

Trees grow more efficient leaves to compensate for hurricane damage

December 18 2018, by Steven Bradley



This vista overlooks Guánica town from Guánica Dry Forest, where Clemson University ecologists have been studying how hurricanes affect tropical dry forests in the Caribbean. Credit: Clemson University

Some tree species heal from the ravages of hurricane damage by growing replacement leaves optimized for greater efficiency, according to a Clemson University field study presented at the British Ecological Society's annual conference.

This new, optimized growth is an apparent attempt to fight back when [hurricane winds](#) rip away limbs and leaves.

When Hurricane Maria hit Puerto Rico last year, ecologists at Clemson's Belle W. Baruch Institute of Coastal Ecology and Forest Science in Georgetown, South Carolina, took the opportunity to study how hurricanes affect tropical dry forests in the Caribbean. The worst natural disaster on record to affect the U.S. territory, the [hurricane](#) stripped numerous trees bare of their leaves and disrupted their ability to absorb the light needed for growth and survival.

Clemson researchers sought to determine whether the trees were capable of compensating for the significant damage by increasing resource acquisition in newly produced leaves. At Tuesday's conference, which brought together 1,200 ecologists from more than 40 countries to discuss the latest research, doctoral student Tristan Allerton presented findings from the year-long field study.

"Our study took us to the Guánica State Forest in southwest Puerto Rico, which comprises one of the best parcels of native dry [forest](#) in the Caribbean," said Allerton. "Rainfall here is extremely erratic, with huge variability within and between years. The forest also sits on limestone from an ancient coral reef, which is extremely porous, meaning trees have little time to capture water as it travels through the underlying rock. As a result, organisms are uniquely adapted to cope with unpredictable water availability."

The researchers examined the leaves of the 13 most dominant [tree](#)

[species](#) one, eight and 12 months after Hurricane Maria struck, comparing them with leaves that were collected before the hurricane. They analyzed whether the immediate changes observed in leaves were temporary or maintained over multiple seasons.

Trees rely on exchanging gas through their leaves, simultaneously collecting carbon dioxide from the atmosphere to convert into energy while trying to minimize water loss. To capture maximum leaf-gas exchange rates by trees, the team attached a sensor to new leaves in the forest at several points during the day. They also looked at the newly produced leaves' shapes and structures, which play an important role in efficiently extracting gas from the atmosphere.

The preliminary findings suggest that 11 of 13 [species](#) studied were taking in carbon dioxide at much higher rates immediately following Hurricane Maria. Many had also changed key characteristics of their leaves, including increasing leaf area relative to leaf biomass investment. Simply put, trees were able to capture the same amount of light while spending less energy on leaf production.

"A key finding was that the leaves of some of the species contained less chlorophyll than prior to the hurricane," said professor Skip Van Bloem, director of the Baruch Institute and Allerton's supervisor. "Even though new leaves were better suited structurally to capture valuable resources, lower leaf quality could reduce leaf lifespan and the trees' ability to produce energy."

Overall, Caribbean tropical dry forests seem to be capable of tolerating major hurricanes, though the ecologists stressed that there may be winners and losers in terms of how species respond.

Currently it is unclear whether dominant evergreen species can exploit post-hurricane conditions to the same extent as deciduous species,

according to Allerton.

"Many of our evergreens displayed little change in gas exchange rates and in general the relative decline in new leaf chlorophyll after Maria was much greater than for deciduous species," he said. "Under normal conditions, evergreens renew their canopies over monthly and yearly timescales, therefore it's likely hurricane canopy damage is a more expensive process for these trees."

As climate change leads to expected increases in hurricane frequency and intensity, the species composition of [tropical dry forests](#) in the Caribbean is likely to change. One concern is whether endemic species will disappear over time.

"This would be a huge shame as Caribbean dry forests are known to have a higher proportion of endemic species than mainland dry forests," Allerton said. "Many [trees](#) found there are also incredibly ancient, making these forests a living museum of biodiversity."

Provided by Clemson University

Citation: Trees grow more efficient leaves to compensate for hurricane damage (2018, December 18) retrieved 16 July 2024 from <https://phys.org/news/2018-12-trees-efficient-compensate-hurricane.html>

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