UC SANTA BARBARA
THE Current

August 19, 2026
Sonia Fernandez

Researchers link wildfires in California's coastal watersheds to the water quality at the beach

As the summer heat bakes the West Coast, the thoughts of many who have lived here for any amount of time will turn naturally to the idea of wildfire. As of writing, California has already experienced almost 5,000 wildfires in 2026 alone, many of them near the coast, or affecting watersheds that lead to the sea. With all the ash, charred material and other debris making it into the waterways and out to the ocean after storms, what are the effects on water quality at the beaches and in the nearshore?

That question has been on the minds of UC Santa Barbara physics professor Jean Carlson and UCLA and Caltech postdoctoral researcher Carl Swindle, authors of a paper that appears in the *Public Library of Science (PLOS) Water* . While we can intuit that there must be some adverse effect of large amounts of nutrients and debris from burned houses, buildings, infrastructure and landscape being pumped into the ocean, they said, for all the decades of wildfires and subsequent rainy seasons, the systematic impacts on California's coastal watersheds have not been thoroughly studied.

"How do you decide that water quality and water pollution can be attributed to a wildfire when there are so many other potential causes?" said Carlson, who specializes in complex and highly connected systems. Real-world watershed systems

involve many, often interrelated variables, and each wildfire comes with its own set of conditions and responses. This makes generalizing across all of California's coastal watersheds a significant challenge.

However, armed with 20 years of data and a handful of case studies, Carlson and Swindle have teased out relationships between California coastal wildfires and their settings, and the potentially harmful bacteria that make their way to coastal waters at the base of the watersheds in which they burn.

"Overall, we see that watersheds dominated by urban areas are associated with more fecal coliforms in the coastal waters following fires," Swindle said, referring to harmful bacteria that come from the gut and feces of warm-blooded animals, humans included. In contrast, less urban areas with more vegetation exhibited more diverse, and typically less harmful coliform bacteria.

"In the urban areas, we see a rise of fecal bacteria associated with wildfires, while total coliforms actually go down," Carlson added. "It's interesting and unexpected to see contrasting effects." Swindle remarked, "I have rarely seen ecological responses as pronounced and consistent as the fecal indicator bacteria responses following major fires."

The researchers' analysis covers 204 individual ocean-bound watersheds across the state, covering a diverse array of terrain, from urban watersheds to systems in agricultural and natural landscapes. Each watershed was mapped and then overlaid with the 20-year historical wildfire footprints to identify burn and non-burn periods defined by a two-year window following fires.

Records for the levels of precipitation and four different fecal indicator bacteria (FIB) types were added to the time evolving map. All watersheds with both burn periods and FIB records were analyzed for their FIB levels during burn and non-burn periods to identify all statistically significant anomalies in each region. The anomalies were further assessed along other attributes, including precipitation, and landcover types, to identify statistically significant correlations and patterns across the state of California.

The first goal was to capture all the local FIB anomalies relative to locally defined baseline levels. This is important because different coastal regions have different

baseline levels as well, according to Carlson. Comparing the anomalies with the burn history, they determined which anomalies were associated with wildfires versus which were associated with other sources and situations.

Based on the beach sampling data collected off California's coasts from 2003 to 2023, the Goleta Watershed in Santa Barbara County was found to have the most post-fire FIB anomalies. This is followed by the Malibu Lagoon State Beach and the Point Dume watersheds in northwest Los Angeles County; the Big Sur, Garrapata and Pfeiffer watersheds in Monterey County; the San Diego River Watershed; the Seal Beach Watershed in Los Angeles County; and the Ventura River Watershed in Ventura County.

The second goal was to sort out generalizable relationships between the anomalies and other watershed attributes. "Ranchlands, forests and urban areas all contribute regionally specific debris and other constituents to storm-generated runoff, making flow through watersheds characteristic of local regions," said Carlson. "Some will have manure, some will have charred leaves, plants and soils, some will have urban runoff from overflowing drains and sewers."

The ability to generalize across California's diverse watersheds can give managers in the state's diverse coastal municipalities better tools to plan for potential beach closures and other measures, such as freshwater supply purification and what to do with debris in the wake of wildfires, according to the researchers.

"If you're at a beach following a major storm in a recently burned area, and you know certain things about the watershed, you might realize that you may be higher at risk due to fecal contamination than if it was a different watershed or had different watershed attributes," said Swindle, a UCSB earth science alum who is conducting his postdoctoral research at the B. John Garrick Institute for the Risk Sciences at UCLA and the Division of Geological and Planetary Sciences at Caltech. This information could also play into longer-term planning that would dictate, for instance, where infrastructure in the watershed could most safely be built.

According to Swindle, "A next step that builds on this work will be to test a wider variety of pollutants and water quality conditions associated with wildfires, such as harmful algal blooms." Ultimately the researchers plan to construct an integrated platform that leverages all this information across even wider coastal spans.

Tags
Disaster Management
Ocean and Beaches

Media Contact
Sonia Fernandez
Senior Science Writer
(805) 893-4765
sonia.fernandez@ucsb.edu

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.