Ecological site group R023XY914OR
Stabilized Dunes

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Key Characteristics

- Site does not pond or flood
- Site on dune landform

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 dunes, within basins and lakebeds, at elevations between 4,500 and 5,000 feet. Slopes are 1 to 10 percent.

Climate

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

The area receives 6 to 10 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 47 °F.

Soil features

The soils in this group are very deep. They consist of fine and very fine eolian sands. These soils are very susceptible to wind erosion and may have small "blow out" areas.

The soil temperature regime is either mesic or frigid. Taxonomically, the soils are Entisols.

Common soil series in this group are Morehouse and Zorravista. Morehouse soils have volcanic ash which increases the water holding capacity of those sites.

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 associated 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). Root length of mature sagebrush plants reached a depth of 2 meters in alluvial soils in Utah (Richards & Caldwell, 1987). However, community types with low sagebrush (*Artemisia arbuscula*) as the dominant shrub were found to have soil depths, and thus available rooting depths, of 71 to 81 centimeters in a study in northeast Nevada (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 the 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 snowmelt the previous winter. 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. 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).

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 (Longland & Young, 1995).

Indian ricegrass (*Achnatherum hymenoides*) is the dominant grass on these sites. Indian ricegrass is a deep-rooted, cool-season, perennial bunchgrass that is adapted primarily to sandy soils. Grasses generally have shallower root systems than the shrubs of these sites; root densities of grasses are often as high as or higher than those of shrubs in the upper 0.5 meters but densities taper off more rapidly than shrubs. The general 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. Four possible states have been identified for this group.

Annual Invasive Grasses:

The species most likely to invade these sites are cheatgrass and medusahead (Taeniatherum). Medusahead is more common on clayey soils, so it may never become dominant on these sandy dune sites. As such, this narrative will focus on cheatgrass. 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.

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 + 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 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. 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:

In many basin big sagebrush (*Artemisia tridentata* ssp. tridentata) communities, changes in fire frequency co-occurred with fire suppression, livestock grazing, and off-highway vehicle (OHV) use. Few, if any, fire history studies have been conducted on basin big sagebrush. However, Sapsis and Kauffman (1991) suggest that fire return intervals in basin big sagebrush communities are intermediate between mountain big sagebrush (*Artemisia tridentata* ssp. vaseyana), 15 to 25 years, and Wyoming big sagebrush (*Artemisia tridentata* ssp. wyomingensis), 50 to 100 years. Fire severity in big sagebrush communities is "variable" depending on weather, fuels, and topography. However, fire in basin big sagebrush communities is typically stand-replacing (Sapsis & Kauffman, 1991). Basin big sagebrush does not sprout after fire. Because of the time needed to produce seed, it is eliminated by frequent fires (Bunting et al., 1987). Basin big sagebrush reinvades a site primarily from off-site seed or seed from plants that survive in unburned patches. Approximately 90 percent of big sagebrush seed is dispersed within 30 feet (9 meters) of the parent shrub (Goodrich et al., 1985). The maximum seed dispersal is approximately 108 feet (33 meters) from the parent shrub (Shumar & Anderson, 1986). Therefore, regeneration of basin big sagebrush after stand-replacing fires is difficult and depends upon proximity of residual mature plants and favorable moisture conditions (Johnson & Payne, 1968; Humphrey, 1984).

Spiny hopsage (Gravia spinosa) is a sprouting shrub (Daubenmire, 1970) that is fairly tolerant of fire due its dormancy during the summer months (Rickard & McShane, 1984). After fire, these sprouting shrubs can produce significant new growth if there is enough moisture available (Shaw, 1992). Other environmental conditions such as salinity and soil temperature determine the level of re-establishment that occurs. In order to germinate, seeds need moist conditions (Monsen et al., 2004). Spiny hopsage does not compete well with annual invasives (Monsen et al., 2004).

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 the 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).

Indian ricegrass is fairly fire-tolerant (Wright, 1985). This is likely due to its low culm density and below ground plant crowns. Indian ricegrass can reestablish on burned sites through 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 in a way that promotes seed production and establishment of seedlings.

Basin wildrye (*Leymus cinereus*) is relatively resistant to fire, particularly fire during the dormant season, as plants sprout from surviving root crowns and rhizomes (Zschaechner, 1985). Miller et al. (2013) reported increased total shoot and reproductive shoot densities in the first year following fire, although by year two there was little difference between burned and control treatments.

The grasses likely to invade the sites of 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 by 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:

Personius et al. (1987) found Wyoming big sagebrush and basin big sagebrush to be intermediately palatable to mule deer when compared to mountain big sagebrush (most palatable) and black sagebrush (*Artemisia nova*) (least palatable).

Spiny hopsage is palatable to livestock, especially sheep, during the spring and early summer (Phillips et al., 1996; Simmons & Rickard, 2003). However, the shrub goes to seed and loses its leaves in July and August, so its usefulness in the fall and winter is limited (Sanderson & Stutz, 1994). Two studies showed little to no utilization by sheep during the winter (Harrison & Thatcher, 1970; Green et al., 1951). Some scientists are concerned about the longevity of the species. One study showed no change in cover or density when excluded from livestock and wildlife grazing for at least 10 years (Rice & Westoby, 1978). Another study seldom observed seedling establishment (Daubenmire, 1970). With poor recruitment rates, some are concerned that repeated fires and overgrazing may eliminate local populations of spiny hopsage (Simmons & Rickard, 2003).

Indian ricegrass is a deep-rooted, cool-season, perennial bunchgrass that is adapted primarily to sandy soils. Indian ricegrass is a preferred forage species for livestock and wildlife (Booth et al., 1980; Cook, 1962). This species is often heavily utilized in winter because it cures well (Booth et al. 2006). It is also readily utilized in early spring because it is a source of green feed before most other perennial grasses have produced new growth (Quinones, 1981). Booth et al. (2006) noted that the plant does well when utilized in winter and spring. However, Cook and Child (1971) found that repeated heavy grazing reduced crown cover, which may reduce seed production, density, and basal area of these plants. Additionally, heavy early spring grazing reduces plant vigor and stand density (Stubbendieck, 1985). In eastern Idaho, productivity of Indian ricegrass was at least 10 times greater in undisturbed plots than in heavily grazed ones (Pearson, 1965). Cook and Child (1971) found significant reduction in plant cover after 7 years of rest from heavy (90 percent vegetation removal) and moderate (60 percent vegetation removal) spring use. The seed crop may be reduced where grazing is heavy (Bich et al., 1995). Tolerance to grazing increases after May, so spring deferment may be necessary for stand enhancement (Cook & Child, 1971; Pearson, 1964). However, utilization of less than 60 percent is recommended.

Basin wildrye is valuable forage for livestock (Ganskopp et al., 2007) and wildlife, but is intolerant of heavy, repeated, or spring grazing (Krall et al., 1971). Basin wildrye is used often as a winter feed for livestock and wildlife since it not only provides roughage above the snow but also cover in the early spring months (Majerus, 1992).

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

- R023XG049CA–SAND DUNES 6-9"
- R023XY011NV–DUNES 8-10 P.Z.
- R023XY610OR–PUMICE DUNES 8-10 PZ

Correlated Map Unit Components

21659129, 21659413, 21500375, 21500796, 21589585, 22176696, 22175538, 22175671, 22175970, 22175844, 22175897, 22175638, 21660382, 21660273, 22175213, 22177004, 22177511, 22177512, 22177025

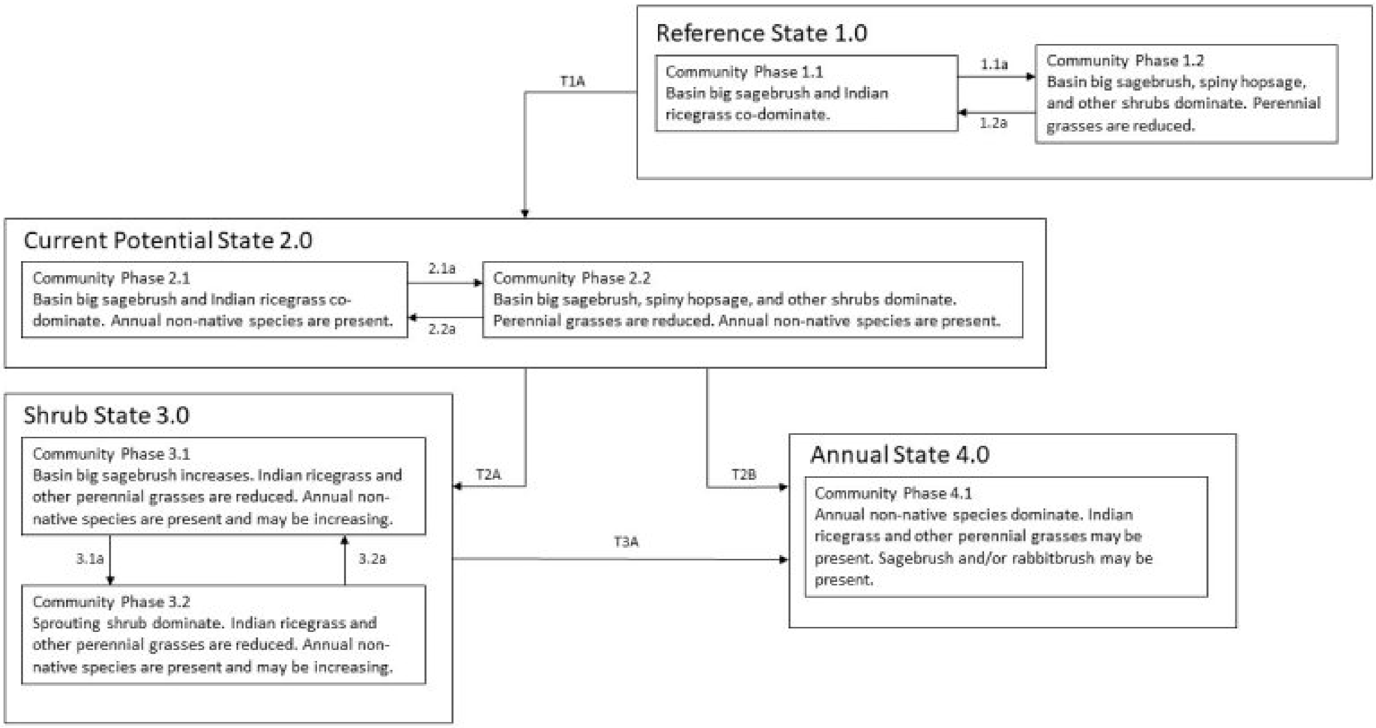
Stage

Provisional

Contributors

T Stringham (UNR under contract with BLM)
DMP

State and transition model



Reference State 1.0 Community Phase Pathways
1.1a: Time and lack of disturbance, which may be coupled with drought, facilitate this pathway.
1.2a: Low-severity fire results in a mosaic pattern. Fall/winter herbivory that causes mechanical damage to shrubs and reduces shrub density may also facilitate this pathway.

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

Current Potential State 2.0 Community Phase Pathways
2.1a: Time and lack of disturbance, which may be coupled with drought, facilitate this pathway.
2.2a: Low-severity fire results in a mosaic pattern. Fall/winter herbivory that causes mechanical damage to shrubs and reduces shrub density may also facilitate this pathway.

Transition T2A: Inappropriate grazing management causes a transition to Community Phase 3.1. Fire and/or brush treatment, which may be coupled with inappropriate grazing management, causes a transition to Community Phase 3.2.
Transition T2B: Fire in the presence of non-native annual species causes this transition.

Shrub State 3.0 Community Phase Pathways
3.1a: Fire and/or brush treatment facilitates this pathway.
3.2a: Time and lack of disturbance facilitate this pathway.

Transition T3A: Fire causes this transition.

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