
THE POLITICS AND BUSINESS OF CLIMATE CHANGE

5. FORESTS:

Sugar maples reveal obstacles facing species in their escape from climate change -- researchers

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Many scientists expect that as the global climate becomes warmer, a growing host of species will shift their normal ranges northward and into higher elevations. Yet whether species will be able to establish themselves in their newly shifted ranges may depend on more than just reaching a cooler habitat, according to a recent study.

Two scientists studying the sugar maple tree in Quebec found that despite rising temperatures in Mont-Mégantic National Park, sugar maple stands didn't move farther up the Appalachian Mountains where temperatures were lower. Sap from these trees is boiled down to produce maple syrup.

"We knew the system had warmed, but we weren't seeing the response you would expect," said Carissa Brown, the study's lead author and a scientist in the Department of Geography at Memorial University of Newfoundland in Canada. Instead of a steady progression of seedlings, saplings and young trees moving up the slopes of the Appalachian Mountains, there were only a few adult sugar maples at higher elevations.

Trees are among the slowest organisms to shift their ranges. According to the 2014 report by the Intergovernmental Panel on Climate Change (IPCC), the maximum rate trees can move is roughly 15 kilometers (9.3 miles) per decade. Projected temperature increases between 2050 and 2090 under high carbon emissions scenarios, will likely far outstrip trees' ability to escape them, possibly leading to higher tree mortality. If trees' movement is further hampered by other elements in the environment, consequences of climate change could theoretically be more widespread.

Brown and the study's co-author, Mark Vellend from the Department of Biology at Université de Sherbrooke in Quebec, tried to isolate the environmental factors preventing the trees from establishing farther up the mountain slopes.

To test the factors influencing the trees' survival in different areas, Brown and Vellend planted the sugar maple seeds in three different elevational zones along the eastern-facing side of the Appalachian Mountains. The zones included the trees' normal range, the edge of the trees' range and just beyond where the trees normally grow.

Sugar maples tend to be most common at low elevations, where they make up about 92 percent of the tree species. At the edge of their range, the deciduous trees make up about 42 percent of the species. No sugar maples naturally grew above 850 meters (about 2,789 feet), according to the study.

A surprising finding

The scientists knew that simply planting the seeds at different elevations was not enough to figure out why sugar maples weren't moving up the mountain range.

"The tricky part of studying an elevation gradient is that as you shift from a warmer to a cooler temperature, a lot of other things change on the slope too, [like] soil structure and nutrient availability," Brown said.

In order to tease out the effect of the soil on the seedlings' survival, Brown and Vellend dug up samples of the soil and accompanying leaf litter and transplanted it at different elevations. By mixing and matching soil and seed samples from different elevations, they made some interesting observations.

In one of the combinations, the researchers carried soil from a high elevation down to the sugar maples' natural range.

"What we found was that the seeds weren't germinating or didn't survive well," Brown said. "That told us there's something up with the soil at high elevations that kept them from being successful."

Since the nutrient composition of the soils from the different elevations was the same, they suspected that certain microbiota in the soil may be adversely affecting the seeds, though they are still working out what precisely was halting the seedlings' growth.

The findings also suggested that the stress of being at a higher elevation was not the only factor limiting sugar maple growth above the trees' normal range.

Brown was most surprised by what happened when they moved seeds into the highest elevation sites. After planting the seeds in the fall, the researchers returned in the spring to find that small mammals had eaten many of the seeds. The next year, the researchers tested how much of a problem seed predation was at all three elevations by putting cages over half of the planted seeds and leaving the rest exposed.

"We did see some seed predation though the gradient," Brown said. "But the seed predation was the heaviest above the [sugar maples'] range. If the seeds didn't have a cage, they were all gone; if they did have a cage they were all there."

The discovery was exciting because it showed that small mammals could play a part in preventing sugar maples from growing at higher elevations, said Brown of the findings, which were published in the journal [*Proceedings of the Royal Society B*](#).

No threat to maple syrup

The study indicates how complicated it can be to predict how plant species will respond to climate change because of the influence of other environmental factors. Although species may be adapting to a changing climate, it may not be fast enough.

"Species are responding to climate change, but these other factors are slowing down their response," she said.

Though the study focused on sugar maples, these trees are not currently at risk from climate change, according to Michael Farrell, the director of the Uihlein Forest, Cornell University's Sugar Maple Research & Extension Field Station in Lake Placid, N.Y.

"There should not be any concern about maples in Quebec; if anything, climate change will help them," Farrell said. Higher temperatures will mean a longer growing season for the trees.

Improved tapping technology means that maple syrup producers in North America are able to collect sap more efficiently.

"The sap yields are the highest they've ever been," Farrell said. "The industry has doubled in the U.S. in the past six years."

This year, Quebec had its second highest amount of maple syrup production since 2006, with the Federation of Quebec Maple Syrup Producers reporting syrup yields of 113.7 million pounds.

The province alone was responsible for producing 71 percent of the world's maple syrup in 2014, according to Caroline Cyr, a spokeswoman for the federation. The maple syrup industry contributes about 750 million Canadian dollars, or about \$672 million, to the country's gross domestic product.

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