

10310

California Montane Jeffrey Pine (- Ponderosa Pine) Woodland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Hugh Safford	hughsafford@fs.fed.us	Hugh Safford/Dave Schmidt	hughsafford@fs.fed.us
Joe Sherlock	jsherlock@fs.fed.us	Todd Keeler-Wolf	tkwolf@dfg.ca.gov
Neil Sugihara	nsugihara@fs.fed.us	Richard Minnich	Richard.Minnich@ucr.edu

Reviewers: US Forest Service Region 5 ecologists

Vegetation Type

Forest and Woodland

Map Zones

2, 3, 4, 5, 6, 12

Geographic Range

Jeffrey pine forest is found along the eastern borders of the North American Mediterranean climate zone (aka California Floristic Province), from its northern limits in southwest Oregon to its southern terminus in Baja, California. The most extensive Jeffrey pine forests are found on the eastern slopes of the Sierra Nevada. In the northern Sierra Nevada, mixed stands with ponderosa pine are common. In the Klamath/Siskiyou mountains of northwest California and southwest Oregon, Jeffrey pine is found in scattered groves on ultra-mafic (“serpentine”) soils. In southern California and Baja, California, Jeffrey pine occurs in “sky island” forests on isolated, high mountain ranges.

This model applies to the Jeffrey Pine Forest in California. It excludes all of the East Cascades-Modoc ecoregion and certain areas within the Klamath Mountains and California North Coast Ecoregions where Jeffrey pine is found on ultra-mafic soils and is represented by Biophysical Setting (BpS) 11700 Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral.

Biophysical Site Description

Jeffrey pine tolerates stress better than ponderosa pine and replaces it in poor soils, in colder locations, at higher elevations, and in more arid sites. This system usually occurs on volcanic and granitic substrates that are shallow with a frigid soil-temperature regime, limited nutrients, or other environmental gradients that make the area less suitable for mixed-conifer and other more mesic forest types. Jeffrey pine is found at elevations down to 2,500ft in the Klamath Mountains, mostly between 5,000ft and 8,500ft in the Sierra Nevada (with elevations rising to the south), and up to the highest summits -- around 10,000ft -- in Baja, California. In the Klamath and Siskiyou mountains, this BpS is found almost exclusively on ultra-mafic soils.

Vegetation Description

Jeffrey pine is the dominant tree in the overstory, usually with an open canopy. White fir is a common associate, which can become co-dominant in the absence of fire. Incense cedar and lodgepole pine are occasionally present. Sugar pine is an infrequent component, as is red fir and Sierra juniper. Some areas of Jeffrey pine forest include a major component of ponderosa pine as well, most notably on the granitic and volcanic plateaus of the northern Sierra Nevada.

West of the Sierra Nevada crest, the understory is composed of scattered shrubs (e.g., greenleaf manzanita [ARPA6], huckleberry oak [QUVA], and mountain whitethorn complex). East of the Sierra crest and into the Modoc Plateau, the less-fire tolerant bitterbrush/mountain sagebrush complex is present. In northeast California, snowbrush (CEVE) is common in the understory as well. The shrub complex present is dependent on the fire history of the site and the microclimate. There is a low cover of forbs and perennial grasses.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
PIJE	<i>Pinus jeffreyi</i>	Jeffrey pine
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine
PUTR2	<i>Purshia tridentata</i>	Antelope bitterbrush
QUVA	<i>Quercus vacciniifolia</i>	Huckleberry oak
ARPA6	<i>Arctostaphylos patula</i>	Greenleaf manzanita

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

Disturbance Description

Surface fire regimes dominate this BpS, with infrequent mixed-severity and very infrequent high-severity fire (Miller and Safford 2017), except in patches of highly flammable early-seral shrubs. In their summary of pre-settlement fire regimes for California, Van de Water and Safford (2011) report a mean fire return interval (FRI) of 11 yrs, a mean minimum FRI of 5 yrs, and a mean maximum FRI of 40 yrs for yellow pine based on reviews of many studies. Fire intervals may be longer for relatively open stands with low understory fuels, especially on shallow granitic soils or serpentine soils, and they are also longer in Jeffrey pine stands in the red fir zone, which are usually accompanied by shrubs and support more of a mixed-severity fire regime. Overall, Jeffrey pine fire regimes may be more variable than the ponderosa pine types due to slower fuel accumulation rates and fewer Native American ignitions. High lightning incidence in eastern Sierra Nevada and Baja, California, sites results in shorter FRIs.

Jeffrey pine forests represent essentially a low-productivity variant of the ponderosa pine fire regime. Because productivity is lower, modern Jeffrey pine forests are probably not as different from pre-settlement conditions as ponderosa pine forests (Dolanc et al. 2014). Minnich et al. (2000) studied 65 yrs of fire in Jeffrey pine forests in the Sierra de San Pedro Mártir (SSPM) in Baja, California. This site has not been logged and has had effective fire suppression only since the early 1980s. Minnich et al. found that open forests are produced by high-intensity surface fire, which kills most saplings and poles, leaving an umbrella-like canopy layer with densities of ca 30-60 stems per hectare. Local stand-replacement burns occur on exposed ridges and peaks with heavy understory fuels. Fire size ranges to as much as thousands of hectares, but fire sequences show self-organized mosaic behavior in which fire occurrence is time dependent on cumulative fuel accumulation, mostly needle cast and buildup of a shrub layer and conifer

recruits. Self-organization constrains fire size to an order of hundreds to thousands of hectares, much smaller than escaped fires in California. Rivera et al. (2016) showed that fires in SSPM Jeffrey pine forests burn less than 5% of their area at high severity, and compared this to the >30% high severity now common in California forests. High-severity patch sizes are also very small in these reference forests, with a median of <1ha in size.

Insect and disease outbreaks are associated with drought and high stem densities. Insects and diseases that affect Jeffrey pine include Heterobasidion root disease, black stain root disease, Armillaria root disease, dwarf mistletoe, and Jeffrey pine beetle (Safford and Stevens in press). The latter is the major insect mortality agent in this BpS.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	169	6		
Moderate (Mixed)	86	11		
Low (Surface)	12	83		
All Fires	10	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

Lightning was historically the main ignition source for fire in this area, but Native American ignitions have been important in some areas. Literature and data from the Baja, California, reference forests suggest a historical average fire size of <500ha (Agee 1993; Safford and Stevens in press). Recent fires in Jeffrey pine forests have been much larger, with many >2,000ha. Skinner and Chang (1996) describe a spatially complex pattern.

Adjacency or Identification Concerns

This BpS includes sites where *Pinus ponderosa* and/or *Pinus jeffreyi* are the predominant conifers, and other tree species do not occur in high abundance, if at all. The exception to this is in southern California on the edges of the Mojave Desert, where *Pinus monophylla* or *Juniperus californica* might occur in a sub-canopy under *Pinus ponderosa* or *Pinus jeffreyi*. Ponderosa pine and/or Jeffrey pine on the west slope of the Sierras with other conifer species are part of the Mediterranean California Dry-Mesic Mixed-Conifer Forest and Woodland (NatureServe 2017). In southwest Oregon, this type is uncommon and could be confused with Klamath-Siskiyou Lower Montane Serpentine Mixed-Conifer Woodland (BpS 1021) or Klamath-Siskiyou Upper Montane Serpentine Mixed-Conifer Woodland (1022); Jeffrey pine on serpentine soils in southwest Oregon is represented by the Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral BpS (11700).

Jeffrey pine stands transition to mixed conifer, white fir, red fir (higher elevations), juniper, pinyon pine, and sagebrush. They often intergrade into the mixed-conifer types in areas with higher precipitation, and into the red fir type at higher elevations. Jeffrey pine intergrades and mixes with ponderosa pine forest in the northern Sierra Nevada. In the Klamath Mountains, Jeffrey pine also occurs adjacent to *Pinus balfouriana*, *Cercocarpus ledifolius*, and other vegetation alliances. It also commonly interdigitates with riparian vegetation along streams

coming out of the east side of the Sierra (e.g., *Betula occidentalis*, *Salix* spp., *Populus tremuloides*, and *P. balsamifera* alliances)

Issues or Problems

The limitations of the LANDFIRE modeling process (limited use of time since disturbance, five classes, and inability to model climate variability) prevent our representing some of the nuances of this system. As a result, replacement fire appears to be too short, but the overall fire regime and landscape proportions are representative. More complex modeling approaches that allow climatic variability to be included in the model result in high-severity fire having intervals around 300yrs (Hugh Safford, pers. comm.). When the LANDFIRE model was run with a replacement mean FRI of 300yrs, the final succession class percentages were 5%, 25%, 55%, 1%, and 14%.

Several reviewers suggested that Jeffrey pine in the eastern Sierra Nevada might need a different state-and-transition model to represent differences in growth and disturbance rates, but this was not done because there were very little data to support the development of a new model specific to that area.

Native Uncharacteristic Conditions

This type is considered generally to be one of the most affected by fire suppression (and other disturbances, including logging). Yellow pine forests (Jeffrey and ponderosa pine) today have higher average tree density and higher average canopy cover, and they experience less-frequent but more high-severity fire than during the pre-settlement era (Safford and Stevens in press).

Comments

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:CLS	49
Mid1:OPN	25	Late1:OPN	199
Mid1:CLS	50	Late1:CLS	149
Late1:CLS	150	Late1:CLS	999
Late1:OPN	200	Late1:OPN	999

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:CLS	49
Mid1:OPN	25	Late1:OPN	199
Mid1:CLS	50	Late1:CLS	149
Late1:CLS	150	Late1:CLS	999
Late1:OPN	200	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	Years Since Last Disturbance
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					Distur bance ?	
Altern ative Succe ssion	Early1 :ALL	Mid1: OPN	0.005	200	Yes	0
Mixed Fire	Early1 :ALL	Early 1:AL L	0.005	200	No	0
Altern ative Succe ssion	Early1 :ALL	Mid1: CLS	0.01	100	Yes	0
Repla cemen t Fire	Early1 :ALL	Early 1:AL L	0.02	50	Yes	0
Altern ative Succe ssion	Mid1: OPN	Mid1: CLS	1	1	Yes	45
Insect s or Diseas e	Mid1: OPN	Mid1: OPN	0.002	500	No	0
Mixed Fire	Mid1: OPN	Early 1:AL L	0.003	333	Yes	0
Repla cemen t Fire	Mid1: OPN	Early 1:AL L	0.004 2	238	Yes	0
Mixed Fire	Mid1: OPN	Mid1: OPN	0.02	50	No	0
Surfac e Fire	Mid1: OPN	Mid1: OPN	0.1	10	No	0
Insect s or Diseas e	Mid1: CLS	Mid1: OPN	0.001	1000	Yes	0
Insect s or Diseas e	Mid1: CLS	Mid1: CLS	0.004	250	No	0
Mixed Fire	Mid1: CLS	Mid1: CLS	0.009 8	102	No	0
Repla cemen t Fire	Mid1: CLS	Early 1:AL L	0.013 6	74	Yes	0
Surfac e Fire	Mid1: CLS	Mid1: CLS	0.027 2	37	No	0
Mixed Fire	Mid1: CLS	Mid1: OPN	0.04	25	Yes	0
Altern ative Succe ssion	Late1: OPN	Late1 :CLS	1	1	Yes	45

Insect s or Diseas e	Late1: OPN	Late1 :OPN	0.001	1000	No	0
Repla cemen t Fire	Late1: OPN	Early 1:AL L	0.001 4	714	Yes	0
Mixed Fire	Late1: OPN	Late1 :OPN	0.002	500	No	0
Surfac e Fire	Late1: OPN	Late1 :OPN	0.122	8	No	0
Insect s or Diseas e	Late1: CLS	Late1 :OPN	0.001	1000	Yes	0
Mixed Fire	Late1: CLS	Late1 :OPN	0.002 6	385	Yes	0
Insect s or Diseas e	Late1: CLS	Late1 :CLS	0.003	333	No	0
Repla cemen t Fire	Late1: CLS	Early 1:AL L	0.006 3	159	Yes	0
Mixed Fire	Late1: CLS	Early 1:AL L	0.012 9	78	Yes	0
Mixed Fire	Late1: CLS	Late1 :CLS	0.017	59	No	0
Surfac e Fire	Late1: CLS	Late1 :CLS	0.019	53	No	0

Disturbance Type	Disturbance occurs In	Move s veget ation to	Distu rbanc e Proba bility	Ret urn Inte rval (yrs)	Reset Age to New Class Start Age After Distur bance ?	Years Since Last Distu rbanc e
AltSuccession	Early1:ALL	Mid1: OPN	0.005	200	Yes	0
AltSuccession	Early1:ALL	Mid1: CLS	0.01	100	Yes	0
ReplacementFire	Early1:ALL	Early 1:AL L	0.02	50	No	0
MixedFire	Early1:ALL	Early 1:AL L	0.005	200	No	0

SurfaceFire	Mid1:OPN	Mid1:OPN	0.1	10	No	0
MixedFire	Mid1:OPN	Mid1:OPN	0.02	50	No	0
Insect/Disease	Mid1:OPN	Mid1:OPN	0.002	500	No	0
AltSuccession	Mid1:OPN	Mid1:CLS	1	1	Yes	45
ReplacementFire	Mid1:OPN	Early 1:ALL	0.0042	238	Yes	0
MixedFire	Mid1:OPN	Early 1:ALL	0.003	333	Yes	0
MixedFire	Mid1:CLS	Mid1:OPN	0.04	25	Yes	0
Insect/Disease	Mid1:CLS	Mid1:OPN	0.001	1000	Yes	0
SurfaceFire	Mid1:CLS	Mid1:CLS	0.0272	37	No	0
MixedFire	Mid1:CLS	Mid1:CLS	0.0098	102	No	0
Insect/Disease	Mid1:CLS	Mid1:CLS	0.004	250	No	0
ReplacementFire	Mid1:CLS	Early 1:ALL	0.0136	74	Yes	0
SurfaceFire	Late1:OPN	Late1:OPN	0.122	8	No	0
MixedFire	Late1:OPN	Late1:OPN	0.002	500	No	0
Insect/Disease	Late1:OPN	Late1:OPN	0.001	1000	No	0
AltSuccession	Late1:OPN	Late1:CLS	1	1	Yes	45
ReplacementFire	Late1:OPN	Early 1:ALL	0.0014	714	Yes	0
MixedFire	Late1:CLS	Late1:OPN	0.00261	383	Yes	0
Insect/Disease	Late1:CLS	Late1:OPN	0.001	1000	Yes	0
SurfaceFire	Late1:CLS	Late1:CLS	0.019	53	No	0
MixedFire	Late1:CLS	Late1:CLS	0.017	59	No	0

Insect/Disease	Late1:CLS	Late1:CLS	0.003	333	No	0
ReplacementFire	Late1:CLS	Early1:ALL	0.0063	159	Yes	0
MixedFire	Late1:CLS	Early1:ALL	0.0129	78	Yes	0

During the 2016 review, U.S. Forest Service Region 5 ecologists suggested that a unique model was not needed for this BpS in map zone (MZ) 12. The MZ12 model (modeler Marchel Munnecke [marchel.munnecke@ca.usda.gov] and reviewers Todd Keeler-Wolf [tkwolf@dfg.ca.gov] and two anonymous reviewers) was combined with the model representing MZ02-MZ06, and the models and descriptions were adjusted accordingly.

LANDFIRE National review comments: MZ04 model was reviewed by Keeler-Wolf and Minnich. The model did not receive review specifically for MZ02.

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	16	Early Development 1 - All Structures
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Indicator Species

Description

Open mid-development forest with diverse herbaceous understory and scattered woody shrubs. Jeffery pine is the dominant tree. Several conifer species could also be present, depending on location. East of the Sierra crest (e.g., Truckee Basin north of Tahoe), this class can have substantial amounts of white fir, but this is mostly in areas subject to long-term fire suppression. Shrubs east of the crest are usually *Purshia tridentate*, *Artemisia tridentata*, and other Great Basin species. Maintained by frequent burning.

Maximum Tree Size Class

Medium 9-21" DBH

Class D	1	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIJE	<i>Pinus jeffreyi</i>	Jeffrey pine	Upper

Description

Open late-development forest; widely spaced trees, open and often diverse understory, and Jeffery pine dominant. Scattered shrubs and forbs such as lupines and Woolly mule ears are found in the canopy openings. Perennial grasses are also present. Surface fuels are limited due to frequent burning.

Maximum Tree Size Class

Very Large >33" DBH

Class E	46	Late Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIJE	<i>Pinus jeffreyi</i>	Jeffrey pine	Mid-Upper
ABCO	<i>Abies concolor</i>	White fir	All

Description

Dense late-development forest, often with significant within-stand mortality. Substantial surface fuel accumulation and ladder fuels. The overstory is often co-dominated by Jeffrey pine and white fir, with white fir dominating the understory; incense cedar is also present on moister sites. There is severe competition for sunlight and water. This stress, combined with insect and disease infestations, creates a high level of tree mortality. The understory vegetation is almost absent due to the lack of sunlight and heavy litter and woody debris accumulations. Current conditions where there are large Jeffrey pine trees along with multiple age classes of white fir suggest that, historically, there were low-intensity fires that maintained stands without killing white fir, but more recently white fir has become dominant in the understory.

Maximum Tree Size Class
Very Large >33" DBH

Model Parameters

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