Multiple colonizations and parallel radiations of Peperomia (Piperaceae) on the Hawaiian Islands suggest context-dependent role of niche preemption in diversification on oceanic islands

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Abstract

Niche pre-emption, where earlier arriving lineages may develop ecological and adaptive advantages and thus inhibit the ecological and evolutionary success of later arriving lineages, has been argued to play a dominant role in the assembly of oceanic island floras. On the Hawaiian Islands, for example, most of the iconic and species-rich groups of the archipelago (e.g., silverswords, lobeliads) are each derived from evolutionary radiations from single colonist lineages whereas many species-poor genera are derived from multiple colonization events. Here, using a molecular phylogeny of Peperomia (Piperaceae) in the Pacific, where it is one of the most species-rich angiosperm groups, we reveal a unique history of colonization and diversification in contrast to other elements of the Hawaiian flora and expectations under niche pre-emption. To better resolve the evolutionary relationships of Pacific taxa, we sequence full chloroplast genomes for half of species in the Pacific (including all native Hawaiian species), using a genome skimming next-generation sequencing approach. Using this phylogeny, which we date using a fossilized birth death model of the Piperales, we find that the Hawaiian Islands have been colonized by at least four separate Peperomia lineages from the Neotropics, with most diversification occurring relatively recently in the Pliocene. Most importantly, while the Hawaiian flora provides examples of spectacular radiations from single colonist ancestors (e.g., silverswords, lobeliads), we show that endemic *Peperomia* taxa on Hawaii are derived from radiations from two distinct colonists, the first documented case among species-rich plant groups of the Hawaiian flora. The diversification of two clades in parallel suggests that ecological release due to the paucity of large native vertebrate herbivores and the relatively open understoreys of Hawaiian wet forests may have allowed both lineages to flourish, and adds a new twist to our understanding of how oceanic island floras assemble.

Keywords: genome skimming, Pacific biogeography, diversification, oceanic island assembly, niche preemption

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