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Generality of biodiversity-productivity relationships in global forests

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Liang et al. (1) analyzed relationships between one aspect of biodiversity, tree species richness, and productivity for a large number of forests around the globe. This was likely motivated by the considerable interest in and debate concerning this relationship, as characterized by scientific discourse from both ecological and conservation perspectives. Although we do not question the accuracy or importance of their findings, we strongly caution against generalizing from mono-trophic and unidimensional biodiversity studies to understand how all trophic levels and dimensions of biodiversity are related to productivity. Like others, we contend that biodiversity has many dimensions, species richness being at best an incomplete indicator of the taxonomic dimension (2–4). Liang et al. state that "because taxonomic diversity indirectly incorporates functional, phylogenetic, and genomic diversity, our results that focus on tree species richness are likely applicable to these other elements of biodiversity, all of which have been found to influence plant productivity" (p4). This statement is an assumption that is not fully justified from conceptual or empirical perspectives.

First, variation in species richness is not always correlated with other aspects of taxonomic biodiversity (e.g. evenness and diversity) that reflect the abundances of species (5), and taxonomic diversity need not be strongly associated with phylogenetic, functional, or genetic dimensions of biodiversity (6). Second, the different dimensions of biodiversity may indeed "influence plant productivity", but do so in different ways (5, 7, 8). Third, although trees may represent the defining constituents of forests, they are only one group of species that affect ecosystem processes and services. Variation in tree biodiversity may not be representative of that of the myriad other taxa that comprise forest food webs. It is well known that plants and animals respond differently to productivity (9), and that the relationship between aspects of biodiversity and productivity may be mediated by disturbances that affect different species groups in markedly different ways (10, 11). Lastly, to support their statement, Liang et al. refered to a review on the knowledge on the relationship between biodiversity and ecosystem functioning by Naeem et al. (2). However, Naeem et al. acknowledge the importance of working with multiple rather than single dimensions of biodiversity, and plead for integrative approaches to better understand why and how multiple dimensions of biodiversity influence ecosystem functioning.

Importantly, these cautions do not contradict the recommendations of Liang et al. to promote biodiversity conservation through forest management. Nevertheless, the results of their analyses only support the conservation of tree species richness. We emphasize that forest

productivity is a consequence of the interactions of many species groups within an ecosystem (12), and stress that the preservation of animals that pollinate flowers or disperse seeds may be equally important for sustaining forest productivity as is the conservation of tree species richness (13).

In conclusion, we do not deny that tree species richness is related positively to productivity at the scales considered by Liang et al., and congratulate the authors for their Herculean and innovative efforts to analyze this relationship at a global extent. At the same time, we emphasize that ample evidence supports the proposition that relationships between productivity and different components of taxonomic biodiversity, or between productivity and different dimensions biodiversity, are not necessarily positive, and that such relationships are in fact largely unknown for most clades of the tree of life.

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