

# California's most iconic trees are entering a silent collapse that could remake forests, rangelands and coastlines

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Coast redwoods, like those found throughout the UC Santa Cruz campus, fall under the IUCN Red List as "endangered," which the new study affirmed. Credit: University of California—Santa Cruz

From the scarecrow-like silhouettes of Joshua Tree National Park to the fog-shrouded Redwood Coast of Mendocino and Humboldt counties, California's identity is deeply rooted in its trees. However, a new study led by researchers at the University of California, Santa Cruz, warns that these foundational species are in much more trouble than international conservation rankings estimate.

The [study](#), published in *Global Change Biology*, reveals that over the next century, California's endemic and near-endemic trees are projected to lose between half and three-quarters of their climatically suitable habitat.

Perhaps most strikingly, the research demonstrates that the trees' current conservation status on the globally authoritative International Union for Conservation of Nature (IUCN) Red List doesn't yet reflect this imminent risk.

Using "[climate-informed](#)" assessments, researchers from UC Santa Cruz's Department of Ecology & Evolutionary Biology found that even under the most conservative climate-change forecasts, most species qualify for higher Red List threat levels than their current status.

The Red List is the global authority on species extinction risk, but does not have the regulatory authority of U.S. federal or state endangered species laws.

One of these species is the blue oak, an iconic tree commonly found in California's inland foothills and rangelands—as seen throughout the recently established Strathearn Ranch Natural Reserve in San Benito County.

[Blue oaks](#) are an important cultural and food species for many Indigenous tribes. Ranchers also depend on these trees because they provide shade for cattle and nutrient cycling. They stabilize soils to

prevent erosion, keep carbon out of the atmosphere, and provide homes to hundreds of other animals—as well as improve property values.

"If you lose a blue oak woodland, you'll generally be left with an invasive grassland," said Blair McLaughlin, a climate change adaptation scientist at UC Santa Cruz and lead author of the study. "The old-growth blue oak woodlands have been here for centuries, so they are a connection to a time before the full impacts of European settlement."

## **The 'backbone' of California ecosystems**

The study focused on 27 "foundational" species: trees that define the structure and function of the state's forests, woodlands, and savannas. "These trees are the backbones of our ecosystems," McLaughlin explained. "They grow nowhere else in the world and provide the essential habitat that native wildlife and humans alike depend on."

The findings are a wake-up call for anyone who treasures the California landscape. The loss of these trees could dramatically change the places people love. Well-known species like the Western Joshua tree, blue oak, and foxtail pine are projected to lose more than half of their climatically suitable habitat by as early as 2055.

Under high-loss scenarios, which reflect present global-emission trajectories, 40% of the species studied could face a complete loss of suitable habitat within their current ranges by the end of the century.



The blue oak, an iconic tree found only in California and seen across the state's inland ranges and hills, is far more vulnerable to climate change than is reflected by its current status on the International Union for Conservation of Nature's "Red List," according to a new climate-informed risk-assessment framework developed by UC Santa Cruz researchers. Credit: Nick Gonzales

## **Bridging a gap between models and reality**

A novel aspect of this study is its "ground-truthing." The research team didn't just rely on computer models—they cross-referenced projections with field-observed data on tree mortality and recruitment.

"We found a clear relationship between the risk our models projected and the demographic shifts we are already seeing on the ground," said

the study's senior author, Erika Zavaleta, professor of ecology and evolutionary biology. Also a member of the California Fish and Game Commission, Zavaleta emphasized that the study's findings are not just theoretical.

"In many cases, the projected responses—higher mortality and lower recruitment in warmer, drier areas—are documented as already happening."

This is particularly evident in what previous research has termed "[zombie forests](#)," which are stands of adult trees that appear healthy but can no longer produce seedlings in the current climate. These living relics are destined to vanish once the current generation dies off, unless conservation measures are implemented.

## **A new map for conservation**

The study used heatmaps to identify "hotspots" of both risk and resilience across the state. Regions like the Sierra Nevada foothills, the eastern edge of the San Francisco Bay Area, and the Transverse Range north of Los Angeles are projected to see the most significant declines in highly vulnerable foundational species.

Conversely, parts of the [Central Coast](#), the north San Francisco Bay, and higher elevations of the Sierra Nevada could serve as critical climate refuges where these species have the best chance of persistence.

The researchers urge conservationists to consider these maps to complement other knowledge to prioritize land acquisition and conservation strategies. McLaughlin explained how "persistence hotspots" are ideal for protecting places where vulnerable species are likely to thrive longer—whereas "loss hotspots" are where increased monitoring, protection of local refugia, and conservation of genetic

resources would be beneficial.

"We need new approaches to address this emerging conservation problem that climate change is creating," McLaughlin said. "Many of these foundational species are widespread right now, and you can see them everywhere. But they are losing suitable habitat very quickly."

## **Expertise in action**

The study represents a major output from UC Santa Cruz's Conservation Science and Stewardship Lab, whose mission is to bridge ecological theory with sound management practice, often incorporating elements of public policy and working with traditional knowledge holders.

The team's diverse expertise, spanning from quantitative ecology and machine learning to anthropology, allowed for a holistic approach to the challenge. For example, McLaughlin and Zavaleta both bring backgrounds in anthropology to their ecological work, ensuring that the cultural value of these trees—their role in the stories, identities, and lives of Californians—is central to the conservation argument.

"Making conservation decisions only around what's happening in today's landscapes is no longer sufficient," McLaughlin said. "We need to be looking ahead to what's coming in order to protect what matters to Californians."

Other co-authors of the study from UC Santa Cruz include Morgan Abbott and Suzanne Lipton, along with David Ackerly from UC Berkeley, Brooke Rose from San Diego State University, and Holly Moeller from UC Santa Barbara.

**More information:** Blair C. McLaughlin et al, Adapting Species Risk Assessments to a Changing Climate: The Underestimated Vulnerability

of Foundational Trees, *Global Change Biology* (2026). DOI: [10.1111/gcb.70866](https://doi.org/10.1111/gcb.70866)

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