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Indigenous Uses, Management, and Restoration of Oaks of the Far Western United States

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Cover photo: Shelled acorns from the California black oak **(***Quercus kelloggii***)** (Courtesy of Kat Anderson, NRCS)

Acknowledgments

This publication was authored by **M. Kat Anderson**, ethnoecologist, National Plant Center, Davis, California, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), and reviewed by **Scott Peterson**, director, National Plant Data Center, NRCS; **Michael Johnson**, anthropologist, NRCS; **Reina Rogers**, American Indian liaison, NRCS; **Pat Shaver,** rangeland management specialist, NRCS; **Pedro Torres**, tribal liaison, NRCS; and **Sarah Bridges**, national cultural resources specialist, NRCS. Editing, illustrative, and design assistance was provided by **Lynn Owens**, editor; **Suzi Self**, editorial assistant; and **Wendy Pierce**, illustrator, NRCS, Fort Worth, Texas.

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Indigenous Uses, Management, and Restoration of Oaks of the Far Western United States

Introduction

For more than 9,000 years before the arrival of Europeans, native peoples in the West led lives enmeshed with the oaks that surrounded them. Oaks and hands interacted in a myriad of ways as people in each of the many ethnic groups went about their daily routines of gathering, tending, and preparing oak parts: acorns, bark, leaves, and branches. The sharp sound of Dumna Yokuts women pounding blue oak (*Quercus douglasii*) acorns echoed across the oak-dotted canyons of the Sierra foothills of California. In the savannahs of the Willamette Valley in Oregon, and Puget Sound in Washington, the crackling of fire could be heard as the Kalapuya and Chehalis burned under Oregon white oak (*Quercus garryana*) to discourage insect pests, keep areas open, and promote the abundance of wildflowers that were important for foods (Boyd 1999; Johannessen et al. 1971; Thysell and Carey 2001).

The memories of Native American elders, the diaries of early Spanish explorers, old anthropological accounts, and archaeological research all provide evidence that native peoples were actually accomplished managers of their oak environments who actively manipulated plants, populations, and habitats to increase yields, sustain production, and improve the quality of natural raw materials. They did so with an impressive breadth of knowledge, keen observational skills, fine-tuned horticultural techniques, and judicious harvesting. Native Americans swept the ground under the oaks, kept brush from acting as fuel ladders, pruned back the trees, and promoted widely spaced, large-canopied, long-lived trees with light, frequent burning. But Indians also influenced oaks at a larger scale. Through burning, Indians affected the number of oak groves, size of the groves, and species composition of the groves (Leiberg 1900; Anderson n.d).

The acorns produced in the oak woodlands of Arizona, California, Oregon, and Washington, kept indigenous families well fed for thousands of years. In California, this plant part is found in greater quantities in archaeological sites than any other edible food. Also, the use of acorns goes back in the archaeological record to 9000 B.P. This food is still relished today in different parts of the West for ceremonies, festivals, dances, and family gatherings.

Oaks were important to human cultures for a myriad of purposes in addition to foods such as basketry, regalia, household utensils, structures, tools, and weapons. If one were to recount the many ways in which oaks were used by indigenous cultures, the descriptions would fill volumes. The Mono and Sierra Miwok in the Sierra Nevada foothills, for example, made smoking pipes of oak. The Pit River near Mt. Lassen used black oak leaves ceremonially as incense in which to roll tobacco. The Hopi crafted a special stick of oak for planting corn along the bottoms of the washes (Whiting 1966).

Varieties of oaks used for acorns and the tribes that used them

The acorns of many kinds of oaks were utilized in the West for food—even the shrubby oaks with often small acorns. The Mojave of Arizona and California, for example, ate the acorns of the Sonoran scrub oak (*Quercus turbinella*). Each tribe had a definite penchant for acorns of particular species, and this preference varied greatly depending upon the geographic region: Oregon white oak (also called Garry oak) (*Quercus garryana*) was eaten throughout Oregon and western Washington. California black oak (*Quercus kelloggii*) was favored in the Sierra Nevada, eastern California, parts of central coastal California, and southern California; coast live oak *(Quercus agrifolia)* was number one along parts of central and southern coastal California, and tan oak *(Lithocarpus densiflora)* was first choice in northwestern California and parts of central coastal California. While tan oak is not considered by modern taxonomists to be a true oak, this distinction was not made among different tribes. Tribes of the Southwest, such as the Hopi and Navajo, ate the acorns of the Sonoran scrub oak and gambel oak (*Quercus gambelii*) (Dunmire and Tierney 1997).

Acorns: the bread of life

For thousands of years, acorns produced in the oak woodlands of the West were one of the most important food sources for the indigenous people. It had all of the characteristics of a diet staple: it was abundant, widespread, carbohydrate-rich, and trustworthy (fig. 1). Acorns are highly nutritious, with more fat than the almond (Chesnut 1974).

Once leached and cooked, acorn has a slightly nutty flavor and its bland taste makes it an excellent accompaniment to other native foods such as venison, salmon, pupae of the California tortoise-shell butterfly, and the army worm. (Many Native Americans in different tribes drop the "s" on "acorns" when they talk about the nut as food after it is leached and cooked. For example, "we had acorn" or "we are making acorn" are common expressions.) Gathering acorns in the fall was one of the most important events in the year. It was a large group activity often involving whole families that would come together to collect this resource. Tribes had specific rules for gathering acorns. As their use of the earth was limited by the recognized rights of other natural beings, native peoples never harvested all of the acorns, but left some for the other animals.

A surplus of acorns was gathered and stored in outdoor granaries, baskets inside the home, or deerskin and elkskin bags (fig. 2). A critical step prior to storage was the thorough drying of the acorns with the shells on or hulled so they would not be subject to molding. If dried properly—long enough in the sun or by the stove in later times—acorns can be stored in baskets or granaries for 2, 3, or 4 years (fig. 3).

"Making acorn" was by and large women's work, and the steps in its preparation were many. If the acorns were stored in their shells, the first step was to remove the shells and bitter red skins (fig. 4). The acorns were then pounded into flour, sifted for fineness, leached of bitter tannins, and cooked as mush, soup, paddies, cakes, bread, biscuits, or a type of cheese (Mason 1912) (fig. 5).

Some oak species have acorns, such as the gambel oak, that are sweet and do not need leaching. The Navajo boiled their acorns like beans, roasted them over coals, or sometimes dried and ground them into flour (Elmore 1943). The acorns of the Oregon white oak were eaten by the Nisqually, Chehalis, Cowlitz, and Squaxin of Washington. Very bitter and astringent when raw, they were generally cooked by steaming, roasting or boiling (Kuhlein and Turner 1991). The Mid-Columbia Indians of the Columbia Gorge area in Oregon and Washington baked the acorns after leaching them in blue mud (Hunn, Turner, and French 1998).

Figure 1 Acorns of California black oak (*Quercus kelloggii*)

Courtesy of Kat Anderson, NRCS

Figure 2 Kumeyaay Granaries for storing acorns circa 1892

#2854B5 Courtesy of Smithsonian Institution, Washington, DC

Figure 3 Two Pomo women drying acorns near a wood frame house in November 1892

#06438700 Courtesy of Smithsonian Institution, Washington, DC

Figure 4 Aida Icho (Wukchumni) cracking acorns on a soapstone boulder circa 1938

#41886–0 Courtesy of Smithsonian Institution, Washington, DC

The value of acorns to native cultures today

Acorn mush is an important component today of many gatherings, dances, ceremonies, and other events throughout the year. Acorns are still considered a cultural treasure among many tribes, reflecting the enormous staying power of native cultures. Making acorn is an assertion of one's ethnic identity. Going through the process of gathering, hauling, drying, storing, pounding, leaching, cooking, and eating allows native people to reenact the Old Ways, thus paying respect to ancestors and demonstrating sustained interest in keeping traditions alive long into the future. At these events, acorn accompanies beef, potatoes, salad, beans, and other modern foods.

Many museums and workshops have cultural demonstrations at which native people show the public the various steps of preparing acorn. Lois Conner, North Fork Mono/Chukchansi, has been showing people how to make acorn at gatherings and conferences since 1991. She explains the value of educating the public about the role of acorn in native culture: "Acorn demonstrations are important because I want to make people aware of our culture. People are impressed with the skill and the process itself. They see all the steps that have gone into it and they appreciate it and they like tasting it" (fig. 6).

Although some elders say that making acorn the old way—pounding on a pounding rock, sifting with a basket, leaching in a sand basin, and cooking with hot rocks in baskets—makes the best-tasting mush, many people today employ newer, more time-efficient ways to dry, pound, leach, cook, and store acorn so that acorn can remain part of the faster paced lives that many Native Americans lead. One contemporary way to store acorns is in an acorn hutch. The acorn hutch

Figure 5 Nisenan woman pouring water from tin pail into basket with acorn flour to prepare acorn mush for a ceremonial feast

#CSA9518 Courtesy of Field Museum of Natural History, Chicago IL

Figure 6 Lois Conner (North Fork Mono/Chukchansi) demonstrating the process of making acorn mush, 2004

Courtesy of Bud Turner

shown in figure 7 has a slanted roof to keep the rain off, and the chicken wire on the sides and the small mesh screen on the hutch bottom give the acorns plenty of good air circulation. Today acorn is also stored in cardboard boxes, grocery sacks, and burlap sacks.

Figure 8 shows an electric corn grinder used today to grind a very fine acorn powder, replacing the traditional method of pounding acorn into a flour with a rock pestle on a pounding rock. Food processors and blenders are also used today.

Modern leaching contraptions as shown in figure 9 usually consist of a wooden bench with a fine mesh screen lining the bottom, next sand, and a cloth or bedsheet on top. An even layer of acorn flour is distributed over the sheet, and water is poured over to leach the acorn. Today a garden hose replaces buckets of water used earlier last century.

Today acorn is often cooked in stainless steel pots rather than baskets. Traditional basalt rocks are used for heating the acorn and an oak implement is used for stirring the mush—a vivid example of blending old and new ways (fig. 10).

Figure 7 Acorn hutch outside a North Fork Mono home

Courtesy of Kat Anderson, NRCS

Figure 8 An electric corn grinder used today in a North Fork Mono home

Courtesy of Kat Anderson, NRCS

Figure 9 Modern leaching contraption

(a)

Courtesy of Kat Anderson, NRCS

(b)

Courtesy of Kat Anderson, NRCS

The decline in the eating of acorn and other traditional foods is closely linked to a rising incidence of health problems among Native Americans in California and elsewhere. In the pre-contact West, 150 to 200 native plant species formed the basic diet of different tribes. As Native Americans lost control of their lands, their diets quickly and radically changed. Wild-gathered foods, such as acorns, small seeds, bulbs, wild greens, and wild mushrooms, all high in fibers, minerals, and vitamins, were substituted with highly processed domesticated plant foods such as cream of wheat, instant mashed potatoes, fry bread, and canned soups and vegetables. Today, one of the top diet deficiencies in the United States is the lack of fiber from plant foods. Sugar levels increased dramatically with the introduction of sweets like cakes, puddings, pies, custards, and cookies. The new, modern Western diet relied on only 30 food crops. This drastic narrowing of the diversity in the diet, coupled with high sugar content and lack of fiber, was devastating to the health of native people (Norgaard 2004). Particularly prevalent now are heart disease and diabetes. Diabetes strikes the Indian communities hard. Husbands, wives, sisters, parents, and children all have it (United Indian Health Service 1995).

Figure 10 Acorn being cooked in stainless steel pot

Courtesy of Kat Anderson, NRCS

Oaks: A hundred other uses

Oaks were truly the "tree of life" in many Native American cultures. Not only were acorns an essential food source, but every other part of the tree had important uses as well—from the mushrooms growing on old trunks, mistletoe lacing the branches, and galls attached to leaves (fig. 11). From the various parts of oak trees, Indians carved bows; wove baskets; derived medicines for treating sicknesses; and obtained fire for warmth, cooking, and firing pottery.

For thousands of years, native families warmed themselves, danced, or told stories in front of campfires fueled with oak firewood. Wood met virtually all of a family's energy needs—for both heating and cooking—and oak was often preferred. Fallen oak limbs make excellent fuel because the fire burns hot and coals retain heat for a long time. Oak wood fueled the fires that warmed people in their shelters and houses and at temporary camps. The Hupa and other tribes also pulled or cut dead branches from oak trees (Davis 1988). Some tribes felled smaller oaks for firewood, as well. Firewood was carried on the back by means of a burden basket or tied in a bundle with a rope (Barrett and Gifford 1933) (fig. 12).

Oak wood was used for cooking: such as for roasting and smoking meat, boiling water, heating acorn mush, and steaming foods in earth ovens. A Wukchumni elder remembers using interior live oak for cooking: "We used to make a soup out of quail. You pull the feathers off. Dip the bird in water and the feathers come off better. Then cut the bird open and gut it. We roasted it in live oak ashes—when the ashes turn red you put the bird in the fire."

In northwestern California, eels and salmon were dried and smoked by burning oak that had been lying in the shade or on damp ground for 2 or 3 years and which had started to decay (Warburton and Endert 1966). Karuk women gathered rotting, dead limbs from oak to smoke venison and other meats. Sometimes the wood was dipped in water to make it burn slower and to produce more smoke (Bell 1991). The Western Achomawi smoked deer meat using California black oak firewood (Voegelin 1942).

Large grassy clearings formed the most important sites for various Indian games of physical dexterity such as archery contests, double ball, shinny, racket ball, football, and the hoop and pole game (Culin 1975). The goal posts or target was located at the ends of a long, grassy field, similar to games of archery, lacrosse, field hockey, and football played today. The goal posts might be of oak, the clubs for hitting a ball down the

Figure 11 Uses of valley oak (*Quercus lobata*) tree parts

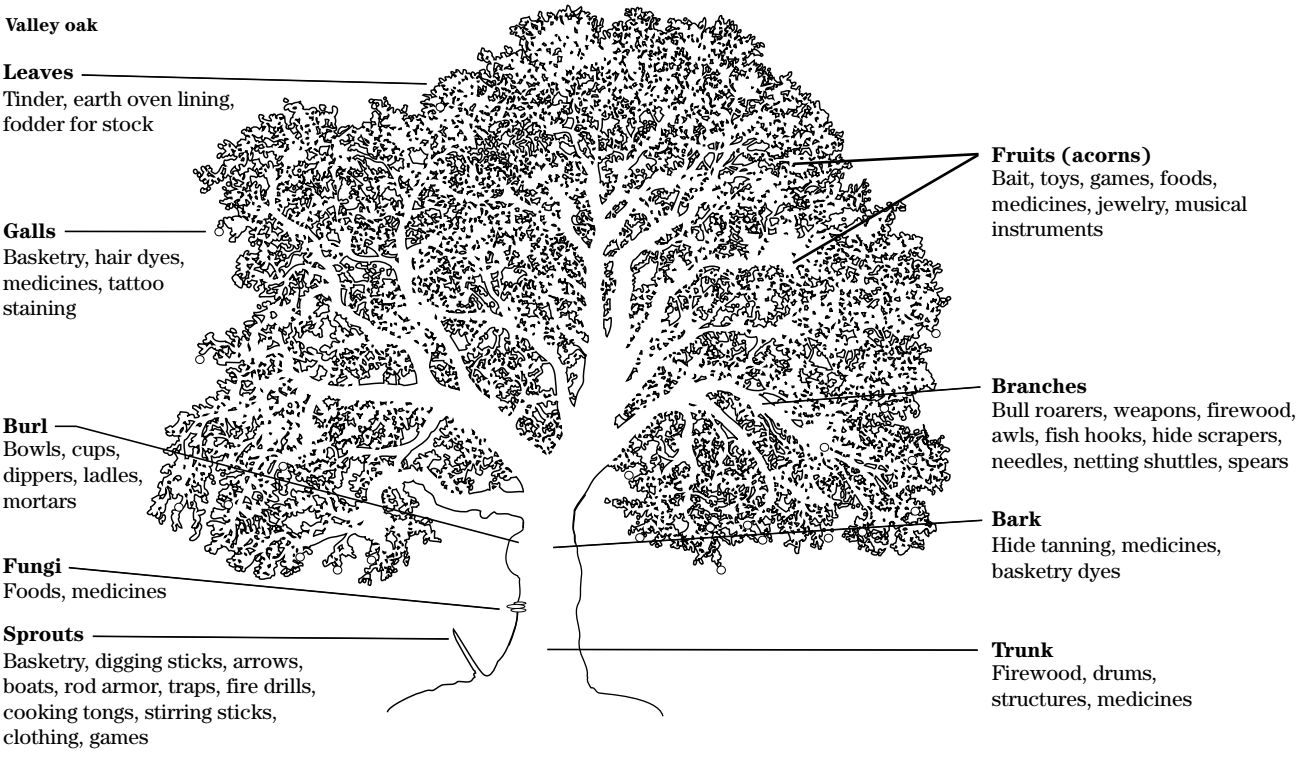


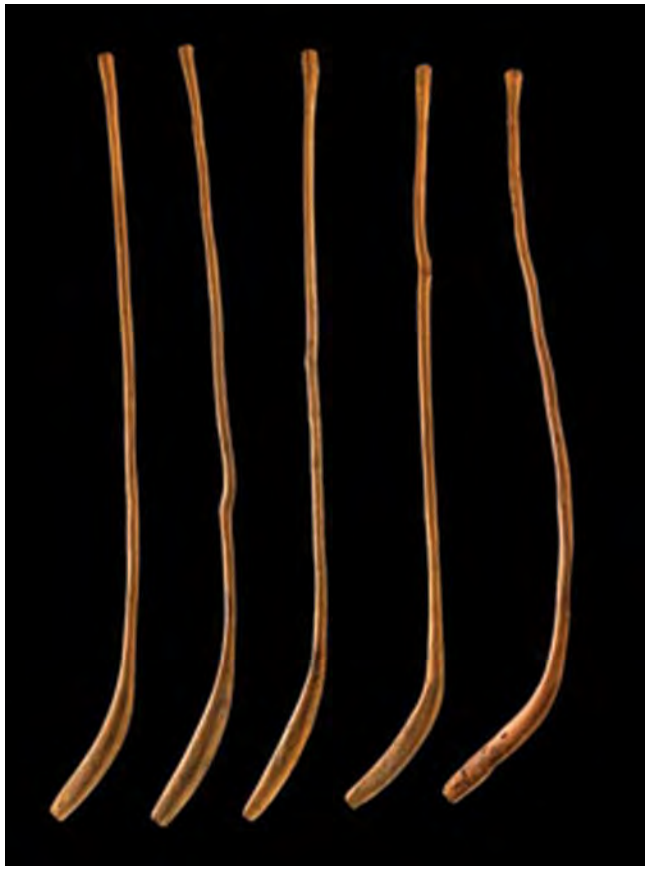
Figure 12 Woman standing with a tumpline around her forehead which supports an open twine burden basket full of wood, probably oak—one of the premier firewoods

#15104 *Courtesy of Grace Hudson Museum, Ukiah, CA*

field were made of oak or tan oak and the ball was carved from an oak burl (Gifford 1965; Farmer 2005) (figs. 13 and 14). The Navajo, for example, used a J-shaped stick of oak in playing the game of shinny (Elmore 1943). Other games incorporated oak parts, as well (fig. 15).

The medicinal value of oak gave it an important place in the pharmacopeias of many tribes. Oak bark was used in treating infections and internal disorders. The Kawaiisu boiled the inner bark of the blue oak and drank the brew to relieve arthritis. To treat indigestion, the Chumash drank a concoction made from the ashes of the green bark of coast live oak soaked in water (Timbrook 1990). Oak served to heal a variety of skin problems and injuries. The Cahuilla made various healing solutions and antiseptic washes by placing oak ashes in water or by soaking bark in water (Bean and Saubel 1972). Oak galls, which concentrate some of the active chemical constituents of oaks, were used extensively for medicinal purposes. One of the most widespread uses of decoctions made from oak galls was the treatment of eye maladies. The Kumeyaay broke up and boiled galls that they found on scrub oaks and used the resulting decoction as an eye-wash (Hedges and Beresford 1986). The Yuki treated cataracts with a mixture of stewed manzanita leaves and oak-gall juice (Foster 1944). The galls of scrub oak were used by the Luiseño in an infusion to wash wounds, ulcers, and sores.

Figure 14 Golf clubs made of oak



Courtesy of Field Museum of Natural History, Chicago, IL

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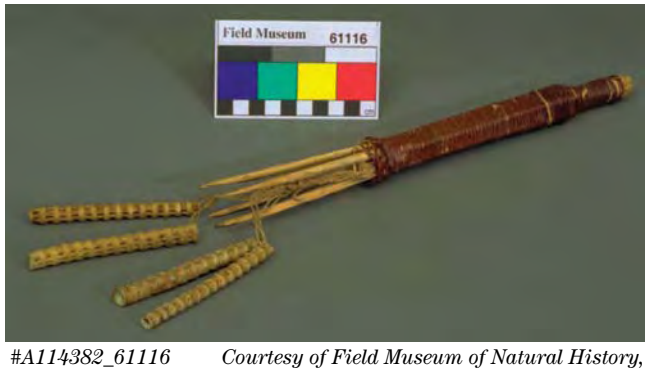
Figure 13 Northern Pomo field hockey racket. The looped frame is probably made of oak.

#1208 *Courtesy of Grace Hudson Museum, Ukiah, CA*

Figure 15 Pomo spearing game. The prongs are made of oak.



#A114382_61116 *Courtesy of Field Museum of Natural History, Chicago, IL*

Oak wood is strong, flexible, hard, dense, heavy, and water-resistant. These characteristics made it a good material to use in constructing a variety of different items used in procuring and processing food and creating clothing and shelter. Wooden mortars were usually made from oak burls (fig. 16). The qualities of oak wood, especially burl wood, that made it ideal for mortars also made it a good choice for bowls, ladles, cups, and dippers. Burls were cut off of trunks by the Southern Sierra Miwok and made into wooden bowls, cups for serving manzanita cider, and wooden platters for carving and serving meat (Barrett and Gifford 1933). Oak sprouts that elongate from the base, roots, or trunk of oaks are extremely flexible and these were bent into looped stirring sticks for cooking acorn mush (fig. 17).

Native hunters and fishermen crafted their equipment out of oak. A Sierra Miwok hunter made a clever deer mask with fake antlers of forked oak sticks, darkened by charring, which was worn as a disguise to attract and kill deer (Barrett and Gifford 1933). Tribes in Southern California and the Southwest threw rabbit sticks made of oak at small to medium game, wounding or killing them (Farmer 2005; Hough 1918). Yurok spears for catching salmon had points of deer horn and the wood was of oak (Warburton and Endert 1966). The Serrano, Owens Valley Paiute, Hopi, and other tribes manufactured bows of oak for hunting small and large game (Benedict 1924; Chalfant 1933; Whiting 1966) (fig. 18). Clubs for killing game, fish, or enemies were made of oak (fig. 19).

In addition to providing a ready material for making implements, cookware, canoes, and other cultural objects, oak trees served as a source material for baskets being incorporated into cradleboards, seedbeaters, drying baskets, and other types of baskets (fig. 20). It also was a popular wood in structures of all kinds including dwellings, shade ramadas, acorn granaries, sweathouses, earth lodges, and hunting blinds. In making these structures, oak trunks and large limbs were valued for their ability to support a great deal of weight, and the smaller diameter branches for their

Figure 16 Woman using stone pestle in wooden mortar (probably of oak) to pound acorns

#CSA1835 Courtesy of Field Museum of Natural History, Chicago, IL

Figure 17 Mono looped stick for stirring acorn mush, made from a young oak sprout, and hanging on a blue oak (*Quercus douglasii*) tree

Courtesy of Kat Anderson, NRCS

Figure 18 Miwok game bow made of oak and Asclepias

#A114497_02d Courtesy of Field Museum of Natural History, Chicago, IL

Figure 19 Hupa club made from an oak root

Courtesy of Field Museum of Natural History, Chicago, IL #A114495_03d

Figure 20 Pomo cradle basket. The reinforcing bar across the top is made of oak.

Courtesy of Grace Hudson Museum, Ukiah, CA

pliability and strength. The posts and ridge and side support poles for Shasta plank houses and assembly houses were made of oak trunks (Holt 1946). The Maidu of Chico Rancheria constructed their houses with posts of oak (Hill 1978). The Ramah Navajo used whole oak trees in shade house construction (Vestal 1952).

Knocking and pruning of oaks

Hand knocking nuts from trees with wooden poles is a very ancient gathering technique. In late summer or early fall throughout California and probably elsewhere, Native Americans knocked the oaks with long wooden poles to retrieve acorns or shook them down with hooked sticks, rather than waiting until they dropped to the ground naturally (fig. 21). At least some of the tribes that knocked or shook acorns off the oaks also cut off, or pruned, acorn-laden branches periodically or selectively (fig. 22).

Knocking can be defined as the striking of woody limbs on trees or shrubs with a pole or stick to cause the fruits to release to the ground. The trees were knocked from the ground or climbed and struck while balancing in the canopy. One or both of these techniques were used by the majority of tribes in California, although the type, size, length, and design of the pole varied widely (Dixon 1905; Schulz 1954; Gayton 1948; Driver 1937). Probably the most common knocking implement was a long, straight pole of pine, hazelnut, willow, redbud, or some other wood. Another Mono elder describes knocking in the Sierra foothills: "Teenagers, men, and women would knock the oaks with a long pole of willow up to 12 feet tall and 2 inches across. Men would also get up in the trees and whack them down with a stick."

Different kinds of oaks were knocked including tan oak, California black oak, valley oak (*Quercus lobata*), blue oak, and coast live oak. Levy, for instant, records among the Ohlone in the San Francisco Bay Area: "Straight poles were used to knock acorns loose from the limbs of live oak" (Levy 1978).

Figure 21 Knocking oaks with long poles to retrieve acorns was a common practice in California, and may have been beneficial to the trees.

Figure 22 Men and boys in some tribes climbed oaks and pruned back limbs to retrieve acorns.

This act expanded the collection time for acorns considerably, ranging from mid-August to early December, as at some sites acorns were also harvested directly from the ground later in the season (McDonald 1990). One reason to harvest acorns early was to beat the many acorn-eating animals to the crop (McCarthy 1993). Rains could ruin the acorns and were a signal that the acorn harvest time had ended. One Mono elder says: "You must get your acorn before it rains. If acorns are gathered from the ground after rains, the insides will often be black."

Another main reason to harvest some of the acorn supply early was due to the fact that many important foods—salmon on their fall runs, waterfowl or ungulates making their seasonal migrations, pine nuts ripening on the east side of the Sierra Nevada—had to be harvested at fairly specific times. Since acorns had a broad window of harvestability, from about a month before they ripened fully to after they fell to ground, it was the other foods that tended to determine how and where most tribes moved over the landscape in later summer and early autumn. Wherever a tribe was at the time, they would harvest the acorns in that vicinity.

A second method of harvest among many tribes was to climb the trees and cut off the branches. The Chukchansi climbed blue, valley, and California black oaks in September and cut off the limbs. The green acorns were placed in 200-pound barley sacks. Anthropologist Anna Gayton describes the work as "an all-day job for many days, a month perhaps" (Gayton 1948). Chesnut (1974) recorded among the Yuki and Pomo: "When the acorns are ripe in autumn the men go out and beat them off the tree or cut off the small branches and throw them to the ground."

Native American elders mention how the oaks don't bear nearly as often as they used to, nor as heavily. Most arborists agree that removing mature fruit from the tree by knocking with long poles should not really have any long-term impact. Some elders believe that knocking is actually good for the trees. According to one Mono elder: "Knocking wakes the tree up. It alerts the tree to bear more."

Few studies have explored the ecological effects of knocking or pruning oaks. There are many unanswered questions which would require experimental studies to solve. Knocking techniques and/or pruning might positively affect oaks in at least five ways:

- remove dead or dying branches that could harbor disease
- invigorate and renew fruitwood
- maximize fruiting area by managing light distribution within the canopy
- maximize fruiting area by reshaping the canopy
- aid in oak seedling establishment

Setting fires in oak ecosystems

Native Americans in the West were well aware that to have the most diverse, healthy, and productive oak woodlands, they had to intervene and actively care for the oaks and the surrounding ecosystems. The most powerful tool they had available to them was fire. Setting frequent, light surface fires in the herbaceous layer of an oak savanna was an ancient practice in California, Oregon, and Washington (fig. 23). Over thousands of years, they learned that by burning regularly under oak trees, they could accomplish at least five objectives, all of which helped maximize acorn production and other useful plants over the long term. Burning could optimize the structure and composition of oak woodlands, facilitate acorn collection, induce the growth of sprouts for material items, control populations of insects that consumed acorns, and control the pathogenic fungi and bacteria that could infect the oaks, sap their vitality, and eventually kill them (Thysell and Carey 2001; Tveten and Fonda 1999; Anderson n.d.).

Figure 23 Rendering of a California Indian woman setting a light surface fire in the understory of an oak savanna

Indian burning reduced the underbrush and fallen leaves and kept the grass from growing too high so that acorns could be easily spotted and retrieved. For example, Shipek (1977) recorded among the Luiseño people, the use of fire as a technique to keep the ground under the oak trees clear and, thereby, improve acorn production and facilitate gathering.

In the absence of fire, many oak species will be encroached by more shade tolerant species on the most fertile sites, drastically reducing canopy development and acorn production. The way Native Americans reduced this competition was to thin the forest around productive trees by setting frequent, light surface fires, which eliminated other trees and shrubs and added nutrients to the soil. This enabled targeted oaks to grow in the open, with full crowns, large girth, and inflated per-tree yields of acorns. Frequent burning also kept catastrophic fires that might injure or outright kill oaks to a minimum. To create a very open structure of oaks that were widely spaced, fires were set in certain areas very frequently—every one to several years.

A long time non-Indian resident of Carmel Valley describes Salinan and Esselen burning in the South Coast Ranges of the Central Coast of California: "Fire doesn't hurt the oaks. There were big live oaks on the edge of the cliff above the Arroyo Seco River with large mortars underneath. Burning kept down the chamise and California sagebrush. They didn't like the chamise to come too close to the oaks because of the fire danger and they were full of bugs. In some places, the Salinan and Esselen burned every year."

Light surface fires moving through oak areas also created many seedling and saplings and sprouts from the base of oaks. These were used for many things such as baskets, looped stirring sticks, construction materials, and clothing.

Acorns can incur heavy losses from insects and diseases. Additionally, the biological health of these oaks was improved as fires—set in the autumn of the year—were used to decrease destructive agents such as insects and pathogens. There is increasing evidence that different Indian tribes frequently burned under oaks to lower insect pests that might damage or spoil many acorns from favored groves (fig. 24). Tribes that burned include the Salinan, Mono, Hupa, Wailaki, Tolowa, Yurok, Karuk, and Wukchumni and probably many others (Anderson 2005).

The two insects that cause the most extensive destruction to acorns in most oak species in the West are the filbertworm, *Cydia latiferreana (*formerly *Melissopus latiferreanus)* and the filbert weevils, *Curculio occidentalis*, *C. pardus* and *C. aurvestis* (Gibson 1969; Swiecki, Bernhardt, and Arnold 1990). Native Americans harvested acorns with a keen eye to blemishes of any kind, and those that exhibited damage by insects were immediately discarded. After shelling acorns, those that had blemishes were also tossed (fig. 25).

The two major pests of acorns, the filbert weevil and filbertworm, both spend part of their life cycles in the duff or soil. The filbert weevil can hibernate for several years in the soil as a pupa while the filbertworm overwinters in a single season as a larva. Thus, fires were set not only to change forest structure, but also timed so as to kill insects that attack acorns as one Mono elder recalls:

> *"They [the Mono] burned in November under the incense cedars, black oaks, and pines. They would just let the fire go. The rain would just put it out. The ashes made the acorn trees grow better. The ashes also killed the bugs that fed on the leaves, bark, and acorns. It probably scorched the oaks but didn't kill them. They burned from the bottom of the slope. They burned in the morning when it got bushy. They burned every year. They'd take different sections. They'd wait a few years to set a fire in the same area again."*

Diseases can attack every part of an oak tree, including the branches, trunk, leaves, roots, flowers, and acorns, affecting the tree's general health, lifespan, and ability to produce acorns (Swiecki, Bernhardt, and Arnold 1990; Swiecki 1997). Indian burning under oaks may have contributed to the curtailing of diseases in various kinds of oaks. Native people assert that "the smoke, from burning under the California black oaks was good for the trees." Anthropological accounts, too, mention the control of disease as one of the many effects of burning under oaks. The Lassik and Pitch Wailaki, for example, after collecting acorns at a gathering site, burned the area so that disease was kept down and the ground was cleared of undergrowth for easier collecting in the future (Keter 1987). Karuk consultant, Mamie Offield, told anthropologists Schenck and Gifford (1952) in 1939: "[tanoak] the trees are better if they are scorched by fire each year. This kills disease and pests. Fire also leaves the ground underneath the trees bare and clean and it is easier to pick up the acorns."

Figure 24 Annual Indian burning cycle (inner circle) under California black oaks compared with annual life cycle of the oak filbertworm (*Cydia latiferreana*) (outer circle)

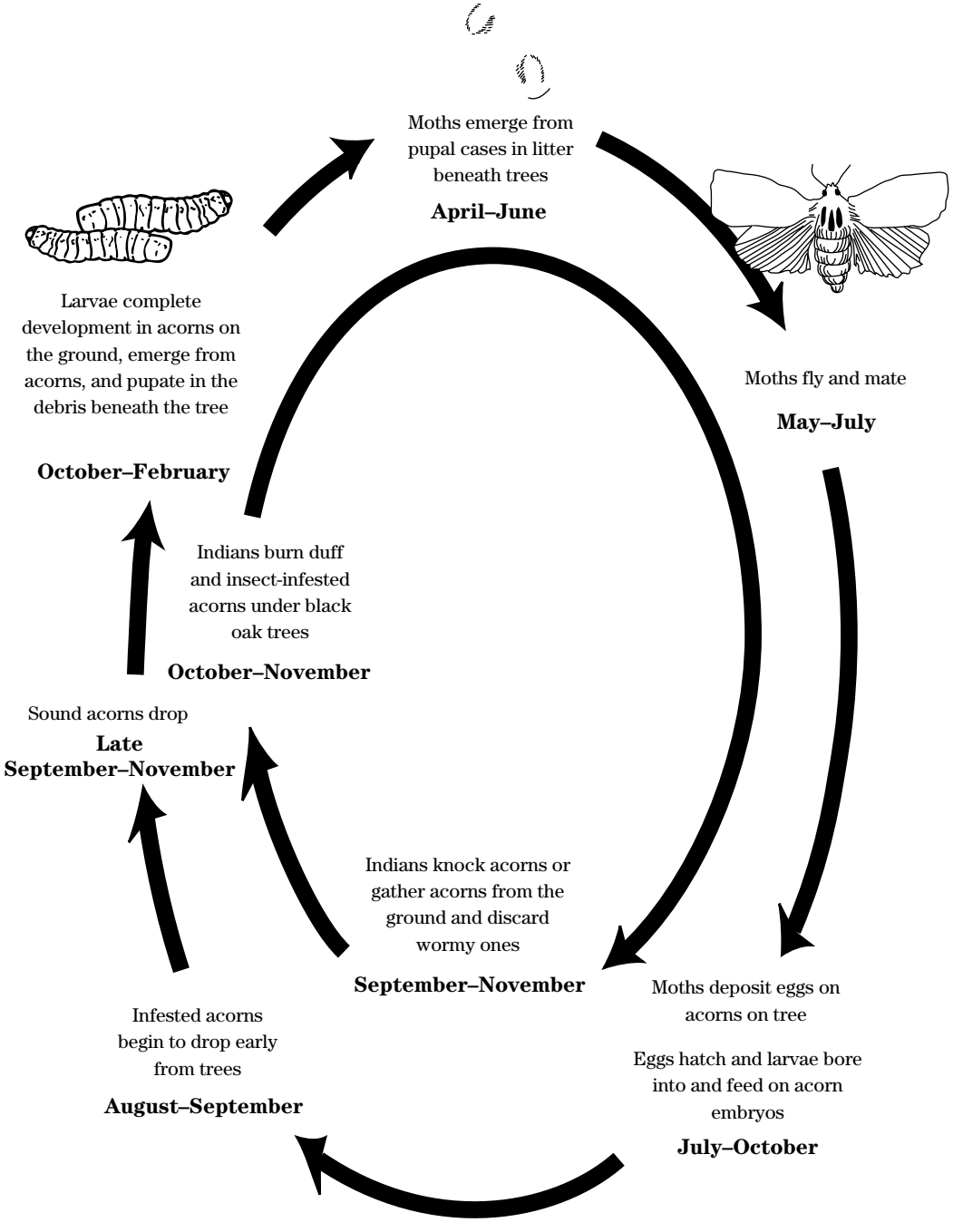


Figure 25 Aida Icho (Wukchumni) sorting the good acorns from the bad (with pathogens or insect damage), Visalia, CA, circa 1938

#41887F Courtesy of Smithsonian Institution, Washington, DC

Oaks as parts of agroforestry systems

Not only the oaks, but many animals, shrubs, herbs, and mushrooms surrounding them provided an array of important products to tribes of the Far West. For example, Indian celery, also known as common lomatium *(Lomatium urticulatum)*, that grows in open areas between blue oaks was widely gathered for its edible greens (fig. 26); many kinds of clovers grow around springs and riparian areas in association with oaks (fig. 27), and these were eaten as greens, and the bulbs and corms of camas (*Camassia* spp.), Ithuriel's spear *(Triteleia laxa)* and many other geophytes were dug for food wherever they were found in oak savannas. Indians set light surface fires not only to keep oaks widely spaced with full canopies for acorn production, but also to foster the growth of many of these edible and medicinal plants, as well as edible and medicinal fungi. Viewing oaks as parts of larger systems, with humans as a crucial part of those interactions, is important as oak health is not fostered in isolation, but rather through association.

Because the understory and the overstory both were managed for products, many of the ecosystems dominated by oaks can be characterized as agroforestry systems. David Bainbridge was the first to apply the term agroforestry to oak ecosystems. Agroforestry can be defined as intensive land-use management that optimizes the benefits (physical, biological, ecological, economic, social) from biophysical interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock (Gold et al. 2000).

These agroforestry systems had an overstory of nut trees and an understory of dense resource patches with one or several dominant useful plants and an array of animals and fungi. Together with other meat and fish resources, this sustained Indian economies. Anthropologist Alfred Kroeber described this working relationship with the landscape that involved both trees and understory plants among the Wailaki: "As spring came on, they [Wailaki] moved into the hills, digging bulbs, beating the prairies for grass and Compositae seeds, and garnering acorns as the summer wore into autumn" (Kroeber 1976).

Figure 26 Melba Beecher (Mono) gathering Indian celery (*Lomatium urticulatum*), an important edible green associated with blue oak (*Quercus douglasii*) savannas

Figure 27 Clammy clover (*Trifolium obtusiflorum*), an important edible green to the Mono that grows in association with blue oaks (*Quercus douglasii*) and valley oaks (*Quercus lobata*)

These understory plants were in a sense crops, because they were managed with the techniques of tillage, seedbeating, sowing, weeding and/or burning for many products. In particular, tillage and sowing are noteworthy because they connote forms of cultivation. Digging wildflowers with edible bulbs or corms for food (*Brodiaea*, *Triteleia*, *Dichelostemma*, and *Allium* spp.) was a common practice in oak savannas and woodlands in prehistoric times. Digging for these underground swollen stems in the vicinity of oaks, may have aerated and softened the ground, aiding jays in their planting of acorns. With the digging of wildflower bulbs, corms, and tubers in oak woodland areas, Indians replanted the smaller bulblets and cormlets or left tuberous root fragments, practicing a form of tillage (figs. 28 and 29). With harvesting edible seeds of wildflowers and grains of native grasses, Indians saved and sowed some of this seed (*Wyethia*, *Mentzelia*, and *Clarkia* spp.) (fig. 30).

Figure 28 Digging wildflowers with edible bulbs or corms for food

Figure 29 (a) Bulblets and cormlets are propagules that are genetically identical to the parent bulb or corm; (b) these were popped off by hand and purposefully replanted to ensure future abundance

(a)

(b)

Figure 30 Sowing edible seeds of wildflowers that grow in association with oaks to ensure future abundance

Sudden oak death

One of the most serious threats to the health of coastal oaks and tan oaks comes from sudden oak death (SOD), an exotic disease that causes bleeding stem cankers and mortality in coast live oak, California black oak, canyon live oak (*Quercus chrysolepis*), and tan oak. This disease kills trees over many months to several years, but oaks appear to die quickly with their leaves turning brown within several weeks, hence the name (Rizzo and Garbelotto 2003). Since 1995, it has killed millions of oak and tan oak trees in California and Oregon coastal forests (fig. 31). The pathogen has been found as far south as the Big Sur coastline in Monterey County, California (fig. 32), and as far north as Curry County, Oregon. It is found from sea level to over 800 meters. "Tan oak is the one that we're most concerned about," says plant pathologist, Dave Rizzo at UC Davis. "There is no real evidence of resistance to the disease—with that one you see massive die-offs."

The causal agent of SOD is *Phytophthora ramorum*, and it is a water mold. It dispenses through the air and in addition to oaks and tan oaks, it lives on a great variety of woody hosts. The disease is associated with several different forest types including coastal redwood forests and mixed evergreen forests (Rizzo, Garbelotto, and Hansen 2005). Humans can also spread the disease, because the spores can be carried on shoes, mountain bike tires, and car tires to new areas. By gathering food plants, mushrooms, hiking, camping, or cutting firewood, a person can carry the pathogen to new areas (Ortiz 2002). The most effective management practices for preventing the spread of the disease and restoring infected trees are still being developed. For more information, go to the California Oak Mortality Task Force Web site (*http://www.suddenoakdeath.org*).

Figure 31 Tan oak (*Lithocarpus densiflorus*) mortality (brown trees) on Mount Tamalpais in Marin County, CA, in 2006

Janet Klein, Marin Municipal Water District, CA

Figure 32 Tan oak and coast live oak mortality (brown trees) in Big Sur, CA, in 2005

David Rizzo, UC Davis

Ethnobotanical restoration

Today, oaks are plagued with problems. There is lack of regeneration in populations of certain species. Acorns are riddled with insect holes from the acorn weevil and the filbertworm and never germinate. Ground squirrels, gophers, and other small mammals undermine the root systems of seedlings and saplings, and they never make it to tree size. Severe diseases, such as sudden oak death, kill many adult oaks and tan oaks. The hydrology has changed in many areas harboring oak populations. Many other mature oaks are having a tough time with fire suppression. With light surface fires, they were able to maintain a stronghold, where other plants were not able to compete and died out. Now oaks are being toppled by more shade tolerant trees that are not fire resistant and would have been killed by Indian-set fires. The "old-growth" oaks—the large old valley oaks, Garry oaks, coast live oaks, and canyon live oaks with huge girth and large canopies—may be a thing of the past. These trees in particular are important because often more terrestrial vertebrates occur in mature oak stands than in seedling and sapling areas. This is because the large crowns of these oaks offer cover and feeding sites for myriad wildlife (Bleier et al. 1993).

The University of California has embarked on an ambitious and needed research program called the Integrated Hardwood Range Management Program to investigate the significant causes of oak decline and offer varied solutions. These include investigating grazing regimes that are compatible with oak seedling establishment, revegetating sites with native grasses to facilitate better germination of oak seedlings, documenting insects and pathogens that attack oaks, and exploring the ways that native people managed oaks in the past. Scientists at the Pacific Northwest Research Station in Olympia, Washington, and Redwood National Park in northern California, are reintroducing mimicked Indian burning to Garry oak ecosystems to keep Douglas fir from encroaching and promote the growth of wildflowers that are important food plants (fig. 33).

This last area of investigation may be essential in figuring out how to maintain oaks in the western landscape today as former Indian burning addresses many of these topics that are now causing oak decline—from how to eliminate insect pests of acorns to how to maintain an open structure in oak groves.

While ecological restoration traditionally viewed humans intervening on a very limited time scale to bring back plants and animals known to have existed in an area historically, the decline of oaks (one of the most significant plants to Native Americans), show us that humans may be an integral part in restoration of oak areas. While jays are recognized as crucial partners in oak well being, humans through the eons may also have been key to their flourishing.

SOD, for example, although of exotic origin, may be curtailed through thinning around coastal oaks and tan oaks and setting light surface fires, simulating ancient fire management practices of Indians. Native shrubs and trees that grow in association with oaks are hosts to the SOD pathogen. By limiting the growth of these shrubs, Indian burning may reduce the chances of disease agents to jump from other plants to oak trees. With a more open environment, it may be harder for the disease to spread.

In California and elsewhere, restoring species to viable population numbers and preserving or restoring ecosystems revolves around captive breeding of animals, propagation, cultivation and outplanting of plants, establishing and managing reserves, and restoring functioning habitat (Ehrlich and Ehrlich 1981). But ultimately, with these kinds of restoration schemes, humans leave as they are perceived as being no longer needed after the restoration project is completed.

The oak landscapes that we inherited from our forebears still bear the marks of former Native American interactions calling for a new kind of restoration that complements other forms of ecological restoration.

Figure 33 Camas 1 year after a prescribed burn in a regularly burned Garry oak savanna, Fort Lewis, WA

David Peter, USDA FS, Pacific Northwest Research Station

This new kind of restoration could be called *ethnobotanical restoration* defined as "reestablishing the historic plant communities of a given area and restoring indigenous harvesting, vegetation management, and cultivation practices (seedbeating, burning, pruning, sowing, tilling, and weeding) necessary to maintain these communities in the long term."

Thus, this kind of restoration is not only about restoring plants, but also about restoring the human place within nature. This type of restoration views restoring as never finished, but rather is about continuous interaction between people and plants as both their fates are intertwined in a place. Uniting oaks and people once again through harvesting acorns, making products from all parts of the tree, knocking the trees, and setting light fires, may offer us ways to coexist, receive products from, and benefit the long-term health and well being of this remarkable tree.

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