UC Irvine scientists reveal what fuels wildfires in Sierra Nevada Mountains

The work could help improve California’s wildfire management efforts.

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Earth system science Ph.D. candidate Audrey Odwuor stands amidst a controlled burn experiment at the UC Berkeley-run Blodgett Forest Research Station in the Sierra Nevada mountains. New research led by Odwuor could help inform the way California performs controlled burns in the future.

Picture Credit:

James Randerson / UCI

Irvine, Calif., Sept 25 2023 — Wildfires in California, exacerbated by human-driven climate change, are getting more severe. To better manage them, there's a growing need to know exactly what fuels the blazes after they ignite. In a study published in *Environmental Research Letters*, Earth system scientists at the University of California, Irvine report that one of the chief fuels of wildfires in California's Sierra Nevada mountains is the decades-old remains of large trees.

Researchers have known for decades that an increasing number of trees and an increasing abundance of dead plant matter on forest floors are the things making California wildfires more severe – but until now it was unclear what kinds of plant debris contribute most to a fire.

To tackle the question, Odwuor and two of the study's co-authors – James Randerson, professor of Earth system science at UCI, and Alondra Moreno from the California Air Resources Board – drove a mobile lab owned and operated by the lab of study co-author and UCI alumna Francesca Hopkins at UC Riverside, to the southern Sierra Nevada mountains during 2021's KNP Complex Fire.

The KNP Complex Fire burned almost 90,000 acres in California's Sequoia and Kings Canyon National Parks. In the fire's smoke, the team took samples of particulate matter-laden air and analyzed the samples for their radiocarbon content at UCI's W.M. Keck Accelerator Mass Spectrometer facility with co-author and UCI Earth system science professor Claudia Czimczik.

Different fuel types, explained Czimczik, have different radiocarbon signatures, such that when they analyzed the smoke they discovered radiocarbon values associated with large fuel sources like fallen tree logs.

"What we did was pretty distinctive, as we were able to identify fuel sources by measuring the wildfire smoke," said Czimczik. "Our approach provides what we think of as an integrated picture of the fire because we're sampling smoke produced over the course of the fire that has been transported downwind."

The team also saw elevated levels of particulate matter that is 2.5 microns in diameter or less, which includes particles that, if inhaled, are small enough to absorb into the bloodstream.

The preponderance of large-diameter fuels is new in western forests. “We’re really in a situation that’s a consequence of both management strategies and climate warming since European-American settlement began in California,” Odwuor said. “These fuels are building up on the forest floor over periods of decades, which is not typically how these forests were maintained."

It’s information that, according to Odwuor, could help California better manage its wildfires.

“The knowledge that large-diameter fuels drive fires and fire emissions – at least in the KNP Complex Fire – can be useful for knowing which fuels to target with fuel treatments and what might end up in the smoke from both wildfires and prescribed fire,” said Odwuor. “The idea is that because we can't control the climate, we can only do our best to manage the fuels, which will theoretically have an impact on fire severity and the composition of the smoke.”

But the solution isn’t as straightforward as removing trees from forest floors, because, among other things, they provide habitat for wildlife. That, and “once you get them out, where do you send them? There are only so many mills in California that can handle all the wood,” Odwuor said.

Where the new knowledge could be helpful is with prescribed burns, wherein teams burn tracks of forest in a planned fashion with the aim of reducing the amount of fuel available for future wildfires.

“We’re hoping to build some urgency for these management strategies,” said Odwuor.

About the University of California, Irvine: Founded in 1965, UCI is a member of the prestigious Association of American Universities and is ranked among the nation’s top 10 public universities by *U.S. News & World Report*. The campus has produced five Nobel laureates and is known for its academic achievement, premier research, innovation and anteater mascot. Led by Chancellor Howard Gillman, UCI has more than 36,000 students and offers 224 degree programs. It’s located in one of the world’s safest and most economically vibrant communities and is Orange County’s second-largest employer, contributing $7 billion annually to the local economy and $8 billion statewide. For more on UCI, visit www.uci.edu.

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