Alpha and beta diversity of plants and animals along a tropical land-use gradient

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Abstract

Assessing the overall biological diversity of tropical rain forests is a seemingly insurmountable task for ecologists. Therefore, researchers frequently sample selected taxa that they believe reflect general biodiversity patterns. Usually, these studies focus on the congruence of α diversity (the number of species found per sampling unit) between taxa rather than on β diversity (turnover of species assemblages between sampling units). Such approaches ignore the potential role of habitat heterogeneity that, depending on the taxonomic group considered, can greatly enhance β diversity at local and landscape scales. We compared α and β diversity of four plant groups (trees, lianas, terrestrial herbs, epiphytic liverworts) and eight animal groups (birds, butterflies, lower canopy ants, lower canopy beetles, dung beetles, bees, wasps, and the parasitoids of the latter two) at 15 sites in Sulawesi, Indonesia, that represented natural rain forest and three types of cacao agroforests differing in management intensity. In total, we recorded 863 species. Patterns of species richness per study site varied strongly between taxonomic groups. Only 13–17% of the variance in species richness of one taxonomic group could be predicted from the species richness of another, and on average 12–18% of the variance of β diversity of a given group was predicted by that in other groups, although some taxon pairs had higher values (up to 76% for wasps and their parasitoids). The degree of congruence of patterns of α diversity was not influenced by sampling completeness, whereas the indicator value for β diversity improved when using a similarity index that accounts for incomplete sampling. The indication potential of α diversity for β diversity and vice versa was limited within taxa (7–

20%) and virtually nil between them (0–4%). We conclude that different taxa can have largely independent patterns of α diversity and that patterns of β diversity can be more congruent. Thus, conservation plans on a landscape scale need to put more emphasis on the high heterogeneity of agroforests and the overarching role of β diversity shaping overall diversity patterns.