USDA Natural Resources Conservation Service

Ecological site R026XY016NV
LOAMY 8-10 P.Z.

Last updated: 4/10/2024
Accessed: 04/25/2024

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): 026X–Carson Basin and Mountains

The area lies within western Nevada and eastern California, with about 69 percent being within Nevada, and 31 percent being within California. Almost all this area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north-south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys are drained by three major rivers flowing east across this MLRA. A narrow strip along the western border of the area is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault block that has been uplifted with a dominant tilt to the west. This structure leaves an impressive wall of mountains directly west of this area. This helps create a rain shadow affect to MLRA 26. Parts of this eastern face, but mostly just the foothills, mark the western boundary of this area. Elevations range from about 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

Valley areas are dominantly composed of Quaternary alluvial deposits with Quaternary playa or alluvial flat deposits often occupying the lowest valley bottoms in the internally drained valleys, and river deposited alluvium being dominant in externally drained valleys. Hills and mountains are dominantly Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks. Quaternary basalt flows are present in lesser amounts, and Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Also of limited extent are glacial till deposits along the east flank of the Sierra Nevada Mountains, the result of alpine glaciation.

The average annual precipitation in this area is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. They generally are well drained, are clayey or loamy and commonly skeletal, and are very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush occur on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, Anderson peachbrush, and several forb species also are common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier sites that have a high concentration of salts.

Some of the major wildlife species in this area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

LRU notes

The Semiarid Fans and Basins LRU includes basins, alluvial fans and adjacent hill slopes immediately east of the Sierra Nevada mountain range and are affected by its climate or have its granitic substrate. Elevations range from 1355 to 1920 meters and slopes range from 0 to 30 percent, with a median value of 6 percent. Frost free days range from 121 to 170.

Ecological site concept

The Loamy 8-10 P.Z. site is located on less than 8 percent slopes on fan remnants, alluvial fans, and lake terraces. Loamy 8-10 P.Z. is found between 4500 and 6000 feet. The soil is deep and well drained. The soil surface texture is sandy loam to gravelly sand loam. The dominant vegetation is Wyoming sagebrush (Artemisia tridentata ssp. wyomingensis) and Thurber's needlegrass (Achnatherum thurberianum).

Associated sites

R026XY010NV	**LOAMY 10-12 P.Z.**
R026XY011NV	**SOUTH SLOPE 8-12 P.Z.**
R026XY020NV	**SANDY 8-10 P.Z.**
R026XY024NV	**DROUGHTY LOAM 8-10 P.Z.**

Similar sites

R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.** ACTH7 codominant grass; PUTR2 codominant shrub
R026XY011NV	**SOUTH SLOPE 8-12 P.Z.** Occurs on steeper slopes
R026XY010NV	**LOAMY 10-12 P.Z.** ACTH7 dominant grass; more productive site
R026XY022NV	**STONY SLOPE 8-10 P.Z.** Less productive site
R026XY102NV	**GRANITIC CLAY LOAM 8-10 P.Z.** ACTH7-ACSP12 codominant; GLSPA important shrub
R026XY024NV	**DROUGHTY LOAM 8-10 P.Z.** Less productive site; ACHY-ACSP12 codominant
R026XY020NV	**SANDY 8-10 P.Z.** ACHY-HECO26 codominant
R026XY101NV	**SANDY LOAM 8-10 P.Z.** ARARL3 dominant shrub
R026XY018NV	**GRANITIC SOUTH SLOPE 10-12 P.Z.** PUTR2 codominant shrub
R026XY015NV	**SHALLOW LOAM 10-12 P.Z.** ACSP12 codominant grass
R026XY029NV	**ERODED SLOPE 10-12 P.Z.** Less productive site; steeper slopes; SADOD3 and PUTR2 important shrubs

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Artemisia tridentata ssp. wyomingensis*
Herbaceous	(1) *Achnatherum thurberianum*

Physiographic features

This site occurs on alluvial fans, fan remnants, and lake terraces. Slopes range from 0 to 8 percent. Elevations are 4500 to 6000 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Fan remnant (3) Lake terrace
Runoff class	Very low to very high
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Elevation	4,500–6,000 ft
Slope	0–8%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters, and hot, dry summers. Mean annual precipitation is 8 to 10 inches. Mean annual air temperature is 48 to 50 degrees F. The average growing season is about 90 to 120 days.

Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.

Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	8-10 in

Frost-free period (average)	105 days
Freeze-free period (average)	
Precipitation total (average)	9 in

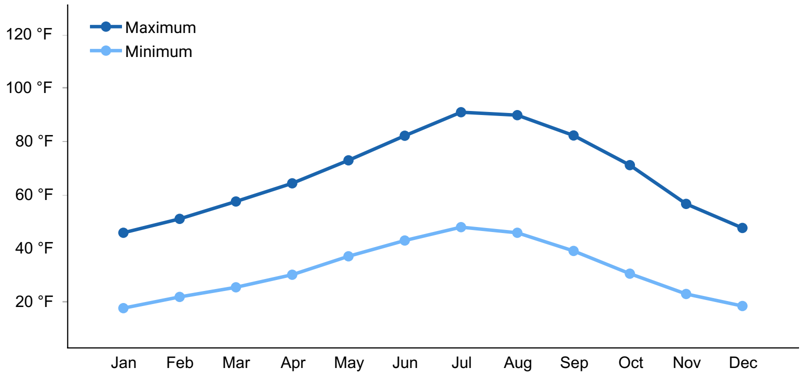


Figure 1. Monthly average minimum and maximum temperature

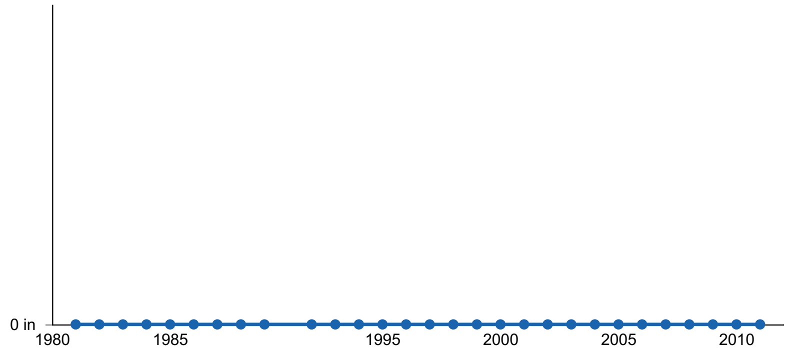


Figure 2. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils associated with this site are formed in mixed alluvium, typically from granitic rocks. They are typically moderately deep to very deep and well drained. These soils often have a sub-surface layer that is restrictive to root development within 20 inches of the soil surface. Surface soils are moderately-coarse to medium textured. Subsoils are medium to fine textured and the soil profile may be modified with 35 to over 50 percent rock fragments, by volume. Soils are usually moist in the winter and spring and dry in the summer and fall. The soil moisture regime is aridic bordering on xeric and the soil temperature regime is mesic. Infiltration is moderate to rapid and permeability is very slow to moderately rapid. The available water capacity is very low to high. Runoff is negligible to high and the potential for sheet and rill erosion is slight to moderate depending on slope gradient. Soil series associated with this site include: Ackley, Aquinas, Charlebois, Doten, Eastval, Greenbrae, Haybourne, Holbrook, Hotsprings, Hunewill, Nevador, Rebel, Reno, Saralegui, Spasprey, Surprise, Turria, Veta, Washoe, Wedertz, and Wellington.

A representative soil series is Eastval, a fine-loamy, mixed, mesic Haploxeralfic Argidurids. An ochric epipedon occurs from the soil surface to 8 cm and an argillic horizon occurs from 8 to 56 cm.

Table 4. Representative soil features

Parent material	(1) Alluvium–granite
Surface texture	(1) Sandy loam (2) Gravelly sandy loam

Family particle size	(1) Fine (2) Coarse-loamy
Drainage class	Well drained
Permeability class	Very slow to moderately rapid
Soil depth	40–84 in
Surface fragment cover <=3"	5–40%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	1.6–6.6 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–41%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasives. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al. 2013). Biotic factors that that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al 2013).

The ecological sites in this DRG are dominated by deep-rooted cool season perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 to over 3.0 m. (Comstock and Ehleringer 1992). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

In the Great Basin, the majority of 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 and 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 has 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).

Variability in plant community composition and production depends on soil surface texture and depth. Needle and thread grass is adapted to coarser textured soils whereas Indian ricegrass will increase with sandy soil surfaces, and bottlebrush squirreltail will increase with silty soil surfaces. Production generally increases with soil depth. The calcium carbonate content often found in the rooting zone of the grass species is thought to be the primary reason for the lack of Thurber's needlegrass in this Loamy 8-10 as compared to the similar sites in MLRA 24 and 25. The amount of sagebrush in the plant community is dependent upon disturbances like fire, Aroga moth infestations, and grazing.

Wyoming big sagebrush, the most drought tolerant of the big sagebrushes, 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 is the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is depended on adequate moisture conditions. The root system is deep and well-developed with many laterals and one or more taproots. The majority of the roots are in the upper foot of soil with tap roots extending up to 6 feet in depth. The roots are infected with the vesicular-arbuscular mycorrhizae (VAM) Glomus microcarpus and Gigaspora spp. Wyoming big sagebrush is a long-lived species with maximum ages to 150 years old (Howard 1999).
Mycorrhizas ('fungus-roots') are the result of a symbiotic relationship between specialized soil organisms and plants roots. Wyoming big sagebrush seedlings exhibit greater drought resistance when inoculated with VAM. Average soil water potential resulting in death of Wyoming big sagebrush seedlings infected with VAM was 0.45 MPa lower than seedlings that were not infected with VAM (Stahl et al. 1998). A number of beneficial changes in the water relations of arbuscular mycorrhizal plants including altered rates of water uptake, hydraulic conductivity, leaf and stem water potentials, stomatal resistance and transpiration rates have been observed by researchers. Stahl et al. (1998) found VAM to be vitally important during the early stages of seedling establishment. Improved ability to extract soil nutrients and improve drought tolerance in Wyoming big sagebrush seedlings may have important consequences for restoration of degraded sagebrush habitat.
Sagebrush species set seed in the late summer and fall. Seeds ripen from September through October and fall from the plant. Cold, moist conditions and exposure to light increase germination in the spring (Johnson 2000). Seeds of sagebrush species are best adapted to germinate in habitats with conditions similar to that of the collection site. Survival of sagebrush seedlings is dependent on adequate moisture conditions. Young plants are susceptible to less than desirable condition for several years following germination.
Sagebrush species are 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 is the foundation of population maintenance (Noy-Meir 1973). Mature properly functioning sagebrush communities have higher infiltration rates and lower sediment production, than degraded systems. Reoccurring disturbances, natural or anthropogenic, will result in decreased sagebrush cover and increased cover of disturbance tolerant shrubs and non-natives. Loss of structural and functional groups affects ecosystem functioning and can result in soil loss.

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 a sagebrush defoliator, Aroga moth (Aroga websteri). Aroga moth infestations have occurred in the Great Basin in the 1960s, early 1970s, and is ongoing in Nevada since 2004 (Bentz, et al 2008). Thousands of acres of big sagebrush 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 and Barr 1975).
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 m but taper off more rapidly than shrubs. General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.
The accumulation and decomposition of litter increase nutrient concentrations under sagebrush shrub canopies. The breakdown of aging roots also contributes to organic matter and nutrient cycling in the sagebrush system. Carbon and nitrogen concentration are higher under sagebrush canopies when compared to interspaces (Chen and Stark 2000). The root systems of sagebrush maximizes water uptake with a deep taproot and shallow branching roots. The combination of deep and shallow roots also provides excellent soil stabilization.

The Great Basin sagebrush 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 or can increase resource pools by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al 2007).

The introduction of annual weedy species, like cheatgrass, may cause an increase in fire frequency and eventually lead to an annual state. Conversely, as fire frequency decreases, sagebrush will increase and with inappropriate grazing management the perennial bunchgrasses and forbs may be reduced.

Infilling by singleleaf pinyon and Utah juniper may also occur with an extended fire return interval. Eventually, singleleaf pinyon and Utah juniper will dominate the site and out-compete sagebrush for water and sunlight severely reducing both the shrub and herbaceous understory (Lett and Knapp 2005, Miller et al. 2000). Bluegrasses may remain underneath trees on north-facing slopes. The potential for soil erosion increases as woodland matures and the understory plant community cover declines (Pierson et al. 2010).

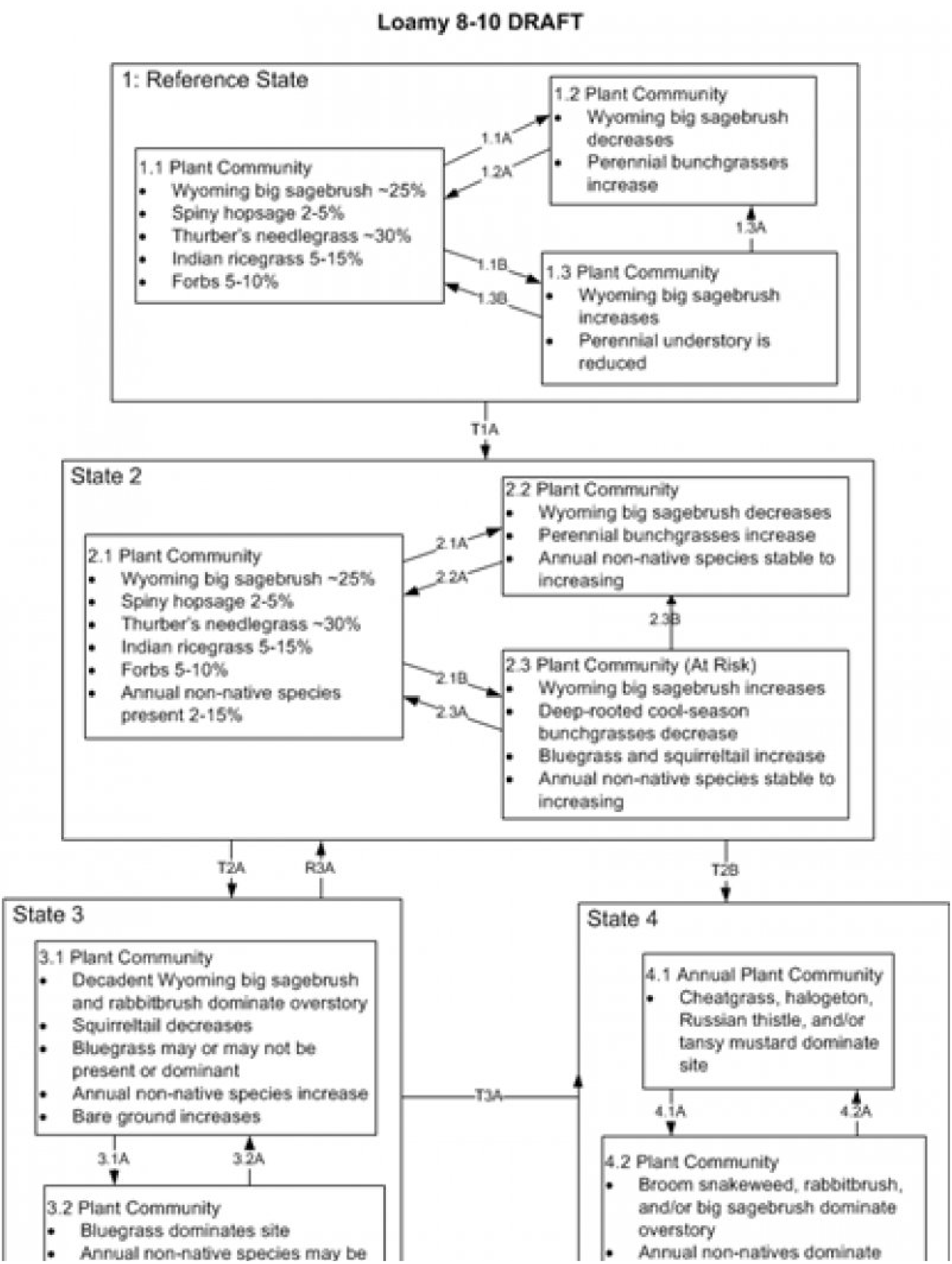
Variability in plant community composition and production depends on soil surface texture and depth. Thurber's needlegrass will increase on gravelly surfaces, whereas Indian ricegrass will increase with sandy soil surfaces. An argillic horizon will promote production of bluebunch wheatgrass. Production increases with soil depth. The amount of sagebrush in the plant community is dependent upon fire frequency, which would be highly infrequent. Inappropriate grazing can lead to an increase in sagebrush and a decline in understory plants like Thurber's needlegrass and Indian ricegrass. Squirreltail (*Elymus elymoides*) will increase temporarily with further degradation. Invasion of annual non-native invasive forbs and cheatgrass could occur with further grazing degradation, leading to a decline in squirreltail and an increase in bare ground. Wetter sites are more resistant to degradation and may result in sagebrush and Sandberg's bluegrass dominating the site. A combination of overgrazing and prolonged drought leads to soil erosion, increased bare ground and a loss in plant production.

Where site degradation has been fire-induced, broom snakeweed (*Gutierrezia sarothrae*) and rabbitbrush (*Chrysothamnus viscidiflorus*) often dominate the site. Repeated burning of the plant community at intervals less than 10 to 15 years results in complete site dominance by non-native annuals (primarily cheatgrass, halogeton (*Halogeton glomeratus*), Russian thistle (*Salsola tragus*), fiddleneck (Amsinkia spp.), and tansy mustard (Descurainia spp.)and the near total absence of woody plants, including sagebrush. This ecological site has low resilience to disturbance and low resistance to invasion. Resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Six possible alternative stable states have been identified for this site.

Fire Ecology:
Prior to Euro-American settlement, Wyoming big sagebrush communities historically had low fuel loads, and patchy fires that burned in a mosaic pattern were common at 10 to 70 year return intervals (Young et al. 1979, West and Hassan 1985, Bunting et al. 1987). Davies et al. (2007) suggest pre Euro-American settlement fire return intervals in Wyoming big sagebrush communities were around 50 to 100 years. The introduction and expansion of cheatgrass has dramatically altered the fire return intervals and restoration potential of Wyoming big sagebrush communities.

Fire is the principal means of renewal for decadent stands of Wyoming big sagebrush. Wyoming big sagebrush plants of all ages are killed by fire. Depending on site conditions prior to wildfire, perennial grasses and forbs will dominate initially after wildfire. Wyoming big sagebrush establishes afterwards from soil stored seed and from seed produced by remnant plants that escaped fire. Prolific seed production from nearby unburned plants coupled with high germination and survival rates is required to ensure establishment following fire. The VAM upon which Wyoming big sagebrush depends on for healthy growth are usually harmed by fire and may take several years to recover. Typically, fewer VAM are killed by low-intensity wildfire than by more severe fire intensities (Howard 1999). Spiny hopsage (*Grayia spinosa*) is considered to be somewhat fire tolerant and often survives fires that kill sagebrush. Mature spiny hopsage generally resprout after fire. Spiny hopsage is reported to be less susceptible to fire during summer dormancy. Thurber's needlegrass is classified as moderately resistant, but depending on season of burn, phenology, and fire severity, it is moderately to severely damaged by fire. Burning has been found to decrease the vegetation and reproductive vigor. Early season burning is more damaging to this needlegrass than late season burning. Indian ricegrass can be killed by fire, depending on severity and season of burn. Indian ricegrass reestablishes on burned sites through seed dispersed from adjacent unburned areas. There is some speculation that Indian ricegrass may sprout from tillers after fire, especially if plant mortality was incomplete. Due to low culm density and below ground plant crowns, this is a fairly fire tolerant species Webber's needlegrass is damaged by burning due to dense plant material that can burn slowly and long, charring to the growing points. Late summer and early fall fires are the least harmful. Sandberg bluegrass is generally unharmed by fire. It produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur.

State and transition model



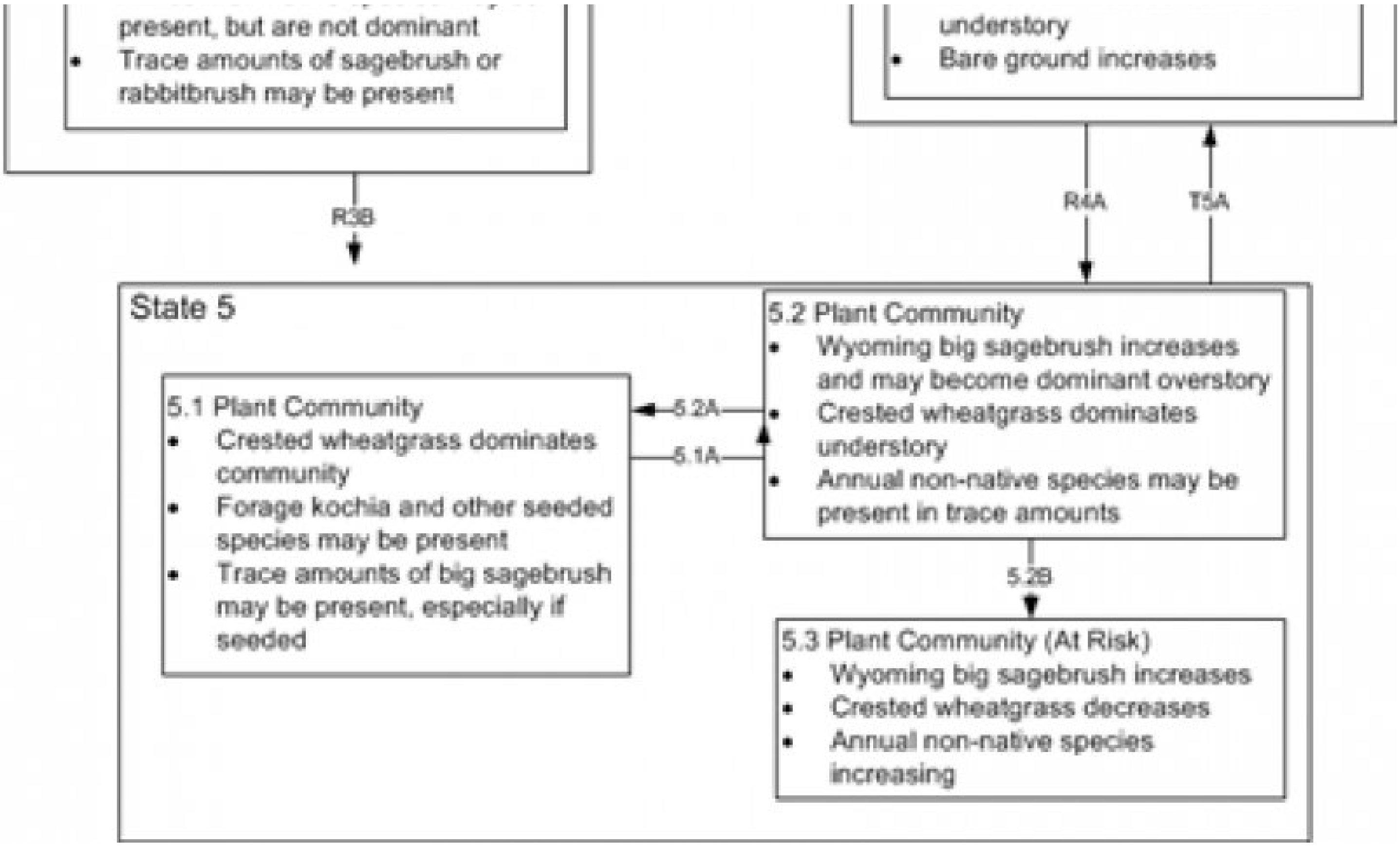


Figure 4. Loamy 8-10

State 1
Reference State

The Reference State is a representative of the natural range of variability under pristine conditions. The reference state has three general community phases: a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant 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 drought and/or insect or disease attack.

Community 1.1
Reference Plant Community

The reference plant community is dominated by Thurber's needlegrass and Wyoming big sagebrush. Potential vegetative composition is about 55% grasses, 5% forbs, and 40% shrubs and sparse trees. Approximate ground cover (basal and crown) is 25 to 35 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	220	330	440
Shrub/Vine	152	228	304
Forb	20	30	40
Tree	8	12	16
Total	**400**	**600**	**800**

Community 1.2
Community Phase 1.2

This community phase is characteristic of a post-disturbance, early to mid-seral community phase. Thurber’s needlegrass can experience high mortality from fire and may be reduced in the community for several years. With low fire severity, Thurber’s needlegrass may dominate the site post-fire. Ephedra, desert peach, spiny hopsage, Indian ricegrass and other perennial grasses are common. Wyoming big sagebrush is killed by fire, therefore decreasing within the burned community. Sagebrush could still be present in unburned patches.

Community 1.3
Community Phase 1.3

Wyoming big sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs or from herbivory. Bottlebrush squirreltail will likely increase in the understory and may be the dominant grass on the site.

Pathway 1.1a
Community 1.1 to 1.2

Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Pathway 1.1b
Community 1.1 to 1.3

Long-term drought, time and/or herbivory favor an increase in Wyoming big sagebrush over deep-rooted perennial bunchgrasses. Combinations of these would allow the sagebrush overstory to increase and dominate the site, causing a reduction in the perennial bunchgrasses. Bottlebrush squirreltail may increase in density depending on the grazing management.

Pathway 1.2a
Community 1.2 to 1.1

Time and lack of disturbance allows for sagebrush to reestablish.

Pathway 1.3b
Community 1.3 to 1.1

Aroga moth infestation and/or release from growing season herbivory may reduce sagebrush dominance and allow recovery of the perennial bunchgrass understory.

Pathway 1.3a
Community 1.3 to 1.2

Fire would decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires would typically be small and patchy due to low fuel loads. A fire following an unusually wet spring or a change in management may be more severe and reduce sagebrush cover to trace amounts. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

State 2
Current Potential State

State 2 This state is similar to the Reference State (1) and the same three community phases occur. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of non-native invasive species (5-15% by weight). Low frequency and low intensity disturbances favor the grass-dominant and grass-shrub mixture phases but the presence of non-natives is favored if frequency and severity of disturbances change from historic conditions. Prescribed grazing and infrequent fire (50-100 year return interval) maintain state dynamics. Prescribed grazing and/or release from drought may reverse declines in Thurber's needlegrass and Indian ricegrass production.

Community 2.1
Community phase 2.1

Figure 6. Loamy 8-10

This community phase is compositionally similar to the 1.1 Reference plant community with a component of annual non-native species, primarily cheatgrass, halogeton, and annual mustards. A biotic threshold has been crossed with the introduction of non-native species. Ecological processes (soil hydrology, nutrient cycling, energy capture) are still functional. Resiliency of this community phase has been reduced by the presence of non-native invasive species. This community phase responds differently following disturbance when compared to non-invaded plant communities.

State 3
Shrub State

State 3 has two community phases. One phase is a dense overstory of decadent Wyoming big sagebrush and an understory of Sandberg's bluegrass, a shallow-rooted cool season perennial bunchgrass. The second community phase is dominated by Sandberg's bluegrass with non-native annuals in the plant community. A trace of deep-rooted perennial bunchgrasses remains in the plant community. Non-native annual grasses and forbs are abundant in the understory. A biotic threshold has been crossed and site resiliency has been reduced with the loss of the deep rooted perennial bunchgrasses. Feedbacks contributing to the stability of this state include the loss of structural and functional groups (deep-rooted perennial bunchgrasses and shrub seedlings), resulting in decreased herbaceous production and reduced organic matter inputs. Changes in infiltration and runoff rates contribute to reduced soil moisture availability thereby reducing reproductive potential of native species.

State 4
Annual State

State 4 has two community phases. One phase is dominated by non-native annual species, primarily cheatgrass, halogeton, Russian thistle, fiddleneck, and annual mustards. Sandberg's bluegrass and squirreltail may also occur. The second community phase is dominated by fire tolerant shrubs and non-native annuals. An abiotic threshold has been crossed and state dynamics are now driven by fire and time. The length of time between fires creates two potential community phases with broom snakeweed and rabbitbrush increasing with fire return intervals >10 years. This alternative stable state is persistent due to strong feedbacks, including presence of non-natives; competition from non-native species for soil moisture and nutrients prevent germination and establishment of native species. Fine-fuel loading supports a modified fire regime too narrow for the successful establishment of Wyoming big sagebrush and favors an increase of non-native invasive annuals. Biogeochemical cycling is altered by dominance of cheatgrass modifying the soil environment. Cheatgrass monocultures have low VAM fungal populations, increasing the difficulty of reestablishing sagebrush and native bunchgrasses that require these mycorrhizae.

State 5
Seeded State

The seeded state that has three community phases; a grass dominated phase, a shrub-grass co-dominated phase and a shrub phase. The seeded species may be native or non-native. Annual non-native species may also be present. Following wildfire, range plantings help to stabilize the soil surface, reduce erosion and provide competition for non-native annuals. Seeded species may include native and non-native species. Annual non-natives may be present. Typically there is an overall lack of native perennial forbs. However, some seeded forbs, like western yarrow (*Achillea millefolium*), may do quite well. Feedbacks contributing to the stability of this state include competitive ability and vigor of seed species. Seeded perennial grasses reduce the availability of critical resources to non-native annuals, reducing fire frequency.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual weeds; such as cheatgrass, Russian thistle (Salsola iberica), medusahead, or stork's bill (Erodium spp.) dominate the understory. Slow variables: Over time the annual non-native plants will increase within the community decreasing organic matter inputs from deep-rooted perennial bunchgrasses resulting in reductions in soil water availability for perennial bunchgrasses. 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 T2A
State 2 to 3

Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during growing season would favor shrubs and initiate transition to Community Phase 3.1. Fire would cause a transition to Community Phase 3.2. Slow variables: Long term decrease in deep-rooted perennial grass density resulting in a decrease in organic matter inputs and subsequent soil water decline. Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and redistribution, and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger: Fire or a failed range seeding leads to plant community phase 4.1. Inappropriate grazing management that favors shrubs in the presence of non-native annual species leads to community phase 4.2. Slow variables: Increased production and cover of non-native annual species. Threshold: Cheatgrass or other non-native annuals dominate understory.

Restoration pathway R3A
State 3 to 2

Shrub removal.

Transition T3A
State 3 to 4

Trigger: Fire or inappropriate grazing management can eliminate the bottlebrush squirreltail understory and transition to community phase 4.1 or 4.2. Slow variable: Increased seed production and cover of annual non-native species. Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact the nutrient cycling and distribution.

Transition T3B
State 3 to 5

Shrub removal and seeding.

Transition T4A
State 4 to 5

Annual species control and seeding of perennial species.

Transition T5A
State 5 to 4

Failed seeding, allowing non-native annual species to dominate.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			162–330	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	120–240	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	30–60	–
	needle and thread	HECO26	*Hesperostipa comata*	12–30	–
2	**Secondary Perennial Grasses**			30–90	
	desert needlegrass	ACSP12	*Achnatherum speciosum*	3–18	–
	squirreltail	ELEL5	*Elymus elymoides*	3–18	–
	basin wildrye	LECI4	*Leymus cinereus*	3–18	–
	Sandberg bluegrass	POSE	*Poa secunda*	3–18	–
Forb					
3	**Perennial**			12–48	
Shrub/Vine					
4	**Primary Shrubs**			144–270	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	120–180	–
	spiny hopsage	GRSP	*Grayia spinosa*	0–30	–
	desert peach	PRAN2	*Prunus andersonii*	12–30	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	6–15	–
	mormon tea	EPVI	*Ephedra viridis*	6–15	–
5	**Secondary Shrubs**			10–50	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	3–18	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	3–18	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	3–18	–
	littleleaf horsebrush	TEGL	*Tetradymia glabrata*	3–18	–
Tree					
6	**Evergreen**			2–10	
	Utah juniper	JUOS	*Juniperus osteosperma*	2–10	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Maintaining resilience of this community by encouraging perennial grass and forb production should be a goal of any grazing strategy. Grazing management considerations include timing, intensity and duration of grazing.
Thurber's needlegrass begins growth early in the year and remains green throughout a relatively long growing season. This pattern of development enables animals to use needlegrass when many other grasses are unavailable. Cattle prefer needlegrass in early spring before fruits have developed as it becomes less palatable when mature. Needlegrasses are grazed in the fall only if the fruits are softened by rain. Indian ricegrass is highly palatable to all classes of livestock in both green and cured condition. It supplies a source of green feed before most other native grasses have produced much new growth. Needleandthread provides highly palatable forage, especially in the spring before fruits have developed. Needlegrasses are grazed in the fall only if the fruits are softened by rain. Livestock browse Wyoming big sagebrush, but may use it only lightly when palatable herbaceous species are available. Green ephedra is heavily browsed by livestock on winter range but only moderately or lightly browsed during other seasons. Nevada ephedra is important winter range browse for domestic cattle, sheep and goats. Heavy grazing by livestock decreased the per/acre stem count of desert peach. Spiny hopsage provides a palatable and nutritious food source for livestock, particularly during late winter through spring. Domestic sheep browse the succulent new growth of spiny hopsage in late winter and early spring.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
This site provide valuable habitat for wildlife. Large and small mammals and songbirds comprise the majority of the resident population. This site, if associated with meadows, streams, springs or seeps may provide temporary habitat for sage-grouse, deer, and coyotes. Wyoming big sagebrush is preferred browse for wild ungulates, and Wyoming big sagebrush communities are important winter ranges for big game. Pronghorn usually browse Wyoming big sagebrush heavily. Wyoming big sagebrush communities are critical habitat for the birds. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Open Wyoming sagebrush communities are preferred nesting habitat. 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. Leks are often located on low sagebrush sites, grassy openings, dry meadows, ridgetops, and disturbed sites. Sage-grouse prefer mountain big sagebrush and Wyoming big sagebrush communities to basin big sagebrush communities. Green ephedra is an important browse species for big game animals. Green ephedra is heavily used by wildlife on winter ranges. Mule deer, bighorn sheep, and pronghorn browse Nevada ephedra, especially in spring and late summer when new growth is available. Use of desert peach by mule deer varies largely by location; as low as 1-5% of diet on some sites and up to 57% on other sites. However, Mule deer were said to "avidly" consume new desert peach growth in the early spring and frequent desert peach habitat. Numerous small mammals gather and consume desert peach fruits and seeds and/or browse desert peach stems. Great Basin pocket mice, deer mice, and Panamint kangaroo rats removed desert peach fruits and seeds primarily from the ground. Black-tailed jackrabbits seasonally utilize desert peach as forage. Spiny hopsage provides a palatable and nutritious food source for big game animals. Spiny hopsage is used as forage to at least some extent by domestic goats, deer, pronghorn, and rabbits. Indian ricegrass is eaten by pronghorn in "moderate" amounts whenever available. In Nevada it is consumed by desert bighorns. A number of heteromyid rodents inhabiting desert rangelands show preference for seed of Indian ricegrass. Indian ricegrass is an important component of jackrabbit diets in spring and summer. In Nevada, Indian ricegrass may even dominate jackrabbit diets during the spring through early summer months. Indian ricegrass seed provides food for many species of birds. Doves, for example, eat large amounts of shattered Indian ricegrass seed lying on the ground. Needleandthread is moderately important spring forage for mule deer, but use declines considerably as more preferred forages become available.

Hydrological functions

Rills and water flow patterns are none to rare, but a few can be expected on steeper slopes in areas subject to summer convection storms or rapid spring snowmelt. Pedestals are none to rare with occurrence typically limited to areas within water flow patterns. Frost heaving of shallow rooted plants should not be considered a normal condition. Gullies are none. Fine litter (foliage from grasses and annual & perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurber needlegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site. Coarse textured surface soils allow medium to rapid infiltration.

Recreational uses

Anderson peachbrush and annual and perennial forbs bloom profusely on this site during spring and provide rewarding opportunities for photographers and nature study. The site offers some potential for upland game and pronghorn hunting.

Other products

Native Americans made tea from big sagebrush leaves. They used the tea as a tonic, an antiseptic, for treating colds, diarrhea, and sore eyes and as a rinse to ward off ticks. Big sagebrush seeds were eaten raw or made into meal. Native Americans used Nevada ephedra as a tea to treat stomach and kidney ailments. Native Americans near desert peach habitats utilized fruits, leaves, and twigs. The Paiute of the Great Basin boiled twigs and leaves into a tea to treat colds and rheumatism. The Lake Mono Paiute along with the Cahuilla gathered desert peach fruits. Desert peaches could be boiled, sweetened with sugar and preserved as jelly. Some Native American peoples traditionally ground parched seeds of spiny hopsage to make pinole flour. Indian ricegrass was traditionally eaten by some Native Americans. The Paiutes used seed as a reserve food source.

Other information

Wyoming big sagebrush is used for stabilizing slopes and gullies and for restoring degraded wildlife habitat, rangelands, mine spoils and other disturbed sites. It is particularly recommended on dry upland sites where other shrubs are difficult to establish. Green ephedra is listed as a successful shrub for restoring western rangeland communities and can be used to rehabilitate disturbed lands. It also has value for reducing soil erosion on both clay and sandy soils. Green ephedra establishes readily through direct seeding, transplants, and stem cuttings. Nevada ephedra is useful for erosion control, and seedlings have been successfully planted onto reclaimed strip mines, with survival ranging from 12 to 94%. Atrazine may be effective in controlling Nevada ephedra, though some plants can survive through crown sprouting. Irrigation may increase control by atrazine. Desert peach is effective in revegetation or rehabilitation projects on disturbed sites within its range due to high survival rates of transplanted seedlings. Spiny hopsage has moderate potential for erosion control and low to high potential for long-term revegetation projects. It can improve forage, control wind erosion, and increase soil stability on gentle to moderate slopes. Spiny hopsage is suitable for highway plantings on dry sites in Nevada. Needleandthread grass is useful for stabilizing eroded or degraded sites.

Inventory data references

NASIS data from soil survey areas CA614, CA686, CA729, NV625, NV628, NV629, NV771, NV772, NV773, NV774, and NV799.

Type locality

Location 1: Douglas County, NV	
Township/Range/Section	T12N R20E S16
General legal description	Lower piedmont slopes, west side of Pine Nut Range, Douglas County, Nevada. This site is also found in Carson City, Douglas, Lyon, Mineral, Storey and Washoe counties, Nevada.

References

Stringham, T.K., D. Snyder, P. Novak-Echenique, K. O'Neill, A. Lyons, and M. Johns. 2021. Great Basin Ecological Site Development Project: State-and-Transition Models for Major Land Resource Area 26, Nevada and Portions of California..

Other references

Fire Effect Information System (Online; http://www.fs.fed.us/database/feis/plants/).

USDA-NRCS Plants Database (Online; http://plants.usda.gov/).

Contributors

DK/FR/GKB

Approval

Kendra Moseley, 4/10/2024

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)	GK Brackley/P.Novak-Echenique
Contact for lead author	State Rangeland Management Specialist
Date	06/01/2007
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few can be expected on steeper slopes after summer convection storms or rapid snowmelt. They are typically short (<1m) and narrow. They will begin to heal during the next growing season.

2. **Presence of water flow patterns:** Water flow patterns are none to rare but can be expected in areas subjected to summer convection storms or rapid snowmelt. Flow patterns are short (<2 m), meandering and not connected.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare with occurrence typically limitec to areas within water flow patterns. Frost heaving of shallow rooted plants should not be considered as a normal condition.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 40-50% depending on amount of surface rock fragments.

5. **Number of gullies and erosion associated with gullies:** None

6. **Extent of wind scoured, blowouts and/or depositional areas:** Very minor evidence of active wind-generated soil movement. Wind scouring would occur after a severe wildfire.

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution by wind and water. Fine litter (foliage from grasses and annual & perennial forbs) is expected to move the distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically fine to very fine granular or weak platy. Soil surface colors are grayish browns and the soils are typified by an ochric epipedon. Organic carbon of the surface 2 to 3 inches is typically 1 to 1.5 percent dropping off quickly below.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurber needlegrass, Indian ricegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site. Coarse textured surface soils allow medium to rapid infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Platy or massive sub-surface structure or subsoil argillic or calcic horizons are not to be interpreted as compacted layers.

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: Reference State: Deep-rooted, cool season, perennial bunchgrasses >> Wyoming big sagebrush (By above ground production)

    Sub-dominant: Associated shrubs > shallow-rooted, cool season, perennial bunchgrasses > deep-rooted, cool season, perennial forbs > fibrous, shallow-rooted, cool season, annual and perennial forbs. (By above ground production)

    Other: Evergreen trees, succulents, microbiotic crusts

    Additional: With an extended fire return interval, the shrub and tree component will increase and the herbaceous understory will decrease in cover and species diversity.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common. Standing dead shrub canopy material may be as much as 25% of total woody canopy. Some of the mature bunchgrasses (<20%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (25-35%) and depth (± ¼ in.)

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (thru June) ± 600 lbs/ac; Spring moisture significantly affects total production. Favorable years ± 800 lbs/ac; unfavorable years ± 400 lbs/ac.

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:** Potential invaders include cheatgrass, halogeton, Russian thistle, and annual mustards.

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Little growth or reproduction occurs during extreme or extended drought periods.