Not So Sudden Oak Death

Conifer Encroachment and the Disappearance of Northern California's Oak Woodlands

By Eamon Engber

The oak woodland landscapes of California not only provide habitat for hundreds of animals and more than a thousand native flowering plants, but have a rich history of management by humans. The abundance of acorns and diversity of fauna attracted Native Americans to these landscapes for thousands of years, and their cultural management practices, which included frequent burning, maintained and enhanced these ecosystems. In northwestern California, Oregon white oak and California black oak woodlands and grasslands are embedded within a more forested landscape, providing critical habitat for light-loving flora and fauna not able to persist in deeply shaded forest environments. Among the numerous factors threatening the persistence of oaks throughout the state (e.g., urbanization and agricultural development), in our region conifer encroachment (the overtopping of oaks primarily by Douglas-fir) ranks the highest.

As encroachment proceeds, crowns of the shade-intolerant deciduous oaks, California black oak and Oregon white oak, are pierced and overtopped by the faster and taller-growing Douglas-fir. This process initially results in partial crown dieback, but over time, oak crown recession leads to tree mortality. Though oaks can sometimes persist for decades after being overtopped by Douglas-fir, research has shown that these suppressed trees produce substantially fewer acorns than open-grown trees. Oregon white oak, the only oak that grows north of California all the way to British Columbia, is estimated to occupy only 10 percent of its historical range in the Pacific Northwest (USDA Forest Service Pacific Northwest Research Station) due to conifer encroachment and other factors resulting in habitat loss. In the Bald Hills of Redwood National Park in northern Humboldt County, scientists estimate that one-third of the oak woodlands converted to Douglas-fir forest between 1850 and 1983. Further, researchers at Humboldt State University's Wildland Fire Laboratory found that overtopped black oaks in the Klamath mountains are on average at least 40 years older than the overtopping Douglas-fir within their crowns. Loss of oak woodlands to conifer encroachment has recently spurred much research on the topic, and generated critical questions such as, is encroachment natural, and what maintained oak woodlands historically? I will try to address these questions, and conclude with a discussion of what is being done to maintain these biologically important ecosystems.

Frequently burned Oregon white oak woodlands maintain species-rich understories and healthy oak canopies. Bald Hills of Redwood National Park, Humboldt County, CA.

Some have argued that conifer encroachment into woodlands and grassland is a natural successional process whereby increased light availability and lack of competition from mature conifers leads to the establishment of natural conifer regeneration—evidence that nature abhors a void. The key fault in this argument is that it fails to account for natural and anthropogenic disturbance processes that historically played a primary role in the maintenance of these plant communities, e.g. human and lightning-caused fires. The mechanism through which woodlands are maintained by fire is the bottleneck that fire places on conifer regeneration. Though research has been carried out on the topic, most of us would guess that young conifers are susceptible to injury from fire. Research I completed in the Bald Hills of Redwood National Park showed high mortality of small (less than 10 feet in height) Douglas-fir following a grassland prescribed burn. Mature oaks are quite resilient to low-intensity surface fires, and young oaks, if injured, will resprout vigorously following fire. If fires occurred at a sufficient frequency in our region historically, conifer regeneration would be eliminated before recruiting into fire-resistant size classes. Naturally, this leads to the question of historical fire frequency in the region's oak woodlands.

The study of fire history is a complex topic that can be approached from multiple angles. To gain an understanding of historical fire occurrence in a particular area, ecologists may examine charcoal

deposits in lake bed sediments, fire scars left in tree rings, forest age structure (e.g., patches of even-aged trees that regenerated following a widespread disturbance), and ethnographies that address Native American cultural practices. In northwestern California, multiple lines of evidence support the hypothesis that fires were quite frequent historically. In lower elevation oak woodlands and grasslands where lightning is less common, Native American tribes are thought to have burned the landscape almost annually in many areas, for a multitude of reasons. In her book, "Tending the Wild," M. Kat Anderson from UC Davis suggests many woodlands and grasslands in California would be forests or shrublands today if not for frequent Native American burning.

Old-growth California black oaks being encroached by Douglas-fir in Mendocino County, CA. The faster growing Douglas-fir will eventually overtop the oaks and shade them out, leading to oak mortality.

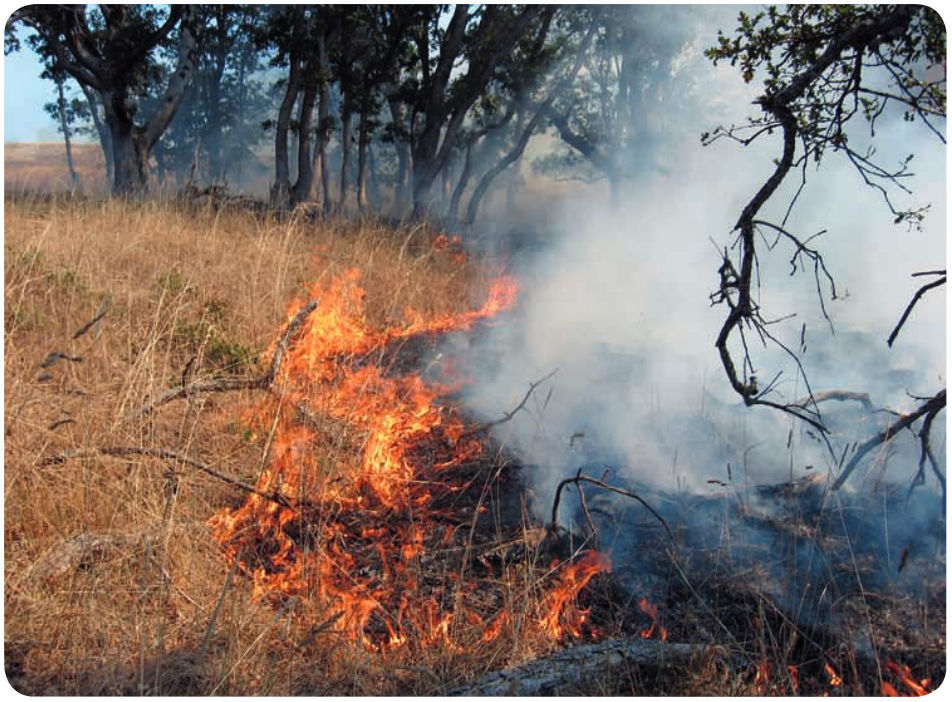
Fire histories have also been conducted in northwestern California from the study of tree rings. In a recent study by Carl Skinner and others in the journal Fire Ecology, fire scars revealed fire return intervals (years between fires) in the Mendocino National Forest that ranged from 4.5 to 6 years up until about 1850, with almost no recorded fires on any research plots after 1900. They concluded that the high historical fire frequency was a result of both lightning and Native American ignitions, and the cessation of fires resulted from removal of tribes and widespread fire suppression. A fire history study in redwood forests of the Jackson Demonstration State Forest reported fire return intervals as frequent as six years, ranging up to 20 years in more coastal, western plots. In another fire history study conducted in Prairie Creek State Park, researchers found a mean fire return interval of six years from 1714 to 1881. Fire history studies specifically in oak woodlands are difficult to conduct and are generally lacking due to the short duration of flames in grassland fuels and minimal scaring of overstory trees during burns.

Given the fact that oak woodlands were heavily inhabited by Native Americans for thousands of years—and that these tribes used fire ubiquitously, combined with evidence provided by fire history studies in forests occurring adjacent to oak woodlands, suggest fire played a major role in the persistence of these landscapes. The region-wide suppression of fire during the 20th century is the likely mechanism responsible for the conversion of oak woodlands and grasslands in the region to coniferous forest. What can we do today to maintain and restore oak woodlands in northwestern California?

A common restoration method in deciduous oak woodlands is known as "oak release," referring to the release of competition (i.e., encroached Douglas-fir) from individual oaks. This requires removing all Douglas-fir not just within the oak crown but usually within a radius of 30 to 40 feet. This allows sufficient sunlight to reach the oak crown, and if trees have not declined too far, they will respond by epicormic branching and rebuilding of the crown, and often, increased acorn production. Douglas-fir that are hung-up in the crown or pose a challenge to removal may be girdled. Girdling requires two cuts through the cambium (using a chainsaw) around the circumference of the tree, approximately eight inches apart, followed by removal of the bark and cambium (with an axe) between the two cuts (bark removal is much easier in spring when sap is flowing). Girdled trees die slowly and eventually provide excellent snag habitat for wildlife. After conifer removal, it is important to deal with slash to mitigate fire hazard. Common methods include piling and burning, or chipping. Be sure to check with your local CalFire station regarding tree removal and burning regulations.

Though prescribed burning can be challenging in California, many federal and state-owned properties are burned frequently with great success. Low intensity prescribed burns are usually too cool to injure conifers large enough to pierce oak crowns, however, so

these trees must be manually removed beforehand. Prescribed burns can then be used to restore the understory species community and maintain oak woodlands and grasslands from future conifer encroachment, simultaneously reducing fire hazard. Burning can also reduce unnatural duff accumulations created by conifer encroachment, thereby speeding up the recovery of the understory herbaceous plant community. Obviously, prescribed burning poses important logistical challenges that must be addressed. Contact your nearest CalFire battalion chief to obtain information about conducting a burn on private property.



Prescribed burn in Oregon white oak woodlands of Redwood National Park.

The oak woodlands and grasslands in northwestern California and throughout the Pacific Northwest provide critical habitat for a diversity of flora and fauna, and are in need of restoration and maintenance. In many areas, if these ecosystems are left alone they will convert to coniferous forest, resulting in substantial loss of biodiversity on a landscape scale. I encourage all of us to walk around our properties and look for the remnant white oaks and black oaks, look at the differences in crown structure between encroached and non-encroached trees, and look at the understory plant community. Make oak release a priority on your lands, and help ensure the persistence of these important ecosystems! For more information on oak release, google "A practical guide to oak release" by C.A. Harrington and W.D. Devine. Also, check with your nearest USDA Natural Resources Conservation Service (NRCS) office regarding potential cost-share programs.

Old-growth California black oaks in Mendocino County, CA released from encroaching Douglas-fir prior to substantial oak crown recession.

Eamon Engber is a Research Associate at Humboldt State University, Wildland Fire Laboratory doing fire ecology research. He grew up in Laytonville, California. Interested in □re ecology, watershed health, and ecosystem restoration, Eamon has a MS in Forestry from Humboldt State University with emphasis in □re ecology (2010) and a BS in Conservation and Resource Studies, University California, Berkeley (2004).