

Progress Report SP 1998-007

**Genetic analysis for the development of vegetation
services and sustainable environmental
management**

Ecosystem Science

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Genetic analysis for the development of vegetation services and sustainable environmental management

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Context

Understanding the genetic structure and function of plants is important for their effective utilisation for revegetation, mine-site rehabilitation and provision of ecosystem services, such as hydrological balance, pollination and habitat connectivity.

Aims

Provide genetic information for the conservation and utilisation of plant species for revegetation and rehabilitation. Current work aims to identify seed collection zones for species used in rehabilitation of minesites in the Pilbara and the Midwest.

Progress

- A paper on genetic patterns in *Acacia ancistrocarpa* and *A. atkinsiana* has been submitted for publication. *Acacia ancistrocarpa* has moderate haplotype diversity with most populations showing specific haplotypes. Nuclear diversity was moderate with little genetic structure across the Pilbara populations of this widespread species. In contrast, the Pilbara endemic, *A. atkinsiana* had low haplotype diversity with little geographic structure. Nuclear diversity was low and genetic differentiation among populations was moderate.
- A paper on genetics patterns in *Eucalyptus leucophloia* has been submitted for publication. This species shows genetic signatures of the Hamersley Range being a historical refugium, supporting a previous hypothesis of inland ranges being refugia in the Australian arid zone.
- A paper on the genetic diversity and differentiation in the rare *Aluta quadrata* has been submitted for publication. The species shows high nuclear genetic differentiation but no chloroplast haplotype variability indicating that the geographic separation of the three species locations is leading to contemporary genetic differentiation but is not a result of historical isolation.
- Studies have commenced on another eight species in the Pilbara for the identification of seed collection zones. Collections and microsatellite genotyping have been completed for all eight species, *Petalostylis labicheoides*, *Indigofera monophylla*, *Senna glutinosa*, *Corymbia hamersleyana*, *A. pruinocarpa*, *A. hilliana*, *A. spondylophylla* and *Mirbelia viminalis*. Reports have been written to summarise the results and provide provenancing recommendations for all species. Chloroplast sequencing is currently underway.
- A paper on phylogeographic patterns and genetic diversity in *Grevillea paradoxa* and *Melaleuca nematophylla* is ready for peer review. In *G. paradoxa* haplotype diversity within populations was low, diversity was moderate overall and there was a phylogeographic signal in chloroplast DNA. Nuclear diversity was low and genetic differentiation among populations was moderate to high with no signal of isolation by distance. In *M. nematophylla* haplotype diversity within populations was low, diversity was moderate overall and there was a phylogeographic signal in chloroplast DNA. Nuclear diversity was low and genetic differentiation among populations was moderate with a signal of isolation by distance.
- A paper on phylogeographic pattern and genetic diversity in *Mirbelia* sp. *bursarioides* and *G. globosa* has been published in *The Botanical Journal of the Linnean Society*. In *Mirbelia* sp. *bursarioides* haplotype diversity within populations was low, diversity was moderate overall and there was no phylogeographic signal in chloroplast DNA. Nuclear diversity was moderate and genetic differentiation among populations low to moderate with a signal of isolation by distance. In *G. globosa* haplotype diversity within populations was low and diversity was low overall. There was no phylogeographic signal in chloroplast DNA. Nuclear diversity was moderate and genetic differentiation among populations was low with a signal of isolation by distance.
- Comprehensive seed collection and restoration establishment guidelines for the four species from the Midwest region have been provided to Karara Mining Limited.

Management implications

- *Pilbara* seed collection zones—The high levels of genetic diversity and low levels of differentiation within *E. leucophloia* and *A. ancistrocarpa* imply that, for these species, seed resources for land rehabilitation and mine-site revegetation programs can be selected from a wide distributional range within the Pilbara. However, phylogeographic analysis of *E. leucophloia* has identified the Hamersley Range as a historical refugia, so seed collections for rehabilitation of mine sites using this species should be targeted within the Hamersley Range to maximise the diversity of these sites. In contrast, the low diversity and high population differentiation in *A. atkinsiana* indicates that more restricted seed collection zones should be observed.
- *Aluta quadrata*—The significant genetic structure in *A. quadrata* indicates three conservation or management units: Western Range, Pirraburdoo and Howie's Hole. Given the genetic differences, restricted distribution and size of the populations, a precautionary approach should be taken to seed collections. Establishment of restoration populations within gene flow distance of existing populations should be done with seed from the location of that population. However, mixing seed collections from the three locations for establishment of restoration sites located distant to existing populations would be a means of maximising genetic diversity for future conservation.
- *Grevillea paradoxa*—Moderate haplotype diversity and low levels of divergence among haplotypes of *G. paradoxa* imply that there are no evolutionarily divergent lineages within this species. Genetic structuring and divergence in the nuclear genome does imply some limitation to pollen dispersal, likely due to territoriality in bird pollinators and an ability to self-pollinate. Three regional seed collection zones for land rehabilitation and mine-site revegetation programs may be appropriate for this species.
- *Melaleuca nematophylla*—Levels of divergence among haplotypes suggest the population of *M. nematophylla* within the Murchison River gorge be treated as a divergent lineage and not incorporated into seed collection for rehabilitation and revegetation programs outside of this area. Low levels of divergence among populations in the nuclear genome implies that seed collections can otherwise be made across wide distributional areas.
- *Mirbelia bursarioides*—Low divergence among haplotypes implies a lack of divergent lineages for *M. bursarioides*. A limited degree of genetic divergence among populations in the nuclear genome suggests that seed collections for rehabilitation and revegetation that encompass the distribution may be appropriate for this species.
- *Grevillea globosa*—Limited haplotype diversity and divergence and limited genetic structure in the nuclear genome imply that seed collections for rehabilitation and revegetation may be made across this species entire distribution.

Future directions

- Manuscripts currently in review will be finalised.
- Analysis of the current eight species will be completed and recommendations on seed collection zones will be made.
- Genetic diversity and phylogeographic patterns will be investigated in two more Pilbara species.