

Oaks 2040: The Status and Future of Oaks in California¹

Tom Gaman² and Jeffrey Firman²

Abstract

California oaks are seriously threatened as a burgeoning state population makes ever more use of the wildland. Most California oaks are not covered by the Forest Practice Act, they are located on private lands, and are potentially at risk. The Oak Woodland Conservation Act of 2004 requires cities and counties to assess their oak resource and to adopt Oak Woodland Management Plans in order to meet their needs for healthy watersheds. Therefore, *Oaks 2040* is designed to provide localized information for planners. This paper presents a forest and woodland map of the 10 oak types found in California. The most recent statewide forest survey data from the Forest Inventory and Analysis (FIA) program are compiled into an inventory. The inventory data are then merged to describe the mapped oak types. By merging this inventory with state urban growth projections, we examine which oak woodlands are most likely to face development between now and 2040. Findings are reported for each of six regions: North Coast, North Interior, Central Coast, Sacramento, San Joaquin, and Southern.

Keywords: At-risk, Calveg, FIA, GIS, inventory, oak forest, oak habitat, oak woodland.

Introduction

Developing Planning Tools for Oak Futures in California

Ecological functions, wildlife habitat, recreational opportunities, and scenic values are seriously impaired as population densities and other landscape use pressures increase. Managers of oak woodlands and forests need to balance the biological, sociological, and economic interests of private landowners, public agencies, businesses, universities, environmental groups, and concerned individuals. Planning must address the complexities of local, regional, and statewide oak issues within the context of practical on-the-ground land use decisions.

Oaks 2040 is based on field data and is designed to serve decision makers who may develop local and regional Oak Woodlands Management Plans or advance other conservation strategies. A statewide map of oak distribution and current forest and woodland inventory tree plot data, created by state and federal researchers, were the starting points for *Oaks 2040*. From those, regional analyses of forest structure and oak types as well as region-specific oak inventory summaries have been developed.

Previous work has provided information on the distribution and inventory of California's oak woodlands. Bolsinger (1988) prepared a benchmark publication on the nature, extent, inventory and many uses of California's oak woodlands. Waddell and Barrett (2005) provided a detailed inventory of California oak woodlands, based on data from the early 1990s. This paper is the first to use the new Forest Inventory

¹ An abbreviated version of this paper was presented at the Sixth California Oak Symposium: Today's Challenges, Tomorrow's Opportunities, October 9-12, 2006, Rohnert Park, California.

² Forest Data, P.O. Box 276, Inverness, CA 94937. e-mail: tgaman@forestdata.com, jfirman@forestdata.com.

and Analysis program (FIA 2005) data and recent statewide GIS products, including the Fire and Resource Assessment Program (FRAP 1994-2005). Merenlender and others (2005) developed a complex model to evaluate exurban development threats to wildlands in Sonoma County. Because it relies on general planning information that varies among counties, their model would be difficult to apply statewide. We are not aware of any approach that evaluates urbanization threats to oaks statewide. We used a direct methodology that overlays the combined vegetation map with current state urban growth projections. *Oaks 2040* identifies the location and extent of oaks most at risk of urban development statewide. We do not address other threats to oak woodlands, such as habitat fragmentation, very low residential development, and conversion of woodlands to intensive agriculture.

Methods

Mapping Oak Types

A number of overall vegetation maps, maps of hardwoods in general, and oak-specific maps have been generated over the years. Currently, the most reliable statewide vegetation map available is the LCMMP Vegetation Map (FRAP map), produced by the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (2003), in conjunction with the U.S. Forest Service Region 5 Remote Sensing Lab in Sacramento. While these maps do not focus specifically on oaks, oak habitat types can be extracted from mapped vegetation types. Using the FRAP map as a foundation (supplemented by other earlier mapping efforts), we have generated species-specific range maps of oak types throughout the state.

The FRAP map uses the Calveg classification system which first divides all vegetation into "covertime." For finding wildland oak habitat, only two covertypes are relevant. All woodland classified as hardwood (HDW) or forest classified as conifer/hardwood mix (MIX) can potentially be oak habitat, provided it contains the relevant hardwood species. All other covertypes were eliminated from the analysis.

After covertime, the Calveg system also specifies "vegtype," which identifies the dominant species association. For both HDW and MIX covertypes, the data were screened to ensure that the hardwood associations being mapped in a particular location are oaks. Nine such associations are dominated by a single species, each forming its own oak habitat type, or "oak type." Three heterogeneous hardwood types were combined to generate a "mixed" oak type. The 10 resulting oak types, each potentially occurring in both "woodlands" and "forests,"³ are listed in *table 1*.

³ "Oak woodlands" are considered to be those mapped vegetation types where oaks dominate the landscape. "Oak forests" include oaks, but oaks may not necessarily be among the dominant species. By definition, forests and woodlands must have at least 10 percent canopy cover and be at least 1 hectare in extent.

Table 1—Oak types.

Oak Type	Scientific Name	Calveg Type(s)
Black Oak	<i>Quercus kelloggii</i>	QK
Blue Oak	<i>Quercus douglasii</i>	QD
Canyon Live Oak	<i>Quercus chrysolepis</i>	QC
Coast Live Oak	<i>Quercus agrifolia</i>	QA
Engelmann Oak	<i>Quercus engelmannii</i>	QN
Interior Live Oak	<i>Quercus wislizeni</i>	QW
Oregon White Oak	<i>Quercus garryana</i>	QG
Tanbark Oak	<i>Lithocarpus densiflorus</i>	QT
Valley Oak	<i>Quercus lobata</i>	QL
Mixed Oaks	not applicable	EX/NX/TX

This selection and reclassification process was applied to the FRAP maps. The results are GIS layers and maps depicting the distribution of woodland and forest oak habitat types throughout the state of California. See the tables in Appendix A for acres of cover in which oaks dominate the woodland by county and oak type and acres of cover in which oaks are present in the forest by county and oak type.

Ownership and Risk Analysis

The land ownership data are courtesy of the California Department of Forestry’s Forest and Rangeland Resources Assessment Program. Using their layer, the state is divided into a variety of public and private ownership categories. The statewide ownership layer overlaid on top of the oak type map reveals ownership patterns among California’s oaks.

The development risk data have been derived from Fire and Resource Assessment Program (FRAP) development projections (1994-2005). This dataset is based on California Department of Finance and U.S. Census data. This layer tracks past development by decade and predicts future development through 2040. Using this information, three categories were defined. “Developed” is defined as anything that was developed (greater than 32 housing units per square mile) by 2000. “At risk” refers to anything that was not developed by 2000 but is expected to develop by 2040. And “stable” refers to anything that was not developed by 2000 and is unlikely to develop before 2040. Once the layer was divided into these three categories, it was overlaid on top of the oak type map. The oak woodlands of the state were thereby divided into groups by oak type, ownership, and development risk.

Inventory and Analysis

The other critical element for assessment of mapped oak types is the inventory summary, which is based upon data obtained from the U.S. Forest Service’s Forest Inventory & Analysis Program (2005; see also <http://fia.fs.fed.us/tools-data/>). This statewide grid of permanent forest survey sample “plots” yields information about what the mapped oak forests and woodlands look like on the ground. The plots provide information not obtainable via remote sensing techniques—an inventory of forest fuels, species distribution, specific size, growth, regeneration, habitat features, pests, and disease. With point-specific data ranging from species composition to

seedling regeneration to tree size and density, these plots help one understand the makeup of each of the 10 oak types.

The 2001-2004 FIA field data were obtained to provide an inventory of each of the oak types discussed above. Combining the ground-based survey data and the GIS mapping data enabled us to provide a new comprehensive oak inventory as shown in Appendix B.

California Oaks: The Statewide Analysis

California has approximately 8.5 million acres of oak woodland and 4.5 million acres of oak forest. These 13 million acres comprise more than one-eighth of the state's area (*fig. 1*). To facilitate statewide analysis, California counties have been grouped into six distinct regions (*fig. 2*), each of which is discussed later in this report. The Sacramento and San Joaquin regions are home to more than half of California's oak woodland. Oak forests are concentrated in the North Coast and North Interior regions. California currently has approximately two billion oaks greater than 1 inch DBH. More than 800 million of these oaks are larger than 5 inches DBH.



Figure 1—California oak forests and woodlands.



Figure 2—California counties are grouped into six regions.

California oaks are diverse. Blue oak (see *table 1* for scientific names of species) is California's dominant oak species, representing more than one-third of the state's oak woodlands. Canyon, coast and interior live oak woodlands comprise approximately one-third of California's oak woodlands. Tanbark, black and canyon live oak forests account for more than 80 percent of California oak forests.

In oak woodland, oaks comprise 60 percent of the total tree basal area, 67 percent of trees greater than 5 inches DBH and 37 percent of trees greater than 24 inches DBH. In oak forest, oaks comprise 18 percent of the total tree basal area, less than 24 percent of trees greater than 5 inches DBH and 8 percent of trees greater than 24 inches DBH. Blue oak, Oregon white oak and, to a lesser extent, interior live oak, are regenerating poorly. Blue oak averages about one seedling per thousand square feet in woodlands, and less than one seedling (1 foot or more in height) per two established oak trees. Not a single Engelmann oak or valley oak seedling was tallied on any of the 932 FIA plots.

Oaks 2040: Future Prospects for California's Oaks

The FRAP development models forecast that more than one million acres of California's oak woodlands are developed, and approximately 750,000 are at risk of urban development before 2040. Twenty percent of California's oak woodlands are facing rapid and increasing urbanization by 2040. The oak woodlands of the Central Valley and Sierra Foothills face the most immediate threats. Eighty percent of California's oak woodlands that are at risk of development are located in the Sacramento and San Joaquin regions. *See figure 3.*



Figure 3—California oak woodlands at risk of development.

California Oaks: The Regional Analyses

This section provides regional summaries. Each describes oak distribution, oak woodland and oak forest diversity, and oaks at risk.⁴

⁴Appendix B summaries are further detailed by region in the full report online at <http://www.californiaoaks.org/Oaks2040>.

North Coast Region

Counties included in this region are Del Norte, Humboldt, Mendocino, and Sonoma.

Oak Distribution and Diversity

The North Coast Region has 1.3 million acres of oak woodland and 1.5 million acres of oak forest. In fact 35 percent of California's oak forest is found in the North Coast region, and oaks are present on 45 percent of the region's land (more coverage than any other region). In the North Coast region, there are 245 million oaks greater than 5- inches DBH. Only the Central Coast tops the North Coast's two million oaks with DBH greater than 24 inches.

The North Coast oak woodlands feature Oregon white oak, tanbark oak and mixed oak. Canyon live oaks and California black oaks are also present, mixing in with Douglas-fir (*Pseudotsuga menziesii*), Pacific madrone (*Arbutus menziesii*), and California bay (*Umbellularia californica*). Oaks comprise approximately one-half of the basal area, trees/acre, and trees greater than 5 inches DBH/acre in white oak woodlands. In tanbark oak woodlands, oaks comprise less than 20 percent of the basal area, trees/acre, and trees greater than 5 inches DBH/acre.

In the North Coast's oak forests, tanbark oak is predominant. Associated species include Douglas-fir, redwood (*Sequoia sempervirens*), madrone, bay, canyon live oak and California black oak.

Oaks at Risk in the North Coast Region

In terms of ownership, 84 percent of the North Coast's oak woodlands are located on private property. Most of the remainder is owned by the U.S. Forest Service and various other federal government agencies. Private ownership of oak woodland increases moving southward, ranging from 40 percent in Del Norte County to 95 percent in Sonoma County.

A total of 8 percent of North Coast oak woodlands have already been developed and 4 percent are at risk of near-time urban development, according to the FRAP forecasting model.

North Interior Region

Counties in this region are Lassen, Modoc, Shasta, Siskiyou, and Trinity.

Oak Distribution and Diversity

Nearly 1 million acres of oak woodland and 1.1 million acres of oak forest reside within the North Interior. The North Interior and the North Coast are the only two regions with more oak forest than oak woodland. The North Interior has nearly 400 million oak trees, and 150 million of these oaks are greater than 5 inches DBH.

In this region, a balanced mixture of blue oak, California black oak, canyon live oak and Oregon white oak woodlands is found. Blue oak woodlands typically include gray pine (*Pinus sabiniana*) and either interior or coast live oak, and oaks comprise more than 80 percent of the basal area and more than 90 percent of the trees. Oregon white oak woodlands include black oak, Douglas-fir, and ponderosa pine (*Pinus ponderosa*), and oaks make up 40 percent of the basal area and more than half of the trees greater than 5 inches DBH. In black oak and canyon live oak woodlands, oaks

comprise 50 percent of the basal area and 70 percent of the trees greater than 5 inches DBH.

In the North Interior oak forests, canyon live oak and black oak are prominent. These two oak species mix in with the local conifer species, including Douglas-fir, ponderosa pine, sugar pine (*Pinus labertiana*) and madrone. In black oak forests, oaks comprise one-fifth of the basal area. One-third of the trees greater than 5 inches DBH are oaks.

Oaks at Risk in the North Interior Region

In terms of ownership, 60 percent of North Interior oak woodlands are privately owned, and 10 percent of the region's oak woodland has already been developed. A total of 3 percent is at risk for urban development by 2040. We project that 87 percent is unlikely to develop into urban and suburban uses before 2040. Shasta County oak woodland is most at risk, as 15 percent has been developed and 5 percent more may develop by 2040.

Central Coast Region

Counties included in this region are Alameda, Contra Costa, Marin, Monterey, San Benito, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, and Ventura.

Oak Distribution and Diversity

The Central Coast is home to 1.6 million acres of oak woodlands and 300,000 acres of oak forests. Oaks are present on 17.5 percent of the region's area. There are 87 million oaks 5 inches DBH and larger within the region.

One-half of the Central Coast's oak woodland is coast live oak, and one-third is blue oak. A total of 80 percent of California's coast live oak woodland is in the Central Coast, and 30 percent of the state's valley oak woodland is in the Central Coast. However, there is not adequate inventory data to confidently describe this critical oak type.

Tanbark oak and coast live oak account for three-quarters of the region's oak forests. Redwood and Douglas-fir dominate in these forests, but 40 percent of the trees are oaks.

Oaks at Risk in the Central Coast Region

A complex land ownership matrix covers the oak woodlands of the Central Coast. Private ownership of oak woodlands predominates, averaging 75 percent throughout the region and ranging from 65 percent in Santa Barbara County to 95 percent in Alameda County. The Los Padres National Forest includes much of the oak woodlands in Ventura, Santa Barbara, San Luis Obispo, and Monterey counties. Additionally, the Bureau of Land Management manages 20 percent of San Benito's oak woodlands, and Fort Hunter-Liggett holds 12 percent of Monterey's oak woodlands. The state owns approximately 10 percent of oak woodland in Santa Clara, Contra Costa, and Santa Cruz counties.

Almost 85 percent of the Central Coast oak woodlands are unlikely to be developed before 2040. Most of the remaining areas have already been developed. Less than 3 percent is at current risk for urban development.

Sacramento Region

Counties in this region include Butte, Colusa, El Dorado, Glenn, Lake, Napa, Nevada, Placer, Plumas, Sacramento, Sierra, Solano, Sutter, Tehama, Yolo, and Yuba.

Oak Distribution and Diversity

The Sacramento region's 2.1 million acres of oak woodlands provide nearly one-quarter of the state's total. Oaks are present on 20 percent of the region's land. There are more than 165 million oak trees >5 inches in diameter in this region.

More than half of the Sacramento region's oak woodlands are blue oak. Gray pines mix in, but oaks comprise 70 percent of the basal area and 80 percent of the trees greater than 5 inches DBH. The region contains more than one-third of the state's blue oak woodland.

Interior live oak woodland contains blue oak, valley oak, California black oak, gray pine, and ponderosa pine. Canyon live oak and black oak woodlands include Douglas-fir, ponderosa pine, and incense cedar (*Calocedrus decurrens*). In canyon and interior live oak woodland, oaks make up 80 percent of the basal area and 90 percent of the trees. The Sacramento region has more than one-third of California's valley oak woodland.

Black oak and canyon live oak dominate the region's oak forests. Canyon live oak forests are 60 percent oaks, mixing with ponderosa pines and Douglas-firs. Black oak forests are 25 percent oaks, along with Douglas-fir, ponderosa pine, white fir (*Abies concolor*), and incense cedar.

Oaks at Risk in the Sacramento Region

More than 80 percent of the Sacramento region's oak woodland is privately owned. The U.S. Forest Service owns about 60 percent of the remaining public lands.

The Sacramento region is more at risk for development than any other. Only two-thirds of the oak woodlands are considered "stable." One-sixth is developed and one-sixth is at risk. More than 300,000 acres of oak woodland could be developed in the Sacramento region by 2040.

El Dorado County has more oak woodlands at risk than any other county in the state, but Tehama, Butte, and Yuba counties are not far behind. By 2040, 80 percent of El Dorado's oak woodlands and more than half of the oak woodlands in Nevada, Yuba, and Placer counties may be developed.

San Joaquin Region

Counties in this region are Alpine, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne.

Oak Distribution and Diversity

The San Joaquin region has more than 2.3 million acres of oak woodlands and 500,000 acres of oak forests. Oaks are present on only 10 percent of the region's land; however, certain portions of the region have far greater oak woodland density than others. Twenty-seven percent of the state's oak woodland fall within these 15 counties. The San Joaquin region currently has 113 million oaks larger than 5 inches DBH.

More than half of the region's oak woodlands are blue oak and another 25 percent are interior live oak. Associated species include gray pine and California buckeye (*Aesculus californica*), as well as valley oak, blue oak and canyon and interior live oaks. The San Joaquin region has more blue oak woodlands and interior live oak woodlands than any other region. In blue oak woodlands, oaks account for 70 percent of the trees, 80 percent of the basal area, and trees greater than 5 inches DBH. In interior live oak woodlands, oaks provide 70 percent of the tree basal area and more than 80 percent of the trees. In canyon live oak woodlands, oaks comprise 55 percent of the basal area, 62 percent of all trees, and 67 percent of trees greater than 5 inches DBH.

Canyon live oak and California black oak comprise almost 90 percent of the oak forests. Associated species in San Joaquin oak forests include incense cedar, ponderosa pine, sugar pine and white fir. In canyon live oak forests, oaks provide one-third of the basal area and nearly one-half of the trees. In black oak forest, oaks comprise more than half of the trees, but only one-third of the trees greater than 5 inches DBH and only one-quarter of the tree basal area.

Oaks at Risk in the San Joaquin Region

Seventy-three percent of the San Joaquin region's oak woodlands are privately owned. The U.S. Forest Service owns 18 percent and the Bureau of Land Management owns 5 percent. A total of 10 percent of the oak woodlands in the region have already been developed, and 10 percent are at high risk of development by 2040. Eighty percent are currently stable; however, targeted planning could ensure that a greater number of acres are conserved for the long-term. Nearly 250,000 acres of oak woodlands in the San Joaquin region are at risk of development by 2040. Only the Sacramento region contains more oak woodlands at risk. In Madera, Amador, and Calaveras counties combined, more than one-third of all oak woodland may be developed before 2040.

Southern Region

Counties in this region are Imperial, Los Angeles, Orange, Riverside, San Bernardino, and San Diego.

Oak Distribution and Diversity

The Southern region is home to more than 300,000 acres of oak woodlands and more than 200,000 acres of oak forests. Combined, these 500,000 acres comprise only 2 percent of the region. However, discounting urban areas and the desert, the oak woodland concentration is much higher.

Coast live oak and canyon live oak are most prevalent, but California black oak and Engelmann oak populations are also significant. Eighty-five percent of the basal area is comprised of oaks. The region has 23 million oak trees > 5 inches DBH. The rare Engelmann oak is found only within this region, mostly in San Diego County.

Canyon live oak and black oak dominate in the Southern region's oak forests.

Oaks at Risk in the Southern Region

The oak woodlands of the Southern region have the highest levels of public ownership found in the state. The U.S. Forest Service owns 44 percent of the region's

oak woodlands, 11 percent are owned by other government agencies, and 45 percent are privately owned.

A total of 20 percent of the Southern region's oak woodlands have already been developed, and 10 percent are at risk of development by 2040. Development of the remaining 70 percent is not anticipated in the near future. Oak woodland development percentages are higher than in any other region in the state.

Summary

The project presents an updated map and inventories of oak forests and woodlands. These data should be useful for conservation planning at the regional, county, and local levels. The FIA plots are also valuable for ongoing monitoring of thousands of individual trees and populations on a landscape scale over a long period of time.

We found that large oak trees are deceptively rare in California. Valley oak and Engelmann oak types need more intensive inventories. Blue oak woodland species have unsustainable rates of regeneration.

Oak woodlands in the Sacramento and San Joaquin regions are most at risk of development. California should plan for protection of its "stable" oak ecosystems now before these ecosystems are fragmented beyond repair.

A more-detailed version of this report, including regional inventories, is presented online at the Web site of the California Oak Foundation <http://www.californiaoaks.org/Oaks2040>.

References

- Bolsinger, C.L. 1988. **The hardwoods of California's timberlands, woodlands, and savannas**. USDA Forest Service Resource Bulletin PNW-RB-148. California Department of Forestry and Fire Protection Fire and Resource Assessment Program (FRAP). 2003. **The Changing California Forest and Range 2003 Assessment**. www.frap.cdf.ca.gov/assessment2003/
- California Department of Forestry and Fire Protection Fire and Resource Assessment Program (FRAP). 2003. **The changing California forest and range 2003 assessment**. www.frap.cdf.ca.gov/assessment2003/
- Fire and Resource Assessment Program (FRAP). 1994-2005. **GIS layers: Hardwood rangeland vegetation; GovtownA; development projections; Land Cover Mapping and Monitoring Program (LCCMP) Vegetation Data; PCTL05**. California Department of Forestry and Fire Protection. <http://frap.cdf.ca.gov/data/frapgisdata/select.asp>
- Forest Inventory and Analysis Program (FIA). 2005. **FIA Database Version 2.1** United States Forest Service. <http://www.fia.fs.fed.us/tools-data/data/>
- Merenlender, A.M.; Brooks, C.; Shabazian, D.; Gao, S.; Johnston, R. 2005. **Forecasting exurban development to evaluate the influence of land-use policies on wildland and farmland conservation**. *Journal of Conservation Planning* 1(1):64-88.
- Waddell, K.L.; Barrett, T.M. 2005. Oak woodlands and other hardwood forests of California, 1990s. PNW-RB-245. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 94 p.

APPENDIX A – ACRES OF COVER WHERE OAKS DOMINATE THE WOODLAND BY COUNTY AND OAK TYPE

REGION	COUNTY	OAK TYPE										
		<i>Black Oak</i>	<i>Blue Oak</i>	<i>Canyon Live Oak</i>	<i>Coast Live Oak</i>	<i>Engelmann Oak</i>	<i>Interior Live Oak</i>	<i>Mixed Oak</i>	<i>Oregon White Oak</i>	<i>Tan Oak</i>	<i>Valley Oak</i>	<i>Total Acres</i>
<i>North Coast</i>	Del Norte	84	0	1,011	0	0	0	2,939	355	42,778	0	47,168
	Humboldt	16,671	0	20,831	10	0	0	13,572	100,484	153,873	0	305,442
	Mendocino	49,553	12,040	60,603	863	0	16,715	119,231	283,036	104,631	4,206	650,879
	Sonoma	3,212	524	7,354	21,601	0	1,484	176,852	41,124	30,402	524	283,077
<i>North Interior</i>	Lassen	7,965	0	0	0	0	0	0	438	0	0	8,403
	Modoc	737	0	0	0	0	0	0	369	0	0	1,106
	Shasta	170,028	268,857	83,918	0	0	4,643	46	21,116	336	6,055	554,998
	Siskiyou	13,053	0	57,570	0	0	0	10,141	97,529	5,646	0	183,938
	Trinity	51,154	275	84,077	0	0	0	0	80,692	15,747	11	231,956
<i>Central Coast</i>	Alameda	0	29,273	12	40,340	0	0	28,255	0	0	1,396	99,275
	Contra Costa	30	29,758	50	32,564	0	2,462	5,051	0	0	691	70,605
	Marin	0	310	0	10,383	0	0	36,792	875	0	108	48,468
	Monterey	679	252,092	0	266,145	0	0	12	0	26,776	6,641	552,345
	San Benito	0	61,729	0	44	0	0	753	0	0	8	62,534
	San Luis Obispo	1,773	68,413	92	83,636	0	0	25,419	0	31	8,672	188,035
	San Mateo	0	515	0	15,021	0	0	3,089	0	65	1,403	20,093
	Santa Barbara	0	22,548	26,794	170,970	0	0	0	0	197	2,925	223,435
	Santa Clara	52	58,083	110	74,259	0	0	58,888	0	10	3,543	194,946
	Santa Cruz	0	0	0	22,474	0	0	6,362	0	48	0	28,884
	Ventura	61	151	14,427	49,929	0	0	0	0	0	1,179	65,747
<i>Sacramento</i>	Butte	20,042	100,835	31,037	0	0	46,668	4,045	0	5,031	429	208,084
	Colusa	353	112,868	3,342	0	0	167	0	450	0	1,563	118,741
	El Dorado	35,900	46,247	24,591	0	0	90,549	15,893	0	0	3,708	216,888
	Glenn	5,842	83,184	23,385	0	0	23	0	2,755	0	2,626	117,816
	Lake	23,948	90,203	34,348	42	0	3,508	15,013	7,777	1,091	2,126	178,056
	Napa	1,236	62,243	941	5,719	0	6,682	88,715	1,380	12	1,474	168,400
	Nevada	27,129	34,650	12,328	0	0	49,647	2,686	0	84	2,172	128,697
	Placer	35,541	49,754	41,854	0	0	24,333	12,212	0	0	2,709	166,403
	Plumas	18,543	0	11,730	0	0	0	38	0	102	0	30,413
	Sacramento	0	7,254	0	0	0	789	26	0	0	49	8,119
	Sierra	9,200	8	8,512	0	0	8	3	0	79	0	17,809
	Solano	44	17,365	0	2,010	0	848	6,228	0	0	1,074	27,568
	Tehama	24,505	443,003	46,383	0	0	1,973	0	1,069	71	12,238	529,242
	Yolo	0	78,912	61	9	0	1,313	0	0	0	1,155	81,450
	Yuba	10,459	47,733	4,150	0	0	26,186	527	0	1,685	1,384	92,122
<i>San Joaquin</i>	Alpine	612	0	130	0	0	0	0	0	0	0	742
	Amador	9,360	49,802	12,071	0	0	44,813	5,912	0	0	1,631	123,588
	Calaveras	11,729	112,449	26,552	0	0	42,538	860	0	0	235	194,362
	Fresno	15,929	228,915	41,437	0	0	81,779	22,354	0	0	424	390,838
	Inyo	590	0	3,546	0	0	0	25	0	0	0	4,161
	Kern	16,732	153,891	49,437	10	0	73,062	22,822	0	0	7,059	323,013
	Kings	0	9,576	0	0	0	343	111	0	0	0	10,029
	Madera	9,407	124,132	29,844	0	0	98,561	1,896	0	0	2,320	266,160
	Mariposa	12,317	120,825	42,628	0	0	106,607	684	0	0	798	283,858
	Merced	0	50,868	0	2,411	0	5	3,973	0	0	532	57,790
	San Joaquin	0	17,484	0	424	0	437	1,686	0	0	18	20,049
	Stanislaus	0	104,218	0	1,288	0	1,279	1,074	0	0	181	108,038
	Tulare	43,406	157,740	43,210	0	0	67,799	33,504	0	0	256	345,915
	Tuolumne	18,082	72,807	48,071	0	0	72,308	349	0	0	186	211,803
<i>Southern</i>	Los Angeles	1,596	2,487	60,102	30,790	32	351	970	0	0	2,177	98,503
	Orange	0	0	2,419	10,440	0	0	0	0	0	0	12,859
	Riverside	3,248	0	14,207	12,128	2,371	910	172	0	0	0	33,036
	San Bernardino	11,083	0	33,953	2,534	0	538	761	0	0	0	48,869
	San Diego	10,623	0	9,255	74,491	17,964	54	8,515	0	0	0	120,903
	ALL COUNTIES	692,507	3,184,018	1,016,373	930,534	20,367	869,380	738,455	639,449	388,695	85,882	8,565,659

APPENDIX A – ACRES OF COVER WHERE OAKS ARE PRESENT
IN THE FOREST BY COUNTY AND OAK TYPE

REGION	COUNTY	OAK TYPE										
		Black Oak	Blue Oak	Canyon Live Oak	Coast Live Oak	Engelmann Oak	Interior Live Oak	Mixed Oak	Oregon White Oak	Tan Oak	Valley Oak	Total Acres
<i>North Coast</i>	Del Norte	1,344	0	1,611	0	0	0	8,762	948	130,743	0	143,408
	Humboldt	18,556	0	32,777	0	0	0	42,345	43,757	519,090	0	656,524
	Mendocino	39,223	544	33,603	484	0	2,100	39,060	69,662	395,741	0	580,416
	Sonoma	675	0	2,618	3,849	0	29	47,157	7,767	68,488	0	130,583
<i>North Interior</i>	Lassen	2,446	0	0	0	0	0	0	0	0	0	2,446
	Shasta	231,378	5,066	48,675	0	0	93	24	13,894	468	0	299,597
	Siskiyou	32,313	0	180,891	0	0	0	73,999	99,747	85,800	0	472,749
	Trinity	76,489	0	130,061	0	0	0	0	49,701	61,739	0	317,989
<i>Central Coast</i>	Alameda	0	0	0	432	0	0	413	0	0	0	844
	Contra Costa	4	286	98	1,042	0	294	236	0	0	0	1,959
	Marin	0	0	0	118	0	0	15,125	0	2,429	0	17,672
	Monterey	0	229	0	24,421	0	0	6	0	26,414	0	51,069
	San Benito	0	50	0	0	0	0	0	0	0	0	50
	San Luis Obispo	1,542	44	0	1,162	0	0	1,775	0	0	0	4,522
	San Mateo	0	0	0	8,113	0	0	2,347	0	46,577	121	57,158
	Santa Barbara	0	0	13,708	4,813	0	0	0	0	0	0	18,521
	Santa Clara	193	36	0	5,080	0	0	4,271	0	5,911	0	15,491
Santa Cruz	0	0	0	58,378	0	0	7,473	0	50,895	0	116,746	
Ventura	0	0	27,705	801	0	0	0	0	0	0	28,505	
<i>Sacramento</i>	Butte	50,365	3,010	28,510	0	0	4,718	9,460	0	41,470	0	137,533
	Colusa	2,088	193	6,071	0	0	0	0	2,551	0	0	10,904
	El Dorado	59,220	157	16,225	0	0	4,155	7,829	0	100	64	87,750
	Glenn	5,522	75	3,954	0	0	0	0	2,483	0	0	12,033
	Lake	17,725	503	18,082	0	0	214	5,601	5,169	284	33	47,612
	Napa	410	68	512	31	0	0	17,396	159	10	0	18,587
	Nevada	75,680	724	18,602	0	0	4,133	407	0	1,328	67	100,941
	Placer	69,336	146	22,150	0	0	752	8,569	0	0	72	101,025
	Plumas	43,057	0	10,980	0	0	0	146	0	237	0	54,420
	Sierra	29,495	0	12,706	0	0	0	84	0	427	0	42,713
	Solano	0	0	0	0	0	6	0	0	0	0	6
	Tehama	32,200	1,004	16,577	0	0	172	0	2,152	61	0	52,166
Yuba	24,450	86	5,272	0	0	1,725	648	0	17,245	156	49,582	
<i>San Joaquin</i>	Alpine	250	0	90	0	0	0	0	0	0	0	340
	Amador	15,502	0	7,446	0	0	3,115	1,644	0	0	47	27,754
	Calaveras	22,842	0	35,566	0	0	13,537	850	0	0	0	72,795
	Fresno	38,798	2,212	37,285	0	0	1,166	65	0	0	0	79,526
	Inyo	173	0	8,147	0	0	0	0	0	0	0	8,320
	Kern	23,428	818	37,609	0	0	572	947	0	0	53	63,427
	Kings	0	213	0	0	0	0	0	0	0	0	213
	Madera	24,728	37	23,870	0	0	5,249	23	0	0	320	54,227
	Mariposa	35,742	34	26,151	0	0	11,900	44	0	0	92	73,964
	Tulare	37,483	9	14,208	0	0	326	631	0	0	0	52,656
Tuolumne	37,778	83	41,705	0	0	14,112	31	0	0	25	93,736	
<i>Southern</i>	Los Angeles	2,863	306	42,577	464	0	14	60	0	0	0	46,283
	Orange	0	0	919	14	0	0	0	0	0	0	933
	Riverside	2,948	0	32,346	183	0	252	0	0	0	0	35,728
	San Bernardino	46,395	0	35,057	32	0	130	151	0	0	0	81,764
	San Diego	16,302	0	8,390	6,490	0	0	8,654	0	0	0	39,836
	ALL COUNTIES	1,118,940	15,933	982,753	115,906	0	68,762	306,234	297,989	1,455,456	1,050	4,363,023

APPENDIX B – OAK INVENTORY SUMMARY FOR 932 FOREST INVENTORY AND ANALYSIS (FIA) PLOTS IN CALIFORNIA OAK WOODLANDS AND FORESTS 2001-2004

OAK WOODLAND

<i>Oak Type</i>	ACRES	# FIA PLOTS	TOTAL BASAL AREA SQ FT /ACRE	OAK BASAL AREA SQ FT /ACRE	NON-OAK REGEN-ERATION SEEDLINGS /AC	OAK REGEN-ERATION SEEDLINGS /AC	# TOTAL TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE 1-5" DBH	# OAK TREES /ACRE 5-10" DBH	# OAK TREES /ACRE 10-16" DBH	# OAK TREES /ACRE 16-24" DBH	# OAK TREES /ACRE 24-32" DBH	# OAK TREES /ACRE >32" DBH
Black Oak	692507	35	91	39	272	454	382	223	135	72	14	1	0	0
Blue Oak	3184018	244	23	19	31	49	101	81	49	22	7	2	0	0
Canyon Live Oak	1016373	76	77	53	129	190	307	239	128	89	17	4	0	0
Coast Live Oak	930534	79	44	36	94	192	234	136	92	23	15	5	1	0
Engelmann Oak	20367	2	20	20	0	0	10	10	0	0	6	3	1	1
Interior Live Oak	869380	60	42	31	70	135	196	172	110	51	8	2	0	0
Mixed Oak	738455	74	59	37	240	138	154	70	25	22	16	6	1	0
Oregon White Oak	639449	40	68	34	223	144	189	121	73	31	14	3	1	0
Tanbark Oak	388695	20	148	68	615	300	610	292	161	95	30	4	1	0
Valley Oak	85882	4	28	20	0	0	67	44	19	18	6	0	1	1

OAK FOREST

<i>Oak Type</i>	ACRES	# FIA PLOTS	TOTAL BASAL AREA SQ FT /ACRE	OAK BASAL AREA SQ FT /ACRE	NON-OAK REGEN-ERATION SEEDLINGS /AC	OAK REGEN-ERATION SEEDLINGS /AC	# TOTAL TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE 1-5" DBH	# OAK TREES /ACRE 5-10" DBH	# OAK TREES /ACRE 10-16" DBH	# OAK TREES /ACRE 16-24" DBH	# OAK TREES /ACRE 24-32" DBH	# OAK TREES /ACRE >32" DBH
Black Oak	1118940	70	143	44	689	326	533	200	135	43	17	4	1	0
Blue Oak	15933	2	72	17	712	263	165	18	0	3	12	3	0	0
Canyon Live Oak	982753	65	117	43	344	404	397	196	125	52	15	4	1	0
Coast Live Oak	115906	7	204	39	129	96	334	137	64	57	10	4	1	0
Engelmann Oak	0	NO PLOTS IN THIS TYPE												
Interior Live Oak	68762	8	74	13	1312	347	123	28	9	11	6	1	0	0
Mixed Oak	306234	16	169	46	586	187	456	175	103	48	20	3	1	0
Oregon White Oak	297989	22	82	22	406	174	259	90	51	30	6	2	0	0
Tanbark Oak	1455456	108	173	63	919	293	497	266	169	69	19	8	1	0
Valley Oak	1050	NO PLOTS IN THIS TYPE												

Regional summaries are available at www.californiaoaks.org/Oaks2040.