Final Report for USDA Ecological Site Description

State-and-Transition Models

for

Major Land Resource Area 24

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Group 4

Disturbance Response Group (DRG) 4 consists of 4 sites. The precipitation zone for these sites ranges from 4 to 10 inches. Soils correlated to this group are deep to very deep and occur on fan piedmonts, alluvial flats, stream terraces and lake plains. They formed in mixed alluvium influenced by loess high in volcanic ash or lacustrine sediments. Some soils formed in loess high in volcanic ash on summits of plateaus. Slopes range from 0 to 30 percent. Elevation ranges from 4000 to 6000 feet. Drainage ranges from somewhat excessive to well. Surface layers are free of salt and sodium accumulation. In some soils concentrations of salts and sodium in the lower substratum is common. Where these soils occur on lake plains, drainage is moderately well with seasonal saturation at a depth greater than 5 feet. Capillary movement of water in these areas contributes to high salt and sodium accumulations below 10 inches of the surface. Ponding is common in areas of less than 1 percent slopes following high rainfall or snowmelt events. Soil temperature regime is mesic. Production is less than 700 lbs/ac with the average production for a normal year being 440 lbs/ac. The potential native plant community for 3 of the sites is dominated by winterfat (*Krascheninnikovia lanata*) with an herbaceous understory of Indian ricegrass (*Achnatherum hymenoides*) and bottlebrush squirreltail (*Elymus elymoides*). Needleandthread (*Hesperostipa comata*) and Sandberg bluegrass (*Poa secunda*) are also present on these sites. The remaining site is dominated by sickle saltbush (*Atriplex falcata*) with Indian ricegrass and bottlebrush squirreltail dominating the herbaceous understory.

Modal Site:
The Silty 4-8” P.Z. is the modal site for this group as it has the most acres mapped. It occurs on lower fan piedmonts, stream terraces and alluvial flats with a slope range from 0 to 4 percent. The soils formed in mixed alluvium influenced by loess high in volcanic ash. These soils are well to somewhat excessively drained with moderate to slow permeability. The surface layers are free of salt and sodium. Moderate to strong concentrations of salts and sodium are common in the lower substratum of some soils. These soils are usually noncalcareous in their upper profiles and highly calcareous in their lower profile. Due to their high silt fraction, the surface layers of these soils will normally crust and bake upon drying, inhibiting water infiltration and seedling emergence. Permeability is moderate to slow with moderate to high available water capacity. Additional moisture is received on this site as overflow from adjacent ephemeral streams or as run-in from higher landscapes. Runoff is slow to very slow and ponding occurs in some areas, particularly following intense storms or low elevation snow melt. Potential for sheet and rill erosion is slight, however, these soils have a potential for formation of gullies, especially in areas near shallow drainage ways. The shrub component of the plant community is dominated by winterfat with a small component of bud sagebrush and the herbaceous component is dominated by Indian ricegrass with a small component of bottlebrush squirreltail. Normal year production is 350 lbs/ac.

Disturbance Response Group 4 – Ecological sites:

024XY004NV	Silty 4-8” P.Z. MODAL
024XY012NV	Saline Terrace 6-8” P.Z.
024XY014NV	Coarse Silty 4-8” P.Z.
024XY059NV	Silty 8-10” P.Z.

Ecological Dynamics and Disturbance Response

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

Winterfat is a long-lived, drought tolerant, native shrub typically about 30 cm tall (Mozingo 1987). It has a woody base from which annual branchlets grow (Welsh et al. 1987). The most common variety is a low growing dwarf form (less than 38.1 cm), which is most often found on desert valley floors (Stevens et al. 1977). Total winter precipitation is a primary growth driver and lower than average spring precipitation can reverse the impact of plentiful winter precipitation. While summer rainfall has a limited impact, heavy August-September rain can cause a second flowering in winterfat (West and Gasto 1978). Winterfat reproduces from seed and primarily pollinates via wind (Stevens et al. 1977). Seed production, especially in desert regions, is dependent on precipitation (West and Gasto 1978) with good seed years occurring when there is appreciable summer precipitation and little browsing (Stevens et al. 1977).Winterfat has multiple dispersal mechanisms: diaspores are shed in the fall or winter, dispersed by wind, rodent-cached, or carried on animals (Majerus 2003). Diaspores take advantage of available moisture, tolerating freezing conditions as they progress from imbibed seeds to germinants to nonwoody seedlings (Booth 1989). Under some circumstances, the degree of reproduction may be dependent on mature plant density (Freeman and Emlen 1995).

These communities often exhibit the formation of microbiotic crusts within the interspaces between shrubs. These crusts influence the soils on these sites and their ability to reduce erosion and increase infiltration; they may also alter the soil structure and possibly increase soil fertility (Fletcher and Martin 1948, Williams 1993). Finer textured soils such as silts tend to support more microbiotic cover than coarse texture soils (Anderson 1982). Disturbance such as hoof action from inappropriate grazing and cheatgrass (*Bromus tectorum*) invasion can reduce biotic crust integrity (Anderson 1982, Ponzetti et al. 2007) and increase erosion.

Drought and/or inappropriate grazing will initially favor shrubs but prolonged drought can cause a decrease in the winterfat, bud sagebrush and other shrubs, while bare ground increases. Indian ricegrass will decrease with inappropriate grazing management. Squirreltail may maintain or also decline within the community. Repeated spring and early summer grazing will have an especially detrimental effect on winterfat and bud sagebrush (*Artemisia tridentata*). Cheatgrass and other non-native annual weeds increase with excessive grazing. Abusive grazing during the winter may lead to soil compaction and reduced infiltration. Prolonged abusive grazing during any season leads to abundant bare ground, desert pavement and active wind and water erosion. Repeated, frequent fire will promote cheatgrass dominance and elimination of the native plant community. These sites frequently attract recreational use, primarily by off highway vehicles (OHV). Annual non-native species increase where surface soils have been disturbed. Three alternative stable states have been identified for this site.

Fire Ecology:

Winterfat tolerates environmental stress, extremes of temperature and precipitation, and competition from other perennials but not the disturbance of fire or overgrazing (Ogle 2001). Fire is rare within these communities due to low fuel loads. There are conflicting reports in the literature about the response of winterfat to fire. In one of the first published descriptions, Dwyer and Pieper (1967) reported that winterfat sprouts vigorously after fire. This observation was frequently cited in subsequent literature, but recent observations have suggested that winterfat can be completely killed by fire (Pellant and Reichert 1984). The response is apparently dependent on fire severity. Winterfat is able to sprout from buds near the base of the plant. However, if these buds are destroyed, winterfat will not sprout. Research has shown that winterfat seedling growth is depressed in growth by at least 90% when growing in the presence of cheatgrass (Hild et al. 2007). Repeated, frequent fires will increase the likelihood of conversion to a non-native, annual plant community with trace amounts of winterfat.

Bud sagebrush (*Picrothamnus desertorum*), a minor shrub to this ecological site, is a native, summer-deciduous shrub. It is low growing, spinescent, aromatic shrub with a height of 4 to 10 inches and a spread of 8 to 12 inches (Chambers and Norton 1993). Bud sagebrush is fire intolerant and must reestablish from seed (Banner 1992, West 1994).

Indian ricegrass, the dominant grass within this site, is a hardy, cool-season, densely tufted, native perennial bunchgrass that grows from 4 to 24 inches in height (Blaisdell and Holmgren 1984). Indian ricegrass has been found to reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983). Thus the presence of surviving, seed producing plants is necessary for reestablishment of Indian ricegrass. Grazing management following fire to promote seed production and establishment of seedlings is important.

Bottlebrush squirreltail, another cool-season, native perennial bunchgrass is common to this ecological site. Bottlebrush squirreltail is considered more fire tolerant than Indian ricegrass due to its small size, coarse stems, and sparse leafy material (Britton et al. 1990). Postfire regeneration occurs from surviving root crowns and from on- and off-site seed sources. Bottlebrush squirreltail has the ability to produce large numbers of highly germinable seeds, with relatively rapid germination (Young and 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 among cheatgrass dominated ranges (Hironaka and Tisdale 1972).

Livestock and Wildlife Grazing Interpretations:
Winterfat is a valuable forage species with an average of 10% crude protein during winter when there are few nutritious options for livestock and wildlife (Welch 1989). However, excessive grazing throughout the west has negatively impacted survival of winterfat stands (Hilton 1941; Statler 1967; Stevens et al. 1977). Time of grazing is critical for winterfat with the active growing period being most critical (Romo 1995). Stevens et al. (1977) found that both vigor and reproduction of winterfat were reduced in Steptoe Valley, Nevada by improper season of use, and he recommended no more than 25% utilization during periods of active growth and up to 75% utilization during dormant season use. Rasmussen and Brotherson (1986) found significantly greater foliar cover and density of winterfat in areas ungrazed for 26 years versus winter grazed areas in Utah. In exclosures protected from grazing for between 5 and 16 years, Rice and Westoby (1978) found that winterfat increased in foliar cover but not in density where it was dominant, and in both foliar cover and density in shadscale-perennial grass communities where it was not dominant.

In addition to grazing by cattle, winterfat is browsed by rabbits, antelope, and other wildlife species (Stevens et al. 1977, Ogle et al. 2001). Winterfat and perennial grasses average 80% of jackrabbits' diet

in southeastern Idaho, with shrubs being grazed in fall and winter particularly (Johnson and Anderson 1984). Pronghorn and rabbits browse stems, leaves, and seed stalks of winterfat year round, especially during periods of active growth (Stevens et al. 1977). Management of wildlife browse is difficult and browse may be harmful to winterfat reestablishment as seed production and regrowth are curtailed if grazing occurs as the plant begins to grow (Eckert 1954).

Heavy spring grazing has been found to sharply reduce the vigor of Indian ricegrass and decrease the stand (Cook and Child 1971). 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%) and moderate (60%) spring use. The seed crop may be reduced where grazing is heavy (Bich et al. 1995). Tolerance to grazing increases after May thus spring deferment may be necessary for stand enhancement (Pearson 1964, Cook and Child 1971); however, utilization of less than 60% is recommended.

Bottlebrush squirreltail generally increases in abundance when moderately grazed or protected (Hutchings and 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 et al. 1987). Squirreltail is more tolerant of grazing than Indian ricegrass but all bunchgrasses are sensitive to over utilization within the growing season.

Bud sagebrush is also a palatable, nutritious forage for upland game birds, small game, big game and domestic sheep in winter, particularly late winter (Johnson 1978), however it can be poisonous or fatal to calves when eaten in quantity (Stubbendieck et al. 1992). Bud sagebrush is highly susceptible to effects of browsing. It decreases under browsing due to year-long palatability of its buds and is particularly susceptible to browsing in the spring when it is physiologically most active (Chambers and Norton 1993). Heavy browsing (>50%) may kill bud sagebrush rapidly (Wood and Brotherson 1986).

State and Transition Model Narrative—Group 4

Reference State 1.0: The Reference State 1.0 is a representative of the natural range of variability under pristine conditions. This state has two community phases, one co-dominated by shrubs and grass, and the other dominated by shrubs. 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. This site is very stable, with little variation in plant community composition. Plant community changes would be reflected in production in response to drought or inappropriate grazing management. Wet years will increase grass production, while drought years will reduce production. Shrub production will also increase during wet years; however, recruitment of winterfat is episodic.

Community Phase 1.1
This community is dominated by winterfat and Indian ricegrass. Bottlebrush squirreltail and bud sagebrush are also important species on this site. Community phase changes are primarily a function of chronic drought. Fire is infrequent and patchy due to low fuel loads.

Community Phase Pathway 1.1a: Long term drought and/or herbivory. Fires would also decrease vegetation on these sites but would be infrequent and patchy due to low fuel loads.

Community Phase 1.2:
Drought will favor shrubs over perennial bunchgrasses. However, long-term drought will result in an overall decline in the plant community, regardless of functional group.

Community Phase Pathway 1.2a: Time, lack of disturbance and recovery from drought would allow the vegetation to increase and bare ground would eventually decrease.

T1A: Transition from Reference State 1.0 to Current Potential State 2.0:
Trigger: This transition is caused by the introduction of non-native annual plants, such as halogeton and cheatgrass.
Slow variables: Over time the annual non-native species will increase within the community.
Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

Current Potential State 2.0: This state is similar to the Reference State 1.0. This state has the same two general community phases. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low fine fuel loads, and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives' high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate, and adaptations for seed dispersal.

Community Phase 2.1:
This community is dominated by winterfat and Indian ricegrass. Bottlebrush squirreltail and bud sagebrush are also important species on this site. Community phase changes are primarily a function of chronic drought. Fire is infrequent and patchy due to low fuel loads. Non-native annual species are present.

Community Phase Pathway 2.1a: Drought will favor shrubs over perennial bunchgrasses. However, long-term drought will result in an overall decline in the plant community, regardless of functional group. Inappropriate grazing management will favor unpalatable shrubs such as shadscale, and cause a decline in winterfat and bud sagebrush.

Community Phase 2.2: This community is dominated by winterfat. The perennial grass component is significantly reduced.

Silty 4-8" (024XY004NV) Phase 2.2 T. Stringham July 2010

Community Phase Pathway 2.2a: Release from long term drought and/or growing season grazing pressure allows recovery of bunchgrasses, winterfat, and bud sagebrush.

T2A: Transition from Current Potential State 2.0 to Shrub State 3.0:

Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during the growing season and/or long term drought will favor shrubs and initiate a transition to Community phase 3.1.
Slow variables: Long term decrease in deep-rooted perennial grass density.
Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0:

Trigger: Severe fire/ multiple fires and/or soil disturbing treatments would transition to Community Phase 4.1. Long term inappropriate grazing management in the presence of non-native annual species would transition to Community Phase 4.2.
Slow variables: Increased production and cover of non-native annual species.
Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Shrub State 3.0: This state consists of one community phase. This site has crossed a biotic threshold and site processes are being controlled by shrubs. Bare ground has increased.

Community Phase 3.1:

Perennial bunchgrasses, like Indian ricegrass are reduced and the site is dominated by winterfat. Rabbitbrush and shadscale may be significant components or dominant shrubs. Annual non-native species increase. Bare ground has increased.

Silty 4-8" (024XY004NV) Phase 3.1 T. Stringham April 2010

Silty 4-8" (024XY004NV) Phase 3.1 T. Stringham June 2010

T3A: Transition from Shrub State 3.0 to Annual State 4.0:

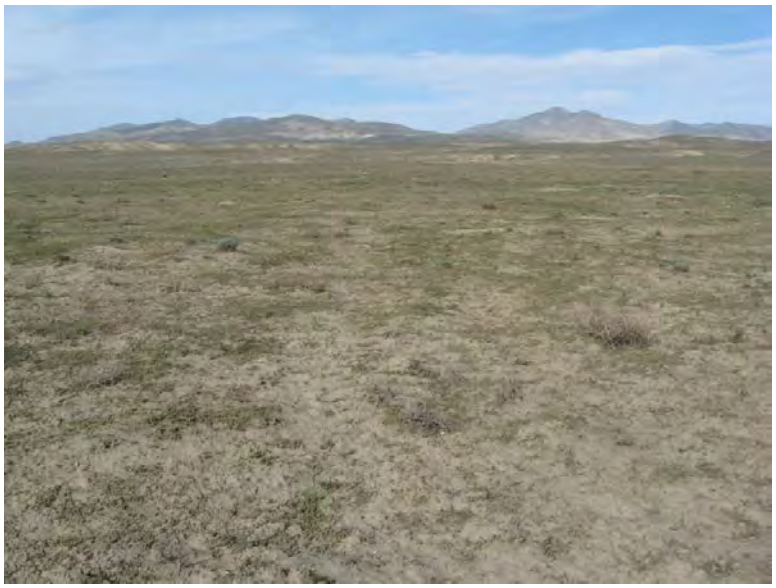
Trigger: Severe fire/ multiple fires, long term inappropriate grazing management, and/or soil disturbing treatments such as plowing.

Slow variables: Increased production and cover of non-native annual species.

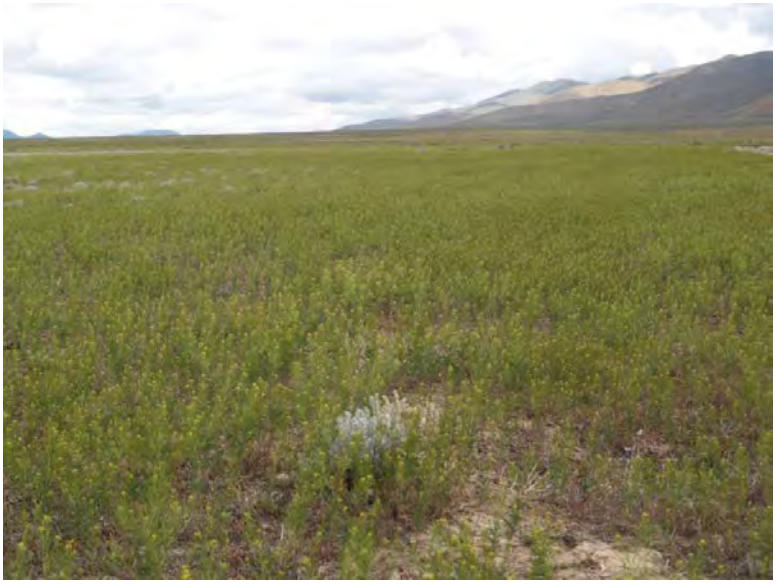
Threshold: Increased, continuous fine fuels modify the fire regime by changing intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Annual State 4.0: This state consists of two community phases. This state is characterized by the dominance of annual non-native species such as halogeton and cheatgrass. Rabbitbrush, shadscale, sickle saltbush and other sprouting shrubs may dominate the overstory.

Community Phase 4.1:
This community is dominated by annual non-native species. Trace amounts of winterfat and other shrubs may be present, but are not contributing to site function. Bare ground may be abundant, especially during low precipitation years. Soil erosion, soil temperature and wind are driving factors in site function.



Silty 4-8" (024XY004NV) Phase 4.1 T. Stringham June 2010



Silty 4-8" (024XY004NV) Phase 4.1 T. Stringham July 2010

Coarse Silty 4-8” (024XY014NV) Phase 4.1 T. Stringham August 2010

Silty 4-8” (024XY004NV) or Saline Terrace 6-8” (024XY012NV) Phase 4.1 T. Stringham August 2010

Community Phase Pathway 4.1a: Reestablishment of winterfat. This pathway is unlikely due to the impact of annual non-native species on the establishment and growth of winterfat seedlings.

Community Phase 4.2:
This community is dominated by winterfat with an understory of non-native annual species. Perennial bunchgrasses may be a minor component or missing. Bare ground may be abundant.

Silty 4-8 (024XY004NV) Phase 4.2 T. Stringham July 2010

Community Phase Pathway 4.2a: Fire

Potential Resilience Differences with other Ecological Sites

Saline Terrace 6-8" 024XY012NV: The soils of this site are very deep. Surface soils are medium textured and less than 10 inches thick. These soils are moderately well drained with a seasonally high water table at a depth of greater than 5 feet. The soils are strongly saline and moderately to strongly sodium affected. The greatest concentration of salts is below 10 inches of the surface where dissolved salts accumulate at the upper limits of capillary movement. These sites are dominated by sickle saltbush with an understory of Indian ricegrass. Black greasewood is a minor component on these sites but may dominate the aspect. Production for a normal year is 400 lbs/ac. This site was only seen in the shrub state on the field visits. However it likely has a similar state-and-transition model with 4 alternative states.

Coarse Silty 4-8" 024XY014NV: The soils of this site are deep to very deep and are well drained. Surface soils are moderately coarse textured and less than 10 inches thick. Soil reaction increases with soil depth. Moderate to strong concentrations of salt and sodium occur within 20 inches of the surfaces. Some soils are modified with a high volume of gravel in the lower profile. Rock fragments in the soil profile and/or high salt concentration in the lower profile reduce the available water capacity of these soils. This plant community is dominated by winterfat and bud sagebrush. Indian ricegrass and shadscale are also common on these sites. Production for this site in a normal year is 500 lbs/acre. This site was only seen in an annual state with a shrub overstory on the field visits. However it likely has a similar state-and-transition model with 4 alternative states.

Silty 8-10" 024XY059NV: The soils in this site are very deep and moderately well drained. Surface soils are typically silt loams and normally less than 10 inches thick. The surface layers are free of salt and sodium. Moderate to strong concentrations of salts and sodium are common in the lower substratum in some pedons. Due to their silty textures, the surface layer of these soils will normally crust and bake upon drying, inhibiting water infiltration and seedling emergence. This site is dominated by Indian ricegrass and winterfat. Production for this site in a normal year is 500 lbs/acre. This site was not seen on the field visits but is similar to the modal site with four alternative states in the state-and-transition model.

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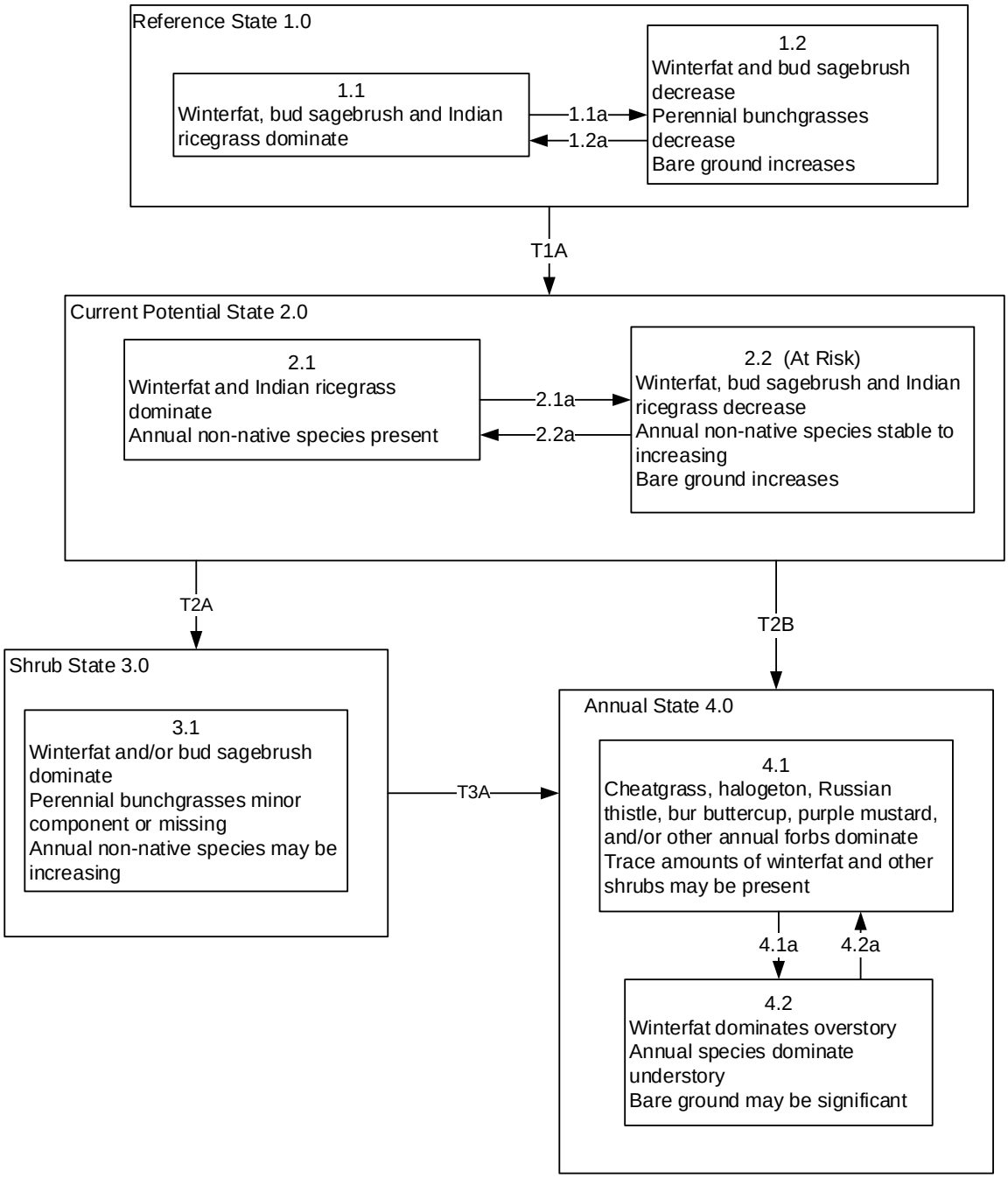
State and Transition Models

Silty 4-8 MODAL

MLRA 24
Group 4
Silty 4-8"
024XY004NV



MLRA 24
Group 4
Silty 4-8"
024XY004NV

Reference State 1.0 Community Phase Pathways
1.1a: Drought and/or excessive herbivory during the growing season will reduce both shrub and perennial bunchgrass production. Fire was infrequent and would be patchy due to low fuel loads.
1.2a: Time, lack of disturbance and release from drought will allow for the perennial grasses to increase, especially with an increase in spring precipitation.

Transition T1A: Introduction of non-native annual species such as cheatgrass, halogeton and mustards.

Current Potential State 2.0 Community Phase Pathways
2.1a: Drought and/or inappropriate grazing management
2.2a: Release from drought combined with appropriate grazing management would allow for both the shrubs and perennial grasses to recover.

Transition T2A: Inappropriate grazing management

Transition T2B: Catastrophic fire, and/or soil disturbing treatments (4.1). Inappropriate grazing management in the presence of non-native species (4.2)

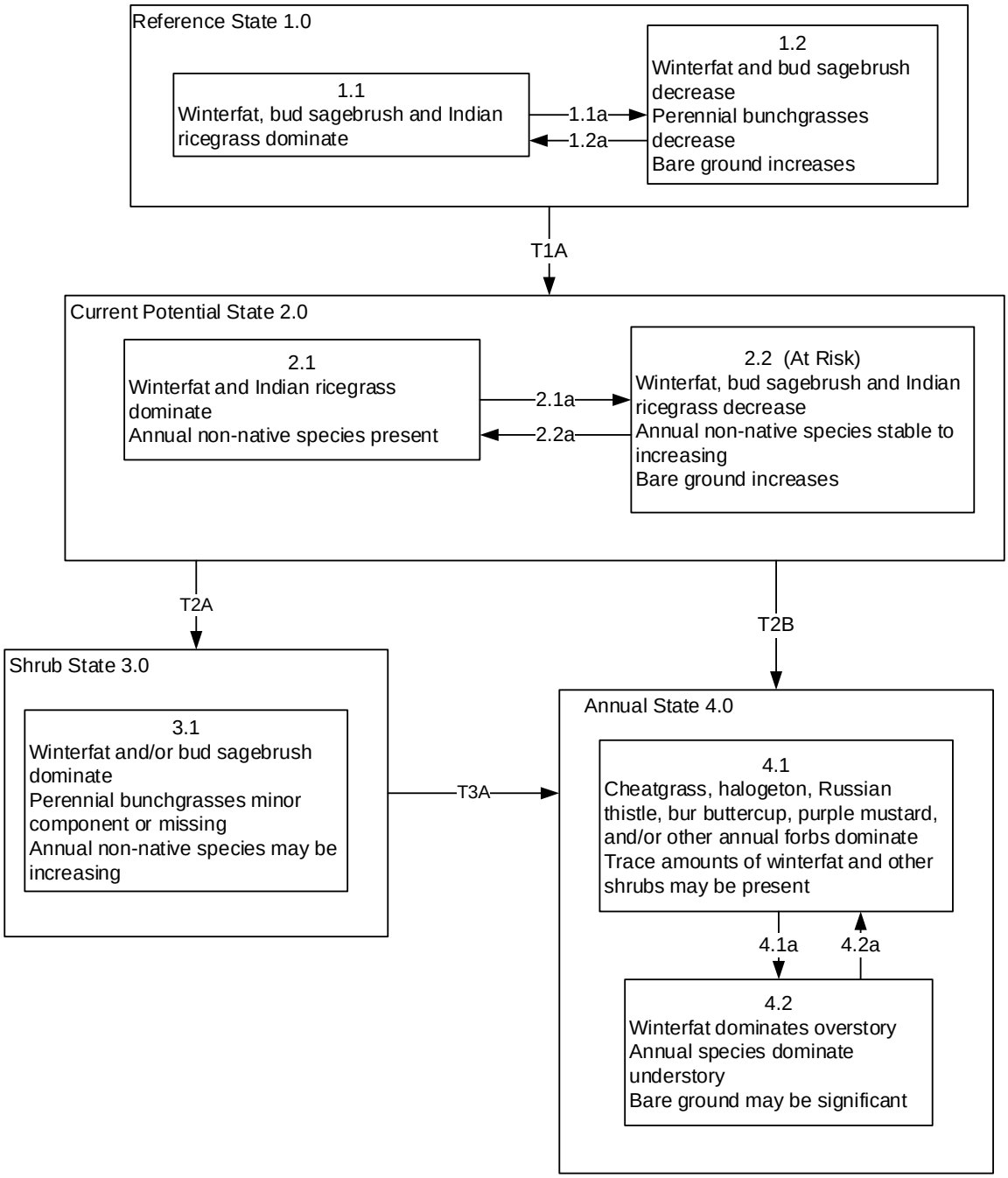
Shrub State 3.0 Community Phase Pathways
None

Transition T3A: Catastrophic fire, long term inappropriate grazing management, and/or soil disturbing treatments.

Annual State 4.0 Community Phase Pathways
4.1a: Reestablishment of winterfat (this pathway is unlikely)
4.2a: Fire

Coarse Silty 4-8

MLRA 24
Group 4
Coarse Silty 4-8"
024XY014NV



MLRA 24
Group 4
Coarse Silty 4-8"
024XY014NV

Reference State 1.0 Community Phase Pathways
1.1a: Drought and/or excessive herbivory during the growing season will reduce both shrub and perennial bunchgrass production. Fire was infrequent and would be patchy due to low fuel loads.
1.2a: Time, lack of disturbance and release from drought will allow for the perennial grasses to increase, especially with an increase in spring precipitation.

Transition T1A: Introduction of non-native annual species such as cheatgrass, halogeton and mustards.

Current Potential State 2.0 Community Phase Pathways
2.1a: Drought and/or inappropriate grazing management
2.2a: Release from drought combined with appropriate grazing management would allow for both the shrubs and perennial grasses to recover.

Transition T2A: Inappropriate grazing management

Transition T2B: Catastrophic fire, and/or soil disturbing treatments (4.1). Inappropriate grazing management in the presence of non-native species (4.2)

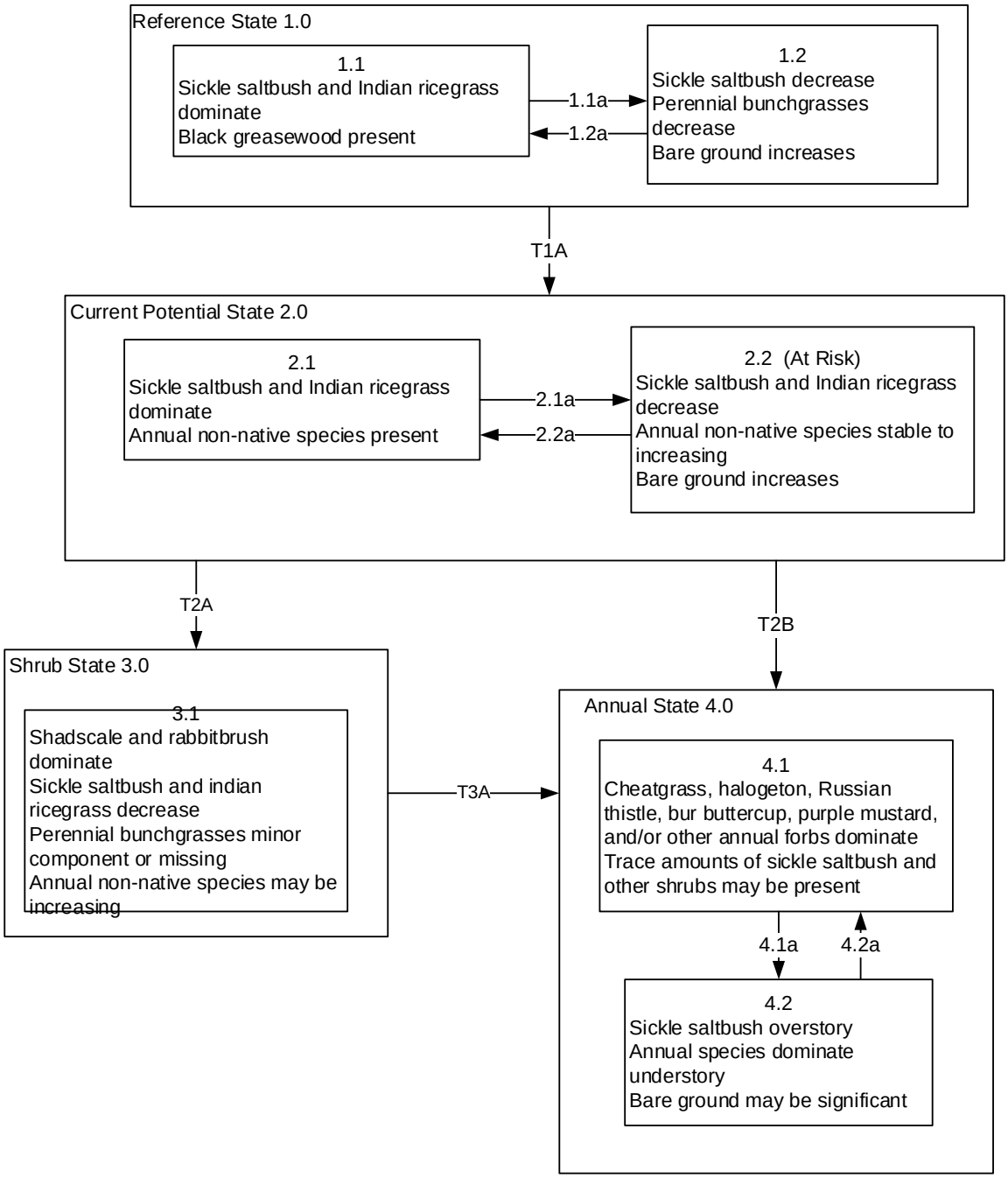
Shrub State 3.0 Community Phase Pathways
None

Transition T3A: Catastrophic fire, long term inappropriate grazing management, and/or soil disturbing treatments.

Annual State 4.0 Community Phase Pathways
4.1a: Reestablishment of winterfat (this pathway is unlikely)
4.2a: Fire

Saline Terrace 6-8

MLRA 24
Group 4
Saline Terrace 6-8"
024XY012NV



MLRA 24
Group 4
Saline Terrace 6-8"
024XY012NV

Reference State 1.0 Community Phase Pathways
1.1a: Drought and/or excessive herbivory during the growing season will reduce both shrub and perennial bunchgrass production. Fire was infrequent and would be patchy due to low fuel loads.
1.2a: Time, lack of disturbance and release from drought will allow for the perennial grasses to increase, especially with an increase in spring precipitation.

Transition T1A: Introduction of non-native annual species such as cheatgrass, halogeton and mustards.

Current Potential State 2.0 Community Phase Pathways
2.1a: Drought and/or inappropriate grazing management
2.2a: Release from drought combined with appropriate grazing management would allow for both the shrubs and perennial grasses to recover.

Transition T2A: Inappropriate grazing management

Transition T2B: Catastrophic fire, and/or soil disturbing treatments (4.1). Inappropriate grazing management in the presence of non-native species (4.2)

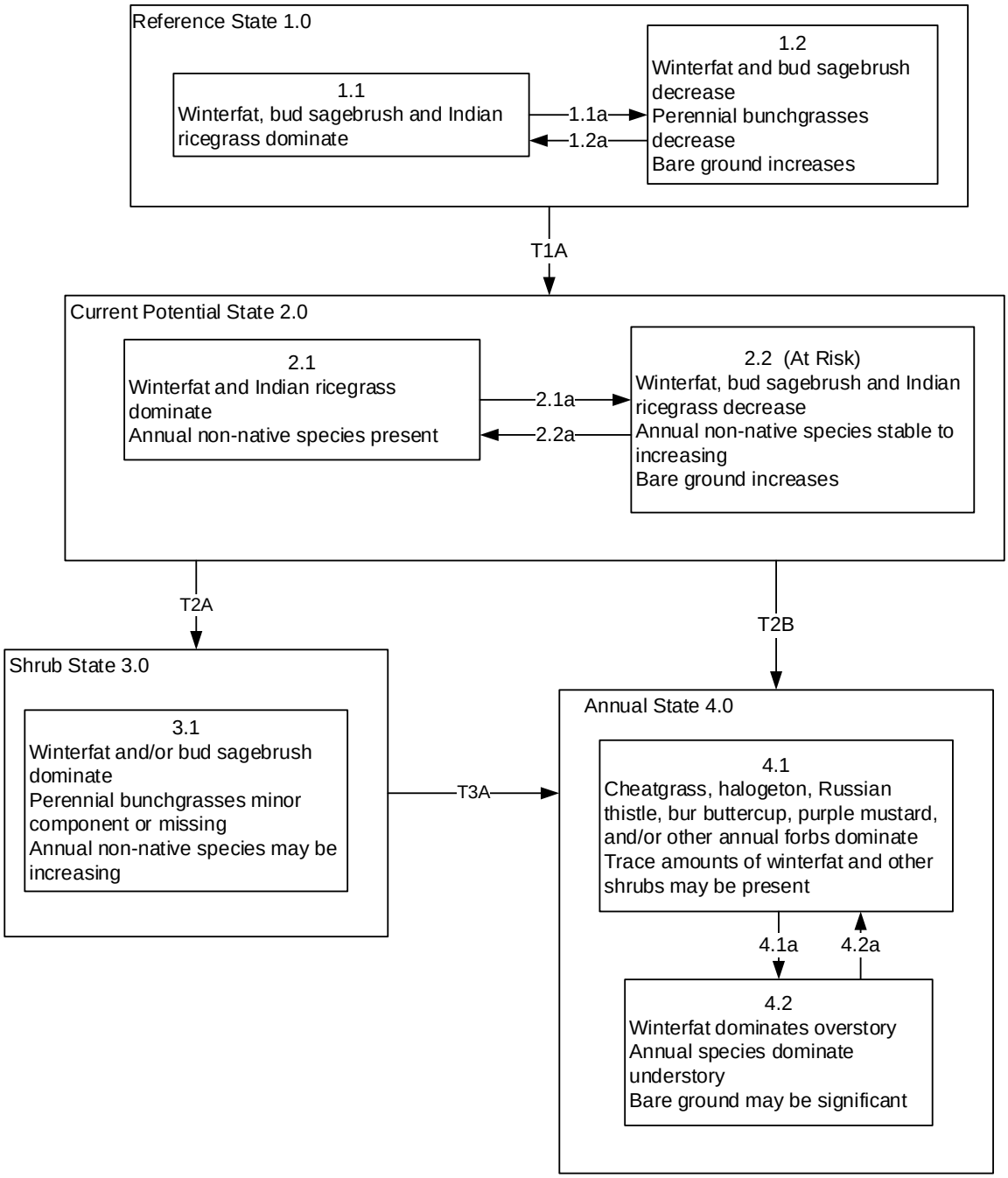
Shrub State 3.0 Community Phase Pathways
None

Transition T3A: Catastrophic fire, long term inappropriate grazing management, and/or soil disturbing treatments.

Annual State 4.0 Community Phase Pathways
4.1a: Reestablishment of sickle saltbush (this pathway is unlikely)
4.2a: Fire

Silty 8-10

MLRA 24
Group 4
Silty 8-10"
024XY059NV



MLRA 24
Group 4
Silty 8-10"
024XY059NV

Reference State 1.0 Community Phase Pathways
1.1a: Drought and/or excessive herbivory during the growing season will reduce both shrub and perennial bunchgrass production. Fire was infrequent and would be patchy due to low fuel loads.
1.2a: Time, lack of disturbance and release from drought will allow for the perennial grasses to increase, especially with an increase in spring precipitation.

Transition T1A: Introduction of non-native annual species such as cheatgrass, halogeton and mustards.

Current Potential State 2.0 Community Phase Pathways
2.1a: Drought and/or inappropriate grazing management
2.2a: Release from drought combined with appropriate grazing management would allow for both the shrubs and perennial grasses to recover.

Transition T2A: Inappropriate grazing management

Transition T2B: Catastrophic fire, and/or soil disturbing treatments (4.1). Inappropriate grazing management in the presence of non-native species (4.2)

Shrub State 3.0 Community Phase Pathways
None

Transition T3A: Catastrophic fire, long term inappropriate grazing management, and/or soil disturbing treatments.

Annual State 4.0 Community Phase Pathways
4.1a: Reestablishment of winterfat (this pathway is unlikely)
4.2a: Fire