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Contact: Dr. William F. Laurance
laurancew@tivoli.si.edu
507-212-8525
[Smithsonian Institution](#)

Undisturbed Amazonian forests are changing, say scientists

A research team of U.S. and Brazilian scientists has shown that rainforests in central Amazonia are experiencing striking changes in dynamics and species composition. Although the cause of these changes—in what are believed to be completely undisturbed, old-growth forests—is uncertain, a leading explanation is that they are being driven by rising levels of carbon dioxide in the atmosphere.

Carbon dioxide levels have risen by 30% in the last 200 years as a result of industrial emissions, automobiles, and rapid forest burning, especially in the tropics. Much of this increase has occurred since 1960. Plants use carbon dioxide from the air for photosynthesis.

"The changes in Amazonian forests really jump out at you," said William Laurance, a U.S. scientist with the Smithsonian Tropical Research Institute in Panama. Laurance was the lead author of the paper, which appeared this week in the scientific journal *Nature* (Mar 11). "It's a little scary to realize that seemingly pristine forests can change so quickly and dramatically."

For the past two decades, the research team studied the fate of nearly 14,000 trees in the central Amazon, scattered across a landscape of 120 square miles in area. During the course of the study, most species of trees began growing faster. The forests also became more dynamic, with existing trees dying faster and being replaced by young new trees.

Even more important is that the species composition of the forest is changing. "There clearly are winners and losers," said Alexandre Oliveira of the University of São Paulo, Brazil, another team member. "In general, large, fast-growing trees are winning at the expense of smaller trees that live in the forest understory."

"The decline of many small trees is intriguing because they tend to be so specialized," said Henrique Nascimento, a Brazilian researcher at the Smithsonian Tropical Research Institute. "They live in the dark interior of the forest, and are the only trees that can flower and reproduce in deep shade."

The most likely reason for these changes, say the researchers, is that rising carbon-dioxide levels are fertilizing the forests, leading to faster growth and more competition among trees for light, water, and soil nutrients. Under these conditions, big, fast-growing species of trees probably have an advantage over small, slower-growing trees.

"Sadly, this could be a signal that the forest's ecology is changing in fundamental ways," said team-leader Laurance. "Tropical rainforests are renowned for having lots of highly specialized species. If you change the tree communities then other species—especially the animals that feed on and pollinate the trees—will undoubtedly change as well."

"This appears to be yet another signal of effects on nature from increasing greenhouse gas concentrations and associated climate change," said Thomas Lovejoy of the Heinz Center for Science, Economics and Environment in Washington, D.C., who helped to establish the tree study in central Amazonian over two decades ago. "We really need more research to see if these remarkable changes are also happening in other tropical forests around the world. If they are, then it's likely that even the world's remotest forests are now being altered by human activities."

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The Biological Dynamics of Forest Fragment Project, a joint effort of the National Institute for Amazonian Research (INPA) in Brazil and the Smithsonian Tropical Research Institute, seeks to answer questions about plant and animal relations, the biology of extinction, the process of forest regeneration, and the effects of forest edge and fragmentation on the genetic structure of tropical species.

The Smithsonian Tropical Research Institute is an international research center established in Panama by the Smithsonian Institution to increase knowledge of the past, present and future of tropical biodiversity and its importance to humanity. For more than 90 years, researchers, students and associates have conducted research in forest and marine habitats in Panama and at other sites throughout tropical regions of the world.
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