

Drought implicated in slow death of trees in Southeastern forests

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It's obvious drought can kill trees. But a new Duke University study of nearly 29,000 trees at two research forests in North Carolina reveals it's not always a swift or predictable end.

"This is the first research to show that declines in [tree growth](#) during a drought can significantly reduce long-term tree survival in Southeastern forests for up to a decade after the drought ends," said Aaron Berdanier, a Ph.D. student in forest ecology at Duke's Nicholas School of the Environment, who led the study

By identifying the species at highest risk and the environmental factors

that shape the odds of survival, the new study may give managers better ways to recognize and reverse drought-induced declines in the region's forests before it's too late, said James S. Clark, Nicholas Professor of Environmental Science at Duke.

"Foresters and ecologists have long gauged the severity of drought from tree mortality that happens the same year. But the damage suffered during drought sets in motion a decline that can kill [trees](#) years later. This study identifies the symptoms that can mark an individual for later death," Clark said.

"As our future climate warms and droughts in the Southeast become more frequent and severe, this is going to be a major region-wide concern," Clark added.

As tree growth slows during a drought, it decreases a tree's ability to take in enough carbon to stay alive, Berdanier said. If the tree can't reverse this trend, its health progressively declines and over time it slowly dies.

These declines are more gradual and less explicit than the catastrophic die-offs that have become increasingly common after major droughts in the West and other regions, but the long-term impacts can be severe.

Berdanier said that of the trees that were affected by drought and failed to recover, 72 percent were dead within the decade.

The findings appeared July 30 in the early online edition of the peer-reviewed journal *Ecological Applications*.

To conduct the study, Clark and Berdanier analyzed data dating back to 1993 on the annual growth rates of 28,879 individual trees from 35 species growing at the Duke University Forest in North Carolina's Piedmont, and at the Coweeta Long Term Ecological Research site in

the state's western mountains.

Both sites are forested primarily with mature stands of mixed conifers and hardwoods—typical of forests found across much of the Southeast—and both sites experienced major droughts in 2000-02, 2007 and 2010. Growth rates were determined by measuring year-to-year changes in tree trunk diameters.

"Averaged across species, we found that a tree's long-term mortality risk increases when its cumulative diameter growth falls below 54 percent of the growth of nearby trees of the same species," Clark said. "This gives scientists and forest managers a useful measure to monitor for."

Trees growing on normally wetter sites and those from drought-tolerant species—including the wood and furniture industry staples, loblolly pine and white oak—are better able to recover their pre-drought growth rates after a drought ends.

Thinning out competing trees from around an injured tree can reduce its risk of death.

"After a [drought](#) occurs, managers may have a couple of years to do something to prevent declines from causing a tree's death," Berdanier said. "Knowing what to do and what to look for can make a big difference."

More information: "Multi-year Drought-induced Morbidity Preceding Tree Death in Southeastern U.S. Forests," Aaron Baird Berdanier and James S. Clark; published July 30, 2015 (pre-print), [dx.doi.org/10.1890/15-0274.1](https://doi.org/10.1890/15-0274.1)

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