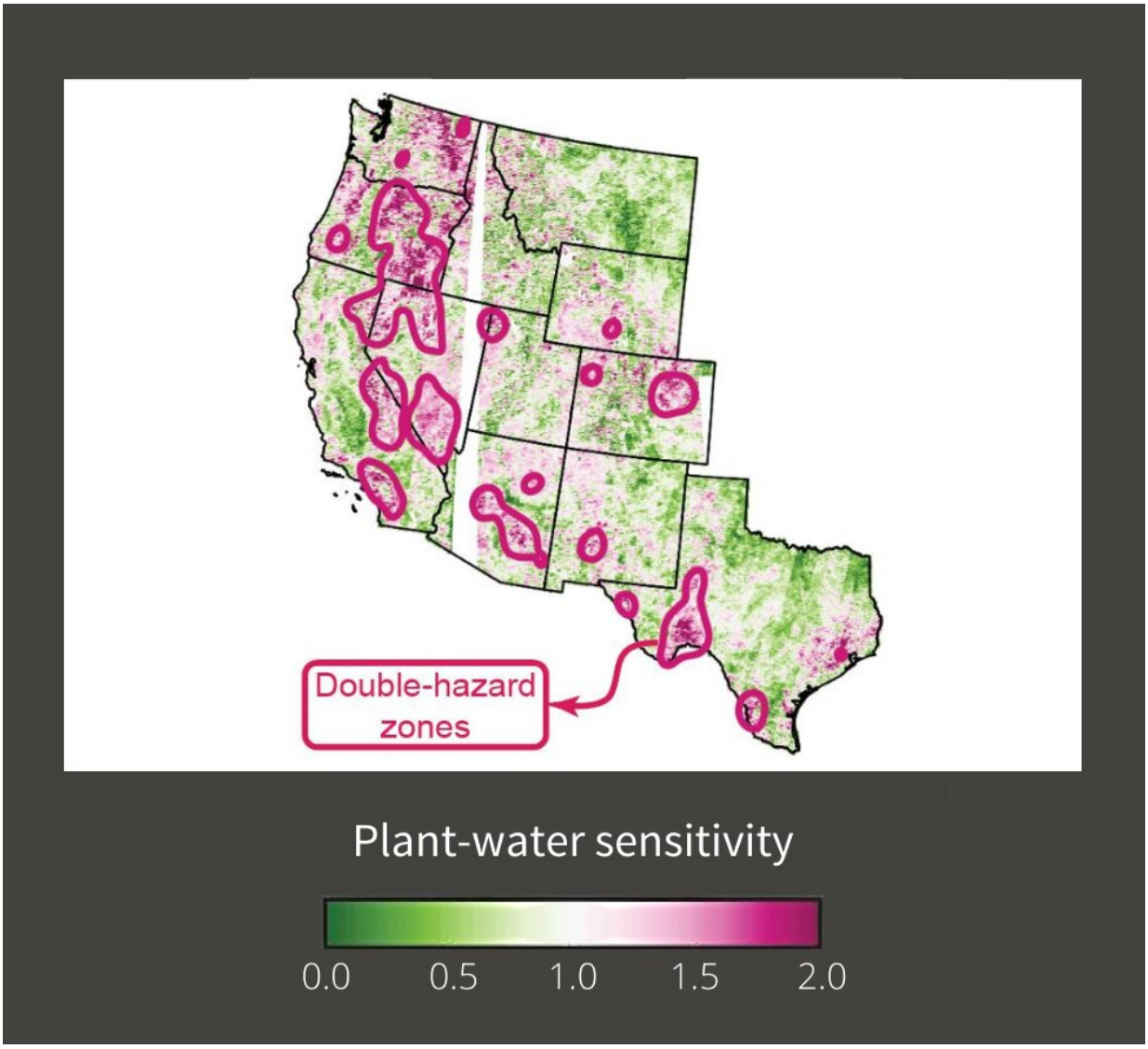
Researchers identify 'double-hazard' zones for wildfire in the West

February 7 2022, by Josie Garthwaite



In 18 zones of the U.S. West, plant water sensitivity is high (>1.5), and the vapor pressure deficit is rising faster than average. Because both factors increase fire

hazards, the overlaps are likely to amplify the effect of climate change on burned areas. Credit: Adapted from Rao et al, 2021, *Nature Ecology and Evolution*

Some plants and patches of Earth withstand heat and dry spells better than others. A new Stanford University study shows those different coping mechanisms are closely linked to wildfire burn areas, posing increasing risks in an era of climate change.

The results, published Feb. 7 in *Nature Ecology and Evolution*, show swaths of forest and shrublands in most Western states likely face greater fire risks than previously predicted because of the way local ecosystems use water. Under the same parched conditions, more acreage tends to burn in these zones because of differences in at least a dozen plant and soil traits.

The study's authors set out to test an often-repeated hypothesis that climate change is increasing wildfire hazard uniformly in the West. "I asked, is that true everywhere, all the time, for all the different kinds of vegetation? Our research shows it is not," said lead author Krishna Rao, a Ph.D. student in Earth system science.

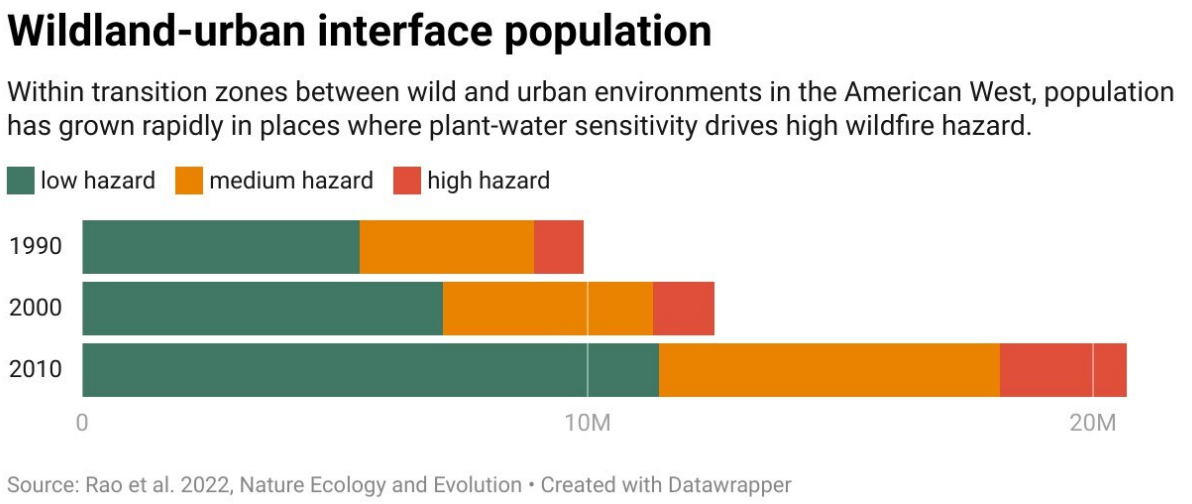
'Double-hazard' zones

The study arrives as the Biden administration prepares to launch a 10-year, multibillion-dollar effort to expand forest thinning and prescribed burns in 11 Western states.

Previous research has shown that climate change is driving up what scientists call the vapor pressure deficit, which is an indicator of how much moisture the air can suck out of soil and plants. Vapor pressure deficit has increased over the past 40 years across most of the American

West, largely because warmer air can hold more water. This is a primary mechanism by which global warming is elevating wildfire hazards.

The new analysis, which comes from the lab of Stanford ecohydrologist Alexandra Konings, suggests vapor pressure deficit is rising fastest in areas where plants are especially prone to drying out. The combination of highly sensitive, tinder-dry plants and a faster-than-average increase in atmospheric dryness creates what the authors call "double-hazard" zones.



Within transition zones in the Western U.S. where homes and wilderness intermix, population has grown rapidly in places where plant-water sensitivity drives high wildfire hazards. Credit: Adapted from Rao et al, 2021, *Nature Ecology and Evolution*

The 18 newly identified double-hazard zones lie within regions that have seen a disproportionately rapid rise in burn area with every uptick in vapor pressure deficit over the past two decades. Ranging in size from a

few hundred to nearly 50,000 square miles, they're concentrated in eastern Oregon, Nevada's Great Basin, central Arizona's Mogollon Rim and California's southern Sierra Nevada, where recent wildfires have destroyed thousands of giant sequoia trees that had survived fires for hundreds of years.

According to the authors, the results suggest the distribution of vegetation across the West—that is, the arrangement of scrub, alpine meadows, sagebrush, coniferous forest and other plant communities from the Pacific Coast to the western fringe of the Great Plains—has "amplified the effect of climate change on wildfire hazard" in the region, specifically, the amount of acreage burned.

"California and other Western states are working hard to figure out how to adapt to the changing wildfire risk landscape, including long-term decisions around issues such as land use, vegetation management, disaster planning and insurance," said study co-author Noah Diffenbaugh, the Kara J Foundation Professor and Kimmelman Family Senior Fellow at Stanford and a senior fellow at Stanford Woods Institute for the Environment. "There's a wealth of information in this analysis to support decisions about how to more effectively manage the risks of living in the West in the context of a changing climate."

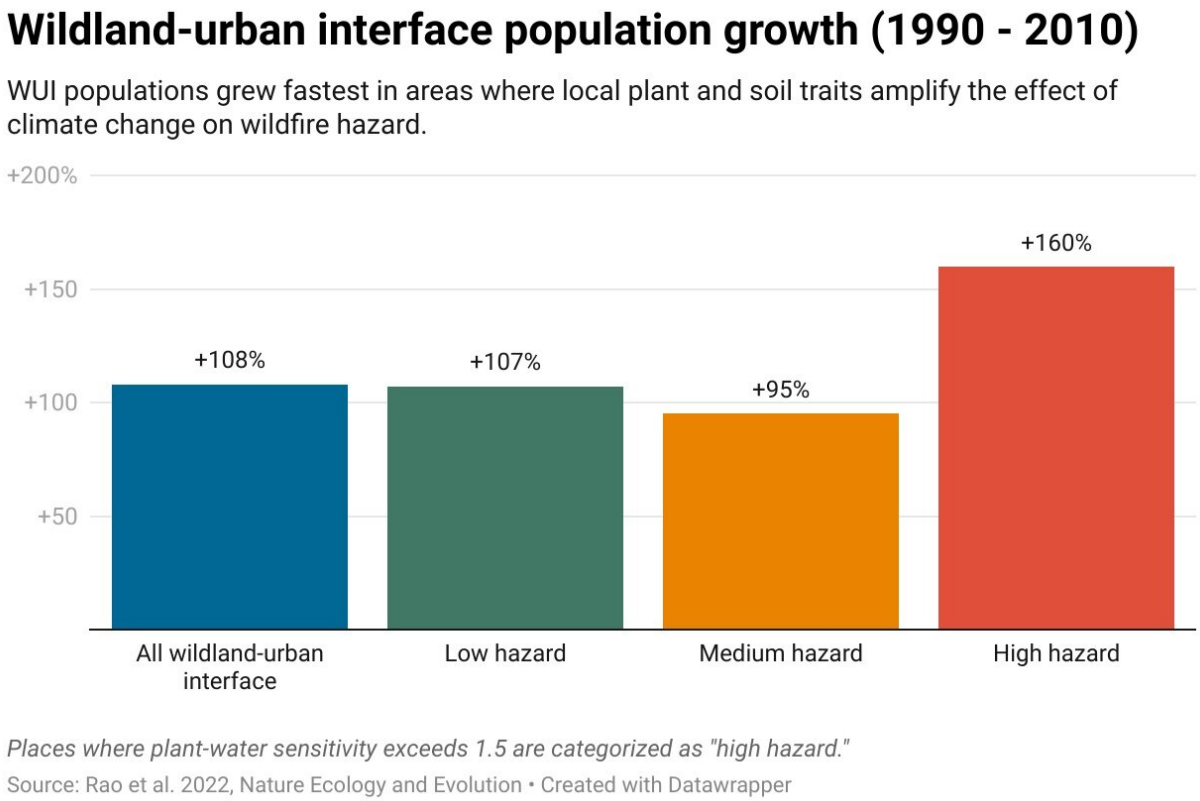
Plant-water sensitivity

Plant physiologists and ecologists, not to mention farmers and home gardeners, have long understood that plants rarely act in unison. "Each plant is different, each species is different and the geography of a place defines how a plant's moisture level responds to different environmental conditions," Rao explained.

But models for calculating wildfire risk at landscape scale generally don't account for the diversity of drought responses, "in part because it's really

difficult," said Konings, who is the study's senior author and an assistant professor of Earth system science at Stanford's School of Earth, Energy & Environmental Sciences (Stanford Earth). "It's very labor-intensive to measure how much an ecosystem is drying out, and it's difficult to predict without those direct measurements because it depends on what kind of soil you have, the topography and what kinds of plants."

To solve this problem, the scientists used satellite data to create a new metric they call plant-water sensitivity. It combines plant and soil hydraulic traits that affect the moisture content of vegetation, such as how much water the soil can hold, how easily water moves through the soil when saturated and root depth.



Wildland-urban interface populations grew fastest in areas where local plant and

soil traits amplify the effect of climate change on wildfire hazards. Credit: Adapted from Rao et al, 2021, *Nature Ecology and Evolution*

The authors used artificial intelligence, statistical analysis and microwave remote sensing data to show that this measure of local vulnerability to drying out in the face of limited rainfall and an arid atmosphere is tightly linked to increases in wildfire burn area with a drying climate in forests and shrublands. In grasslands, they found annual burned area did not increase much with vapor pressure deficit, suggesting that other factors such as fuel availability, ignitions, the plants' growth stage and strong winds may play a bigger role. They then used census data to track the population rise in vulnerable regions.

Disproportionate growth

The underlying causes for catastrophic wildfires that have scorched so much of the American West in recent years are complex, including not only climate change but also decades of fire suppression and growing populations along the periphery of undeveloped wilderness—a transition zone sometimes called the wildland-urban interface or WUI.

In California alone, more than 11 million of the state's 40 million residents live in the WUI, which encompasses not only densely forested areas like Paradise—a northern California town destroyed in the deadly 2018 Camp Fire—but also parts of the wooded coastal foothills around Silicon Valley, the brush-and-grass covered hills around Santa Barbara and Los Angeles, and neighborhoods in the Oakland hills, just a few miles east of the San Francisco Bay.

Throughout the WUI, in Western states and beyond, people provide the vast majority of ignitions for fires that then torch the abundant

vegetation and threaten human lives and structures. Simply having more people and homes nestled among flammable trees, chaparral and grasses add to wildfire risks.

The new research underscores how unevenly climate change is amplifying those risks. It also shows that communities within the WUI are booming in the very places where ecosystems are most sensitive to drought, having added an estimated 1.5 million people between 1990 and 2010. Populations in parts of the WUI with high plant-water sensitivity have grown 50 percent faster than the West's wildland-urban interface overall, the study finds.

According to Konings, "This redoubles the need to be thinking about what we can do to reduce wildfire impacts in the WUI in general, including for this subgroup of people who are in the most vulnerable locations."

More information: Krishna Rao et al, Plant-water sensitivity regulates wildfire vulnerability, *Nature Ecology & Evolution* (2022). DOI: 10.1038/s41559-021-01654-2

Provided by Stanford University

Citation: Researchers identify 'double-hazard' zones for wildfire in the West (2022, February 7) retrieved 25 June 2024 from https://phys.org/news/2022-02-double-hazard-zones-wildfire-west.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.