11140

California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
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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 |

References

Arno, Stephen F. 2000. Fire in western forest ecosystems. In: Brown, James K. and Jane Kapler Smith, eds. Wildland fire in ecosystems: Effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 97-120.

Barbour, Michael G. 1988. Californian upland forests and woodlands. In: Barbour, Michael G. and William Dwight Billings, eds. North American terrestrial vegetation. Cambridge, NY: Cambridge University Press. 131-164.

Biswell, H.H. 1956. Ecology of California grasslands. Journal of Forestry 9: 19-24.

Borchert, Mark, Nancy Cunha, Patricia Krosse and Marcee Lawrence. 1993. Blue Oak Plant Communities of Southern San Luis Obispo and Northern Santa Barbara Counties, California. PSW-GTR-139. CA: USDA Forest Service, Pacific Southwest Research Station.

Brown, James K. and Jane Kapler Smith, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

Chang, Chi-Ru. 1996. Ecosystem responses to fire and variations in fire regimes. In: Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options, Chapter 39. Davis, CA: University of California, Centers for Water and Wildland Resources. 1071-1099.

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

Eyre, F.H., ed. 1980. Forest cover types of the United States and Canada. Washington, DC: Society of American Foresters. 148 pp.

Griffin, James R. 1977. Oak woodland. In: Barbour, Michael G. and Jack Malor, eds. Terrestrial Vegetation of California. New York: John Wiley and Sons. 383-415.

Haggerty, Patricia K. 1991. Fire effects in blue oak woodland. In: Standiford, Richard B., technical coordinator. Proceedings of the symposium on oak woodlands and hardwood rangeland management. 31 October-2 November 1990, Davis, CA. Gen. Tech. Rep. PSW-126. Berkeley, CA: USDA Forest Service, Pacific Southwest Research Station. 342-344.

Hardy, Colin C., Kirsten M. Schmidt, James P. Menakis and R. Neil Samson. 2001. Spatial data for national fire planning and fuel management. Int. J. Wildland Fire 10(3&4): 353-372.

Hickman, J.C., ed. 1993. Jepson Manual: Higher plants of California. Berkeley, CA: University of California Press. 1400 pp.

Howard, Janet L. Quercus douglasii. 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/ Accessed July 3, 2006.

James, R. 1980. Sprouting in fire-damaged valley oaks, Chews Ridge, California. In: Plumb, Timothy R., technical coordinator. Proceedings of the symposium on the ecology, management, and utilization of California oaks. 26-28 June 1979, Claremont, CA. Gen. Tech. Rep. PSW-44. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station. 216-219.

Keeley, J.E. 2006. Fire management impacts on invasive plants in the western United States. Conservation Biology 20: 375-384.

Kilgore, Bruce M. 1981. Fire in ecosystem distribution and structure: western forests and scrublands. In: Mooney, H.A., T.M. Bonnicksen, N.L. Christensen et al., technical coordinators. Proceedings of the conference: Fire regimes and ecosystem properties. 11-15 December 1978, Honolulu, HI. Gen. Tech. Rep. WO-26. Washington, DC: USDA Forest Service. 58-89.

Kuchler, A.W. 1964. Manual to accompany the map of potential vegetation of the conterminous United States. Special Publication No. 36. NY: American Geographical Society. 77 pp.

McClaran, Mitchel P. 1987. Yearly variation of blue oak seedling emergence in northern California. In: Plumb, Timothy R. and Norman H. Pillsbury, technical coordinators. Proceedings of the symposium on multiple-use management of California's hardwood resources. 12-14 November 1986, San Luis Obispo, CA. Gen. Tech. Rep. PSW-100. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station. 76-78.

McClaran, Mitchel P. and James W. Bartolome. 1989. Fire-related recruitment in stagnant Quercus douglasii populations. Canadian Journal of Forest Research. 19: 580-585.

Muick, Pamela C. and James W. Bartolome. 1987. Factors associated with oak regeneration in California. In: Plumb, Timothy R. and Norman H. Pillsbury, technical coordinators. Proceedings of the symposium on multiple-use management of California's hardwood resources. 12-14 November 1986 November, San Luis Obispo, CA. Gen. Tech. Rep. PSW-100. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station. 86-91.

Mensing, S. 1992. The impacts of European settlement on blue Oak (Quercus douglasii) regeneration and recruitment in the Tehachapi Mountains, California. Madrono 39:36-46.

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

Parsons, David J. and Thomas J. Stohlgren. 1989. Effects of varying fire regimes on annual grasslands in the southern Sierra Nevada of California. Madrono. 36(3):154-168.

Schmidt, Kirsten M., James P. Menakis, Colin C. Hardy, Wendel J. Hann and David L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Swiecki, Tedmund J. and Elizabeth Bernhardt. 1998. Understanding blue oak regeneration. Fremontia 26(1): 19-26.

Thorne, Robert F. 1976. The vascular plant communities of California. In: Latting, June, ed. Symposium proceedings: plant communities of southern California. 4 May 1974, Fullerton, CA. Special Publication No. 2. Berkeley, CA.

Vogl, Richard J. 1977. Fire frequency and site degradation. In: Mooney, Harold A. and C. Eugene Conrad, technical coordinators. Proceedings of the symposium--On the environmental consequences of fire and fuel management in Mediterranean ecosystems. 1-5 August 1977, Palo Alto, CA. Gen. Tech. Rep. WO-3. Washington, DC: USDA Forest Service. 193-201.

White, Keith L. 1966. Structure and composition of foothill woodland in central coastal California. Ecology 47(2): 229-237.