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An ecological telescope to view future terrestrial vertebrate diversity

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ABSTRACT

Background: Some regions of the Earth sustain their own diversities through the processes of speciation and extinction. Theory predicts and data support the conclusion that the number of species (S) in such regions should attain a steady state whose value correlates with their areas (extents). Other data strongly suggest that climate plays a significant role in determining S.

Aim: Combine the influences of area and climate in a mathematical model that fits known global terrestrial vertebrate species diversities.

Data: The *WildFinder* terrestrial vertebrate data set of the World Wildlife Fund as it stood in January 2006 (less some data associated with islands). Each of *WildFinder*'s 825 ecoregions is accompanied by a set of abiotic variables (area and values of climate variables), as well as a list of the resident vertebrate species it contains.

Methods: Assign each ecoregion to a zoological region (*sensu* Sclater, 1858). Compile a list of all species that reside in each zoological region. Calculate the area of each region (A), the number of species in it (separated into the four vertebrate classes: Amphibia, Reptilia, Aves, Mammalia). Find a suitable variable to represent annual energy flow (i.e. ecological productivity). Determine the number of species endemic to each zoological region. Calculate the mean annual temperature (T) and actual evapotranspiration (AE) in each zoological region. Find the regression equations that best fit the numbers of species.

Results: The land has nine zoological regions (in order of area): Palearctic, Nearctic, Sub-Saharan Africa, Neotropics, Australasia, Indo-Malaysia, Madagascar, New Zealand, and Hawaii. The number of species, S, fits area ($R^2 = 0.84$; $P = 6 \times 10^{-4}$). Neither T by itself nor AE by itself is significantly correlated with S. However, adding either T or AE as the second variable in the regression does increase R^2 significantly. Their statistical effects on R^2 are virtually identical: using $\log A$ and $\log AE$ as independent variables yields $R^2 = 0.974$; using $\log A$ and T yields $R^2 = 0.973$. The results for the diversities of the four separate classes are quite similar to those of the total S, except that their four z-values vary from 0.53 to 1.07.

Conclusion: The Earth's terrestrial vertebrates face a mass extinction of 30–96%.

Keywords: climate, ecoregions, endemicity, mass extinction, realms, species–area relationships, species diversity, steady states, zoological regions.

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