Identifying refugia in a warming, drying global biodiversity hotspot

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Background/question/methods: Refugia are habitats where species can contract to, persist in and expand from as the regional climate changes. Therefore they have potential for facilitating the regional persistence of biodiversity under anthropogenic climate change, and are critically important in climate change adaptation management. The identification of refugia is problematic in drying landscapes of subdued topography; exemplified by the South-western Australian Floristic Region (SWAFR)—a global biodiversity hotspot. In the landscapes of this region, refugia must provide protection against three increasing environmental stressors: reduced moisture availability, increasing fire severity and more frequent extreme temperature events. We review spatially explicit evidence for refugia in the SWAFR, based on the distribution of environmental (e. g. water, temperature, fire) and biological processes (species traits, phylo and phytogeography) in the region. High resolution spatial data, phylogeography, ecophysiology and community data provides an integrated, transdisciplinary framework for the identification and management of refugia in the region.

Results/conclusions: Current environmental and biotic signals such as high habitat heterogeneity, increased vegetation height and vigour, and populations outside their predominant range are good indicators for areas serving as refugia. Historical signals from the ecological and evolutionary dynamics of plant communities (i.e. species traits), and from phylogeographic patterns also separate refugia from the surrounding matrix. Particular riparian habitats, granite outcrop systems, high rainfall forest ecosystems and the few mountain ranges of limited extent provide a wide range of habitats with specific refugial characteristics. Experimental hypothesis testing is now needed to materially advance the understanding developed from our correlative and observational findings.

Grant Wardell-Johnson leads the team that represents a current Australian Research Council grant (Protecting the safe havens: will granite outcrop environments serve as refuges for flora threatened by anthropogenic climate change?). Grant works at the Curtin Institute for Biodiversity and Climate.

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