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Using HMSC models to understand interaction assembly

Recently, an extension of hierarchical modeling of species communities (HMSC) has been applied to evaluate how species traits affect the strength of pairwise interactions (HMSC-I). In classical HMSC models, species environmental responses are sampled from a common distribution whose expected values depend on species traits and phylogeny. In HMSC-I model, interaction rates depend on trait-matching between partners and their phylogeny. For example, interaction strength between frugivores and plants can rely on animal preferences for small fruits, which in turn depends on their body size and some phylogenetically-preserved behavior like fruit-handling.

HMSC-I formulation results particularly attractive for studying interactions since it reflects in a simple and tractable way the behavioral mechanisms underpinning partner choices. From a theoretical perspective, it allows to quantify the relative effect of trait-matching vs coevolution in interaction assembly or rank traits according to their importance. Both issues are cornerstone questions of interaction research. From an applied standpoint, HMSC-I model can predict pairwise interactions in new environmental contexts, which is critical in a global change scenario. Finally, HMSC-I model can provide valuable information about foraging preferences of rare species, something largely overlooked.

To illustrate the potential of HMSC-I, we used a zero-inflated model that quantifies trait and phylogeny effects on plant-frugivore interaction networks from contrasting communities. According to the theory of forbidden interactions, we expect trait-matching between fruit diameter and frugivores' body size to determine the probability of an interaction to occur (not all fruits can be handled by small frugivores). In addition, we expect species abundances and fruit nutrient content to affect interaction rates. This reflects that common species encounter more frequently and highly frugivorous' species restrict their diet to sugar-rich fruits. Finally, we hypothesize that the strength of trait effects will depend on the community context. In communities with a higher number of fruiting species or more functionally diverse, animals can be more selective; thus, trait effects should be stronger. In contrast, in communities with a lower number of resources available, animals should forage more randomly, and hence, interactions would mostly depend on species-specific abundances. We hope this work stimulates applying HSMC models to interaction research.