Like humans, ants use bacteria to make their gardens grow

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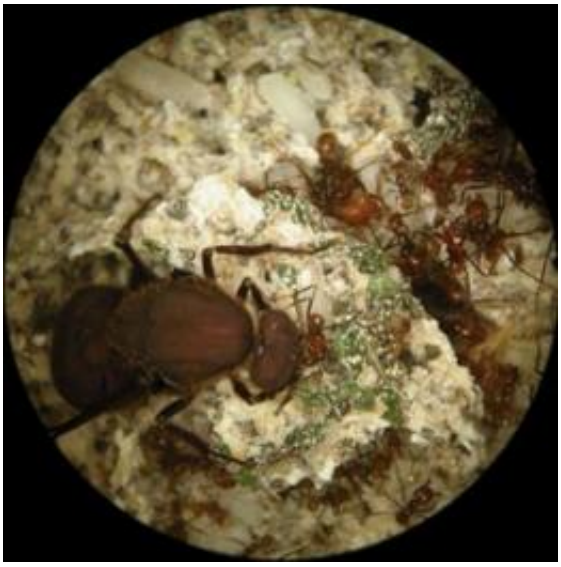

Pictured in October 2009, a leaf-cutter ant queen tends to a fungus garden in her colony, surrounded by her brood. These ants grow a fungus, which serves as the primary food source for the entire colony, using leaves the ants harvest from the rainforest. Recent research in the lab of Cameron Currie, associate professor of bacteriology at the University of Wisconsin-Madison, has revealed two symbiotic bacteria in the fungus garden that fix nitrogen for these ants. Nitrogen is a limiting nutrient in Neotropical ecosystems. Photo: Michael Poulsen

(PhysOrg.com) -- Leaf-cutter ants, which cultivate fungus for food, have many remarkable qualities.

Here's a new one to add to the list: the ant farmers, like their human

counterparts, depend on nitrogen-fixing bacteria to make their gardens grow. The finding, reported this week (Nov. 20) in the journal *Science*, documents a previously unknown symbiosis between ants and bacteria and provides insight into how leaf-cutter ants have come to dominate the American tropics and subtropics.

What's more, the work, conducted by a team led by University of Wisconsin-Madison bacteriologist Cameron Currie, identifies what is likely the primary source of terrestrial nitrogen in the tropics, a setting where nutrients are otherwise scarce.

"Nitrogen is a limiting resource," says Garret Suen, a UW-Madison postdoctoral fellow and a co-author of the new study. "If you don't have it, you can't survive."

Indeed, the partnership between ant and microbe permits leaf-cutters to be amazingly successful. Their underground nests, some the size of small houses, can harbor millions of inhabitants. In the Amazon forest they comprise four times more biomass than do all land animals combined.

"This is the first indication of bacterial garden symbionts in the fungus-growing ant system," says Currie, a UW-Madison professor of bacteriology.

A critical finding in the new study, according to the Wisconsin scientist, is that the nitrogen, which is extracted from the air by the bacteria, ends up in the ants themselves and, ultimately, benefits the nitrogen-poor ecosystems where the ants thrive.

The fungus-growing ants, Currie notes, are technically herbivores. They make their living by carving up foliage and carrying it back to their nests in endless columns to provide the raw material for the fungus they grow as food. "But plant-feeding insects are known to be nitrogen limited,"

explains Currie, "and the plant biomass nitrogen is lower than what the insects need for survival."

Enter the nitrogen-fixing bacteria, two species of which were isolated in laboratory and field colonies of the ants. But merely finding the bacteria, Suen emphasizes, wasn't enough. It was necessary to prove that the ants were actually utilizing the nutrient to confirm a true mutualism.

"This is important because it could be that the bacteria are fixing nitrogen for themselves and not actually benefiting the ants," says Suen. "Showing that the nitrogen fixed by the bacteria is incorporated into the ants establishes that these bacteria aren't just transient visitors."

One other type of insect, the termite, has been previously shown to utilize nitrogen-fixing bacteria. And other bacteria-ant symbioses have been documented.

However, the discovery of the nitrogen-fixing mutualism in ants has significant ecological implications given the dominance of ants in virtually all of the word's terrestrial ecosystems. The new work suggests that an important source of nitrogen in the American tropics and subtropics is derived through the partnership of ant and bacteria.

Says Currie: "It is possible that this fixed nitrogen can have ecosystem scale impacts."

The partnership with bacteria, which Currie says could extend back to the origins of the gardening ants some 50 million years ago, confers a competitive edge that has permitted the leaf-cutters to prevail in their environments.

Says Suen: "Without nitrogen, there is no way these guys could achieve such large colony sizes. These ants are one of the most dominant insects

in the Neotropics. The ability to have colonies with millions of ants is predicted to require a tremendous amount of nitrogen."

Source: University of Wisconsin-Madison (news : web)