10270

Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
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Reviewer: Ecologists at U.S. Forest Service Region 5

Vegetation Type

Forest and Woodland

Map Zones

4, 5, 6

Geographic Range

This type occurs throughout California and into southern Oregon and westernmost Nevada. In southern California, this Biophysical Setting (BpS) includes small stands in the south coast ranges (e.g. Mt. San Benito, San Benito Co.; Big Pine Mtn., Santa Barbara Co.; Pine Mtn., Ventura Co.; Palomar Mountain, San Diego Co.; Cuyamaca Mountains, San Diego Co.) and larger stands in the San Gabriel and the San Bernardino mountains and the San Jacinto and San Pedro Mártir ranges (Baja California) of the Peninsular Ranges.

This particular model and description applies within the East Cascades-Modoc Plateau ecoregion and throughout California except within the Klamath Mountains and California North Coast ecoregions.

Biophysical Site Description

This type occurs on all aspects in lower montane zones from about 600-1,800m elevation in northern California and southern Oregon to above 1,500m in southern California. This system occurs in a variety of topo-edaphic positions but tends to occur on relatively warmer and drier slopes (including ridgetops and convex slopes) except at its lower elevations where it may occur on north slopes. Except at lower elevations, it is replaced by mesic mixed conifer forest on north slopes, in canyons, and in other locations with moister soils and higher site productivity. Upper elevations defined by ecotone with red fir and lodgepole.

Vegetation Description

Mixed conifer forests are typically composed of three or more conifer species, with ponderosa pine, sugar pine, incense cedar, white fir, and Douglas-fir being the most important. California black oak is also an important component. Canyon live oak is found in steep, rocky soils at lower elevations. Douglas-fir is not a major component and drops out south of Yosemite National Park. Incense cedar may compose a larger proportion of BpS in the south. Other conifers that can occasionally be present include *Pinus jeffreyi*, *P. contorta*, *P. attenuata*, *P. coulteri*, and *Pseudotsuga macrocarpa* (the latter two found at the southern end of the range). *P. jeffreyi* is found in drier, colder locations and in northwestern California and southwestern Oregon is found almost exclusively on ultramafic (“serpentine”) soils. *P. contorta* (lodgepole pine) is most common near waterbodies, at upper elevations.

Common sub-canopy trees include *Quercus kelloggii* and *Q. chrysolepis*. *Arbutus menziesii* commonly occurs in the northern extent and in Oregon. Understory shrubs can include poison oak, *Ceanothus integerrimus*, *C. velutinus*, *C. cordulatus*, *Arctostaphylos pringlei*, *Arctostaphylos viscida*, *Chamaebatia foliolosa*, Chinquapin (*Chrysolepis sempervirens*), *Symphoricarpos mollis*, and *Ribes* spp. In northwestern California and Oregon, *Holodiscus discolor* and *Berberis* spp. can occur. Herbaceous species are varied and generally sparse and may include *Carex multicaulis*, *Elymus glaucus*, *Aster foliosus*, *Solidago californica*, *Festuca californica*, *Elymus glaucus*, and *Whipplea modesta*.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIPO | *Pinus ponderosa* | Ponderosa pine |
| PILA | *Pinus lambertiana* | Sugar pine |
| QUKE | *Quercus kelloggii* | California black oak |
| CADE27 | *Calocedrus decurrens* | Incense cedar |
| ABCO | *Abies concolor* | White fir |
|  |  |  |

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

Disturbance Description

Historical fire regimes were similar to mesic mixed conifer types (BpS 1028) but with less mixed- and high-severity fire and more surface fire. In their summary of pre-settlement fire regimes for California, Van de Water and Safford (2011) report a mean fire return interval (FRI) of 11yrs, a mean minimum FRI of 5yrs, and a mean maximum FRI of 50yrs for dry mixed conifer based on review of 38 studies.

Surface fire occurs at an average generally between 5-10yrs; mixed-severity occurs about every 50yrs; replacement fires were relatively rare. While model is aspatial, most medium- and high-severity fire may actually occur on mid- and upper-slope positions (Taylor and Skinner 1998; Taylor 2000; Bekker and Taylor 2001). This BpS becomes drier along a north-to-south gradient and therefore supports a little more mixed- and high-severity fire in the north. Fire regimes in this type varied with the ratio of lightning to human ignitions and the balance between ignitions, climate, and site productivity.

Insect/pathogen drought-related mortality occurs every 7-10yrs. More severe events that could open up late-seral closed stands occur about every 100yrs. However, this disease estimate is from contemporary stands and is probably conditional on the legacy of fire suppression. When a tree dies, it is lost from the historical record, so we don’t know how important the insect/pathogen and drought-related transitions are relative to the fire transitions in the historical state. The presence of an insect/disease transition in the state-and-transition model in the late-seral closed state is used to represent that this transition probably occurred, although the rate at which it occurred historically is not known and its current effect could be different. With historic fire regimes, insect outbreaks may have been much reduced compared to current conditions.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 150 | 7 |  |  |
| Moderate (Mixed) | 36 | 31 |  |  |
| Low (Surface) | 17 | 62 |  |  |
| All Fires | 11 | 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

Small patch size (<1-10ac) mosaic, driven by variations in topography and soils, historic fire patterns and fire intensity, and insect/pathogen-related mortality. Relatively rare occurrence of patches >100ac, driven by extreme weather events and fuel continuity. At lower elevations, may occur in patchy mosaic with chaparral and oak woodland types.

Adjacency or Identification Concerns

This type is found at similar elevations to Mediterranean California Mesic Mixed Conifer Forest and Woodland (BpS 1028), although it extends to lower elevations than the latter and does not extend as high. The principal difference between the Dry-Mesic and Mesic Mixed Conifer types is moisture balance. For mapping in the central Sierra Nevada, a first (very coarse) approximation of splitting the two types could be based on putting the Mesic above 1,000mm precipitation and the Dry-Mesic below. Ideally, mapping could be based on climatic water deficit or some similar/related variable.

This BpS may be adjacent to chaparral, oak woodland, and grassland types or mixed evergreen forests at lower elevations and extends to the red fir forests of the upper elevations.

In many southern California mountains, there is an ecotone with chaparral, particularly where the type occurs at lower elevations and there is an abrupt slope exposure difference (chaparral south slope vs. dry-mesic mixed conifer on north slope). It is assumed that this boundary has changed historically and has been blurred by more Class A and Class B stands being produced following high-intensity and relatively high-frequency fires in the chaparral-forest interface.

CALVEG types that are included in the model are MP, PP, and QK.

Issues or Problems

It is difficult to generalize across the latitudinal range of mixed-conifer forests -- there is a considerable variation in the frequency of fire by fire type as you go from north to south. It is unknown if there is a need for a northern (latitude) versus a southern mixed conifer BpS. Literature inferences suggest that "north" slopes, perhaps especially in the northern Sierra Nevada through the Klamath region, have a longer fire regime and larger patch size than estimated by work in the southern and central Sierra Nevada. Likewise, the Klamath region literature also indicates that the topographic complexity also contributes to disparity between the two types; aspect plays a more significant role there in determining differences in fuel loading and fire severity, particularly in the southern portions to be replaced by elevation in the most northern extent of this type. Even though a mean fire return interval difference may exist between north and south aspects, Skinner and Taylor (1998) found that the numbers were not statistically significant in their study. Difference in severity between aspects may be more important. It is suspected that these same issues occur in the Transverse and Peninsular ranges and the few south coast range mountains where elevations are high enough. It is also unclear whether a distinct model is needed for this BpS in the East-Cascades Modoc Plateau ecoregion. During the 2016 review, Forest Service region 5 ecologists decided that this one model could adequately represent the BpS throughout most of California (i.e., East Cascades-Modoc Plateau and Sierra Nevada ecoregions and areas further south). A separate model is used to represent the BpS in areas at the northwestern end of the range (Klamath Mtns., California North Coast ecoregion, etc.).

Due to the vegetative effects of the mixed-severity fire regime, mapping is difficult. Also, the limitations of the LANDFIRE modeling process (fuel accumulation, five boxes, and inability to model climate variability) prevent our representing some of the nuance of this system. As a result, replacement fire appears to be too short, but the overall fire regime and landscape proportions are representative.

California Montane Woodland and Chaparral (BpS 1098) can be regarded as a successional stage (Class A) within this BpS, but reviewers in map zone (MZ) 3 and MZ04 suggested the need for a separate class representing chaparral. They stated that there are very different transition probabilities to get “mid-aged” trees from chaparral versus little trees without much chaparral or grass/herbs. In both the Klamath Mountains and the Sierra Nevada, there are plenty of brush fields that don’t have regeneration for a century or more, even without fire. Other sites can be encroached upon within a century, especially on more mesic sites. This phenomenon of dry mixed conifer arrested succession may be even truer in southern California than to the north and in the mesic mixed conifer. Not having a chaparral class weakens the model, but given the imposed modeling constraints (e.g. no more than five classes can be used to represent a system), a limited-functional model is all that may be possible. The dry mixed conifer system of California may simply be too complex to be meaningfully modeled as per the imposed constraints. See the Comments section for additional information on this topic.

Native Uncharacteristic Conditions

In southern Oregon, uncharacteristic conditions included: high density of Douglas-fir and loss of pine species due to selective logging; conversion to hardwood types by historic logging; past prolonged fire-free interval; and subsequent severe fire in some areas.

In the southern California mountains and southern Sierra Nevada, there has been an uncharacteristic loss of ponderosa and sugar pine due to selective logging and drought-related death by insects and disease.

Comments

During the 2016 review period, Forest Service Region 5 ecologists suggested that only two models were needed to represent the Mediterranean California Dry-Mesic Mixed Conifer forests in California: one model to represent most of California (i.e., East Cascades-Modoc Plateau and Sierra Nevada ecoregions and areas further south) and one to represent the wetter, more productive areas at the northwestern end of the range (Klamath Mtns., California North Coast ecoregion, etc.). The BpS models and descriptions were adjusted accordingly.

The review revived debate about the successional status of chaparral within mixed conifer forest as noted in the Issues and Problems section. Forest Service reviewers felt the Montane Chaparral BpS (1098) was almost always successional to conifers and did not need a separate model, except possibly on serpentine soils. NatureServe staff, responsible for the Ecological Systems classification, indicated that Montane Chaparral is a distinct concept because of its geophysical setting and resulting floristic composition. It occurs across rocky and very thin-soil conditions that take centuries (if ever) to develop a closed tree canopy. The Ecological Systems description indicates that major fire events can open up areas and enable this type to occur as larger patches than previously, but it’s generally distinguishable (on the ground, floristically) from the successional patches where soils are better developed and where they close in as forest within decades. Finally, NatureServe staff indicated that plot data would help mappers distinguish Montane Chaparral from other successional shrublands among existing vegetation. Kori Blankenship was unable to resolve this debate and did not make any changes to either the mixed conifer BpS (10270 and 10280) or the Montane Chaparral (1098). Future review should reconsider this issue.

LANDFIRE National information for this BpS in southern California was taken from the model (10270) that was originally created for MZ04 by Todd Keeler-Wolf (tkwolf@dfg.ca.gov) and Hugh Safford (hughsafford@fs.fed.us) and reviewed by Joe Sherlock (jsherlock@fs.fed.us) and Richard Minnich (Richard.Minnich@ucr.edu). Information for this BpS in southern Oregon was taken from the model (10270) that was originally created for MZ02, MZ03, and MZ07 by Darren Borgias (dborgias@tnc.org), Tim Bradley (tim\_bradley@nps.gov), and Steve Norman (snorman@fs.fed.us) and reviewed by Diane White (dewhite01@fs.fed.us), Charley Martin, Ed Reilly, Hugh Safford (hughsafford@fs.fed.us), and Dave Schmidt.

The 50% canopy cover break between the open and closed states in this BpS was chosen intentionally because it is used in California forest management plans.

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 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | A | A | A | A | A | A | A | A |
| Tree | 5-10 | A | A | A | A | A | A | A | A | A | A |
| Tree | 10-25 | C | C | C | C | C | B | B | B | B | B |
| Tree | 25-50 | D | D | D | D | D | E | E | E | E | E |
| Tree | >50 | D | D | D | D | D | E | E | E | E | E |

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 21 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PILA | Pinus lambertiana | Sugar pine | Upper |
| QUKE | Quercus kelloggii | California black oak | Mid-Upper |
| ARPA6 | Arctostaphylos patula | Greenleaf manzanita | Mid-Upper |

Description

Early succession, after localized mortality or mixed-severity fire, comprised of grass, shrubs, and tree seedlings, saplings, and poles. This stage can occur as small patch (10-100ac) within mixed-severity fire or less likely as large patches from more extensive fire (100-1000ac). This class includes the California Montane Woodland and Chaparral (BpS 1098).

In some cases, tree seedlings may develop a nearly continuous canopy and succeed relatively quickly to mid-development conditions. In other cases, chaparral conditions may dominate Class A and persist for long periods of time. Shrub species may include: *Ceanothus* spp.; *Arctostaphylos patula*; *A. viscida*; and *Quercus vaccinifolia*. Snags are typically present.

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

Class B 8 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PILA | Pinus lambertiana | Sugar pine | Upper |
| CADE27 | Calocedrus decurrens | Incense cedar | Mid-Upper |
| ABCO | Abies concolor | White fir | Low-Mid |

Description

Pole- to large-sized conifers. These stands develop as an alternate successional pathway in settings and climatic periods that support longer intervals between mixed-severity fires -- a fire-free interval of ~30yrs. They can be crowded stands of conifers along with hardwood trees in younger stages.

Ladder fuels and sub-canopy height can be low enough for crown fire initiation. Depauperate understory. Surface fuel moderate and complex.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class C 26 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PILA | Pinus lambertiana | Sugar pine | Upper |
| CADE27 | Calocedrus decurrens | Incense cedar | Mid-Upper |
| QUKE | Quercus kelloggii | California black oak | Mid-Upper |

Description

Pole- to large-sized conifers. These stands develop as the typical succession pathway with frequent, low-severity fires. Open stands of predominantly pines, with hardwood trees scattered throughout. *Calocedrus decurrens* can be very sparse or quite common. Rich herbaceous and woody understory, and native grasses and forbs are favored with frequent fires. Surface fuel light and complex.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class D 41 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PILA | Pinus lambertiana | Sugar pine | Upper |
| CADE27 | Calocedrus decurrens | Incense cedar | Mid-Upper |
| QUKE | Quercus kelloggii | California black oak | Mid-Upper |

Description

Overstory of large and very large trees. Occurring in small to moderately sized patches on southerly aspects and ridge tops. Multi-aged. These stands develop as the typical succession pathway with frequent, low-severity fires. Open stands of predominantly pines, with hardwood trees very patchy, in younger stages, persisting in protected sights, on knolls and noses with many scars. *Calocedrus decurrens* can be very sparse or quite common. Rich herbaceous and woody understory. Native grasses and forbs are favored with frequent fire. Surface fuel is light and complex.

Lidar data for California national forests suggest that the minimum height in this class is 32-40m. The 33m height aligns with 25in DBH break in eastern Sierra and 33in or larger DBH elsewhere.

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

Class E 4 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIPO | Pinus ponderosa | Ponderosa pine | Upper |
| PILA | Pinus lambertiana | Sugar pine | Upper |
| ABCO | Abies concolor | White fir | Mid-Upper |
| CADE27 | Calocedrus decurrens | Incense cedar | Mid-Upper |

Description

Overstory of large and very large trees with a multi-layered complex canopy structure. Occurring in small to moderately sized patches on north aspects and lower slope positions. These stands develop as an alternate succession pathway in settings and climatic periods that support longer intervals between mixed severity fires – fire-free interval of >35yrs. Crowded stands of conifers can overtop the hardwood layer. At the northern extent of this BpS, Douglas-fir dominates the canopy and begins to edge out the other species. Understory characterized by medium- and smaller-sized shade-tolerant conifers. Hardwoods begin to be shaded out. Undergrowth is highly variable from depauperate to quite dense, depending on canopy density and local site conditions.

Ladder fuels and sub-canopy height are low enough for crown fire initiation in most stands. Surface fuel moderate to high and complex.

Lidar data for California national forests suggest that the minimum height in this class is 32-40m. The 33m height aligns with 25in DBH break in eastern Sierra and 33in or larger DBH elsewhere.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 49 |
| Mid1:OPN | 25 | Late1:OPN | 129 |
| Mid1:CLS | 50 | Late1:CLS | 99 |
| Late1:CLS | 100 | Late1:CLS | 999 |
| Late1:OPN | 130 | Late1: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** |
| Alternative Succession | Early1:ALL | Mid1:OPN | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | No | 0 |
| Alternative Succession | Early1:ALL | Mid1:CLS | 0.01 | 100 | Yes | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Mid1:CLS | 1 | 1 | Yes | 32 |
| Insects or Disease | Mid1:OPN | Mid1:OPN | 0.002 | 500 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0032 | 313 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.03 | 33 | No | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.0678 | 15 | No | 0 |
| Insects or Disease | Mid1:CLS | Mid1:OPN | 0.001 | 1000 | Yes | 0 |
| Insects or Disease | Mid1:CLS | Mid1:CLS | 0.004 | 250 | No | 0 |
| Mixed Fire | Mid1:CLS | Mid1:CLS | 0.0098 | 102 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.0136 | 74 | Yes | 0 |
| Surface Fire | Mid1:CLS | Mid1:CLS | 0.0272 | 37 | No | 0 |
| Mixed Fire | Mid1:CLS | Mid1:OPN | 0.04 | 25 | Yes | 0 |
| Alternative Succession | Late1:OPN | Late1:CLS | 1 | 1 | Yes | 35 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0008 | 1250 | Yes | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.001 | 1000 | No | 0 |
| Mixed Fire | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.03 | 33 | No | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.09 | 11 | No | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.003 | 333 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:CLS | 0.003 | 333 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0063 | 159 | Yes | 0 |
| Mixed Fire | Late1:CLS | Early1:ALL | 0.0148 | 68 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:CLS | 0.017 | 59 | No | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.0221 | 45 | No | 0 |

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