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Tropical rainforest plants can switch nitrogen source

Plants in tropical rainforests are able to switch their source of the nutrient nitrogen in response to changes in precipitation. That's according to researchers from Princeton University and the University of Florida, US, who believe the findings indicate that tropical forest plants could be able to adapt to large charges in rainfall.

"As the climate continues to warm, tropical forests are expected to undergo radical changes in rainfall amounts, some becoming wetter, some drier," Ben Houlton, previously of Princeton University and now at Stanford University told *environmentalresearchweb*. "While other aspects of global warming and rainfall change may devastate tropical ecosystems, the acclimation of tropical plants to changes in nitrogen nutrition provides some hope for the future."

Houlton and colleagues looked at six montane tropical forest sites on the windward slopes of Mount Haleakala on the island of Maui, Hawaii. Mean annual precipitation in the region varies from 2,200 to 5,050 mm per year. The researchers measured the $^{15}N/^{14}N$ of leaves from a dominant canopy tree species, a subdominant canopy tree, a tree fern and an understorey woody plant.

"[Our study is] the first to completely characterize the N isotopic cycle of tropical forests," said Houlton. "Instead of manipulating the ecosystems to understand how they work, we used natural variations in the atomic masses of nitrogen in plants and soils to examine the nutrition of ecosystems."

For plants from the same site, the four species only showed slight differences in the value of $\delta^{15}N$, indicating that they were using the same nitrogen source. What's more, as the amount of rainfall increased, the plants' $\delta^{15}N$ value decreased roughly twice as much as the soil's.

By examining isotope ratios in this way, the team established that at drier sites the dominant source of nitrogen for vegetation was nitrates in soil whereas at wetter sites ammonium was the main contributor of the element. The plants appeared to switch nitrogen source at a threshold mean annual precipitation ratio of about 3,300 mm.

It looks like the plants switched to the most abundant form of inorganic nitrogen in the soil: rainfall affects rates of microbial nitrogen mineralization, nitrification and denitrification.

According to Houlton, one of the central questions of ecology is how ecological communities can be so diverse in a world of limited resources. "The so-called 'niche' argument posits that, by specializing on different forms of the same nutrient, diverse groups of species can coexist in ecosystems," he said. "Our results contrast with this idea, indicating that natural selection has not caused tropical plant species to separate into nutrient niches. It therefore appears that other mechanisms are responsible for the tremendous diversity of species found in tropical rainforests."

Now the researchers plan to develop a global perspective of forest-nutrient-climate interactions by using a similar approach. "The goal is to develop a theory that's applicable to the tropical biome as a whole, and then use this theory to forecast ecosystem responses to rapid changes in carbon dioxide and global warming," said Houlton.

The researchers reported their work in *PNAS*.

About the author
Liz Kalaugher is editor of *environmentalresearchweb*.

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