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Research

Intraspecific trait variation and covariation in a widespread tree species (*Nothofagus pumilio*) in southern Chile

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Summary

• The focus of the trait-based approach to study community ecology has mostly been on trait comparisons at the interspecific level. Here we quantified intraspecific variation and covariation of leaf mass per area (LMA) and wood density (WD) in monospecific forests of the widespread tree species *Nothofagus pumilio* to determine its magnitude and whether it is related to environmental conditions and ontogeny. We also discuss probable mechanisms controlling the trait variation found.

• We collected leaf and stem woody tissues from 30–50 trees of different ages (ontogeny) from each of four populations at differing elevations (i.e. temperatures) and placed at each of three locations differing in soil moisture.

• The total variation in LMA (coefficient of variation (CV) = 21.14%) was twice that of WD (CV = 10.52%). The total variation in traits was never less than 23% when compared with interspecific studies. Differences in elevation (temperature) for the most part explained variation in LMA, while differences in soil moisture and ontogeny explained the variation in WD. Traits covaried similarly in the altitudinal gradient only.

• Functional traits of *N. pumilio* exhibited nonnegligible variation; LMA varied for the most part with temperature, while WD mostly varied with moisture and ontogeny. We demonstrate that environmental variation can cause important trait variation without species turnover.

Introduction

Knowledge of plant functional traits and diversity offers a promising path to understanding and predicting how vegetation properties and composition change along geographical gradients (Díaz & Cabido, 2001; McGill *et al.*, 2006; Westoby & Wright, 2006). Aspects such as plant morphology, function and diversity of a community can be partially assessed by determining variation in plant traits (Weiher *et al.*, 1999; Westoby *et al.*, 2002; Preston *et al.*, 2006; Díaz *et al.*, 2007). The focus has correspondingly been on functional trait comparisons at the interspecific level, while intraspecific trait variation has received remarkably little attention (Alonso & Herrera, 2001; Hulshof & Swenson, 2010); that is, traits are commonly pooled together around a community and only an average trait value for species is considered, ignoring intraspecific variation (Cianciaruso *et al.*, 2009; Lake & Ostling, 2009; Albert *et al.*, 2010). This does not mean, however, that intraspecific trait variation is either negligible or not important, but it is recognized as being lower, particularly in places where plant diversity is high. Notably, when cross-species studies are conducted, it is acknowledged that trait values are the result of both phylogenetic inertia and natural selection of the environment (Falsenstein, 1985). One special case, however, where phylogenetic inertia is absent and not artificially ruled out (i.e. most of the variation is the result of selective forces from the environment) is when trait comparisons are done at the within-species level.

Within the functional trait paradigm, intraspecific trait variation across environmental gradients has, in the main, been disregarded and consequently less studied than interspecific variation, for several reasons. First, in most of the cases, species composition changes substantially along