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Research Brief for Resource Managers

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The effects of prolonged drought on vegetation dieback and megafires in southern California chaparral

Keeley, J.E., Brennan, T.J., Syphard, A.D. 2022. The effects of prolonged drought on vegetation dieback and megafires in southern California chaparral. Ecosphere 2022; e4203. https://doi.org/10.1002/ecs2.4203

In a new study, USGS scientists and partners have found extensive drought-caused dieback in Southern California shrublands that subsequently burned in large wildfires, which suggests the need for considering current dieback estimates in predictions of fire hazard.

In Southern California, a large portion of the landscape is dominated by chaparral shrublands. Many of California's most destructive wildfires occur in chaparral. Fires that burn in chaparral have historically been high-severity fires driven by the region's Santa Ana winds, and the proximity of chaparral to major population centers means more human-caused ignitions and greater risks to people and infrastructure.

Previous research has found that dead plant biomass can contribute to fire spread in multiple ways. Understanding where dieback is most likely to occur can help managers identify areas most vulnerable to high-intensity fire and assess the role of drought-induced wildfire in fire spread.

Management Implications

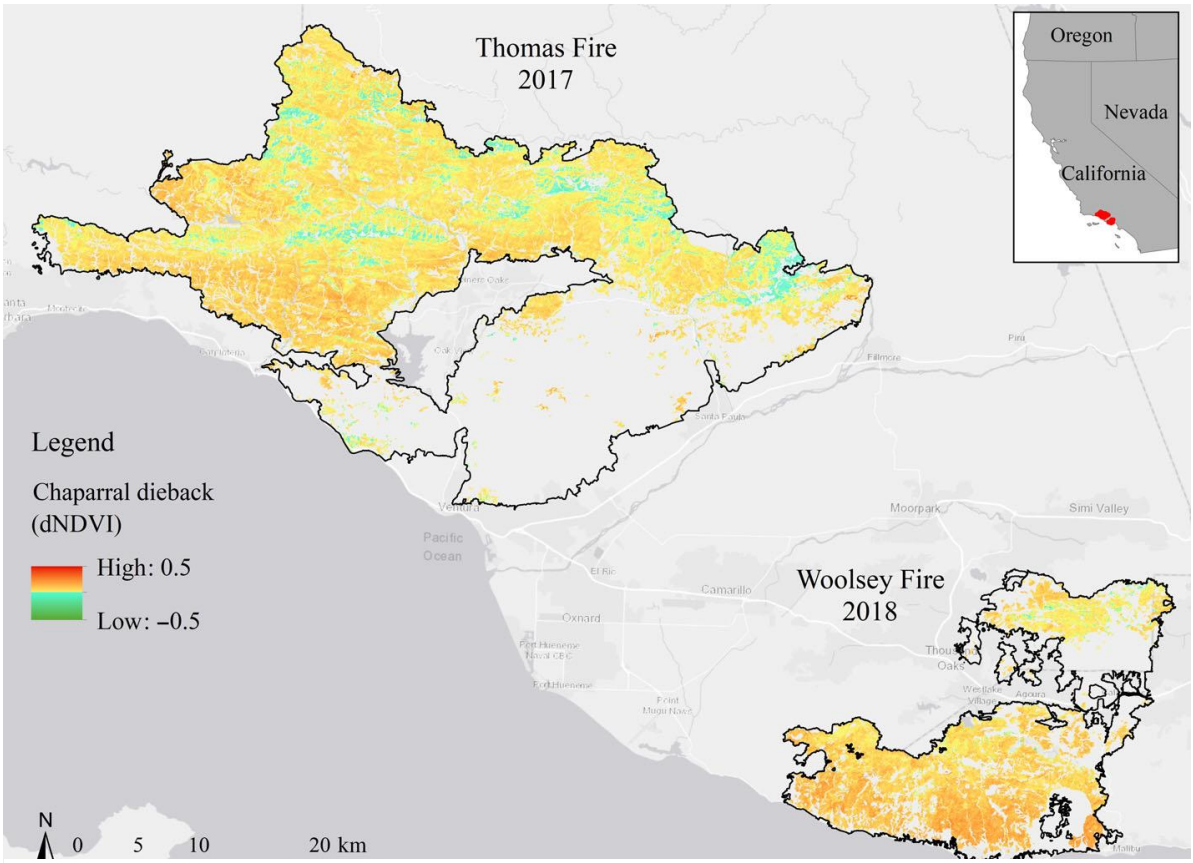
- Drought-induced dieback was extensive in chaparral areas that later burned in the Thomas and Woolsey fires and was likely a major contributor to the size of these fires.
- Current fire danger indices for the region do not incorporate drought-caused dieback, instead using stand age as an estimate of dead fuels. The study highlights the potential importance of drought-induced dieback in chaparral and suggests that existing fire danger indices may be inaccurate.
- The highest levels of dieback were found at lower elevations, a particular concern because low-elevation chaparral is often adjacent to urban environments, where ignition sources are common and infrastructure is most at risk.

To investigate dieback in Southern California during the drought, the researchers compared aerial imagery from 2010, prior to the start of the drought, and 2016, several years into the drought. They used a measure of "greenness", the Normalized Differential Vegetation Index, to determine the extent of live vegetation in each year. By comparing the amount of live green vegetation before and after years of drought, the researchers could calculate how

much of the shrubland had died. Because dead chaparral is thought to drive higher intensity wildfire, the study focused on the areas within the perimeters of two major recent wildfires, the 2017 Thomas Fire and the 2018 Woolsey Fire.

Results indicated that some level of dieback had occurred in 93% of chaparral plots within the fire perimeters in the drought years before the fires. Modeling studies show that the likely ways in which dieback affects fire size is by increasing the rate of fire spread due to wind driven embers that ignite spot fires ahead of the fire front.

These results suggest managers should pay closer attention to shrub dieback in predicting fire hazard. Fire hazard indices generally use long-term averages for dieback and this study shows the need for incorporating up-to-date dieback estimates in predicting current fire hazards.



Chaparral dieback within the 2017 Thomas Fire and 2018 Woolsey Fire perimeters, calculated as the difference in mean annual normalized difference vegetation index (NDVI) between 2010 and 2016 (difference in NDVI [dNDVI]), California, USA. Positive values indicate a decrease in live vegetation plus other human disturbances that reduced the amount of live biomass. (From Keeley et al. 2022)