

Like Tens of Millions of Matchsticks, California's Dead Trees Stand Ready to Burn

By CYNTHIA H. CRAFTAUG. 29, 2016

Credit

Gabrielle Lurie for The New York Times

INVERNESS, Calif. — At the height of California's fierce wildfire season, the [Sierra Nevada](#) and North Coast forests are choked with tens of millions of dead and dying trees, from gnarly oaks to elegant pines that are turning leafy chapels into tinderboxes of highly combustible debris.

Ground crews wielding chain saws, axes and wood chippers are braving the intense summer heat in the Sierra's lower elevations, where most of the pine trees have died. The devastation and danger are greatest in the central and southern Sierra Nevada, where the estimated number of dead trees since 2010 is a staggering 66 million.

Scientists say rarely is one culprit to blame for the escalation in the state's tree deaths, and the resulting fire hazard. Rather, destruction on such a broad scale is nearly always the result of a complex convergence of threats to forest ecosystems.

Chief among them is a [severe, sustained drought](#) in the Sierra Nevada that is stressing trees and disabling their natural defenses. Climate change is raising temperatures, making for warmer winters. No longer kept in check by winter's freeze, [bark beetle](#) populations are growing. Separately, a nonnative, potent plant pathogen is thriving in the moist areas of the North Coast, introduced to California soil by global trade. Opportunistic fungi are standing by, ready to finish the kill.

Factor in human shortcomings — poor or absent forest management, a failure to clear out ignitable dead wood, the darker temptation of arson, unchecked carelessness — and you have a lethal recipe.

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"It's never just one thing that brings down trees," said David Rizzo, the chairman of plant pathology at the University of California, Davis. "It's always a combination. The first may weaken trees; the next stresses trees over time. Then comes a third, shutting down the trees' immune and defense systems. Finally, the last may come along to disrupt nutrient systems. When all this happens at once, or in rapid succession, trees are no longer able to save themselves."

Two of California's prized forest regions are in failing health because such conditions have stacked the odds against them. In the Sierra Nevada, the losses of pines and other conifers are concentrated and widening.

Along the North Coast, a picturesque blink of a town called Inverness and the surrounding Marin County woodlands are “ground zero,” Dr. Rizzo said, for the mysterious plant pathogen that began infesting coast oaks probably as far back as the mid-1980s.

Dr. Rizzo, who closely studies [Phytophthora ramorum](#), also known as sudden oak death, returns often to this cozy glen on a peninsula overlooking the clear blue water. Graduate students, research associates and others accompany him to this patch of forest serving as an outdoor classroom, laboratory and demonstration plot.

It took years of research — detective work, really — before experts like Dr. Rizzo and Matteo Garbelotto, a professor of environmental science policy and management at the University of California, Berkeley, discerned that the funguslike pathogen had infested coast oaks years before their showy demise.

Dr. Rizzo estimated that five million to 10 million coastal trees had died because of sudden oak death.



A related pathogen, [Phytophthora infestans](#), was responsible for the [Great Potato Famine](#) in Ireland in the mid-1800s.

In Marin County, home to some of California's priciest land, sudden oak death spread onto such landmark properties as George Lucas's [Skywalker Ranch](#) and the renowned [Spirit Rock Meditation Center](#). The pathogen has taken hold as far south as Big Sur, a rugged, misty stretch of Highway 1 with a bohemian flavor to its exclusive community.

On a recent, sun-dappled afternoon in Inverness, Dr. Rizzo looked to the sky and noted, “[Big Sur is burning.](#)” The same gray, coarse woody debris that Dr. Rizzo had just pointed out to visitors had accumulated in the woods not far from Big Sur.

Sudden oak death thrives in the moist, cool climate of the North Coast. Dr. Rizzo is investigating whether it moves through streams as well.

Near the Oregon border, the Native American [Yurok](#) and [Hoopa Valley](#) tribes are participating in Dr. Rizzo's research, periodically checking bags of leaves retrieved from streams for signs of disease. “Culturally, the [tanoak](#) are very important to Native Americans,” he said.

Katie Harrell, a spokeswoman for the nonprofit [California Oak Mortality Task Force](#), said Native Americans mourned the death of trees in their habitat. “Trees are part of their holy lands,” Ms. Harrell said. “They break

down in tears talking about the loss of trees as family members.”

Photo



Credit

Gabrielle Lurie for The New York Times

No one knows exactly where *Phytophthora ramorum* first showed up in California, but Dr. Rizzo said the pathogen was probably a stowaway aboard a shipment of imported nursery plants.

What is known is that alarm over dying oaks has instilled in coastal residents a new esprit de corps. Armed with GPS devices, envelopes and markers, crews of citizen scientists respond to Dr. Garbelotto's call for seasonal "blitzes." Volunteers scour wooded areas for signs of the disease. Upon coming across a tree with blighted leaves, they note the coordinates, collect samples and send them to a laboratory for identification.

The pathogen spreads by rain splash. The forest's Typhoid Mary is the [bay laurel tree](#), a faithful host for the disease but one that never succumbs to its perils.

When rain falls on bay laurel leaves, contaminated droplets scatter, reaching neighboring trees. If those neighbors are coast oaks or tanoaks, the pathogen penetrates bark with ease and establishes residence. At the end of outstretched filaments too small for the naked eye to see, the pest launches lethal spores that sap the tree of its nutrients. Native fungi follow, as do pests. Within a couple of years, the tree is dead.

Millions of coastal oaks have died that way. Interest in sudden oak death has taken on a life of its own, with the [Sixth Sudden Oak Death Symposium](#) this year drawing scientists from around the world. Dr. Rizzo and others are growing more concerned that, as tanoaks spread in Northern California's iconic redwood forests, sudden

oak death will follow. Because tanoaks quickly fall to the disease, the danger of fire fed by dead wood will rise and the redwood ecosystem may be damaged.

Already, researchers have detected the killer pathogen among redwoods in [Humboldt Redwoods State Park](#), along the [Avenue of the Giants](#), a 31-mile route through the world's largest stand of virgin redwoods.

Photo



Sudden oak death is caused by a funguslike pathogen. This tree was killed by sudden oak and then covered in another fungus, *Phellinus gilvus*.

Credit

Gabrielle Lurie for The New York Times

Dr. Rizzo's lab is monitoring 600 forest plots of 500 square meters each. According to [his website](#), researchers will periodically visit the plots, and "every tree and shrub will be assessed for presence of pathogen(s)."

Dr. Garbelotto is experimenting to see if a preventive treatment he is applying to vulnerable trees will ward off sudden oak death.

On the other side of California, the tree die-off in the Sierra Nevada continues to worry firefighters and public officials. Under stress in the fifth year of severe drought, the [ponderosa pines](#), the [pinyons](#) and the [sugar pines](#) lack the moisture needed to manufacture the sticky resin that prevents bark beetles from burrowing into their trunks. With nothing to stop the voracious pests — no bigger than a grain of rice — they bore into the pines, where they produce larvae. In turn, the larvae feed off the trees' nutrients, and the tall, proud pines die in place, standing upright like matchsticks waiting for a light.

The official count of dead trees, taken by [United States Forest Service](#) and [California Department of Forestry and Fire Protection](#) officials during flights over the Sierra Nevada, is almost certain to grow. More are being spotted from the air in the Lake Tahoe Basin and farther north.

Neither of the two enormous die-offs seems to be ending anytime soon, and the Big Sur blaze is still burning — with more than 90,000 acres destroyed.

When hit with fire like this, many forests return only as scrubland, with trees no bigger than shrubs.

Gov. Jerry Brown of California issued [emergency declarations](#) for the Sierra's central and southern regions last October. Mr. Brown also called for a task force to devise strategies to clear the forests of deadwood. He also sought additional federal funds.

In that pursuit, he received an assist from Agriculture Secretary Tom Vilsack, who as overseer of the Forest Service predicted disaster if Congress failed to allocate much more money for preventive forest management.

“Tree die-offs of this magnitude are unprecedented and increase the risk of catastrophic wildfires that put property and lives at risk,” Mr. Vilsack said earlier this summer. “We must fund wildfire suppression like other natural disasters in the country.”

Correction: August 29, 2016

An earlier version of a picture caption of a fungus on a dead tree misidentified the type of fungus shown. It was *Phellinus gilvus*, which came in after the tree was dead, not the pathogen that causes sudden oak death. A version of this article appears in print on August 30, 2016, on page D1 of the New York edition with the headline: Forest Killers Aplenty. [Order Reprints](#) | [Today's Paper](#) | [Subscribe](#)