11140
California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna

BpS Model/Description Version: Aug. 2020

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Vegetation Type
Steppe/Savanna

Map Zones
4, 5

Geographic Range
This system is primarily in the valley margins and foothills of the Sierra Nevada and Coast Ranges from ~120-1,200m (360-3,600ft) elevation on rolling plains or dry slopes.

A foothill type found from subsection 261Bb (Cleland et al. 2007) north along the bathtub ring.

Biophysical Site Description
Sea level to 4,000ft elevation, on rolling plains or dry slopes with relatively poor to well-developed soils that are well drained.

Vegetation Description
Over a century of anthropogenic changes have altered the density and distribution of woody vegetation. A high-quality occurrence often consists of open and park-like stands dominated by *Pinus sabiniana*, with oaks and various broadleaf tree and shrub species, including *Quercus douglasii*, *Quercus wislizeni*, *Quercus agrifolia* (primarily in map zone [MZ] 04), *Quercus lobata*, *Aesculus californica*, *Arctostaphylos* spp., *Cercis canadensis* var. *texensis* (*Cercis occidentalis*), *Ceanothus cuneatus*, *Frangula californica* (*Rhamnus californica*), *F. ilicifolia*, *Ribes quercetorum*, *Toxicodendron diversilobum*, *Juniperus californica*, and *Pinus coulteri*. *Pinus sabiniana* tends to drop out all together in the driest sites, which are often dominated by *Quercus douglasii*. Northern extensions of this system include *Quercus garryana* as the dominant oak, where it becomes successional to oak-evergreen woodlands. Historically, understory vegetation included mixed chaparral to perennial bunchgrass and annual herbs. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime, parent material, natural patch dynamics of fire, and land use (fire suppression, livestock grazing, herbivory, etc.). Denser vegetation on north- versus south-facing slopes, where shrubs (e.g., *Cercocarpus betuloides*, *Cercocarpus montanus*) occur on northerly slopes and denser annual grass understory on southerly slopes.

Typical phases dominated by open cover oak savanna with relatively uniform mature trees at low densities (<40% cover), with understory vegetation structure and function of frequent surface fire mediating woody plant development. In some instances and in some sites, tree density will increase to 60% or greater forming a relatively stable hardwood forest type subject to surface fires in the hardwood litter and rare stand-replacement fire.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
QUDO	*Quercus douglasii*	Blue oak
QUWI	*Quercus willdenowiana*	Quercus willdenowiana
QUAG	*Quercus agrifolia*	California live oak
QULO	*Quercus lobata*	California white oak
AECA	*Aesculus californica*	California buckeye
TODI	*Toxicodendron diversilobum*	Pacific poison oak
RHIL	*Rhamnus ilicifolia*	Hollyleaf redberry
CECU	*Ceanothus cuneatus*	Buckbrush

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

Disturbance Description

Overstory typically dominated by deciduous hardwood species, though pine cover may be relatively similar in some situations. Herbaceous surface fuel complex commonly dominates fuel/fire influences. 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. Fires often kill scattered individual trees in this type, and although this effect was not modeled, it does have a significant impact on stand structure over time. Grass fuels allow very frequent fire, up to annually. Fire regime likely strongly influenced by Native American ignitions. Areas dominated by greater species richness -- typically on higher elevations with understory shrub species and *P. sabiniana* result in higher-intensity fire and likely a greater proportion of stand-replacement fire. A reviewer noted that soil productivity will have a major effect on fire severity.

Literature indicates that blue oak is fire-tolerant but not fire-dependent. Studies showed varied results, with fire promoting seedling/sapling recruitment in some cases and not in others. Oak regeneration does appear to be controlled by local site factors such as soils and moisture. Under grazing, seedling/sapling growth form may become more prostrate, and hence more susceptible to foliar combustion and direct fire related mortality. The complexity of grazing interactions is not captured by this model version; however, natural deer browsing may have a prominent impact on reducing the shrub understory and tree component, especially in the early seral stage. A reviewer noted that insects and diseases have probably had an important influence on this system but also indicated that there was not sufficient information that would allow for this to be incorporated into the model.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	127	9		
Moderate (Mixed)	150	8		
Low (Surface)	14	83		
All Fires	11	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
Fire regime in grass surface fuel complexes likely were large in size but limited in significant influence on overstory. Patches of stand-replacement fire likely limited to individual or groups of trees to 100ac, with smaller gaps more prevalent. Stand replacement is also more likely when shrub cover is moderate to high up to stand size. Fire size may have ranged from <1ac to several thousand acres.

Adjacency or Identification Concerns
This BpS is often intermixed with chaparral and mixed evergreen forest types as well as mixed oak-conifer types in more closed stands in the Sierra Nevada. In MZ04, this Biophysical Setting (BpS) may be adjacent to coastal sage scrub. In more open stands, this BpS can be difficult to differentiate from grassland (e.g., BpS 1129).

Issues or Problems
Relatively wide variance in species associations and site productivity likely influences the frequency and extent of stand-replacement fire events; however, the resiliency of the system to lack of fire (both in terms of vegetation and fuel changes) indicate that the model is likely relatively robust in determining significant disturbance effects on the distribution of phases and fire impacts on key ecosystem components.

Grazing by domestic livestock adversely impacts successful recruitment of immature individuals into the mature phase.

Replacement of native perennial grasses by annual grasses can likely lead to increases in fuel continuity and a longer fire season, both contributing to increases in fire frequency in many areas. Keeley (2006) states that "fire has diverse effects on alien species, and except for a small handful of cases, it generally promotes persistence of aliens." While precisely timed prescription burning can be an effective treatment for eliminating certain noxious alien annuals, fire can have a propensity to exacerbate alien invasion of plants. In addition, burned sites, when coupled with grazing, may be a dangerous combination, exacerbating alien invasion (Keeley 2006).

Modelers and a reviewer disagreed about the link between repeated fires and the perpetuation of exotic annual understory. Modelers felt that increased fire frequency can favor a positive feedback for alien annual grasses presence and abundance, while a reviewer felt that this statement could not be supported by the literature. Reviewer noted that the distribution of native understory species is highly patchy and may be more related to local site factors than fire effects or biotic interactions. Modelers added that different management regimes (e.g., repeated low-intensity fire) may modify the herbaceous fuel load; however, the annual climatic patterns have a large effect on determining the herbaceous abundance.

Native Uncharacteristic Conditions

Comments
MZs 04 and 05 were combined during 2015 BpS Review.

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	B	B	B	B	E	E	E	E	E	E
Tree	10-25	C	C	C	C	D	D	D	D	D	D
Tree	25-50	C	C	C	C	D	D	D	D	D	D
Tree	>50	C	C	C	C	D	D	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 15 Early Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUDO	Quercus douglasii	Blue oak	Upper
QUWI2	Quercus wislizeni	Interior live oak	Upper
CECU	Ceanothus cuneatus	Buckbrush	Upper
RHIL	Rhamnus ilicifolia	Hollyleaf redberry	Upper

Description

Post-replacement sapling/regeneration phase. Largely a function of either early seral remaining in early seral due to replacement fire or to less common later seral replacement fire. Reestablishment can occur from basal resprouting or sexual reproduction, depending on composition, growth form, seed dynamics, and climate. Patch size likely ranges from very small gap recruitment to areas of ~100ac. Diameter up to 4in typical. May include interior and/or coast live oak and a variety of shrubs and herbs. Trees and shrubs may have similar cover, though toward the end of the class, trees would overtop shrubs. The combined cover of trees and shrubs could reach 20%.

Maximum Tree Size Class

Sapling >4.5ft; <5" DBH

Class B 27 **Mid Development 1 - Open**

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUDO	Quercus douglasii	Blue oak	Upper
QUWI2	Quercus wislizeni	Interior live oak	Upper
PISA2	Pinus sabiniana	California foothill pine	Upper
RHIL	Rhamnus ilicifolia	Hollyleaf redberry	Middle

Description

Intermediate phase -- some new recruitment of cohorts occurs in the later stages of this phase, increasing tree density. Periodic surface fire is relatively common, but replacement fire rare due to low-intensity fire type and resilience of typical species to topkill. Patch size in the 100s of acres or smaller. Diameter up to 14in. May include interior and/or coast live oak and a variety of shrubs. Today it is possible to find a greater proportion of this class on the landscape than under the reference condition due to logging. A portion of the landscape (e.g., north-facing slopes and draws) can develop into Late Closed stands (Class E, late2-closed, modeled as alt. succession).

Maximum Tree Size Class

Pole 5-9" DBH

Class C 25 **Late Development 1 - Open**

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUDO	Quercus douglasii	Blue oak	Upper
QUWI2	Quercus wislizeni	Interior live oak	Upper
PISA2	Pinus sabiniana	California foothill pine	Upper
RHIL	Rhamnus ilicifolia	Hollyleaf redberry	Middle

Description

Mature Oak Woodland phase -- highly stable, as most fire is frequent, low-severity fire acting as a maintenance agent. Tree density and canopy cover increase over time to relatively stable conditions. In some cases, woody encroachment and increased tree density occur under rare events of missed fire cycles. Some replacement fire occurs, initiating secondary succession in early seral. Patch size in the 100s to possibly 1,000s of acres. May include interior and/or coast live oak and a variety of shrubs.

Maximum Tree Size Class

Medium 9-21" DBH

Class D 17 **Late Development 1 - Closed**

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUWI2	Quercus wislizeni	Interior live oak	Upper
QUDO	Quercus douglasii	Blue oak	Upper
PISA2	Pinus sabiniana	California foothill pine	Upper
RHIL	Rhamnus ilicifolia	Hollyleaf redberry	Middle

Description
Late seral stage arising from a rare period without fire, allowing woody understory encroachment and higher tree density. Surface fire is rare; mixed fire and stand-replacement fire are the normal pathways to stage retardation (back to late-seral open conditions) or secondary succession (back to early seral). Patch size likely in the 10s of acres. May include interior and/or coast live oak and a variety of shrubs.

Maximum Tree Size Class
Medium 9-21" DBH

Class E 16 Late Development 2 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
QUDO	Quercus douglasii	Blue oak	Upper
QUWI2	Quercus wislizeni	Interior live oak	Upper
RHIL	Rhamnus ilicifolia	Hollyleaf redberry	Middle
LOIN4	Lonicera interrupta	Chaparral honeysuckle	Middle

Description
Late seral stage arising from topographic positions (e.g., north-facing slopes and draws), allowing woody understory encroachment and higher tree density. Borchert et al. (1993) and White (1966) found that on north-facing slopes, high-density stands of small trees (2-7in DBH) were common. Surface fire is rare; mixed fire and stand-replacement fire are the normal pathways to stage retardation (back to late-seral open conditions) or secondary succession (back to early seral). Patch size likely in the 10s of acres. May include interior and/or coast live oak and a variety of shrubs.

Maximum Tree Size Class
Pole 5-9" DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:OPN	0	Mid1:OPN	19
Mid1:OPN	20	Late1:OPN	59
Late1:OPN	60	Late1:CLS	99
Late2:CLS	60	Late2:CLS	999
Late1:CLS	100	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
Replacement Fire	Early1:OPN	Early1:OPN	0.005	200	Yes	0
Native Grazing	Early1:OPN	Early1:OPN	0.02	50	No	0
Surface Fire	Early1:OPN	Early1:OPN	0.1	10	No	0
Replacement Fire	Mid1:OPN	Early1:OPN	0.005	200	Yes	0
Alternative Succession	Mid1:OPN	Late2:CLS	0.017	59	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.1	10	No	0
Replacement Fire	Late1:OPN	Early1:OPN	0.01	100	Yes	0
Surface Fire	Late1:OPN	Late1:OPN	0.12	8	No	0
Replacement Fire	Late1:CLS	Early1:OPN	0.01	100	Yes	0
Mixed Fire	Late1:CLS	Late1:OPN	0.02	50	Yes	0
Replacement Fire	Late2:CLS	Early1:OPN	0.01	100	Yes	0
Mixed Fire	Late2:CLS	Mid1:OPN	0.02	50	Yes	0

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