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Rainforests at risk from altered ant ecology  
 28 March 2003 15:00 GMT

by *William F. Laurance*



[Caption]

The contrasting activities of a vast array of ant species are central to rainforest ecology, but worrying data from research groups in Brazil and Germany suggest that the balance is under threat.

Ants are extraordinarily diverse in tropical forests, as evidenced by biologist E. O. Wilson's famous discovery that a single Amazonian tree contained more species of ant than occur in all of Great Britain. In rainforests, ants play many ecological roles, but perhaps none are more important than those of army ants and leaf-cutting ants. Unfortunately, as revealed by recent studies presented at the Tropical Ecology Society meeting in Rostock, Germany (19-22 February 2003), both groups are seriously affected by forest fragmentation.

Leaf-cutting ants are unique among non-human animals in being true farmers, cutting and harvesting leaves that they use to cultivate a specific, coevolved garden fungus. For the leafcutters, the fungus provides food and decomposes many defensive compounds (e.g. terpenoids, phenols, and alkaloids) in leaves, markedly increasing their potential dietary diversity.

Leafcutters normally occur at low densities in rainforests, but their populations can explode in agricultural lands where they kill or damage young cultivated trees and other crops. The ants also increase sharply on small (<10 hectares) land-bridge islands in Venezuela and along the margins of Amazonian forest remnants, suggesting that they can achieve atypically high densities in fragmented forests.

Studies led by Ranier Wirth and his graduate student Pille Urbas of Kaiserslautern University in Germany, and by Inara Leal of the Federal University of Pernambuco in Brazil, reveal that fragmented forests at Usina Serra Grande in Brazil's highly degraded Atlantic coastal region also have exceptionally high leafcutter densities. The

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David M. Wilkinson  
 The fungus-growing leaf-cutter ants (Attini: Formicidae) are well known from textbooks and television programmes<sup>1,2</sup>, and from field experience for some lucky biologists. The Attini are an American group comprising around...  
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authors studied forest fragments ranging from 500-3500 hectares (1 hectare = 2.5 acres) in areas that were surrounded by sugarcane plantations, and found that smaller fragments and fragment margins had nearly six times more leafcutter colonies than did forest interiors.

The authors suggest that both top-down and bottom-up processes could account for the super-abundance of leafcutters. As a result of microclimatic stresses and increased windthrow, the margins of forest fragments suffer chronically elevated tree mortality, leading to a proliferation of young 'pioneer' trees. These pioneers are favored by leafcutters because their leaves are often palatable and poorly defended against herbivore attack.

Urbas and colleagues found that colonies near fragment edges had much shorter foraging trails than those in forest interiors, indicating that they traveled less to find suitable food plants, and the diversity of their food plants was lower near edges, suggesting that the ants focused on a few superabundant pioneer species. The ants also occasionally fed on sugarcane in fields adjoining the fragments. Thus, bottom-up processes (greater food availability) clearly influenced the leafcutters in these fragmented forests.

The evidence for top-down control of leafcutters, by predators or parasites, is less compelling at present, although field experiments are still preliminary.

Regardless of the ecological mechanisms involved, the superabundance of leafcutters could have serious repercussions. By attacking and perhaps killing many pioneer trees near fragment edges, leafcutters may exacerbate the already-high rates of tree turnover in forest fragments, which affect forest structure and rates of nutrient cycling. The abundances of ecologically linked predator, prey, and parasite species are also likely to change in response to elevated leafcutter densities.

Of the countless number of tropical ant species, perhaps the most ecologically important of all are army ants. They are comprised by taxonomically diverse species that have converged ecologically to forage in large marauding swarms that attack any live animal they encounter. In the degraded Kakamega Forest of western Kenya, graduate student Marcell Peters and his advisor Manfred Kramer at the Alexander Koenig Research Institute in Bonn, Germany are studying the effects of rainforest fragmentation on the dominant army-ant species in east Africa, *Dorylus molestus*, whose massive swarms can involve up to ten million workers.

Army ants are believed to decline rapidly in Amazonian forest fragments, and Peters and Kraemer's results confirm these trends in east Africa. In forest fragments ranging from 100-1500 hectares in area, *D. molestus* colonies were less than half as abundant as in intact forest. The reasons

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for their reduced numbers are still unclear, but it is known that *D. molestus* rarely use agricultural fields surrounding fragments and may therefore suffer from the deleterious effects of population isolation in fragmented forests.

The decline of army ants could have large ecological reverberations. Their random foraging raids are thought to help maintain the remarkable diversity of rainforest invertebrates by creating areas of different species make-up and by preventing the dominance of forests by a few highly competitive species. Peters and Kraemer are currently sampling leaf-litter invertebrates to determine whether forest fragments are in fact more species poor than intact forests.

Army ants also sustain other species, such as specialized insectivorous birds that follow the marauding swarms in order to capture fleeing insects. Peters and Kraemer found that certain bird species, including ant-thrushes, greenbills, bristlebills, and illadopsis, show strong associations with ant swarms and thus are likely to be vulnerable should the ants disappear. In the Amazon, specialized ant-following birds vanish from most smaller (<100 hectares) forest fragments.

Collectively, these new studies suggest that two of the most ecologically important ant groups in the tropics are strongly affected - albeit in opposite ways - by habitat fragmentation, with leafcutters increasing and army ants declining in isolated forest remnants. In both cases, the trends appear similar across different continents or regions, suggesting that the observed changes are general in nature. The disruption of keystone ant assemblages and resulting ecological upsets reveal just how pervasive are the effects of habitat fragmentation on complex tropical rainforests.

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An army-ant column crossing a road in Gabon, central Africa (photo: William F. Laurance)

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More and more, biodiversity is at risk. Both in the Amazon and globally, ecosystems are being encroached upon, altered, and transformed by human activity. This in turn impacts the biodiversity of an area and the types and quality of functions an environment can provide. Scarlet Macaw (*Ara macao*) are seen here in Cristalino State Park. This park reserve is one of the most bio-diverse in the region and is currently under threat from illegal logging and fire. Drivers of Biodiversity Loss. The extinction of species is happening at rates never seen before – up to a thousand times faster than what w Rainforests are tall, hot and dense forests found all around the world and serve a significant purpose in the environment. They serve as the Earth’s oldest ecological system. Drought increase the risk of forest fires. The smoke can cause widespread health problems and increases concatenation of carbon dioxide in the atmosphere. What Can You Do? Today tropical rainforests are disappearing from the face of the globe. Despite growing international concern, rainforests continue to be destroyed at a pace exceeding 80,000 acres (32,000 hectares) per day. Tropical cover now stands at 2 billion hectares (7.7 million sq miles), an area about the size of the United States plus China and representing around 13 percent of the world's land surface. Much of this remaining area has been impacted by human activities and no longer retains its full original biodiversity. Economic, political, and social pressures will not allow rainforests to persist if they are completely closed off from use and development. So, what should be done? If we replant rainforests, could we bring deforested areas back to life? Learn how you can replant rainforests and possibly help prevent extinction. They also plan to increase the acreage of the core forest and study the ecology of the forest's animals, particularly its chimpanzees. Indonesia, where extensive rainforests have been severely decimated, is also investing in reforestation. On Nov. "Tropical forests are often talked about as the 'lungs of the earth,' but they're more like the sweat glands," said Lawrence. "They give off a lot of moisture, which helps keep the planet cool. That crucial function is lost -- and even reversed -- when forests are destroyed." The study found that relatively small plots of deforestation can actually increase rainfall at a local scale. There is, however, a critical clearing size above which rainfall declines dramatically. Any additional forest clearing would lead to rainfall reductions that could significantly change ecosystems, and compound the risk of additional dangers, such as an increase in forest fires. The location of deforested areas can also affect their impacts on regional climates, the study finds.