

11180

Southern California Oak Woodland and Savanna

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Julie Evens	jevens@cnps.org	Zach Principe	zprincipe@tnc.org
Anne Klein	aklein@cnps.org	Richard Minnich	Richard.Minnich@ucr.edu
None	None	Hugh Safford/Dave Schmidt	hughsafford@fs.fed.us

Vegetation Type

Steppe/Savanna

Map Zone

4

Geographic Range

This system occurs in coastal plains and intermountain valleys from Santa Barbara County, CA, south into Baja, Mexico, at <1,500m (4,920ft) elevation.

Found throughout subsections (Cleland et al. 2007) M262B and 261B.

Biophysical Site Description

Less than 1,500m elevation, on variable aspects and topography with rainfall between 13-102cm (5-40in). Soil textures normally vary from sandy loam to silty clay loam.

Vegetation Description

Overstory dominated by deciduous to evergreen hardwood species, including *Quercus agrifolia*, *Quercus engelmannii*, and *Juglans californica*. *Q. engelmannii* is endemic to southern California and northern Baja California (Minnich 1987). The understory can vary from low to high shrub cover, and the same is true for herbaceous cover (especially depending on canopy density). Herbs include *Bromus* spp., *Leymus condensatus*, *Erodium* spp., and *Nassella pulchra*, and shrubs include *Salvia apiana*, *Adenostoma fasciculatum*, *Artemisia californica*, *Eriogonum fasciculatum*, *Malosma laurina*, and *Toxicodendron diversilobum*. Stand structure can vary from open savannas with herbs along gentle slopes and flats, open canopies with coastal scrub or chaparral on variable slopes, and to denser canopies in more mesic situations. These woodlands may occur as remnant patches on offshore islands, where they include endemic species such as *Quercus tomentella* and *Lyonothamnus floribundus*.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUAG	<i>Quercus agrifolia</i>	California live oak
QUEN	<i>Quercus engelmannii</i>	Engelmann oak
JUCA	<i>Juglans californica</i>	Southern california walnut
ARCA11	<i>Artemisia californica</i>	Coastal sagebrush
ERFA2	<i>Eriogonum fasciculatum</i>	Eastern mojave buckwheat
TODI	<i>Toxicodendron diversilobum</i>	Pacific poison oak
RHIL	<i>Rhamnus ilicifolia</i>	Hollyleaf redberry

HEAR5	<i>Heteromeles arbutifolia</i>	Toyon
-------	--------------------------------	-------

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

Disturbance Description

Fire severity can range from high in woodlands with a high shrub component to moderate or low in open woodlands and savannas with an herbaceous understory. Lightning-ignited fires can occur at a frequency of 10-30yrs, and human-ignited fires may occur more frequently, especially with historic Native American burning and with recent wildland-urban interface fires (Keeley 2002). Herbaceous surface fuel complex dominates fuel/fire influences. In addition, a lightning strike could impact an individual tree, a part of the stand, or the entire stand; this is primarily dependent upon the amount of understory fuel (e.g., a cured grass understory could allow spread of a fire across the entire stand). Over Holocene time, occurrences and intensities of fire were highly aperiodic in response to short-term fluctuations in productivity of sub-shrubs and flash fuels. Fire mosaic turnover may be unrelated to previous fire history.

Typical regime is frequent, low-severity fire that likely exerts positive influence on overstory productivity and canopy resilience to fire damage. Infrequent isolated areas of stand-replacement fire create gaps of grasslands that require patch-gap recruitment and edge recolonization over time. Grass fuels allow very frequent fire, up to annually. A high proportion of seedlings and saplings are top-killed in low- to moderate-severity fires. Mortality rates of different size trees decrease with increasing height and DBH. Mortality may be as much as 50-60% for trees <40cm (15.7in) DBH. In plants that survive fires, there is a significant amount of resprouting (Lathrop and Osborne 1991; Lawson 1997; Steinberg 2002).

Comparisons of *Quercus agrifolia* and *Q. engelmannii* show that seedlings and saplings of *Q. engelmannii* have a higher frequency of survival after top-kill. Further, natural browsing and desiccation have a more significant impact of killing seedlings and saplings than natural and prescribed burning (Lathrop and Osborne 1991). After fire, *Q. engelmannii* showed higher height growth than *Q. agrifolia* because of thicker bark (Lawson 1993). *Juglans californica* are top-killed by most fires (Quinn 1990). In addition, *Q. engelmannii* has been found to have much lower mortality than 50% if there are grass fuels in the understory. Mortality for saplings (average DBH of 1.5cm) was documented at 40% for high and moderate damage and at only 20% for low damage. Mortality for adults (DBH>20cm) can be extremely low for both *Q. engelmannii* and *Q. agrifolia* when there are grass fuels (Principe 2002, Principe unpublished data).

There was some disagreement about the fire return interval (FRI) in this system between modelers and a reviewer. One reviewer indicated the need for a slightly shorter FRI in this system. Reviewer commented that since herb fires can spread great distances without time-dependent patch mosaic influences, one ignition could be sufficient to produce extensive burning virtually every year, especially since grass fires can burn at relatively high humidity in the presence of 100% dead fuel. Modelers and a second reviewer felt confident with the original estimate, so the modeled FRI was not changed.

Per Minnich (personal communication, July 2006), vegetation maps clearly show that *Q. agrifolia* grows extensively in heavy fuel loads of chaparral. *Q. engelmannii* is also found with chaparral understories but not at the same extent as *Q. agrifolia*. It is likely that the resprouting

or establishment of *Q. engelmannii* in chaparral has been selected against by high fire severities, since it responds poorly to high fire intensities compared to *Q. agrifolia*. In addition, *Q. agrifolia* and *Q. engelmannii* both grow in lower fuel loads or in abundant herbaceous fuel loads, where it is not associated with chaparral.

A wide range of disturbances -- biotic and abiotic -- influence the life history of oaks. Most of these woodlands and savannas have been heavily altered by urban and agricultural development. Grazing interactions are not captured by this model version.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	173	9		
Moderate (Mixed)	43	37		
Low (Surface)	30	54		
All Fires	16	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

Fires could vary from less than stand size to beyond stand size. Partially dependent on the understory species component (i.e., shrubs vs. herbs) and adjacent vegetation, as well as topography.

Adjacency or Identification Concerns

Can be adjacent to chaparral, coastal scrub, oak forest, mixed evergreen forest, riparian forest, and grasslands. Development and agriculture may also be adjacent to or encroaching on this system. Fire frequency and severity would be influenced in part by these adjacent systems.

Today more of Class C may be present on the landscape than under the reference condition due to fire suppression because there has been less regeneration and resprouting caused by the lack of fire.

Issues or Problems

Variable site conditions and understory species create a range of fire effects. This system is very similar to the California Coastal Live Oak Woodland system (BpS 1113). They may overlap in composition, structure, and fire effects. The main difference would be the fire response of *Q. engelmannii* vs. *Q. agrifolia*. *Q. engelmannii* is a much better resprouter following fire damage at juvenile-size classes, then appear to lose capacity to resprout in the 20-25cm DBH size range. The opposite is true for *Q. agrifolia*, which does not resprout as well in juvenile-size classes but as adults can appear to resprout from high levels of damage. Principe (personal communication, July 2006) has also observed a much greater density of understory vegetation under *Q. engelmannii* than *Q. agrifolia* and mixed stands due to differences in canopy density.

The understory of a majority of *Q. engelmannii* is dominated by thick stands of non-native annual grasses. This is mostly likely much different than pre-settlement times when the understory would have been dominated by low- to moderate-density herbaceous or mixed herbaceous *Salvia apiana*. Fuel loads adjacent to and under trees are thus most likely higher than in pre-settlement times.

Native Uncharacteristic Conditions

Excessive burning or grazing may result in less canopy cover and more significant understory of herbs and shrubs (e.g., *Bromus* spp., *Avena* spp., *Eriogonum fasciculatum*, *Rhamnus ilicifolia*, and *Artemisia californica*). Research by Principe (2002 and unpublished data) confirmed the Osborne (1989) and Lathrop and Osborne (1991) findings that fire, even relatively frequent fire (return interval of 3 or more yrs), does not seem to be as an important mortality factor as others (drought and herbivory). Principe (personal communication, July 2006) has found in surveys he conducted that grazed areas appear to have lower numbers of juvenile oaks than ungrazed areas.

Comments

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	B	B	B	B	B	B	B	B
Tree	5-10	B	B	B	B	B	B	B	B	B	B
Tree	10-25	C	C	C	C	C	C	D	D	D	D
Tree	25-50	C	C	C	C	C	C	D	D	D	D
Tree	>50	C	C	C	C	C	C	D	D	D	D

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	11	Early Development 1 - All Structures
----------------	-----------	---

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAG	<i>Quercus agrifolia</i>	California live oak	Upper
QUEN	<i>Quercus engelmannii</i>	Engelmann oak	Upper
JUCA	<i>Juglans californica</i>	Southern californica walnut	Upper
RHIL	<i>Rhamnus ilicifolia</i>	Hollyleaf redberry	Upper

Description

Comprised of fire-following herbs, resprouting bunchgrasses, understory woody perennials, and resprouting tree saplings. Early-stage shrub layer can promote recruitment of new tree saplings but also increases the risk of severe fire.

Replacement fire severe enough to kill most overstory oaks is unlikely at this stage due to lack of enough fuel to generate fire severe enough to kill fire-tolerant oaks. Mixed fire or surface fires will tend to promote open woodland/savanna of older/larger fire-tolerant oaks by stimulating resprouting of trees and shrubs (e.g. *Q. agrifolia* trees with vigorous epicormic and basal sprouting and *Q. engelmannii* trees [DBH>20cm or so] with only epicormic sprouting; if top-killed, they do not resprout).

Quercus agrifolia currently is reproducing better in southern California than *Q. engelmannii*; as a result, more juveniles of *Q. agrifolia* have made the transition to mature trees. Mixed fire can remove regenerating shrub, tree seedling, and sapling components. Surface fire influences the shrub/seedling/sapling layer by thinning and removing above-ground shrub and herbaceous material.

Maximum Tree Size Class

Sapling >4.5ft; <5" DBH

Class B 24 Mid Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAG	<i>Quercus agrifolia</i>	California live oak	Upper
QUEN	<i>Quercus engelmannii</i>	Engelmann oak	Upper
JUCA	<i>Juglans californica</i>	Southern california walnut	Upper
RHIL	<i>Rhamnus ilicifolia</i>	Hollyleaf redberry	Middle

Description

Comprised of herbs, understory shrubs, tree saplings, and medium-sized trees. Stands may vary in understory composition with herbs abundant in some stands and shrubs in others; stands will respond differently to fire depending on their understories, where shrub understories have higher fire severity.

Replacement fire severe enough to kill most overstory oaks is unlikely at this stage due to lack of enough fuel to generate a severe fire. Mixed fire or surface fires will promote open woodland/savanna of older/larger fire-tolerant oaks by stimulating resprouting of trees and shrubs. Mixed fire has a tendency to remove shrub, tree seedling, and sapling components; it also can remove older trees that are shorter statured or have previous fire scars at the base of the trunk. Surface fire influences the shrub/seedling/sapling layer by thinning and removing above-ground shrub and herbaceous material. Most medium-sized trees will survive.

Maximum Tree Size Class

Medium 9-21" DBH

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAG	<i>Quercus agrifolia</i>	California live oak	Upper
QUEN	<i>Quercus engelmannii</i>	Engelmann oak	Upper
JUCA	<i>Juglans californica</i>	Southern californica walnut	Upper

Description

Comprised of mixed-size classes of trees. Stand understory is generally herb-dominated while shrub layer is open, and in general the understory diversity and density are low.

Replacement fire severe enough to kill most overstory oaks is unlikely at this stage due to lack of enough fuel to generate a severe fire. Mixed and surface fires are less likely than in Class B because understory is generally less dense. Mixed fire can remove tree seedling, sapling, and older tree components. Surface fires will maintain open woodland/savanna of older/larger fire-tolerant oaks by stimulating sprouting of trees and shrubs. Surface fire influences the shrub/seedling/sapling layer by thinning and removing above-ground shrub and herbaceous material. Most medium-sized trees will survive.

Today, under *Q. engelmannii* in savannas, the understory density of non-native annual grasses can be very high, reaching heights of 1.25m with virtually complete cover. The thought is that this thick mat of fuel builds up against the trunk, resulting in a fire scar in a surface fire. This leads to the tree being susceptible to mortality in subsequent surface fires. This high-density understory is generally only present in pure *Q. engelmannii* stands to 40% canopy cover.

Maximum Tree Size Class

Very Large >33" DBH

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUAG	<i>Quercus agrifolia</i>	California live oak	Upper
QUEN	<i>Quercus engelmannii</i>	Engelmann oak	Upper
JUCA	<i>Juglans californica</i>	Southern californica walnut	Upper
PLRA	<i>Platanus racemose</i>	California sycamore	Middle

Description

Comprised of mixed-size classes of trees. Occurs in mesic and riparian settings, especially with a mixture of tree species in the overstory. Stand understory composition may be variable with herb and shrub species at low cover. Hardwood leaf litter can be >80% cover on the exposed ground surface.

This class maintains itself in the absence of disturbance. High-severity fires are typically rare.

Maximum Tree Size Class

Large 21-33" DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	20
Mid1:OPN	21	Late1:OPN	60
Late1:CLS	61	Late1:CLS	999
Late1:OPN	61	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
Replacement Fire	Early1:ALL	Early1:ALL	0.005	200	Yes	0
Surface Fire	Early1:ALL	Early1:ALL	0.05	20	No	0
Mixed Fire	Early1:ALL	Early1:ALL	0.05	20	No	0
Alternative Succession	Mid1:OPN	Late1:CLS	1	1	Yes	35
Replacement Fire	Mid1:OPN	Early1:ALL	0.005	200	Yes	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.033	30	No	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.05	20	No	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	40
Replacement Fire	Late1:OPN	Early1:ALL	0.005	200	Yes	0
Mixed Fire	Late1:OPN	Late1:OPN	0.013	77	No	0
Surface Fire	Late1:OPN	Late1:OPN	0.033	30	No	0
Mixed Fire	Late1:CLS	Mid1:OPN	0.01	100	Yes	0
Mixed Fire	Late1:CLS	Late1:OPN	0.01	100	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.01	100	Yes	0

References

Barro, Sue. 1989. Riparian vegetation after fire--a case study. Riverside, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Forest Fire Laboratory. Missoula, MT: USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. On file.

Cleland, D.T.; Freeouf, J.A.; Keys, J.E.; Nowacki, G.J.; Carpenter, C.A.; and McNab, W.H. 2007. Ecological Subregions: Sections and Subsections for the conterminous United States. Gen.

Tech. Report WO-76D [Map on CD-ROM] (A.M. Sloan, cartographer). Washington, DC: U.S. Department of Agriculture, Forest Service, presentation scale 1:3,500,000; colored

Davis, Frank W., Edward A. Keller, Anuja Parikh and Joan Florsheim. 1989. Recovery of the chaparral riparian zone after wildfire. In: Protection, management, and restoration for the 1990's: Proceedings of the California riparian systems conference. Gen. Tech. Rep. PSW-110. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station.

Evens, J.M. and S. San. 2005. Vegetation alliances of the San Dieguito River Park region, San Diego County, CA. Sacramento, CA: California Native Plant Society.

Keeler-Wolf, T. and J. Evens. 2006. Vegetation classification of the Santa Monica Mountains National Recreation Area and environs in Ventura and Los Angeles counties, CA. Sacramento, CA: California Department of Fish and Game and California Native Plant Society.

Klein, A.K. and J.M. Evens 2005. Vegetation classification and mapping of Western Riverside County, California. Sacramento, CA: California Native Plant Society.

Lathrop, E.W. and C.R. Osborne. 1991. Influence of fire on oak seedlings and saplings in southern oak woodland on the Santa Rosa Plateau Preserve, Riverside County, California. Gen. Tech. Report: PSW-126. Berkeley, CA: USDA Forest Service, Pacific Southwest Research Station.

Lawson, D.M. 1993. The effects of fire on stand structure of mixed *Quercus agrifolia* and *Q. engelmannii* woodlands. Unpublished MS thesis, San Diego, CA: San Diego State University.

Lawson, D.M., P.H. Zedler and L.A. Seiger. 1997. Mortality and growth rates of seedlings and saplings of *Quercus agrifolia* and *Quercus engelmannii*: 1990-1995. In: Pillsbury N.H., J. Verner and W.D. Tietje, eds. Proceedings of a symposium on oak woodlands: ecology, management, and urban interface issues. Gen. Tech. Report: PSW-GTR-160. Albany, CA: USDA Forest Service, Pacific Southwest Research Station..

Minnich, R.A. 1987. The distribution of forest trees in northern Baja California. *Madrono* 34: 98-127.

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

Osborne, C.D. 1989. Early establishment of *Quercus engelmannii* (Fagaceae) on the Santa Rosa Plateau, Riverside County, California. PhD dissertation. Loma Linda, CA: Loma Linda University.

Principe, Z.A. 2002. Factors affecting Engelmann oak (*Quercus engelmannii*) regeneration. MS thesis. San Diego, CA: San Diego State University.

Quinn, Ronald D. 1990. The status of walnut forests and woodlands (*Juglans californica*) in southern California. In: Schoenherr, Allan A.,ed. Endangered plant communities of southern California: Proceedings,15th annual symposium. 29 October 1989. Fullerton, CA. Special Publication No. 3. Claremont, CA: Southern California Botanists. 42-54.

Steinberg, P.D. 2002. *Quercus agrifolia*. In: Fire Effects Information System. [Online] Missoula, MT: USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available: <http://www.fs.fed.us/database/feis> [June 27, 2006.]