apparently not injurious, grazing animals avoid them when they begin to mature. Sheep, however, have been observed grazing the leaves closely, leaving stems untouched (Eckert & Spencer, 1987). Heavy grazing during the growing season has been shown to reduce the basal area of Thurber's needlegrass (Eckert & Spencer, 1987). This suggests that both 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 this needlegrass (Ganskopp, 1988).

Bottlebrush squirreltail generally increases in abundance when moderately grazed or protected (Hutchings & Stewart, 1953). In addition, moderate trampling by livestock in big sagebrush rangelands of central Nevada enhanced bottlebrush squirreltail seedling emergence compared to untrampled conditions. Heavy trampling, however, was found to significantly reduce germination sites (Eckert & Spencer, 1987). Bottlebrush squirreltail is more tolerant of grazing than Indian ricegrass (*Achnatherum hymenoides*) but all bunchgrasses are sensitive to over-utilization during the growing season.

Inappropriate grazing practices can be tied to the success of medusahead, but eliminating grazing will not eradicate medusahead if it is already present (Wagner et al., 2001). Sheley and Svejcar (2009) reported that even moderate defoliation of bluebunch wheatgrass resulted in increased medusahead density. They suggested that disturbances such as plant defoliation limit soil resource capture, which creates an opportunity for exploitation by medusahead. Avoidance of medusahead by grazing animals allows medusahead populations to expand. This creates seed reserves that can infest adjoining areas and cause changes to the fire regime. Medusahead replaces native vegetation and cheatgrass directly by competition and suppression; it replaces native vegetation indirectly by an increase in fire frequency.

Medusahead litter has a slow decomposition rate because of its high silica content, allowing it to accumulate over time and suppress competing vegetation (Bovey et al., 1961; Davies & Johnson, 2008).

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Major Land Resource Area

MLRA 023X
Malheur High Plateau

Subclasses

- R023XF093CA–SHALLOW CLAY 9-16"
- R023XY001NV–CHURNING CLAY
- R023XY044NV–VERY COBBLY CLAYPAN

Correlated Map Unit Components

21660636, 21659847, 21660515, 21500726, 21500930, 21500340, 21501378, 21500632, 21501370, 21500671, 21500691, 21500330, 21500684, 21500921, 21589560, 21589565, 21589436, 21604604, 21604171, 21605062, 21604465, 21604469, 21605079, 21604768, 21604770, 21605171, 21604886, 21605172

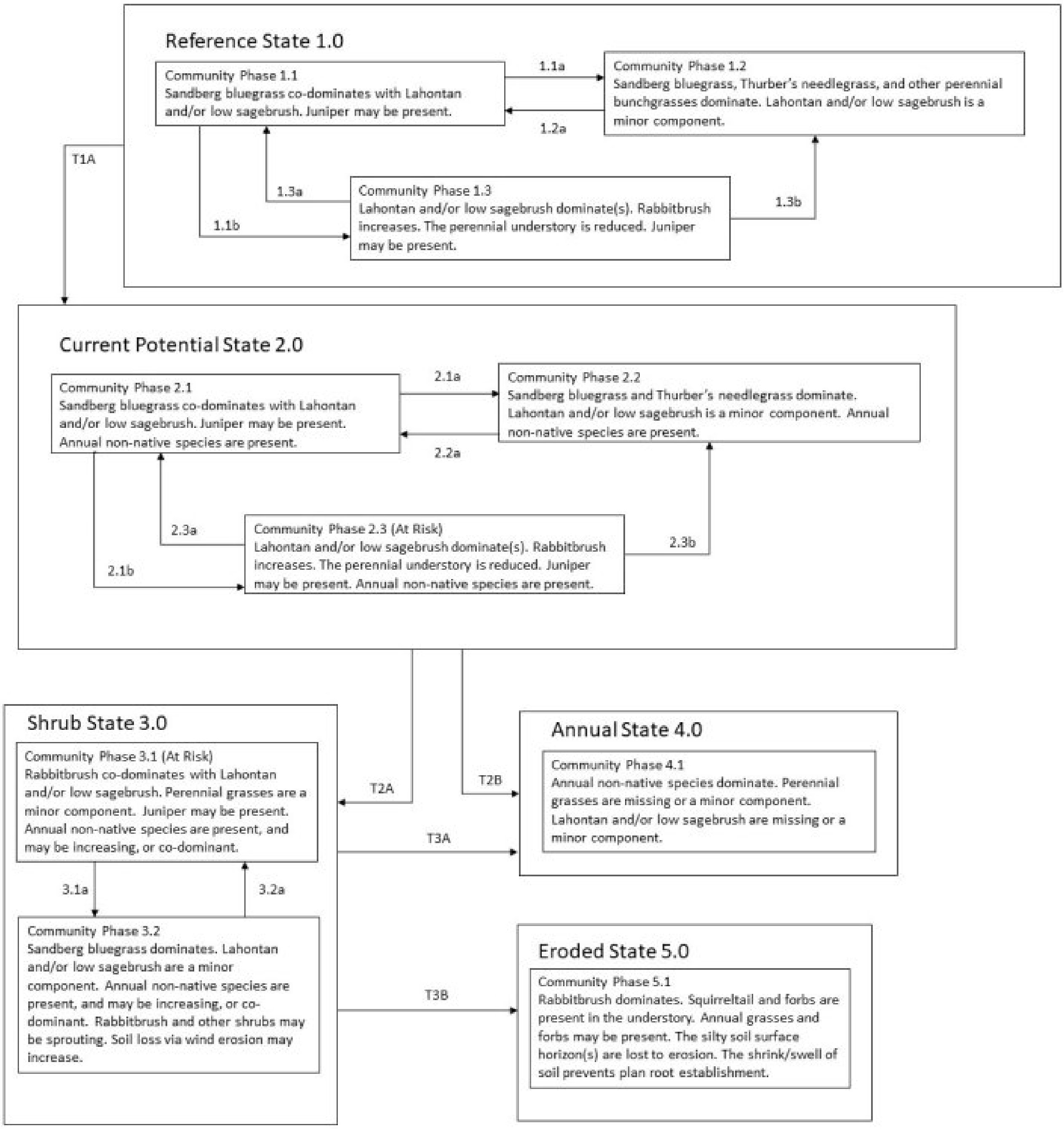
Stage

Provisional

Contributors

T Stringham (UNR under contract with BLM)
DMP

State and transition model



Reference State 1.0

Community Phase 1.1
Sandberg bluegrass co-dominates with Lahontan and/or low sagebrush. Juniper may be present.

Community Phase 1.2
Sandberg bluegrass, Thurber's needlegrass, and other perennial bunchgrasses dominate. Lahontan and/or low sagebrush is a minor component.

Community Phase 1.3
Lahontan and/or low sagebrush dominate(s). Rabbitbrush increases. The perennial understory is reduced. Juniper may be present.

Current Potential State 2.0

Community Phase 2.1
Sandberg bluegrass co-dominates with Lahontan and/or low sagebrush. Juniper may be present. Annual non-native species are present.

Community Phase 2.2
Sandberg bluegrass and Thurber's needlegrass dominate. Lahontan and/or low sagebrush is a minor component. Annual non-native species are present.

Community Phase 2.3 (At Risk)
Lahontan and/or low sagebrush dominate(s). Rabbitbrush increases. The perennial understory is reduced. Juniper may be present. Annual non-native species are present.

Shrub State 3.0

Community Phase 3.1 (At Risk)
Rabbitbrush co-dominates with Lahontan and/or low sagebrush. Perennial grasses are a minor component. Juniper may be present. Annual non-native species are present, and may be increasing, or co-dominant.

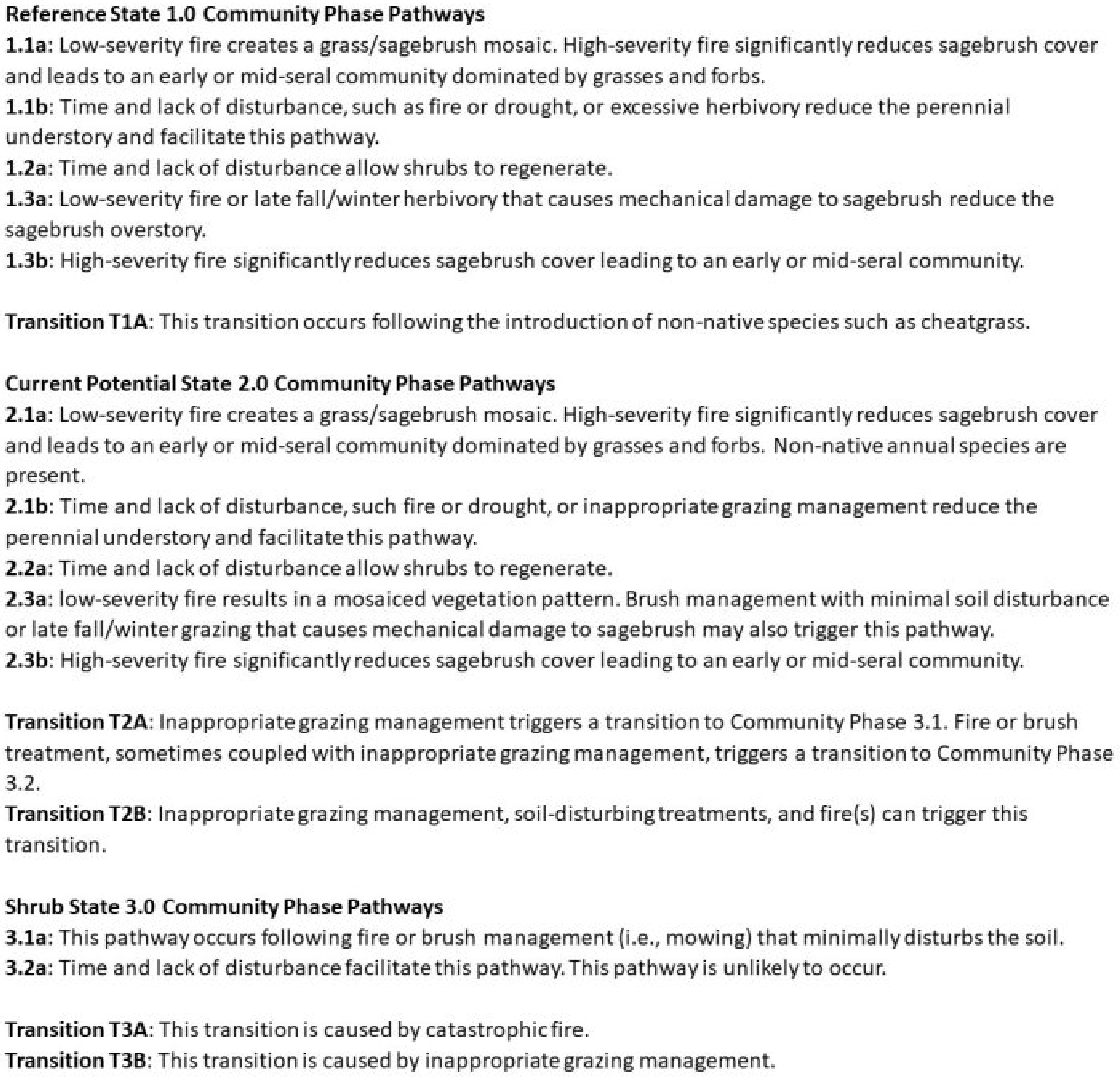
Community Phase 3.2
Sandberg bluegrass dominates. Lahontan and/or low sagebrush are a minor component. Annual non-native species are present, and may be increasing, or co-dominant. Rabbitbrush and other shrubs may be sprouting. Soil loss via wind erosion may increase.

Annual State 4.0

Community Phase 4.1
Annual non-native species dominate. Perennial grasses are missing or a minor component. Lahontan and/or low sagebrush are missing or a minor component.

Eroded State 5.0

Community Phase 5.1
Rabbitbrush dominates. Squirreltail and forbs are present in the understory. Annual grasses and forbs may be present. The silty soil surface horizon(s) are lost to erosion. The shrink/swell of soil prevents plan root establishment.



Reference State 1.0 Community Phase Pathways

1.1a: Low-severity fire 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, or excessive herbivory reduce the perennial understory and facilitate this pathway.

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

1.3a: Low-severity fire or late fall/winter herbivory that causes mechanical damage to sagebrush reduce the sagebrush overstory.

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

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

Current Potential State 2.0 Community Phase Pathways

2.1a: Low-severity fire 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 fire or drought, or inappropriate grazing management reduce the perennial understory and facilitate this pathway.

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

2.3a: low-severity fire results in a mosaiced vegetation pattern. Brush management with minimal soil disturbance or late fall/winter grazing that causes mechanical damage to sagebrush may also trigger this pathway.

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

Transition T2A: Inappropriate grazing management triggers a transition to Community Phase 3.1. Fire or brush treatment, sometimes coupled with inappropriate grazing management, triggers a transition to Community Phase 3.2.

Transition T2B: Inappropriate grazing management, soil-disturbing treatments, and fire(s) can trigger this transition.

Shrub State 3.0 Community Phase Pathways

3.1a: This pathway occurs following fire or brush management (i.e., mowing) that minimally disturbs the soil.

3.2a: Time and lack of disturbance facilitate this pathway. This pathway is unlikely to occur.

Transition T3A: This transition is caused by catastrophic fire.

Transition T3B: This transition is caused by inappropriate grazing management.

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