10190

Great Basin Pinyon-Juniper Woodland

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |

Vegetation Type

Forest and Woodland

Map Zone

4

Geographic Range

This ecological system represents the westernmost extent of this widespread vegetation type. It occurs on arid, eastern, or desert-side slopes in the interior central coast and in montane areas of the Peninsular and Transverse ranges of Southern California.

Biophysical Site Description

System typically found at lower elevations ranging from 1,000-2,600m. This type generally occurred on well-drained rocky soils (foothills, low mountains, plateaus, and mesas) or rock-dominated sites protected from frequent fire (alluvial fans, pediments, rocky ridges, steep slopes, broken topography, mesa tops). Severe climatic events such as frost 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 and range from stony, cobbly, gravelly, sandy loams to clay loam or clay.

Vegetation Description

In this part of the range, there is a greater influence of Californian flora, with gradations into Joshua tree woodlands or desert scrub communities. These woodlands are dominated by a mix of *Pinus monophylla* and *Juniperus* spp., with *Juniperus californica* being more important than in Great Basin woodlands, especially at lower elevations (<2,000m), largely replacing *Juniperus occidentalis* and *J. osteosperma*,which are more dominant at higher elevations (>2,000m). Shrub cover within this habitat type is generally intermittent or open and the ground layer is sparse to grassy. The open shrubby understory consists of species commonly found in adjacent non-forested stands. Important shrubs include *Adenostoma fasciculatum*, *Artemisia tridentata*, *Arctostaphylos glauca*, *Ceanothus greggii* var*. vestitus*, *Cercocarpus betuloides*, *C. ledifolius*, *Chrysothamnus nauseosus*, *Coleogyne ramosissima*, *Eriogonum fasciculatum*, *Eriophyllum confertiflorum*, *Fremontodendron californicum*, *Garrya flavescens*, *Gutierrezia sarothrae*, *Nolina parryi*, *Purshia tridentata*, *Quercus dumosa*, *Q. turbinella*, *Q. wislizeni*, *Rhamnus crocea*, *Yucca baccata*,and *Y. schidigera*. Great Basin species are more dominant at higher elevations (>2,000m); desert chaparral (e.g., *Ceanothus greggii* ssp. *vestitus* and *Fremontodendron* *californicum*) are more important at lower elevations. In open areas, often between the tree and shrub layers, grows a diverse herbaceous understory of native annuals and perennials including *Achnatherum hymenoides*, *A. speciosum*, *Elymus elymoides*, *Eriogonum kennedyi*, *Hesperostipa comata*, *Opuntia basilaris*, *O. parryi*,and *Stylocline gnaphalioides*. Sites in the woodland with a grassy understory can potentially support relatively dense stands of *Poa fendleriana* ssp. *Longiligula* or *Achnatherum coronatum*.

Because disturbance was uncommon to rare in this ecological system and the overstory conifers may live for >1,000yrs, patches were composed primarily of later seral stages (Class D and Class E; discussed later) that did not occur as extensive woodlands and that should be distinguished from shrubland ecological sites encroached by pinyon or juniper during the past 150yrs. It is estimated that 400yrs is required for old juniper woodland stands to develop (Romme et al. 2002). The age structure may vary from uneven to even age. The overstory cover is normally <25%, although it can sometimes be greater. Large, intense fires may extirpate these stands or leave isolated patches or individuals. Re-colonization may require large tracts of connected habitat where seeds may be transported via animals. Furthermore, specific successional pathways after disturbance in pinyon stands are dependent on a number of variables such as available seed sources in the soil or adjacent areas, past management, plant species present at the time of disturbance and their individual responses to disturbance, site and climatic conditions throughout the successional process, and the type and size of disturbance.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIMO | *Pinus monophylla* | Singleleaf pinyon |
| JUOS | *Juniperus osteosperma* | Utah juniper |
| CELE | *Ceanothus lemmonii* | Lemmon’s ceanothus |
| ARTR2 | *Artemisia tridentata* | Big sagebrush |
| CEGRV | *Ceanothus greggii var. vestitus* | Mojave ceanothus |
| PUTR2 | *Purshia tridentata* | Antelope bitterbrush |
| FRCA6 | *Fremontodendron californicum* | California flannelbush |
| ERNA10 | *Ericameria nauseosa* | Rubber rabbitbrush |

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

Disturbance Description

Uncertainty exists about the fire frequency of this ecological system, especially because this system gathers together diverse types of pinyon-juniper communities that occur on different slopes, and at different exposures and elevations. Fire occurrence may be influenced by the composition of associated species, site location, and stand structure, and fire may spread from surrounding vegetation. Stands with limited understories can become fire resistant. For example, thinner stands below 2,000m, high-elevation stands above the shrubland zone, or those found on gentle slopes have less influence from crown fire. The primary reason for long fire intervals is low primary productivity, growth, and fuel accumulation rates. Low precipitation and poor soil fertility may also limit understory development, limiting fire spread, whereas greater understory cover leads to increased fire frequency.

The majority of fires that do occur are brief and short-lived, producing a mosaic of small, scattered burned patches within uniform old-growth stands. Replacement fire was uncommon to rare and occurred primarily during extreme fire behavior conditions. Very-high-severity fire occurred during severe weather and was characterized as a mosaic of replacement and surface fires distributed through the patch at a fine scale.

There was some disagreement between modeler and a reviewer about the influence of Native Americans on this type. Modeler felt that the influence of Native Americans was possibly responsible for the further lengthening of fire return intervals within this type. Some tribes traditionally pruned low-lying limbs, removed dead wood, raked litter and duff, and removed shrubs as a strategy to protect these trees from fire. Tribes relied on pine nuts as an essential food source and had to move from one stand to another because pine nut production is highly erratic. Also, due to the sparse nature of the fuels and Native American understanding of fire patterns, they didn’t have to do this type of clearing on the entire landscape for their work to be effective. A reviewer indicated that the influence of Native Americans in reducing fire intervals is uncertain and that, although Native Americans may have protected local favorite trees, they did not protect the forest.

Grazing has been important in that heavy grazing has increased the presence of sagebrush and rabbitbrush in the understory. Last, pinyon pine is subject to attacks by a host of pests and pathogens, most of which weaken, but only occasionally kill a tree.

In southern coastal California, there is a greater influence of Californian flora with, gradations into Joshua tree woodlands, sagebrush, or desert chaparral communities. These woodlands are dominated by a mix (segregated along elevational and moisture gradients) of *Pinus monophylla* and Juniperus spp., with *Juniperus californica* being more important than in Great Basin woodlands, especially at lower elevations (<1,500m), largely replacing *Juniperus occidentalis* and *J. osteosperma*, which are more dominant at higher elevations (>2,000m). Four-leaf pinyon pine (*Pinus quadrifolia*) occasionally occurs in this system in a narrow band on slopes with western drainage. Shrub cover within this habitat type is generally intermittent or open and the ground layer is sparse to grassy, although cover can exceed 60% in some areas. The open shrubby understory consists of species commonly found in adjacent non-forested stands (i.e., chaparral and sagebrush shrublands). Important shrubs include *Adenostoma fasciculatum*. This shrub is not dominant throughout the majority of the range of pinyon-juniper; however, in southern California, pinyon-juniper mixes with desert chaparral, one of whose dominants is *Adenostoma fasciculatum* and is perhaps more commonly associated with California juniper than with the pinyon, although it is found in stands of *Pinus quadrifolia*. Other important shrubs include *Artemisia tridentata*, *Arctostaphylos glauca*, *Ceanothus greggii* var. *vestitus*, *Cercocarpus betuloides*, *C. ledifolius*, *Chrysothamnus nauseosus*, *Coleogyne ramosissima*, *Eriogonum fasciculatum*, *Eriophyllum confertiflorum*, *Fremontodendron californicum*, *Garrya flavescens*, *Gutierrezia sarothrae*, *Nolina parryi*, *Purshia tridentata*, *Quercus dumosa*, *Q. turbinella*, *Q. wislizeni*, *Rhamnus crocea*, *Yucca baccata*, and *Y. schidigera*. Great Basin species are more dominant at higher elevations (>2,000m); desert chaparral (e.g., *Ceanothus greggii* ssp. *vestitus* and *Fremontodendron californicum*) is more important at lower elevations. In open areas, often between the tree and shrub layers, a diverse herbaceous understory grows comprised of native annuals and perennials, including *Achnatherum hymenoides*, *A. speciosum*, *Elymus elymoides*, *Eriogonum kennedyi*, *Hesperostipa comata*, *Opuntia basilaris*, *O. parryi*, and *Stylocline gnaphalioides*. Sites in the woodland with a grassy understory can potentially support relatively dense stands of *Poa fendleriana* ssp. *longiligula* or *Achnatherum coronatum*.

Because disturbance was uncommon to rare in this ecological system, and the overstory conifers may live for > 1000yrs, patches were primarily composed of later seral stages (Class D and Class E; described later) that did not occur as extensive woodlands and should be distinguished from shrubland ecological sites encroached by pinyon or juniper during the past 150yrs. It is estimated that 400yrs is required for old juniper woodland stands to develop (Romme et al. 2002). The age structure may vary from uneven to even age. The overstory cover is normally <25%, although it can sometimes be greater.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 632 | 32 | 10 | 1000 |
| Moderate (Mixed) | 461 | 43 | 10 | 1000 |
| Low (Surface) | 803 | 25 | 5 | 1000 |
| All Fires | 200 | 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

This system can occupy large areas (>5,000ac). The most common disturbance in this type is very small scale -- either single trees or small groups. If the conditions are just right, then it replacement fires may 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 represents the western limit of Great Basin Pinyon-Juniper Woodland (BpS 1019) wherein the California flora becomes more important. This ecological system also grades into the Sonora-Mojave Semi-Desert Chaparral (BpS 1108), which occurs in the western Mojave. *Pinus monophylla* drops out and *Juniperus californica* becomes part of the California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna (BpS 1114) in the Coast Ranges and the California Central Valley Mixed-Oak Savanna (BpS 1112) in the Central Valley. Great Basin Xeric Mixed-Sagebrush Shrubland (BpS 1079) intergrades with this system on desert-facing slopes and on interior portions where salinity and riparian conditions do not exist.

Approximately 60% of the time, succession flows as indicated by the model, in which Great Basin species provide early-seral species. In the remaining 40% of the total area dominated by this system, the remaining surrounding communities supply the primary succession species, with Sonora-Mojave Semi-Desert Chaparral (25% of the total) species being the most common. Some authors have noted that chaparral species such as *Adenostoma sparsifolium* are present in areas with repeated burns.

Issues or Problems

Several authors have noticed the effect of aspect and elevation on all stages of this community. Northern and eastern slopes tend to support a greater cover and occurrence of shrubs, perennial grasses, and perennial forbs, whereas southern and western slopes generally have a high cover and occurrence of annual forbs and annual grasses. Lower elevation communities include more species from the desert chaparral community, and high-elevation sites tend to slow pinyon establishment by 10-15yrs. In addition, the variability in tree- and shrub-dominated communities described as “pinyon-juniper” complicates the extrapolation of any results to sites of different growing conditions. On some sites the overstory does not recover even after 20 yrs; it does recover only after the shrub layer senesces (>60 yrs). Large, intense fires may extirpate these stands or leave isolated patches or individuals. Re-colonization may require large tracts of connected habitat where seeds may be transported via rodents for juniper species. In pinyon-dominated areas, however, this connectivity may not be as important, because corvids provide dispersal for these species. Furthermore, specific successional pathways after disturbance in pinyon stands are dependent on a number of variables, such as available seed sources in the soil or adjacent areas, past management, plant species present at the time of disturbance and their individual responses to disturbance, site, and climatic conditions throughout the successional process, and the type and size of disturbance. 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 pinyon-juniper woodland type.

Two major modern issues, climate change and invasive plant species (e.g., cheatgrass [*Bromus* *tectorum*] and red brome [*B. madritensis* ssp. *rubens*]), can potentially lead to non-equilibrial vegetation dynamics for this ecological system, making it difficult to categorize and apply natural disturbance regimes usefully. Sites with an important non-native annual component in the understory experience greater fire frequency and respond differently to fire. Currently, this is not an issue in this map zone (MZ) above 1,000m and thus is not a problem in this community as of yet (see later discussion for an example). However, due to climate change, these species may become more dominant at higher elevations and may become a significant ecological factor.

As seen recently (e.g., Pioneertown fire, July 2006), large fires can take place in pinyon-juniper as a result of increased native herbaceous fuels. The winter of 2004-02005 was a once-in-a-century event of heavy rainfall that produced a phenomenal ground layer of dried wildflowers (mixed with some invasive species) that primarily fueled this 80,000-ac fire. Hence, one must also accept that, although these invasive species have the potential to modify local and regional fire regimes, this has not occurred within this MZ as of yet. Biomass from native annuals doubtlessly carried large fires across the California deserts at Holocene timescales, but infrequently after rare, very wet winters. Red brome was not a major player in the Pioneertown fire. It had been greatly diminished by extreme drought in 1996-1997 and 1999-2002 compared to its abundance and distribution in California during the 1980s and 1990s. In the Pioneertown fire, brome was most abundant around disturbed ground around the town proper, but the surrounding slopes were covered with *Amsinkia* and other forbs.

Native Uncharacteristic Conditions

Comments

The MZ04 model was initiated from the MZ06 model by Weisberg. Substantial changes to the description resulted in a change in primary authorship, but Weisberg’s name is listed to recognize his contribution to this model.

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 | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | B | B | B | C | C | C | C | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | B | C | C | C | C | UN | UN | UN |
| Shrub | 1.0-3.0 | B | B | B | C | C | C | C | UN | UN | UN |
| Shrub | >3.0 | B | B | B | C | C | C | C | UN | UN | UN |
| Tree | 0-5 | C | C | C | C | C | C | UN | UN | UN | UN |
| Tree | 5-10 | D | D | D | D | D | D | UN | UN | UN | UN |
| Tree | 10-25 | E | E | E | E | E | E | UN | UN | UN | UN |
| Tree | 25-50 | E | E | E | E | E | E | UN | UN | UN | UN |
| Tree | >50 | E | E | E | E | E | E | 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 1 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CEGRV | Ceanothus greggii var. vestitus | Mojave ceanothus | Upper |
| PUTR2 | Purshia tridentata | Antelope bitterbrush | Upper |
| FRCA6 | Fremontodendron californicum | California flannelbush | Upper |
| ERNA10 | Ericameria nauseosa | Rubber rabbitbrush | Upper |

Description

Initial post-fire community dominated by shrubs (resprouts and seedlings) and forbs. Later stages of this class contain greater amounts of perennial grasses and forbs, with shrub cover and density continuing to increase. Evidence of past fires (burnt stumps and charcoal) should be observed. Surface fire occurring every 5-10yrs on average (due to Native American influence) maintains this class as a small subset of the stand (this was not modeled).

Replacement fire occurs.

*Maximum Tree Size Class*  
None

Class B 5 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CEGRV | Ceanothus greggii var. vestitus | Mojave ceanothus | Mid-Upper |
| PUTR2 | Purshia tridentata | Antelope bitterbrush | Mid-Upper |
| ERNA10 | Ericameria nauseosa | Rubber rabbitbrush | Upper |
| ARTR2 | Artemisia tridentata | Big sagebrush | Upper |

Description

Dominated by shrubs, perennial forbs, and grasses. Tree seedlings starting to establish on favorable microsites (e.g., beneath “nurse” shrubs). Total cover and density continues to increase except on shallow, unproductive soil.

It is important to note that replacement fire at this stage does not eliminate perennial grasses. Mixed-severity fire thins the woody vegetation but does not change its succession age.

*Maximum Tree Size Class*  
None

Class C 32 Mid Development 2 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMO | Pinus monophylla | Singleleaf pinyon | Upper |
| JUOS | Juniperus osteosperma | Utah juniper | Upper |
| CELE | Ceanothus lemmonii | Lemmon’s ceanothus | Middle |
| ARTR2 | Artemisia tridentata | Big sagebrush | Middle |

Description

Shrub and tree-dominated community with young juniper, pinyon seedlings, and saplings becoming established. Shrub cover and density peaks and begins to decline during this phase as trees begin to dominate.

It is important to note that replacement fire at this stage does not eliminate perennial grasses. Mixed-severity fire noted. Mortality from insects, pathogens, and drought cause transitions by killing older trees.

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

Class D 25 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 |
| CELE | Ceanothus lemmonii | Lemmon’s ceanothus | Middle |
| ARTR2 | Artemisia tridentata | Big sagebrush | Middle |

Description

Community dominated by young to mature juniper and pine of mixed age structure. In this class, juniper and pinyon are becoming competitive and beginning to affect understory composition.

Mixed-severity fire is less frequent than in previous states and maintains vegetation. Surface fire is infrequent and does not change successional dynamics (recovery to pre-fire conditions in <5yrs). Tree pathogens and insects (i.e., black stain root disease [significant in the San Bernardinos; deemed second only to stand-replacing fires as a mortality agent in pinyon]) and pinyon ips (which may be a disease vector) become more important for woodland dynamics to occur -- including both patch mortality and thinning of isolated individual trees.

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

Class E 37 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 |
| CELE | Ceanothus lemmonii | Lemmon’s ceanothus | Mid-Upper |
| ARTR2 | Artemisia tridentata | Big sagebrush | Lower |

Description

Some sites dominated by widely spaced old juniper and pinyon whereas elsewhere there are dense, old-growth stands with multiple layers. May have all-age, multi-story 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 stands with pinyon compared to those with juniper only.

Replacement fire and mixed-severity fires are rare. Surface fire occurs when especially dry years follow wet years, and ancient trees are scarred. Tree pathogens and insects associated with drought conditions kill patches of trees and individual trees. This class maintains in the absence of disturbance.

*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 | 9 |
| Mid1:OPN | 10 | Mid2:OPN | 29 |
| Mid2:OPN | 30 | Late1:OPN | 149 |
| Late1:OPN | 150 | Late2:OPN | 299 |
| Late2:OPN | 300 | 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 | 0.0022 | 455 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.0025 | 400 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:OPN | 0.0025 | 400 | Yes | 0 |
| Insects or Disease | Mid2:OPN | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Mid2:OPN | Mid2:OPN | 0.0025 | 400 | No | 0 |
| Replacement Fire | Mid2:OPN | Early1:OPN | 0.0025 | 400 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:OPN | 0.001 | 1000 | Yes | 0 |
| Insects or Disease | Late1:OPN | Mid2:OPN | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late1:OPN | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.002 | 500 | No | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.002 | 500 | No | 0 |
| Insects or Disease | Late2:OPN | Mid2:OPN | 0.001 | 1000 | Yes | 0 |
| Insects or Disease | Late2:OPN | Late1:OPN | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late2:OPN | Early1:OPN | 0.001 | 1000 | Yes | 0 |
| Surface Fire | Late2:OPN | Late2:OPN | 0.002 | 500 | No | 0 |
| Mixed Fire | Late2:OPN | Late2:OPN | 0.002 | 500 | No | 0 |

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