You move, I change: model-based approaches reveal striking differences between the evolution of plants and animals in the Canary Islands

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Abstract

We assembled published molecular and phylogenetic data for a wide range of terrestrial animal and plant groups occurring in the Canaries to study similarities and differences in how their diversity on the islands originated. In total, we analysed 20 animal clades (383 taxa, 659 sequences) and 16 plant clades (449 taxa, 659 sequences). For each clade, we partitioned the molecular dataset by type of marker and applied different molecular rates. Clock and dispersal rates were also allowed to differ among clades. We used discrete-state continuous-time Markov chains to model how different lineages colonized the islands and subsequently moved between islands and habitats as they diversified. We used the phylogenetic graphical model framework introduced in RevBayes to modify the structure of the biogeographic rate matrix, such that we could tease apart different factors (area, geographic distance, age) influencing the relative carrying capacities and exchangeability rates. Inference was based on Bayesian Markov chain Monte Carlo analyses that integrated out uncertainty concerning phylogenetic relationships and all molecular and biogeographic model parameters. Our results show that inter-island dispersal rates and island carrying capacities (equilibrium number of lineages) do not correlate with geographic distance or island size. Carrying capacities in plants are lower for all islands but higher for the mainland compared to animals. Plant lineages move between islands faster than animal lineages, though inter-island dispersal patterns are similar. Plants shift between islands more readily than they shift between habitats, whereas the reverse is true for animals; when animals move between islands, they often shift to a new habitat. The proportion of the island's carrying capacity that is not dependent on island area is larger in animals than in plants, suggesting a larger role for environmental heterogeneity. Conversely, dispersal rates, after partitioning out geographic distance, are higher in plants than in animals. We conclude that in the Canary Islands, animals have a tendency to diversify locally into different ecological habitats, but rarely colonize new islands. In contrast, plants move readily between islands but rarely shift habitat. This agrees with observed patterns at continental scale and points to interesting conclusions about community assembly on islands.

Keywords: Animals, Bayesian inference, Canary Islands, carrying capacities, dispersal rates, island biogeography, plants, phylogenetic graphical models, RevBayes

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