UC Davis researcher leads climate-change discovery

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A team of researchers led by a first-year UC Davis faculty member has resolved a longstanding paradox in the plant world, which should lead to far more accurate predictions of global climate change.

A paper describing the research will be published online Wednesday (June 18) by the journal *Nature*.

The paradox centers on puzzling aspects of the nitrogen cycle in temperate and tropical forests. Defying laws of supply and demand, trees capable of extracting nitrogen directly from the atmosphere (a process called nitrogen fixation) often thrive where it is readily available in the soil, but not where it is in short supply.

Nitrogen is essential to all life on Earth, and determines how much carbon dioxide ecosystems can absorb from the atmosphere, said UC Davis assistant professor Benjamin Houlton, who tackled the problem with colleagues including top international ecologist Peter Vitousek, the Clifford G. Morrison Professor in Population and Resource Studies at Stanford University.

"You would expect that nitrogen-fixing species would have a competitive advantage in ecosystems where nitrogen is in low supply, but not where nitrogen is abundant, because fixation is energetically very costly to an organism," says Houlton, lead author of the paper.

"And in fact that's the way ecologists have found it works in the open

ocean and in lakes. But in mature temperate forests, where the soils have limited amounts of nitrogen, nitrogen-fixing tree species are scarce. And in the tropical lowland forests, which are nitrogen-rich, nitrogen-fixing trees often are abundant.

Houlton and his collaborators found the explanation lies in the key roles played by two other factors: temperature and the abundance of another key element, phosphorus.

Temperature, they determined, affects the activity of a nitrogen-fixing enzyme called nitrogenase. In cooler, temperate climates, more of the enzyme is needed to fix a given amount of nitrogen. This higher cost would offset the benefit of nitrogen fixation in temperate forests, despite low-nitrogen soils.

In tropical forests, it's the link between nitrogen and phosphorus that explains the abundance of nitrogen-fixing species.

"Many tropical forest soils are severely depleted in phosphorus, even where nitrogen is relatively abundant," said Houlton. "The extra nitrogen added to the soil by nitrogen-fixers helps mobilize phosphorus, making it easier for roots to absorb. That stimulates the growth of these plant species and puts them at a competitive advantage, despite the energetic cost of nitrogen fixation."

Source: University of California - Davis