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Tests of neutral theory predictions for the Barro Colorado Island tree community informed by regional abundance data

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Neutral theory has the potential to serve as a quantitative process-based null model in ecology, whose rejection indicates the importance of processes of interest in assembling communities, such as niche differentiation and habitat filtering. So far tests of neutral theory have not been revealing however. Its predictions provide a good fit to the relative abundance distribution of tree species in the tropical forest on Barro Colorado Island, as well as other data sets. However, these predictions are based on using a neutral model for the regional or "meta" community as well as for the local community. This neutral model for the regional community is problematic in its assumptions regarding speciation, and its key parameter is allowed to vary in generating neutral theory fits to local community observations. Processes assembling the local community might be better detected by testing a neutral model instead informed by observations of the state of the regional community. Here we carry out such a test, comparing the structure of the community of tree species in the 50 ha Barro Colorado Island plot with predictions of a spatially-implicit neutral model that bases each species' regional abundance on data from over 50 plots that have been established around the Panama Canal Basin since 1994. We find that an unrealistically low immigration rate is needed for the neutral model to accurately predict species richness and the species abundance distribution. We detect selection for and against some species in the community. We are currently examining potential relationships between detected selection and biological parameters such as dispersal ability, abiotic associations, and life-history strategy. Our results suggest more refined versions of this approach, involving a more detailed neutral or dispersal-assembly model, may be fruitful. Detected selection could then be organized along trait axes to look indications of niche differentiation and habitat filtering.

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