

# Competition is at the root of diversity in rainforests: study

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Another attractive theory falls foul of the facts. A census of trees in rainforests on three continents has confirmed that competition plays a central role in structuring communities. This contradicts the so-called neutral theory in ecology, which views random fluctuations as the decisive factor.

Ecologists are still arguing about the nature of the factors that determine the [species](#) composition of ecological communities. On the one hand, there are those who view interspecies competition as the key element. A second group of influential ecologists postulates that [random fluctuations](#) in [population structure](#) and rates of species dispersal play the dominant role, particularly in the biological communities found in species-rich [tropical rainforests](#). LMU biologist Professor Susanne Renner, who is Director of the Botanic Garden and herbaria in Munich, and Professor Robert E. Ricklefs of the University of Missouri in St. Louis have now analyzed data from censuses of tree species in rainforests around the globe and also taken advantage of [fossil evidence](#), allowing them to chart diversity in both space and time. Their findings show that variation in species richness among families is very similar in all [tropical forests](#) in spite of millions of years of independent evolution and diversification. This correspondence strongly suggests that community structure in rainforests cannot be attributed to the action of stochastic factors. "The high degree of similarity was a surprise even to us," says Renner. "The results can be regarded as a nail in the coffin of the neutral theory."

In even the best habitats, resources are inevitably limited. This means

that species must compete with each other for access to them. And for many ecologists, interspecies competition for resources is the critical factor that determines the composition of the community found in a given environment. According to the principle of competitive exclusion, two species that depend on the same vital resource or [ecological niche](#) for their survival cannot stably coexist. The better adapted species will ultimately displace its competitor.

In contrast, what is known as "neutral" theory postulates that stochastic variations in factors such as the rate of dispersal and extinction of species determine the patterns of species abundance in different communities. The American ecologist Stephen Hubbell is the leading proponent of neutral theory, which he developed to explain species-rich communities, such as tropical rainforests.

In these environments it is not uncommon to find hundreds of tree species growing close together. Hubbell contends that this makes it very unlikely that segregation of ecological niches and the principle of competitive exclusion are the overriding forces that determine community structure. His neutral theory has received a great deal of attention in recent years.

LMU biologist Professor Susanne Renner and her American colleague Professor Robert Ricklefs have now challenged the theory with the help of quantitative data. In Central and South American, African and Asian rainforests, the two researchers compared the abundance patterns of different [tree species](#) growing in plots of between 25 and 55 hectares. In addition, they compared the relative abundance of different families of trees in a 55- to 65-year-old fossil flora from tropical Colombia with their representation there today.

On the basis of the neutral theory, which assigns a leading role to stochasticity, one would not expect to find much similarity in

[community structure](#) over such a wide area and such a long span of time. However, the results of the new study show that when families are arranged in order of [species richness](#), the rankings that emerge are very similar on all three continents.

"The correlation is statistically highly significant," says Renner. "So we have uncovered a very substantial degree of agreement between the seven forest plots; even the numbers of trees per unit area that belong to a given taxonomic family are similar in all three regions. Moreover, the families with the highest species diversity in the Colombian rainforests today were already dominant 50 million years ago. The findings are astonishingly clear-cut, and should suffice to rule out the neutral theory."

**More information:** Global correlations in tropical tree species richness and abundance reject neutrality, Ricklefs, R. E.; and S. S. Renner, *Science Express*, January 26, 2012.

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