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Mediterranean California Mixed-Evergreen Forest -- Interior

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

2, 3, 6, 7

Model Splits or Lumps

The Mediterranean California Mixed-Evergreen Forest is a major biophysical setting (BpS) from southwest Oregon through northwest California that spans broad environmental gradients in precipitation, temperature, and topography. Throughout its range, precipitation generally decreases and temperature generally increases north to south and west to east. The average annual rainfall varies from >120in/yr to 40in/yr (Jimerson et al. 1996; Atzet et al. 1996) and mean monthly temperatures can be as low as 30°F at upper elevation inland locations in the winter to 72°F in the summer (Jimerson et al. 1996).

To address some of this variability, LANDFIRE has split the Mediterranean California Mixed-Evergreen BpS into a Coastal type and an Interior type, acknowledging that even these two variants encompass a broad range of climate and site potentials. Atzet et al. (1996) and Jimerson et al. (2006) recognized a similar distinction in their plant association guides for southwest Oregon and northwest California. Atzet et al. distinguished a group of drier, cooler, inland tanoak associations from the wetter, warmer coastal tanoak associations. Jimerson et al. recognized a warmer, drier Douglas-fir sub-series and a cooler, wetter tanoak sub-series.

The Coastal/Interior split is used to represent differences in species composition, successional rates, and fire regimes, primarily due to fire and climatic (precipitation and frost) limitations on tanoak survival and competitive edge. The Coastal type occupies an area with a more maritime influence, generally found west of the Coast Range crest or in inland coves on northerly aspects (typically <2,000ft in elevation in southwest Oregon [Atzet et al. 1996]). The Interior type is generally found east of the Coast Range crest and at higher elevations, where the maritime influence diminishes and sites are relatively drier.

Geographic Range

This BpS covers large areas of southwest Oregon and northwest California interior landscapes generally east of the Coast Range crest. It occupies large parts of the Rogue River-Siskiyou National Forest, and the west side of the Klamath and Six Rivers National Forests (Jimerson et al. 1996). This model includes parts of map zones 2 and 3.

Biophysical Site Description

The distribution of this BpS is influenced by the maritime climate, but it does not exist on the coast itself. It occurs on hot and dry or cold and dry sites, on a variety of slopes with variable geology. It is found on Franciscan Formation soils (meta-sedimentary sandstones, schists, and shales [NatureServe 2015]). Soils are generally shallow and skeletal, and retain little water. In southwest Oregon, this BpS typically occupies an elevation range of 2,000-4,000ft and is most common around 3,000ft (Atzet et al. 1996). In northwest California, this BpS can be found up to 6,000ft in elevation (Jimerson et al. 1996).

Vegetation Description

This type is characterized by the combination of coniferous and broadleaf evergreen trees. Characteristic trees include *Pseudotsuga menziesii*, *Lithocarpus densiflorus*, *Arbutus menziesii*, *Quercus chrysolepis*, and *Chrysolepis chrysophylla*. Species composition is primarily determined by the environmental gradients of temperature and moisture availability. Black oak (*Quercus kelloggii*) and live oak (*Quercus chrysolepis*) are found on drier sites on the inland portion of the range. Sugar pine (*Pinus lambertiana*) and ponderosa pine (*Pinus ponderosa*) can be present in this type. Late-seral stands are generally open (<35% overstory cover); hence, this type is close to a woodland in character. The more northerly stands tend to have dense or diverse shrub understories, with *Rhododendron macrophyllum*, *Gaultheria shallon*, *Quercus sadleriana*, *Mahonia nervosa*, and *Toxicodendron diversilobum* being common.

Southwest Oregon Plant Associations (Atzet et al. 1996) included in this type are:

SWOPAG	Plant Association	PAG Name
1501	LIDE3-ABCO/BENE2	Tanoak-Canyon Live Oak and/or Sadler Oak
1501	LIDE3-CACH6-PILA	Tanoak-Canyon Live Oak and/or Sadler Oak
1501	LIDE3-CACH6/GASH-QUSA2	Tanoak-Canyon Live Oak and/or Sadler Oak
1501	LIDE3-PSME-QUCH2/BENE2	Tanoak-Canyon Live Oak and/or Sadler Oak
1501	LIDE3-PSME-QUCH2/RHDI6	Tanoak-Canyon Live Oak and/or Sadler Oak
1501	LIDE3-PSME/QUSA2-BENE2	Tanoak-Canyon Live Oak and/or Sadler Oak
1521	LIDE3/ARCTO3/XETE	Tanoak-Ultramafic

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
LIDE3	<i>Lithocarpus densiflorus</i>	Tanoak
ARME	<i>Arbutus menziesii</i>	Pacific madrone
QUCH2	<i>Quercus chrysolepis</i>	Canyon live oak
CACH6	<i>Chrysolepis chrysophylla</i>	Golden chinquapin
MANE2	<i>Mahonia nervosa</i>	Dwarf Oregongrape
TODI	<i>Toxicodendron diversilobum</i>	Pacific poison oak

Disturbance Description

Fire is the dominant disturbance event, but other disturbances include flooding, windthrow, ice storms, and insects and disease (Jimerson et al. 1996). Western pine beetle (*Dendroctonus brevicomis*), and mistletoe also generate important disturbances. The vast majority of fires occur in late summer or early fall and are associated with lightning. Native American burns locally increased the frequency and may have been extensive prior to 1850. Mixed-severity fire has been common, creating patches of varying age and species composition. Hardwoods typically provide the greatest cover after fire due to root-crown sprouting. Depending on fire severity, many hardwoods may have epicormic sprouting well into the crown. Species composition, density, and inter-species competition within stands contribute to multiple pathways following a disturbance. In stands with high tanoak cover, tanoak may dominate the stand for many years before conifers can re-establish. Typically, it may take 15yrs or longer before Douglas-fir can establish and emerge through the hardwood canopy.

Within the mixed-evergreen forest, fire frequency and severity were highly variable, with more coastal forests generally burning less frequently than interior sites (Fryer 2008; Atzet and Wheeler 1982). Jimerson et al. (1996) describe Douglas-fir plant associations in northwest California as having a fire regime characterized by moderate- to low-severity fire events, with occasional high-severity events and increasing fire frequency from north to south within the range of the association. In their summary of pre-settlement fire regimes for California, Van de Water and Safford (2011) report a mean fire return interval (FRI) of 29yrs, a mean minimum FRI of 15yrs, and a mean maximum FRI of 80 yrs for mixed evergreen based on review of 21 studies (they did not distinguish coastal vs. interior mixed evergreen).

In the Middle Applegate Watershed, for eight sites representing oak woodlands, mixed-evergreen forests, and, at higher elevations, mixed-conifer forests, Comfort et al. (in press) reported pre-settlement mean FRIs of 3.5-13yrs from 157 cross-dated fire scars. The longest fire-free period they recorded was 28yrs.

Fire history information specific to the Mediterranean California Mixed-Evergreen Forest -- Interior BpS indicates that fire was probably more frequent than for the Mediterranean California Mixed-Evergreen Forest -- Coastal BpS, but still variable.

- Agee (1991) reported historical mean FRIs for Douglas-fir forests in Oregon of about 50yrs for inland sites in the North Coast ranges and about 20yrs in the eastern Siskiyou Mountains.
- Sensenig et al. (2013) field-counted (rather than cross-dated) fire scars at six mixed-evergreen sites in southwest Oregon's mid coast region to understand stand-level fire regimes. Their most conservative estimate of the mean FRI at these sites varied from 16-23yrs, with a range of 5-58 yrs. The recorded fires occurred between 1700 and 1900; the last recorded fire at any site was in about 1910. Only three sites had fire-free periods of >30 yrs.

- In the western Siskiyou Mountains of Oregon, Atzet and Wheeler (1982) reported a 20-yr mean FRI.
- White et al. (1997) reported highly variable mean fire frequency in tanoak series plots in the Siskiyou National Forest and the Klamath Province portion of the Rogue River National Forest. They reported mean FRIs of 9yrs for the LIDE3-PSME-QUCH2/BENE2, 13yrs for the LIDE3-PIMO/QUVA/XETE. and 3yrs for LIDE3-PSME-QUCH2/RHDI6 (RHDI6 is now TODI) plant associations. The occurrence of disturbance events in this study was inferred from the presence of pioneer species on a plot rather than by fire scar analysis.
- Cross-dated fire scar samples from interior mixed-evergreen sites in the western Rogue Basin (Briggs, Grayback Creek, and Taylor sites) show mean FRIs between 9yrs and 17yrs (Metlen et al. 2016). The Grayback site, which was the most riparian of the three, had both the highest mean FRI (17yrs) and the highest variance (15-yr standard deviation).
- Wills (1991) reported pre-settlement mean FRIs from 10-15yrs for three Douglas-fir/mixed-evergreen sites in the Klamath National Forest in California. The range of FRIs reported across the three sites was 5-23yrs.

In the Klamath-Siskiyou Mountains, White et al. 2003 found that fires are burning more area and have larger patches of high-severity fire today than they did historically, but Miller et al. (2012) found no significant trend in fire severity in national forests in northwest California. Wills (1991) and Comfort et al. (in press) reported declines in fire occurrence during the 20th century for this BpS in the Klamath National Forest in California and the Middle Applegate Watershed in southwest Oregon, respectively.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	164	8	100	200
Moderate (Mixed)	46	30	15	50
Low (Surface)	23	62	5	30
All Fires	14	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

Replacement fire generates patches in the range of hundreds to thousands of acres. Insects and diseases generate patches in the tens and hundreds of acres.

Adjacency or Identification Concerns

Surrounding types include the mixed-conifer types (upslope and/or east), pine-oak woodlands (south), the Mediterranean California Mixed-Evergreen Forest -- Coastal BpS (west), and even some Abies types (upslope).

Serpentine patches within this type may contain *Pinus jeffreyi*, *Chamaecyperis lawsonii*, and *Rhamnus californicus*, and are represented with the respective serpentine model. However, CHLA is not obligate to serpentine, merely tolerant.

Currently, sudden oak death (SOD; *Phytophthora ramorum*) has become established in the southern portions of the range of the type and is spreading northward. SOD is often lethal to tanoak, but may affect black oak and some shrub species. Also, activities that result in reduced site potential (high grading and/or salvage with plantation planting) can result in establishment of persistent chaparral.

Pinus lambertiana has declined significantly due to preferential logging and white pine blister rust.

Issues or Problems

Native Uncharacteristic Conditions

Comments

Several assumptions were made when creating the Mediterranean California Mixed-Evergreen Forest -- Coastal and Interior models.

1. The state-and-transition models for these types incorporate the “precocious development model” presented by Donato et al. (2012) by specifying that the dominant development pathway is open and that stands reach, relatively quickly, the competitive exclusion and overstory development phases. The inclusion of more frequent high-severity, fire-maintaining early stands and the alternative closed development pathways are used to incorporate the ideas of Odion et al. (2010), which suggest that feedback loops promote self-maintaining, pyrogenic shrubby conditions and less-pyrogenic, closed-canopy conifer-dominated systems.
2. We assumed closed stands grow more slowly than open stands for both BpSs, and that overall growth rates are faster near the coast than at more interior locations.
 - a. For Interior, we developed growth rates based on data from the Sensenig et al. (2013) Mid-Coast sites using the old-growth rate for Open succession classes and the young rate for Closed succession classes (see figure 4, Sensenig et al. [2013]).
 - b. For Coastal, we developed growth rates from Forest Vegetation Simulator (FVS) results and stand exam data from several stands in a coastal Douglas-fir/tanoak co-climax association provided by Steve Boyer (Gold Beach Ranger District Silviculturist). The transition from early to mid-development was set at 30yrs based on an FVS run that showed that after a clearcut (stand-replacement event) it took about 30yrs to reach 9in in quadratic mean diameter (QMD), the minimum DBH for mid-development stands in the model. Stand exam data from five thinned stands showed that, by about 67yrs of age, the QMD was 22.2in, which we translated into a transition from mid to late open at 70yrs in the model. Stand exam data from three un-thinned stands showed that, by about 66yrs of age, the QMD was 15.0in. Growth rates for these stands estimated from FVS showed that it would take another 30-40yrs to grow another 5.4in to reach about 21in QMD,

3. We assumed that we would burn more frequently on Interior sites than on Coastal sites because they are drier and more prone to natural lightening ignitions (Rorig and Furguson [1999] provide data showing lightning caused fires in the northwest from 1986-1993). We further assumed that Interior fire regimes would be characterized predominantly by low mixed-severity fire whereas coastal sites, which are typically wetter and have greater biomass, would experience less frequent but higher severity fire events.
4. We assumed that insects/disease in Interior and wind events in Coastal could open stands periodically, but we have no information to support the probabilities used for these transitions in the model.
5. To set the threshold for the canopy cover break that would represent Open versus Closed classes, we tried to identify a canopy cover level at which early-seral species could no longer regenerate successfully. For the Mediterranean California Mixed-Conifer BpSs in southern Oregon and northern California, a 40% break was used based on the work of Bigelow et al. (2011), which demonstrated that thinning forest to 40% canopy cover was sufficient to perpetuate the growth and development of early-seral species in Sierra Nevada mixed-conifer forests. Observations from the Gold Beach Ranger District, Rogue River-Siskiyou National Forest on Mixed-Evergreen – Coastal BpS sites suggested that Douglas-fir will regenerate in stands that were thinned to between 40% and 60% canopy cover, but that the fir growth stagnated in stands thinned only to 60% (Stephen Boyer and Matthew Timchak, pers. comm.). This suggested that the Open/Closed Class break should probably be less than 60%. We chose 40% for consistency with the mixed-conifer BpSs.

Succession Classes

[illegible]

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	C	C	C	C	B	B	B	B	B	B
Tree	10-25	C	C	C	C	B	B	B	B	B	B
Tree	25-50	D	D	D	D	E	E	E	E	E	E
Tree	>50	D	D	D	D	E	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 17 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
LIDE3	Lithocarpus densiflorus	Tanoak	Upper
ARME	Arbutus menziesii	Pacific madrone	Upper
QUCH2	Quercus chrysolepis	Canyon live oak	Upper
PSME	Pseudotsuga menziesii	Douglas-fir	Low-Mid

Description

Scattered Douglas-fir and pine seedlings with thickets of madrone, canyon live oak, and tanoak. Sprouting shrubs such as dwarf Oregongrape and salal may be significant. Shrub growth from seed banks, such as deer brush (*Ceanothus integerrimus*), can also be high. Due to the resprouting hardwoods, the canopy quickly closes (or nearly so) after fires. Chaparral conditions can exist for significant periods of time if resprouting hardwoods occupy the site before conifers re-establish.

Maximum Tree Size Class

Pole 5-9" DBH

Class B 17 Mid Development 1 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PSME	Pseudotsuga menziesii	Douglas-fir	Upper
LIDE3	Lithocarpus densiflorus	Tanoak	Upper
ARME	Arbutus menziesii	Pacific madrone	Upper

QUCH2	Quercus chrysolepis	Canyon live oak	Upper
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Description

ARME	Arbutus menziesii	Pacific madrone	Middle
LIDE3	Lithocarpus densiflorus	Tanoak	Middle

Description

Douglas-fir and pine species with relatively large canyon live oak, Pacific madrone, and tanoak.

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:OPN	39
Mid1:OPN	40	Late1:OPN	89
Mid1:CLS	40	Late1:CLS	159
Late1:OPN	90	Late1:OPN	999
Late1:CLS	160	Late1:CLS	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:CLS	1	1	Yes	40
Replacement Fire	Early1:ALL	Early1:ALL	0.02	50	Yes	0
Mixed Fire	Early1:ALL	Early1:ALL	0.025	40	No	0
Surface Fire	Early1:ALL	Early1:ALL	0.05	20	No	0
Alternative Succession	Mid1:OPN	Mid1:CLS	1	1	Yes	20
Replacement Fire	Mid1:OPN	Early1:ALL	0.002	500	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.02	50	No	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.05	20	No	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.005	200	Yes	0
Insects or Disease	Mid1:CLS	Mid1:OPN	0.01	100	Yes	0
Mixed Fire	Mid1:CLS	Mid1:OPN	0.02	50	Yes	0
Surface Fire	Mid1:CLS	Mid1:CLS	0.05	20	Yes	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	20
Replacement Fire	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Mixed Fire	Late1:OPN	Late1:OPN	0.02	50	No	0
Surface Fire	Late1:OPN	Late1:OPN	0.05	20	No	0
Replacement Fire	Late1:CLS	Early1:ALL	0.005	200	Yes	0
Insects or Disease	Late1:CLS	Late1:OPN	0.01	100	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.02	50	No	0

Mixed Fire	Late1:CLS	Late1:OPN	0.025	40	Yes	0
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