

Positive associations revealed as key driver in maintaining soil biodiversity and ecological networks

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In a study published in [PNAS](#), researchers analyzed 151 ecosystems across six continents, delved into the intricate coexistence network

among diverse species including bacteria, fungi, protists, and invertebrates, and for the first time, linked biotic coexistence relationships with global biodiversity maintenance, which offers insights into the understanding of soil biodiversity and its ecological networks.

This study by researchers from the Institute of Soil Science of the Chinese Academy of Sciences, the Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), and Universidad de Cádiz, challenges the traditional views that predominantly focus on competitive interactions in ecological networks by uncovering facilitative networks as more common in soil ecosystems.

This paradigm shift stems from recognizing that soil processes, like organic matter decomposition, necessitate cooperation among various species, which suggests that facilitation might play a more significant role. However, [empirical evidence](#) supporting this hypothesis has been scarce.

This study closed a gap in the understanding of the basic structures of biotic associations that form complex soil organism communities. While research on plant and animal networks has explored network motifs—associations among species triads—and their ecological significance, their application to soil networks remained unexplored.

The study offers insights into questioning whether soil networks significantly differ from those of other taxa or follow universal ecological principles.

Moreover, the study demonstrates that soil networks characterized by higher levels of positive facilitation foster richer soil taxa and more stable biotic coexistence patterns, even when accounting for variables like soil properties, climate, and spatial factors.

It identifies temperature seasonality as a predictor of the global distribution of positively facilitated soil network modules, offering new perspectives on the widespread nature of facilitative associations among soil organisms and their pivotal role in sustaining global soil biodiversity.

"This study underlines that positive facilitation is predominant in soil microbial associations and is vital for the diversity and stability of soil biological networks. This globally consistent pattern underscores the role of cooperative interactions in complex soil networks," said Prof. Chu Haiyan, one of the authors of this study.

Prof. Manuel, another author, pointed out that the complexity of ecological networks, encompassing both specific and higher-order associations across multiple [trophic levels](#), underscores the need to consider unexplored variables in biodiversity and functioning, and [rare species](#) and weak correlations could be included in further soil [network](#) studies.

In conclusion, the study establishes facilitation as a key driver in maintaining diverse and stable soil networks, which is crucial for supporting soil biodiversity and enhancing ecological stability against global changes.

More information: Xu Liu et al, Positive associations fuel soil biodiversity and ecological networks worldwide, *Proceedings of the National Academy of Sciences* (2024). [DOI: 10.1073/pnas.2308769121](https://doi.org/10.1073/pnas.2308769121)

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