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# Drivers of orchid diversity, endemism and disharmony on islands

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## Abstract

The Orchidaceae are highly diverse (~28,000 species) and have fascinated scientists for over 150 years, owing to their complex biotic interactions and attractive floral morphology. The extraordinary diversity and cosmopolitan distribution of orchids is often attributed to their ‘dust-sized’ seeds, which are produced in huge quantities and can disperse thousands of kilometers by wind currents. In this regard, orchids are expected to be proficient long-distance dispersers, which has been invoked to explain their sometimes rapid colonisation of volcanic islands or isolated archipelagos. Despite this, recent evidence suggests that patterns of orchid diversity on islands at the global scale are spatially complex, being under-represented on most islands, yet highly diverse on a small number of islands (e.g. in the western Pacific, Caribbean, La Réunion). This finding, however, may actually be an artefact of the analyses, which do not take into account orchid growth form, island type or the spatial arrangement of islands. Here, we present a comprehensive global analysis of orchids on 449 islands, relating patterns of orchid diversity and endemism to geophysical (island area, geographical isolation, age, topographic heterogeneity) and bioclimatic (forest cover, cloud cover, precipitation, temperature) island characteristics using Linear Mixed Effects Models. In contrast to previous studies, we split orchids into two functional growth forms (epiphytic and terrestrial) and determine whether their diversity patterns can be predicted by the same factors. We then compare drivers of total orchid diversity and endemism on islands, making the additional distinction between island types (continental, oceanic, continental fragment). Epiphytic and terrestrial orchids showed variable diversity patterns among islands, both being positively related to increasing units of cloud cover, temperature, and island area, yet responding differently to all other variables. Similarly, determinants of total orchid diversity and endemism varied across different island types, demonstrating a complex interplay of biogeographic and bioclimatic factors. These results illustrate that by considering key functional differences among growth forms, island types, and the spatial arrangement of islands, we can enhance our understanding of species diversity patterns on islands.

**Keywords:** endemism, disharmony, diversity, growth form, island type, orchids

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