Predicting the functional trait composition of insular communities: an application to tropical reef fishes

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Abstract

The Theory of Island Biogeography (TIB) predicts how area and isolation, through colonization and extinction dynamics, influence species richness equilibrium on insular habitats.However, the TIB remains silent about functional trait composition and provides no information on the scaling of functional diversity with area, an observation that is now documented in many systems. To fill this gap, we develop a probabilistic approach to predict the distribution of a trait as a function of habitat area and isolation, extending the TIB beyond the traditional species–area relationship. We then compare model predictions to the body-size distribution of piscivorous and herbivorous fishes found on tropical reefs using a database compiling the presence/absence of 991 reef-associated fishes in 134 locations worldwide. We find that small and isolated reefs have a higher proportion of large-sized species than large and connected reefs. We also find that knowledge of species body-size and trophic position improves the predictions of fish occupancy on tropical reefs, supporting both the allometric and trophic theory of island biogeography. The integration of functional ecology to island biogeography is broadly applicable to any functional trait and provides a general probabilistic approach to study the scaling of trait distribution with habitat area and isolation. This framework open new perspectives in the fields of macroecology, functional ecology and biodiversity management since it highlights the potential impact of habitat destruction and fragmentation on the functional reorganization of species assemblages.

Keywords: island biogeography, functional traits, tropical reefs, allometric theory

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