Oaks 2040

The Status and Future of Oaks in California

By Tom Gaman and Jeffrey Firman
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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, business, universities, environmental groups and concerned individuals. Planning must address the complexities of local, regional and state-wide oak issues within the context of practical on-the-ground land use decisions.

Oaks 2040 is based on objective oak 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 a current forest and woodland inventory, 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. By evaluating these maps and inventories against current economic growth projections, Oaks 2040 identifies the location and extent of oaks most at risk.

Cover photo: Black Oak at Big Sur

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Oaks 2040

Citizens Concerned with Oak Conservation:

Oaks are more than a distinct component of the landscape for many of us who live in California. For hundreds of years, people have lived in, raised families under, and worked around these generous, natural and cultural icons. Today, increasing population pressures and poorly-planned development are threatening oak sustainability.

The Oak Woodland Conservation Act requires cities and counties to assess their wealth in oak resources and to adopt Oak Woodlands Management Plans in order to meet the need for healthy watersheds, clean air and water, and sufficient high quality wildlife habitat. These Plans must include a description of native oak species and their current and historical distribution, as well as existing threats, status of natural regeneration and urban growth trends. These Plans must also recognize the economic value of oak woodlands in their respective jurisdictions and encourage and support farming, ranching and grazing operations compatible with oak woodland conservation.

Oaks 2040 is designed to provide various stakeholders involved with developing or updating their community's Oak Woodlands Management Plan with current information on 48 of the 58 counties that contain significant oak resources. Every effort has been made to present this important information fairly.

Readers must realize, however, that COF is an advocate for sustainable oak resources. To that end, the full report mentions the importance of using available tools, such as acquisition in fee, conservation easements in perpetuity, deed restrictions and oak mitigation banks, in a timely fashion to achieve conservation of oak resources.

COF's Board of Directors thanks its members, associates and friends for their individual and collective efforts to establish a viable Oak Reserve system made up of well-managed oak woodlands and forests on private and public lands throughout California.

Sincerely,
Janet Santos Cobb

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 (FRAP) in conjunction with the US Forest Service (USFS) Region 5 Remote Sensing Lab (RSL) in Sacramento. While these maps do not focus specifically on oaks, oak habitat types can easily be extracted from these vegetation types. Using these maps as a foundation (supplemented by other earlier mapping efforts), species-specific range maps of oak types throughout the state (FRAP 2005) have been generated.

The FRAP map uses the *Calveg* classification system which first divides all vegetation into *Covertype*. Covertype can be equal to the following: conifer (CON), shrub (SHB), barren (BAR), hardwood (HDW), grass (HEB), water (WAT), conifer/hardwood mix (MIX), urban (URB), or agricultural (AGR). For finding 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.

"The Oak Woodland Conservation Act requires cities and counties to assess their wealth in oak resources and to adopt Oak Woodlands Management Plans in order to meet the need for healthy watersheds, clean air and water, and sufficient high quality wildlife habitat."

After *Covertype*, 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. Dozens of hardwood *Vegtypes* are mapped throughout the state, but only twelve are dominated by tree oaks. Nine of these 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 ten resulting Oak Types, each potentially occurring in both "woodlands" and "forests"[2], are listed in the following Table 1:

This rigorous 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 California. These geographic data provide the foundation for the landscape-level analysis of the distribution and diversity of California's oak woodlands and oak forests. See the tables in Appendix A for acres of cover where oaks dominate the woodland by county and Oak Type and acres of cover where oaks are present in the forest by county and Oak Type.

OAK TYPE	SCIENTIFIC NAME	TYPE(S)
Black Oak	*Quercus kelloggii*	QK
Blue Oak	*Quercus douglasii*	QD
Canyon Live Oak	*Quercus chrysolepis*	QC
Coast Live Oak	*Quercus agrifolia*	QA
Engelmann Oak	*Quercus engelmannii*	QN
Interior Live Oak	*Quercus wislizeni*	QW
Oregon White Oak	*Quercus garryana*	QG
Tanbark Oak	*Lithocarpus densiflorus*	QT
Valley Oak	*Quercus lobata*	QL
Mixed Oaks	not applicable	EX/NX/TX

Table 1. Oak Types

[2] "Oak Woodlands" are considered to be those mapped vegetation types where oaks dominate the landscape. By definition, they have at least 10% canopy cover. "Oak Forests" are those vegetation types dominated by trees, but *Quercus spp.* or *Lithocarpus densiflorus* may not necessarily be among the dominant species.

OWNERSHIP AND AT RISK ANALYSIS

Two additional layers are added to further intensify the oak mapping analysis. Land ownership and development risk layers are incorporated into the map to assess pertinent conservation issues. The land ownership data is courtesy of the California Department of Forestry's Forest and Rangeland Resources Assessment Program (FRAP 1999). Using the FRAP 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 of California's oaks.

The development risk data has been derived from the California Department of Finance's projected development layer. This dataset is based on 2000 US Census Data (FRAP 2001). 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 has been developed (greater than 32 housing units per square mile) by 2000. 'At Risk' refers to anything that has not been developed by 2000 but is expected to develop by 2040. 'Stable' refers to anything that has not been developed by 2000 and is unlikely to be developed before 2040.[3] 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 USFS Forest Inventory and Analysis Program (FIA). 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, pest 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 ten oak types.

The most recent FIA field data was 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 the authors to provide a comprehensive oak inventory using new vegetation maps and the 2001-2004 FIA inventory data.

Using conventional computer programs, inventory data was processed to produce summaries of each plot. The survey plots were grouped by oak type within each region and a customized program was used to produce inventory summaries per acre by oak type by region. Regional totals were then summed up to provide an inventory for the entire state. A variety of other factors were analyzed using the inventory data including basal area and tree counts per acre of oaks relative to total trees, size distribution, regeneration status, and determination of associated hardwood and conifer species. Appendix B summarizes these details for woodlands and forests statewide by oak type.

[3] The 'developed' and 'at risk' designations are assigned to privately owned lands only, as those held in public ownership are considered 'stable' with regard to development. However, publicly-owned lands do face other challenges such as poor oak regeneration and non-sustainable land management practices.

California oaks: the statewide analysis

To facilitate statewide analysis, California counties have been grouped into six distinct regions, each of which is discussed later in this report. In an attempt to represent the levels at which conservation policy is often decided, county boundaries have been utilized for this regional split (see Figure 1), rather than natural boundaries such as watersheds or bioregions.[4] The tables in Appendix B summarize inventory details for woodlands and forests statewide by oak type.

"The plots provide information not obtainable via remote sensing techniques – an inventory of forest fuels, species distribution, specific size, growth, regeneration, habitat features, pest and disease."

Figure 1 – California is divided into six regional groupings of counties.

[4] These are the same regions used in Bolsinger's 1988 *The Hardwoods of California's Timberlands, Woodlands, and Savannas,* except that the San Joaquin Valley has been separated from the rest of Southern California.

OAKS PLAY A MAJOR ROLE IN THE CALIFORNIA LANDSCAPE

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 (see Figure 2). 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" DBH. More than 800 million of these oaks are larger than 5" DBH.

California oaks are diverse. Blue oak 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's oak forests.

In oak woodland, oaks comprise 60 percent of the total tree basal area, 67 percent of trees greater than 5" DBH and 37 percent of trees greater than 24" DBH. In oak forest, oaks comprise 18 percent of the total tree basal area, less than 24 percent of trees greater than 5" DBH and eight percent of trees greater than 24" 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 (one 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

More than one million acres of California's oak woodlands are developed and approximately 750,000 are at risk of 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.

"More than one million acres of California's oak woodlands are developed and approximately 750,000 are at risk of development before 2040."

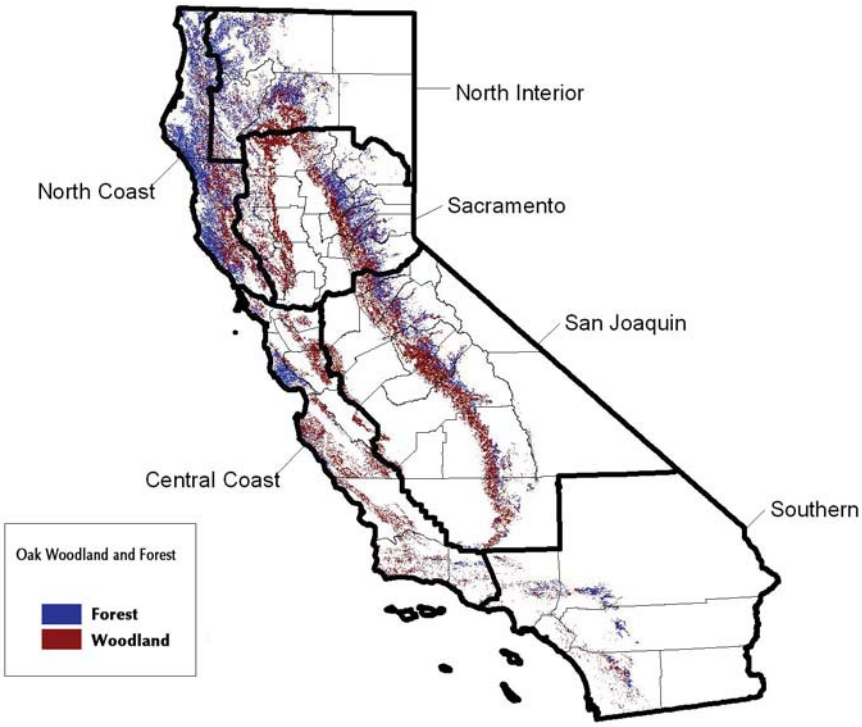


Figure 2 – This map shows the distribution of oak woodlands and oak forests.

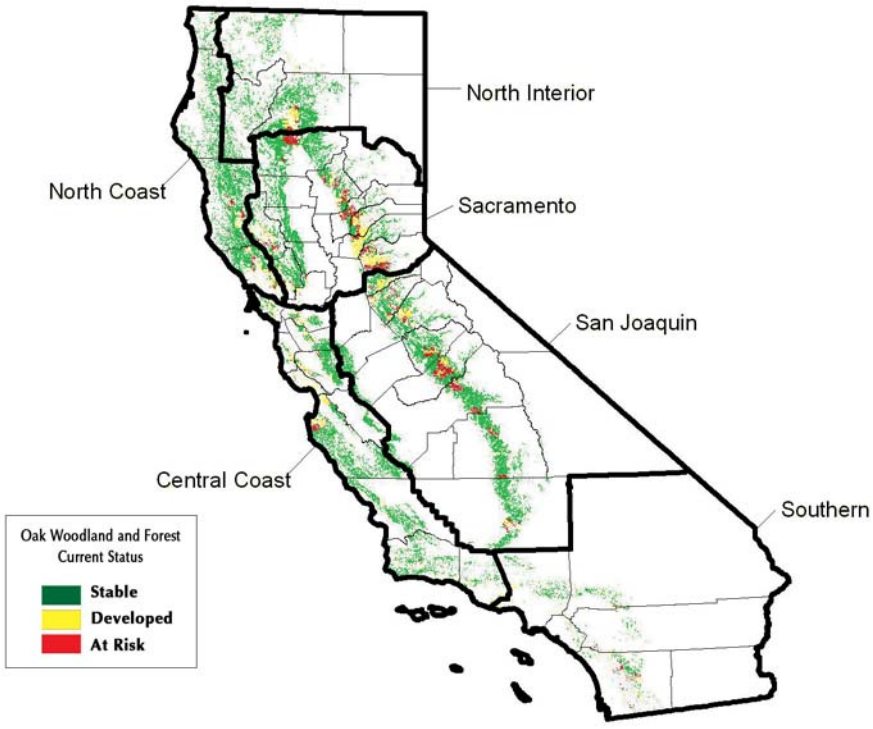


Figure 3 – This map illustrates the distribution of California's oaks 'developed,' 'at risk' and 'stable.'

North Coast Region

Del Norte
Humboldt
Mendocino
Sonoma

California oaks: the regional analyses

This section provides regional summaries. Each regional description includes oak distribution, oak woodland, oak forest diversity and oaks at risk.[5]

Oaks 2040 co-author Tom Gaman is pictured in a mixed forest of Oregon white oak, interior live oak and canyon live oak.

[5]Appendix B summaries herein presented statewide 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

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).

Mendocino County contains more than one-half of the region's oak woodland, but Humboldt and Sonoma counties also have significant stands. The North Coast's oak forests are found primarily within Humboldt and Mendocino counties.

In the North Coast region, there are 210 million oaks greater than 1" DBH and 110 million oaks greater than 5" DBH. Only the Central Coast tops the North Coast's two million oaks with DBH greater than 24".

NORTH COAST OAK DIVERSITY

The North Coast oak woodlands feature Oregon white oak, tanbark oak and mixed oak. Canyon live oaks and black oaks are also present, mixing in with Douglas-fir, madrone and bay. Oaks comprise approximately one-half of the basal area, trees/acre, and trees greater than 5" DBH/acre in white oak woodlands. In tanbark oak woodlands, *Quercus spp.* (true oaks) comprise less than 20 percent of the basal area, trees/acre, and trees greater than 5" DBH/acre, but when including tanbark oak *(Lithocarpus densiflorus)* oaks then comprise 48 percent of basal area and number of trees per acre.

In the North Coast's oak forests, tanbark oak is predominant. Associated species include Douglas-fir, redwood, madrone, bay, canyon live oak and black oak. In tanbark oak forests, oaks provide 42 percent of the basal area and more than half of total trees greater than 1" DBH.

OAKS AT RISK IN THE NORTH COAST REGION

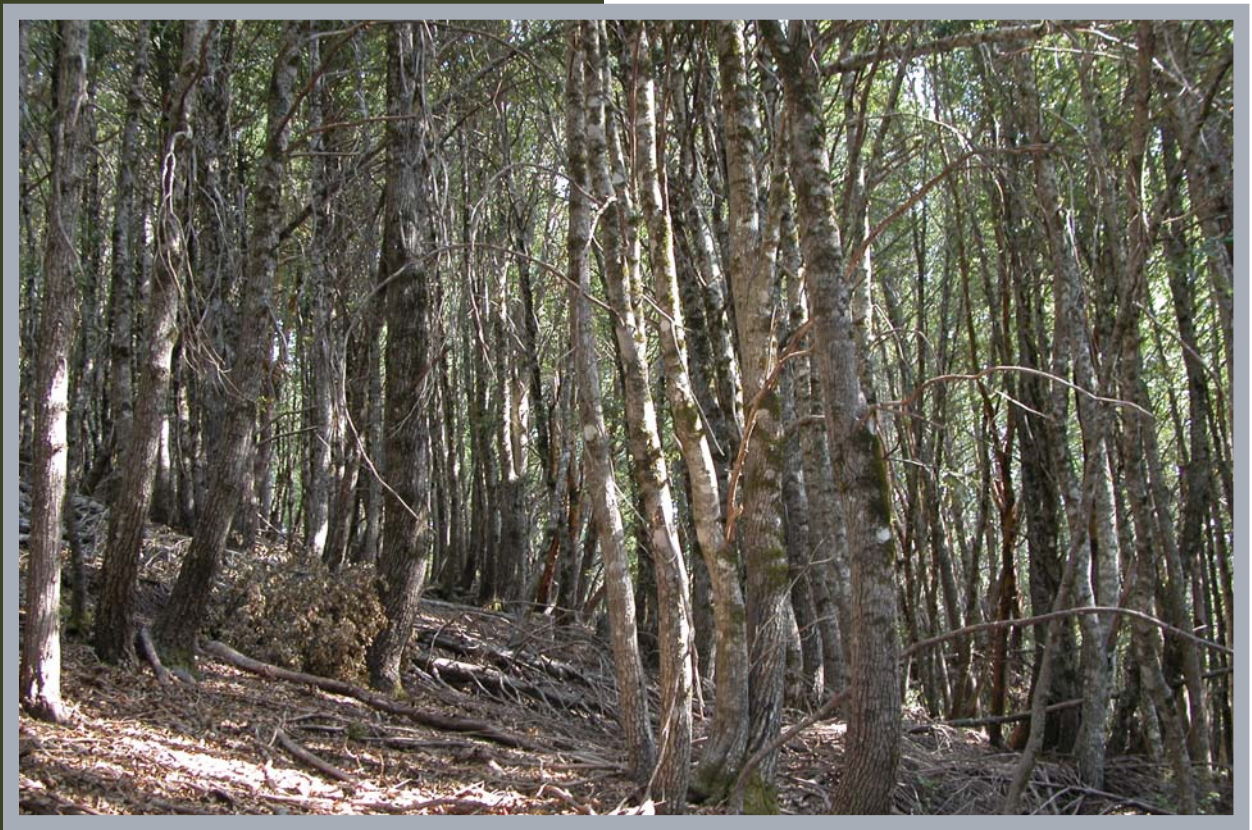
In terms of ownership, 84 percent of the North Coast's oak woodlands are located on private property. Most of the remainder is owned by the USFS and various other federal government agencies. Private ownership of oak woodland increases moving southward, ranging from 40 percent in Del Norte County to 95 percent in Sonoma County. Eight percent of North Coast oak woodlands have already been developed and four percent are at risk of near-time development. Nearly 90 percent of the oak woodlands are reasonably stable for the time being.

Sonoma County has experienced the most urbanization with 20 percent of oak woodlands developed and 10 percent at risk. Oak woodland development rates are relatively low in Del Norte and Humboldt counties with more than 95 percent of oak woodlands being stable for now. Mendocino County oak woodland is already five percent developed and another five percent is at risk of development before 2040.

Oaks 2040

North Interior Region

Lassen
Modoc
Shasta
Siskiyou
Trinity



Tanbark oak forest

North Interior Region

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

OAK DISTRIBUTION

Nearly one 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. With over 550,000 acres of oak woodland, Shasta County contains more than half of the region's totals. Trinity and Siskiyou Counties also contain large areas of oaks, with nearly 800,000 acres of oak forest and more than 400,000 acres of oak woodland in total. The North Interior has nearly 400 million oak trees, and 150 million of these oaks are greater than 5" DBH.

NORTH INTERIOR REGION OAK DIVERSITY

In this region, a balanced mixture of blue oak, black oak, canyon live oak and Oregon white oak woodlands is found. Blue oak woodlands typically include gray pine 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, and oaks make up 40 percent of the basal area and more than half of the trees greater than 5" 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" 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 and madrone. In black oak forests, oaks comprise one-fifth of the basal area. One-third of the trees greater than 5" DBH are oaks. In canyon live oak forests, one-third of the tree basal area is oaks and less than half of the trees greater than 5" 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. The USFS manages 33 percent and the Bureau of Land Management (BLM) manages six percent. Excluding Shasta County, oak woodland ownership is split roughly 50-50 between private and public; the USFS manages most of the public oak woodland. Shasta County's oak woodland ownership is 73 percent private, 20 percent USFS, and six percent BLM.

Ten percent of the region's oak woodland has already been developed. Three percent is at risk for development by 2040. Eighty-seven percent is unlikely to develop before 2040. Shasta County oak woodland is most at risk with fifteen percent having been developed and five percent more to be developed by 2040. Oak woodlands in Trinity, Siskiyou, Modoc and Lassen Counties are all less than five percent developed and less than one percent at risk.

Central Coast Region

Alameda

Contra Costa

Marin

Monterey

San Benito

San Francisco

San Luis Obispo

San Mateo

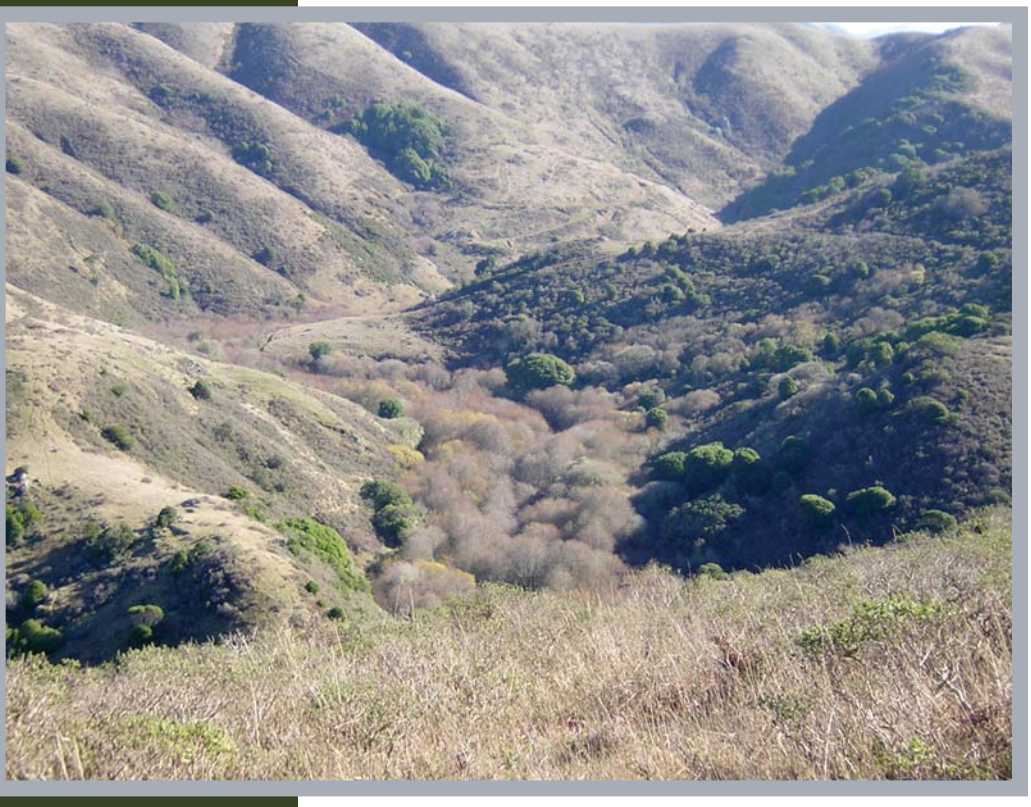
Santa Barbara

Santa Clara

Santa Cruz

Solano

Ventura



Coast live oak savannah in Marin County

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

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.

Four counties provide 75 percent of the Central Coast oak woodlands: Monterey, Santa Barbara, Santa Clara and San Luis Obispo. Oak woodlands comprise more than 20 percent of the area in Alameda, Monterey and Santa Clara counties. Santa Cruz County has more than 100,000 acres of forest oaks, and there are oaks present on over 50 percent of county land.

CENTRAL COAST OAK DIVERSITY

One-half of the Central Coast's oak woodland is coast live oak, and one-third is blue oak. Eighty percent of California's coast live oak woodland is in the Central Coast. Coast live oak woodland regularly includes bay trees, but oaks account for nearly 80 percent of the basal area in this oak type and over 90 percent of the trees greater than 10" in diameter. Blue oak woodland often includes coast live oaks.

Overall, more than 95 percent of trees in all size classes are oaks. Mixed oak woodlands include coast live oak and bay mixing with black and/or blue oaks. Oaks account for more than 60 percent of the basal area and more than 50 percent of the trees greater than 5" DBH in these stands. Thirty percent of the state's valley oak woodland is in the Central Coast, but 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 are dominant in tanbark oak forests, but oaks comprise 40 percent of the trees greater than 5" DBH and one-quarter of the basal area. Coast live oak forests often include canyon and/or interior live oak, with bay and redwood or Douglas-fir. Overall, oaks account for 10 percent of the basal area of oak forest stands and provide more than 20 percent of the trees greater than 5" DBH.

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. Another 15 percent is managed by the Los Padres National Forest, five percent by the US Military, and five percent by state and local governments. The Los Padres National Forest covers much of the oak woodlands in Ventura, Santa Barbara, San Luis Obispo and Monterey counties. Additionally, the BLM 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. Local ownership covers nearly 20 percent of oak woodland in Marin and Contra Costa 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 three percent is still at risk of development. Monterey County once again leads the way with 24,000 acres of oak woodland at risk, more than half of the region's total. Santa Clara, Santa Barbara, and San Luis Obispo counties are next on the list. Four percent of Monterey's oak woodlands are at risk, topped in the region only by Santa Cruz County at eight percent. In fact, more than three-quarters of Santa Cruz's oak woodlands have already been developed and less than 16 percent are currently in the stable category. Both of these figures are records for the state.

Sacramento Region

Butte

Colusa

El Dorado

Glenn

Lake

Napa

Nevada

Placer

Plumas

Sacramento

Sierra

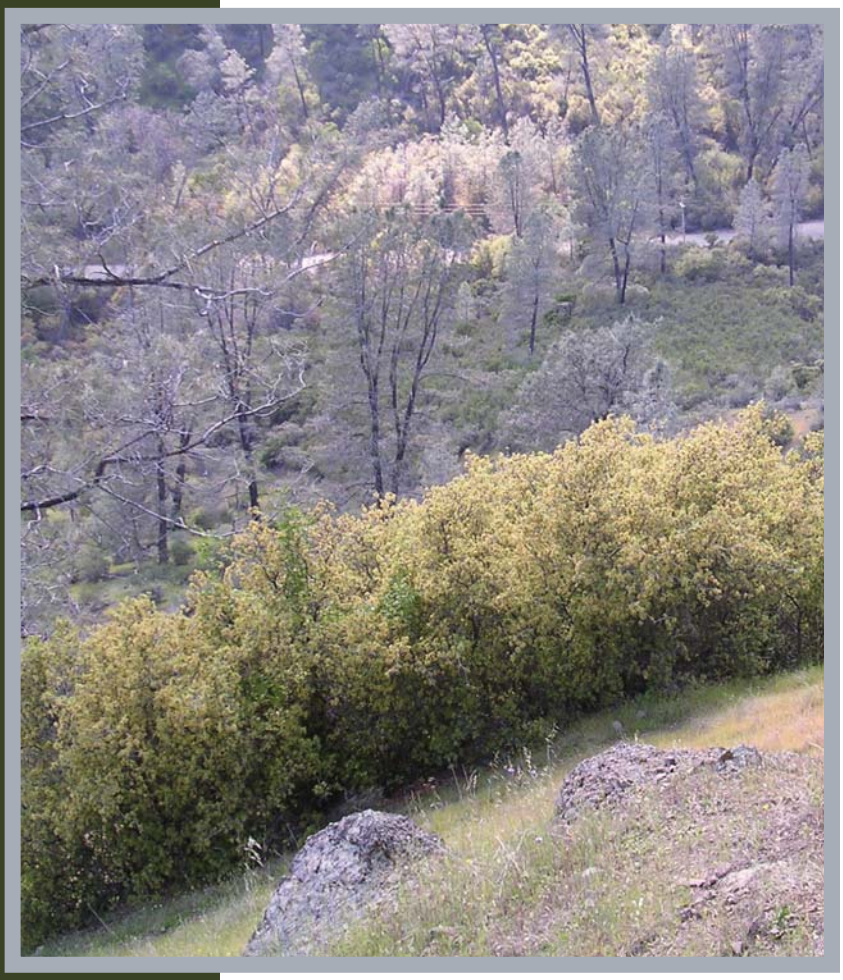
Solano

Sutter

Tehama

Yolo

Yuba



Mixed oak woodland dominated by gray pine

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

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.

Tehama County has more oak woodlands than any other county in the region, but large oak populations are found in many counties. Thirty-three percent of Napa County is covered by oak woodlands, giving it the greatest density of oak woodlands in the state. Tehama, Yuba, Lake and Nevada counties are each at least 20 percent covered by oak woodlands.

SACRAMENTO REGION OAK DIVERSITY

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" DBH. The region contains more than one-third of the state's blue oak woodland.

Interior live oak woodland contains blue oak, valley oak, black oak, gray pine, and ponderosa pine. Canyon live oak and black oak woodlands include Douglas-fir, ponderosa pine, and incense cedar. 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. Tehama County has the most blue oak, valley oak and canyon live oak woodland. El Dorado has the most interior live oak and black 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 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 USFS owns about 60 percent of the remaining public lands, including large portions of the oak woodlands in Plumas (81 percent), Sierra (74 percent), Glenn (28 percent), Placer (20 percent) and Lake (19 percent) counties.

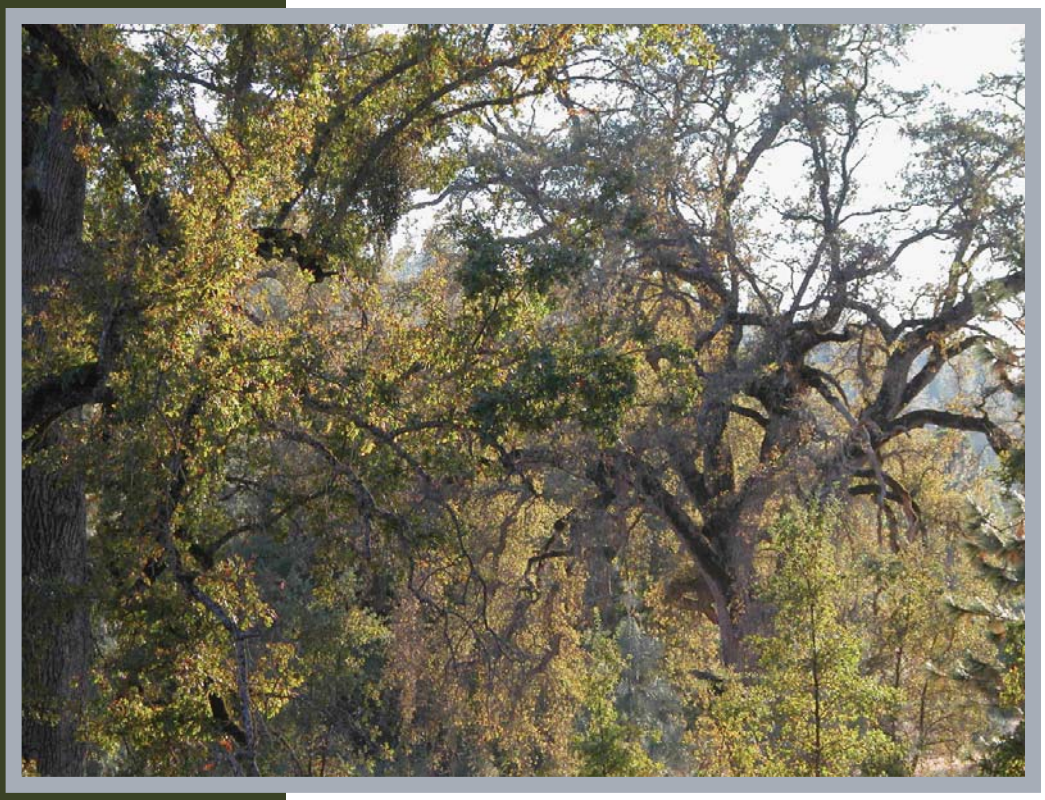
Private ownership of oak woodlands surpasses 80 percent in all other counties, topped off by Solano (98 percent), Yolo (97 percent), Sacramento (96 percent), Colusa (94 percent), and Napa (93 percent) counties.

The Sacramento region is more at risk of development than any other. Only two-thirds of its 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

Alpine
Amador
Calaveras
Fresno
Inyo
Kern
Kings
Madera
Mariposa
Merced
Mono
San Joaquin
Stanislaus
Tulare
Tuolumne



Valley oaks in Calaveras County

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

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 woodlands fall within these 15 counties. The San Joaquin region currently has more than 450 million oak trees. More than one-third of these oaks are larger than 5" DBH.

SAN JOAQUIN REGION OAK DIVERSITY

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 buckeye, 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 and 80 percent of the basal area and trees greater than 5" DBH. In interior live oak woodlands, oaks provide 70 percent of the tree basal area and more than 80 percent of all 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" DBH.

Canyon live oak and black oak comprise almost 90 percent of 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" 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 USFS owns 18 percent and BLM owns five percent. Ten percent of the oak woodlands in the region have already been developed. Ten 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

Imperial
Los Angeles
Orange
Riverside
San Bernardino
San Diego

Blue oak woodland in Machesna Mountain Wilderness, Los Padres National Forest

Southern Region

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

OAK DISTRIBUTION

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 two percent of the region. However, discounting urban areas and desert, oak woodland concentration is much higher. San Diego and Los Angeles counties collectively contain more than two-thirds of the Southern region's oak woodlands. San Bernardino County has the greatest area (90,000 acres) of oak forests in the region.

SOUTHERN REGION OAK DIVERSITY

Coast live oak and canyon live oak are most prevalent, but black oak and Engelmann oak populations are also significant. Eighty-five percent of the basal area is comprised of oaks. Ninety-two percent of the trees greater than 5" DBH are oaks and 96 percent of the trees greater than 1" DBH are oaks. The rare Engelmann oak is found only within this region, mostly in San Diego County. Los Angeles County is home to the majority of the region's blue oak and valley oak woodlands.

Canyon live oak and black oak dominate in the Southern region's oak forests. These oaks mix with Coulter pine, Jeffrey pine, incense cedar and white fir.

Oaks comprise less than 50 percent of the basal area but more than 80 percent of the trees and 65 percent of the trees greater than 5" DBH.

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. USFS owns 44 percent of the region's oak woodlands. Eleven percent of oak woodlands are owned by other government agencies, and 45 percent are privately owned. The land ownership patterns within this region are variable. The oak woodlands in San Diego and Orange counties are predominantly privately-owned, but the USFS owns most of the oak woodlands in San Bernardino, Riverside and Los Angeles counties.

Twenty percent of the Southern region's oak woodlands have already been developed. Ten 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. Only the Sacramento region has a lower percentage of oak woodlands that are considered stable.

Riverside and San Diego counties lead the region with almost 20 percent of their oak woodlands at risk. Both Orange and Los Angeles counties have already had over 20 percent of their oak woodlands developed.

San Diego and Orange counties have the lowest percentages of stable oak woodland with 65 percent in each county. San Bernardino tops the list with 78 percent stable for the time being.

Oaks 2040

Post-fire black oak regeneration in Mendocino National Forest

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APPENDIX A – TABLE ONE: ACRES OF COVER WHERE OAKS DOMINATE THE WOODLAND 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*
North Coast	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
North Interior	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
Central Coast	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
Sacramento	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
San Joaquin	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
Southern	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 – TABLE TWO: 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*
North Coast	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
North Interior	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
Central Coast	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
Sacramento	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
San Joaquin	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
Southern	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

Oak Type	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

Oak Type	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.

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Oaks

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