Between geometry and biology: How and why does the number of species depend on area

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There are few universal rules in ecology, but arguably one is the relationship between the area of a study plot and the number of species counted within that plot, the so called species-area relationship. Larger study plots obviously host on average more species than do smaller plots, and ecologists have long sought a universal description of this relationship.

Recently, it has been suggested that a universal species-area relationship can be calculated using Maximum Entropy methods once we know the average species richness for plots of a single size and the average number of individuals per species. If such a universal curve could be found, it would allow the development of practical tools for estimating species richness of large areas from smaller samples, or to estimate how many species go extinct after some portion of their habitat is destroyed.

In a paper published in the American Naturalist, a team of ecologists from Charles University in Prague, Czech Republic, and the University of Leeds, UK, have called such grand aspirations into question. They demonstrate that although there is indeed a relationship between the mean population size and the rate at which number of species increases with area, it cannot be universal across different groups of organisms.

"Mathematically, the same species-area relationship cannot hold both for a larger set of species and for the sub-groups within it. For example, the species-area relationship for animals overall cannot be the same as those for verterbrates or invertebrates examined separately", says Arnošt

Šizling, theoretical biologist from the Charles University. Rather than a deterministic relationship, the researchers found and described geometric limits that constrain how quickly the number of species can increase with area, and under which conditions it takes place.

Within these constraints, there is a room for biological effects such as the spatial aggregation of individuals within each species to affect the relationship. The species-area relationship is thus driven by the interplay of purely geometrical constraints and biological effects concerning patterns of distribution of individual species. Consequently, even though the shape of the species-area relationship shows pronounced regularities, its variation can reflect ecological differences between groups.

More information: Between Geometry and Biology: The Problem of Universality of the Species-Area Relationship. Arnošt L. Šizling, William E. Kunin, Eva Šizlingová, Jiří Reif and David Storch. *The American Naturalist* Vol. 178, No. 5 (November 2011), pp. 602-611. DOI: 10.1086/662176

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