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U.S. DEPARTMENT OF AGRICULTURE

2025 Aerial Detection Survey Results: California

State & Private Forestry, Region 5
Forest Health Monitoring Program
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COVER PHOTO
Ongoing oak mortality likely caused by goldspotted oak borer in Southern California taken in 2024 with similar findings in 2025. Notice it is mostly older gray dead trees killed in prior years and so not recorded again.
Photo by: U.S. Forest Service

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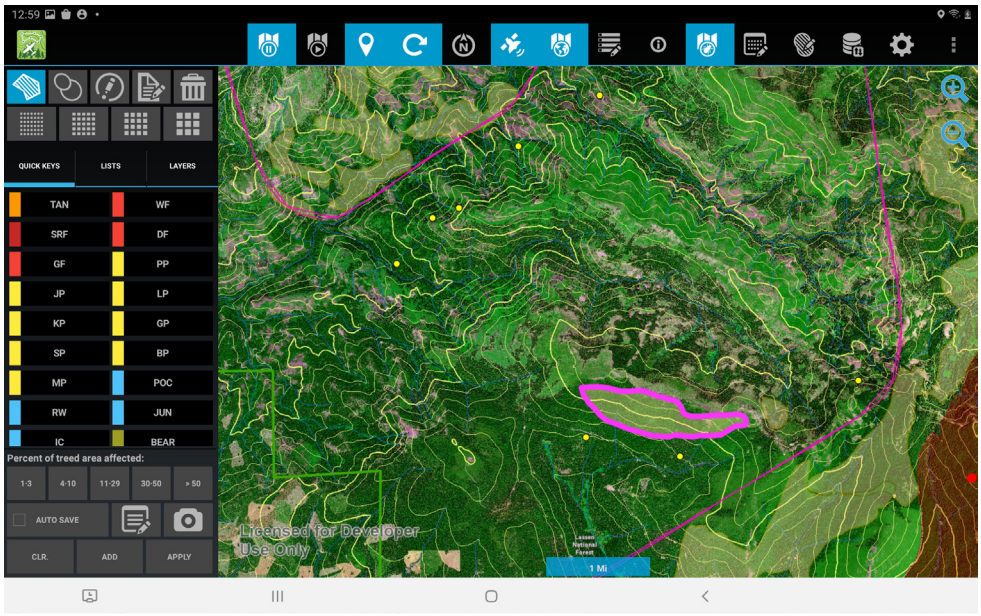

Screenshot of the Digital Mobile Sketchmapping System used to record tree mortality and damage data

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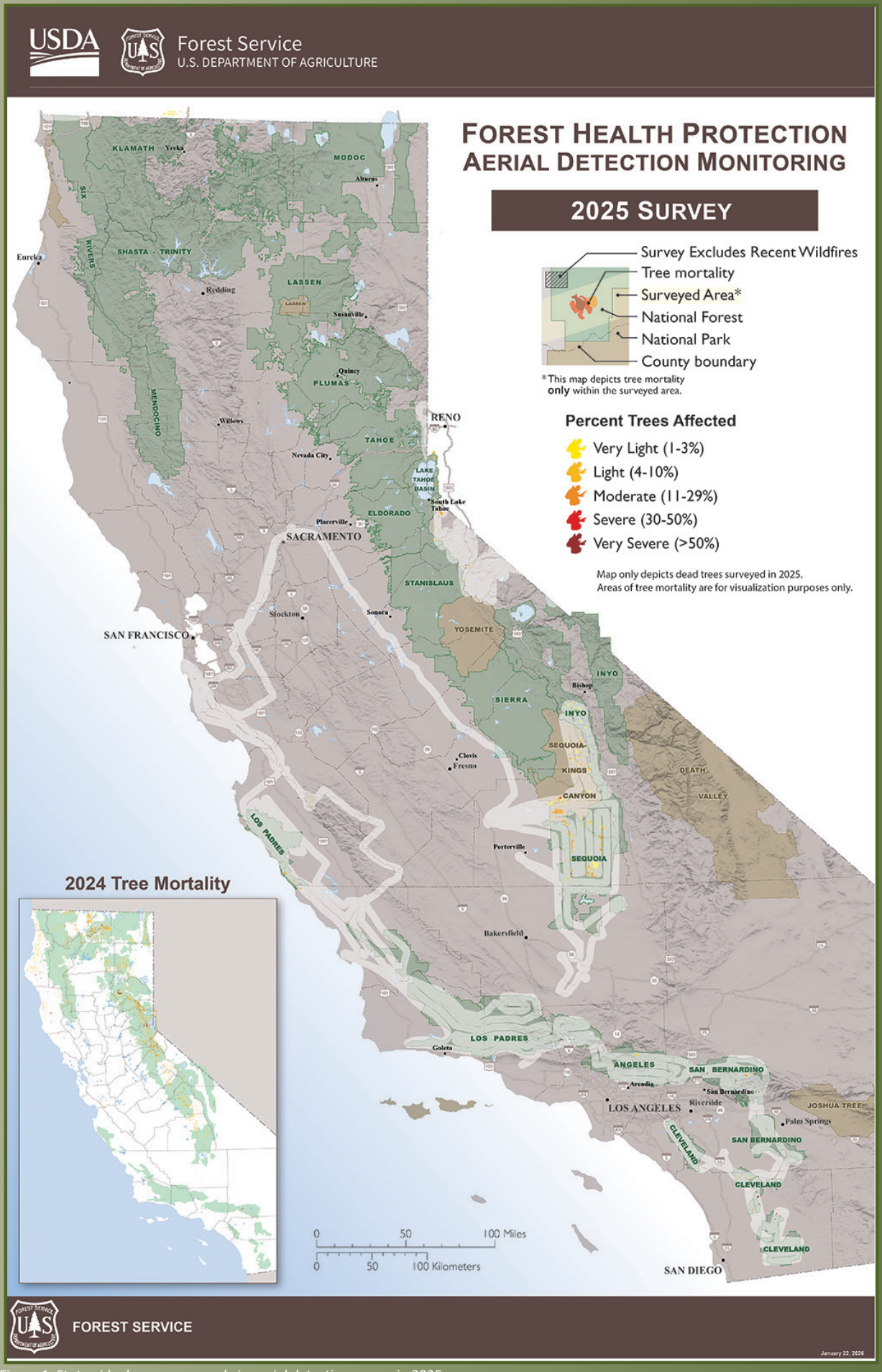

Figure 1. Statewide damage mapped via aerial detection survey in 2025.

Overview

The U.S. Forest Service, Pacific Southwest Region, State & Private Forestry staff conduct annual aerial detection surveys throughout forested areas of California to detect tree mortality and tree damage such as defoliation or dead/dying branches. Surveys are flown in small, fixed-wing aircraft on a 4–5-mile grid pattern with two observers recording from opposite sides of the plane. Most national forests and national parks in California are typically surveyed, along with other federal, state, and private forested lands. This report summarizes observations from the 2025 aerial detection survey. Approximately 9.8 million acres were surveyed during the 2025 flight season (June–July) approximately 10-15 percent of typical coverage (Figure 1).

Elevated levels of tree mortality (i.e., more than one percent of forested area affected) were recorded on approximately 44,000 acres, totaling an estimated 6.7 million dead trees. Most of the trees killed were recorded as fir (*Abies* spp.), followed by whitebark pine (*Pinus albicaulis*), Jeffrey pine (*P. jeffreyi*), and other pine species (*Pinus* spp.). Despite this, mortality occurred at lighter intensities and in smaller affected areas compared to the past few years.

Elevated levels of tree mortality can be attributed, in part, to the ongoing effects of long-term, intermittent, exceptional drought conditions and subsequent successful bark and engraver beetle attacks. These cumulative effects have resulted in an estimated 253 million trees killed since 2010 (Figure 2).

Drought Conditions

The exceptional drought of 2011 to 2017 was prolonged and concentrated in central California with associated tree mortality occurring primarily in the southern Sierra Nevada Range. In contrast, the 2020-2022 exceptional drought was much shorter in duration but was one of the hottest, driest three-year periods on record[1], concentrated primarily in north central California. Associated tree mortality was most intense and widespread in the northern Sierra Nevada Range (primarily Plumas to Tuolumne counties) and the northern interior of the state (primarily Siskiyou, Shasta, Trinity, Tehama, and Glenn counties). Unlike the previous exceptional drought, where the early mass die-off occurred primarily in low elevation pine, mortality in California has primarily impacted fir since 2018.

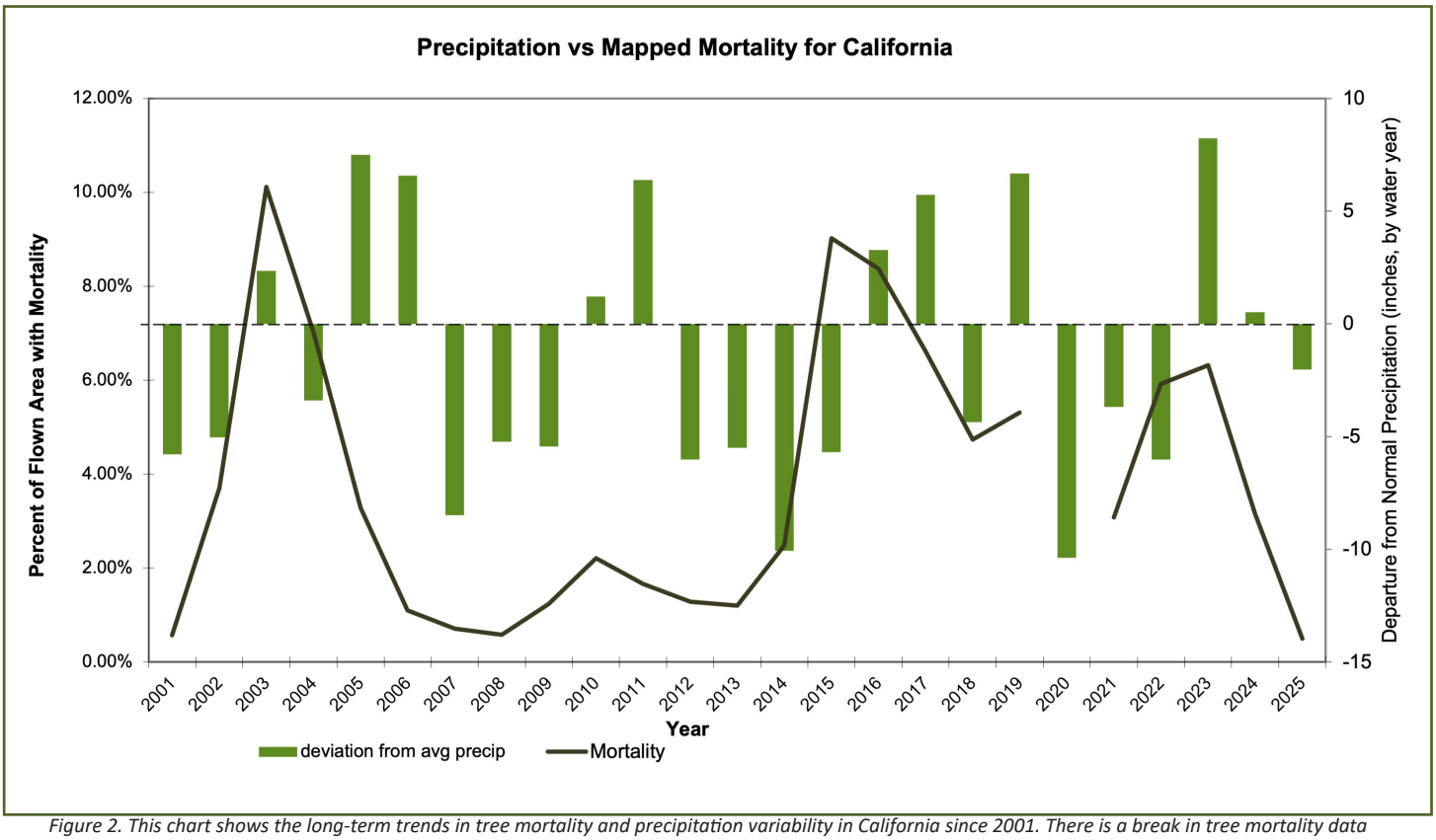

Figure 2. This chart shows the long-term trends in tree mortality and precipitation variability in California since 2001. There is a break in tree mortality data for 2020 because aerial survey was not flown that year due to COVID-19 restrictions.

1 https://water.ca.gov/News/News-Releases/2022/Oct-22/New-Water-Year-Begins-Amid-Preparations-for-Continued-Drought

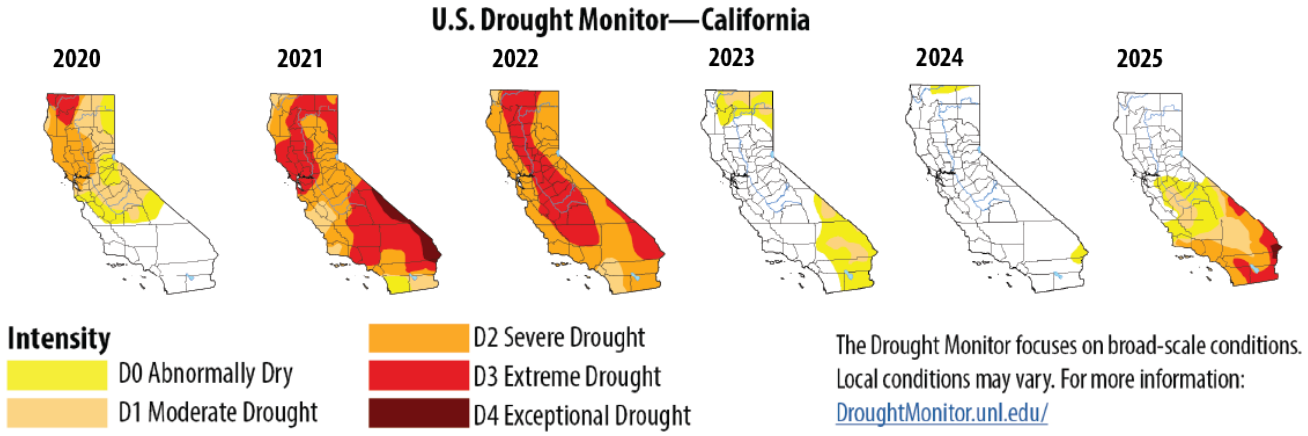

Figure 3. The U.S. Drought Monitor maps of 2020 through 2025 illustrate the severity, range, and ebb and flow of drought in California over the past six years. Maps are presented from the report date in April of each year. D1 is the least intense drought level and D4 the most intense; D0 areas are not in drought. A full description of each drought severity classification is available from the U.S. Drought Monitor. Source: U.S. Drought Monitor

Despite multiple short-term drought episodes since 2022, California has generally had normal to above normal precipitation for at least three to four years (Figure 3), and associated tree mortality has fallen consistently each consecutive year. This longer-term drought reprieve has not occurred in California since 2013. The status of California's forest health is largely unknown for 2025 since most areas were not surveyed by aerial detection survey, however other monitoring efforts and field reports can be found here.

Though much of California's forests have been weakened by chronic drought and other stressors, mortality along with beetle pressure has generally declined starting in 2022. Reduced competition from mortality incurred during these mortality events should also favor surviving tree health, even though vast forested areas are still overcrowded, primarily due to fire exclusion.

Methodology

Recent tree mortality and damage was mapped on a mobile device by aerial observers flying in a small, fixed wing aircraft at about 1,000' above ground level (AGL). Aerial observers primarily search for visibly dried and discolored foliage, typically yellow to reddish brown. The following information was collected for each area with tree mortality or damage: a) damage type (mortality, top kill, defoliation, branch flagging, die back or discoloration), b) percent of area affected (see below for severity scale), c) affected tree species or genus and d) probable damage agent (root disease, bark beetles, etc.). Not all trees in reported acres are dead or damaged. Typically, most trees are still healthy.

Tree mortality and damage was recorded on a severity scale based on the percent of trees affected within a given area. Severity of mortality and damage was classified as follows:

Very Light (1-3% of mapped area affected), Light (4-10%), Moderate (11-29%), Severe (30-50%) and Very Severe (>50%).

Surveyors visually detect current tree damage, such as defoliation via the red coloring of chewed, dried foliage and recent mortality by the red or yellow color of the existing foliage on the tree. When a tree dies, it typically appears green and healthy until dry hot conditions ensue. This is known as a "lag effect" and mortality recorded in 2024 likely occurred in summer to fall 2023. Mortality is not recorded once foliage fades to gray or falls off the tree.

Note: Aerial detection survey is a systematic overview survey accomplished over 2-3 months in the summer, often in difficult mountainous terrain. Damage is sometimes missed.

Below we report the estimated number of acres affected, the severity of mortality or damage, and estimated number of trees affected within those areas (rounded as appropriate).

Acres of mortality or damage may be noted in more than one point, as multiple damage types, damage causal agents, and/or species affected can occur in the same location.

State Highlights

Elevated levels of tree mortality (i.e. more than 1% of forested area affected) caused primarily by insects or diseases were recorded on approximately 44,000 acres. Most of the dead trees were recorded as fir (*Abies* spp.), followed by whitebark pine (*P. albicaulis*), yellow pine (*P. ponderosa*, *P. jeffreyi*, *P. coulteri*), redwood (*Sequoia sempervirens*), and tanoak (*Notholithocarpus densiflorus*).

Bark Beetles and Wood Borers

- California/Shasta red fir (*A. magnifica*, *A. magnifica* var. *shastensis*) and white fir (*A. concolor*) comprised more than 71% of the tree mortality recorded in 2025. Within areas surveyed both years, mortality increased from an estimated 120,000 trees across 24,000 acres in 2024, to an estimated 160,000 trees across ~33,000 acres recorded in 2025.
  - White fir mortality has been widespread throughout much of its range for many years but more recently the intensity has generally been light to moderate and associated with heavily stocked mixed conifer stands. In 2025, mortality was much less widespread in the areas surveyed but locally had higher severities.
  - Red fir mortality has generally occurred throughout much of its range in mature, pure, high-elevation stands at light to severe intensities. Mortality has been most intense and widespread in the Central Sierra Nevada Range where the most recent drought was most exceptional; these areas were not surveyed in 2025. In areas surveyed, activity was reduced from ~160,000 trees across 21,000 acres in 2024 to ~115,000 trees across 24,000 acres with mortality in 2025 occurring in higher elevations of the southern Sierra Nevada Range.

  Note: Red and white fir often occur together in mixed conifer mid-elevation stands and can be difficult to differentiate from the air.
- In the surveyed areas, pine mortality attributed to western pine beetle (*Dendroctonus brevicomis*) increased slightly to ~7,800 trees across 1,200 acres recorded in 2025 compared to ~7,300 trees across 990 acres with mortality in 2024. Mortality primarily occurred in the southern Sierra Nevada Range on the Sequoia National Forest.
- In the surveyed areas, pine mortality attributed to mountain pine beetle (*D. ponderosae*) remained elevated with an estimated 29,000 trees across 8,800 acres compared to ~24,000 trees across 5,200 acres in 2024. Mortality was primarily in lodgepole pine (*P. contorta*) and primarily located west of Kennedy Meadows within the Sequoia NF. Single tree and small group mortality of whitebark pine was commonly detected in eastern high elevation areas of Sequoia-Kings Canyon NP and northern Inyo NF. Most of the ranges for both species were not surveyed in 2025.
- Mortality of high-elevation five-needle pine (i.e. whitebark, limber (*P. flexilis*), western white (*P. monticola*), and foxtail (*P. balfouriana*)) in the surveyed areas increased from an estimated 5,000 trees across 1,000 acres with mortality in 2024 to ~7,400 trees across 5,400 acres in 2025. Whitebark pine was the most heavily impacted species though single trees and small groups of western white pine mortality were not uncommon. The elevated levels of high-elevation pine mortality in recent years is concerning since these trees are very long lived, difficult to replace, and provide critical food and shelter for many alpine species.
- Jeffrey pine mortality attributed to Jeffrey pine beetle (*D. jeffreyi*) or *Ips* spp. remained unchanged across the surveyed areas with ~2,000 acres with mortality in both 2024 and 2025. Mortality was common throughout its range in 2024 but was greatly reduced in Southern California in 2025.
- Goldspotted oak borer (*Agrilus auroguttatus*)-caused oak (*Quercus* spp.) mortality increased to an estimated 4,500 dead trees across 710 acres in 2025 compared to ~1,700 dead trees across 660 acres in 2024. Most mortality detected via aerial survey again occurred in and near the Palomar Ranger District on the Cleveland National Forest (San Diego County). Additionally, oak mortality within the northern Trabuco Ranger District continues to increase.
- Pinyon pine (*P. monophylla*) mortality attributed to *Ips* spp. decreased from ~160 acres with mortality in 2024 to a few single trees and small groups of mortality in 2025 totaling ~110 trees across 4 acres. Multiple years of non-drought conditions has resulted in only background rates of mortality of this species.
- Douglas-fir (*Pseudotsuga menziesii*) mortality caused by flatheaded fir borer (*Phaenops drummondi*) was not recorded in 2025 since it is not known to occur in the areas surveyed. An estimated 55,000 dead trees across 16,000 acres were recorded in 2024, mostly in the greater Redding area (Shasta County) and to a lesser extent along the northern Coast Range, both of which exhibited severe mortality in 2022 and closely correlated where recent drought conditions were also exceptional.

Defoliation

- Fir defoliation caused by Douglas-fir tussock moth (*Orgyia pseudotsugata*) or western/Modoc budworm (*Choristoneura* spp.) and lodgepole pine defoliation caused by lodgepole needleminer (*Coleotechnites milleri*) were not recorded in 2025. Areas where previous years' defoliation outbreaks occurred were not surveyed. Further information can be obtained in previous years' Aerial Survey Reports.

Diseases

- Tanoak mortality attributed to sudden oak death (*Phytophthora ramorum*) has been historically low in recent years as generally dry spring weather has inhibited the spread of this invasive disease. The wet spring of 2022 and ensuing field reports in 2023 indicated significant new infections. But detection of whole tree mortality was not elevated in 2023 or 2024, and most of this habitat type was not surveyed in 2025. However, all areas of the south bay and central coast were surveyed and indicate continued low incidences of mortality in those areas. An estimated 4,900 dead trees across 550 acres were detected in 2025 compared to ~12,000 dead trees across 870 acres in 2024.

Drought

- Though still rare, an unusually high incidence of scattered single tree redwood mortality was recorded in several coastal areas of the southern Bay Area. Causal agents are unknown, but drought may be a factor.
- Three years of exceptional drought conditions (2020-2022) caused large scale mixed conifer (white fir, Douglas-fir, ponderosa pine, knobcone pine (*P. attenuata*), and incense-cedar (*Calocedrus decurrens*) mortality in the north interior of California in 2023 which lingered into 2024. It is unknown how this situation progressed since none of these areas were surveyed in 2025.

Acres with Mortality and Estimated Number of Dead Trees by Forest (2025)

National Forest	Acres	Dead Trees
Angeles National Forest	1,100	2,800
Cleveland National Forest	1,200	27,000
Eldorado National Forest	430	18
Humboldt-Toiyabe National Forest	4,800	22,000
Inyo National Forest	7,800	14,000
Klamath National Forest	3,300	2,900
Lake Tahoe Basin Management Unit	1,800	4,200
Los Padres National Forest	940	6,900
Rogue River-Siskiyou National Forest	270	240
San Bernardino National Forest	1,100	5,600
Sequoia National Forest	22,000	76,000
Six Rivers National Forest	1	13
Stanislaus National Forest	82	40
Tahoe National Forest	49	180

The numbers of acres and trees throughout this report have been rounded as appropriate.
* Includes acreages outside of California, but within the National Forest boundary.

Acres with Mortality and Estimated Number of Dead Trees by County (2025)

County	Acres	Dead Trees
Alameda County	1	11
Alpine County	3,500	14,000

County	Acres	Dead Trees
Amador County	1	2
Calaveras County	1	15
Contra Costa County	1	6
Del Norte County	1	14
El Dorado County	270	380
Fresno County	4,300	9,300
Inyo County	4,900	4,900
Kern County	200	1,500
Los Angeles County	1,100	2,800
Madera County	1	12
Mariposa County	1	17
Mono County	930	5,000
Monterey County	720	6,400
Orange County	2	54
Placer County	15	13
Riverside County	11	230
Sacramento County	1	6
San Benito County	78	37
San Bernardino County	1,100	5,600
San Diego County	1,600	41,000
San Luis Obispo County	190	1,500
San Mateo County	59	5,100
Santa Barbara County	160	420
Santa Clara County	55	500
Santa Cruz County	28	160
Sierra County	270	2,300
Siskiyou County	1	21
Tulare County	39,000	164,000
Tuolumne County	74	23
Ventura County	52	140

The numbers of acres and trees throughout this report have been rounded as appropriate.

Citatation

Williams, A.P., Cook, B.I. & Smerdon, J.E. Rapid intensification of the emerging southwestern North American mega-drought in 2020–2021. Nat. Clim. Chang. 12, 232–234 (2022). https://doi.org/10.1038/s41558-022-01290-z