Sex in SPAs

Genetic issues in Seed Production Areas (SPAs)

Seed Production Areas (SPAs) are one solution to the increasing demand for native seed for revegetation.

Although genetic issues are critical to the success of SPAs, they are often perceived as complex and difficult to understand. The goal of this brochure is to help you understand the main genetic issues associated with SPAs.

Why does genetics matter?

Genetic issues contribute directly to the productivity of SPAs and will determine both the quality and value of the seed produced.

Due to the importance of genetics to the success of SPAs, genetic issues need to be considered in all stages of production, from seed sourcing to the design and establishment of SPAs. The four main genetic issues for SPAs are:

1. Genetic diversity,
2. Inbreeding,
3. Hybridisation, and
4. Provenance.

What are the key messages when considering genetic issues in establishing SPAs?

1. More parent plants are better than less. Sample from greater than 20 parent plants from a large (> 100–200 plants) healthy population. This will ensure maximum diversity and provide the best genetic basis for your SPA.
2. When considering local provenance issues, stay local if you can, but the key criteria for sourcing seed for SPAs should be making sure seed is sourced in a regional context from a large, genetically diverse population.
3. Design the SPA to maximise opportunities for cross pollination between unrelated plants.

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Genetic issues in SPAs

1. Genetic diversity

Genetic diversity is important for the long-term viability of SPAs and determines the ability of plants to adapt to changing environmental conditions.

Genetic diversity is especially critical for species that cannot self-pollinate. For these species, seed production requires plants to be genetically different (i.e. to be of a different mating type). If there is a low diversity of genetically different mating types in SPAs (as a result of sourcing seeds for the SPA from a small population) then seed production will be reduced due to the lack of compatible mates.

2. Inbreeding

Cross-pollination between related plants can reduce seed quality though inbreeding. Inbreeding is an important consideration when sourcing seeds to establish parent plants and in the design of SPAs.

Sourcing seeds from large populations (> 100–200 reproductive plants) will reduce the chance of collecting inbred seed. Also, collecting seed from as many parent plants as possible (> 20) and ensuring that plants from a single parent are widely distributed in SPAs will improve seed quality by reducing the chance of cross-pollination between related plants.

Having a total population size for each species of at least 100 plants will also prevent inbreeding by assisting cross-pollination between unrelated plants.

3. Hybridisation

Hybridisation between cross compatible species is common to several important plant genera such as Grevillea, Banksia and Eucalyptus. For hybridising species, genetic considerations are important for seed sourcing and in the design of SPAs.

When sourcing seed from potentially hybridising species, it is important to sample from populations where the species to be collected outnumbers other possible compatible species at that site. This will result in greater genetic purity by reducing the chance of sampling hybrid seed. For example, when sampling *Eucalyptus aggregata* (Black Gum) collect from populations where it outnumbers

E. viminalis (Ribbon Gum) and *E. rubida* (Candlebark Gum) which are both species *E. aggregata* can hybridise with.

When establishing SPAs it is important to keep potentially hybridising species separate or limit the SPA to one species per site to avoid genetic contamination through the transfer of pollen between compatible species.

For species that readily hybridise, it is also important to be aware of the exchange of pollen between the SPA and natural bush remnants.

4. Provenance

Provenance is based on the idea that local plants are genetically adapted to local environmental conditions. Provenance is an important issue for SPAs in relation to both seed sourcing and the value of the seed produced by SPAs for use in revegetation.

Local adaptation and provenance issues tend to be species specific (see **Research highlights** 'Does provenance matter?'), but the best approach to provenance when sourcing seed is to match the environment (climate and soil) of the seed source area and the SPA as closely as possible. This is because environmental differences between sites can be a much better predictor of provenance than geographic distance.

However, when choosing between seed source areas it is much more important to source seed from large (> 100–200 plants), genetically diverse populations rather than from smaller populations that happen to be geographically closer.

Keeping a record of the origin of parent plants in your SPA will also assist in determining the genetic composition of SPAs which is important when selecting seed for revegetation activities.

Recommendations for establishing genetically healthy SPAs

Production stage	Recommendation	Why?
Seed Sourcing	**A** Source from a large healthy population (>100 – 200 plants)	This will reduce the chance of collecting inbred seed Ensures a good genetic basis for the SPA
	B Match seed sources with local climatic and soil conditions as closely as possible	This ensures that local provenance is maintained. However, when choosing source populations, **A** is more important than local provenance
	C For hybridising species, source seed from populations where the species to be collected outnumbers other compatible species	This reduces the chance of collecting hybrid seed
Design and establishment of the SPA	**A** Establish as many parent plants as possible (i.e. > 20)	This reduces the chance of producing inbred seed Ensures a high number of compatible mates for species that don't self-pollinate
	B Plant at least 100 plants of each species	This assists cross pollination among unrelated plants
	C Block plantings of a single species	This optimises opportunities for cross pollination within a single species
	D Separate parent plants from a single source	This reduces the chance of producing inbred seed Ensures that plants in close proximity are of a different mating type and are therefore genetically compatible
	E Separate species that can potentially hybridise or limit to one species per site	This reduces the chance of producing hybrid seed and maintains genetic purity

Research highlights

Does provenance matter? A tale of two species

The issue of provenance and mixing local and non-local plants has recently been investigated in the perennial daisy *Rutidosis leptorrhynchoides* (Button Wrinklewort)[1], which is native to the grasslands and grassy woodlands of SE Australia.

This research found very little local adaptation in the Button Wrinklewort and that mixing genetic material between widely separated populations had no negative effects on growth, and in some cases resulted in superior plant growth.

Another key finding of this research was that geographic distance was not a good predictor of provenance and that sourcing seed from large populations produced the best outcomes for plant growth.

In contrast, research on *Acacia acinacea* (Gold Dust Wattle)[2], which is widespread throughout SE Australia, found that some populations were morphologically and genetically distinct.

This means that for this species, it is important to maintain local provenance and that careful consideration would be required before mixing plants from different populations. This research also found that geographic distance was not always the best consideration for seed sourcing.

So although provenance is difficult to predict across different species, these examples highlight that collecting local seed is always best when it can be sourced from a large, healthy population. However, when this is not available, collecting seed from a large population that is further away (but from a similar environment) is the next best option.

Rutidosis leptorrhynchoides

Photo: M. Dudash

Photo: M. Dudash

Acacia acinacea

Photo: L. McMahon

Photo: L. Broadhurst

[1] Pickup, M (2007) Local Adaptation and Outbreeding depression in Fragmented Populations of *Rutidosis leptorrhynchoides* (Asteraceae) PhD Thesis, Australian National University.

[2] Broadhurst, L. M., Young, A. G., Thrall, P. H. and Murray, B. G. (2006) Sourcing seed for *Acacia acinacea*, a key revegetation species in south eastern Australia. *Conservation Genetics*, 7: 49-63

Contacts

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- Florabank – **www.florabank.org.au** or call **02 6202 1600** *Florabank helps people across Australia exchange information and ideas about native seed.*
- For further information on establishing SPAs see the *Introducing Seed Production Areas* brochure available from Greening Australia (Capital Region).

Produced by Greening Australia (Capital Region). All photos Greening Australia (Capital Region) unless otherwise acknowledged. September 2008.

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