



Greening Australia

Thinking Bush

Thinking Seeds

At Greening Australia when we think of the bush, we always think about seeds. We want to know what are the seed requirements for revegetating a particular patch of bush; what is the opportunity for collecting the right type of seed for the area; what is the most efficient use of that seed and how can we improve its chance of survival.

Land & Water Australia's research has been instrumental in helping us to find answers to these questions and has been pivotal in reshaping everyone's thinking on native seed management in Australia.

As Australia's largest environmental non-government organisation focused on delivering practical results on-ground, Greening Australia measures our success by the amount of bush we can restore, and we rely on the best science to get us there.

Greening Australia has worked with Land & Water Australia for a number of years collaborating on research trials, providing advice on research questions, participating in and testing research, and using and promoting that research. We welcome the opportunity to be part of their magazine Thinking Bush, which brings together the latest research in native vegetation management in Australia.



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Australian Government

exchange
national vegetation knowledge service

Why all the talk about Revegetation?



For the first time, regional catchment management groups exist in all states and territories, making a total of 56 Catchment Management Authorities (CMA) nationally. All are locally driven statutory bodies responsible for coordinating natural resource management activities, including setting and coordinating revegetation targets in their catchment. In most cases, these targets are divided into 'categories of need' for revegetation works such as increasing ecosystem services* and improving

“Revegetated sites with low genetic diversity have a limited gene pool to respond to environmental changes and may have a limited number of reproductive partners, while non-local seed can introduce poorly adapted genes into the local gene pool.”

(Mortlock & Hawkesbury-Nepean Catchment Management Trust, 2000)

biodiversity, hazard reduction (e.g. salinity and erosion work), commercial forestry and other regionally specific categories. Along with existing native vegetation that we retain and improve, these revegetation projects will be the landscapes of the future and may determine the survival of some species.

As a long-term investment, revegetation must be planned carefully to maximise its potential benefits including the provision of ecosystem services rather than just treating existing environmental issues. Don Alcock's article, *'Thinking Big with Vegetation Management'* in *Thinking Bush* addresses the issues of scale and multiple uses, noting *'a healthy landscape needs to have basic ecological functions intact, such as the ability to store nutrients and capture water so that it can support pastures and vegetation. Diversity of plants and animals is also necessary.'*

The CMAs are taking the right steps for the protection and management of our native vegetation by developing revegetation targets. These are big, bold and ambitious targets for long-term landscape change so it is important to have a process to develop the steps needed to meet these targets. *Backcasting* (Manning *et al.*, in press) – setting a long-term goal and working backwards to meet it – can develop these steps. There are many impediments to reaching these targets, including community capacity (the will, skills and resources to carry out the work), as well as biophysical constraints such as seed supply. Backcasting allows regions to estimate how to overcome these constraints, by first presuming that they can be overcome.

Seed supply is fundamental to the success of the revegetation activities:

Where will all the seed come from? How will it be harvested? How can we guarantee the genetic diversity of our future planted vegetation communities? Should seed provenance still be considered when the supply is limited?

Current estimates for three different CMAs, taken from their regional plans, show they will individually need in excess of 200 000 kg seed to meet their existing five year targets. Many CMAs, when developing implementation plans, are now reviewing these targets.

* Ecosystems provide many "services" from which humans benefit. Ecosystem services are the transformation of a set of natural assets (soil, plants and animals, air and water) into things that we value. CSIRO Ecosystem Services project <http://www.ecosystemservicesproject.org/html/overview/index.htm>.

Provenance - There are new rules

In an effort to maintain local genetic diversity and prevent 'genetic pollution', all Natural Heritage Trust (NHT) projects and regional natural resources management groups (CMAs) specify that revegetated areas use local species and seed collected from 'local provenance'. Whilst the desire to maintain local genetic diversity is both well founded and admirable, seed collected using strict 'local provenance' principles may limit the quality of seed and be restrictive to the success of the project.

The term provenance is French for 'origin' and was initially used to describe variations in survival, growth rates and form within the same species. Provenance for seed collection generally refers to the site or area from which the seed has been collected in a natural population. This is different from seed collected from cultivated sources such as plantations or ornamental plantings. The term has also come to describe genetic variation that species may show over a geographic range.

Four things you should know about seed provenance.

Understanding the provenance of your seed is important for seed collection and revegetation activities. However, there is more to best-practice seed collection than simply trying to stay within 'provenance'. Greening Australia has drawn on new research, such as the work of Andrew Young and Linda Broadhurst from CSIRO Plant Industry to consider what is most important for seed collection:

1. Local provenance isn't always the best. Seed collected from small, isolated populations can be highly inbred, leading to plants with low vigour and poor resistance to disease or disturbance. For example, studies of the endangered Daisy, *Rutidosia leptorrhynchoides* show that small populations produce much less seed (Morgan, 1999). In the rare *Swainsona recta*, (Small Purple Pea) seed is still produced but the seedlings are often weak and have low genetic diversity (Buza et al., 2000). Also, local provenance plants may not be the best suited for particular revegetation aims such as salinity or erosion remediation.

2. It's more important to collect from a sufficient number of parent plants to maximise genetic diversity. The more plants that are used for collection the greater the chance of capturing high genetic diversity. This improves the chances of producing high quality seed that will germinate, grow and

produce more viable seed for future generations. By maximising genetic diversity we can also provide an important genetic resource to help plants adapt to the possible impacts of climate change (Ellstrand & Elam, 1993).

3. Collect seed from widely spaced individuals within a population. Plants that grow close together are more likely to be related, and have similar genetic makeup (Adams, 1993).

4. In most instances local provenance isn't defined by distance. It can be better defined by similarities in soil type, topography, climate, vegetation communities, and the means of pollination and dispersal (Young, 2005).



florabank

Greening Australia is well placed to provide information about seed supply and the increasing demand through the Florabank program.

What is Florabank?

Florabank aims to improve the availability and quality of native seed for revegetation and conservation purposes by providing quality information for seed collectors and users. Florabank started in the late 1990s, and published the 10 Florabank Guidelines, Model Code of Practice and the Florabank website.

The initial funding for Florabank finished in 2001 but it has now been given new funding by the Australian Government through the Natural Heritage Trust. It continues to provide high-quality native seed information and brings together the leading research in native seed management into practical formats.

Want to know more?

Contact: Kimberlie Rawlings, Florabank Manager
Tel 02 6281 8585 Email general@Florabank.org.au
www.florabank.org.au

Seed supply

Ensuring sufficient, high quality seed is critical for the long-term success of revegetation activities. Most seed is currently collected from natural stands. However, natural stands may not be large enough to collect from and often require extensive travelling for collectors with no certainty that the seed will be ripe. Many species are difficult to collect or have very narrow collection windows, so often don't make it into revegetation. Seed production areas or farms designed for seed harvesting are one way of increasing the volume, diversity and availability of seeds. **Seed production areas**, if appropriately designed and managed should be able to grow high quality seeds to meet the scale of the current regional revegetation targets.

Farmers may be interested in developing these seed production areas on their farm as they can serve multiple purposes such as generating income, reducing soil erosion, increasing biodiversity and providing shade and shelter for stock.

It's your choice - Direct seeding or planting seedlings. Which one, when and why.

There are two schools of thought about direct seeding in Australia. Those who favour direct seeding say it is cheaper, produces better plants and is the only way to achieve the levels of revegetation we require. Those who favour tubestock planting say direct seeding uses too much seed and is unreliable.

Direct seeding is significantly cheaper than planting seedlings. On average, it costs around \$500 per hectare to direct seed and \$1500 per hectare to plant seedlings. (These figures are based on direct seeding at a rate of 1500g/ha, at \$250 per kg of seed and planting 800 seedlings per hectare. Cost of fencing and herbicide treatment is not included.)

Low establishment costs of direct seeding and the ability to cover large areas is attractive for commercial investors. But the unreliability of direct seedling is an issue for inexperienced operators. Direct seeding relies on the right mix of weather at the time of sowing for success, but good operators can do



a lot to lower their risk – such as good seed selection, site preparation and timing. However, the most critical thing to get right is weed control. When these factors are taken care of, direct seeding is as reliable as tubestock in medium to high rainfall areas.

'There is so much we don't know about direct seeding and there is very little monitoring of sites. What is known is that the quality of the seed, machinery and site preparation and management are significant factors in the success of the seeding.' Dave Carr, Greening Australia.

The often long establishment times can also be a significant issue when considering direct seeding. In some cases it may take 2-3 years for the seedlings to germinate. In this time, weeds and exotic grasses can recolonise an area if it hasn't been well managed. Not all species suit being directly sown. These species are better to be planted after sowing as tubestock. Direct seeding, supplemented by appropriate tubestock planting, is the only method to achieve the landscape change we have planned.

For further information contact:

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Direct seeding	Tubestock planting
(+) Lower establishment costs	(+) More reliable
(+) Natural look and more diversely structured	(+) Uniform
(+) Establishes healthier plants	(+) Revegetation is visible to passers by
(-) Long establishment times may lead to more maintenance such as weed control	(+) Uses small quantities of seed
(-) Ants have been known to take seed	(-) Often results in unnatural looking rows
(-) Uses lots of seed	(-) Higher establishment costs

Innovations in Direct Seeding in Temperate Australia

There's quite a bit of innovation in direct seeding but much of it is only known by the few experts working in their regions. More research into overcoming inhibitors, improvements in seed collection and storage techniques, sowing depths and improvements in machinery are needed to reduce the unreliability of direct seeding, particularly in low rainfall areas.

The Joint Venture Agroforestry Program funded a Greening Australia review of what is needed to improve the reliability and uptake of direct seeding, particularly for commercial woody species.

The information below is adapted from (Carr & Bonney, 2004).

Growing better Wattles - Inoculation of Acacia seed

The root-nodule bacteria *Bradyrhizobium* forms a symbiotic relationship with native legumes such as *Acacia*, *Pultenaea*, *Daviesia* and *Hovea*, where the host plant benefits from the bacteria's ability to fix nitrogen. Wattle-Grow®, a granular inoculant developed by CSIRO Plant Industries, containing selected strains of *Bradyrhizobium*, has been developed to enhance the growth and survival rates of many wattles and is showing positive results.

Smoke Water

Smoke is a natural germination trigger in some natural ecosystems and can be used in nurseries to enhance germination. Smoke can be impregnated into water, which traps the chemical compounds in smoke that encourage germination. Regen 2000® is used in many nurseries and is available commercially as a smokewater product.

Direct seeding in Saline Soils

In Western Australia alone, 780,000 ha of agricultural land are currently affected by salinity (Department of Environment 2003), and about half of this area appears suited to the growth of saltbush-based saltland pastures (Barrett-Lennard E, 1999). In addition, estimates from (WA Department of Environment in 2003) also show that 4.3 million ha of agricultural land are at risk from shallow water tables. In at least some of this land, the planting of saltbush-based pastures would be likely to increase water use to the extent that salinity risk could be substantially delayed or avoided.

Niche (direct) seeding has shown to be more effective for growing saltbush than conventional cultivations. Trials from the Department of Agriculture and Sustainable Grazing on Saline Land (SGSL) have also shown that niche seeding is also more effective when used on a raised M-shaped mound as it allows salt to be leached from the mound. Direct seeders designed specifically for saline land are now readily available.



Improvement in germination rates for Saltbush

New research trials in Western Australia from the SGSL program have shown that saltbush germination rates have been increased by:

- Removing saltbush seeds from the enclosing bracts, and
- Priming the seeds in solutions of gibberellic acid, kinetin or salicylic acid.

For further information about SGSL, contact:

Dr Warren Mason, coordinator, SGSL
Email warren@rpcsolutions.com.au

Direct seeding on difficult soils

Cracking alluvial clays and non-wetting sands generally result in poor establishment or survival after direct seeding. Cracking soils are difficult because as the soil dries out it cracks, exposing roots. When the soil is wet, the clay often sticks to the seeder, clogging it up and making the process very slow. If possible, seeding should be done in spring on mounded ground rather than deeply ripped soil.

On non-wetting sandy soils, bitumen mulch, coarse sand mulches, deep ripping, V-blade scalping and good weed control improves establishment success ((Hein *et al.*, 2000): (Knight *et al.*, 1998).

Knowing your seeds

‘Regional targets of tens of thousands of hectares of revegetation may be at risk because of the limited supply of seed. Without seed supply strategies, regional plans may be likened to plans for building supermarkets, but having no food to sell,’

*David Carr, National Technical Capacity
Manager for Greening Australia Ltd.*

What you should know about the plants and seeds that are being used in revegetation projects.

The revegetation we undertake today creates the landscapes of tomorrow. It is critical to make sure the species you use is well adapted to the site and won't become a weed in the existing or adjacent ecosystems or farmland. Consider what purpose(s) the revegetation will have. This will help decide the most suitable seed or seedling supply and type. As much as possible, ensure that:

1. The planted material is well adapted to the site to survive, grow and reproduce;
2. The new plants contain enough genetic diversity to produce a new generation of healthy plants;
3. Seed is selected from sites with similar environments to the planting site;
4. The new plants won't negatively impact on populations of the same species in adjacent natural vegetation, through hybridisation or outbreeding depression.*

Remember that the genetic quality and health of the source plants used for seed collection is probably more important than where it comes from. In fragmented landscapes with small natural stands, its better to collect widely from many source plants and then mix the seeds for revegetation, rather than collect from just small local populations (Carr, 2005).



Where are all the plants?

The Bureau of Rural Sciences has developed a set of core attributes for describing and mapping revegetation across Australia. These attributes promote nationally standardised methods for collecting information on distribution of revegetation, and is aimed primarily at land managers, land management agencies, catchment management groups and research organisations.

These attributes will assist in monitoring and evaluating the effectiveness of national and regional investments in revegetation activities to see if the revegetation work is making a difference. Groups will also be able to link with other activities in their area.

Further information contact:

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* Outbreeding depression occurs when the genetics of a dissimilar population essentially dilutes, or "pollutes" the genetics of the locally adapted population, and can result in less well adapted individuals

Who's exchanging what?

Many of the regional people and organisations managing native vegetation rely on their wealth of practical local experience to carry out their work. Sometimes though, research can help us do things better or more efficiently or help us look at problems in a new light. Exchange helps people find and use this research.

Exchange – the national vegetation knowledge service, is helping regional groups and land managers throughout Australia to find information, look at new ways of doing things,

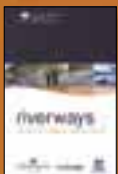
tap into research and meet people who are addressing similar issues in managing native vegetation.

Exchange is an Australian Government initiative supported by the Natural Heritage Trust and managed by Greening Australia. Our extensive networks and vegetation expertise allows us to link natural resource managers, scientists, policy makers and educators to information, organisations, people and research. Exchange offers a number of services including:



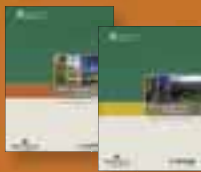
Bush Tracks Online

The highly successful publication 'Bush Tracks' is now online. Key resources about native vegetation management at your fingertips. Look for Bush Tracks Online from the Exchange link on the Greening Australia website at www.greeningaustralia.org.au



Riverways

Like BushTracks, Riverways identifies key resources about riparian management. You can obtain copies of Riverways by contacting Greening Australia. Riverways will also be available online in the near future.



Comprehensive Resource Directories

Native Vegetation and Regional Management and Native Vegetation and Property Management identify research and resources for native vegetation management. These are available in hard copy by contacting Greening Australia or electronically from the Exchange link on the Greening Australia website at www.greeningaustralia.org.au.

Enquiry Service – Call Exchange on 1300 886 589

If you want to know something about native vegetation management, Exchange's Enquiry Service will help you search for the information. It's like having your own native vegetation private detective! Questions can also be emailed to Exchange at exchange@greeningaustralia.org.au.

The Exchange Incentive Fund

The Incentive Fund provides funds to help you develop a better understanding of an issue, look at different management techniques, or improve communication about

native vegetation. Exchange can put the latest research into your region by funding visiting scientists, publications or reviews to answer your vegetation questions. The Incentive Fund is jointly funded by Greening Australia and Land & Water Australia. Look for calls for proposals on the Greening Australia and Land & Water Australia websites.

For further information, contact Exchange:
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Disclaimer

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