

# Rethinking the nature of intraspecific variability and its consequences on species coexistence

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## Abstract

Context Intraspecific variability (IV) has been proposed to explain species coexistence in diverse communities. Assuming, sometimes implicitly, that conspecific individuals can perform differently in the same environment and that IV blurs species differences, previous studies have found contrasting results regarding the effect of IV on species coexistence. Objective We aim at showing that the large IV observed in data does not mean that conspecific individuals are necessarily different in their response to the environment and that the role of high-dimensional environmental variation in determining IV has been largely underestimated in forest plant communities. Methods and Results We first used a simulation experiment where an individual attribute is derived from a high-dimensional model, representing “perfect knowledge” of individual response to the environment, to illustrate how a large observed IV can result from “imperfect knowledge” of the environment. Second, using growth data from clonal Eucalyptus plantations in Brazil, we estimated a major contribution of the environment in determining individual growth. Third, using tree growth data from long-term tropical forest inventories in French Guiana, Panama and India, we showed that tree growth in tropical forests is structured spatially and that despite a large observed IV at the population level, conspecific individuals perform more similarly locally than compared with heterospecific individuals. Synthesis As the number of environmental dimensions that are typically quantified is generally much lower than the actual number of environmental dimensions influencing individual attributes, a great part of observed IV might be misinterpreted as random variation across individuals when in fact it is environmentally-driven. This mis-representation has important consequences for inference about community dynamics. We emphasize that observed IV does not necessarily impact species coexistence per se but can reveal species response to high-dimensional environment, which is consistent with niche theory and the observation of the many differences between species in nature.

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