

# California's forests are choking

**Roadside trailers and cottages** sweep by as two windy lanes plunge into the Plumas National Forest. It's early summer in Yuba County, and the sky is an endless blue. These sparsely populated foothills of the Sierra Nevada are marked by meadows, waterfalls and canyons carved by rushing water—in fact, the surrounding 1.2 million acres are the source of half the water used by Californians. Here, some 150 miles north of the worst of the bark-beetle epidemic, the forest is lush and impressive; the ponderosa pines towering in the overstory are 100 to 140 years old.

A sign for Challenge Experimental Forest marks the turnoff to a decades-old research area. Jianwei Zhang, a researcher for the U.S. Forest Service, leads on foot along a row of power lines. He gestures toward some low-lying shrubs and says, "Follow me and you probably won't touch the poison oak."

This 3,520-acre research area was set aside to study a range of forest management issues from wildfire fuels reduction to sustainable harvesting. In his forest lab, Zhang observes how tree density relates to tree health and, therefore, carbon storage.

Which is a problem as vast as California's forests. The Sierra Nevada Conservancy, an agency concerned with the growing forest-carbon imbalance, estimates 200 million trees have been killed by drought, fires and bark beetles since 2010, meaning the wildlands of the Sierra Nevada are releasing carbon dioxide on an enormous scale. That's right:

California's forests are polluting the atmosphere.

## Like one big CO<sub>2</sub> bomb

Picture smoke from the wildfire billowing in a thick column, shading the sun a reddish orange: That's a lot of carbon dioxide, or CO<sub>2</sub>, escaping at once, like the detonation of one big carbon bomb.

It happened five summers ago, when a hunter lost control of his campfire in the Stanislaus National Forest and started the largest forest fire ever recorded in the Sierra Nevada. When the ash finally settled in October, the Rim Fire had burned 257,000 acres in and around Yosemite National Park. Media coverage of the disaster justly focused on the potential evacuation of 15,000 residents and destruction of homes, but the fire had other, largely unreported consequences.

Specifically, it released as much CO<sub>2</sub> as the annual emissions of 2.57 million cars.

Catastrophic fires such as the Rim Fire also release black carbon, a short-lived but acutely potent climate pollutant produced by burning biomass and the incomplete combustion of fossil fuels.

Less dramatically, when trees die and decompose rather than burn, they release CO<sub>2</sub>—along with more potent greenhouse gases like methane—over several decades, invisibly.

Ideally, trees take CO<sub>2</sub> emitted by our cars, factories and faces and store it in their branches, trunks and foliage through a process known as sequestration. Old-growth forests sequester carbon for centuries, or even millennia in the case of giant redwoods and sequoias.

But these climate benefits are faltering.

According to Zhang, most of California's forested public land—some 19 million acres, including parts of all 18 national forests—are overstocked and must be "treated." Due to our history of interference, the forests have become "anthropogenic," or heavily altered by people. Now, ironically, the only way out is through further interference. We can no longer trust the forest to heal itself.



A swath of forest charred by the Rim Fire, which burned 257,000 acres in Stanislaus National Forest from August 2013 to November of the following year.

PHOTOS BY HOWARD HARDEE

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“Humans are already a component of the ecosystem,” he says. “You have to consider that. I understand why you wouldn’t want to treat a natural stand [a small, delineated area of the forest]. But you have to treat a stand in order to save it.”

### Carbon is the new black

Carbon science is a relatively new way to understand our relationship with trees. As recently as 15 years ago, wildfire assessments focused on potential loss of life, property and watersheds, not how much carbon escaped into the sky. As wildfires have increased in both frequency and intensity throughout western North America, however, the field of forestry has shifted to account for CO<sub>2</sub>.



Jianwei Zhang, a researcher for the U.S. Forest Service, maintains that humans are a major component of the forest ecosystem in California.

“It is a big deal, this role of wildlands breathing in carbon and holding it into the landscape,” said Bruce Goins, a retired California forester. “And it’s not just carbon management: You’re protecting the water; you’re providing habitat for wildlife; you’re providing habitat for fisheries; you’re providing beautiful aesthetic areas where people can hike and recreate. Carbon sequestration is just one attribute of a healthy, resilient forest.”

Goins’ personal perspective on humanity’s connection with conifers changed when Gov. Arnold Schwarzenegger signed Assembly Bill 32, the Global Warming Solutions Act of 2006, mandating a statewide reduction in heat-trapping pollution to 1990 levels by 2020. State officials began looking at the role forests play in capturing CO<sub>2</sub>, and Goins helped set the rules for tracking forest carbon under the law.

The concept of forests acting as the state’s lungs can be difficult to absorb, Goins said: “To this day, lots of people understand fire risk, but very few people understand forest carbon.”

Indeed, carbon scientists come armed with jargon-heavy talking points and graphs, but that tends to make people go cross-eyed. It doesn’t help that scientists don’t agree on the extent of the problem.

For example, the authors of a 2015 paper published in the journal *Forest Ecology and Management* concluded that, between 2001 and 2010, California’s forests emitted more CO<sub>2</sub> than they sequestered. And some experts say that we probably can’t count on carbon-capturing conifers to have our backs on climate change anymore—that they are, in fact, doomed to recede from the slopes of the Sierra Nevada and make way for scrubby brushland as rain and snow becomes more scarce and average temperatures rise. If climate models prove accurate in the coming decades and centuries, the Sierra Nevada backcountry we know from hiking, camping and beer-can labels may transform into a hardly recognizable landscape.

Others say that is not coming to pass quite yet. Andrew Gray, an Oregon-based USFS research ecologist, likes to keep the discussion simple, so he talks about walking in the woods and counting trees. By revisiting plots every decade or so and noting the differences, his team records how forest carbon changes over time (obviously, dead trees no longer pull CO<sub>2</sub> from the atmosphere). Looking at the latest 10-year averages, the number of trees growing in California well outpaced the number of trees dying despite the severe drought from 2011 to 2016, suggesting the carbon balance is still positive overall.

“Given the high levels of growth we have, California’s forest are still probably a net carbon sink,” Gray said. “You’d have to keep killing trees for quite a while to actually change the overall trajectory. It’s a big state. There are a lot of trees. I don’t see them becoming a net source of carbon yet.”

But another research forester with the Forest Service, Jeremy Fried, believes the tree inventory alone paints an incomplete picture: “Overall, we’re growing more than we’re losing, and if you just focus on that, you think, ‘We’re OK!’ And, yeah, it’s better than if we were carbon-negative. But there’s a lot of room for improvement if your objective really is to keep carbon out of the atmosphere.”

That’s why Fried talks about “gross growth,” or how much CO<sub>2</sub> is turned into live wood, foliage, bark, roots, cones and flowers—as he put it, “the total productive capacity of an acre of forest.”

In California’s reserved wilderness areas, trees are dying as fast as they are growing, which means the gross growth is zero. It’s Fried’s professional opinion that all of those logs rotting on the forest floor are a lost opportunity to store carbon long term. Here’s his thinking: Whether it takes 15 or 50 years to totally

decompose, a dead tree is going to release its carbon back into the atmosphere eventually. But if that tree becomes lumber used to build houses, other buildings and furniture, it's locked up for decades.

"If you're talking about climate benefits," he said, "you need to look at the harvest, and recognize that some of that harvest is producing significant benefits for a long time."

Dominick DellaSala, on the other hand, doesn't think we can chainsaw our way out of this. He's the president of the Geos Institute, an environmental consulting group based in Ashland, Ore., that works on climate solutions up and down the west coast.

Citing research overseen by the Oregon Global Warming Commission's Forest Carbon Task Force, DellaSala said that wood products such as furniture store about 36 percent of the source material's carbon—meaning that nearly two-thirds of it escapes into the sky. And that's not accounting for emissions from logging trucks and overseas shipping, manufacturing, damage to soils and the reduced sequestration potential of the forest itself.

"Most of that carbon is becoming a global warming pollutant," he said. "It doesn't pencil out. When you compare this to the scale at which thinning needs to take place to influence fire behavior—even if you could do that—you would be sending out more emissions in the process of thinning the forest than what you're preventing."

### **Burning the hard way**

So, yeah. It's complicated. But there is little debate about what's causing the problem: The forests are too dense.

The phenomenon is rooted in 150 years of post-European settlement activity. Previously, Native Americans used fire to convert shrubland to promote grassland for deer-hunting, protect themselves from predators and as a tool of intertribal warfare, and lightning started fires throughout the West for many thousands of years, clearing away dense underbrush and unhealthy trees and naturally regenerating the landscape.

The introduction of Euro Americans to California profoundly changed the role fire plays in forest ecology, especially following the railroad expansion. Locomotives spewing cinders and sparks ignited piles of slash—unmillable limbs and branches left behind by loggers—which, combined with unrestrained fires to clear land for animal grazing, corrosive mining practices and the lumber harvest, threatened to strip the West bare.

In 1891, California's forest reserves were established in the name of conservation. The U.S. Forest Service was created in 1905 and Gifford Pinchot, considered the grandfather of modern forest management, was appointed head of the new agency. "Today," he declared at the time, "we understand that forest fires are wholly within the control of men." The era of fire suppression was born.

In recent decades, California has spent billions on airplanes, fire engines, chemical deterrents and heavy machinery to fight wildfires, and it has worked too well. Whereas most stands used to be touched by fire every 10 to 20 years, some areas haven't burned in a century. As a result, the forests have become overloaded with fuel, said Jeff Webster, a senior forester with the Jefferson Resource Co., a consulting firm based in Weed.



From left: Jim Branham and Brittany Covich of the Sierra Nevada Conservancy, and Mark Egbert, manager of El Dorado County Resource Conservation District.

"The forest needs a certain level of disturbance," he said. "We haven't been disturbing the forests hardly at all, especially for the last two decades. ... We're loving our forests to death."

Now, when wildfires rip through the forest, they are bigger and hotter than ever before, consuming even healthy old-growth trees and leaving only scorched earth and skeletal snags. As California's population encroaches deeper into the woods, we cannot afford to let wildfires run unchecked. More than 11 million people live in the Sierra Nevada's wildland-urban interface, and, in addition to health concerns about air quality, the risk to life and property is enormous. For example, the October 2017 Northern California wildfires killed 44 people and caused \$9.5 billion in insured damages.

And so our culture has come to pray for rain and demonize fire, two equally critical ecological processes, said Craig Thomas, conservation director of Sierra Forest Legacy. He's been beating the drum to strategically reintroduce fire onto the landscape for many years.

"Frequent fire is California," he said.

However, the state hadn't committed to ecologically significant prescribed burning programs until recently. During Gov. Jerry Brown's state of the state address in January, he said, "Trees in California should absorb CO<sub>2</sub>, not generate huge amounts of black carbon and greenhouse gas as they do today when forest fires rage across the land."

Last month, Brown signed a multipronged executive order which, among other actions, will double the area of forestland actively managed through vegetation thinning, controlled fires and reforestation from 250,000 acres to 500,000 acres. The order coincides with the release of the state's 2018 Forest Carbon Plan, which recognizes that the forests "will become a source of overall net greenhouse gas (GHG) emissions if actions are not taken to enhance their health and resilience" and that "these conditions threaten progress toward meeting the state's long-term climate goals."

To that end, fiscal year 2017-18 marked a dramatic increase in the state budget for forest health programs through an appropriation of \$220 million from the California Climate Investment Fund, and there are several fire-related bills currently working through the Legislature, including Senate Bill 1260 by Santa Barbara Democrat Hannah-Beth Jackson. And significant action has already been taken: More than 1.2 million dead or dying trees have been removed from the state's forests since California established a Tree Mortality Task Force in 2015.

Thomas is greatly encouraged by the action from the state's highest office and efforts by foresters, firefighters and air regulators to step up prescribed burning statewide. "They're pulling it together and realizing we don't have a no-fire option in California," he said. "There's a general, broad acceptance of that across the board, and it's pretty stunning. ... To me, it's a cultural phenomenon I really didn't expect a couple of years ago."

With state agencies mostly on the same page, now it's a matter of actually removing enough trees to save the forests—and fighting fire with fire.

### **If these trees could cough**

Oak trees gradually give way to evergreens as Highway 50 rises from the Sacramento Valley floor to the mountain community of Pollock Pines, just west of Placerville. An exit leads to Jenkinson Lake at Sly Park Recreation Area, a reservoir that serves as one of the primary water sources for the residents of rural El Dorado County. It's a brisk morning and a gaggle of geese calls overhead, unseen in the overcast sky.

On the scene are Jim Branham, the executive officer of the Sierra Nevada Conservancy, and Mark Egbert, manager of El Dorado County Resource Conservation District, or RCD. Overlooking the glass-smooth lake, the pair explains that the 3,724 acres of surrounding forestland are encompassed by the Sly Park Vegetation Management Project, an example of proactive forest management in action.

In March, the Sierra Nevada Conservancy awarded the RCD \$500,000 to create a fire-resistant landscape around Sly Park. Now, multiple agencies—including Cal Fire, the Forest Service, the El Dorado Irrigation District and others—are working to avoid a disaster on the magnitude of the 2014 King Fire, which consumed nearly 100,000 acres of nearby forest and a dozen homes. Workers hand-thin brush and small trees, in addition to employing mechanical removal, with the goal of using prescribed fire to mimic natural processes.

The alternative isn't pretty, Egbert says. He subscribes to the philosophy that excess trees either leave the forest as lumber or wood chips, or burn. "The trees in the King Fire, they're not sequestering carbon anymore," he says. "They've burned up. They're dead."

The strategy remains hard to sell to the public. "It's somewhat counterintuitive to say we need to cut a bunch of these green, live trees to make the forest healthy," Branham says. "It's not the easiest message to deliver to people who've grown up thinking more trees are better." But there's been a shift in public perception since the King Fire, Egbert says. Now, residents regularly thank them for their work; they understand that it benefits forest health, air quality and their own safety.

Count Branham and Egbert among those who are optimistic that full restoration is still achievable, despite the daunting scale of California's forest-carbon problem. They say reducing stand density promotes growth, and therefore carbon storage; and bigger trees are generally more resilient to fire, insects and disease.

That's why Jenkinson Lake can be a model for proactive forest management throughout the Sierra Nevada, Branham says: "This is exactly what we need to be doing if we want to store carbon long term."

With another fire season heating up, it's a good time to remember that forests provide more than lumber for our homes, recreational settings and pretty backgrounds for our profile pictures. Our dependence on trees is as basic as breathing. And if Mother Nature keeps coughing up carbon like this, we're pretty much on our own with this whole climate change thing.