

10280

Mediterranean California Mesic Mixed-Conifer Forest and Woodland

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

2, 3

Geographic Range

This type is also found in the portion of map zone (MZ) 7 that falls within the Klamath and West Cascade ecoregions, and the portions of MZ05 and MZ06 that fall within the Klamath ecoregion.

This type occurs in the Klamath-Siskiyou region (California and Oregon) and may extend to the west side of Mount Shasta and the upper Sacramento and Pitt rivers, and south through much of the upper elevations of the Mendocino National Forest. This particular model and description apply within the Pacific Northwest Coast, West Cascades, Klamath Mountains, and California North Coast ecoregions.

Biophysical Site Description

This type occurs primarily in northern and eastern aspects, in moist sites such as toe-slopes, as well as in protected settings throughout the geographic range. Typically occurs with 100-150cm annual precipitation, with 50% as snow. It is found from 800-1,000m (2,400-3,000ft) in the Sierra Nevada range and from 1,250-2,200m (3,800-6,700ft) in the Klamath Mountains.

Vegetation Description

Mesic mixed-conifer forests are typically composed of three or more species typically including *Abies concolor*, *Pinus lambertiana*, and *Calocedrus decurrens*. *Pseudotsuga menziesii*, *Pinus ponderosa*, and *Pinus jeffreyi* occur but are not dominant. In limited locations in the central Sierra Nevada, *Sequoiadendron giganteum* dominates, usually with *Abies concolor* and *Pinus lambertiana*, and at highest elevations also with *Abies magnifica*. *Chrysolepis chrysophylla*, *Arbutus menziesii*, and other hardwood species are also common components. Common understory species include *Corylus cornuta* and *Cornus nuttallii*, and, at higher elevations, *Chrysolepis sempervirens*. *Arctostaphylos patula*, *Ceanothus integerrimus*, *Ceanothus*

cordulatus, *Ceanothus parvifolius*, and *Ribes* spp. are more common in areas of recent fire or other disturbance.

Southwest Oregon Plant Association Groups (SWOPAG, Atzet et al. 1996) included in this type are:

SWOPAG	Blue Book Plant Association	P/A Blue Book PAG Name
1409	PSME-CACH6/BENE2	Douglas-fir-Chinquapin/Salal - SWO
1409	PSME/GASH-BENE2	Douglas-fir-Chinquapin/Salal - SWO
1409	PSME/RUSP/POMU	Douglas-fir-Chinquapin/Salal - SWO
1409	PSME/GASH-RHMA3	Douglas-fir-Chinquapin/Salal - SWO
1411	PSME/QUVA-ARNE/XETE	Douglas-fir-Ultramafic - SWO
2001	ABCO-LIDE3/CHUM	White Fir - cool, dry
2001	ABCO/ARNE	White Fir - cool, dry
2001	ABCO/QUVA	White Fir - cool, dry
2001	ABCO/XETE	White Fir - cool, dry
2002	ABCO/ACCI/OXOR	White Fir/Pacific Rhododendron
2002	ABCO/RHMA3-BENE2	White Fir/Pacific Rhododendron
2002	ABCO/RHMA3-QUSA2	White Fir/Pacific Rhododendron
2003	ABCO-CADE27/TRLA6	White Fir/Dwarf Oregongrape
2003	ABCO/BENE2	White Fir/Dwarf Oregongrape
2003	ABCO/BENE2/ACTR	White Fir/Dwarf Oregongrape
2003	ABCO/BENE2/LIBOL	White Fir/Dwarf Oregongrape
2004	ABCO-PSME/ROGY	White Fir-Douglas-fir - warm, dry
2004	ABCO/SYMO	White Fir-Douglas-fir - warm, dry
2004	PSME-ABCO	White Fir-Douglas-fir - warm, dry
2006	ABCO-TSHE/BENE2/LIBOL	White Fir-Western Hemlock/Dwarf Oregongrape
2006	ABCO/GASH-BENE2	White Fir-Western Hemlock/Dwarf Oregongrape
2098	ABCO-ABMAS/ACTR	White Fir-Shasta Red Fir
2098	ABCO-ABMAS/CHUM-ANDE3	White Fir-Shasta Red Fir
2098	ABCO-ABMAS/QUSA2	White Fir-Shasta Red Fir
2098	ABCO-PIBR/CHUM-PYPI2	White Fir-Shasta Red Fir

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
ABCO	<i>Abies concolor</i>	White fir
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
PILA	<i>Pinus lambertiana</i>	Sugar pine
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine
CADE27	<i>Calocedrus decurrens</i>	Incense cedar

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

Disturbance Description

Fire is a dominant disturbance shaping mesic mixed-conifer forest. Research suggests that fire-mediated development pathways and low-intensity fires were more important in the mesic mixed-conifer forests than previously recognized in western Oregon (Poage et al. 2009; Sensenig 2013). A sample of relevant fire history studies summarized in the following list suggests pre-settlement mean fire return intervals (FRIs) may have varied from 1-80yrs. Surface and mixed-severity fires occur on an average of about 10-15yrs (Taylor and Skinner 1998). Although the model is aspatial, most medium- and high-severity fires may actually occur on mid- and upper slope positions (Taylor and Skinner 1998; Taylor 2000; Bekker and Taylor 2001).

- In their summary of pre-settlement fire regimes for California, Van de Water and Safford (2011) report a mean FRI of 16yrs, a mean minimum FRI of 5yrs, and a mean maximum FRI of 80yrs for moist mixed-conifer forests based on review of 53 studies.
- In the Siskiyou Mountains, Metlen et al. (2016) found median FRIs of 10yrs and 8yrs (mean FRI, 13yrs and 7yrs) using cross-dated fire scar samples at their Winburn and Horn Gap sites, respectively. Across these sites, FRIs largely ranged between 1yr and 37yrs.
- Sensenig et al. (2013) field-counted (rather than cross-dated) fire scars at six mixed-conifer sites in the Cascades of southwest Oregon to understand stand-level fire regimes from 1700-1900. Their most conservative estimate of the mean FRI at these sites varied from 16-25yrs, with a range of 5-50yrs.
- Taylor and Skinner (1998) report a pre-settlement (1626-1849) median FRI of 14.5yrs, with a range of 6-116yrs, for a mixed-conifer study area in the northern Klamath Mountains. They found that 85% of fires in the area burned during the summer and fall, and that south- and west-facing slopes burned more frequently than other aspects.
- In the Cub Creek Research Natural Area in Lassen National Forest, Beatty and Taylor (2001) reported a highly variable fire regime for mixed-conifer forests. The pre-settlement (before 1850) mean composite FRI was 7.7yrs (range, 2-15yrs). More than 69% of upper slopes burned with high severity. Middle-slope positions had a mix of fire severities; lower slopes burned predominantly with low and moderate severity. Most fires burned in the dormant season.
- In the Thousand Lakes Wilderness, California, Bekker and Taylor (2001) reported a pre-settlement (before 1850) mean composite FRI of 11yrs and 7yrs for two types of mixed-conifer sites. They found that high- and moderate-severity fires burned more area than low-severity fires and that fires occurred most often during the dormant season.

A sharp decline in fire frequency (Taylor 2000; Taylor and Skinner 1998; Comfort et al. in press) and changes in tree recruitment and species composition (Messier et al. 2012; Poage et al. 2009), which occurred during the 1900s, have been noted in mixed-conifer forests and are attributed, at least in part, to fire suppression policies.

With historical fire regimes, insect outbreaks may have been much reduced compared to current conditions. Snow breakage can be relatively frequent in some mid-seral closed stands at higher elevations. This disturbance does not impact stand structure enough to warrant modeling.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	238	6		
Moderate (Mixed)	47	33		
Low (Surface)	25	61	10	40
All Fires	15	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 forest type occurs in a small to medium patch-size mosaic (100-1,000ac), driven by variations of topography, historical fire patterns, and fire intensity. Insect-caused mortality has a minor contribution to overall forest pattern.

Adjacency or Identification Concerns

Extends between the low-elevation hardwood forests up to the red fir forests of the upper elevations. Upper elevations defined by ecotone with red fir and lodgepole. The western ecotone occurs with mixed-evergreen forests, and lower elevations encounter dry-mesic mixed-conifer forests on south slopes, especially *Pinus attenuata* stands, and exposed ridgetops.

This type is similar to the Rapid Assessment PNVG R#MCONsw from the Pacific Northwest model zone with some differences in species composition.

Issues or Problems

It is unknown whether there is a need for a northern (latitude) versus a southern mixed-conifer type. This version is intended to respond to literature inferences 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 southern and central Sierra Nevada. Likewise, the Klamath region literature also indicates that topographic complexity also contributes to disparities between the two types. Even though an FRI 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.

Native Uncharacteristic Conditions

Mistletoe is probably more abundant now than historically, and white fir is much more abundant now. Current conditions reflect abundant plantations post-clearcut, which differ from post-fire stand replacement.

Lauvaux et al. (2016) suggest that climate changes that are likely to increase fire frequency and severity may lead to more areas of chaparral dominance on the landscape in the future where, historically, chaparral was interspersed with mixed-conifer forest. They conclude that “if the decades needed for trees to re-establish from seeds from forest at the chaparral edges exceed the new fire return interval, chaparral may emerge as an alternative stable state to forest.”

Comments

Several assumptions were used in this model:

- A cumulative frequency for surface and mixed-severity fires of 10-15yrs was targeted for all succession classes except Late Closed, consistent with Taylor and Skinner (1998). It was assumed that Late Closed would have less-frequent surface and mixed-severity fires than the other classes.
- The alternative succession pathway, which is used to transition open to closed stands in the absence of fire, was set at 30yrs, or roughly twice the mean FRI.
- The closed versus open class canopy cover break was set at 40% based on the work of Bigelow et al. (2011), which demonstrated that thinning forest to 40% canopy cover resulted in 10-20% of the area available for pine regeneration -- a level they deemed to be sufficient to perpetuate the fine-scale regeneration mosaic of Sierra Nevada mixed-conifer forests.

During the 2016 review, reviewers (Darren Borgias, Clint Emerson, Lyndia Hammer, Patricia Hochhalter, Kerry Metlen, and Jena Volpe) suggested that one model be used to cover MZ02, MZ03, and parts of MZ06 and MZ07. Based on the review, Kori Blankenship made minor edits to some fire transitions and the alternative succession settings in the model, as well as descriptive edits.

LANDFIRE National Review Comments:

- Another reviewer felt there was too little high-severity fire modeled and that there should be more low-severity than mixed-severity fire.

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	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
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	Upper
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine	Upper
PILA	<i>Pinus lambertiana</i>	Sugar pine	Upper
ABCO	<i>Abies concolor</i>	White fir	Upper

Description

These early succession stands, have vegetation comprised of grass, shrubs, and shade-intolerant tree species such as seedlings, saplings, and poles. Snags are typically present. This stage can occur as a small patch (10-100acs) within mixed-severity fire or as large patches from more extensive fire (100-1000ac).

Maximum Tree Size Class

Pole 5-9" DBH

Class B	13	Mid Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ABCO	<i>Abies concolor</i>	White fir	None
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine	None
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	None
PILA	<i>Pinus lambertiana</i>	Sugar pine	None

Description

Pole to large conifers (up to 30in DBH). These stands develop in settings and climatic periods that support longer intervals between surface and mixed-severity fires. Crowded stands of conifer along with hardwood trees in younger stages. White fir continues to recruit below ponderosa pine or Douglas-fir, depending on local site conditions. Ladder fuels and sub-canopy low enough for crown fire initiation. Hardwoods are shaded out at later stages. Depauperate understory. Surface fuel moderate and complex.

Maximum Tree Size Class

Large 21-33" DBH

Class C	18	Mid Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine	Upper
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	Upper
PILA	<i>Pinus lambertiana</i>	Sugar pine	Upper
ABCO	<i>Abies concolor</i>	White fir	Middle

Description

This class is composed of pole to large conifers (up to 30in DBH). These stands develop with frequent surface and mixed-severity fires. Open stands of predominately pines (with hardwood trees very patchy) in younger stages, persisting in protected sites, on knolls and noses with many scars. *Calocedrus decurrens* can be very sparse or quite common. White fir continues to reseed below ponderosa pine or Douglas-fir, depending on local site conditions, but is consumed completely and periodically by fire. Rich herbaceous and woody understory. Native grasses and forbs, and mostly resprouting shrubs favored with frequent fires. Surface fuel light and complex.

Maximum Tree Size Class

Large 21-33" DBH

Class D	35	Late Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ABCO	<i>Abies concolor</i>	White fir	None
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine	None
PILA	<i>Pinus lambertiana</i>	Sugar pine	None
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	None

Description

Large conifers (>33in DBH). These stands develop with frequent low- and mixed-severity fires. Open stands of predominately pine (hardwood trees very patchy) in younger stages, persisting in protected sites, on knolls and noses with many scars. *Calocedrus decurrens* can be very sparse or quite common. White fir continue to reseed below ponderosa pine or Douglas-fir, depending on local site conditions, but is replaced periodically by severe fire. Rich herbaceous and woody understory. Native grasses and forbs, and mostly resprouting shrubs are favored with frequent fires. Surface fuel light and complex.

Maximum Tree Size Class

Very Large >33" DBH

Class E	17	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
ABCO	<i>Abies concolor</i>	White fir	None

PSME	Pseudotsuga menziesii	Douglas-fir	None
PIPO	Pinus ponderosa	Ponderosa pine	None
PILA	Pinus lambertiana	Sugar pine	None

Description

These stands are old-growth, closed-canopy, large conifers (>33in DBH) with a multi-layer, complex canopy structure. These stands develop in settings and climatic periods that support longer intervals between surface and mixed-severity fires. Crowded stands of conifer can overtop the hardwood layer. White fir is now co-dominant with the larger ponderosa pine and Douglas-fir, and contributes to their mortality through competition for moisture and nutrients. Ladder fuels and sub-canopy may be low enough for crown fire initiation in some stands. Hardwoods are shaded out at later stages. Undergrowth is highly variable -- from depauperate to quite dense -- depending on canopy density and local site conditions. Surface fuel is moderate to high and complex.

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	49
Mid1:OPN	50	Late1:OPN	119
Mid1:CLS	50	Late1:CLS	209
Late1:OPN	120	Late1:OPN	999
Late1:CLS	210	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	30
Replacement Fire	Early1:ALL	Early1:ALL	0.0066	152	Yes	0
Mixed Fire	Early1:ALL	Early1:ALL	0.025	40	No	0
Surface Fire	Early1:ALL	Early1:ALL	0.04	25	No	0
Alternative Succession	Mid1:OPN	Mid1:CLS	1	1	Yes	30
Replacement Fire	Mid1:OPN	Early1:ALL	0.005	200	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.025	40	No	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.05	20	No	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.005	200	Yes	0
Mixed Fire	Mid1:CLS	Mid1:OPN	0.0133	75	Yes	0
Surface Fire	Mid1:CLS	Mid1:CLS	0.0222	45	No	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	30

Replacement Fire	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Mixed Fire	Late1:OPN	Late1:OPN	0.025	40	No	0
Surface Fire	Late1:OPN	Late1:OPN	0.05	20	No	0
Replacement Fire	Late1:CLS	Early1:ALL	0.005	200	Yes	0
Mixed Fire	Late1:CLS	Late1:OPN	0.0133	75	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.0222	45	No	0

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