The role of observation scale, trait correlation and competitive regime in community assembly patterns

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Résumé

Disentangling community assembly processes is a major aim in Ecology. Many empirical studies rely on the "filtering framework," which characterizes community assembly as a sequence of abiotic and biotic filters. The success of the ecological filtering framework lies in its theoretical foundation, linking environmental filtering to niche theory, and competitive interactions to coexistence theory. It has provided evidence of environmental filtering in a wide range of environments. However, while competitive interactions are omnipresent, few applications of the filtering framework found significant evidence of competition. Consequently, the framework has been criticised for being overly simplistic. We argue that this unbalanced picture is likely due to specific conceptual challenges. First, several traits are used in empirical work without a clear distinction between traits that capture species responses' to the environment *vs.* their effects on other species, and without consideration of how these traits co-vary. Second, it neglects that abiotic filters and competition can produce the same diversity patterns. Third, the spatial scale at which the community is observed strongly impacts the resulting patterns but not always in the expected way.

Here, we explore these three conceptual challenges and test how functional patterns resulting from different assembly processes, traits and scales vary. Using a theoretical simulation model, we demonstrate that the functional patterns resulting from environmental filtering and competition respond differently to variations in traits' correlation structure and observation scales. We then identify the actual parameter ranges in which it is possible to distinguish signals of distinct assembly processes from patterns, given the correlation and relevance of traits and the inherent constraints of the observational scale.

Mots-Clés: environmental filter, biotic filter, limiting similarity, fitness difference, functional diversity, trait, based patterns

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