Team finds natural reasons behind nitrogen-rich forests

January 16 2012, By Evelyn Boswell

This nitrogen-rich mountain rainforest is located on Volcan Orosi in Costa Rica. (Photo by Jack Brookshire).

(PhysOrg.com) -- Many tropical forests are extremely rich in nitrogen even when there are no farms or industries nearby, says Montana State University researcher Jack Brookshire.

It's because of biological interactions that occur naturally in the forests, Brookshire and four colleagues said in a paper they published Jan. 15 in the online version of the journal Nature Geoscience.

Disputing some long-held beliefs about high nitrogen levels in forests, Brookshire said pollution isn't always the reason behind it. It can also be caused by natural interactions between the forest and nutrient cycles.

Brookshire and his team suggested that in mountainous tropical forests, nitrogen availability may not limit plant growth or its response to higher carbon dioxide levels in the atmosphere.

Brookshire began his study in 2006 when he was a postdoctoral researcher at Princeton University. He continued it after moving to MSU in 2009. He is now an assistant professor in the Department of Land Resources and Environmental Sciences.

To conduct their study, Brookshire, two scientists from Princeton University and two researchers from the Stroud Water Research Center in Avondale, Pa., used data collected between 1990 and 2008 to examine the concentration of dissolved nitrogen compounds and the isotopic composition of nitrate in streams in six mountain forests in Costa Rica and 55 mountain forests across Central American and the Caribbean.

All of the forests were old-growth tropical forests with no signs of large-scale disturbance. They were classified as mountain evergreen, mountain rainforest or cloud forest. Evergreen forests in Costa Rica are at lower altitudes. Rainforests are at higher elevations. Cloud forests are at the highest elevation. They are bathed in clouds or moisture for much of the year.

A stream drains a nitrogen-rich rainforest in the Northern Range of Trinidad. (Photo by Jack Brookshire).

The researchers also examined new samples that Brookshire collected in Costa Rica and Trinidad. Sampling was an exciting process that involved hiking through thick forests and swimming through narrow rock gorges, Brookshire said. He was able to avoid snake bites, but not the stinging insects or oppressive humidity.

"You don't dry out," Brookshire said.

The research team found high levels of nitrate in the streams of the tropical forests, indicating large losses of bioavailable nitrogen, Brookshire said. They also found evidence that the loss wasn't recent or a one-time thing. They discovered that the nitrate resulted from plant-soil interactions and not directly from atmospheric deposition.

Tropical forests are significant reservoirs for carbon, and their future relies on forest interactions with nutrient cycles, he said.

Scientists in the past have compared the effect of industry and agriculture on the temperate forests of the northern hemisphere, but relatively little research has been conducted on forests near the equator, Brookshire said. He decided to look at forests in Costa Rica and Trinidad because he already had colleagues there and they, like him, were intrigued by the fact that some tropical forests have dramatic nitrogen exports without apparent human causes.

"These systems have a natural capacity to build up levels of nitrates in soil that we only see in the most polluted temperate forests," Brookshire said.

The research published in *Nature Geoscience* will continue, Brookshire said.

"This is an on-going research project to figure out how forests work in the larger earth climate system and how they might respond to global change," Brookshire said. "The deep mysteries about how these ecosystems work, we are just beginning to understand. Things are much more complex than previously thought."

Co-authors on the Nature Geoscience paper were Lars Hedin and Daniel Sigman at Princeton University, and Denis Newbold and John Jackson from the Stroud Water Research Center. Their research was supported by grants from the A.W. Mellon Foundation, the National Science Foundation, the National Oceanic and Atmospheric Administration and research endowments at Stroud.

Provided by Montana State University