

10300

Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Tim Bradley	Tim_Bradley@nps.gov	Diane White, Charley Martin, Ed Reilly	None
Dana Sandifer	Dana_sandifer@nps.gov	Hugh Safford/Dave Schmidt	hughsafford@fs.fed.us
Robin Wills	Robin_wills@nps.gov	Todd Keeler-Wolf	tkwolf@dfg.ca.gov

Reviewer: Olivia Duren

Vegetation Type

Forest and Woodland

Map Zones

2, 3, 4, 5, 6, 7

Geographic Range

This type is found throughout California's Coast Ranges down to the southern California mountains in the Peninsular Ranges (e.g., Cuyamaca Rancho State Park). It is also found along the lower slopes of the western Sierra Nevada and in the Klamath Mountains of Oregon and California from 400-1,600m (1,300-4,850ft [Gilligan and Muir 2011]). It occurs in valleys and lower slopes on a variety of parent materials, including granitics, metamorphic and Franciscan meta-sedimentary parent material, and deep, well-developed soils.

Biophysical Site Description

Most stands occur at <2,000ft in elevation, but range between 1,700ft and 3,000ft (500-900m) in California, and down to 1,300ft in Oregon. In the Sierra Nevada, the stands can occur up to 5,000ft. Soils can be skeletal in some places, and deeper in valley bottoms. In southwest Oregon, this BpS was found on the wetter end of the environmental gradient among *Q. garryana* communities with annual precipitation from 220-1,160mm (8-46in [Riegel et al. 1992]).

Vegetation Description

This BpS is characterized by woodlands or forests of *Pinus ponderosa* with one or more oak, including *Quercus kelloggii*, *Q. garryana*, *Q. wislizeni*, or *Q. chrysolepis*. *Pseudotsuga menziesii* may co-occur with *Pinus ponderosa*, particularly in the North Coast and Klamath ranges and in the lower elevations of the northern Sierra Nevada. On most sites, oak are dominant, forming a dense sub canopy under a more open canopy of conifers. On many sites, *Q. kelloggii* is the dominant species; in late-seral stands on the more mesic sites, conifers such as *Pinus ponderosa* or *Pseudotsuga menziesii* form a persistent, emerging canopy over the oak. In the absence of fire, *Pseudotsuga menziesii* often forms a closed canopy that shades out the oak. Gilligan and Muir (2011) found that in stands currently dominated by *Quercus garryana*, 14% of sampled stands had a clear potential for conversion to *Pseudotsuga menziesii*.

In Jackson and Josephine counties in Oregon, *Quercus garryana* is dominant. Other common associates in the Klamath Mountains are *Arbutus menziesii* and *Calocedrus decurrens* (Gilligan and Muir 2011). South of the North Coast Ranges and the central Sierra Nevada, the main diagnostic species are *Pinus ponderosa* and *Quercus kelloggii*.

Stands may have shrubby understories (in Klamath Mountains and Sierra Nevada) and, more rarely, a grassy (in North Coast Ranges) understory. Common shrubs include *Arctostaphylos viscida*, *A. manzanita*, *Ceanothus integerrimus*, *C. cuneatus*, *Toxicodendron diversilobum*, *Heteromeles arbutifolia*, *Cercocarpus betuloides* (*Cercocarpus montanus*, Klamath mountain mahogany), *Amelanchier alnifolia*, and *Mahonia aquifolium* (*Berberis aquifolium*). Grasses can include *Festuca californica*, *F. idahoensis* (*roemerii*), and *Melica* spp.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUKE	<i>Quercus kelloggii</i>	California black oak
QUGA4	<i>Quercus garryana</i>	Oregon white oak
QUCH2	<i>Quercus chrysolepis</i>	Canyon live oak
PIPO	<i>Pinus ponderosa</i>	Ponderosa pine
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
QUWI2	<i>Quercus wislizeni</i>	Interior live oak
FEID	<i>Festuca idahoensis</i>	Idaho fescue
TODI	<i>Toxicodendron diversilobum</i>	Pacific poison oak

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

Disturbance Description

Fire frequency of <10yrs is required to prevent the development of conifers (Agee 1993). Fire intensities were probably low in open stands but increased in severity as woodland vegetation transitioned to a denser, closed canopy type along watercourses and in some upland settings. Closed-canopy *Quercus garryana* woodlands also occur in uplands; dense (i.e., non-savanna) oak woodlands were commonly documented concurrent with Euro-American settlement (Hickman and Christy 2009). Vegetation is fire tolerant; therefore, fire severity is low. The natural fire regime was a type I regime in the upland. With the more dense vegetation and the occurrence of fuel ladders, fire severity became mixed. The fire regime may reflect a type III in this more mesic habitat.

- In its *Quercus kelloggii* species review, the Fire Effects Information System reported a historical fire frequency of 1-30yrs based on three studies (Fryer 2007).
- In their summary of pre-settlement fire regimes for California, Van de Water and Safford (2011) reported mean and median fire return intervals (FRIs) of 12yrs, a mean minimum FRI of 5yrs, and a mean maximum FRI of 45yrs for oak woodland. Skinner and Chang (1996) and Stephens (1997) are part of this review, but are listed here because they offer information specific to black oak. They also reported a mean FRI of 11yrs, a mean minimum FRI of 5yrs, and a mean maximum FRI of 40 for yellow pine, which includes *Quercus kelloggii*.

- In a summary of fire frequency in the Sierra Nevada, Skinner and Chang (1996) reported a median FRI of 8yrs, a minimum FRI of 2yrs, and a maximum FRI of 18yrs for black oak-ponderosa pine.
- Stephens (1997) reported a mean FRI of 7.8yrs and a range of 2-18yrs between 1850 and 1952 for mixed oak-pine forest in the foothills of the Sierra Nevada.
- Warner (1980) reported that a fire burned a portion of his Kings Canyon National Park study area characterized by ponderosa pine, Jeffrey pine, incense cedar, and California black oak every 3.5yrs on average, and that the mean FRI for individual pine trees was 11.4yrs between 1775 and 1909.

Insects and disease may impact individual trees (ponderosa pine) locally. Armillaria root rot, western pine beetle, western oak looper, western tent caterpillar, and the pine engraver have the greatest potential for damage.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	177	6	100	300
Moderate (Mixed)	38	27	50	200
Low (Surface)	15	67	5	30
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

This woodland type is usually a component in the low- to mid-elevation landscape and creates a mosaic with chaparral and forested communities. Fire usually occurs at a scale of magnitude larger than the patch size -- in the thousands of acres size during extreme weather conditions. Patch size is smaller (hundreds of acres) in the northern end of the type's range.

Adjacency or Identification Concerns

These types occur between broadleaf chaparral below, and ponderosa pine and mixed-conifer woodlands above.

Non-native annual grasses are a major component of this type in the current landscape. The degree to which these understories differ from pre-settlement types is a measure of uncharacteristic vegetation and departure from historic conditions.

This might be a seral stage of a Douglas-fir ponderosa pine type that occurred from Native American frequent burning (Max Creasy, pers. comm.). This BpS would have been more abundant on the landscape historically in the Sierra Nevada and Klamath ecoregions than it is today (Hugh Safford, pers. comm.).

Issues or Problems

This type is the nearest timber type to many of the gold-rush towns of the Sierra Nevada foothills, and was impacted severely by the logging of ponderosa pine starting in the mid 1800s.

There has also been modification due to fire suppression in the chaparral and now more increased ignitions, thus initiating more resprouting black oak and reducing the multiple age classes of ponderosa (which either crowns out and/or kills the mid-age ponderosa). Research on current distribution based on mapping this type in the central Sierra Nevada west slope suggests major upslope migration of this type since the 1930s (Thorne et al. 2006).

Fire suppression has led to denser, less-oak-dominated forests (Long et al. 2016). In Oregon's Jackson and Josephine counties, fire frequency appears to have declined since 1940, taken as the year of effective fire suppression, without a recent increase in ignitions on a landscape level (based on fire record maintained by BLM, 1910-2007; see also Appendix D in Duren [2009]). In a study area in Kings Canyon National Park, Warner (1980) reported a decrease in fire beginning in 1880 and a cessation in 1909. He indicated that lack of fire has shifted dominance in ponderosa pine-incense cedar-black oak fir sub-climax forests from black oak to white fir and sugar pine.

An additional issue is lack of sapling recruitment into the canopy, an apparent problem noted throughout the range of Oregon white oak (Gilligan and Muir [2011] and citations therein).

Native Uncharacteristic Conditions

Canopy closure <10% for full-canopy forest is uncharacteristic.

Comments

During the 2016 model review, this model was reviewed and descriptive changes were made by Olivia Duren (olivia@thefreshwatertrust.org). Conversations with Eamon Engber and Clint Isbel informed this model. Based on review feedback, Kori Blankenship slightly increased the mixed- and surface-fire frequency, and increased the alternative succession time-since-transition setting in the model.

Several assumptions were made when creating this model:

- A mean FRI of about 10yrs was targeted for consistency with several fire history studies (Van de Water and Safford, 2011) and because review indicated that this BpS likely had a slightly longer FRI than the Mediterranean California Mixed-Oak Woodland (mean FRI, 8yrs) due to the increased presence of conifers.
- The alternative succession pathway, which is used to transition open to closed stands in the absence of fire, was set at 20yrs, or roughly twice the mean FRI.
- The Closed versus Open Class canopy cover break was set at 40% because Long et al. (2016), citing Bigelow et al. (2011), suggested that oak and pine will be favored over conifers at <40% canopy cover. Bigelow et al. demonstrated that thinning forest to 40% canopy cover resulted in 10-20% of the area available for pine regeneration.

This model covers the entire range of the Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland. Future review should consider the need for more than one model to represent changes in the vegetation dynamics of this BpS across its range.

LANDFIRE National Comments:

Diane White, Charley Martin, Ed Reilly, Hugh Safford, and Dave Schmidt reviewed the model for map zone (MZ) 3. Kyle Merriam also contributed to the development of this model. MZ02 model was imported from MZ03 by Brendan Ward at MFSL on 10/12/06. Todd Keeler-Wolf edited the MZ03 model for use in MZ04 and MZ05.

A reviewer for MZ04 and MZ05 felt this type is really a pathway within a south-slope mixed-conifer model (i.e., BpS 1027). Modelers and reviewers of BpS 1027 agreed that this type should be incorporated into that model, but they could not do so within the LANDFIRE modeling constraints (i.e., systems must be represented by five or fewer classes). See Comments field in BpS 1027 for more information. Reviewer also questioned whether, during the reference period, 60% of the black oak stands had <50% cover as indicated by the results of this model, but did not offer suggestions for revision.

One reviewer for MZ03 felt a five-box model would be preferable for this type -- perhaps to capture a stage when fire does not occur. Another reviewer thought there was too much high-severity fire in this model. When the model was run with a mean FRI of 250yrs for all classes, the landscape percentages did not change.

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	C	C	C	C	C	B	B	B	B	B
Tree	10-25	C	C	C	C	C	B	B	B	B	B
Tree	25-50	C	C	C	C	C	B	B	B	B	B
Tree	>50	C	C	C	C	C	B	B	B	B	B

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	12	Early Development 1 - All Structures
---------	----	--------------------------------------

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUERC	Quercus	Oak	Upper
TODI	Toxicodendron diversilobum	Pacific poison oak	Middle
FECA	Festuca Californica	California fescue	Lower
FEID	Festuca idahoensis	Idaho fescue	Lower

Description

The early stage is the initial post-disturbance community dominated by coppicing oak sprouts. Oak species vary by location. Poison oak may be abundant. Bunchgrasses and associated forbs dominate understory. Localized native herbivory may maintain oak sprouts in “shrub” form for extended period. Early stage includes oak sprouts or seedling/sapling growth to 4-6in DBH (up to 5m; reviewer noted that DBH may be a poor predictor of oak age). Occasional sites with PIPO or PSME will have diameters up to 6in.

Maximum Tree Size Class

Pole 5-9" DBH

Class B	30	Mid Development 1 - Closed
----------------	-----------	-----------------------------------

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUERC	Quercus	Oak	Upper
PIPO	Pinus ponderosa	Ponderosa pine	Upper
PSME	Pseudotsuga menziesii	Douglas-fir	Upper

Description

The mid-seral closed stage occurs at the more mesic end of the environmental gradient and supports a dense canopy of oak (species vary by location) and ponderosa pine and/or Douglas-fir. Oak diameter ranges from 6-12in DBH, with crown closure approaching 70%. Ponderosa pine and Douglas-fir may be 8-20in DBH. Sod-forming grasses and shade-tolerant shrubs will be prominent on the majority of sites. *Aesculus californica*, *Toxicodendron diversilobum*, and *Ceanothus* spp. may be present. Species from more arid sites may be remnants of earlier, more open post-fire communities.

Maximum Tree Size Class

Very Large >33" DBH

Class C	58	Mid Development 1 - Open
----------------	-----------	---------------------------------

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUERC	Quercus	Oak	Upper
PIPO	Pinus ponderosa	Ponderosa pine	Upper
TODI	Toxicodendron diversilobum	Pacific poison oak	Middle

Description

The mid-seral open stage has hardwoods dominating the canopy and may have sporadic conifer presence at low coverage levels. Oak species will vary by location, and diameter ranges from 8-30in DBH. Bunchgrasses and shade-intolerant shrubs, most notably, will be prominent on the majority of sites.

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	24
Mid1:OPN	25	Mid1:OPN	999
Mid1:CLS	25	Mid1: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	20
Mixed Fire	Early1:ALL	Early1:ALL	0.003	333	No	0
Replacement Fire	Early1:ALL	Early1:ALL	0.0057	175	Yes	0
Surface Fire	Early1:ALL	Early1:ALL	0.0667	15	No	0
Alternative Succession	Mid1:OPN	Mid1:CLS	1	1	Yes	20
Replacement Fire	Mid1:OPN	Early1:ALL	0.0057	175	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.03	33	No	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.0667	15	No	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.0057	175	Yes	0
Mixed Fire	Mid1:CLS	Mid1:OPN	0.03	33	Yes	0
Surface Fire	Mid1:CLS	Mid1:CLS	0.0667	15	No	0

References

Agee, James K. 1993. Fire ecology of Pacific Northwest forests. Washington, DC: Island Press. 493 p.

Bigelow, S.W., M.P. North and C.F. Salk. 2011. Using light to predict fuels-reduction and group-selection effects on succession in Sierran mixed-conifer forest. Canadian Journal of Forest Research 41: 2051-2063.

Boyd, R. 1990. Strategies of Indian burning in the Willamette Valley. In: Boyd, R., ed. Indians, fire, and the land in the Pacific Northwest. Corvallis, OR: Oregon State University Press. 94-138.

Brown, James K. and Jane Kapler Smith, eds. 2000. Wildland Fire in Ecosystems: Effects of Fire on Flora. RMRS-GTR-42-volume 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

Duren, O.C. 2009. Chaparral history, dynamics, and response to disturbance in southwest Oregon: insights from age structure. Thesis. Oregon State University.

Fryer, Janet L. 2007. *Quercus kelloggii*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2017, January 31].

Gilligan, L.A. and P.S. Muir. 2011. Stand structure of Oregon white oak woodlands, regeneration, and their relationship to the environment in southwest Oregon. *Northwest Science* 85:141-158.

Hickman, E. and J.A. Christy. 2009. GLO historical vegetation of central Rogue, lower Applegate, and upper Illinois Valleys, Oregon, 1854-1919. Digital vector data available online through the Oregon Biodiversity Information Center website

Leopold, E.B. and R. Boyd. 1999. An ecological history of old prairie areas in southwestern Washington. In: Boyd, R., ed. Indians, fire, and the land in the Pacific Northwest. Corvallis, OR: Oregon State University Press. 139-163.

Lillybridge, T.R., B.L. Kovalchik, C.K. Williams and B.G. Smith. 1995. Field Guide for Forested Plant Associations of the Wenatchee National Forest. PNW-GTR-359. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 337pp.

Long, J.W., M.K. Anderson, L. Quinn-Davidson, R.W. Lenya, F.K. Lake and C.N. Skinner. 2016. Restoring California black oak ecosystems to promote tribal values and wildlife. PSW-GTR-252. USDA Forest Service, Pacific Southwest Research Station. 110p.

McShea, W.J. and W.M. Healy, eds. 2002. Oak Forest Ecosystems. Baltimore, MD: The John Hopkins University Press. 432 pp.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Riegel, G.M., B.G. Smith and J.F. Franklin. 1992. Foothill oak woodlands of the Interior Valleys Southwestern Oregon. *Northwest Science* 66(2): 66-76.

Skinner, C.N. and C. Chang. 1996. Fire regimes, past and present. In: SNEP Science Team and Special Consultants, ed. Status of the Sierra Nevada, Sierra Nevada Ecosystem Project Final Report to Congress. Vol. II. Davis, CA: University of California-Davis: 1041-1069.

Stephens, S.L. 1997. Fire history of a mixed oak-pine forest in the foothills of the Sierra Nevada, El Dorado County, California. In: Pillsbury, N.H., J. Verner and W.D. Tietje, eds. Proceedings of the symposium on oak woodlands: ecology, management, and urban interface issues. PSW-GTR-160. USDA Forest Service, Pacific Southwest Research Station: 191-198.

Thorne, James H., Brian J Morgan and Jeffery A Kennedy. 2006. Vegetation Change over 60 Years in the Central Sierra Nevada, California, US. In manuscript.

Topik, Christopher, Nancy M. Halverson and Tom High. 1988. Plant Association and Management Guide for the Ponderosa Pine, Douglas-fir, and Grand Fir Zones. R6-Ecol-TP-004-88. Portland, OR: USDA Forest Service, Pacific Northwest Region. 136 pp.

Van de Water, K.M. and H.D. Safford. 2011. A summary of fire frequency estimates for California vegetation before Euro-American settlement. *Fire Ecology* 7(3): 26-58. doi: 10.4996/fireecology.0703026.

Warner, T.E. 1980. Fire history in the yellow pine forest of Kings Canyon. *Proc. Fire History Workshop*. GTR-RM-81. Pp.89-92.

Whitlock, C. and M.A. Knox. 2002. Prehistoric burning in the Pacific Northwest: human versus climatic influences. In: Vale, T.R., ed. *Fire, native peoples, and the natural landscape*. Chapter 6. Washington, DC: Island Press. 195-231.