



Ryan D. Phillips<sup>\*1,2</sup>, Andrew L. Batty<sup>1</sup>, Andrew P. Brown<sup>3</sup>, Kingsley W. Dixon<sup>1,2</sup>  
& Stephen D. Hopper<sup>2,4</sup>

<sup>1</sup> Kings Park and Botanic Garden, Botanic Gardens and Park Authority  
West Perth, 6005, Western Australia

<sup>2</sup> School of Plant Biology, University of Western Australia, Nedlands, 6009  
Western Australia

<sup>3</sup> Department of Conservation and Land Management, Western Australian Threatened  
Species and Community Unit, PO Box 51, Wanneroo, Western Australia, 6005

<sup>4</sup> Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3DS, UK

\* Author for correspondence: rphillips@bgpa.wa.gov.au

### **Biogeography and factors associated with rarity in Orchidaceae in a biodiversity hotspot**

The south-west Australian biodiversity hotspot has a highly diverse terrestrial orchid flora characterised by numerous rare species and a diversity of pollination syndromes. The flora is highly threatened due to several factors including massive habitat loss and fragmentation, invasive weeds and changing salinity, rainfall and fire regimes. While conservation techniques for orchids in this region are progressing rapidly, little is known of their biogeography or factors influencing species formation and rarity of species. We tested two hypotheses; firstly, that the pattern of orchid species richness and endemism would differ from those of the flora in general because of specialised associations with localised pollinators or mycorrhizal symbionts and secondly, that pollination syndrome, site of fungal infection or habitat specialisation are linked to rarity and the extent of a species' distribution. The distribution of 405 orchid taxa was mapped as presence/absence data on a quarter-degree grid using the 12,000+ records from the Western Australian Herbarium. Species richness was highest in the High Rainfall Floristic Province (>600mm *per* year), particularly in areas with a diverse edaphic environment. Species richness was considerably lower in the semi-arid area comprising the Transitional Rainfall and South East Coastal Provinces, which is in contrast with the flora in general. Biogeographical regions for orchids were established using UPGMA cluster analysis and showed strong similarity to those of the general flora and strong correlation with both edaphic and climatic variation. This suggests that large-scale edaphic and climatic variation effect orchid speciation as they do the remainder of the flora. However, the high diversity in the mesic south-west indicates prolific speciation within this region and its high conservation priority. Site of infection and pollination syndrome showed no relationship with the distributional extent of a species or abundance reflected by the number of herbarium collections. However, sexually deceptive pollination was prominent amongst rare species. This trend probably results from pollinator specificity leaving the orchid susceptible to changes in abundance or the distribution of the pollinator and rapid speciation from pollinator switching. Rare orchids were more frequently associated with naturally fragmented habitats such as swamps and granite outcrops that may favour greater levels of speciation and persistence of rare taxa. This study highlights factors associated with vulnerable taxa and identifies areas of high conservation priority for orchids. We propose hypotheses regarding the factors driving speciation and rarity in this biodiversity hotspot, which are currently being tested.