Restoring California Black Oak to Support Tribal Values and Wildlife[1]

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Abstract

Mature California black oak (*Quercus kelloggii*) trees are a keystone for many Native American cultures and support important ecological values. Black oaks depend on low-intensity, relatively frequent fires to reduce competition from conifers, yet they are also vulnerable to intense fires. Restoring mature, large canopy oaks that produce high quality acorns for tribal gatherers will depend upon reestablishing a more frequent fire regime. However, in many areas that have become overly dense, thinning treatments, out-of-season burns, and/or relatively severe fires may be needed to reopen the forest and reduce fuel levels before more traditional use of fire can achieve desired outcomes. Treatments that enhance acorn production may conflict with policies to maintain high forest canopy cover and decadent structures that support some sensitive wildlife species. However, both acorn gathering and habitat for sensitive species can be supported by adopting a landscape-scale strategy that sustains black oaks in a variety of conditions and plans for gaps and decadent areas based upon their relative suitability. Restoration of California black oak would not only sustain tribal values and wildlife habitat, but it would also promote greater ecological resilience in dry, frequent-fire forest types in the Sierra Nevada and throughout its range.

Key words: California black oak, cultural burn, ecosystem services, landscape restoration, prescribed burning, resilience, traditional ecological knowledge

Introduction

California black oak (*Quercus kelloggii*) is a cultural keystone species, according to the definition proposed by Garibaldi and Turner (2004) as "culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine, and/or spiritual practice" (p. 4). Black oak clearly meets the criteria for this distinction based upon its multiplicity of uses; significance in names, stories, and ceremonies; value for trade; and lack of substitutability for California Native Americans who live in the heart of its range, such as the North Fork Mono (Aginsky 1943, Anderson 2007). Much information has been published about California black oak ecology (McDonald 1969, 1990) as well as its importance to Native Americans (Anderson 1993, 2005). This paper builds upon that foundation by laying out a strategy to restore desired

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[1] An abbreviated version of this paper was presented at the Seventh California Oak Symposium: Managing Oak Woodlands in a Dynamic World, November 3-6, 2014, Visalia, California.

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conditions for black oaks within the range where Native peoples have traditionally used fire to tend this keystone species.

Acorns have long been central to indigenous cultures in California (Baumhoff 1963), serving as both a direct food source and an indirect food source by sustaining game animals. Desirable properties of black oak acorns include a large nut that is easier to deshell, pound, and grind than other nuts; a distinctive taste and texture that yields excellent acorn soup or porridge (Figure 1); a high oil content; and storability (Anderson 1993).

Figure 1—Black oak acorn porridge, a traditional food prepared by Lois Conner, North Fork Mono, in a basket made by her grandmother, Lilly Harris, circa 1920. (Photo by Jonathan Long)

Black oaks also support a wide array of animal species. A study of ponderosa pine forests on the Sierra National Forest identified 19 bird species that nested in California black oak, with a greater use of live trees than snags (Purcell and Drynan 2008). The acorn woodpecker depends on black oak acorns, and good crops demonstrate potential to expand the bird's breeding season (Koenig and Knops 1995). Band-tailed pigeons may be an important indicator of the condition of black oaks because of their strong association with those trees for roosting and acorns (Bottorff 2007, McDonald 1969). California black oak is also an important habitat element for sensitive species, including the California spotted owl and the fisher (Long and others 2014). Acorns play a foundational role by supporting black bears, small mammals, and other animals in the fall and winter when other food sources are not available (Mazur and others 2013, McShea and Healy 2002, Tevis 1952). Black oaks continue to provide great economic value through their association with successful deer hunting enterprises in California (Loomis and others 1995). Black oaks also have relationships to various fungi, including mycorrhizal species that help to exchange carbon, nitrogen, and water within soils and among plants, and species that produce truffles and mushrooms that support both wildlife and tribal subsistence (Anderson and Lake 2013, Southworth and others 2011).

Desired conditions

Tribal acorn gatherers emphasize the importance of the productivity and health of black oaks for the larger ecosystem, including the multitude of wildlife species that utilize acorns. However, they particularly emphasize the importance of black oak trees that produce large quantities of good quality acorns (those that are not infested with weevils or worms) (Anderson 2005). The mere presence of oaks is not sufficient because black oaks take 80 to 100 years before they become mature enough to produce large quantities of acorns (McDonald 1969). The current condition of California black oak in the Sierra Nevada appears characterized by declining quality and dominance, as fire exclusion has caused old-growth, open ponderosa pine-California black oak woodlands to become rare (Taylor 2010). Fire suppression has helped shade-tolerant conifers invade and outcompete black oak, causing the remnant mature oaks to have reduced vigor (Cocking and others 2012, Skinner and others 2006).

Trees that are desired for acorn harvest have full crowns (high canopy volume) with few broken limbs and low rates of mistletoe infection (Figure 2). Cavities, which are important for wildlife, are common in both wild and tended oak trees, and gatherers do not consider cavities to be detrimental to acorn production. Gatherers do desire low branches (Figure 2) that facilitate use of beater sticks for gathering. Wildfires do not promote this architecture, but instead promote taller and narrower growth forms (see Crotteau and others, these proceedings), as can be found in the Beaver Creek Pinery (Figure *3*).

Figure 2—Black oak tree with desirable architecture for acorn gatherers, including full crown and low branches on Tom Harris ranch, North Fork. (Photo by Jonathan Long)

Figure 3—Black oak trees in the wildfire-maintained Beaver Creek Pinery exhibit full crowns but lack low branches. (Photo by Carl Skinner)

Impacts of fires and tending practices

Available fire history indicates a strong association between black oak and frequent, regular fires in the southern and central Sierra Nevada and throughout its range on south aspects, ridges, and lower elevations (Van Wagtendonk and Fites-Kaufman 2006). At a more northerly site in the Klamath Mountains, black oak appears more common on mesic, north-facing slopes at lower elevations with a median fire return interval of about 11 years (Taylor and Skinner 2003). Frequent fires create openings that give shade-intolerant black oak the space and resources needed to thrive within conifer-dominated forests. Traditional practitioners and researchers have both shared the perspective that large oaks (specifically trees >20 cm diameter at 1.37 m above ground) tolerated frequent, low-intensity fires that maintained low fuel levels (Jack 1916, Skinner 1995, Skinner and others 2006). However, because of their relatively thin bark, black oaks are more sensitive to fire than the mature forms of associated conifers, such as Douglas-fir, ponderosa pine, sugar pine, and white fir (Skinner and others 2006). For that reason, McDonald (1969) described fire as “black oak's worst enemy” (p. 15), reflecting a concern that black oaks are highly vulnerable to fire damage, even from prescribed fires. That black oak both needs fire and is threatened by it suggests that fuels and structural conditions need to fall within particular margins for fire to favor large trees and their associated benefits. This complex relationship with fire helps explain why the pros and cons of fire in forests with black oak have been debated for at least a century (for example, Jack 1916).

Fires may kill the stems of black oaks (top-kill) or the entire tree. Research at Blodgett Forest in the mid-1980s showed that tree-sized (>3 m tall) black oaks survived fall and spring prescribed burns without top-kill (Kauffman and Martin 1990). However, a more recent study found that burning not only killed small trees, but also induced mortality of larger trees after several years (Kobziar and others

2006, Krasnow and Stephens 2012). Oaks underneath overtopping conifers may demonstrate greater sensitivity to fire than would otherwise be expected due to compromised vigor and increased fuel loading (Cocking and others 2014). Although black oaks that are top-killed by fire do not disappear from a site, the ecological services that they provide may be lost for many years or even longer if conditions do not facilitate regrowth of mature trees. McDonald (1969), who documented that oaks need many decades to mature, noted that nearly all trees he had seen were resprouts, which can grow much faster than ones from seeds (McCreary and Nader 2011) and competing conifers (Skinner and others 2006). Consequently, where oaks are merely top-killed they will reestablish mature trees much more rapidly than in areas where acorns must germinate or seedlings are planted following severe fires.

Cultural burns

Goode (2014) described cultural burning as a traditional use of fire intended to stimulate desired conditions for targeted cultural resource species, including California black oak. He noted that traditional cultural burning in the North Fork Mono area would have been conducted about three times in 10 years, with another two to three burns in the following 2 decades. Consistent with these observations, Anderson (1993) noted that indigenous fires were set annually in the Sierra Nevada wherever the land "needed it," as indicated by abundant growth of brush, with the result that tended areas were customarily burned every 2 to 10 years.

Season of burning

The typical season of burning reported by tribal practitioners from the central and southern Sierra Nevada was autumn or early winter (October through December, typically after or before rains) (Anderson 1993, Appendix R). Burning during the fall prior to gathering of the new acorn crop was beneficial for clearing the forest floor and controlling pest incidence, as well as limiting the density of competing conifers. However, Anderson (1993) pointed out one account of late winter burning by Hazel Hutchins, Mono, who reported that, "The Mono women set the fires in January, February, or March before the leaves sprouted and the mushrooms grew" (p. 39).

In a review of season of burning research, Knapp and others (2009) noted that black oak-dominated forests below the snowline are well suited to burning during tree dormancy, when leaves are available as flashy fuels and leafless canopies allow sufficient sunlight to dry the forest floor. Burning in the dormant season when the trees do not have their canopy also results in less scorch (Knapp and others 2009). Concerns associated with spring burning include impacts to wildlife and plants. The primary denning time for fisher is mid-March to mid-April, which can coincide with budburst in oaks. Pups in dens may be vulnerable to smoke, leading to concerns over prescribed burning during that period (Long and others 2014). These natural cycles and traditional practices suggest the need to consider potential negative effects when burning during early spring.

Effects on acorn production and other values

California black oaks and native peoples represent a mutualism where the oaks benefit humans and human tending benefits trees. Anderson (2005) explained that burning treatments can provide a very effective biological control on filbert worms and weevils. In addition to increasing production of high quality acorns, other benefits of burning and other tending cited by practitioners include producing charcoal for wildlife, reducing mistletoe infection, and encouraging growth of grasses, forbs, and mushrooms (Anderson 2005, Anderson and Lake 2013). In the 1970s, U.S. Department of Agriculture, Forest Service managers at Shasta Lake sought to mimic the historical burning by local Wintu and Pit River people to improve acorn production, with a goal of enhancing deer and elk populations (Skinner 1995). They found that by burning the stands in January, there would be a large increase in that year’s fall acorn crop even while surrounding unburned areas experienced a poor crop (Skinner 1995).

Intersections with broader restoration issues

Restoration of California black oak lies at the heart of broader discussions of how to promote socioecological resilience in the Sierra Nevada (Long and others 2014). The species has suffered long-standing declines due to fire suppression and other historical activities, including widespread efforts to systematically replace it with conifers favored for timber production. But today, the many values of California black oak as wildlife habitat and a source of forest products position it as a centerpiece for demonstrating the potential benefits of fire-centric restoration of forests in California (Long and others 2014). Challenges associated with this type of approach include balancing concerns for sustaining old-forest wildlife species as well as limiting fire-induced losses of mature black oaks, whether through wildfire or prescribed fire.

Black oak has a particularly important role in the evolving approach toward restoration forestry in the Sierra Nevada, which emphasizes the importance of retaining hardwoods, restoring heterogeneity, and designing treatments according to topography (North and others 2009). Treatments to increase sunlight to black oak trees may conflict with policies intended to conserve the California spotted owl and fisher, both of which have been associated with maintaining high forest canopy cover (Long and others 2014). However, treatments may promote high variability at the landscape scale, which would allow society to retain decadent conditions to support those wildlife species in the near term while also maintaining healthy oaks that can provide food resources and habitat for the long term. Restoration treatments may promote openings in areas that are more valued for acorn gathering and are closer to roads and in flatter areas. Locations of historically tended “orchards” identified by gatherers or in historical records would provide a useful starting point. At a finer scale, expanding gaps around mature oaks may encourage both acorn production and recruitment of young trees that can take off when mature trees fall (Purcell and others 2012). Meanwhile, tree clusters with high canopy cover and desirable structures for wildlife, including resting platforms (Figure 4), may be preserved for their short-term habitat value (North and others 2009).

Figure 4—A large legacy black oak used by a fisher for a rest site. (Photo by Rebecca Green)

Restorative burning and other treatment strategies

The strategies to reclaim degraded forests may entail practices that differ from those typically employed in actively maintained forests. Black oak groves that have been overgrown with conifers due to fire exclusion may have changed so dramatically in terms of fuels and structure that restoring their condition may not be feasible simply by reintroducing fire. Under indigenous regimes, burns were so frequent and fuel levels so low that they did not pose a hazard to the forest, according to elders' accounts (Anderson 1993, 2005). For example, burning from the bottom of a slope was reported as a common practice (Anderson 1993), although that practice tends to be hazardous in contemporary forests with extensive areas of high fuel loads. Reclamation of degraded stands may require multiple reentry burns before the resource is set up for intensive use and frequent fall burning, and burning outside of the historical fall-winter seasons may realign the system to the point where in-season burning can occur more safely (see Knapp and others 2009).

Treatments that kill and remove invading conifers are important for restoring desired conditions for black oaks. Various researchers have studied how thinning conifers can promote acorn production and other values in black oak (McDonald and Vaughn 2007) as well as white oak (Devine and Harrington 2013). Such treatments may be particularly important in the short term for reducing the threat from fire and promoting renewed growth of suppressed black oaks. However, for the long term, tribal practitioners highlight the importance of reintroducing fire to promote desired understory plants and reduce the incidence of undesirable pests and pathogens.

The potential use of managed wildfire or more intense prescribed fire as a forest restoration strategy becomes very complex when considering black oaks. Cocking and others (2014) suggested that fires may need to be relatively severe in order to curtail dominance by conifers, at least in stands where conifers are already well established and mechanical thinning is not practical. This idea recalls the "corrective burning" used by aborigines in Australia and described by Lewis (1994) as a way to reclaim forests that had gone too far from their desired condition; those more severe burns would effectively reset the system, then be followed up with maintenance burning at intervals that promote desired conditions. However, if such burns were to occur over a wide area, they might reduce the flow of ecological services provided by mature black oaks for decades. Therefore, strategies may need to be tailored to reduce the potential for unusually large and severe wildfires and to safeguard particularly sensitive, high-value legacy trees.

Conclusion

Treatment strategies to enhance California black oaks for acorn gathering should increase resilience of forests to drought, disease, and wildfires by reducing the likelihood of losing mature trees for extended periods, promoting more open stands with fewer conifers, and enhancing structural diversity, pyrodiversity, and biodiversity. Research at the scale of large landscape demonstration areas, as well as smaller experimental plot studies, will help to understand the benefits of more active caretaking of mature black oaks. Useful indicators for evaluating trends in black oak conditions include the abundance of trees with large, full canopies, and the availability of high quality acorns for gathering. Continuing research partnerships among scientists, land managers, and tribal gatherers will improve adaptive management systems for forests with black oak and sustain the many benefits from these "trees of life."

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