Global patterns of vascular plant species richness, endemic richness and endemicity: a new approach to identify hotspots and cold spots

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Background: Endemic species, and their spatial distribution, have fascinated botanists for centuries, and regions with high levels of endemism have been the focus of much botanical and ecological research (Hobohm 2014). In this paper we refer to endemicity as the percentage of endemic species within an assemblage of species (flora), and to endemism as the corresponding absolute number and phenomenon in general. Endemicity is an ecological concept that is hard to tackle, as the level of endemism inevitably increases with area, both absolute and relative terms. This raises the question when a certain geographic entity can be considered as exceptionally rich in endemics. This study aims to propose a general framework to explain the variation of endemicity and the positive and negative deviation from its expectations.

Methods: We addressed this question by calculating a global mean level of endemicity of vascular plants in relation to grain size, for different regions spread in all the biomes of the planet. We did this by using a comprehensive data set of value triplets of area, native species richness and endemic species richness for several hundreds of geographic entities covering all continents and biomes and a very wide range of different sizes in a balanced manner. These triplets were collected by published and unpublished sources, as well as databases but also by the kind contribution of several colleagues from different continents. We then analysed the area dependence of total species richness (species-area relationships), endemic species richness (endemics-area relationships) and fraction of endemics (endemicity-area relationships). We carried out these analyses separately for islands and continents, and on the continents separately for the major zonobiomes. Several function types including some with breakpoints (Dengler 2010) were fitted for each of the datasets with non-linear regression.

Main Results & Interpretations: Generally, power functions provided a valid model to describe all three relationships. Like in the global analysis for species-area relationships of vascular plants by Gerstner et al. (2014), we found pronounced differences between zonobiomes (mostly in the c-value, partly also in the z-value) for all three types of diversity-area relationships. Islands had steeper species-area and shallower endemics-area curves than mainland areas. Finally, consistently across all subsets, the species-area relationships became steeper (i.e. had a higher z-value) above a certain grain size, typically at a grain size of about 100 000 km². Then, we combined the various diversity-area relationships of the various zonobiomes and islands into global mean functions, weighted by fractional area, of global vascular plant species richness, endemic richness and endemicity. Based on these global mean relationships we proposed a normal endemicity index to assess how much a geographic entity (of any size) is below or above the expected value.

References

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Chiarucci, A., Beierkuhnlein, C., Essl, F., Fernández-Palacios, J.M., Jentsch, A., Hobohm, C., Kreft, H., Krestov, P.V., Löbel, S., Steinbauer, M.J., Storch, D., Triantis, K., Weigelt, P. & Dengler, J. 2014. Global patterns of vascular plant species richness, endemic richness and endemicity: a new approach to identify hotspots and cold spots. In: Mucina, L., Price, J.N. & Kalwij, J.M. (eds.), ***Biodiversity and vegetation: patterns, processes, conservation*****, p. 78. Kwongan Foundation, Perth, AU.**