Increasing drought stress challenges vulnerable hydraulic system of plants

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The hydraulic system of trees is so finely-tuned that predicted increases in drought due to climate change may lead to catastrophic failure in many species. A recent paper co-authored by George Washington University Assistant Professor of Biological Sciences Amy Zanne finds that those systems in plants around the globe are operating at the top of their safety threshold, making forest ecosystems vulnerable to increasing environmental stress.

In the current issue of the journal *Nature*, Dr. Zanne and lead authors from the University of Western Sydney in Australia and Ulm University in Germany, report that the hydraulic system trees depend on is a unique but unstable mechanism that is constantly challenged.

"Drought is a major force shaping our forests," said Dr. Zanne, a faculty member within the Columbian College of Arts and Sciences. "Over the last century, drought has been responsible globally for numerous large-scale forest diebacks. To make effective predictions of how forest landscapes may change in the future, we need to first understand how plants work."

The primary challenge plants face during drought is how to keep their plumbing working. Drought stress creates trapped gas emboli in the water system, which reduces the ability of plants to supply water to leaves for photosynthetic gas exchange and can ultimately result in desiccation and death.

"Vulnerability to embolism is one of the main factors determining drought effects on trees," Dr. Zanne said. "However, plants vary dramatically in their resistance to drought-induced embolism, which has made predictions of how forests might be altered under future climates more difficult."

While the research findings are alarming, plants do have a few other tricks up their sleeves. They may have some flexibility of changing their plumbing or new species of trees may replace species no longer capable of persisting in a given place.

An international team consisting of Dr. Zanne and 23 other plant scientists organized via the ARC-NZ Research Network for Vegetation Function at Macquarie University in Sydney, Australia, analyzed existing measures of plant hydraulic safety thresholds in forest species around the world.

The surprising result that the group discovered is that while plants vary greatly in their embolism resistance, they are sitting at similar safety thresholds across all forest types. The team found these thresholds are largely independent of mean annual precipitation.

The findings explain why drought-induced forest decline occurs in arid as well as wet forests, which had historically not been considered at risk.

Provided by George Washington University