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Climate-resilient vegetation of multi-use landscapes: exploiting genetic variability in widespread species

Ecosystem Science

Project Core Team

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Climate-resilient vegetation of multi-use landscapes: exploiting genetic variability in widespread species

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Context

Multi-million dollar investments in the restoration of Australia's degraded and fragmented multi-use landscapes currently take little account of climate change. Until recently there has been a strong focus on maintaining local genetic patterns for optimal restoration. In a changing climate this paradigm may no longer be relevant and a new framework is urgently needed. The proposed project will deliver such a framework by undertaking pioneering research and development at the interface between molecular genetics, plant physiology and climate adaptation. Specifically, it will test hypotheses of adaptation in widespread eucalypt species, by investigating correlations between key physiological traits and genetic signatures of adaptation across climatic gradients utilising recent advances in eucalypt genomics. Addressing this question will ensure optimal, climate-resilient outcomes for Australia-wide investment in ecological restoration, offering a novel solution to ecosystem adaptation in changing environments.

Aims

The project will test the following alternative hypotheses:

- 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).
- Widespread species, having evolved across wide ecological gradients, comprise a suite of locally adapted sub-populations (implying that genetic material should be sourced not from local populations but from distant and potentially resilient populations that are pre-adapted to the future climate).

Progress

- Analysis of genomic variation and environmental traits in nine populations across a climate gradient has been completed in *Eucalyptus loxophleba* with evidence of 50 outlier markers associated with climate adaptation.
- A paper describing the genomic architecture of climate adaptation in three species, *E. salubris*and*E. loxophleba*from Western Australia and *E. tricarpa* from Victoria has been written and is in review.
- To further explore geographic patterns in the two genetic lineages detected in *E. salubris*, 13 additional populations have been collected across the species' distribution and genomic sequencing completed. The raw genomic data is currently under analysis.

Management implications

The findings of both genetic adaption to local conditions and capacity for plastic responses highlight the complex nature of climate adaptation. Widespread eucalypts are therefore likely to be able to adjust to a changing climate to some extent, but selection of seed sources to match projected climate changes may confer greater climate resilience in environmental plantings. A strategy of 'climate-adjusted provenancing' with seed sources biased toward the direction of predicted climatic change is recommended for restoration and revegetation.

Future directions

- Complete final scientific paper on the genomic architecture of adaptation.
- Complete analysis of lineage divergence in *E. salubris*.