# Understanding biodiversity dynamics by applying eco-evolutionary simulation models to insular systems

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**Abstract**

Assessing mechanisms underlying biodiversity patterns requires appropriate study systems and methods. Islands offer ideal study systems, having sparkled influential theories in both ecology and evolution. Recent advancements in mechanistic models for biodiversity dynamics are providing the tools to manipulate factors and processes at a spatiotemporal scale that is impossible in real-world experiments. We aim to promote the application of eco-evolutionary simulation models in insular settings to understand biodiversity dynamics in general. We present three experiments using spatially-explicit, eco-evolutionary, individual- and population-based models of plant metacommunities applied to oceanic islands to address different questions concerning biodiversity: 1) how genetic and ecological traits interact to generate different diversification dynamics; 2) what factors facilitate species invasions; 3) what are the effects of isolation on species diversification. In the experiment contrasting genetic and ecological traits, we found that a high degree of gene linkage causes lineages to show more niche conservatism, whereas low linkage results in populations with more flexible capabilities in ecological adaptation. In the experiment contrasting different scenarios of propagule pressure, disturbance and species pool to assess island invasibility, propagule pressure showed the strongest positive influence on the success of plant invaders. In the experiment contrasting isolation scenarios, we found that abiotic (e.g. distance, propagule pressure) and biotic (e.g. dispersal ability and specie spool size) components of isolation increased the number of diversifying lineages and of species per diversifying lineage. These examples illustrate aspects of eco-evolutionary dynamics that are difficult to address in real-world systems, but that can be tackled with mechanistic models. Considering that there have been an increase of mechanistic models for large spatiotemporal scales in general, we believe that applying those models to island-like systems will provide valuable insights and will speed up our understanding of complex process interactions governing biodiversity dynamics.

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