

Climate change is causing Calif.'s forests to shrink -- study

Elizabeth Harball, Environment & Energy Publishing, 1-20-15

Call it the incredible shrinking forest -- scientists claim that climate change, among other factors, is behind a striking decline of California's large, old trees in favor of smaller ones.

Scientists have found that even though the density of trees in California's forests increased by 30 percent between the 1930s and the 2000s, there are far fewer big trees in many California regions. For example, there was a 50 percent decline in the number of trees with a diameter of over 60 centimeters in Northern California, the Sierra Nevada highlands, and the state's southern and central Coast Ranges.

This phenomenon is documented in a [study](#) released yesterday in *Proceedings of the National Academy of Sciences*. It was led by ecologist Patrick McIntyre during his postdoctoral studies at the University of California, Berkeley.

As temperatures rise, causing snowpack to melt earlier and rainfall to evaporate more quickly, California's forests must work harder to survive. This trend favors smaller trees, said McIntyre, who now works for the California Department of Fish and Wildlife.

"People have noticed that in periods of drought stress, large trees can be more vulnerable and die disproportionately," said McIntyre.

More little oaks, fewer big pines

The authors used a model to estimate changes in what is called the climatic water deficit, which McIntyre describes as "an integrated measure of drought stress from a plant's perspective." They determined that during the last decade, plants had to work harder to get water due to factors like increased evapotranspiration and earlier snowmelt, even though overall precipitation increased.

They then examined historical data on tree size, species and density collected from California's forests during the 1930s and compared them to analogous data collected between 2000 and 2010.

"We observed striking declines in large trees ... across all regions of California between the historical and contemporary forest surveys," the study states.

"These findings suggest increased temperatures and changes in the timing and levels of water availability are contributing to large area changes in western North American forests," it adds.

More small trees and fewer large trees also mean that California's forests hold less biomass and therefore less carbon than they did before, the study states; this is evidenced by a 19 percent reduction in trees' basal area across the state.

Additionally, the study saw evidence of a species shift. Oak trees, which thrived tens of thousands of years ago when California had a warmer, drier climate, are returning. Pine trees, which grew well during colder periods, appear to be dying off.

Beyond climate change, Jerry Franklin, a professor at University of Washington's college of forest resources who was not involved in the study, believes fire suppression is another factor leading to water stress. Without relatively frequent wildfires, small, young trees are able to proliferate, and Franklin said this may also contribute to big trees' decline.

"You fill these forests up as a result of the suppression of fire and allow them to become dense, yes, you are going to have a problem with drought," Franklin said.

Forests losing their 'backbone'

Scientists are still debating why bigger trees suffer more when water is scarce, McIntyre said, but he offered one possible explanation.

"You have all these leaves, you have all this tissue you need to provide and support," he said. "A large tree has so much more of that, it might be more difficult to get through a time of low water."

McIntyre and Franklin both said this is not the first study to document this phenomenon -- it's likely something that's happening across the globe.

"It's very consistent with what we have seen in lots of areas across the Intermountain West," said Franklin.

Because smaller trees hold less carbon, this has greater implications for the climate.

"On their own, California's forests are only a small piece of the puzzle," said co-author and University of California, Berkeley, professor David Ackerly. "But as impacts on forests are increasingly felt worldwide, the concern is that carbon that is sequestered in these forests will now be released to the atmosphere ... and recent work by others has shown that these large trees continue to grow and in fact capture more and more carbon per tree as they get larger. So the loss of these large trees means the loss of their future growth and carbon capture."

But Franklin said it's important to focus not just on declining tree size -- the fact that there are fewer older trees is also cause for concern.

"Old trees are not simply enlarged versions of younger trees," said Franklin, explaining that as a forest ages, the canopy architecture changes, providing structures that are important for other organisms. Old trees also commonly have thicker bark, making them more resistant to wildfire, he said.

"The large, old pine trees are the structural backbone of these systems," said Franklin.