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Ecology, Management, and Utilization of California Oaks

June 26-28, 1979, Claremont, California

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June 26-28, 1979, Claremont, California

Timothy R. Plumb
Technical Coordinator

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History of Cultural Influences on the Distribution and Reproduction of Oaks in California[1]

Randall S. Rossi[2/]

Abstract: Prior to the advent of European colonization, the California Indians' impact on oaks was confined to acorn collecting and the occasional use of fire. Since 1769 oaks have been vulnerable to six human activities: stock raising, wood cutting, agriculture, flood control, fire supression, and urbanization. Specific research concerning human impacts on the distribution and reproduction of oaks has been meager. In this survey of cultural influences, grazing activity is identified as the most persistent pressure on oak reproduction. Charcoal production consumed a significant amount of oak until the 1960's; incomplete data suggest that cordwood sales continue to account for much wood cutting. Agricultural clearing, initially for orchards, and later for row and field crops, has greatly reduced the range of some species, e.g. valley oak (Quercus lobata). Extensive clearing of blue oak (Q. douglasii) from foothill range in the late 1950's and 1960's was partially supported by federal payments. Riparian oak in the Sacramento Valley have been disappearing since early American occupance and today only a fraction of the original woodland remains. Because of fire suppression efforts since 1900, the build up of fuels and the invasion of woody plants in oak communities make lethal, high-intensity fires more likely. Finally, urban and suburban land uses continually displace native oaks and condemn remnant stands to slow decline without replacement.

INTRODUCTION

Human activities of the last two hundred years have greatly reduced the range of many California oaks and adversely affected their reproduction. While we are aware of the general course of this demise, the actual losses have been incremental, unchallenged, and unrecorded. Further, we are only beginning to ask: What are the consequences of this impoverishment of the landscape?

This paper surveys the state of our knowledge about human impacts on California's oaks. Historically, oaks have been vulnerable to at least six human activities: stock raising, wood cutting, agriculture, flood control, fire supression, and urbanization. The biggest change of the last two hundred years, of course, is that the foothills and valley floors, once occupied by many species of oaks, are largely covered by the farms, cities, and freeways of twenty-two million people.

Four major oak communities, covering about 10 percent of the state, have been recognized as part of California's original landscape. These are: 1) Northern Oak Woodland of the North Coast Ranges and valleys, (Quercus garryana, Q. kelloggii, Q. chrysolepis, and Q. wislizenii); 2) Foothill Woodland of the alluvial terraces

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[1/] Presented at the Symposium on the Ecology, Management, and Utilization of California Oaks, Claremont, California, June 26-28, 1979

[2/] Ph.D. Candidate, Geography Department, University of California, Berkeley.

Figure 1 - Areas of Oak Savanna and Woodland in California

and surrounding hills of the Central Valley and Inner Coast Ranges, (Q. douglasii, Q. lobata, Q. chrysolepis, Q. agrifolia, and Q. wislizenii); 3) Southern Oak Woodland of the coastal valleys of Southern California, (Q. agrifolia, and Q. engelmannii); and 4) Riparian Woodlands especially on the Central Valley river margins, where valley oaks (Q. lobata) were locally abundant (Munz and Keck 1963; Griffin 1977).

Each species and certain associations have sustained different kinds of impacts at different times. While some areas are relatively unchanged, in others some species have been eliminated over wide areas, or exist only as remnant stands. And where individual trees or woodland tracts remain there may be a false sense of well-being, since few, if any seedlings are becoming established.

The nature and extent of human impacts on oaks before 1930 is not comparable to that of the last fifty years. Pressures on oaks have increased due to the rapid increase and spread of population, increasing land values, the lengthy periods of fire suppression, the development of practices and machinery for clearing range land, channelizing streams, and building roads and cities. The oaks, which were the single most important plants in the lives of the Indians, are valued by modern man only as amenities in real estate.

Oaks are part of what we define and identify as typically Californian. Attention naturally focuses on the California endemics, Quercus lobata (valley oak) and Q. douglasii (blue oak) which are widely distributed in and around the Central Valley and Coast Ranges. The valley oak, largest of the North American oaks, grows on deep alluvial soils and up onto broad ridge tops. It often forms strikingly beautiful savannas, having a parklike appearance. The blue oak grows on rolling hills and drier sites, singly or in clumps, and is common on thousands of acres throughout the state.

The task of reconstructing how our oak woodlands have changed is a difficult one, and there will always be great gaps in our knowledge. Only a handful of studies have been concerned with landscape changes in the oak woodland (Thompson 1961; Brooks 1967; Vankat 1970; Griffin 1971, 1976; Snow 1972; Dutzi 1979; Rossi 1979). While university and government personnel have advocated and aided in the clearing of thousands of acres of oaks, no state or federal agency has monitored or inventoried the extent or cumulative effects of the activity. Today we find we lack any accurate estimates of even the most recent clearing. Further, with notable exceptions (Griffin 1971, 1976; Snow 1972), the conspicuous lack of oak regeneration, perhaps the most important issue in oak management, has received virtually no study. In strong contrast to the long history of conservation and land stewardship examined by Parsons (1962) in Spain's oak woodlands, California oaks have been disregarded as a natural resource.

ABORIGINAL INFLUENCES

The extensive, almost continuous oak woodlands and savannas of California provided the staple food of the native Indians for centuries. The acorn and the oak were worshipped by these hunter-gatherers (Pages 1937). The extent of their adverse impact on oaks was confined to acorn collecting and the occasional use of fire.

An estimated 500 pounds (230 kg) of acorns were consumed each year (Hoover 1977). In poor seed years it is likely that nearly all of the crop from some species was collected and stored. The preference for acorns of tan oak (Lithocarpus densiflora) and California black oak, (Q. kelloggii) and the accessibility of acorns from valley oak must have created a considerable pressure on these species (Chestnut 1902; Baumhoff 1963). In the Central and Southern Coast Ranges, coast live oak (Q. agrifolia) sustained California's densest Indian population. The effects on reproduction of acorn collecting should not be ignored, but the extent to which it may have

altered oak distribution is not known.

The use of fire to clear the ground before acorn harvesting has been noted in Northern California and Yosemite Valley (Baxley 1865; Harrington 1932; Schenck and Gifford) 1952). Fire was used to drive game, aid in collecting food, and make clearings for growing tobacco (Kroeber 1925). Any such fire could kill oak seedlings, but light ground fires would not harm established trees. Captain Belcher observed on the Sacramento River in 1837 that during the dry season the natives burned the annual growth, "and probably by such means destroy many oak plantations which otherwise would flourish" (Belcher 1969, p.48). Hinds, a botanist on Belcher's expedition reported Sacramento Valley natives' practice of lighting their fires at the bases of valley oaks. He continued, "and as they naturally select the largest, it was really a sorrowful sight to behold numbers of the finest trees prematurely and wantonly destroyed" (Hinds 1844, p. 3). From this brief description the death of the trees must be interpreted as accidental, since they represented a perennial food resource.

Regarding the valley oaks, Jepson felt "it is clear that the singular spacing of the trees is a result of the periodic firing of the country — an aboriginal practice of which there is ample historical evidence" (Jepson 1923, p. 167). Lewis (1973) has argued that the California native had an active role in manipulating vegetation with fire. Sampson (1944), Burcham (1957), and Clar (1959) have suggested the influence was more benign. Periodic burning by the California Indians may have thinned oak stands or caused certain areas to remain open, but probably was not a significant factor in altering the overall abundance or distribution of oaks.

EARLY STOCK RAISING

Before European contact, California oaks were principally a food resource, and had evolved in the absence of grazing, agriculture, or commercial uses. However, this changed forever when the Spaniards brought their faith, agriculture, and grazing animals to Alta California in 1769. Cattle and sheep certainly consumed acorns and many seedling oaks in the vicinity of the missions. The grazing tracts, or ranchos, of many missions were in oak studded lands, for example Mission Santa Clara, San Jose, San Antonio, San Miguel, Santa Ines, and San Juan Capistrano. Jepson (1910) observed that the chain of missions corresponded roughly to the range of the coast live oak, and that Spanish land grants encompassed most of the valley oak forests. Local overgrazing, droughts, and the introduction of Mediterranean annual plants contributed to the rapid replacement of the original bunchgrass vegetation (Hendry 1931; Burcham 1957). There is evidence that this change resulted in greater competition for oak seedlings in the thick annual cover (Holland 1976).[3/] Further, poisoning and trapping of predators, coupled with the increase in seed-bearing plants, has brought an increase in seed-eating rodents and birds, putting added pressures on the acorn crop (Holland 1976).

When a mission was established, it would customarily receive from other missions gifts of livestock to begin new herds. In 1827, four years after the founding of the last mission, Thomas Coulter reported that collectively they had 210,000 branded and 100,000 unbranded cattle (Coulter 1951).

Grazing continued to be the most widespread pressure on oaks throughout the Rancho era that followed mission secularization in 1833. Most of the land grants and grazing activity were in the Southern and Central Coast Ranges where huge herds roamed the grasslands and the woodlands alike (Cleland 1941). Burcham (1957) in his history of California range land considers the foothill woodland a grazing resource second only to the grasslands. In the woodlands, grazing impacts are highly selective, since cattle seek out the shade, devouring the oak seedlings and acorns. Further, repeated trampling of clay soils makes germination of woody plants more difficult (Wells 1962). The acorn crop suffers doubly because of its palability and the time of its ripening at the end of the dry season when forage is scarce. Bryant (1848) observed in the Central Valley that "during the period of transition from the dry grass to fresh growth, horses, mules, and even horned cattle, mostly subsist and fatten upon these large and oleginous nuts" (p. 351). Jepson (1910)called the acorns of blue oak in the Sierra foothills "one of the ranchman's assets for stock feed" (p. 216.).

Beginning in the late 1700's swine fed on acorns at Mission San Antonio and other missions (Bolton 1926; Engelhardt 1929). During the 19th century hogs were driven to oak groves for mast feeding in the Coast Ranges (Q. agrifolia), Central Valley (Q. lobata), and Sierra foothills (Q. douglasii), and the acorns were also collected and fed to the animals in lieu of grain (Bryant 1848; Sudworth 1908; Jepson 1923; Fages 1937). In the 1920's hogs were still being fattened on acorns in the Santa Lucia Mountains for shipment to San Francisco (Coulter 1926).

[3/] Personal communication, C.B. Hardham, Botanist, Paso Robles, California.

In 1834 the number of cattle held by the missions alone was estimated to be 400,000 (Bolton 1917). As private ranchos replaced the mission holdings, stock raising spread throughout the state. Cattle numbers burgeoned in response to the Gold Rush influx, until an estimated one million roamed the land in 1860 (Burcham 1957). From 1849 on, month-long cattle drives were regularly made from Southern California ranchos to San Francisco. Treks involving herds of several thousand were made through the Central Coast Ranges and San Joaquin Valley in the fall as the acorns ripened (Cleland 1951). The drought of 1862-64 brought cattle numbers plummeting, but the oaks continued to suffer. During the droughts of 1862-64 and 1897-98, small trees and branches from larger ones, especially Q. agrifolia in the South Coast Ranges, were cut to provide browse in the path of starving cattle and sheep (Jepson 1910; Lynch 1935). The recurring droughts, while temporarily reducing the cattle population, actually heightened the immediate grazing pressures, and seedling oaks stood little chance of survival.

In the 1870's and 1880's the livestock industry began recovering with sheep numbers reaching over four million in 1880, and cattle one million again by 1890 (Burcham 1957). During the wheat "bonanza" decades at the end of the 1800's, grazing land was pushed out to the margins of the cropland, and into the oak woodland and foothills (Hutchinson 1946). The poor natural reproduction in California's oak woodlands since that time has been generally attributed to grazing-related influences (Sudworth 1908; Jepson 1910).

WOOD CUTTING

In 1793 on Vancouver's voyage down the California coast, parties were landed near Santa Barbara to secure water and fuel. Menzies reported in his journal wood "was easily procured at no great distance from the beach as there were some large trees of a kind of ever green Oak, which they were suffered to cut down for the purpose" (Menzies 1924).

During the 19th century, oak wood was a primary source of fuel, but it is impossible to know how much was cut for this purpose. It was reported that mission padres in the San Gabriel Valley had instructed the Indians to cut only oak tree limbs for fuel "preserving the trunks with sacred care" (Clar 1957). Oak wood was used for heating and cooking throughout the mission and rancho period. Fuel and timber demands were locally heavy during the mining era. Blue oak and pine were used as fuel and mine timbers in the Mother Lode mines, with forest removal greatest in El Dorado County (Watts 1959). Oak wood was used to fuel the quicksilver (mercury) retorts at New Almaden (Santa Clara Co.) and New Idria (San Benito Co.), as well as at mines in Napa, Lake, and San Luis Obispo Counties (Yale 1904).[4/]

Fire wood cutting was incidental to land clearing in some instances, but in others a profitable activity in itself. Sudworth (1908) noted that valley oak from the river banks, and interior live oak (Q. wislizenii) from the Sierra foothills were "highly prized for domestic use" in the Sacramento Valley. In 1914-1916, as part of an orchard development, 20,000 cords of oak (valley oak, blue oak, coast live oak) were cleared from 12,000 acres (4800 ha) on the Salinas River near Atascadero in San Luis Obispo County (Rossi 1979). The wood was shipped by rail to San Francisco and Los Angeles. There are, no doubt, numerous examples such as these from all over the state.

For more than a century oak has been the preferred wood for manufacture of charcoal in California. Bancroft (1890) says that charcoal from oak had been burned in California since the early 1850's. Oak was cut around San Francisco Bay to supply charcoal burners in the 1850's and 1860's (May 1957). In 1855, 11,000 bags of charcoal, the equivalent of 110 tons made from "red", white, and live oak, was consumed in and about San Francisco. In the 1860's powder mills in Santa Cruz and Marin Counties used charcoal as a major constituent of their product. In the 1880's the Clipper Gap Iron Company annually burned 10,000 to 15,000 tons of charcoal in its furnace near Auburn, requiring as much as 30,000 cords of wood each year (May 1956).

In the early 1900's charcoal from oak was made in large quantities throughout the state, especially in Sacramento, Shasta and Sonoma Counties. Between 1905 and 1910 California's annual charcoal production averaged 160,000 sacks from 3200 cords of wood. Sonoma County was the top producer then, with about 100,000 sacks annually, or about 1,000 tons of charcoal per year. In 1914 at Heroult on the Pit River, a site now under Shasta Lake, 50 cords a day of California black oak were distilled to charcoal for the Noble Electric Steel Company (May 1956).

In the decades from 1920 to 1940 there were only a few charcoal plants of substantial size in operation. During the early 1920's a charcoal plant near Templeton in San Luis Obispo County was making charcoal out of coast live

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[4/] Rossi, R.S. (1975) The quicksilver mines of the Santa Lucia Mountains in northwestern San Luis Obispo County, California. Unpublished manuscript. 40 p.

oak and valley oak, and one near Ukiah in Mendocino County was using canyon live oak (Q. chrysolepis). In 1939 about 1400 tons were produced, but eight years later only a few small kilns in San Luis Obispo County were operating (May 1956). However, ten years later, following World War II, the increasing popularity of "outdoor living" sustained the operation of over forty charcoal plants once again in the state. A 1955-56 survey found 30 wood charcoal kilns in San Luis Obispo County, seven in the Sierra foothills, and four in Southern California. In that year San Luis Obispo accounted for more than 80 percent of the 4,650 tons produced (May 1957). Questionnaires determined that 99 percent of the wood burned was oak. Coast live oak was the most commonly used in San Luis Obispo County, cut from the Santa Lucia foothills in the Upper Salinas Valley. Oregon white oak (Q. garryana) was used in Sonoma and Yolo Counties; blue oak and to a lesser extent California black oak in the Sierra foothills (May 1957). By 1961 twenty producers in California were making 5,400 tons of charcoal from 10,000 cords of oak; eleven of these were in San Luis Obispo County (USDA 1963). In the last 15 years, production in the state has dwindled as inexpensive imported charcoal has become available from Mexico.

Use of California oaks for manufactured products has always been limited. Jepson (1923) thought when the name "Mush Oak" was applied to valley oak it was a contemptuous reference to its failure to meet the requirements of a strong, straight wood. He says that the most valuable oak, canyon live oak, was used for shipbuilding, wheels, axles, plow beams, tool handles, and furniture in the early days of the state (Jepson 1910). Coast live oak and blue oak were utilized to a lesser extent for tools and wagon parts. In the 1870 - 1880's in Mendocino County, the forks of open grown California black oak were used as "naturally assembled" ship keels and ribs (McDonald 1969). Wood from valley oak was used in California shipyards during World War II for keel blocks, and a very limited use has been made of it for wine barrels (Schniewind and Bryan 1959; Dost and Gorvad 1977).

Generally oaks have not been managed for commercial uses in California, and in conifer stands have been considered undesirable forest components. California black oak in particular has been removed from softwood stands on state and national forest land, where experiments have shown trees as large as 24" dbh can be poisoned by herbicides (Otter 1960). However, California black oak remains the most important commercial hardwood species in the state.

Statistics point out that 7.8 million board-feet of hardwoods were cut in 1976, virtually all of it California black oak. At the state's largest hardwood mill, Cal Oak, located at Oroville, the wood is used primarily for pallet stock, with a small volume entering furniture manufacturing in Los Angeles.[5/] A smaller amount of white oak, mostly Q. lobata is cut annually, and estimated to be between one and two million board-feet (Dost and Gorvad 1977). Recently riparian oaks (Q. lobata) have been cut and sold for wood chips (McGill 1975). Additionally, each year thousands of cords of oak firewood are sold in metropolitan areas, but the sales reported are only a fraction of the actual volume involved. In 1977 California Department of Forestry reported 18,500 cords of fuelwood cut in the state (California Dept. of Forestry 1977). For the last three quarters of 1977 the State Board of Equalization reported 6,000 cords of oak firewood sold in California (three million board-feet)[6/], but this may reflect as little as 10 percent of the total.

AGRICULTURE

Throughout California's history, agriculture has displaced extensive tracts of native oaks, and eventually much of the land has become sprawling suburbs. Agricultural operations have made reproduction virtually impossible even when mature trees have been left in the cropland.

The earliest agricultural clearing affecting oaks was for orchards. Following the early Gold Rush immigration, orchards were planted where blue oak, black oak and interior live oak had been cleared from the Sierra foothills (Hutchinson 1946). Between 1900 and 1920 orchards expanded greatly in the Sierra foothills, and in the 1930's Placer, El Dorado, and Nevada Counties were still among the top four counties in pear acreage (Hutchinson 1946; Watts 1959). Early orchards planted on the broad natural levees of the Sacramento River were at the expense of riparian valley oak groves, especially between Rio Vista and Marysville.

In the Santa Clara Valley, the expansion of orchards in the early 1900's led Broek (1932) to observe: "Once a grassland dotted

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[5/] Personal communication, Brian Barrette, California Department of Forestry.

[6/] Personal communication, J.C. Denny, Chief, Resource Management, The Resource Agency, State of California.

with evergreen oaks, a large portion of the valley is now covered by a veritable forest of deciduous trees" (p. 137). In the Coast Ranges around Paso Robles, a huge promotional development from 1915 to 1925 converted 8,000 acres (3200 ha) of dense coast live oak woodlands and 6,000 (2400 ha) acres of valley oak and blue oak savanna to almond orchards.[7] When most of the acreage proved unprofitable due to marginal rainfall, early frosts and increasing competition from irrigated plantings, the trees were removed in favor of dry farming uses. At least from 1910 on it was recognized that oaks are host to the fungus Armillaria mellea, which may subsequently attack the roots of orchard trees (Smith 1909). After 1925 fewer oaks were cleared specifically for orchards.

For cropland, however, as Jepson (1910) observed, early settlers knew well that the presence of valley oaks was a "sign of the richest soil". Being flat and accessible, these parklike, often pure stands of valley oak, developed on deep alluvial soils, have continually been under the greatest pressure from agriculture. Land cleared of valley oaks includes huge tracts on the east side of the San Joaquin Valley, where today scattered individual trees on the Kaweah River plain attest to the report of 400 square miles (104,000 ha) of valley oaks there in 1910 (Jepson 1910). Valley oaks have been removed or isolated by agricultural uses in the Sacramento Valley, Livermore Valley, Napa Valley, Santa Clara Valley, parts of the Santa Ynez Valley, and the upper Salinas Valley. Round Valley in Mendocino County and San Antonio Valley in the Santa Lucia Range are examples of a few locations where sizable valley oak savannas remain.

In 1861 William Brewer traveling through northern San Luis Obispo County remarked: "... in these valleys are trees every few rods — great oaks, often of immense size, ten, twelve, eighteen, and more feet in circumference ... In passing over this country, every hill presents a new view of these trees — here a park, there a vista with the blue mountains ahead" (Brewer 1864, p. 93). Today, in this area where I have examined the extent of clearing, over 70 percent of the valley oak parkland has been eliminated to facilitate agriculture. Of the trees that remain, nowhere is there a reproductively viable tract of Q. lobata (Rossi 1979).

Clearing, however, is not the only activity affecting the survival of oak savanna. More important is the widespread lack of reproduction. Even where mature trees remain in the fields, reproduction is precluded by recurring planting and harvest operations, and the practice of grazing animals on the crop stubble, where they eat both the acorns and any seedling trees. Characterizing the plight of valley oak, Griffin (1973) observed: "... the scene is now one of tired relics towering over an intensively cultivated system" (p. 6). Very often the only areas where oaks become established is in waste places, abandoned fields, and along roadsides, between the asphalt and the fences. Ironically, one place in San Luis Obispo County where thickets of valley oak saplings have become established is on the freeway borders and median.

STOCK RAISING

Over a large area, particularly in the foothill woodland, grazing activities have caused the same impacts on oak reproduction. The results of predator control and overgrazing included explosive ground squirrel numbers, which in at least one instance, at Fort Hunter Liggett, received national attention.[8]

Oak reproduction also has been found absent in areas protected from grazing (White 1966). Mice, wild pigs, and especially deer consume acorns and oak seedlings, and gophers kill many seedlings by girdling and chewing oak roots (White 1966; Griffin 1970, 1977).

Fifty years ago, Bauer (1930) observed in the Tehachapi Mountains, "grazing explains the openness of the understory and ... absence of young growth generally in oak communities... the very young oaks being readily grazed" (p. 279). Studying the vegetation of the San Luis Obispo quadrangle, Wells (1962) found oak seedlings everywhere absent, except occasionally outside fences, and pointed to heavy cattle stocking to account for the poverty of oak reproduction. In the Santa Ana Mountains, Snow (1972) found that browsing and trampling by cattle destroyed all unprotected seedlings of coast live oak and Engelmann oak (Q. engelmannii) in open habitats. He observed that the absence of grazing in the area between 1895 and 1905 corresponded to a period of successful reproduction of these species. Observing oak reproduction on 50,000 acres (20,000 ha) at heavily grazed Hunter Liggett, Fieblekorn found seedlings of valley oak and blue oak exceedingly rare, and those of coast live oak present on

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[7] Rossi, R.S. (1974) Paso Robles area almond orchard promotion 1910-1925. Unpublished manuscript. 45 p.

[8] San Francisco Examiner-Chronicle, September 12, 1976.

only about 2,000 acres (800 ha).[9] Over an area as large as the Santa Lucia Mountains, Griffin (1976) found a general absence of valley oak seedlings more than one year old and saplings less than 50 years old. Holland (1976) has made the same observation about blue oak throughout its range.

In the blue oak foothill woodlands, ranchers have been clearing oaks and digger pine (Pinus sabiniana) for range improvement since about 1940. It was assumed that the removal of these "weed" trees would improve the forage production and therefore the output of meat. The practice became widespread on the east and west side of the Sacramento Valley when inexpensive methods of killing the oaks were developed. The practice was advocated and directed by the Agricultural Extension Service and university advisors (Leonard 1956; Leonard and Harvey 1956; Johnson et al. 1959; Murphy and Crampton 1964; Dal Porto 1965; Brown 1973). Extensive clearing was done in the period 1945-1960, especially of blue oak and live oak in the Sierra foothills and North and Central Coast Ranges. Methods have included bulldozing, burning, girdling, cutting, and chemical treatment with 2,4-D and 2,4,5-T applied in axe cuts, and even broadcast spraying from aircraft.

From 1945 to 1953 some of the clearing was paid for through matching funds by federal programs of the Agricultural Adjustment Administration (now the Agricultural Stabilization and Conservation Service, A.S.C.S.). Beginning in 1945 the A.A.A. offered payments for clearing land for tillage, and in 1947 payments were extended to clearing land for pasture. Though the statistics reflect only the total clearing it appears that counties with large areas of oak woodland were the most active participants. For instance, in 1947, Amador, Calaveras, and El Dorado counties accounted for one-third of the 1,500 acres (600 ha) cleared for pasture (U.S. Ag. Adj. Adm. Annual Reports 1944-53). From 1948 to 1952 six central Sierra counties (Amador, Calaveras, El Dorado, Placer, Tuolomne, and Mariposa) accounted for over 50 percent of the 110,000 (44,000 ha) acres cleared for range. San Luis Obispo Co. lost over 6500 acres (2600 ha) of oak savanna and woodland under these programs. In Tehama County, where clearing was most extensive, the A.S.C.S. Director estimates that during the last half of the 1950's through the 1960's, blue oak trees were removed from 90,000 acres (36,000 ha). Herbicides were used on about 5,000 acres (2,000 ha), but in these areas subsequent resprouting has reversed the clearing effort.[10] [11]

It was not until 1973 that the practice of clearing oaks from rangeland was seriously questioned. Holland (1973) working in oak savanna sites near Madera, in the Temblor Range, in Kern County, and at Hastings Reservation in Carmel Valley, showed that forage production and nutritional quality are greater under the blue oaks than between them. Further, the forage has greater nutritional value and remains greener into the dry season; the trees also modify the micro-climate and improve range land soils. Further details of this blue oak canopy effect and its implications for oak clearing appear in Holland (1980) and Holland and Morton (1980). Where oaks form a nearly closed canopy (120-200 trees per acre) tree removal has reportedly not affected forage value in some areas (Murphy and Crampton 1964) and enhanced it in others (Johnson et al. 1959).

RIPARIAN OAKS

The riparian forests of the Central Valley, in which valley oaks were a conspicuous element, have undergone a complete transformation, most having disappeared without description. Captain Sir Edward Belcher, visiting the Sacramento Valley about 1840, said of the forests lining the river: "Within, and at the verge of the banks, oaks of immense size were plentiful. These appeared to form a band on each side, about three hundred yards in depth, and within (on the immense park-like extent, which we generally explored when landing for positions) they were seen to be disposed in clumps, which served to relieve the eye, wandering over what might otherwise be described as one level plain or sea of grass" (Belcher 1843). Based on historical accounts of the Sacramento Valley there were about 775,000 acres (310,000 ha) of riparian woodland in 1850. By 1952 only about 20,000 acres (8,000 ha) remained. Today the estimate is 12,000 acres (McGill 1975; Dutzi 1979). Thompson (1961) in his study of the Sacramento Valley concluded that the riparian forests were effaced during the first two or three decades of Anglo-American occupance. Cronise (1868) recognized large-scale destruction of riparian forests by 1868 in Colusa,

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[9] Fieblekorn, C. (1972) Interim report on oak regeneration study. Unpublished report on file, Natural Resources Conservation Office, Fort Hunter Liggett, Jolon, California, 23 p.

[10] Personal communication, A. Cornell, Agricultural Stabilization and Conservation Service, Davis, California.

[11] Personal communication, R. Christianson, Agricultural Stabilization and Conservation Service Advisor, Tehama County, California.

Yuba, Solano, and Sacramento Counties. At Knight's Landing, huge quantities of cordwood were loaded onto the numerous steamboats navigating the Central Valley rivers during the mining days (Thompson 1961). Agricultural land uses, especially orchards on the broad natural levees, displaced further miles of gallery forests.

Tree removal was also incidental to flood control projects and levee construction. The construction of Shasta Dam by the U.S. Bureau of Reclamation in the mid 1940's caused landowners to respond to dramatically reduced flood and erosion dangers on low lying alluvial soils. Moving onto the floodplain, they converted much riparian vegetation to permanent cropland and orchards (McGill 1975). During the period 1952-1972 over 50 percent of the high terrace riparian vegetation on the margins of the Sacramento River was converted to other uses, especially new orchards (13,100 acres (5,240 ha))(McGill 1975).

Valley oaks have been killed indirectly in some areas by greatly lowered water tables created by water impoundment in the foothills and local ground water pumping; in other areas the accumulation of saline irrigation runoff has been equally destructive.

In the Sacramento Valley, local concern for the continuing loss of riparian habitat has been manifested in a workshop and several conferences (e.g., Sands 1977). At the state level, the Secretary for Resources has established the Upper Sacramento River Task Force whose work includes specific interest in diminishing riparian vegetation.

FIRE SUPPRESSION

Fire suppression policies of the last 50 years have resulted in the unnatural build up of fuels in oak woodland communities. The absence of frequent low intensity fires has permitted the invasion of chaparral species, or highly flammable conifers into the understory (Dodge 1975; Griffin 1976). Overgrazing has aggravated the situation by eliminating ground cover to carry low intensity burns. When fires do start, the oaks are consumed in the conflagration unless they are protected in a canyon bottom or by rocky outcroppings. In San Diego County, Dodge (1975) noted that an oak woodland between Pine Valley and Corte Madera that was "fairly open" in 1931 had become covered with a dense understory of brush. When the 1970 Laguna Fire burned through, approximately 50 percent of the oaks were killed, and the remainder extensively damaged. He concluded that high intensity fires are having the effect of converting oak woodlands to pure chaparral stands. In the 1977 Marble Cone fire, the valley oaks in the area of Chews Ridge which had not burned in almost fifty years, were greatly damaged where Coulter pines (Pinus coulteri) had invaded. Griffin (1980) found 47 percent of the valley oaks were killed in the areas of crown fire and that the thicket of pine saplings and litter had greatly increased the fire hazard to the oaks.

URBANIZATION

Since 1945 the most conspicuous impact on California's oaks has resulted from the growth of cities and suburbs. At both ends of "El Camino Real" huge population centers have grown up. In the Los Angeles basin where Engelmann oak used to be extensive between Pasadena and Claremont, no intact woodland remains in the path of suburban growth (Griffin 1977). Cities named for their oaks, such as Thousand Oaks, Sherman Oaks and Encino, are often left only with token examples of their natural heritage in order to accommodate growth and development. Around San Francisco Bay, there are few oaks in Oakland, very few left among the suburbs filling in the Livermore Valley, and even fewer in the Santa Clara Valley. Between San Jose and Redwood City, Cooper (1926) found a "more or less skeletonized form" of what was "originally a continuous belt of oak forest" on the alluvial fans that reach the bay. Observing this same area in 1798, Captain George Vancouver compared it to a well kept park planted with huge oaks, and added prophetically, it "required only to be adorned with the neat habitations of an industrious people" (Vancouver 1798). These people certainly have come; the area today numbers over one million people in ten cities and endless suburbs, shopping centers and freeways.

Very often, of course, where urban areas have developed, oaks were originally cleared for agriculture. Yet, where they were spared it is paradoxical that now in large and small cities alike, they fare so poorly and are so little revered. However susceptible oaks are to cutting, grazing and other rural pressures, they succumb just as quickly to overwatering, blankets of asphalt, grade changes and pruning. As parcel sizes become smaller, and the land uses intensify, it becomes less likely that viable oak communities will persist on the metropolitan fringes. Often, in fact, the new suburban residential uses put greater pressures on the native plants than did the previous agricultural uses. Horses and cattle in "backyard" corrals are typically overstocked. Home owners cut and disk weed from their property and also often from the roadsides. In the

foothill woodland, land for residential uses includes areas that were too steep or inaccessible for farming; now even these waste places have lost their protected status. Seedling oaks are treated as weeds, and the heavily manicured gardens and public parks are filled with non-native plants.

Many cities have adopted tree ordinances primarily intended to save their remaining oaks, as for example in Visalia, Menlo Park and San Luis Obispo. Unfortunately, the fine for cutting a two-hundred-year-old oak is generally far less than the value of the cordwood from the tree.[12/] County-wide tree ordinances pertain only to incorporated cities, and therefore exempt the vast rural areas and unincorporated suburbs. Steinhart (1978) observed that the luxury of fine healthy groves of oak seem to be the sole possession of the most exclusive and expensive communities, such as Brentwood, Beverly Hills, Montecito, Atherton, Woodside and Piedmont.

SUMMARY

In a brief span of time, modern man has made impacts on California oaks which will affect their distribution and abundance for centuries to come. This stands in contrast to the gentle tenancy of the native Indians.

The oaks in the riparian woodlands have suffered the most extensive losses. Almost everywhere, the range of valley oaks has been seriously reduced and the remaining tracks are largely barren of seedlings. In the foothills, hundreds of thousands of acres of blue oak have been converted to grassland and crops, and grazing activity inhibits oak regeneration in the remaining woodland. Until recently, oaks were cut in the state for charcoal production, but currently fuelwood accounts for the bulk of cutting. In Southern California Engelmann oak and coast live oak have been displaced by suburban growth. Approximately 10 million board feet of oaks are cut each year for manufactured products, most of it being California black oak from Northern California.

The clearing of oaks and the impairment of reproduction indirectly affects wildlife populations, soil development, and the ecosystem in general. The landscape is impoverished both in a visual sense and in terms of its natural diversity. It is slowly losing its appeal, its distinction, its uniqueness. Although the individual species of oak are not likely to become extinct, human use has fragmented the handsome oak landscape, and the unique character of many oak communities is already gone or frozen in premature senescence.

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