Moving toward data-driven ecological restoration of vegetation in the Hawaiian islands

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Abstract

Habitat loss and invasive species have drastically modified Hawaiian ecosystems. Numerous ecological restoration efforts seek to expand native dominated vegetation and provide habitat for endangered species. However many of these efforts are limited by incomplete information about baseline conditions or realistic objectives for endangered species. Mounting data now permits a more objective approach toward representing appropriate population densities of dominant and rare plant species in a spatial context. First, an extensive collection of vegetation plot data from over 1400 locations across all of the main islands provides a quantitative basis for assessing canopy cover in a wide range of climatic environments. A focus on high quality habitat necessitates considering only of vegetation plots with minimal invasive species cover and without a history of degradation from cattle grazing. Second, a comprehensive set of habitat suitability models, compiled in GIS and based on a wide range of source data, provides a spatial context for evaluating potential habitat. For a baseline set of 176 woody species with sufficient data, we assessed vegetation plots falling within each species' habitat envelope to determine its canopy cover under high quality habitat conditions. For these baseline species, we used ecological traits (dispersal mode, pollination mode, breeding system) and phylogenetic traits (whether it belongs to a monotypic, small or large colonist lineage) to build a multivariate model, which estimates the potential local abundance as measured by canopy cover. Species exhibiting wind pollination or a dioecious breeding system, or belonging to monotypic or small colonist lineages exhibited greater cover than species without those traits. This model was then used to estimate potential local canopy cover for the remaining species with insufficient data from vegetation plots. We then converted estimated canopy cover values to local densities (based on plant size) to provide a target density for out-planting of rare species. Combined with using habitat envelopes (among other criteria) to identify suitable reintroduction sites, these estimated densities represent a data-driven technique for rebuilding populations that have fallen due to severe anthropogenic alteration.

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