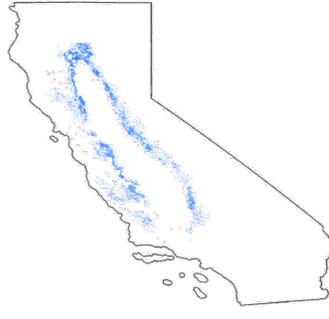


# HEALTHY FORESTS: BLUE OAK WOODLAND

This brief is part of the Healthy Forests series, authored by the [Science Advisory Panel of the California Governor's Forest Management Task Force](#) in collaboration with the USDA Climate Hubs and USGS Climate Adaptation Science Centers. The series is intended to characterize healthy forest attributes, their ecological function, and key stressors.



Photos: Alex Palmerlee (left) and UCANR (right)

## BLUE OAK WOODLANDS AND DISTRIBUTION IN CALIFORNIA

### WHAT DO HEALTHY BLUE OAK WOODLANDS LOOK LIKE?

Blue oak woodlands are a mosaic of grassy plains and scattered oak trees. These woodlands ring the Central Valley of California and are endemic to the foothills of the Coast Ranges, Cascades, and Sierra Nevada. The Healthy Forest briefs series is designed to describe the physical nature, key features, and stressors of ecosystems.

Blue oaks are slow-growing and are typically 20 - 60 feet in height, with a round canopy and crooked branches. Oaks are often found in dry, shallow, and somewhat rocky soils. Importantly, healthy oak woodlands are dominated by oaks and feature a mix of mature, young, standing dead, and downed dead oaks. Presence of young oaks greater than 2 inches in diameter and 4 feet in height is especially important because these have survived the stage of growth most vulnerable to grazing pressures and will likely replace mature trees. Tree densities are variable and may be as few as two adult trees per acre, or as many as several hundred. Woodlands, however, are defined by a discontinuous canopy of trees with a robust grassland understory.



Photo credit: Alex Palmerlee

The understory was once dominated by native, long-lived, bunch grasses, but today they have been replaced by invasive grasses. This grass-dominated ground cover also features a diverse suite of native forbs, such as species of California poppy, *Oenothera*, and *Clarkia*. California oak woodlands also feature shrubs and other small trees such as coffeeberry, western redbud, and various species of manzanita and *Ceanothus*. Additionally, valley, coast live, and interior live oaks may be codominant with blue oaks in these woodlands. In the coast range, Pacific madrone and California bay are also present, particularly on north-facing and mesic locations, respectively, while in the Sierra foothills gray pine and buckeye are intermixed.

Seedling oaks are often found under the canopies of shrub, which may act as a nursery and offer protection from heat and herbivores. In autumn, the ground beneath the wide canopies of mature oaks is littered with acorns, which are a crucial food source for many small mammals and birds, including the acorn woodpecker, an oak specialist. Prior to European settlement of the region, native

tribes used controlled burning to tend the woodlands, manage the acorn crop, and promote growth of other plants and grasses valued for basketry materials and grains<sup>1</sup>.

### Benefits of healthy blue oak woodlands

- Source of food, medicine, and fiber for many Indigenous peoples.
- Support tremendous native biodiversity, including oak specialists like the acorn woodpecker.
- Protect soils from erosion and landslides<sup>2</sup>.
- Valued as grazing lands; oaks can benefit forage for cattle by uplifting water from lower soil layers, enriching soil nutrients, and providing shade for grasses and cattle<sup>3,4</sup>.

## KEEPING BLUE OAK WOODLANDS HEALTHY

### REGENERATION



Since the turn of the century, oak recruitment (the addition of new adult trees) has been highly variable, with many areas experiencing total failure<sup>2,5</sup>. The cause is unclear, but is likely a combination of site-specific factors affecting acorn, seedling, and sapling survival. Acorns may be eaten by animals before they can germinate into a seedling. Most oak woodlands in California are privately owned and used for grazing; cattle and deer may graze or physically damage seedlings and saplings, thereby limiting their establishment and growth<sup>5</sup>. Young oaks may also be outcompeted for water by grasses. Finally, the spread of vineyards and residential development<sup>2</sup> is a growing threat. Conversion of oak habitat to development can fragment populations, creating gaps so large that pollen distribution is limited and acorn production declines<sup>6</sup>.



### CLIMATE CHANGE



Many species of oaks are adapted to hot and dry conditions; their deep roots give them access to underground water sources even when surface soils are dry. However, seedlings are drought-sensitive and increasing dryness in a changing climate may narrow the opportunities for them to establish. Further, early season water uptake by non-native annual grasses may exacerbate drought stress and seedling deaths. Additionally, recent mortality in adults has been linked to oak canker - a disease caused by a fungus. Blue oaks are not typically hosts for this fungus, but extended periods of drought and overall climatic changes may stress the trees so much that they are especially susceptible to infection<sup>7</sup>.

**ADDITIONAL RESOURCES:** FOR MORE INFORMATION, VISIT: [UC OAKS](#)

### CITATIONS:

- <sup>1</sup>Anderson, M.K. 2013. Tending the wild Native American knowledge and management of California's natural resources.
- <sup>2</sup>Zalaveta, E.S., K.B. Hulvey, and B. Fulfroost. 2007. Regional patterns of recruitment success and failure in two endemic California oaks. Diversity and Distributions 13. 735-745.
- <sup>3</sup>Callaway, R. M., N.M. Nadkarni, & B.E. Mahall 1991. Facilitation and interference of *Quercus douglasii* on understory productivity in central California. Ecology 72.1484-1499.
- <sup>4</sup>Ishikawa, C. M. & C. S. Bledsoe 2000. Seasonal and diurnal patterns of soil water potential in the rhizosphere of blue oaks: evidence for hydraulic lift. Oecologia 125. 459-465.
- <sup>5</sup>Tyler, C.M., B. Kuhn, F.W. Davis. 2006. Demography and recruitment limitations of three oak species in California. The Quarterly Review of Biology 81(2).
- <sup>6</sup>Knapp, E.E., M.A. Goedde, K.J. Rice. 2001. Pollen-limited reproduction in blue oak: implications for wind pollination in fragmented populations. Oecologia 128. 48-55.
- <sup>7</sup>Macon, D., T. Schohr, D. Schmidt, and M.M. Garbelotto. 2020. Recent blue oak mortality on Sierra Nevada foothill rangelands may be linked to drought, climate change. California Agriculture 74(2). 71-72.