

Gene flow kept under watchful eye

By Jill Griffiths

With broadscale planting of woody perennials an imperative to combat dryland salinity, it is important to understand the implications for remnant populations of the species being planted.

Dr Margaret Byrne from the Western Australian Department of Environment and Conservation (DEC) in Perth is working on a FFI CRC-funded project to increase understanding of gene flow from plantations to native remnants.

"When you have natives planted in their own range, you are likely to get gene flow into remnant populations," Dr Byrne said.

key points

- Gene flow is a naturally occurring process, fundamental to evolutionary processes
- Current research aims to identify the extent of gene flow from planted to remnant populations
- Results to date suggests pollen spread is greater than traditionally thought.

*ABOVE: Current gene flow research has focused on *E. loxophleba* ssp *lissophleba* which has a mallee form. (Photo: W Edgecomb)*

*RIGHT: Dr Byrne investigates seed pods on *Acacia saligna*. (Photo: C Twomey)*

Dr Byrne said that while it is essential woody perennials are planted to address land degradation, it was also important to understand and minimise any risks.

Gene flow is a natural process with generally positive results. It is fundamental to evolutionary processes and maintains connectivity among populations. However, in disturbed or fragmented landscapes it can lead to genes moving from non-local planted populations into native populations. This gene flow can lead to a phenomenon known as outbreeding depression, which is the opposite of the more well-known inbreeding.

Hybridisation between genetically divergent populations leads to locally adapted genotypes becoming diluted and co-adapted gene complexes being disrupted.

The effects of outbreeding depression may not become apparent for two generations.

Dr Byrne said the greatest potential problem is when the remnant populations are small and 'pollen swamping' occurs.

Other factors that need to be taken into account are the genetic variation of the planted population compared to that of the remnant, or 'sink'.

"When genetic variation is widespread, the issue is not so great," Dr Byrne said. "When there is differentiation, there can be a problem."

Current research aims to identify the extent of gene flow to determine the level of potential risk to remnants. To date most research has focused on *Eucalyptus loxophleba* (oil mallee) and *Acacia saligna*. Both species are widely distributed with subspecies occurring in distinct areas across the range. They are also being widely promoted in Western Australia to combat





land degradation, so large-scale plantings are occurring.

Study sites were selected based on the relative locations of planted trees and remnant populations. One site at Wubin, in WA's northern wheatbelt, has natural populations of *E. loxophleba* ssp. *surpaiaevis* and a plantation of *E. loxophleba* ssp. *lissophloia*. Trees were genotyped, then seed taken and assigned paternity, based on the genotype. (The maternity is known as seed and is collected from the 'mother' tree.)

"We found 20-50% of seed produced in the remnants was fathered by pollen from the planted stand up to two kilometres away," Dr Byrne said. "It was more than we expected to find, but it is consistent with the pollen dispersal patterns we have found in other species. Now that we have the genetic tools, we are finding that widespread pollen dispersal is the norm."

The traditional view has been that most pollen is distributed at relatively short distances and that a small amount is distributed over a much further distance. The gene flow research indicates that the distribution graph does not tail off as quickly as previously thought – rather a large amount of pollen is spread over a long distance.

A positive aspect of these research findings is that the frequently held assumption that remnant populations are genetically doomed is incorrect.

"Extensive pollen dispersal among small remnant populations means they are genetically connected, so their effective population size is actually much greater," Dr Byrne said.

"Ecosystem processes are much more complex than the simplistic ways we choose to look at them."

Dr Byrne is quick to reiterate that it is important to plant woody perennials to combat land degradation and that local natives are generally a sound option. Her work on gene flow is about understanding the risks and their implications.

"We need to assess risk to assist its management," Dr Byrne said.

More information

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Established species



Planted species

ABOVE: The Wubin study site. The natural populations are *Eucalyptus loxophleba surpaiaevis*. The plantation is *E. loxophleba* ssp. *lissophloia*. Results indicated pollen dispersal over 2 km, with 32% and 58% immigration into subspecies.

forum to give world view

The 2nd International Salinity Forum to be held in Adelaide in April 2008 will be an opportunity for people to look beyond their own experience, both in a geographic sense and in terms of their profession or discipline. Conference convenor Richard Price said the forum would also provide valuable networking opportunities, with the possibility that future collaborations would arise from contacts made.

The forum will cover five major themes – the where, why and how of salinisation and water impacts; salinity and people – social and economic dimensions; policy and government; managing salinity on-the-ground, and sustaining the environment.

"Within each theme, there is a pathway to questions about management: questions like - How do you manage salinity at the farm, regional or even national scales? How do you go about rehabilitation? How do you go about prevention? How will we live with salinity? How do you even know the nature of the issue?" Dr Price said.

A forum highlight will be the depth and breadth of speakers.

Among the international speakers are Roland Robertson (Professor of Sociology and Global Society at the University of Aberdeen, Scotland), Dr Warren Wood (John Hannah Professor of Integrated Studies at Michigan State University, USA) and Dr Karen Willhloth (The International Water Management Institute).

There will also be eminent Australian researchers providing significant local input, including Professor David Pannell (UWA), Dr John Williams (Commissioner of the NSW Natural Resources Commission) and Professor Will Steffen (The Australian National University).

On the final day, the five themes of the conference will be integrated – a group of farmers will discuss how the themes come together on their farms and the chief executive officers of the authorities associated with the Murray Darling Basin, the Colorado River Basin (USA) and the Indus Basin (Pakistan) will talk about their own areas and how the themes are integrated there.

More information

W: www.internationalsalinityforum.org