Oaks

FALL/WINTER 2020 CALIFORNIA OAKS

CALIFORNIA'S OAKS IN THE 21ST CENTURY: FIRE AND OAKS

Historically, fire has been an important component of almost all California ecosystems, including forests and woodlands. An estimated 4.5 million acres burned annually prior to European settlement.[1] California's fires are larger and the fire season is longer since the publication of the *Oaks 2040* reports, *Status and Future of Oaks in California* in 2006 and *Carbon Resources in California Oak Woodlands* in 2008. As of mid-October 2020, more than 4 million acres burned this year alone, despite considerable expenditures on fire suppression.

Research has explored the long and complex relationship between fire, humans, and woodlands and forests, with numerous analyses of historical fire regimes and the impacts of fire frequency and suppression, climate change, and other anthropogenic factors. Some of this research is summarized below, with a focus on oaks in forests. This newsletter presents broad trends associated with shifts in historic fire intervals in oak ecosystems in the southern and northern parts of the state, discusses research into fire restoration in a number of black oak ecosystems in Northern California, and presents a case study of oak recovery at the University of California Hopland Research Center in Mendocino County.

Inside

Bryant Baker, M.S., Conservation Director, Los Padres ForestWatch

Coast live oak resprouts after the 2019 Cave Fire

Human impacts on California's fire regime

Human impacts on the landscape are intertwined with fire in California. Indigenous peoples used regular prescribed fire to steward California's landscape for subsistence and cultural resources for millennia. Indigenous fire and lightning-ignited fires created a pattern of frequent, mostly mild fire that maintained California oak woodlands. Following European settlement in the late 18th century and the genocide and removal of Indigenous peoples as stewards of the land, resource management practices shifted to value commercial timber over the ecosystem and cultural values of oaks. Oak ecosystems have been degraded by wood extraction, grazing, and other land management regimes favoring oak removal, with negative impacts most closely associated with the period beginning in 1848, described by researcher S. Mensing as the "American Period."[2]

The shift to commercial forestry has also affected the fire regime. Logged landscapes burn hotter than normal during forest fires, in part because they lack structural heterogeneity.[3]

Post-fire salvage logging degrades the landscape, reversing many beneficial effects of fire on forest ecology. This logging, conducted by U.S. Forest Service and private timber operators, is often followed by applications of herbicides to destroy oaks and other hardwood species before dense monocultures of conifers are planted. Salvage logging and subsequent replanting changes the trajectory of forest succession and may lead to the extirpation of even relatively common forest species.[4] The land disturbance can also foster the establishment of non-native grasses, which exacerbates fire risk and disrupts ecosystems. This type conversion also occurs in chaparral and coastal sage scrub landscapes.

Interest in the restoration of hardwoods in conifer-dominated landscapes has gained traction as a means of slowing fire and restoring biodiversity. In *Forest Ecology and Management*, M. North et al. note that groves of oaks, aspens, and other hardwoods help to diversify wildlife habitat and often serve as natural fuel breaks in conifer forests, helping to advance landscape heterogeneity and resilience: "In some locations, it may be both financially and ecologically beneficial to accept some degree of hardwood dominance in a post-fire landscape."[5]

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Protecting and sustaining oak ecosystems is good climate policy

Statement from California Wildlife Foundation/California Oaks Executive Officer

It is in our collective interest to safeguard oaks, the state's primary old-growth resource. Oaks sequester carbon, protect watersheds, and provide vital plant and animal habitat. They are also culturally significant landscapes. As you will read in this report, oaks are fire-resilient, and healthy oak stands can slow fire in forested lands.

The importance of California's oak ecosystems, which sequester millions of tons of carbon, is brought into focus as evidence mounts that increased atmospheric carbon and associated warming are straining tropical carbon sinks. Conserving California's natural lands must be part of the global solution. Overall, tropical forests now take up more carbon than they lose, but disturbing trends are emerging. An article published in *Nature* reports a long-term decline in the Amazonian carbon sink and a mortality-dominated decline of the African carbon sink, the latter of which appears to have begun only recently.[1]

California Wildlife Foundation/California Oaks leverages our efforts through the California Oaks Coalition, which brings together national, state, regional, and local organizations to keep oaks standing. Our collective efforts require enhanced protections to sustain and perpetuate oak ecosystems. California must adopt and enforce a no-net-loss policy if it is to adequately respond to current conditions. Cumulative threats to oak landscapes—including conversions for real estate and agricultural development, overgrazing, fire, disease, invasive species, drought, and climate change—are fragmenting and degrading California's oak ecosystems.

Most oaks are not designated as commercial species, thus the ecosystem services they provide do not receive the regulatory attention afforded by the 1973 California Forest Practice Act (FPA). FPA requires a timber harvest plan to protect public trust resources such as water quality and wildlife habitat from negative environmental impacts when timber is harvested.[2] While FPA's provisions are arguably insufficient, no such comprehensive approach to safeguarding the ecosystem services that oaks provide is required for conversions of oak woodlands.

California Oaks advocated for the passage of Senate Bill 1334 as an interim measure to secure oak protections.[3] This legislation requires that when a county is determining the applicability of the California Environmental Quality Act (CEQA) to a project, it must determine whether that project "may result in a conversion of oak woodlands that will have a significant effect on the environment." If such effects (either individual impacts or cumulative) are identified, the law requires that they be mitigated for the removal of oaks that are not commercial species (those 5 inches or more in diameter as measured at a point 4.5 feet [breast height] above natural grade level). Acceptable mitigation measures include the conservation of other oak woodlands through the use of easements and planting replacement trees, which must be maintained for 7 years.

Unfortunately, the reliance on counties to determine thresholds of significance is far less protective of oaks as a public trust resource than a uniform statewide system for oak conversions would be, in part because exemptions in applications of CEQA include conversions of oaks woodlands on agricultural lands. It is also not uncommon for counties to establish significance thresholds that run counter to stated oak protection goals in plans that enable the counties to receive funding from the California Wildlife Conservation Board's Oak Woodlands Conservation Program. Further, the lax standards that do exist are often not upheld when projects are approved.

The state must determine the appropriate agency to improve existing regulations, to ensure that a no-net-loss standard is achieved. Governor Newsom's October 7, 2020 Executive Order directs the California Natural Resources Agency, in consultation with the California Environmental Protection Agency, the California Department of Food and Agriculture, the California Air Resources Board, Governor's Office of Planning and Research, the California Strategic Growth Council, and other state agencies to develop a Natural and Working Lands Climate Smart Strategy to utilize natural and working

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Map

Tom Gaman, registered professional forester, prepared this map, which illustrates the impacts of fires from 2000 to 2020 on California's oak landscapes. The map shows conflagrations larger than 100 acres in relationship to oak woodlands and oak-forested lands.

The oak woodland and forest map was produced by Gaman utilizing Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) predictive vegetation maps (see: https://lemma.forestry.oregonstate.edu/data). LEMMA is a collaborative research group of the U.S. Forest Service Pacific Northwest Research Station and Oregon State University, which is engaged in modeling forest structure and composition using Landsat imagery and other environmental variables in combination with U.S. Forest Service Forest Inventory and Analysis (FIA) ground data.

The map estimates oak forest and woodland structure utilizing LEMMA data from 2012. Gaman characterized oak types by selecting oak genera, including tanoak, in areas where oak types were cumulatively greater than 10 square feet of basal area per acre and greater than 10% hardwood canopy density. This group was further subdivided into forests and woodlands.

Bryant Baker, M.S., Conservation Director, Los Padres ForestWatch

Epicormic sprouting of coast live oak after the 2019 Cave Fire

Acknowledgements

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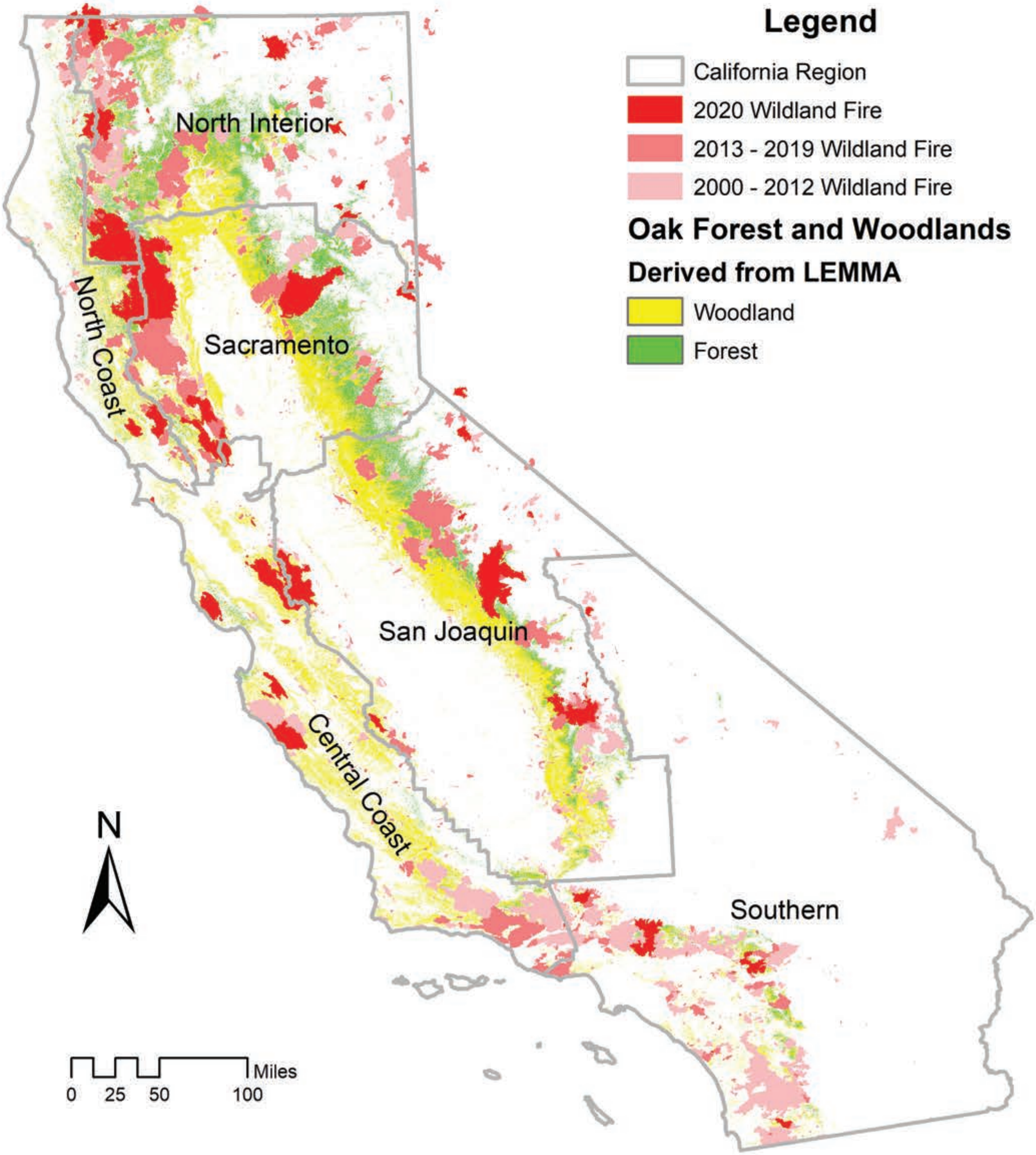
California Wildland Fires among Oak Forests and Woodlands



Sources / notes: Vegetation derived by California Oaks from USFS/OSU LEMMA. Fire Perimeters from CalFire, National Interagency Fire Center.
All fires 100+ acres shown.
October 2020.

Bryant Baker, M.S., Conservation Director, Los Padres ForestWatch

Coast live oak resprouts after the 2013 Rim Fire

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Greater forest diversity confers greater resilience in forest ecosystems. In *Ecological Applications*, C. Restaino et al. suggest that forest managers consider cultivating "a more diverse set of forest species to buffer against insects and pathogens that target individual species, particularly when they are at high densities, as well as projected increases in both drought and fire." In the drier portions of their study area, oaks such as California black oak and canyon live oak experienced very low mortality rates despite high levels of mortality in shade-tolerant and intolerant conifers. The promotion of oaks and other hardwoods that tend to resprout after topkill "may confer greater stand resistance to future hotter droughts and bark beetle outbreaks, as well as greater resilience to disturbances like fire."[6]

Concerns about wildfire have also prompted reexamination of historical forest conditions and fire regimes in the West, challenging prior assumptions about forest structure and fire patterns. For example, M.A. Williams and W.L. Baker reported in 2012 that spatially extensive reconstructions from the late 1800s showed these forests to be "structurally variable, including areas of dense forests and understory trees and shrubs, and fires varied in severity, including 15% to 65% high-severity fire." They also found that reconstructions and palaeoecological studies showed that higher-severity fires were intrinsic to the normal dynamics of dry forests.[7,8]

This analysis also questions the role of forest management in mitigating fire risk. Laws, policies, and initiatives that aim to uniformly reduce fuels and fire severity are likely to "move many of these forests outside their historical range of variability with adverse effects on biological diversity."

We have also entered a new chapter of the "American period" for California's oaks as the effects of the warming climate play a growing role in fire.

Our changing climate

Anthropogenic climate change is increasingly recognized as creating conditions conducive to wildfire. Climatic effects on moisture and air temperatures, which have grown since the *Oaks 2040* reports were published, are linked to fire. Since the early 1970s, the increasing number of warm-season days has increased the atmospheric vapor pressure deficit (VPD), the relationship between the amount of moisture in the air and how much moisture the air can hold when it is saturated.

"Nearly all of the increase in summer forest fire area during 1972–2018 was driven by increased VDP … In fall, wind events and delayed onset of winter precipitation are the dominant promoters of wildfire," A.P. Williams et al. wrote in *Earth's Future*.[9] At the same time, background warming and consequent fuel drying have increasingly enhanced the potential for large fall wildfires.

These changed conditions also facilitate the spread of invasive species, disease, and pathogens. When ecosystems are stressed and vulnerable, altered temperatures may be conducive to the establishment and spread of pathogens.

Human ignition remains a primary starter of California's fires, including via arson, cigarettes, untended or illegal campfires, hot exhaust pipes and wheels coming into contact with dry fuel, downed power lines, and transformer box malfunctions.

The warming climate is expected to increase the frequency and extent of lightning strikes, another source of ignition.[10]

Alongside the changed fire regime, housing development in fire-prone landscapes has "increased suppression costs, exacerbated risk to human safety and infrastructure, and reduced management options."[11]

Managing old-growth oaks

The ecosystem and cultural values of oaks, California's primary old-growth resource, do not receive sufficient protection under California law, as described in the Executive Officer statement on page 2. It is encouraging, but not sufficient, that management practices are beginning to recognize the value of oaks in forests. Many ill-conceived proposals to "treat" vegetation to mitigate fire risk pose threats to oak ecosystems, which are already being degraded and fragmented by development and environmental stressors. Robust regulation and incentives are needed to protect and perpetuate oaks.

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[1] Pinckard A, "Living with fire: Q&A with fire ecologist Scott Stephens," *California Magazine*, California Alumni Association, Jan-Feb 2009.

[2] Mensing S, "The history of oak woodlands in California, Part II: The Native American and historic period," *California Geographer*, Vol 46, California Geographical Society, Arcata, CA, 2006, 1-31.

[3] Zald HSJ, Dunn C, "Severe fire weather and intensive forest management increase severity in a multiownership landscape," *Ecological Applications* 2018 Jun; 28(4):106880, 1-13.

[4] Parker V, "Restoring biodiversity after fire: Report from the Sierra," *Oaks*, Fall-Winter 2017, 1, 4, 8.

[5] North M et al., "Tamm Review: Reforestation for resilience in dry western U.S. forests," *Forest Ecology and Management*, 432(2019), 213.

[6] Restaino C et al., "Forest structure and climate mediate drought-induced tree mortality in forests of the Sierra Nevada, USA," *Ecological Applications*, 2019; 29(4):11.

[7] Williams MA, Baker WL, "Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests," *Global Ecology and Biogeography*, 2012; 21:1042–52.

[8] Odion DC et al., "Examining historical and current mixed-severity fire regimes in ponderosa pine and mixed-conifer forests of Western North America," *PLOS ONE*, 2019; 9(2):e87852.

[9] Williams AP et al., "Observed impacts of anthropogenic climate change on wildfire in California," *Earth's Future*, 2019; 7:892–910.

[10] Romps DM et al., "Projected increase in lightning strikes in the United States due to global warming," *Science*, Nov 2014, 346(6211):851–4.

[11] Stephens SL et al., "Managing forests and fire in changing climates," *Science*, Oct 2013, 342(4):41-2.

RESOURCES

PUBLICATIONS

Fire intervals in oak woodlands
McCreary D, "Fire in California's Oak Woodlands," University of California Integrated Hardwood Range Management Program, June 2004. https://oaks.cnr.berkeley.edu/oak-woodland-fires/

Literature review on fire and oaks
Holmes KA et al., "California oaks and fire: A review and case study" in Merenlender, A et al. tech eds. *Proceedings of the Sixth California Oak Symposium: Today's Challenges, Tomorrow's Opportunities*. 2008. General Technical Report PSW-GTR-217. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 551-565.

Protected landscapes and fire
Bradley CM et al., "Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States?" *Ecosphere* Oct 2016,7(10):e01492. 10.1002/ecs2.1492

INTERNET RESOURCES

California Fire Science Consortium
Links to research, publications, events, and webinars: http://www.cafiresci.org/

Fire Adapted Communities Learning Network
Information for local leaders, land managers, and firefighters to increase community resilience to wildfire: https://fireadaptednetwork.org/

Joint Fire Science Program of U.S. Department of Interior (DOI) Bureau of Indian Affairs, DOI Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, DOI National Park Service, U.S. Geological Society: Research, publications, and funding information: https://www.firescience.gov/

Sierra Forest Legacy
Links to research articles on salvage logging and other post-fire and post-disturbance issues, information on prescribed fire, and more: https://www.sierraforestlegacy.org/

UC Oaks website
Use the search tool on the University of California's oaks website to download publications on fire and oaks: https://oaks.cnr.berkeley.edu/

Also, see the notations on pages 6 and 7 about California Oaks Coalition member websites that have information on fire.

Fire and oaks: A tale of two states

Michael Jones, PhD, University of California (UC) Cooperative Extension Forest Advisor

Severely burned oaks after the 2018 River Fire at the University of California Hopland Research and Extension Center

Sprouting to survive

Fire has always been a part of oak woodlands and forests. Oak woodlands persist because they have adapted to live with fire over thousands of years.

One main way that oaks adapt to fire is sprouting. Coast live oaks, for example, can survive crown scorch and then vigorously sprout from their base. Deciduous oaks are not known for their sprouting capability, although studies found that only 3% of burned valley oaks died even when 85% of the trees were completely top-killed.

Bark thickness and branching habits are also adaptations that protect oaks from fire damage, but sprouting is what provides a competitive edge over conifers. Sprouting is especially advantageous when fire frequency is high.[1]

C. Rice and T. Gaman, co-authors of "Oak woodlands and fire" in the Fall–Winter 2018 *Oaks* newsletter, observed that too much or too little fire plays an outsized role in the health, growth, and persistence of California's oak ecosystems. They reported on H. Safford and K. Van de Water's investigation of the difference between pre-European settlement and current fire-free intervals and found that it varied by location.[2] "Intervals between fires are far longer than before European settlement in Northern California and far shorter in Southern California. Human ignitions are a primary factor for the shorter intervals in Southern California. Additionally, the higher frequency changes the fuels to ignitable annual grasses, thereby exacerbating fire frequency."[3]

They noted, based on the spatial distribution of oak woodlands and fire-return interval measurements, that "blue and coast live oak, as well as canyon live oak are most impacted by frequent fires. Interior live, tan, and Oregon white oak are most impacted by lack of fire."[4] (See the adjacent Resources column for more information on fire intervals in oak woodlands.)

Rice and Gaman summarized threats to oaks in Southern California: "Non-native pests are devastating oak woodlands. Additionally, non-native annual grasses are fueling more frequent fires in the oak savannas of Southern California." Threats in coastal Northern California "are from overtopping by Douglas-fir and bays and from overtopping by pines in the Sierra."[5]

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1 Rice C, Gaman T, "Oak woodlands and fire," *Oaks*, Fall-Winter 2018, 2, 4.

2 Van de Water et al., "A summary of fire frequency estimates for California before Euro-American settlement," *Fire Ecology* Volume 7, Issue 3, 2011, doi: 10.4996/fireecology.0703026, 26-8.

3 See *Supra* note 1.

4 See *Supra* note 1.

5 See *Supra* note 1.

Restoring fire to oak ecosystems with fire deficits

Lomakatsi Restoration Project

Lomakatsi Restoration Project Engine Boss Matt Cox uses a drip torch to ignite slash piles during a controlled burn operation in Shasta County in 2019. The project is restoring fire to ancestral homelands of the Ajumawi people of the Ajumawi-Atsuge Nation. The project team is thinning encroaching conifers to improve wildlife habitat, reduce wildfire risks to adjacent homes and the town of Fall River Mills, and to enhance living cultural resources for the tribal community.

By understanding the role of fire in oak woodlands, we can do a better job of working with nature to let oaks continue to live with fire. — Carol Rice and Tom Gaman[7]

Oaks are fire-adapted, and many have been harmed by the exclusion of fire. A U.S. Forest Service (USFS) publication reports that black oaks depend on low-intensity, more-frequent fires to reduce ecological stressors, including competition from conifers, pest loads, and buildup of fuels that promote intense fires.[1]

For millennia before the arrival of Europeans, Indigenous peoples tended black oak woodlands to encourage more-frequent, lower-intensity fires and maintain mature, broad-crowning, productive oaks. This historic management regime also influenced the broader ecosystem through an array of food webs and fire-related interactions. "Restoration of California black oak would not only sustain tribal values and wildlife habitat, but it would also promote greater ecological resilience to drought and wildfire during this time of a warming climate," the USFS authors wrote.[2]

Another USFS summary of research on black oaks and fire recovery indicates that the season of burning also affects the density of sprouting in California black oaks. Individual California black oaks grew significantly more sprouts after prescribed fires in early fall and early spring compared to after prescribed fires late fall and late spring, in ponderosa pine and mixed-conifer forests.[3]

A 2012 article in *Forest Ecology and Management* examining conifer encroachment on oaks reported growing problems when fire is excluded from black oak ecosystems. The authors studied canopy competition, paired tree ages, and post-fire effects in a recently burned California black oak woodland in the Klamath Mountains. The pre-fire woodland overstory in this ecosystem was heavily dominated by Douglas-fir, which commonly pierced and overtopped California black oak crowns. The researchers found that competitive pressure from encroaching trees "may compromise California black oak's ability to survive fire while resilience of encroaching Douglas-fir improves with greater size." As a result, restoration activities in California black oak woodlands following fire should aim to "minimize loss of compromised, remnant oaks while still achieving adequate removal of encroaching conifers."[4]

Further, writing about oak ecosystems in Oregon, J. Agee cautioned that fire restoration planning must be informed by current as well as historical conditions. Fire's historical presence in an ecosystem alone should not be the only consideration in planning for its restoration. "Alien species may create new competitive environments for native species, even though the reintroduced fire regime may mimic the historical fire regime. The structure of the system may have changed, so that the effect of a natural process like fire may be different now than in the past." New conditions "may require a comprehensive analysis of the ecological costs and benefits associated with the proposed fire

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California Oaks Coalition

California Oaks Coalition brings together national, state, regional, and local organizations to conserve and perpetuate the state's primary old growth resource. Members of California Oaks Coalition are united by the vital role of oaks in sequestering carbon, maintaining healthy watersheds, providing habitat, and sustaining cultural values.

Notations are added to denote members of California Oaks Coalition that conduct research on wildfire and/or provide informational resources about fire on their websites. Additionally, many organizational members of the coalition engage in programmatic and/or policy work on fire issues, and/or send information about fire to followers on social media.

- Amah Mutsun Land Trust *Research* and *Information*
- American River Conservancy
- American River Watershed Institute *Information*
- AquAlliance
- Banning Ranch Conservancy
- Butte Environmental Council *Information*
- California Invasive Plant Council (Cal-IPC) *Information*
- California Native Plant Society (CNPS), including CNPS Dorothy King Young Chapter, CNPS San Diego Restoration Committee, and CNPS Sanhedrin Chapter *Research* and *Information*
- California Rangeland Trust
- California Water Impact Network (C-WIN)
- California Wilderness Coalition (CalWild) *Information*
- Californians for Western Wilderness (CalUWild)
- Canopy *Information*
- Carpe Diem West *Information*
- Center for Biological Diversity *Research* and *Information*
- Chimineas Ranch Foundation
- Clover Valley Foundation
- Conejo Oak Tree Advocates
- Dumbarton Oaks Park Conservancy
- Elder Creek Oak Sanctuary
- Endangered Habitats Conservancy
- Endangered Habitats League
- Environmental Defense Center

Environmental Protection Information Center (EPIC) *Information*
Environmental Water Caucus
Foothill Conservancy *Information*
Forests Forever
Friends of the Richmond Hills
Friends of Spenceville
Hills For Everyone *Research* and *Information*
Laguna de Santa Rosa Foundation
Lomakatsi Restoration Project *Research* and *Information*
Los Padres ForestWatch *Research* and *Information*
Lower Kings River Association
Napa County Water, Forest and Oak Woodland Protection Committee
Northern California Regional Land Trust
Planning and Conservation League
Redlands Conservancy
Resource Conservation District of Santa Monica Mountains *Research* and *Information*
River Partners
River Ridge Institute
Rural Communities United
Sacramento Tree Foundation
Santa Clarita Organization for Planning and the Environment (SCOPE)
Save Lafayette Trees *Information*
Shasta Environmental Alliance
Sierra Club Placer Group
Sierra Foothill Conservancy
Tejon Ranch Conservancy
Templeton Heritage Tree Foundation
Tuleyome *Research* and *Information*
Tuolumne River Trust *Research* and *Information*
University of California Los Angeles Mildred E. Mathias Botanical Garden

California Oaks provides four areas of support for coalition members:
1) Research and advocacy updates.
2) Information to educate and engage the public.
3) Tools for participating in planning processes and educating opinion leaders.
4) Materials to inform local, regional, and state governmental agencies of the opportunities for and benefits of protecting oak woodlands.
For more information, please contact Oaks Network Manager Angela Moskow, amoskow@californiaoaks.org or 510-763-0282.

Case study of oak wildfire recovery

Michael Jones, PhD, University of California (UC) Cooperative Extension Forest Advisor

Burned oaks in the fog, after the 2018 River Fire at the Hopland Research and Extension Center

Michael Jones, PhD, a University of California (UC) Cooperative Extension forest advisor, designed a study to help answer the question of how recent large wildfires impact oak woodlands. He established 35 burned and 10 unburned 0.07-hectare research plots at the UC Hopland Research and Extension Center in Mendocino County following the July 2018 River Fire, which burned 3,400 acres of the property's rangeland, oak woodland, and chaparral habitats.

Jones collected data on 468 oak trees, representing 7 species, at 2 months and 1 year after the fire. Forty trees with moderate- to high-severity burn damage (extensive bark consumption, cambium damage, and significant canopy torching) appeared dead after the fire. However, new (post-fire) epicormic and/or basal sprouts were observed on 29% of top-killed trees, suggesting that most of the tree mortality observed may have been limited to aboveground biomass.

One year after the fire, he found that mortality had decreased to 20%, with 81% of top-killed trees growing basal sprouts. Almost 100% of vegetative ground cover returned, and oak seedlings were detected in several burned plots. Long-term monitoring of the study plots will follow the success of regeneration and seedling survival.[1]

"The oaks were exposed to persistent, intense heat. They were cooked. But 2 months after the fire, we were already seeing basal sprouts. This was an amazing response by the trees. Oaks are … tough."[2]
— Michael Jones, PhD, UC forest advisor

[1] California Oak Health, University of California Cooperative Extension, Mendocino County (accessed Nov. 4, 2020) http://cemendocino.ucanr.edu/Forestry/Workshops/California_Oak_Health/#videos

[2] Warnert J, "Attention to oak woodland conservation does not wane amid COVID-19 crisis," Forest Research and Outreach, University of California Cooperative Extension Forestry blog, https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=41321

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lands to conserve biodiversity, address climate change, and build climate resilience. The strategy needs to include measures to protect and perpetuate California's oaks.

Financial incentives are also needed to conserve and perpetuate oak woodlands. A 2014 study of rangeland conversions on 13.5 million acres in the Central Coast, Bay Area, and Central Valley found that 37% of blue oak woodlands on rangeland had no conservation designation, as well as 51% of montane hardwoods, 32% of coastal oak woodlands, 41% of blue oak-foothill pine, and 50% of valley oak woodland.[4] The California Rangeland Conservation Coalition identified 13 million acres in the Central Valley that needed conservation easements or restoration.

The history of California's oaks begins before the Quaternary ice ages—the most recent 2.588 million years of the Earth's history. The persistence of California's old-growth oak ecosystems through prior climate shifts offers a degree of certainty during these uncertain times. We must act to ensure the future of California's oaks in the 21st century.

Sincerely,

Janet Cobb
Executive Officer

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[1] Hubau W et al., "Asynchronous carbon sink saturation in African and Amazonian tropical forests," *Nature* Vol 597, March 5, 2020, 80-94.

[2] Morrison H et al., University of California Publication 8249, Forest Stewardship Series, *Laws and Regulations Affecting Forests*, Part I: "Timber Harvesting," 1.

[3] Kuehl, 2004, California Public Resources Code §21083.

[4] Cameron DR et al., "Whither the rangeland?: Protection and conversion in California's rangeland ecosystems," *PLOS ONE* 2014:9(8).

— *continued from page 6*
regime: its frequency, intensity, extent, timing, and synergism with other disturbance factors."[5]

In the years since Agee's article was published (in 1996), climate change effects have been recognized as variables that must also be taken into account in considering the potential and goals for restoration, and the pace and scale of restoration actions.

The passage of AB 1958 (Wood, 2016), which is effective until January 1, 2024, amends the Forest Practice Act of 1973. This legislation, alongside the California Board of Forestry's Oak Woodland Management Exemption in 2017 and adoption of a Timber Harvest special prescription, address the problem of conifer encroachment in oak woodlands. These measures allow landowners in the Coast (but not the Southern Subdistrict) and Northern Forest districts to remove invading conifers to restore and conserve California black or Oregon white oak woodlands and associated grasslands.[6] This regulatory step is an important development that is facilitating the restoration of fire to black and white oak ecosystems.

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[1] Long JW et al., *Restoring California Black Oak Ecosystems to Promote Tribal Values and Wildlife*. U.S. Forest Service, Pacific Southwest Research Station, PSW-GTR-252, 2016, 59–60.

[2] *Ibid.*

[3] Fryer JL., 2007. "*Quercus kelloggii*." In: *Fire Effects Information System*, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/tree/quekel/all.html.

[4] Cocking MI et al., "California black oak responses to fire severity and native conifer encroachment in the Klamath Mountains," *Forest Ecology and Management* 270 (2012) 25–34.

[5] Agee JK, Fire in restoration of white oak woodlands," In: Hardy CC et al., (eds.). *The Use of Fire in Forest Restoration*. Gen. Tech. Rep. INT-GTR-341. Ogden, UT. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 1996. 72–73.

[6] *Forestland Steward*, California Forest Stewardship Program, Summer 2020, https://ucanr.edu/sites/forestry/newsletters/Forestland_Steward_Newsletters86584.pdf, 3.

[7] Rice C, Gaman T, "Oak woodlands and fire," *Oaks*, Fall-Winter 2018, 4.

How you can help:

- Donate to California Wildlife Foundation/California Oaks. A secure donation can be made from our website: californiaoaks.org.
- Spend time in an oak woodland or forest. Click on californiaoaks.org/resources for a partial listing of oak landscapes around the state that have public access.
- Please consider including oak conservation in your financial and estate planning efforts. Information can be found at: californiaoaks.org/donate.
- Be vigilant about threats to oak woodlands and oak-forested lands in your community and consult californiaoaks.org for guidance.
- Sign up for the *Oaks* e-newsletter at californiaoaks.org.
- Support local and statewide measures to protect natural resources.
- Hold decision-makers accountable for protecting green infrastructure.

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