

Twelfth International Symposium on Pollination (ISPXII)

16 - 20 October 2023

Kirstenbosch Botanic Gardens, Cape Town, South Africa

Moving with your mutualist: Predicted climate-induced mismatch between Proteaceae species and their avian pollinators

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ABSTRACT

Climate change influences species distribution in space and time, but predicting locations where climate change may induce mismatches in the ranges of mutualistic partners will aid in the identification of vulnerable ecosystems. Here, we explore how climate change influences shifts in species ranges among mutualists. We used machine-learning algorithm to predict range shifts of 11 bird-pollinated Proteaceae species in the CFR and their two most important, endemic, pollinator bird species. We determined the proportion of overlap in the ranges of nectar-feeding birds and Proteaceae under current and future climate scenarios. Species ranges were projected to the year 2050 and 2070 using Representative Concentration Pathways (RCP) 4.5 and 8.5. The majority of Proteaceae species in our model are predicted to experience range contractions which ranged from 21% for *Protea neriifolia* under RCP 4.5 2050 to 59% for *P. laurifolia* under RCP 8.5 2070 climate scenarios. Only *Leucospermum cuneiforme* is predicted to expand its range under future climate scenarios. Cape sugarbird and orange-breasted sunbird are predicted to experience 22% and 45% range contraction, respectively, under RCP 8.5 2070 condition. Overlap in suitable ranges of Proteaceae species with Cape sugarbird and orange-breasted sunbird is predicted to decline by 42% and 44%, respectively, under the more extreme climate scenario. Individual Proteaceae species show varying range overlap with nectar-feeding birds, but most species do not track the range shift of nectar-feeding birds. In conclusion, climate change threatens species occupying the mountain range of the northern limit of the CFR. Predicted range mismatch of mutualists may have significant implications for the reproduction and persistence of Proteaceae under extreme climate scenarios. We suggest active monitoring of Proteaceae populations and nectar-feeding birds at their northern distribution limits, particularly so for highly threatened small-range species.