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A geometric model to explore multiple macroecological patterns across scales

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Macroecological patterns, such as the species area relationship (SAR), relative species abundance (RSA), and endemic area relationship (EAR) provide us useful information of ecosystem structures that can be applied to, for example, ecosystem conservations. To understand these patterns across spatial scales is one of the central challenges recent years. To tackle the challenge, we develop a spatially explicit geometric model where a set of species distribution ranges and individual distributions therein are described by spatial point processes. Essentially by calculating the number of individuals or distribution ranges given a sampling region, several well-known macroecological patterns are recovered including the tri-phasic SAR on a log-log plot with its asymptotic slope, and various RSAs such as Fisher's logseries and the lognormal distribution. In a simple manner, the EAR is also calculated in our framework. These multiple macroecological patterns can be derived with a single set of biological parameters, and therefore it may provide us a convenient way to discuss the multiple patterns in a consistent manner.

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