

Restoration genetics in Murray Mallee and Neotropical forests: implications for management and planning

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Major findings and outcomes of the collaboration:

During Martin's visit to Costa Rica, manuscripts were prepared based on data collected in Costa Rica and a literature review of scattered trees. *The findings have major application to worldwide revegetation practices where climate change is an emerging threat.*

Fitness impacts of mating system alterations due to spatial isolation in Big-Leaf Mahogany were observed. We found that spatial isolation and outcrossing rates consistently negatively affected growth, but pollen diversity effects were provenance dependant. Reductions in pollen diversity significantly impacted dry provenance growth. Evidence for stronger self-incompatibility in the dry provenance was demonstrated (fully outcrossed families: dry-89%, wet-66%), potentially buffering negative selfing effects, but accentuating pollen competition effects. This is a novel finding, and highlights that seed quality is profoundly affected by mating-patterns, and we highlight the importance of pollen diversity for outcrossing populations. Consequently, fragmented landscape management should not rely on passive regeneration and seed collecting to maximise growth and evolutionary potential should focus on mother-tree diversity by avoiding isolated trees.

Management of scattered trees to facilitate adaptation of biota to climate change is a growing area of research. We summarised literature on scattered tree genetic data, and show how this literature is integrated and complimentary to the role of scattered trees facilitating adaptation by migration of their inhabitants. We proposed that scattered trees can have positive and negative application to tree adaptation to climate change. There is evidence that scattered trees may potentially facilitate evolutionary adaptation of trees by gene flow, but may potentially compromise tree adaptive capacity by the provision of poor quality seed. As such, we recommended that scattered trees should be avoided as sources of seed, but should be foci for revegetation projects that increase population sizes and aim to connect scattered trees with genetically diverse fragments.

Outcomes of the collaboration

Field outcomes during Martin's visit to Costa Rica include the collection of cambium samples and spatial information for many putative mother trees, hopefully completing a large existing dataset. Confirmation of coverage of the missing data will need to wait until genetic analysis is conducted later in 2010. Martin discussed his Australian experimental design and genetic and ecological data analyses with CATIE experts. This experience will significantly benefit his experimental design, and the planting of this component will be completed in July 2010, so timing of these discussions was optimal. As well, Martin spent the vast majority of this trip in the field with CATIE researchers, significantly progressing his knowledge of the study system, furthering his understanding of the biology of the system, potential species interactions, focal species biology and historical and contemporary human impacts. This culminates to improving Martin's capacity to prepare good scientific manuscripts, benefitting

his PhD outcome, and benefiting the broader scientific and management community's capacity to adapt to climate change, with a focus on Australia.

Together with CATIE ecology and genetic experts, academic outcomes were achieved with the analysis of ecological, growth performance and genetic data and the drafting of a manuscript on *Swietenia macrophylla*, Big-Leaf Mahogany. As well, analysis of additional species was discussed and plans prepared for future manuscripts. Further, University of Adelaide and Costa Rica partner organisation collaboration was progressed, with numerous projects nominated, international funding agencies identified and proposals drafted.

Information from the growth experiments, from the data collected in the field and discussions about the study system and experimental design are all crucial for Martin's PhD. These achievements were not possible in Australia, and we greatly appreciate NCCARF's financial support of Martin's travel.

Significance to adapting and protecting Australia's terrestrial biodiversity:

Tree offspring adaptive potential is profoundly affected by mating-patterns, and we highlight the importance of pollen diversity for outcrossing populations. Consequently, fragmented landscape management looking to facilitate adaptation to climate change of trees and tree dependant fauna should not rely on passive regeneration, but should focus on collecting genetically diverse seeds by targeting mother-tree diversity and avoiding isolated trees. This is particularly relevant to Australia, as there is great interest in revegetation and rehabilitation of degraded lands. Australia pastoral land has large numbers of scattered trees, and these trees have significant ecological and evolutionary values. As such, we recommend that scattered trees should be foci for revegetation, assisting adaptation of these species and dependant fauna to climate change. Seed used for this revegetation should be collected from genetically "healthy" stock, avoiding the local scattered trees if possible. Expansion should be focussed towards connecting scattered trees with genetically diverse fragments, as this will help connect the scattered trees to the fragments, to some extent protecting scattered tree offspring from inbreeding.