Climate Change Adaptation Research Grants Program
- Terrestrial Biodiversity Projects

Project title:
Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species.

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Objectives:
This project seeks options for facilitating climate adaptation by targeting the question "Can adaptive variation in widespread species be used to enhance resilience to climate change and maintain ecological function in landscape restoration investments?"

Project design and methods:
Ecological restoration to maximise climate resilience is likely to be at odds with current genetic paradigms used to inform restoration. Until recently, there has been a strong theoretical and practical focus on maintaining local genetic patterns of variation and associated genetic-environmental relationships. Inappropriate sourcing of seed for revegetation can lead to a range of negative outcomes, including founder effects, genetic swamping of local populations, and outbreeding depression. Yet in a changing climate, maintenance of ecological function will be imperative and a static view of genetic-environmental relationships may no longer be relevant. Strategies to maximise resilience should instead utilise the adaptive variation present in key species to facilitate persistence of plantings and maintain ecosystem and landscape function.

Identifying adaptive variation requires targeted analysis of eco-physiological traits and signatures of adaptation reflecting differential regulation of genes during stress (water availability or temperature). Studies of eco-physiological trait variability along climatic gradients in Australia are beginning to provide insights into the adaptability of native taxa, especially Eucalyptus species. Correlation of variation in eco-physiological traits with variation in gene frequency will provide a molecular basis for predicting the adaptive response of species to differing climatic environments and provide tools for identification of appropriate adaptation management responses in multi-use landscapes where maintenance of ecosystem function is critical.

The project will test the following alternative hypotheses:
1. Widespread species, having evolved under highly variable environments, retain high potential for adaptability to environmental change within the gene pool of local populations or individuals (implying that genetic material sourced from local populations will have tolerance to changing climatic conditions).
2. Widespread species, having evolved across wide ecological gradients, comprise a suite of locally adapted sub-populations each (implying that genetic material should be sourced not from local populations but from distant and potentially resilient populations which are pre-adapted to the future climate).

The project will be implemented along the following lines, focusing on widespread eucalypt species spanning climatic gradients across the Western Australian wheatbelt and Great Western Woodlands, and the box woodlands of the eastern Australian wheatbelt.
1. Identify target eucalypt species and physiological traits relevant to climate change.
2. Characterize variation in selected physiological traits within and between populations across climatic gradients.
3. Analyse patterns of adaptive genetic variation within and between populations across the same environmental gradients..
4. Combined analysis of ecophysiological and genetic data to evaluate potential effectiveness of the genome scan approach for detecting adaptive variation across environmental gradients.
5. Integrate findings into decision tools for evaluation of assisted migration and sourcing genetic material for ecological restoration and revegetation under the effects of climate change.