

Tropical plants go with the flow ... of nitrogen

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Tropical plants are able to adapt to environmental change by extracting nitrogen from a variety of sources, according to a new study that appears in the May 7 early online edition of *The Proceedings of the National Academy of Sciences*.

By demonstrating that not all plants specialize in one specific source of nitrogen, the result turns a commonly held theory on its head. It also provides a dose of optimism that tropical forests will be able to withstand environmental shifts in nutritional cycles brought on by global climate change.

Nitrogen is an essential nutrient that plants must absorb from the soil to survive. Most land plants outside the tropics appear to have evolved to rely on just one of three common sources of nitrogen: nitrate (NO_3^-), ammonium (NH_4^+), or dissolved organic nitrogen (DON). As a result of this limitation, they usually inhabit "niches" defined largely by the available nitrogen source. When that source crashes for any reason—often because of shifts in climate—the plants cannot adapt, with potentially disastrous consequences for natural ecosystems.

However, tropical species appear to be far more adaptable than their temperate kin when it comes to their nitrogen needs. A team of researchers* has found that, when confronted with shifts in nitrogen availability, these plants simply "flip a switch" and use whatever is handy.

"When it comes to nitrogen, the tropical plants we studied behave like kids at a pizza party—they may prefer pepperoni, but if only plain cheese is available, they'll still have a slice," said lead author and postdoctoral researcher Benjamin Houlton of the Carnegie Institution's Department of Global Ecology. "This result gives a glimmer of hope that tropical ecosystems may have the capacity to adjust to certain aspects of climate change."

Working in six well-known sites with variable rainfall on Hawaii's Maui Island, the researchers measured the soil content of nitrate, ammonia, and dissolved organic nitrogen. They also determined each source's relative contribution to the growth of a variety of plant species, from small floor-dwelling shrubs, to tree ferns, to tall canopy trees.

In dry areas, nitrate was most readily available, while in wetter areas, ammonium was the dominant source. The plants made use of whichever of these two sources was most common in their native soil. Dissolved organic nitrogen was plentiful, but did not make a significant contribution to plant growth at any of the sites.

To examine the plants' nutritional response to climate change, the researchers combined new measures and models of variations in the atomic masses of nitrogen compounds that occur naturally in plants and soils. By examining these different masses, known as isotopic ratios, across different rainfall climates, they discovered an abrupt shift in the nitrogen cycle and in the nutritional strategies of entire forest communities.

"It really is quite striking; once the soil gets wet and nitrate drops below a certain threshold, the tropical plants all begin using ammonium in near-perfect unison," Houlton explains. "If these diverse plant species can be flexible in their nitrogen metabolism—thought to be non-negotiable in many temperate ecosystems—then maybe they can react to other

environmental stresses just as gracefully. Still, our results will need further testing in vast areas of the tropics before we will know how well they truly represent the entire ecosystem."

Source: Carnegie Institution

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