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Trees Living on the Edge

by Elizabeth Pennisi on 21 November 2012, 1:00 PM | 2 Comments

Trees may stand tall and majestic and endure for centuries, but many are living on the edge: New research has shown that the more climate dries out—a predicted consequence of global change in many places—the more likely water transport systems of many trees are to fail. "We can expect more forest diebacks," says Bettina Engelbrecht, a tropical forest ecologist at the University of Bayreuth in Germany who was not involved with the work. "No forest is immune."

ENLARGE IMAGE

Fatal blow. Drought made these white spruce trees more vulnerable to insect pests and disease.

Credit: Steven Katovich/USDA Forest Service

Water transport up trees occurs through the xylem, a set of tiny channels that extends from the roots to the top of the tree, working like a giant straw. Pores on leaves allow water to evaporate, and that evaporation pulls water up the tree, faster if the air is drier or if there's not much moisture in the ground. This dryness causes problems, though, and not just because trees are trying to get the water they need: If the tree tries too hard to extract water from the ground, air bubbles get pulled into the xylem from surrounding tissue. They clog the channels and, eventually, prevent water flow altogether, a potentially dire outcome called hydraulic failure.

To find out which species are most at risk for hydraulic failure—and, therefore, most likely to struggle in dry conditions—functional plant anatomist Steven Jansen of Ulm University in Germany and his colleagues scanned the scientific literature, collecting water transport information on 226 trees from 81 sites around the world. They calculated the safety margin for each one by looking at the difference between the amount of pressure in the xylem when each species was drought-stressed and the pressure at which half of the xylem was clogged.

The researchers expected that trees in arid places would have large safety margins because they were already adapted to dry weather. They thought that trees in wet climates would be more vulnerable. But actually, 70% of the trees studied had narrow safety margins, irrespective of their environments, Jansen and colleagues report today in *Nature*. Overall, flowering plants—the angiosperms—were at greater risk than pine trees and their relatives—the gymnosperms. This is especially worrying because scientists had thought that trees in wetter environs would do just fine—when in fact, it seems, whenever a region gets drier, its trees suffer, no matter what its climate was to start. "All forests are equally vulnerable," Jansen says. "As climate changes, we will see millions of trees suffering and potentially dying and not just in areas where it is really dry."

The tendency to have a small safety margin reflects the tradeoffs that plants have to contend with. Trees need to build in some tolerance to drought, "but you want to bump up as close to that margin as you can because then you can grow better and compete better with other plants," explains Craig Allen, a U.S. Geological Survey ecologist

ScienceNOW. ISSN 1947-8062

precipitation locally is difficult, but the global change models agree that temperatures will rise globally. Increased temperatures also increase the suction in the xylem, which could worsen water transport problems for trees, Allen says.

Photosynthesis is important for the global carbon budget, as plants remove carbon dioxide in the air and convert it into sugar for energy. If water transport issues shut down photosynthesis, that could be fatal. And while a living forest soaks up carbon from the atmosphere, a forest of dead trees can do the opposite, Allen notes.

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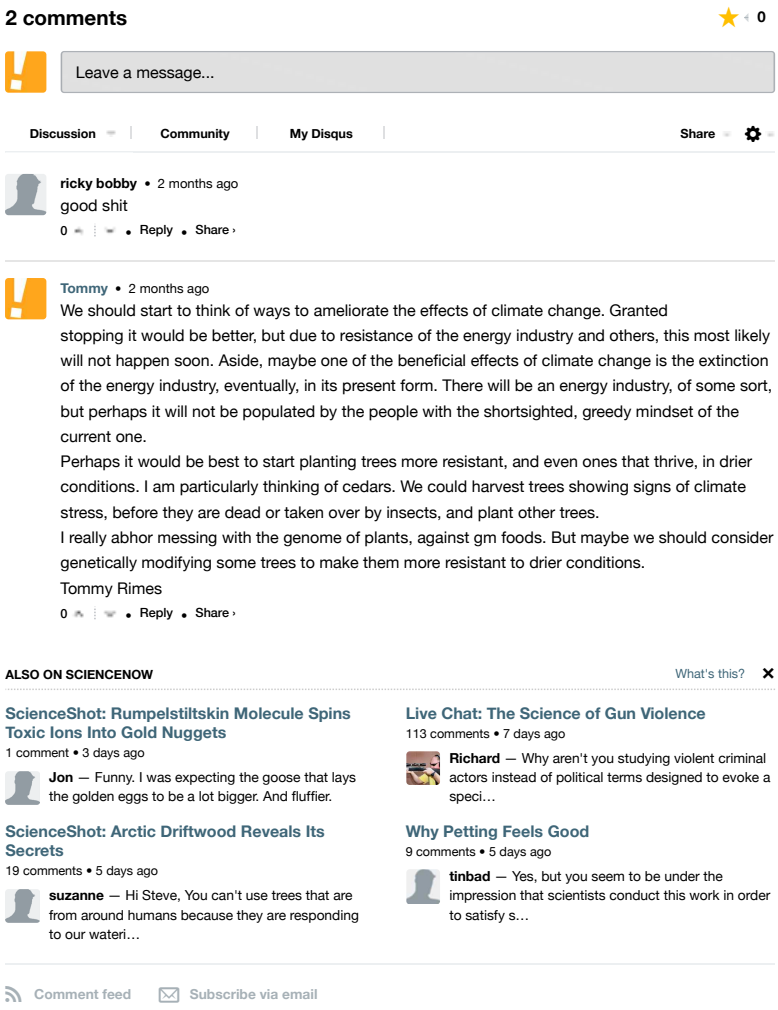

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We should start to think of ways to ameliorate the effects of climate change. Granted stopping it would be better, but due to resistance of the energy industry and others, this most likely will not happen soon. Aside, maybe one of the beneficial effects of climate change is the extinction of the energy industry, eventually, in its present form. There will be an energy industry, of some sort, but perhaps it will not be populated by the people with the shortsighted, greedy mindset of the current one.
Perhaps it would be best to start planting trees more resistant, and even ones that thrive, in drier conditions. I am particularly thinking of cedars. We could harvest trees showing signs of climate stress, before they are dead or taken over by insects, and plant other trees.
I really abhor messing with the genome of plants, against gm foods. But maybe we should consider genetically modifying some trees to make them more resistant to drier conditions.
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