1. DISTRIBUTION AND STATUS OF THE VALLEY OAK (QUERCUS LOBATA NEE) IN CALIFORNIA

The valley oak (*Quercus lobata* Neé) is among the largest and longest lived of the North American oaks, attaining trunk diameters up to 4 m, heights of 12 to 25 m, and ages of 300 years or more. Unique to California, this oak is also one of California's most familiar and evocative icons. Where they occur, large valley oaks are focal visual and ecological elements of both developed and rural landscapes.

Ironically, the valley oak has also been more impacted by human activities than any other oak in the State, and recent research indicates that the species is in demise over much of its range. Many counties have adopted or are considering strong valley oak conservation measures, provoking angry debates among environmentalists, agricultural and development interests. Unfortunately, as we hope to summarize in this paper, information on the distribution and status of the valley oak that could help inform the development of appropriate policy is very sketchy and biased. In fact, the species has never been reliably surveyed, and alternative mapping and inventory strategies may be needed if we are to obtain data that can usefully inform ongoing policy debates.

STATEWIDE INVENTORY AND MONITORING

Valley oak occurs mainly in the Central Valley and surrounding valleys and foothills, ranging from near Shasta Lake to the Santa Monica Mountains (Figure 1.1). The species is generally restricted to deep loamy soils at elevations less than 600 m, but some populations occur above 1500 m in Southern California (Griffin and Critchfield 1972). The savanna community type is found on alluvial soils of valley floors and some broad ridge tops throughout the Coast Ranges. Denser riparian stands are found along the margins of rivers, especially in the Central Valley. valley oaks are not found in valleys directly exposed to coastal winds, as the species is sensitive to salt aerosols.

Valley oaks occur mainly in five general land use/land cover settings: 1) valley oak and mixed oak riparian or gallery forest; 2) valley oak and mixed oak woodland and savanna; 3) Upland mixed oak and mixed evergreeen forest; 4) as relict trees in improved pastures, croplands, orchards and vineyards; and, 5) as relict trees in residential and developed recreational areas (e.g., golf courses, county parks, etc.).

Despite recent, ambitious and well-designed efforts to inventory California's hardwood rangelands (e.g., Pillsbury et al. 1991, Pacific Meridian Resources 1994), we lack complete

statewide estimates of valley oak distribution, status and trends in all except perhaps the upland woodland types. This is mainly because current vegetation classification and mapping systems only register valley oaks in woodland and forest vegetetion when the species attains canopy cover levels greater than 10% over areas larger than 40-100 acres (Table 1.1). Throughout much of its range, valley oak occurs in sparser savannas, in smaller remnant woodlots and riparian stringers, as a minor component of other hardwood communities, or as isolated relict trees. Thus, from the perspective of assessing the species' status and trends, a large fraction of remaining valley oak populations is excluded from existing monitoring efforts. Some counties are conducting more detailed inventories, but there is no consistency among the local and statewide mapping efforts that would allow regional- or range-wide assessments.

Table 1.1. Statewide estimates of Valley Oak Woodland

Source	Canopy Cover Class (%)	Acres	%Private
Bolsinger (1988)	>10%	274,000	86
Pillsbury et al. (1991)	All	251,000	90
	0-10	106,000	
	10-33	89,000	
	10-34	49,000	
Davis et al. (1998)	>10%	227,734	95
PMR (1994)	All	73,169	

The first systematic mapping of vegetation containing valley oak was the Vegetation Type Mapping (VTM) survey directed by A. W. Weislander between 1930 and 1945. Although the maps are distorted and out of date, this ground-based survey of California is still the most detailed and accurate description of the distribution of upland valley oak over much of its range, excluding the Central Valley. Crews recorded valley oak in their mapping units, which had a minimum size of 40 acres, whenever tree canopy from all species covered at least 20% of the ground area and valley oak contributed at least 20-25% of that cover. Our impression in reviewing the VTM maps and historical photos is that the VTM mapping crews recorded valley oak even when tree canopy cover fell well below the prescribed 20% level, so that their maps generally indicate both valley oak woodlands and dense savanna. Apparently, they did not record sparse valley oak savanna.

The VTM maps and the subsequent Vegetation and Soils Survey of the 1950's, were the main basis for the statewide distribution map produced by Griffin and Critchfield (1972) (Figure 1.1). VTM maps were also consulted heavily by the California Gap Analysis Project (Davis et al.1998) to produce the 1990 distribution map shown in Figure 1.2.

GAP mapped valley oak woodland (>10% canopy cover) over a total of 227,734 ac throughout California. The species was also mapped as a constituent of other hardwood community types over a much larger area (Figure 1.2).

Pillsbury et al. (1991) mapped valley oak statewide using air photos from the early 1980's. The valley oak type was mapped over 251,000 ac, although 40% of the area mapped as valley oak supported less than 10% tree cover. This map was used by the USDA Forest Service to extrapolate field plot data from the California Hardwood Inventory Program (Bolsinger 1987). This survey, which included areas greater than 40 ac that supported at least 10% crown closure by a hardwood species, included 120 plot samples in valley oak woodlands. By combining

ground-**Figure 1.1.** The general distribution of valley oak in California (scanned from Griffin and Critchfield 1972).

based occurrence data and the map from Pillsbury et al. (1992), Bolsinger (1988) estimated the extent of valley oak woodland to be 274,000 ac.

The California hardwoods GIS database developed by Pillsbury et al. (1991) was subsequently refined by Pacific Meridian Resources using 30 m resolution Thematic Mapper imagery. Based on the use of this smaller mapping unit, the extent of valley oak woodland was substantially

reduced to only 77,000 ac statewide. The large discrepancy between estimates in Bolsinger (1988) vs. Pacific Meridian Resources (1994) indicates the strong dependence of valley oak map and inventory information on the scale of the analysis and information sources.

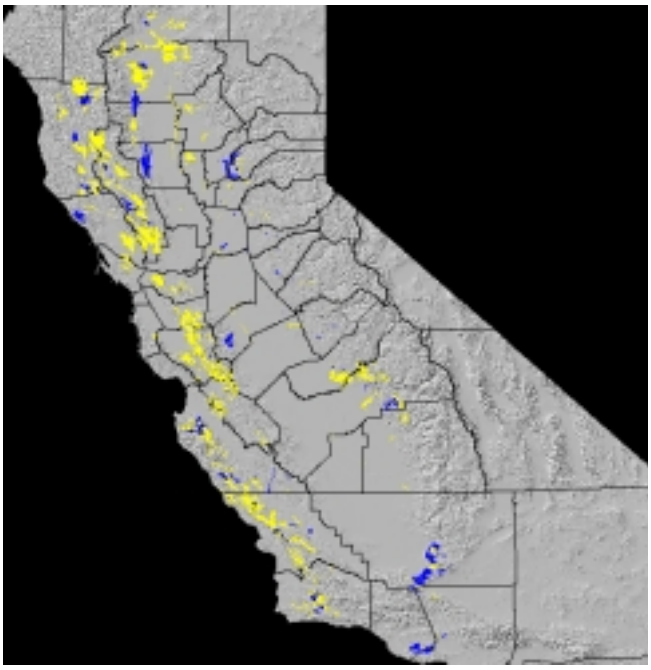

Figure 1.2. Distribution of valley oak developed by the California Gap Analysis project. Blue areas support valley oak woodland. Yellow areas are other plant community types in which valley oak is one of the co-dominant tree species (mainly other hardwood community types).

STATEWIDE PATTERNS OF VALLEY OAK REGENERATION

For over thirty years ecologists have called attention to the apparent lack of regeneration of valley oaks due to drought, rodent and insect damage, and grazing by cattle (e.g., White 1966, Griffin 1971). A systematic statewide analysis of valley oak regeneration was conducted as part of a California hardwood inventory by the USDA Forest Service during the mid-1980's. Only 120 valley oak stands were sampled and these included public or private lands supporting at least 10% tree cover, thus excluding sparse valley oak savannas. Nevertheless, valley oak appeared to exhibit the lowest levels of regeneration of the three widespread deciduous oak species of the foothill woodland system (Figure 1.3). (We should add that the species appears to recruit seedlings and saplings much more readily in riparian forests of the Central Valley and adjacent floodplains.)

Adams et al. (1992) compared valley oak seedling establishment at seven widely distributed sites from Mendocino to San Luis Obispo Counties and observed low seedling survivorship (average 7-13% survival after 2 years). Survival increased markedly (42-43%) when weeds were controlled and seedlings were protected from rodents.

There are several additional studies of valley oak regeneration in other foothill woodland sites that generally support the idea that rodents and competition from exotic grasses strongly impact valley oak seedling survivorship during the first few years. The study by Bernhardt and Swiecki (1997) is one of the few that has monitored survivorship over a longer period (6 years) in both grazed and ungrazed areas. In that study, high (>80%) survival rates were observed for mulched seedlings that were protected from cattle in grazed pastures, and lowest (<25%) for non-mulched seedlings in ungrazed areas. Similar research is currently underway at Sedgwick Ranch Reserve in Santa Barbara County (see below).

The existing literature and ongoing studies provide good information on factors affecting valley oak regeneration at the acorn to small sapling stages. Unfortunately, we lack longer term experimental studies that would help understand factors that are preventing the recruitment of tree-sized individuals from small saplings.

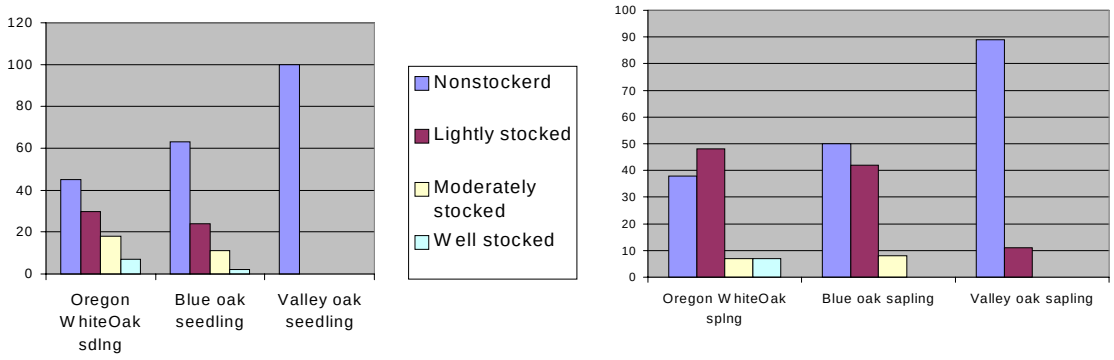

Figure 1.3. Comparison of seedling and sapling stocking rates in Oregon white oak, Blue oak, and valley oak types based on the California state hardwood survey. Valley oak had the lowest sapling and seedling stocking rates of any of the 10 major forest types in the survey.

A STATEWIDE PERSPECTIVE ON LOSS OF VALLEY OAK HABITAT

For decades scientists have raised concern over the loss of valley oak habitats. Because they occur on deep, fertile soils, valley oaks have been actively cleared for agriculture and urban development for 200 years. Now virtually all valley oak plant community types are considered threatened and of high prioirity for inventory by both the California Department of Fish and Game and by The Nature Conservancy (California Department of Fish and Game 1997).

Between 1945 and 1973, roughly 900,000 acres of oak woodlands in California were cleared for range improvement and another 100,000 were converted for development (Bolsinger 1987). Between 1973 and 1987 over 200,000 additional acres of oak woodland were converted to nonforest, and predictions of future loss run as high as another quarter million acres by the year 2010 (Bolsinger, 1988). Valley oak habitat may be especially vulnerable because it is not well represented on public lands or in existing reserves, and the remaining distribution coincides with areas that are predicted to undergo rapid development in the future. Bolsinger (1988) estimated that 20% (40,000 ac) of the oak woodland conversion between 1973 and 1987 occurred in valley oak woodland, a substantial fraction given the limited area in this type.

Estimates vary, but perhaps 90% of remaining valley oak woodland is privately owned (Table 1.1), and less than 5% of valley oak woodland is in formally designated reserves, with protection concentrated in Monterey and Santa Clara Counties (Greenwood 1993, Davis et al. 1998). Similarly, only 4-5% of Valley Oak Riparian Forest is in reserves (Davis et al. 1998).

Table 1.2. Buffer widths assigned to road classes for calculating roadedness index (from Davis et al. 1998).

Census Feature ClassCode	Description	Buffer width (m)
A10-A18	Primary road with limited access or interstate highway	500
A20-A28	Primary road without limited access (US and state highway)	250
A30-A38	Secondary and connecting road (state and county roads)	100
A40-A48	Local, neighborhood, or rural road	100
A50-A53	Vehicular trail (4 wheel drive route)	25

Using County-level population projections, land ownership, proximity to roads, and distance from existing population centers, Davis et al. (1998) developed a rough measure of threat for major plant communities in California. This analysis suggests that remaining valley oak woodland is more threatened than other widespread foothill woodland community types. Using the 1990 1:100,000 scale TIGER files produced by the Bureau of Census, they estimated the fraction of each plant community's mapped distribution that is influenced by roads by buffering road segments with a buffer width related to the class of road (Table 1.2).

County-level population projections through the year 2020 AD were obtained from the California Department of Finance (1997). By assuming that development associated with population growth will occur on private land near existing urban areas and to a lesser extent along major road corridors, Davis et al. (1998) produced a simple GIS-based model to predict the increase in human population density in each major plant community type. As summarized

in Table 1.3 valley oak woodland appears from this analysis to be more impacted by roads and more vulnerable to future development than any other major foothill woodland type in California.

Table1.3. Surrogate measures of threat to oak woodlands in California (see Davis et al. 1998 and text for explanation).

	% in Road Buffer	Projected pop growth (#/km^2)
Valley oak	**27**	**26**
Blue oak	13	18
Interior live oak	18	21
Oregon oak	4	21
Foothill pine-oak	17	20

VALLEY OAK DISTRIBUTION IN SANTA BARBARA COUNTY

Smith (1998) describes the distribution of valley oak in the County as commonly scattered in and valleys from Santa Ynez to Los Alamos, in the lower Cuyama Valley, and into foothills and mountains to around 4500 ft. The species also occurs on Santa Cruz Island.

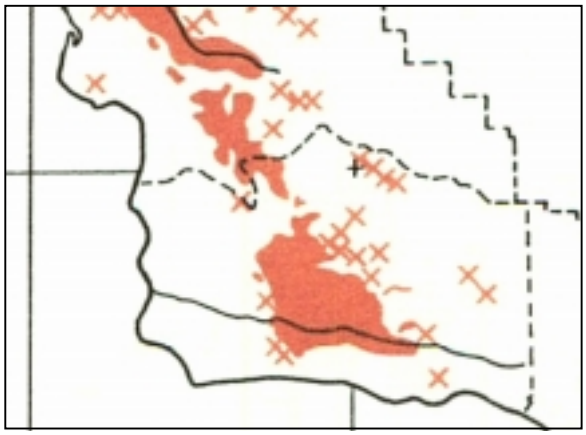

Figure 1.4. General distribution of valley oak in Santa Barbara County (enlarged from Figure 1.1, Griffin and Critchfield 1972).

The map by Griffin and Critchfield (1972) provides a general depiction of this distribution pattern (Figure 1.4).

The County has been included in the statewide mapping efforts described above, but these sources disagree considerably on the location and extent of remaining valley oak woodland and savanna (Figure 1.5). This disagreement arises from the use of different lines of evidence and classification systems for mapping and inventory. Until the current study, there have been no efforts to achieve a more detailed view of the species over a significant portion of the County. The need for such information has arisen with the rapid changes in land use in the Santa Ynez and Los Alamos Valleys, including large scale conversion of valley oak and mixed oak savannas to vineyards as well as rural residential development (Gira et al. 1999).

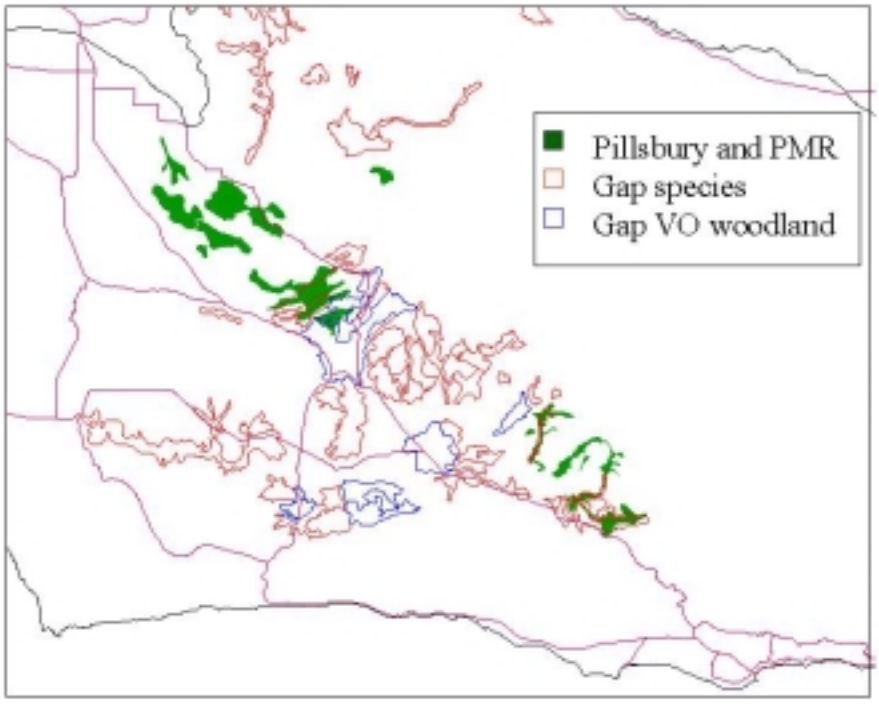

Figure 1.5. Comparison of mapped areas of extensive valley oak woodland or savanna in Santa Barbara County according to Pillsbury et al. (1991) (green areas) versus the California Gap Analysis Project (blue lines surround areas mapped as valley oak woodland. Red lines surround other areas where valley oak is mapped as a co-dominant species of other vegetation types). Major roads and county lines are also shown.

VALLEY OAK REGENERATION IN SANTA BARBARA COUNTY

Despite ample acorn and seedling production, tree cover and density in remaining valley oak populations are declining in Santa Barbara County. In the Santa Ynez Valley, Brown and Davis (1991) used archival air photos to document a 21% decline in the number of overstory valley oaks between 1938 and 1989. No new trees established in the twelve surveyed populations during this time period. At UCSB's Sedgwick Ranch Reserve near Los Olivos,

Davis and others (Unpublished data) used archival air photos to monitor twenty-one areas supporting valley oak and mixed oak woodland. The number of overstory oaks declined from a starting population in 1944 of 5343 individuals (roughly half of which were valley oaks) to 4446 trees in 1989, representing a 19% decline in tree density over the period (Figure 1.6). Although we have observed some rangeland sites in Santa Barbara County where valley oak seedlings and saplings are plentiful, these sites are rare, and the only environments where valley oaks are recruiting in abundance are along roadsides. These roadside areas have been ungrazed for many years and may also be receiving supplemental runoff from the road surface. Changes in other mortality factors such as rodents, weed competition, and deer may also contribute to this pattern.

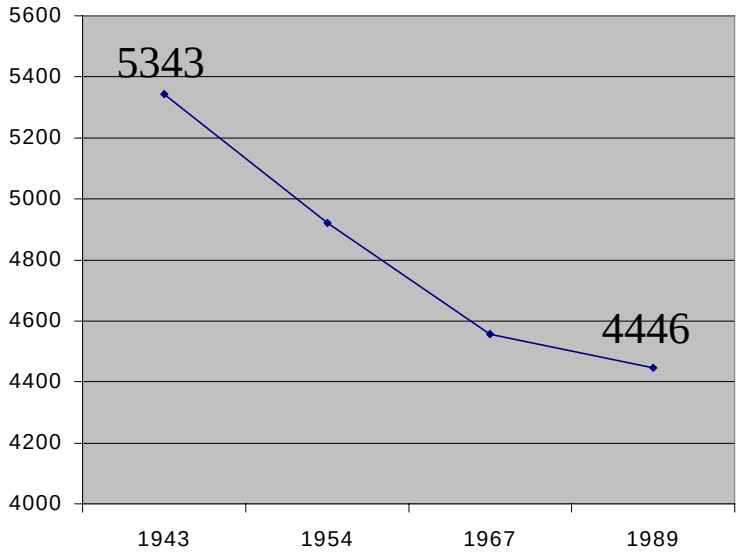

Figure 1.6. Decline in overstory oaks in twenty-one stands of valley oak or Mixed oak woodland and savanna at UCSB's Sedgwick Reserve (near Los Olivos, CA), 1943-1989, based on analysis of archival air photos.

In 1994, UCSB researchers, with funding from Santa Barbara County's Energy Division, initiated a long term experimental study of factors affecting valley oak recruitment in Santa Barbara County. This study is designed to isolate the effects of small rodents versus large grazers and browsers, including cattle, and is aimed at developing low-cost methods for restoring valley oaks in existing rangelands of the County. There has not yet been enough time in this study to evaluate long term patterns of seedling and sapling survival. However, data on seedling establishment over the first 1-2 years are consistent with findings from previous studies in indicating the importance of small rodents (especially gophers) as agents of seedling

mortality (Figure 1.7). It is also worth noting that cattle grazing as it is being practiced on Sedgwick Reserve (winter-spring grazing only) appears to have no negative effect on seedling establishment.

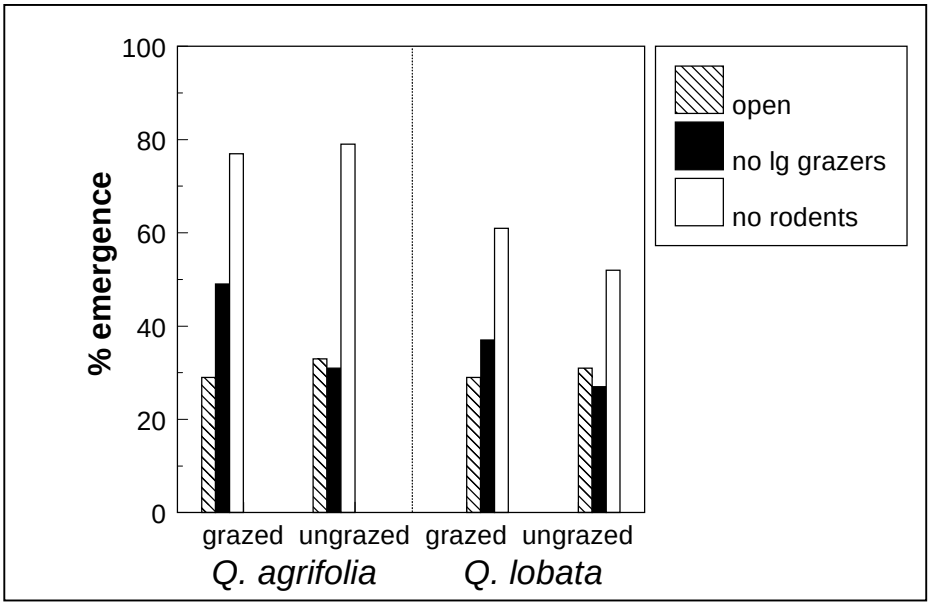

Figure 1.7. Percent emergence of seedlings from acorns sown in large plots grazed by cattle, vs. those fenced to exclude cattle. Data are total percent emergences for three experimental treatments, May 1998. See http://www.biogeog.ucsb.edu/projects/oak/ for details.

CONCLUSIONS

Valley oak woodlands and savanna are scattered over a large area of California's Central Valley and surrounding valleys and foothills. Populations in Santa Barbara County are near the southern range limit of the species in the Santa Monica Mountains. Because valley oaks often occur at very low densities and canopy cover and are often in agricultural and residential areas, the status and trends in valley oak are not well described by previous surveys aimed at monitoring oak woodland and forest types. Nevertheless, there is strong evidence from recent statewide surveys that the species is in decline over most of its range and is also especially vulnerable to habitat loss though land use conversion from rangeland to intensive agriculture and residential development.

As is the case elsewhere in the State, the distribution and abundance of valley oak in Santa Barbara County has been highly modified by agricultural and residential development, cutting, and poor regeneration in remaining stands. Existing surveys of valley oak in Santa Barbara

County provide conflicting views of the distribution of the species. More detailed information is certainly needed to monitor local status and trends. The next chapters of this report will describe how such information was generated for the Los Alamos Valley and will summarize some of our major findings for that area.

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