10190

Great Basin Pinyon-Juniper Woodland

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
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Reviewer: Louisa Evers

Vegetation Type

Forest and Woodland

Map Zones

6, 7, 9, 12, 16, 17, 18, 19

Geographic Range

This Biophysical Setting (BpS) occurs on dry mountain ranges of the southern Great Basin region (map zone [MZ] 12 and MZ17), eastern foothills of the Sierra Nevada (boundary area between MZ06 and MZ12), western foothills of the Wasatch Ranges (boundary area of MZ16 and MZ17), and extreme southeastern Idaho (MZ18). Utah juniper extends further northward into the southern parts of MZ07 and MZ09, where it hybridizes with western juniper but pinyon pine is absent.

Biophysical Site Description

Historically, pinyon-juniper woodlands occurred primarily on shallow rocky soils or rock-dominated sites that are protected from frequent fire (rocky ridges, steep slopes, broken topography, and mesa tops). Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. The soil temperature regime is typically mesic and frigid, and the soil moisture regime is typically aridic bordering on xeric and xeric.

Pinyon-juniper woodlands typically range from about 5,000-9,200ft (1,600-2,800 m) in elevation, bounded by montane shrub and forest settings at the upper elevations, and sagebrush and salt desert shrub settings at the lower elevations. Average annual precipitation ranges from 12-16in but can reach as high as 22in. Monsoonal moisture in summer allows the presence of pinyon and the extent of this BpS is determined by where the climatic precipitation regime is predominantly winter and summer, with spring and fall relatively dry. Utah juniper, the primary juniper species present, is more tolerant of drought than pinyon pine; as such, the lower elevations of this setting may lack pinyon.

Vegetation Description

Woodlands are dominated by a mix of pinyons and junipers, pure or nearly pure occurrences of pinyon, or woodlands dominated solely by juniper. Some 80% of the type consists of pinyon and juniper in combination, however. Singleleaf pinyon and Utah juniper is the most common combination, with Rocky Mountain juniper and two-needle pinyon appearing on the Colorado Plateau in the eastern portion of MZ17 where summer precipitation is higher. The amount of juniper tends to be relatively stable whereas the amount of pinyon fluctuates, declining under severe drought episodes. Overstory cover ranges from 25-50%, although cover was more typically on the lower end of the range, while the combination of bare ground, exposed rock, gravel, and litter ranges from 25-75%.

Curl-leaf mountain mahogany is a common associate. Understory layers are variable and differ between the northern and southern parts of the setting and upper and lower elevations, depending on the amount of summer precipitation. Understory layers are variable. Cool season bunchgrasses tend to prevail in the northern and western parts of the range where summer precipitation is lower and more variable, while the southern and eastern parts of the range, where summer precipitation is higher and less variable, contain more warm-season grasses. Associated species include shrubs such as *Arctostaphylos patula*, *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus ledifolius*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, and bunchgrasses *Hesperostipa comata*, *Festuca idahoensis*, *Pseudoroegneria spicata*, *Leymus cinereus* (=*Elymus cinereus*), and *Poa fendleriana*. *Quercus gambelii* and *Quercus turbinella* may be present in eastern woodlands of MZ17 and in MZ16.

Due to the lack of fuels in historical old-growth settings, fire was rare. Since the overstory conifers are very long-lived (800yrs to >1,000yrs), old-growth patches were primarily composed of later seral stages that did not occur as extensive woodlands. Old pinyon-juniper stands may take as much as 400yrs to develop. The age structure may vary from uneven to even-aged.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIMO | *Pinus monophylla* | Singleleaf pinyon |
| JUOS | *Juniperus osteosperma* | Utah juniper |
| ARTEM | *Artemisia spp.* | Sagebrush |
| SYOR | *Symphoricarpos orbiculatus* | Coralberry |
| CERCO | *Cercocarpus spp.* | Mountain mahogany |
| ACHNA | *Achnatherum spp.* | Needlegrass |
| HECO26 | *Hesperostipa comata* | Needle and thread |
| PSSP6 | *Pseudoroegneria spicata* | Bluebunch wheatgrass |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Most studies indicate that fire frequencies in this BpS were long, although there is uncertainty over those frequencies. Historically, both low-intensity surface fire and high-intensity crown fires were apparently rare. Most fires were small, mixed-severity fires that burned single trees or small groups. Occasionally, fires would spread from shrub- and grassland-dominated vegetation of lower elevations or forests and montane shrubs from higher elevations, affecting a larger portion of old stands and creating mixed stands of younger and older trees. Replacement fires required extreme burning conditions, likely in combination with severe drought. Limited evidence to date suggests that while lightning ignitions in this BpS may have been common, the resulting fires only rarely spread to affect more than a few trees.

Prolonged weather-related stress (drought mostly) and insects and tree pathogens are coupled disturbances that thin trees to varying degrees and kill small patches every 250-500yrs on average, with greater frequency in more closed stands.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 842 | 51 | 10 | 1000 |
| Moderate (Mixed) | 876 | 49 | 10 | 1000 |
| Low (Surface) |  |  | 5 | 1000 |
| All Fires | 429 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

The most common disturbance in this type is very small-scale -- either single-tree or small groups. If the conditions are just right, then it will have replacement fires that burn stands up to 1,000s of acres. This type may also have mixed-severity fires of 10-100s of acres.

Adjacency or Identification Concerns

This system occurs at lower elevations than Colorado Plateau Pinyon-Juniper Woodland (BpS 1016) where sympatric. Inter-Mountain Basins Juniper Savanna (BpS 1115) is generally found at elevations below the physiological tolerance of *Pinus monophylla*.

Infill and stand densification likely means that earlier successional classes cannot be reliably identified through remote sensing. Tree densities in historical woodlands may have increased as much as 10-fold.

Pinyon-juniper expansion has been so extensive into the Inter-Mountain Basins Montane Sagebrush (BpS 11260) and Inter-Mountain Basins Big Sagebrush Steppe (BpS 11250) as well as into other BpSs such as aspen and riparian areas that the probability of misclassification as Great Basin Pinyon-Juniper is very high. The degree of expansion into other BpSs is less well documented but has occurred to some degree. Some estimates indicate historically pinyon-juniper woodlands occupied only 10-30% of the central and southern Great Basin where pinyon-juniper is presently found. The combination of soil type (rock outcrop, talus or scree, lava blisters or flows, exposed sandstone), soil depth, and soil moisture and temperature regimes can be used to better identify the historical locations of Great Basin Pinyon-Juniper Woodland.

An additional screen would be tree and stand characteristics. Old juniper trees typically have rounded tops, unsymmetrical shapes, and spreading canopies that may be sparse with dead limbs or spike tops. The bark is deeply furrowed and fibrous. Height growth has largely ceased and bright green arboreal lichens often cover the branches. Black stain fungus and black lichens may be mistaken for char. These characteristics tend to develop around age 150 (+ or - 30). Standing dead trees and downed wood may be present but typically are sparse.

In contrast, pinyon-juniper stands that are the result of expansion into another BpS are characterized by occurrence on gentler landforms below rocky outcrops and ridges and by deeper, loamy soils. Stands have very few to no old trees, and trees are generally of multiple heights with junipers having conical, generally symmetrical shapes and pointed crowns. Bark is scaly, and furrows are shallow or absent. Dead wood is sparse to nonexistent in the absence of tree management.

Issues or Problems

There is much uncertainty in model parameters, particularly the fire regime. Recent research indicates that historical fire return intervals (FRIs) were very long, approaching 1,000yrs or more in some settings. Quantitative data are lacking, and research is ongoing. The literature for this ecological system's fire history is based on the chronologies from other pines species that are better fire recorders, growing under conditions that may not represent fire environments typical of infrequent-fire pinyon and juniper communities. For example, surface fire, which leaves scars on these other pine species (but not generally on fire-sensitive pinyon or juniper), has no effect on the dynamics of the model, although surface fire maintains the open structure of Class D and Class E by thinning younger trees.

Two major modern issues, climate change and invasive plant species (especially cheatgrass), lead to nonequilibrial vegetation dynamics for this BpS, making it difficult to categorize and usefully apply natural disturbance regimes. Sites with an important cheatgrass component in the understory experience greater fire frequency and will respond differently to fire. Further study is needed to better elucidate the independent and interactive effects of fire, insects, pathogens, climate, grazing, and anthropogenic impacts on historical and current vegetation dynamics in the Great Basin Pinyon-Juniper Woodland type.

Hugh Safford added that the extent of this system has changed significantly since the settlement era (Miller and Tausch 2000).

Native Uncharacteristic Conditions

In modern days, surrounding matrix vegetation has changed to young to mid-aged woodlands that burn more intensely than the former sagebrush matrix. Also occurring under post-settlement management of woodlands (includes both fire exclusion and the reduction of grasses that would prevent woody establishment) is the uncharacteristic growth of younger trees among older trees. These canopy closures allow fires to crown and kill older trees (>200yrs) that would normally not experience these fires in unproductive soils.

Shrub cover >50% is uncharacteristic for this BpS (added July 15, 2005, by Louis Provencher and Kelly Pohl).

Comments

During the 2016 BpS Review, Louisa Evers reviewed this model and made descriptive edits. Evers also suggested possible changes to the model including restructuring the succession classes and increasing the fire frequency. K. Blankenship evaluated the suggested changes and accepted the Evers model because 1) the age class ranges were supported by Hood and Miller (2007) and 2) the fire frequency and severity of the Evers model were supported by a synthesis paper on western pinon-juniper (Romme et al. 2009). The LANDFIRE National model included low-severity fires, which were extremely unlikely in pinyon-juniper woodlands (Romme et al. 2009). The old model also had an overall fire frequency of ~166 years, but Romme et al. (2009) conclude that fires were probably less frequent than this and in many pinyon-juniper woodlands could be measured in centuries.

Map zones 6, 7, 9, 12, 16, 17, 18, and 19 were combined during 2015 BpS Review. The primary difference between the original models was in the s-class mapping rules, which did not comply with LANDFIRE class breaks (e.g., some zones used 5% breaks) and mapping rules (some zones had overlapping height/cover combinations). S-class rules from MZ07 were used in the combined description because they complied with LANDFIRE rules.

Insects/disease are incorporated in the model in both "patch mortality" and "woodland thinning" manifestations and are intended to also represent associated drought mortality influences.

For LANDFIRE National, this model was developed by Peter Weisberg and reviewed by Louis Provencher for MZ12 and MZ17. It was accepted without changes by Krista Waid-Gollnick for MZ18 and reviewed again by Jon Bates.

LANDFIRE National review comments: Different experts offered that fire was much more frequent or much less frequent than proposed here and that min and max cover values per class were lower or higher. Experts argued strongly for less or more surface fire. Because the parameter values of the FRIs for surface fire, mixed-severity, and replacement fire are actually comparable to those of surrounding sagebrush systems (see descriptions for Wyoming big sagebrush, black sagebrush, and dwarf sagebrushes), the proposed FRIs were judged frequent enough and retained. The key parameter was the long FRI of replacement fire in Class D and Class E.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | UN | UN | UN | UN | UN | UN |
| Herb | 0.5-1.0 | A | A | A | A | UN | UN | UN | UN | UN | UN |
| Herb | >1.0 | A | A | A | A | UN | UN | UN | UN | UN | UN |
| Shrub | 0-0.5 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Shrub | >3.0 | B | B | C | C | C | UN | UN | UN | UN | UN |
| Tree | 0-5 | C | C | D | D | D | D | UN | UN | UN | UN |
| Tree | 5-10 | D | D | D | D | D | D | UN | UN | UN | UN |
| Tree | 10-25 | D | D | D | D | D | D | UN | UN | UN | UN |
| Tree | 25-50 | D | D | D | D | D | D | UN | UN | UN | UN |
| Tree | >50 | D | D | D | D | D | D | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 9 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| FEID | Festuca idahoensis | Idaho fescue | Lower |
| HECO26 | Hesperostipa comata | Needle and thread | Lower |
| ELEL5 | Elymus elymoides | Squirreltail | Lower |
| CHRYS9 | Chrysothamnus spp. | Rabbitbrush | Mid-Upper |
| ARTRV | Artemisia tridentata ssp. vaseyana | Mountain big sagebrush | Mid-Upper |
| ARTRW8 | Artemisia tridentata ssp. wyomingensis | Wyoming big sagebrush | Mid-Upper |
| PIMO | Pinus monophylla | Singleleaf pinyon | Upper |
| JUOS | Juniperus osteosperma | Utah juniper | Upper |

Description

This class includes an early development, post-fire community and a tree-establishment phase.

Initial post-fire community dominated by annual grasses and forbs; trees and shrubs are present with tree seedlings within the shrub crowns. Herb cover is typically 0-20%, and herb height may be >1m. Shrub/tree cover is 5-10%. Evidence of past fires, such as charred wood and charcoal, may be present. Site characteristics mean bare ground and exposed rock is very common and vegetation is patchy.

Phase 1 encroachment, early tree establishment. Dominated by shrubs such as rabbitbrush, perennial forbs, and grasses. Tree seedlings starting to establish on favorable microsites. Tree crowns begin to emerge above the shrubs in the latter part of this stage and are difficult to impossible to detect in satellite imagery and most other forms of remote sensing. Total plant cover remains low due to shallow unproductive soils and exposed rock. During multiyear drought periods, insects may reduce the extent of pinyon, opening the stand.

*Maximum Tree Size Class*  
None

Class B 12 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMO | Pinus monophylla | Singleleaf pinyon | Upper |
| JUOS | Juniperus osteosperma | Utah juniper | Upper |
| ARTEM | Artemisia | Sagebrush | Middle |
| CELE3 | Cercocarpus ledifolius | curl-leaf mountain mahogany | Middle |

*Description*

Phase 2 encroachment, increasing tree dominance. Shrub- (10-40% cover, .5-1.5m tall) and tree-dominated community with young juniper and pinyon seedlings becoming established. It is important to note that replacement fire at this stage does not eliminate perennial grasses. Mortality from insects, pathogens, and drought kill older trees.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class C 22 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMO | Pinus monophylla | Singleleaf pinyon | Upper |
| JUOS | Juniperus osteosperma | Utah juniper | Upper |
| CELE3 | Cercocarpus ledifolius | curl-leaf mountain mahogany | Middle |
| ARTEM | Artemisia | Sagebrush | Middle |

Description

Phase 3 encroachment, tree dominance. Community dominated by young to mature juniper and pine of mixed-age structure. Juniper and pinyon becoming competitive on site and beginning to affect understory composition. Tree pathogens and insects such as pinyon Ips become more important for woodland dynamics, including both patch mortality and thinning of isolated individual trees during periods of multiyear drought.

*Maximum Tree Size Class*  
Large 21-33" DBH

Class D 57 Late Development 2 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMO | Pinus monophylla | Singleleaf pinyon | Upper |
| JUOS | Juniperus osteosperma | Utah juniper | Upper |
| CELE3 | Cercocarpus ledifolius | curl-leaf mountain mahogany | Mid-Upper |
| ARTEM | Artemisia | Sagebrush | Lower |

Description

Old growth. Some sites dominated by widely spaced old juniper and pinyon, while elsewhere there are dense, old-growth stands with multiple layers. May have all-aged, multi-storied structure. Occasional shrubs with few grasses and forbs and often much rock. Understory depauperate and high amounts of bare ground present. Grasses present on microsites with deeper soils (>20in) with restricting clay subsurface horizon. Potential maximum overstory coverage is greater in those stands with pinyon as compared to those with only juniper. Stand is closed below ground.

Surface fire occurs when especially dry years follow wet years and will scar ancient trees but otherwise have no discernible impact. Tree pathogens and insects associated with multiyear drought conditions kill patches of trees.

*Maximum Tree Size Class*  
Very Large >33" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Mid1:OPN | 49 |
| Mid1:OPN | 50 | Late1:OPN | 99 |
| Late1:OPN | 100 | Late2:OPN | 199 |
| Late2:OPN | 200 | Late2:OPN | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:OPN | Early1:OPN | 0.003 | 333 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.002 | 500 | No | 0 |
| Insects or Disease | Mid1:OPN | Early1:OPN | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.0013 | 769 | No | 0 |
| Insects or Disease | Late1:OPN | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late1:OPN | Early1:OPN | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late2:OPN | Mid1:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:OPN | Late2:OPN | 0.001 | 1000 | No | 0 |
| Insects or Disease | Late2:OPN | Late1:OPN | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late2:OPN | Early1:OPN | 0.001 | 1000 | Yes | 0 |

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