Bigleaf maple decline tied to hotter, drier summers in Washington state

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A healthy bigleaf maple tree. The species is found in across urban, suburban and forested areas in western Washington. Credit: Jacob Betzen/University of Washington

As its name suggests, the bigleaf maple tree's massive leaves are perhaps its most distinctive quality. A native to the Pacific Northwest's wet westside forests, these towering trees can grow leaves up to 1.5 feet across—the largest of any maple.

But since 2011, scientists, concerned hikers and residents have observed more stressed and dying bigleaf maple across urban and suburban neighborhoods as well as in forested areas. Often the leaves are the first to shrivel and die, eventually leaving some trees completely bare. While forest pathologists have ruled out several specific diseases, the overall cause of the tree's decline has stumped experts for years.

A new study led by the University of Washington, in collaboration with Washington Department of Natural Resources, has found that bigleaf maple die-off in Washington is linked to hotter, drier summers that predispose this species to decline. These conditions essentially weaken the tree's immune system, making it easier to succumb to other stressors and diseases. The findings were published Sept. 16 in the journal *Forest Ecology and Management*.

"These trees can tolerate a lot, but once you start throwing in other factors, particularly severe summer drought as in recent years, it stresses the trees and can lead to their death," said co-author Patrick Tobin, associate professor in the UW School of Environmental and Forest Sciences.

A bigleaf maple tree that has nearly died in Washington state. Credit: Washington Department of Natural Resources

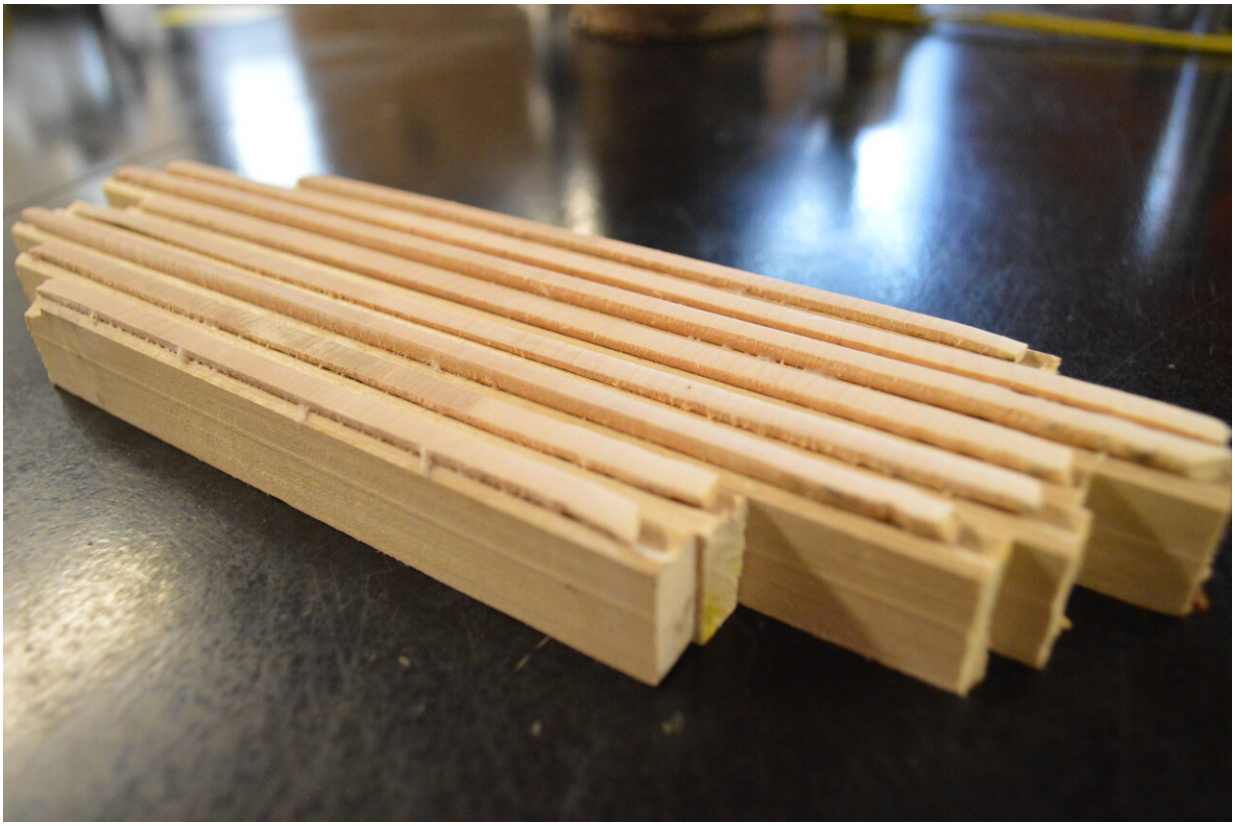
In addition to warmer, drier weather, the researchers found that bigleaf maple are more likely to decline near roads and other development—especially in hotter urban areas. Across multiple years and sites in Western Washington, they weren't able to find any single pest or pathogen responsible for the mass decline; rather, all signs point to climate change and human development as the drivers behind the regional die-off.

"Managing, protecting and utilizing our urban and wild ecosystems in the face of climate change and human population growth is and will continue to be one of the major challenges facing us," said lead author Jacob Betzen, a biological technician with the U.S. Forest Service who completed this work as a UW graduate student. "This research investigating bigleaf maple is one small piece of that larger puzzle."

From field sampling and lab work, the researchers found that bigleaf maple grew less in summers that were hot and dry, both in their overall mass as well as leaf size. One of the signature signs of distress, they found, was significantly smaller leaves. In drought conditions, trees use more energy trying to survive and defend themselves from diseases and other threats.

"These results show that summer heat and drought impact the health of iconic tree species of Washington, like bigleaf maple, even in Western Washington, a region known for abundant precipitation. Health impacts to our forests and tree species are likely to continue as we have increased periods of drought each year," said co-author Amy Ramsey, an

environmental planner and forest pathologist with Washington DNR.



Processed tree cores used in analyses to estimate the timing of decline in bigleaf maple trees. Credit: Jacob Betzen/University of Washington

For this study, the research team revisited a selection of sites around Western Washington where DNR in 2014 and 2015 had taken samples and performed testing on trees in decline. They also chose 36 roadside sites where maples were present. Finally, they randomly selected an additional 59 sites on public land across the region where bigleaf maple are known to exist. Across these randomly chosen sites, they found that nearly a quarter of the bigleaf maple trees showed signs of decline.

From each study site, they collected soil, leaves, stems and tree cores, which they analyzed in the lab. Tree cores allow scientists to learn about the age and growth rate of a tree—as well as weather history at that location—without having to cut it down.

From the analysis of the tree cores, the team found that the growth of bigleaf maple has varied significantly since 2011, and was especially lower in years with hotter, drier summers. They compared this growth to that of Douglas fir trees, which they also cored, and found their annual growth was consistent—meaning that bigleaf maple are especially sensitive to dry, hot weather.

"For us, these analyses were a big piece of the puzzle," Tobin said. "This helped us determine that their decline is a recent phenomenon that is linked to weather conditions."

These findings will likely change the way foresters manage bigleaf maple in both urban and wild settings. This might mean planting the trees in different locations, watering more in urban areas or using seed stock better adapted to the projected future conditions of a site, Betzen said. In forests, it might mean a focus on keeping intact landscapes free from more urbanization.

More information: Jacob J. Betzen et al, Bigleaf maple, Acer macrophyllum Pursh, decline in western Washington, USA, *Forest Ecology and Management* (2021). DOI: 10.1016/j.foreco.2021.119681

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