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2018 Aerial Survey Results: California

Forest Health Monitoring Program • 1731 Research Park Drive, Davis, CA 95618
www.fs.usda.gov/detail/r5/forest-grasslandhealth

Forest Service
Pacific Southwest Region
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COVER PHOTO

Relatively intense tanoak and scattered white fir mortality west of Alder Peak, Monterey Ranger District.

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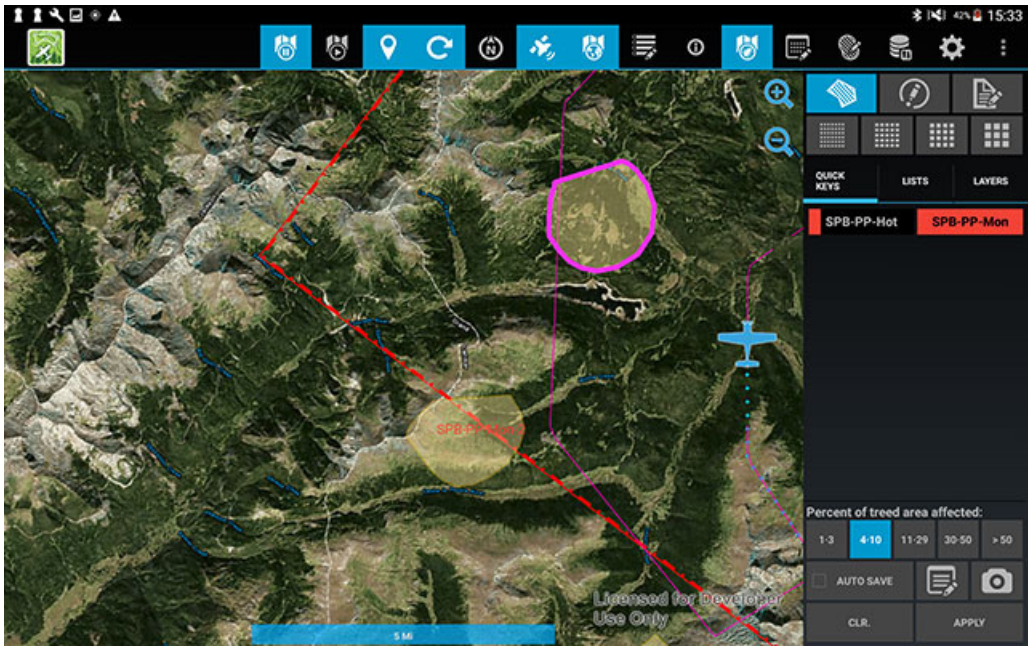

Photo of the Digital Mobile Sketchmapping System (DMSM) used to record tree mortality and damage data

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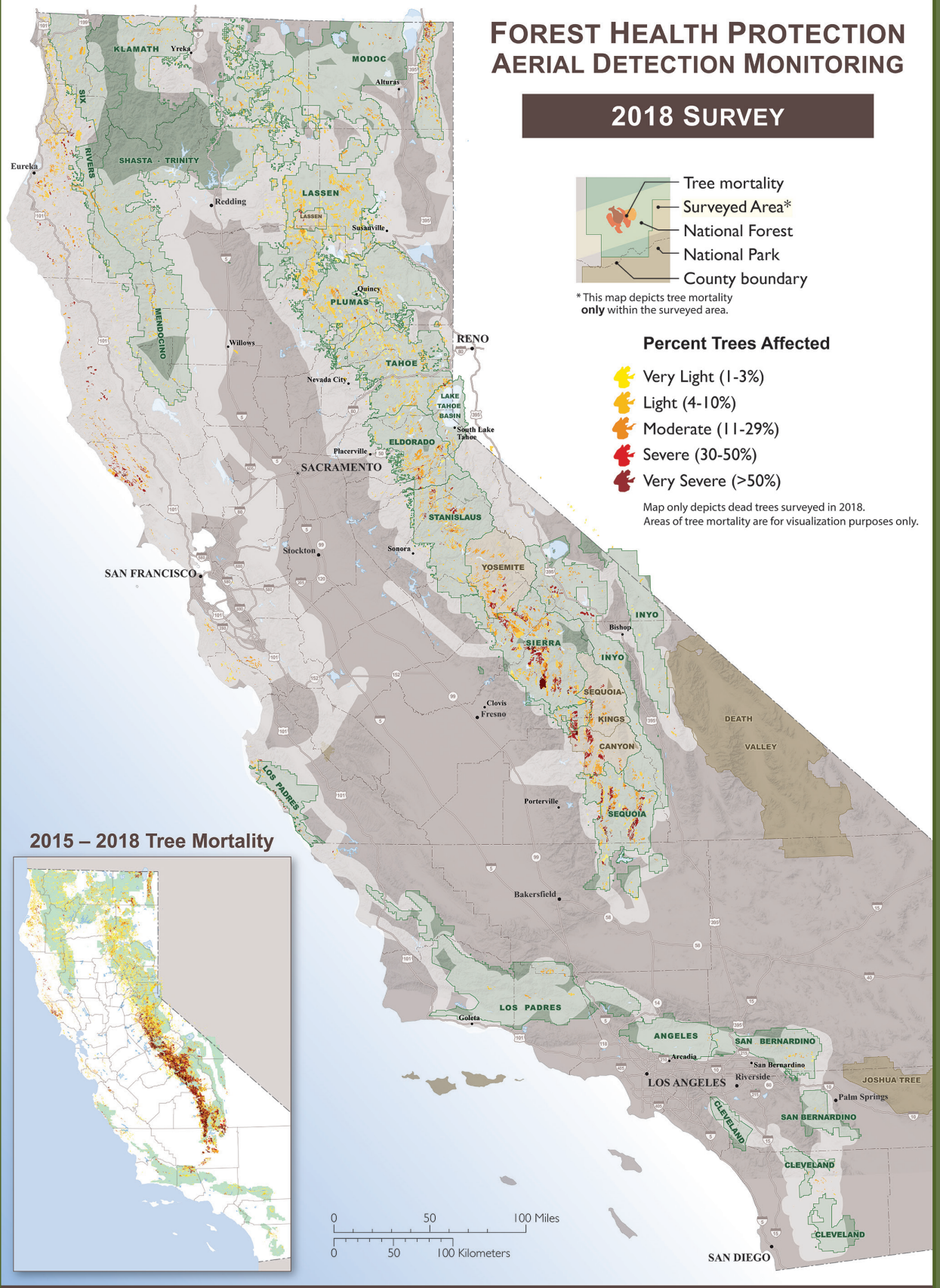

FOREST SERVICE

February 4, 2019

Overview

US Forest Service (USFS), Pacific Southwest Region, State and Private Forestry staff conduct annual aerial surveys throughout forested areas of California to detect recent tree mortality and current tree damage, such as defoliation or branch flagging. Surveys are flown in small, fixed-wing aircraft on a 4-5 mi grid pattern with 2 observers recording from opposite sides of the plane. Most national forests and parks in California are surveyed, along with other federal, state, and private lands. For the 2018 flight season, approximately 37 million acres were surveyed. Elevated levels of tree mortality were recorded on ~2 million acres, totaling an estimated 18 million dead trees, mostly California red or white fir. Some level of mortality was recorded on 801,000 acres not previously recorded in recent years; primarily in fir and tanoak-dominated forests.

Most of the mortality recorded in 2018 was strongly correlated to lingering effects of the recent drought (2012-2016) and subsequent successful bark beetle attacks, which resulted in a total of ~142 million dead trees since 2012, mostly in lower elevations and principally pine.

Surveys were primarily flown from July - September. Some surveys were delayed due to wildfires and poor visibility. Some flight lines were greater than the standard 4-mi grid, and some areas were not flown in 2018, most notably western portions the Klamath NF.

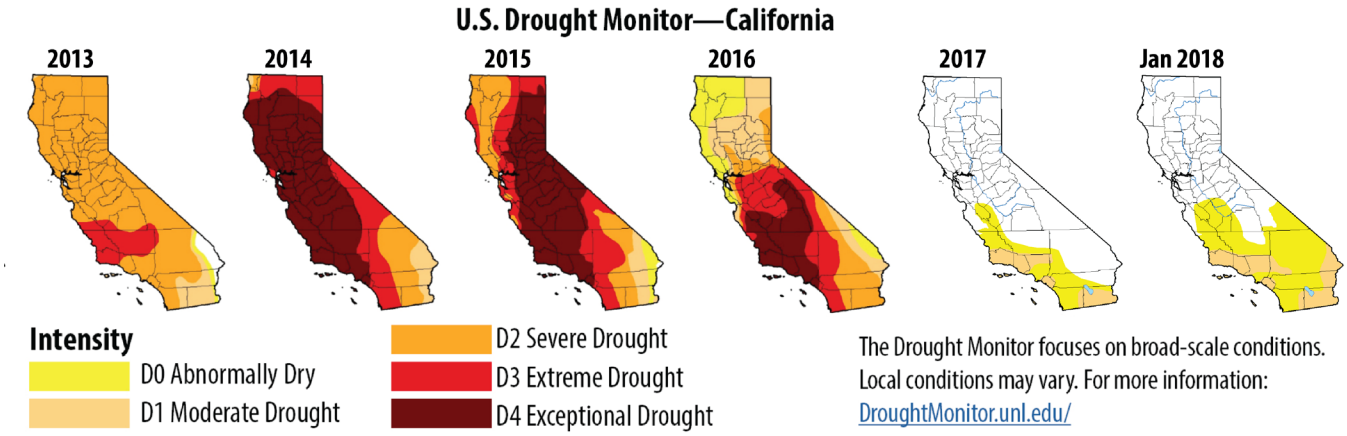

Figure 1. The U.S. Drought Monitor maps of 2013 through early January 2018 illustrate the severity of the drought event in California. Maps are presented from the last water year report date in September. D1 is the least intense drought level and D4 the most intense; D0 areas are not in drought. A full description of each drought severity classification is available from the U.S. Drought Monitor website. Source: U.S. Drought Monitor

Background

2010 to 2016 was the worst drought in CA recorded history, so intense and prolonged the USGS created a new classification of drought called exceptional. In 2015-2016 most of central CA fell into this category and is where the bulk of the high levels of tree mortality occurred.

The drought was broken during the winter of 2016-2017 with an average of ~170% of normal precipitation received, primarily in the northern part of the state, followed by the 2017-2018 winter which was near normal. California red and white fir trees unable to recover from the higher precipitation levels continued to die into 2018, primarily from overstocked stand conditions and fir engraver beetle attacks. Tanoak mortality associated with sudden oak death greatly increased in 2018 as a result of the wetter conditions since 2016.

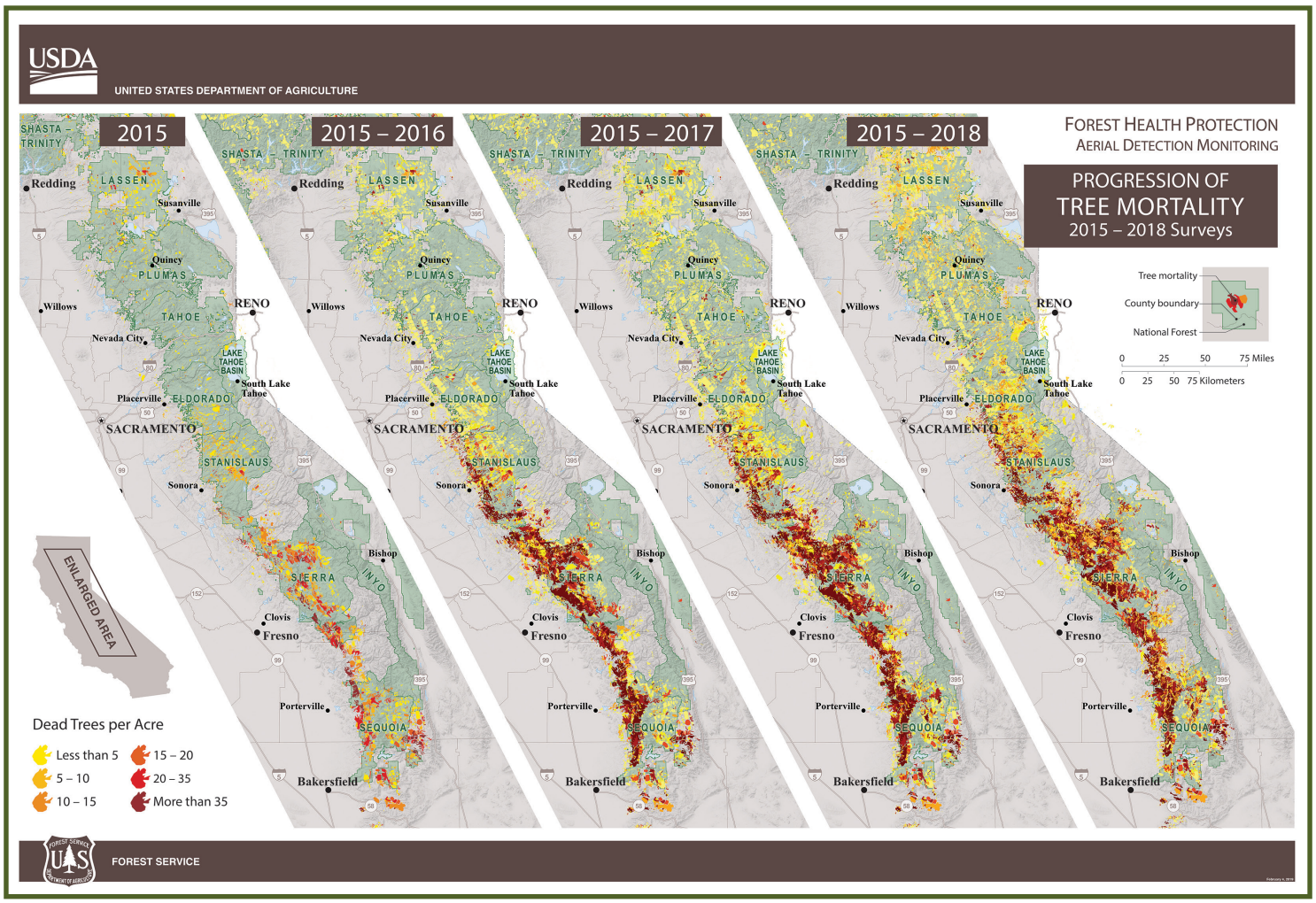

Figure 2. This map shows the cumulative progression of drought induced mortality in the most impacted areas of the Sierra Nevada range of California from 2015-2018. Map on the far right depicts the cumulative mortality over the preceding four years.

Highlights

Acres reported below may be noted in more than one bullet as multiple damaging agents often occur in the same location. Additionally, although acres reported had some elevated level of mortality, not all host trees in any given area were killed.

Bark Beetles and Wood Borers

Fir mortality attributed to fir engraver beetle (*Scolytus ventralis*) comprised over 75% of the total tree mortality observed in 2018. Approximately 14 million dead firs were recorded across 1.4 million acres, compared to ~23 million dead fir trees across 2 million acres in 2017.

- White fir (*Abies concolor*) mortality was widespread throughout its range and was closely correlated with overstocked stand conditions and recent drought.
- California red fir (*Abies magnifica*) mortality was most widespread and intense in the southern Sierra Nevada range, but moderate levels of mortality were also detected further north. Mortality was routinely detected in very high remote wilderness areas.

Note: Red and white fir often occur together in mixed conifer mid-elevation stands and can be difficult to differentiate from the air in these conditions.

Overall pine mortality attributed to mountain pine beetle (*Dendroctonus ponderosae*) decreased from an estimated more than one million dead trees across 113,000 acres in 2017 to ~500,000 dead trees across 50,000 acres in 2018. However, increases in mortality were observed in limber and western white pine.

- Whitebark pine (*Pinus albicaulis*) decreased from ~99,000 trees across 18,000 acres to ~40,000 trees across 6,000 acres in 2018.
- Lodgepole pine (*Pinus contorta*) mortality decreased from an estimated 754,000 trees across 63,000 acres in 2017 to 270,000 trees across 34,000 acres in 2018
- Sugar pine (*Pinus lambertiana*) mortality decreased from ~136,000 trees across 15,000 acres in 2017 to ~18,000 trees across 3,000 acres in 2018.
- Limber pine (*Pinus flexilis*) mortality increased from ~95,000 trees across 17,000 acres in 2017 to ~200,000 trees across 12,000 acres in 2018.
- Western white pine (*Pinus monticola*) mortality increased from ~300 trees across 1,000 acres in 2017 to ~800 trees across 200 acres in 2018.

Western pine beetle (*Dendroctonus brevicomis*)-related pine mortality decreased to ~950,000 dead trees across 166,000 acres; a significant decrease from the ~4 million dead trees across 330,000 acres recorded in 2017. Ponderosa pine (*Pinus ponderosa*) accounted for most of this mortality.

- Coulter pine (*Pinus coulteri*) mortality decreased from ~41,000 dead trees across 7,000 acres in 2017 to ~9,000 trees across 2,000 acres in 2018.

Jeffrey pine (*Pinus jeffreyi*) mortality attributed to Jeffrey pine beetle (*Dendroctonus jeffreyi*) decreased from ~1.4 million dead trees across 139,000 acres in 2017 to ~753,000 dead trees across 99,000 acres in 2018

Goldspotted oak borer (*Agrilus auroguttatus*) related oak mortality in San Diego County decreased in 2018 to ~11,000 dead trees across 3,700 acres, down from ~16,000 dead trees across 5,700 acres in 2017. However, this may be an underrepresentation since new areas of activity are being reported further north.

Knobcone pine (*Pinus attenuata*) mortality attributed to California flatheaded borer (*Melanophila californica*), although likely multiple agents are involved, decreased from ~21,000 trees across 4,000 acres in 2017 to ~11,000 across 2,000 acres in 2018.

Mortality of ~7,000 pinyon pine trees (*Pinus Monophyla*) attributed to pinyon ips (*Ips confusus*) across 700 acres was recorded primarily on the east side of the Sierra Nevada range.

Douglas-fir (*Pseudotsuga menziesii*) mortality (not attributed to bear damage) increased to ~107,000 dead trees across 32,000 acres, up from ~42,000 dead trees across 18,000 acres in 2017.

Diseases

Tanoak (*Notholithocarpus densiflorus*) mortality attributed to sudden oak death (*Phytophthora ramorum*) increased to ~1.6 million dead trees across 106,000 acres, up from ~214,000 dead trees across 18,000 acres in 2017. Mortality generally increased in extent and severity in most infested coastal areas likely associated with the wetter conditions in 2017.

Defoliation/Dieback

Dieback and defoliation of quaking aspen (*Populus tremuloides*) was observed across 5,000 acres in the eastern Sierra Nevada range and east of the Warner Mountains (Modoc County).

Acres with Mortality and Estimated Number of Dead Trees by Forest

National Forest	Acres	Dead Trees
Angeles National Forest	700	9,000
Cleveland National Forest	700	4,000
Eldorado National Forest	72,000	571,000
Humboldt-Toiyabe National Forest	6,000	29,000
Inyo National Forest	47,000	574,000
Klamath National Forest	34,000	172,000
Lake Tahoe Basin Management Unit	14,000	94,000
Lassen National Forest	184,000	686,000
Los Padres National Forest	14,000	125,000
Mendocino National Forest	32,000	131,000
Modoc National Forest	83,000	869,000
Plumas National Forest	125,000	523,000
Rogue River National Forest	3,000	10,000
San Bernardino National Forest	8,000	42,000
Sequoia National Forest	142,000	2,404,000
Shasta-Trinity National Forest	64,000	259,000
Sierra National Forest	206,000	3,712,000
Six Rivers National Forest	38,000	213,000
Stanislaus National Forest	75,000	671,000
Tahoe National Forest	94,000	387,000

Acre and tree counts throughout this report have been rounded to the nearest thousand

Acres with Mortality and Estimated Number of Dead Trees by County

County	Acres	Dead Trees
Alameda	300	600
Alpine	6000	45,000
Amador	15,000	99,000
Butte	37,000	193,000
Calaveras	22,000	211,000
Colusa	1,000	4,000
Contra Costa	0	0
Del Norte	41,000	152,000
El Dorado	75,000	614,000
Fresno	170,000	3,504,000
Glenn	7,000	28,000
Humboldt	138,000	1,172,000

County	Acres	Dead Trees
Inyo	13,000	82,000
Kern	20,000	114,000
Lake	8,000	18,000
Lassen	116,000	440,000
Los Angeles	600	7,000
Madera	86,000	1,145,000
Marin	1,000	15,000
Mariposa	47,000	585,000
Mendocino	44,000	532,000
Modoc	82,000	914,000
Mono	25,000	424,000
Monterey	12,000	169,000
Napa	10	300
Nevada	32,000	113,000
Orange	50	2,000
Placer	65,000	304,000
Plumas	193,000	726,000
Riverside	1,000	3,000
San Benito	0	0
San Bernardino	9,000	49,000
San Diego	4,000	26,000
San Luis Obispo	1,000	13,000
San Mateo	4,000	27,000
Santa Barbara	1,000	6,000
Santa Clara	7,000	72,000
Santa Cruz	8,000	31,000
Shasta	88,000	338,000
Sierra	69,000	273,000
Siskiyou	102,000	442,000
Solano	0	0
Sonoma	44,000	847,000
Stanislaus	0	0
Tehama	40,000	165,000
Trinity	47,000	234,000
Tulare	200,000	3,709,000
Tuolumne	91,000	731,000
Ventura	4,000	26,000
Yolo	0	0
Yuba	3,000	19,000

Acre and tree counts throughout this report have been rounded to the nearest thousand