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Environmental heterogeneity patterns plant species richness and turnover in two hyperdiverse floras

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Environmental heterogeneity can explain the paradoxically high levels of species co-existence, by stimulating ecological speciation and supporting diverse assemblages with a larger potential niche space. Two Mediterranean-type terrestrial biodiversity hotspots, the Southwest Australia Floristic Region (SWAFR) and the Greater Cape Floristic Region (GCFR), are ecologically very similar. Yet, the former is flat while the latter is mountainous. The question thus arises whether heterogeneity is a significant contributor to SWAFR species richness, as is likely the case in the GCFR. In the absence of topographic variability in the SWAFR, we propose that the edaphic heterogeneity (due to the juxtaposition of soil types) may contribute to species richness in that region. We hypothesise that the greater abiotic heterogeneity in the GCFR compared to the SWAFR, and finer spatial scale of that heterogeneity, accounts for the GCFR's greater species richness per unit area. We test whether (i) the GCFR is more environmentally heterogeneous than the SWAFR and (ii) at a finer spatial scale than the SWAFR. After testing whether (iii) plant species turnover is generally greater in the GCFR, we test whether (iv) plant species richness and turnover are related to environmental heterogeneity in both regions, aligning with our hypothesis, and whether (v) the GCFR and SWAFR have different sets of environmental axes that predict plant species richness and turnover. Using both statistical and machine-learning techniques, we find support for these predictions. This further generalises the positive relationship between environmental heterogeneity and species richness, and how species richness encapsulates environmental turnover and species turnover.