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# Defining geographical island isolation for terrestrial mammalian dispersal

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## Abstract

Geographical isolation is often invoked to facilitate biogeographic enquiry. General practice of elucidating isolation through *ad hoc* species richness metrics may not properly inform such concepts, though. Here we addressed this problem by defining geographical insular isolation for dispersing terrestrial mammals, using a multivariate characterisation of contemporary and conventional metrics explaining species richness. This study was conducted on the 890 offshore islands ( $\geq 1$  hectare) of the New Zealand archipelago (latitude: 34.1-47.3oS, longitude: 166.2-178.4oE). Principal components analysis (PCA) was used to reduce dimensionality of the island dataset, thereby creating composite variables (principal components, PCs) characterising the primary drivers of insular isolation. An amalgamation of 16 variables were considered, including: Euclidean-based distance measurements, stepping-stone sequences, landscape measures of isolation, graph-theoretic metrics, and island area. For each island, relevant variables were quantified in a context-specific manner matching the life-history of specific dispersing species. Distance from the mainland (PC1 Distance) and the number of stepping stones utilised *en route* (PC2 Stepping Stones) comprised 72.2% dataset variance. PC1 Distance explained over half of New Zealand's isolation alone, and multiple variables had high factor loading scores. Focal island area (PC3 Area) was only marginally important, comprising 7.3% dataset variance. Based on dataset variance, PC1 Distance and PC2 Stepping Stones suitably characterised insular isolation for New Zealand, reaffirmed through parallel analysis and Kaiser's criterion. Moreover, a simple Euclidean distance measurement is likely sufficient when quantifying PC1 because it describes distance from the mainland equally well as other methods, including graph-theoretic least-cost and circuit theory methods, in a much simpler manner. This depiction can be used to facilitate subsequent biogeographic enquiries characterising isolation because the demonstrated metrics were substantiated.

**Keywords:** geographical isolation, offshore islands, principal components analysis, mammal dispersal, New Zealand

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