Final Report
USDA Ecological Site Description
State-and-Transition Models
Major Land Resource Area 28A and 28B Nevada
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Disturbance Response Group 24AB

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Modal Site: PILO-PIFL2 RICE-JUCO6/CARO5-POA 028AY081NV

Group	Name	Site ID
24AB	**PILO-PIFL2 RICE-JUCO6/CARO5-POA**	**028AY081NV**
	PILO-PIFL2 RICE-JUCO6/CARO5-POA	028AY082NV
	PILO-PIFL2 SYOR2/POA	028BY106NV
	PILO-PIFL2 RICE/POFE	028BY107NV

MLRA 28
Group 24

Disturbance Response Group (DRG) 24 consists of four ecological sites. Precipitation on these sites is typically 20+ inches annually. Slopes range from 2 to 75 percent but slopes of 15 to 50 percent are more typical. Elevations range from 8500 to over 11,000 feet. The soils associated with this site are shallow to deep and well drained. The soils are formed in residuum and colluvium from limestone and dolomite. There are high amounts of gravels, cobbles and/or stones on the soil surface and throughout the soil profile. The soil temperature regime is cryic and the soil moisture regime is xeric. The sites are dominated by Great Basin bristlecone pine (*Pinus longaeva)* and limber pine (*Pinus flexilis*) in the overstory. Understory species include wax currant (*Ribes cereum*), whitestem goldenweed (*Ericameria discoidea*), common juniper (*Juniperus communis* var. *depressa*), Ross' sedge (*Carex rossii*) and bluegrasses (*Poa* spp.). Understory production ranges from 50 to 300 pounds per acre depending on canopy cover.

Modal Site:
The modal site for this group is Great Basin bristlecone pine-Limber pine/currant-common juniper/Ross' sedge and bluegrass (F028AY081NV). This forest site occurs on high mountain ridges and upper sideslopes associated with rock outcrops and talus. Slopes range from 2 to 75 percent, but are typically 15 to 50 percent. Elevations are 9000 to over 10,500 feet. Average annual precipitation is over 20 inches. The soils of this site are shallow or very shallow and have formed in highly calcareous colluvium and residuum of limestone and dolomite parent materials. There are extremely high amounts of gravels, cobbles and/or stones on the soil surface and throughout the soil profile. Available water holding capacity is to very low and the soils are well drained. This site is dominated by Great Basin bristlecone pine and limber pine. Ross' sedge and bluegrasses are the principal understory grasses. Wax currant, whitestem goldenweed and common juniper are the principal understory shrubs. Overstory tree canopy is about 80 to 95 percent bristlecone pine, 5 to 20 percent limber pine and 5 percent or less other conifers such as white fir (*Abies concolor*), Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), and Engelmann spruce (*Picea englemannii)*. Average understory production ranges from 50 to 200 pounds per acre with a canopy cover from 10 to 20 percent. Understory production includes the total annual production of all species within 4½ feet of the ground surface.

Disturbance Response Group 24 – ecological sites:

PILO-PIFL2/RICE-JUCO6/CARO5-POA	028AY081NV
PILO-PIFL2/RICE-JUCO6/CARO5-POA	028AY082NV
PILO-PIFL2/SYOR2/POA	028BY106NV
PILO-PIFL2/RICE/POFE	028BY107NV

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 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).

Great Basin bristlecone pine is found in Nevada, Utah and California usually on dry, rocky mountain slopes in the transition zone between subalpine forests and alpine tundra (Beasley 1972). Great Basin bristlecone pine ranges in elevations from 6760 to 11,600 feet. It is one of the most widely distributed high-elevation pines in Nevada, second to the limber pine. It has been found in 20 of Nevada's mountain ranges in eight counties (Charlet 1996). These pines grow in harsh climates characterized by strong winds, intense solar radiation, and limited soil moisture. In the White Mountains of California, the Great Basin bristlecone withstands temperatures well below freezing, to only 50 degrees F in the summer. Precipitation averages 18 inches annually. Most trees reach a height of 30 feet, but pines in the White Mountains have been measured as tall as 60 feet with five foot diameter trunks. Bristlecone pine needles can live up to 40 years of age, and are functional throughout (Lanner 2002).

Great Basin bristlecone pine is an extremely long-lived, native conifer of highly variable growth form. Low-elevation trees are tall and upright in dense stands, while at high-elevations they become twisted and contorted in open communities (Fryer 2004, Lanner 2007). The current elevational zone ranges from 7200 to 12000 feet, but has varied over time in response to natural variations in the climate. In geologic time, it has shown the greatest population expansion with cool temperatures. During the Pleistocene, Great Basin bristlecone pine forests extended far down mountain slopes toward the shoreline of ancient Lake Bonneville.

Great Basin bristlecone pines are generally on thin, rocky substrates, derived from limestone or dolomite. The longevity and harsh growing conditions of Great Basin bristlecone pine often make the trees sensitive to climatic fluctuations (Beasley and Klemmedson 1973). Measurements of leaf water potential indicate that bristlecone pine may be adapted to maintain lower internal water stress than some of its associated plants. This may allow the tree to be more resistant to winter desiccation as well as summer drought (Beasley and Klemmedson 1973). Year-to-year fluctuations are reflected in the widths of annual growth rings. Narrow rings reflect unusually dry years and the widest rings are formed during unusually moist years (Beasley and Klemmedson 1973). This species is of unique biological and dendrological interest because of the great age attained by some individuals. Trees over 4900 years old have been found on Wheeler Peak in the Snake Range of Nevada.

Great Basin bristlecone pine is highly drought tolerant and can subsist throughout the successional process. While these trees have low requirements for nutrients and moisture they are intolerant of shady conditions and prefer exposed slopes and ridges. High light requirements preclude the establishment of bristlecone pine under dense canopies (Beasley 1972). Great Basin bristlecone pine has a highly branched, shallow root system. Few large branching roots provide structural support and maximize water absorption. Tolerance of dry conditions is increased by waxy needles and thick needle cuticles, which help regulate water loss (Fryer 2004). Bristlecone pine is also able to withstand relatively high internal water stress, plant-water potential values as low as -32 bars have been measured (Beasley 1972).

A common insect pest of the Great Basin bristlecone pine is mountain pine beetle (*Dendroctonus ponderosae*) (Lanner 2007). Heavy infestations are often fatal and affect many trees over large areas. White pine blister rust (WPBR) is of great concern to Great Basin bristlecone pines. It is caused by the fungus *Cronartium ribicola* and spreads to five-needled white pines from its host plant, Ribes. White pine blister rust has not yet been discovered in Great Basin bristlecone pine (Schoettle and Sniezko

2007). However, WPBR was not discovered in Rocky Mountain bristlecone pine until almost 100 years after its first detection in North America and there is no biological or environmental reason to expect Great Basin bristlecone pine is resistant to infection. Life history traits of Great Basin bristlecone pine promote susceptibility to WPBR. All North American five-needle pines have some resistance to WPBR, although frequency of resistance is low in all species. High elevation white pines have adaptive traits that allow them to persist for hundreds to thousands of years on harsh sites. This longevity is also contributed to a lack of stand-replacing disturbances. As a result, even where trees with rust-resistance are present, without regeneration opportunities the number of individuals with this resistance will not increase (Schottle and Sniezko 2007). Management options to protect uninfected populations or increase resistance may include managing forest composition, increasing host vigor, introduction of resistant container stock and diversifying age class structure.

Limber pine ranges from 6000 to 11,500 ft. in elevation, it has been found in 51 mountain ranges in Nevada and 11 counties. These trees often exhibit a stunted growth form also known as *krummholz* where they exceed 10,800 ft. in elevation (Lanner 2002).

Primary natural disturbance mechanisms affecting this ecological site are periodic long-term drought, infrequent wildfire, disease and insect attack. This site experiences an extended fire return interval due to lack of herbaceous understory and widely spaced trees. High-elevation Great Basin bristlecone pine forests are largely influenced by climate and seed dispersal instead of fire. The plant community phases of this state can last for extended periods of time. Great Basin bristlecone pine are slow growing, tolerant of harsh environmental conditions and can attain extremely old ages. Non-native plant species have not been found in these sites, therefore this STM consists of one state; the reference state.

Fire Ecology:
Fire is very infrequent in high elevation forests dominated by Great Basin bristlecone pine forests, due to low herbaceous production and widely spaced trees. Fires in these zones are more likely related to El Nino events and higher production years (Sherriff et al. 2001). In the more productive sites bristlecone pine and limber pine may be dependent on infrequent stand replacing fires which reduce competition by other tree species and create open areas that promote regeneration (Coop and Schoettle 2009). Fire increases limber pine and bristlecone pine seedling establishment but the regeneration of these species is slow (Coop and Schoettle 2009).

The spread of wildfire from lightning is unlikely, but individual trees may ignite. As a thin-barked pine Great Basin bristlecone pine is only able to survive low–severity fires. Stand dynamics are more heavily influenced by climate and seed dispersal patterns than fire. Muttongrass is tolerant of low severity fire, but may be killed by more severe fires. Post-fire regeneration occurs from surviving root crowns and from seed. Ross' sedge survives fire through buried seed with long term viability. These seeds germinate after heat treatment.

Limber pine has been noted to be the first to colonize areas after burn. This is in part due to the seed dispersal mechanism; which is mainly by Clark’s nutcracker which prefers to cache in open burn sites (Lanner and Vander Wall 1980, Rebertus et al. 1991). Limber pine decreases in later succession with the increase in other more shade tolerant species (Donnegan and Rebertus 1999).

Logging and other ground disturbance can cause an increase in Ribes species such as gooseberry. This is in part due to the exposure of mineral soil, the removal of forest canopy which increases sunlight, and alterations in the soil moisture (Benedict and Harris 1931).

Wildlife Interpretations:
Great Basin bristlecone pines and a wide array of other plants, provide shelter and forage for numerous wildlife (Fryer 2004). Bristlecone pine acts as a major source of cover for animals in high-elevation ecosystems (Logan and Powell 2001). Ground squirrels (*Otospermophilus beecheyi*) that occur in subalpine habitat will use Great Basin bristlecone pines for shelter (Lanner 1984, Fryer 2004). Several other mammals, although do not actively use the tree for food or shelter, inhabit the same ecosystems (subalpine, montane, timberline and limberpine) in which Great Basin bristlecone pines occur in Nevada. Yellow bellied marmot (*Marmota flaviventris*) found in meadows, valleys, and foothills, where forests and meadows form a mosaic will also inhabit subalpine communities above 6500 feet (Great Basin National Park, Listing Sensitive and Extirpated Species 2006, Linzey and Hammerson 2008). The water shrew (*Sorex palustris*) although restricted to riparian environments occurs in montane communities where Great Basin bristlecone pines are known to grow (Great Basin National park, Listing Sensitive and Extirpated Species 2006). Inyo shrew (*Sorex tennellus*) is confirmed to occur in subalpine communities at 9900 feet. The ringtail (Bassaricus atutus), ermine (Mustela ermine), long-tailed weasel (Mustela frenata), and striped skunk (*Mephitis mephitis*) all have a wide ranging habitat including high-elevation, forested subalpine uplands and are documented as occurring above 9,000 feet (Gold berg 2003, Great Basin National Park, Listing Sensitive and Extirpated Species 2006, Zevit 2012, Kiiskila 2014).
Several bat species occur within Great Basin bristlecone pine habitat, adding to the community's diversity. The fringed myotis (*Myotis thysanodes*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), silver-haired bat (*Lasionycteris noctivagans*), Townsend's big-eared bat (*Corynorhinus townsendii*), all are documented as occurring in coniferous, subalpine forests above 9000 feet (Keinath 2003, Arroyo-Calbrales and Alvares-Castneda 2008, Warner and Czaplewski 1984, Armstrong 2007, Sullivan 2009, Great Basin National Park, Listing Sensitive and Extirpated Species 2006).
Many species of birds also use the Great Basin bristlecone pine habitat for shelter and food. Censuses determined the broad-tailed hummingbird (*Selasphorus platycereus*), northern flicker (*Colaptes auratus*), dusky flycatcher (*Empidonax oberholseri*), mountain chickadee (*Parus gambeli*), White-breasted nuthatch (*Sitta carolinensis*), rock wren (*Salpinctes obsoletus*), American robin (*Turdus migratorius*), hermit thrush (*Catharus guttatus*), mountain bluebird (*Sialia currucoides*), Townsend's solitaire (*Myadestes townsendi*), yellow-rumped warbler (*Dendroica coronata*), Cassin's finch (*Carpodacus cassinii*), pine siskin (*Carduelis pinus*) and dark-eyed junco (*Junco hyemalis*) use the Great Basin bristlecone pine for nesting. (Medin, 1984, Fryer 2004). The Clark's nutcracker (*Nucifraga columbiana*) is believed to help with seedling establishment and dispersal (Lanner 1984). The small winged seeds of Great Basin bristlecone pine are not favored by the Clark's nutcracker, but when limber pines and singleleaf pinyons do not bear seeds, the Clark's nutcracker will forage on the Great Basin bristlecone (Lanner 1984). The seeds provide food for the Clark's nutcracker; they remove the seeds of pines from their cones, eat some, and store others in shallow subsurface caches (Lanner 1988). In a study by Lanner (1988), it was indicated that Great Basin bristlecone pine regeneration was dependent on these birds in harsh sites.

Habitat distribution of reptiles and amphibians is not as widely studied as other animals and few reptiles and amphibians are found at such high elevations where Great Basin bristlecone pines occur. However; the Sonoran mountain kingsnake (*Lampropeltis pyromelana*), a highly secretive reptile, which prefers ponderosa pine habitat has been captured at elevations upwards of 9000 feet; suggesting that this snake could occur in habitats shared with Great Basin bristlecone pine (Brennan 2008, Great Basin National Park, Listing Sensitive and Extirpated Species 2006). Also, the western toad (*Anaxyrus boreos)* has a very wide ranging habitat throughout Nevada, and, if it is near vernal pools the western toad's habitat could also overlap with Great Basin bristlecone pine habitat. In fact, it has been trapped at

elevations of 9000 feet (Lindsdale 1940). The distribution of most of herpetafuana present in these high-elevation woodlands is poorly understood and more research and management are needed.
Great Basin bristlecone pines are host for two species of bark beetles (*Scolytus dentatus*, and *Carphoborus declivis***)** that have only been collected in the White Mountains (Bright 1964).

Management Interpretations:
Climate change may be hindering regeneration of Great Basin bristlecone pines on sites in the interior Great Basin; however these changes are difficult to predict. In many places, populations shift occur upslope of existing populations, indicating a potential to accommodate a warming climate. Concern grows over the susceptibility of Great Basin bristlecone pine to White Pine Blister Rust. Great Basin bristlecone pine is one of the five-needle pines susceptible to the exotic pathogen and populations in the White and Inyo Mountains occur close to moderately high infection centers in the Sierra Nevada. However, the Great Basin bristlecone pine has shown high resistance to blister rust in laboratory tests, in part due to wax-occluded stomata. Great Basin bristlecone pine is susceptible to mountain pine beetle (*Dendroctonus ponderosae*), dwarf mistletoe, wood-rot basidiomycetes and wood decay fungi. The dry high-elevation sites of most Great Basin Bristlecone Pine currently serve to slow fungal growth and wood decay (Stritch et al. 2011).

State and Transition Model Narrative—Group 24

Reference State 1.0: The Reference State 1.0 is representative of the natural range of variability under pristine conditions. This Reference State has two general community phases: a dominant tree/shrub phase and a dominant tree/grass 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 long-term drought and/or insect or disease attack.

Community Phase 1.1:
This community phase is characterized by mature Great Basin bristlecone pine trees and limber pine trees. Gooseberry is the dominant shrub in the understory. Ross' sedge and bluegrasses are the dominant grasses. Common juniper, whitestem goldenbush and muttongrass are also common.

NV7785250 Phase 1.1 P.Novak-Echenique, August 2007

Community Phase Pathway 1.1a: A low severity, lightning strike would reduce a few trees and the shrubs in the understory and allow the sedges and perennial bunchgrasses to increase.

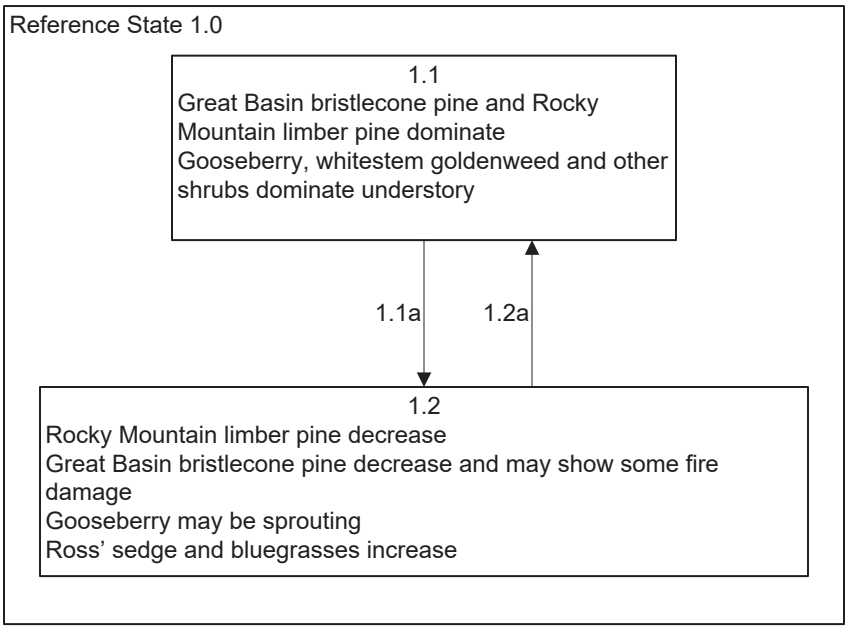
Community Phase 1.2:
Bristlecone pine trees may show some fire damage but will most likely survive a low intensity fire. Limber pine may be reduced but remain a major component of the overstory. Juniper is killed by fire and may take many years to reestablish. Sprouting shrubs such as currant and creeping barberry may be sprouting or increasing in the understory. Sedges and perennial bunchgrasses may be reduced the first season after fire but will likely increase in cover and density due to the reduced competition from shrubs and trees.

Community Phase Pathway 1.2a: Time without disturbance such as fire, long-term drought or disease will allow for the trees and shrubs to increase in height and density.

NV7785250 Phase 1.2 P. Novak-Echenique, August 2007

Potential Resilience Differences with other Ecological Sites

None – all sites will have the same states and community phases.



Key
Reference State 1.0 Community Phase Pathways
1.1a: Lightening strike and/or low severity fire
1.2a: Time and lack of disturbance

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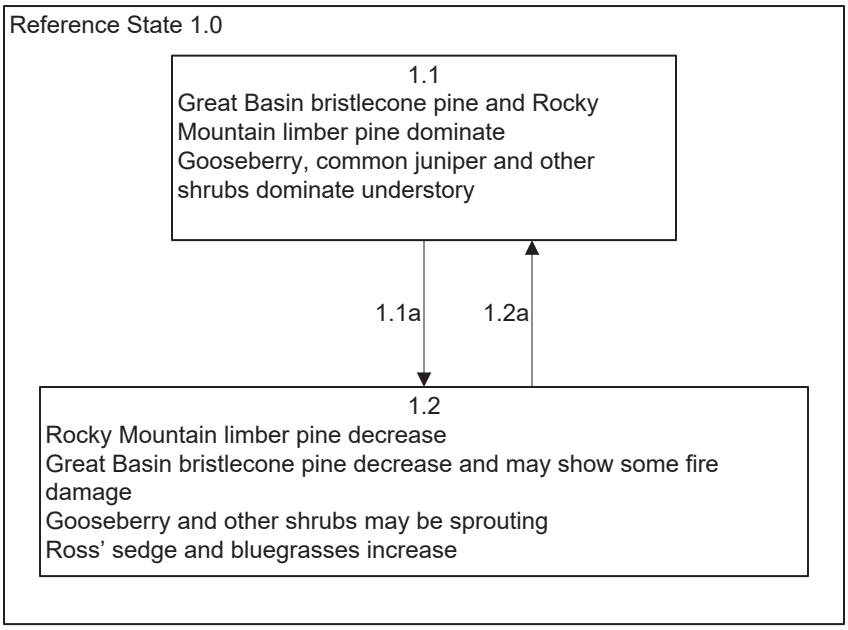

Key
Reference State 1.0 Community Phase Pathways
1.1a: Lightening strike and/or low severity fire
1.2a: Time and lack of disturbance