

Overcrowding increases tree mortality, perhaps explaining higher biodiversity in tropical forests

February 28 2024, by Jennifer Opel



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When a tree is surrounded by many similar individuals, its mortality increases, which is probably caused by specialized pathogens or

herbivores. This effect occurs in forests all over the world, but is more pronounced in rare tropical tree species, which could contribute to the astonishing tree species diversity of tropical forests.

This was discovered by a team of 52 scientists led by Lisa Hülsmann, Professor of Ecosystem Analysis and Simulation at the University of Bayreuth, and Florian Hartig, Professor of Theoretical Ecology at the University of Regensburg. Their paper is [published](#) in the journal *Nature*.

How tropical forest communities can support hundreds of species without one species becoming dominant and others going extinct has puzzled ecologists over centuries.

More than 50 years ago, ecologists Daniel Janzen and Joseph Connell hypothesized that the stable climatic conditions in the tropics allow [pathogens](#) to specialize more strongly on individual tree species, causing trees to grow less and die more frequently when surrounded by other trees of the same species—a reaction called [density](#) dependence.

If this density dependence increases towards the equator, this could explain the increase in tree species [diversity](#) towards the equator. Ecologists have long sought evidence of this phenomenon. But, until now, they did not have the data and analytical tools to compare the strength of the mechanism between tropical and temperate forests. The large international research team now used new methods and data to find out whether the hypothesized mechanism really exists.

"The nearly 2.5 million trees monitored at 23 sites worldwide show density dependence, but not necessarily more towards the tropics," says Lisa Hülsmann. However, in [tropical forests](#), species with stronger density dependence tended to be less abundant. The authors of the study suspect that this pattern is due to a more effective regulation of

population sizes in tropical forests.

This, in turn, could contribute to the comparatively high species diversity.

According to Florian Hartig, the results are partially consistent with Janzen and Connell's idea. Specialized pathogens may indeed have a stronger influence on tropical biodiversity than in temperate forests, but the link is more subtle than suspected.

Stuart Davies, Director of the ForestGEO network, states, "This study illustrates the fundamental importance of long-term, large-scale studies of the world's forests to elucidate the key processes that sustain biodiversity in these critical ecosystems."

The results of this study offer valuable insights into the mechanisms that influence biodiversity in tropical and [temperate forests](#). Especially in times of climate change, the highly specialized interactions between trees and pathogens could be disrupted, with potentially unfavorable effects on local tree species diversity. However, the researchers emphasize that further studies are needed to fully understand the implications of these findings for tree species diversity in different forest ecosystems.

More information: Lisa Hülsmann, Latitudinal patterns in stabilizing density dependence of forest communities, *Nature* (2024). [DOI: 10.1038/s41586-024-07118-4](https://doi.org/10.1038/s41586-024-07118-4).
www.nature.com/articles/s41586-024-07118-4

Provided by Bayreuth University

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