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## Rethinking the role of intraspecific variability in species coexistence

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► **To cite this version:**

Camille Girard-Tercieux, Isabelle Maréchaux, Ghislain Vieilledent, Raphaël Pélissier. Rethinking the role of intraspecific variability in species coexistence. Lessons, advances, and opportunities in the face of global change, Association for Tropical Biology and Conservation (ATBC), Jul 2021, Virtual Meeting, United States. hal-03333671

**HAL Id: hal-03333671**

**<https://hal.inrae.fr/hal-03333671>**

Submitted on 3 Sep 2021

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**ID:** ATBC202155

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**Title:**

Rethinking the role of intraspecific variability in species coexistence

**Abstract:**

How species coexist while competing for the same resources is a long-standing question in community ecology, particularly for hyperdiverse communities like tropical forests. In the past decades, intraspecific variability (IV) and its ecological consequences became of major interest, and IV was perceived as a potential mechanism enabling species coexistence, with contrasting results in the literature however.

We argue that taking the nature of IV into account is important to understand its effects on coexistence, and hypothesise that environmental variation alone can produce IV in performance.

Focusing on spatial environmental variation, we build a body of evidence to support this idea. First, we use a theoretical model using virtual data of individual growth across environmental gradients, using less explicative environmental variables in the model than to generate the data. Second we analyse a Eucalyptus clonal dataset in Brazil. Lastly we analyse three datasets from contrasting tropical forests : Paracou in French Guiana (Amazonia), Barro Colorado Island in Panama (Central America) and Uppangala in the Western Ghats in India (Southeast Asia).

The theoretical model shows that observed IV can emerge due to the lower dimensionality of field observations compared with the high dimensionality of the environment, without any intrinsic differences between conspecifics; the clonal dataset analysis shows that IV can emerge from exogenous factors; the tropical dataset analyses show that IV in growth is high in tropical forests, that growth is broadly spatially

autocorrelated, which we suppose is a mark of its environmental origin, and that locally, conspecifics have a more similar growth than heterospecifics.

This body of evidence shows that IV can emerge from environmental variation and without any intrinsic differences between conspecific individuals. Based on theory, which shows that intraspecific competition must be stronger than interspecific competition to enable species coexistence, we link higher local similarity to higher competition and conclude that intraspecific variability does not preclude this condition, enabling multiple species to coexist in high dimensional and spatially structured environments.

**Keywords:**

Coexistence, Intraspecific-variability, high-dimensional-niche, spatial-structure, Performance, Competition