



NATIVE SEED IN AUSTRALIA

A SURVEY OF COLLECTION,
STORAGE AND DISTRIBUTION OF
NATIVE SEED FOR REVEGETATION
AND CONSERVATION PURPOSES

WARREN MORTLOCK



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A REPORT TO THE FLORABANK PROJECT

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This report was prepared by Warren Mortlock (FloraBank National Coordinator) as advice to the partners of the FloraBank project and Environment Australia. Greening Australia manages FloraBank in partnership with CSIRO Forestry and Forest Products through the Australian Tree Seed Centre, and the Australian National Botanic Gardens. FloraBank is funded by the Bushcare program of the Natural Heritage Trust and operates under the 'Agreement between the Commonwealth of Australia and Greening Australia Limited in relation to financial assistance for FloraBank'.

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Note; The word 'states' in this report generally refers to states and territories.

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Executive Summary

This report presents the results of a survey, conducted in 1998, into native seed collection, storage and distribution in Australia. The survey was conducted as part of the FloraBank project, which is managed by Greening Australia, in partnership with CSIRO Forestry and Forest Products through the Australian Tree Seed Centre, and the Australian National Botanic Gardens. The Bushcare program of the Natural Heritage Trust funds FloraBank. The survey comprised a national tour of seedbanks, structured consultations with stakeholders, a national questionnaire and minor literature review. It was undertaken to determine the role of community-based seed collection and storage operations in wider revegetation and flora conservation programs.

The major focus of the report is on community-based seed operations that support revegetation and landcare initiatives, but the report broadly describes the collection, storage and distribution of native plant seed for revegetation purposes across Australia. The major users of seed are identified in all sectors of the community, including government, mining and commercial operations. The report looks at the availability and quality of seed as a raw material, but touches on how and where native seed is actually used. It describes the current operations and practices of community seed operations and how they integrate with commercial and government seed suppliers. It identifies the issues for community operators and their needs.

Based on this foundation information, the report identifies strategic approaches to community seed operations and, in particular, to community seedbanks and seed production areas.

Draft recommendations arising from this report are presented under separate cover and public comment will be invited on them. It is envisaged that FloraBank will make recommendations to Environment Australia

in February 1999. These recommendations are also of relevance to the Commonwealth, to state and territory governments, local governments and many other organisations, groups and interested parties.

Indications are that nationally and in states where the mining industry uses native seed extensively (Queensland, New South Wales, Victoria and Western Australia), about 70% of all seed collected is supplied to mining companies for their rehabilitation needs. A large part of the remainder is used by the combined revegetation and landcare activities of the community, and following this the public sector on public lands. Forestry and bushfood operations are significant users, but on a much smaller scale nationally. In South Australia and the Northern Territory, where there is comparatively little mining rehabilitation, community and landholder revegetation activities and bushfood operations are the major users, followed by the revegetation activities of government. In Tasmania, where there is also comparatively little mining rehabilitation, forestry is the biggest user of native seed, followed by community and landholder revegetation activities.

Mining companies plant by far the greater amount of seed, mostly by direct seeding methods, over comparatively small areas. The area covered in revegetation by other users is much larger. These users, for the most part, still rely heavily on mass planting of seedlings, called tubestock. While direct seeding typically uses a limited number of species, comparatively little seed and a much larger range of species is typically used in nursery production of tubestock. The implications are that the greater bulk of native seed collected originates from and is used over comparatively small areas and represents only a tiny part of Australia's biodiversity.

Continuing increase in demand for native seed for revegetation and landcare activities is reported across Australia for all seed users.

This demand is strongly for seed indigenous to the local area in which it will be used – and increasingly so for all revegetation activities. This trend is commendable and should be supported. It is widely considered that indigenous plants are better adapted to perform in the local environment. The trend is also welcome from the viewpoint of maintaining biodiversity.

However, with the focus of commercial suppliers on mining and the collect and supply contracts of big users, there is uncertainty about their ability to satisfy demand for native (especially indigenous) seed from the many small community users involved in revegetation throughout Australia. Many community seed users reported that they are unable to source any local indigenous seed or have difficulty obtaining a reasonable range of species in the quantities required. The questionnaire found that 15% of community seed users usually have such difficulties and a further 35% sometimes do. The results show South Australia to be the easiest State in which to source local seed (from any source) and the Northern Territory and Queensland to be the most difficult.

A further difficulty here is that seed users must trust that the seed purchased from their supplier comes from the locality claimed, for there is no other practical way of determining seed origins. There is currently no native seed certification system operating in Australia. The questionnaire found that while 37% of all respondents consider that commercial suppliers usually provide sufficient information about seed, the remainder consider that they only sometimes, rarely or never do. This is particularly true of respondents to the questionnaire in Queensland and New South Wales, but less so for respondents from Tasmania, South Australia, Northern Territory and Western Australia. Among community respondents, half considered that commercial suppliers rarely or never provide sufficient information.

During consultation there were no concerns expressed about the physical quality of seed available commercially, however, the genetic

quality of seed is another matter. Genetic quality is concerned with how representative seed collected is of its parent population, and most guidelines available are for (more stringent) flora conservation purposes rather than for revegetation. A key concern is from how narrow a genetic base (how few plants) seed is collected. Consultation indicated that many commercial collectors would have little time for genetic parentage considerations and would be more inclined to use collection strategies that maximise seed return for minimum effort.

The provenance (collection location) of seed is also increasingly considered a seed quality issue. In most states indications are that indigenous seed is available in some regions only and within all regions there are local areas for which little or no local indigenous seed is available. The questionnaire found that most seed collectors, including commercial collectors, tend to collect seed in *their* local area. So, the nearer you are to the collection areas of commercial or community suppliers, the easier it will be to obtain local indigenous seed. There are still many areas where commercial suppliers simply do not operate or do not supply indigenous seed. There are also many regions where no community-based seed suppliers operate.

Even where commercial or community suppliers do supply local indigenous seed, there may be considerable natural, logistical, and bureaucratic barriers to collection. The factors responsible for collection difficulties relate to climate, vegetation, terrain, access, and isolation and may vary greatly between regions and contribute greatly to regional scarcity. There are also large gaps in available information on key aspects of collection and storage practice for many species. Anyone can readily collect seed and use it to propagate seedlings. But to do this on any scale, in every season, for a wide range of local plants, and deliver viable seed for successful propagation is demanding and not an endeavour to be taken lightly. To do it cost-effectively, where so much depends on seasonal factors, adds an extra element of difficulty. You can spend a lifetime learning to do it in one region, and only a handful of

people can do it for the plants of their whole state or for Australia.

Where landcare and community revegetation projects continue to create demand, it is very likely that the trend for increased seed collection in the community will also continue unabated. Wherever there is increased effort in revegetation, or a switch from tubestock to direct seeding, increased community seed collection capacity will be required *unless* commercial operators are quickly able to supply locally collected seed in that area.

While 93% of community operators who responded to the questionnaire collect seed, only 45% also buy seed (and then on average less than 10% of their seed requirements) and as many (42%) acquire seed at no cost from other collectors. So these operators already depend heavily for their local indigenous seed needs on the capacity of community-based seed collection and storage operations. Community seedbanks are responsible for supplying the majority of this seed. There are also significant quantities collected in some areas by individual landholders for use on their land, but this is difficult to document.

It is estimated that there are less than 50 community seedbanks (that store in excess of 20 kilograms of native seed) operating in Australia. These facilities are generally established and operated by the community to collect, store and distribute native seed to meet the ongoing seed needs in a region. Despite their name, they do much more than store seed. Almost all provide advice, assistance and training, and promote and develop local capacity for wider use of native seed from a wider range of local species and provenances in revegetation work. They promote and develop an understanding of the local flora and may have important strategic roles, such as coordination of indigenous seed collection and supply in a region. Seedbanks perform the vital carry-over role, storing seed for use in unfavourable seasons and allowing revegetation initiatives to continue where they otherwise could not.

The longer term storage of seed in the community is also of great interest, for it may

have implications for the conservation and protection of Australian flora generally, and in particular the rare and threatened species. This report highlights the potential for community seedbanks to be more involved in flora conservation programs.

Not much is known about native seed collection, storage and use in Australia outside of the public sector and the network of people directly involved: that is, the seed collectors, seed merchants, some seed users, responsible authorities and some research and industry organisations. Knowledge about native seed is increasing in parallel with the increasing interest in revegetation using native species. It is a major task for community extension to stay abreast of the ever-changing information now available on species viability and germination alone. However, there are still many fundamental questions to answer and basic research is greatly needed. During consultation, many reported that the state of our knowledge about seed collection, storage and germination limits our capacity to revegetate and almost certainly our ability to maintain and improve biodiversity.



Natural Heritage Trust

*Helping Communities Helping Australia
A Federal Government Initiative*

The Natural Heritage Trust and Bushcare

Bushcare, which provided funding for FloraBank, is a program of the Natural Heritage Trust. The Trust is the foundation of the Federal Government's program to conserve Australia's native vegetation, land, biodiversity, water resources and seas. The Trust is to provide \$1.25 billion to give local communities a greater opportunity to participate in conservation by identifying sites for environmental action and applying for funding to conserve, protect, rehabilitate and better manage local areas. FloraBank and seedbanks are an example of the partnerships being formed and the strategic approaches being adopted under the Trust. Bushcare is the largest new program of the Natural Heritage Trust. The goal of Bushcare is to reverse the long-term decline in the quality and extent of Australia's native vegetation communities, in order to conserve biodiversity and contribute to the ecologically sustainable management of natural resources on the ground, where it matters.



The FloraBank partners



Greening Australia

Greening Australia has been advising and helping Australians to re-establish, rehabilitate, manage and protect Australia's vegetation since 1982. Today, some 200 staff operate from 44 offices in capital cities and regional centres throughout the country. Greening Australia owns and operates a network of 24 seedbanks and 15 nurseries and supports 214 community and school-based nurseries. It collects, buys, sells and donates seed and plant material, and acts as a custodian of genetic stock of rare and threatened species. It also advises and trains seedbank and nursery operators on propagation methods, collection and storage techniques, recording systems and maintenance of standards.



*Australian Tree Seed Centre
CSIRO Forestry & Forest Products*

The Australian Tree Seed Centre has been a national and international tree seedbank for over 35 years. It supplies seed of Australia's unique woody flora to researchers in Australia and more than 100 other countries. The Centre maintains a store of more than 30,000 tree and shrub seed records from natural populations in all parts of Australia. It sets standards in methods of collection and documentation. The Centre provides technical advice and training on species selection, tree improvement, silviculture and utilisation, and conducts research on seed germination and handling, taxonomy, tree improvement and genetic variation in Australian trees.



*Australian National
Botanic Gardens*

The Australian National Botanic Gardens (ANBG) in Canberra has a living collection of about 100,000 specimens representing more than 6,000 taxa, or about one-third of the species of flowering plants known to occur naturally in Australia. The ANBG and the Centre for Plant Biodiversity Research are the custodians of three nationally important data sets: The Census of Australian Vascular Plants, Australian Plant Name Index, and Rare or Threatened Australian Plants. The ANBG's sophisticated computer-based Integrated Botanical Information System forms the link between the scientific information of herbarium accessions, the living collections, the photographic collection and bibliographic materials held in the library.



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PART ONE

INTRODUCTION AND SUMMARY FINDINGS



Introduction

This report presents the results of a survey conducted in 1998 as part of the FloraBank project, which is a joint initiative of Greening Australia, CSIRO Forestry and Forest Products through the Australian Tree Seed Centre, and the Australian National Botanic Gardens. The Bushcare program of the Natural Heritage Trust (NHT) funds FloraBank.

The survey broadly described the collection, storage and distribution of native plant seed for revegetation purposes across Australia. It identified the major users of seed in government, mining and commercial operations, and all sectors of the community in Australia. The survey was principally concerned with the availability and quality of seed as a raw material but touched on how and where native seed is actually used.

The survey comprised a national tour, national questionnaire and literature review. It was undertaken to determine the current role of community-based seed collection and storage operations in wider revegetation and flora conservation programs. In particular, the survey described the current operations

and practices of community seedbanks, and identified the needs and issues of managers and operators. It described how community seedbanks integrate with other seed collection and supply operations.

This report contains foundation information about community-based initiatives that involve seed and identifies strategic approaches to them. In particular, it identifies strategic approaches to community seedbanks and seed orchards.

Draft recommendations arising from this report are presented under separate cover and public comment will be invited on them. It is envisaged that FloraBank will make recommendations to Environment Australia in February 1999. These recommendations are also of wider relevance to the Commonwealth, state and territory governments, local government and many other organisations, groups and interested parties.



Background

This survey began in early 1998 with the commencement of the FloraBank project and started with discussions between the Bushcare program at Environment Australia and the three FloraBank project partners. There were an increasing number of seedbank and seed-related applications being submitted for funding under the Bushcare Program of the NHT. It was not clear how these related to wider seed collection and supply in the community.

Greening Australia Limited was involved in some of these applications and expressed strong interest in networking among seedbanks and providing support and extension services about seed collection and storage to the community. The Australian Tree Seed Centre and the Australian National Botanic Gardens shared these concerns and brought considerable technical ability and an interest in compiling extension materials to the partnership.

Greening Australia has a mission to work with the community to achieve sustainable land and water resources, primarily through improving vegetation management practices.

The Australian Tree Seed Centre has a mission to collect and provide seed and information on Australian trees and shrubs to researchers and the community.

The Australian National Botanic Gardens has a commitment to making botanical information available to the community through its extensive national and international network of herbaria, botanic gardens and community groups.

Revegetation

At the outset of this survey there was a perception that the demand for native seed in the landcare community is gathering momentum with increased use of seed. Fundamental to this survey was the notion that this trend is a good thing. There was uncertainty about the ability of commercial

suppliers to satisfy this demand and the role of community groups in seed collection and storage for landcare and revegetation purposes.

There were fundamental questions to answer. Why does the community collect and store seed? Who stores seed and how? What operations and practices are used? Is there enough native seed, of sufficient quality, to provide the raw material for the current and any increased revegetation effort in Australia? What are the issues confronting community seedbank managers and operators and what needs do they have? Recent Federal Government initiatives to increase funding available through the NHT and step up the pace of revegetation place a special focus on such questions.

There were also questions about the seed-related practices of the community. Why, how and where does the landcare community obtain native seed? How much seed is used in landcare? What species are in demand? From where is seed collected or acquired? How are provenance, viability, germination and seed quality issues handled?

Not much is known about native seed collection, storage and use in Australia outside of the public sector and the network of people directly involved; that is, the seed collectors, seed merchants, some seed users, responsible authorities and some research and industry organisations.

Knowledge about native seed is increasing in parallel with the increasing interest in revegetation using native species. It is a major task for all to stay abreast of the ever-changing information now available on species viability and germination alone.

There are few published surveys of collection and storage of native seed for revegetation. Those that are available focus on particular areas of revegetation work. For example, native plant seed usage by the mining industry is reported in a survey by Langkamp and Plaisted (1987) and the work of Loch et

al. (1994) provides a good summary of the native grass seed industry.

There have been several successful and informative national workshops about the use of native plant seed catering to the seed sector:

- The Australian Centre for Mine Site Rehabilitation Research held two national workshops on 'Native Seed Biology for Revegetation' (Bellairs & Bell 1994; Bellairs & Osborne 1997).
- The Australian Network for Plant Conservation held two national conferences: 'Conservation of Rare and Threatened Plants in Australasia' (Butler et al. 1991) and 'Integrated Plant Conservation in Australia' (Meredith 1993).
- The Australian Native Grass and Legume Seed Industry Association held a workshop in Roma (Waters & Noad 1997).

Involvement in flora conservation

Revegetation, rehabilitation and replanting programs, within and outside the landcare movement, involve collection of large quantities of seed and short-term storage before planting out – usually in the next suitable growing season. However, seed may be (and is) kept in storage for extended periods for a variety of reasons. The motivation may be as simple as to provide carry-over stock for use when seed harvests are poor, for example, during drought years.

Such longer term storage in the community is of great interest, for it may have implications for the conservation and protection of Australian flora generally, and in particular rare and threatened species. There has been increasing interest in long-term conservation of our indigenous flora over the last 10 years through Australian botanic gardens and arboreta and such organisations as the Australian Network for Plant Conservation. The Australian National Botanic Gardens, the Australian Network for Plant Conservation and the Commonwealth Heads of Botanic Gardens have a keen interest in the potential for long-term plant conservation associated with the rise of community seedbanks and landcare in general.

A study of the status and prospects for ex-situ germplasm conservation of rare and threatened Australian plants in 1993 found that excellent genebank facilities operated in Australia. Facilities existed in all states and operated at all levels of sophistication and size. The study further found that, with some limitations, 'these facilities between them possess the appropriate expertise, equipment, capacity and interest to undertake the task of conserving the germplasm of Australia's rare and threatened flora' (Morse et al. 1993). At the time of this survey the storage (if any) of germplasm by community groups was considered insignificant.

What are community seedbanks?

The ‘community’ referred to throughout this report includes individuals, landholders, community groups and other grass roots organisations involved in landcare, revegetation and replanting of Australian native plants. ‘Community seedbanks’ then are facilities established and operated by the community for collecting, storing or distributing native plant seed. Many such seedbanks have their origins in the landcare movement and revegetation or replanting work.

In this report a distinction is made between a ‘community seedstore’ and a ‘community seedbank’. The distinction is largely a matter of scale and purpose, and that a seedbank, unlike a seedstore, does much more than just collect and store seed.

A **seedstore** is a temporary storage usually linked to the needs of one or more specific revegetation projects. It only stores and supplies seed in the short term. It is not intended to be a continuing facility. Rather, it exists as a matter of necessity where seed storage is required during the life of some revegetation projects. One would not expect a seedstore to hold seed other than that needed in a revegetation project. Few resources are required and methods are basic and low cost. A seedstore may be as small as a toolbox or cardboard carton or a few containers in the fridge.

In some current terminology, seedstores are called ‘satellite’ or ‘local’ seedbanks, emphasising the geographic location or the trading relationship between small local seed collections and larger regional ones at the community level. However, the term ‘seedstore’ used here is broader and emphasises roles and the degree of permanence as key factors.

A **seedbank** is intended as a more *permanent* facility with some commitment to meeting ongoing seed needs in a region or state. Despite their name, community seedbanks do much more than provide storage of seed. Almost all seedbanks provide advice, assistance and training to the community on seed collection, storage and use. Seedbanks promote and develop local capacity for wider use of native seed from a wider range of local species and provenances in revegetation work. They promote and develop an understanding of the local flora and seed collection from it. Seedbanks quickly become involved in revegetation initiatives generally in a region and may have important strategic roles such as coordination of seed collection and supply. They extend assistance and training to seedstore operators and staff or volunteers of local projects that have a seed use component.

A seedbank performs the vital role of storing seed that may be used during drought or unfavourable seasons when seed is scarce in the bush. This carry-over role allows revegetation initiatives to continue where they otherwise could not.

A seedbank may be anything from a large fridge or cupboard full of native seed to a well-staffed laboratory with walk-in cold rooms storing tonnes of native seed and an array of sophisticated equipment and facilities.

The term ‘**regional seedbank**’ refers to a seedbank with a regional coverage and role. Under the definition used in this report, all ‘seedbanks’ have regional coverage and the term ‘regional seedbank’ is redundant. There is no standard system of comparable regions in place for seedbanks to refer to – nor would many seedbanks recognise such a system were it in place. The geographic coverage of seedbanks and issues about the potential for duplication of resources are discussed in Part Three.



The FloraBank project

FloraBank is a project funded by the Bushcare program of the NHT and supports the effective delivery of the Bushcare program. The requirements for the current project are set out in the 'Agreement between the Commonwealth of Australia and Greening Australia Limited in relation to financial assistance for FloraBank, 1998'.

The project is managed by a Steering Committee comprising representatives of the three project partners: Greening Australia, CSIRO Forestry and Forest Products through the Australian Tree Seed Centre, and the Australian National Botanic Gardens. The committee operates under a memorandum of understanding to implement the agreement with the Commonwealth on FloraBank. The project commenced with the appointment of a National Coordinator on 1 March 1998.

Aims

FloraBank seeks to improve the availability and quality of native seed and plant material for revegetation and conservation purposes in Australia. This will be achieved through support, advice and assistance to collectors, seedbank managers and distributors of native seed and plant material. FloraBank seeks to enhance existing networks between seedbanks and plant collections. The project will assist with training and provide guidelines for the collection, storage and

handling of seed to local, regional and community-based seedbanks and groups. FloraBank encourages practices that protect Australia's biodiversity.

Contracted and actual outcomes

The agreement with the Commonwealth requires, in part, that FloraBank document the operations of existing community and regional seedbanks and plant collections and assess regional training needs. This commitment is met by the national survey of seedbanks conducted by FloraBank and this report. In addition, the Steering Committee considered that, to better address the aims of FloraBank, the national survey should be extended to:

- identify the current roles of community seedbanks in revegetation and flora conservation
- describe the current operations *and practices* of community seedbanks
- describe the issues seedbank operators face
- describe the needs of seedbank operators (rather than simply regional training needs)
- better inform the study by including other major sectors of the community involved with native seed.



National survey

The objective of the 'National survey of the collection and storage of native plant seed in Australia' (national survey) is to document the roles, operations, practices, needs and issues of seedbanks in Australia.

The national survey began in mid-March 1998 and has three parts:

- a national tour involving visits to seedbanks, and discussion forums

- a literature review and collection of available data from researchers, agencies and the like
- a questionnaire distributed nationally to collectors, seedbank operators and seed users.

Stakeholders

At the outset of the survey it was difficult to establish with certainty a list of stakeholders who collect or store native seed. Nor was it possible to establish with any certainty what might constitute a representative sample for the purposes of the survey. FloraBank identified and distributed survey material to approximately 1,500 stakeholders in the following broad groups:

- state and federal government departments and agencies (including herbaria and seedbanks within them)
- Greening Australia's network of seedbanks
- landcare and catchment management groups
- native plant protection and conservation groups such as Men of the Trees, the Australian Society for Growing Native Plants, the Australian Network for Plant Conservation, and wildflower societies
- mining companies undertaking rehabilitation of mined areas
- commercial revegetation, forestry, agroforestry, and like operators
- commercial and amateur native seed collectors and suppliers
- commercial plant breeders and amateur societies for plant breeding
- commercial floriculture, horticulture and nursery operators
- local governments
- schools, particularly those with nurseries, seed orchards, herbaria or revegetation programs
- interested individuals.

Seedbank tour program

The national tour involved visits by the Coordinator and Steering Committee members to seedbank operations in all states from March to August 1998. The tour participants observed and documented operations and practices at seedbanks across a variety of government, mining, commercial and community organisations. A pro-forma interview format was used in all seedbank visits, major consultations and forums conducted. An effort was made to elicit unprompted responses, especially about needs and issues, from a very wide variety of people involved with native seed.

The tours enabled FloraBank to question seedbank managers in greater detail than was possible through the questionnaire and to compare anecdotal information with actual operations, practices, issues and needs.

Forty-nine seedbank operations were visited and structured discussions were held with operators and managers. A further 20 major structured consultations were held during the tour involving key seed users and those with a good knowledge of revegetation initiatives at regional and state levels. See Appendix 1 for details.

Forums were organised to allow for informed discussion of needs and issues between key people involved with native seed. Eleven structured discussion forums were held across most states. See Appendix 1 for details.

Numerous informal consultations were held during the survey period.

Literature search

A brief review of recent literature was undertaken. The review concentrated on previous surveys and description of seed collection and storage practices in Australia, of which there are few. Current initiatives in this area were also reviewed and contact made with their principals where possible.

Questionnaire

A questionnaire (see Appendix 2) was developed by FloraBank covering:

- identification and contact details
- general description of purpose, size of seedbank and scale of seed operations
- description, origins and end use of seed collected
- seed collection and storage operating parameters and practices
- identification of difficulties and needs experienced in collection and storage
- description of record-keeping practices, use of computers and the Internet.

Questionnaires were distributed from mid-May to mid-July 1998, for return by 15 August 1998.

Distribution was accomplished through the Greening Australia network in each state, targeting those people directly involved with native seed rather than, for example, the head offices of organisations and companies.

Response to the questionnaire

The response to the questionnaire was good nationwide, with 325 returned – a response rate of 22%. Fewer questionnaires were distributed in those states with smaller populations (see Table 1). Response rates ranged between 10% and 30% on a state basis.

The questionnaire provides a valid sample of stakeholders at the national and state level, and across the broad groupings of respondents – community, commercial and government sectors. The response from all states was generally representative of the stakeholder groups actually involved with native seed. In some states, the response under-represented commercial seed collectors and merchants. It is a measure of the enthusiasm for this questionnaire that almost all respondents gave contact details.

The response from the three main sectors and categories within each varied between states and did not mirror distribution patterns. Table 2 shows, for example, that

the response across commercial, community and government sectors from Tasmania (14, 3 and 1 responses respectively) was the opposite of the response from the Northern Territory (1, 6 and 11 responses respectively). Closer inspection of the response by categories shows that the major response from Tasmania came from commercial nurseries (10 responses), whereas state government (7 responses) was the major respondent category in the Northern Territory. The variation in response has significance for the interpretation of questionnaire results generally, and is in itself an indicator of differences in the native seed sector between the states.

There were 167 questionnaire responses from the community sector. Map 1 shows the distribution of respondents from this sector and indicates seedbank and seedstore locations. Most responded on behalf of a community group (101 responses), about half of which were landcare groups. There were also community nurseries (10), community botanic gardens or arboretums (8), non-government organisations (22) and individuals (26).

Map 1: Location of community sector respondents who collect or store seed

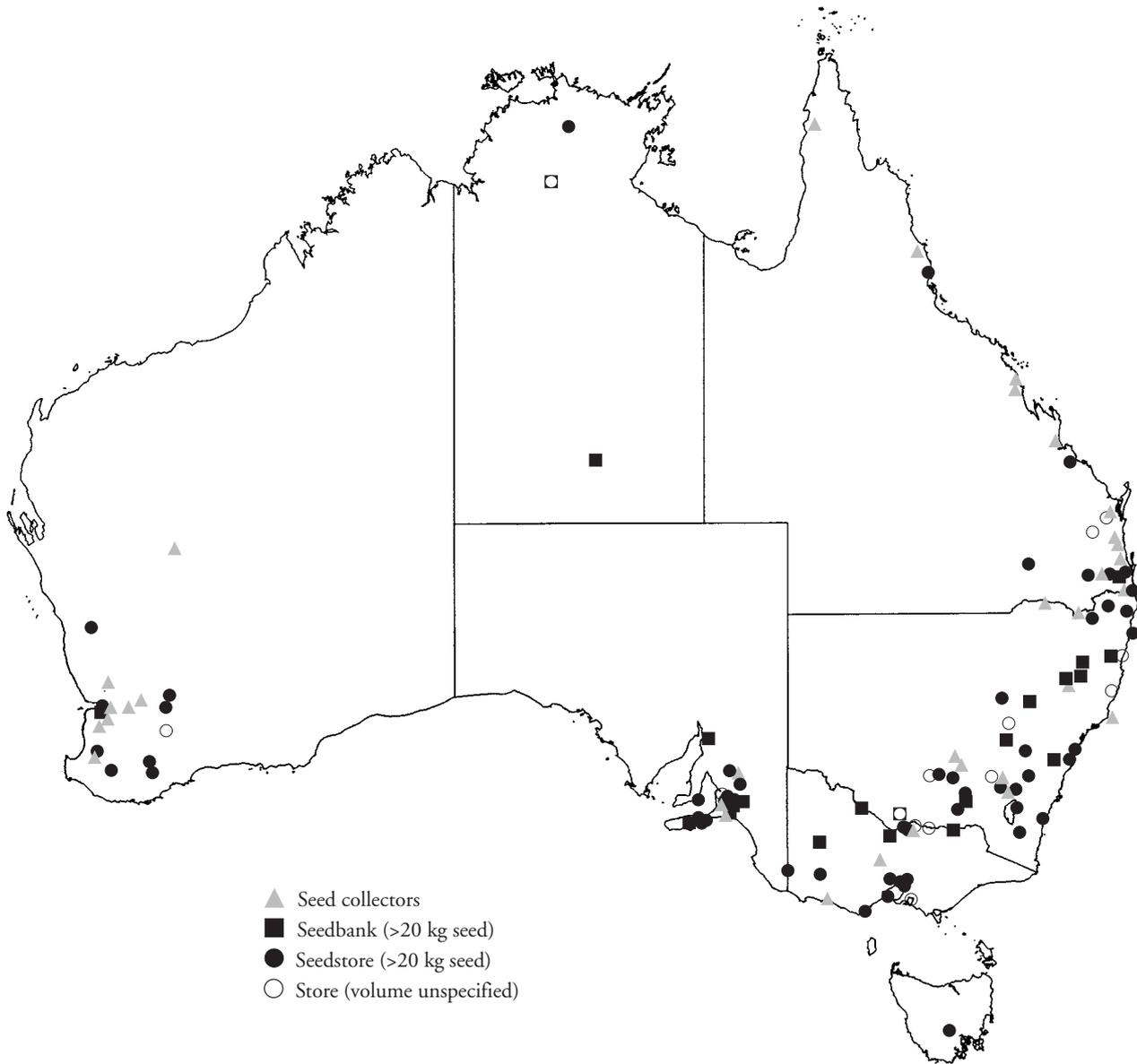


Table 1: Questionnaire distribution and response rates, by state

	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Blank	National	Total
Distributed	30	300	100	210	210	100	300	242		171	1,663
Responses	3	74	18	62	44	18	53	47	6		325
Percentage response from each state	10	24.6	18	29.5	20.9	18	17.6	19.4			19.6
Percentage of national response	0.1	22.8	5.5	19.1	13.5	5.5	16.3	14.5	1.8		

Table 2: Number of questionnaire responses for sectors and categories of respondents, by state

	Questionnaires returned, by state									Total
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Other	
Community sector										
Commercial		21	1	17	8	14	21	14	1	88
Community		48	6	33	31	3	20	23	3	167
Government	3	5	11	12	5	1	21	10	2	70
Community category										
Community group		5	1	12	8	2	11	11		50
Landcare/ICM group	1	19	2	6	16		2	6		51
Community nursery		3			2		3	2		10
Individual		8		3	5		3	4	3	26
Non-government organisation		1	1	5						7
Greening Australia		8	1	4		1	1			15
Botanic garden/arboretum	1	6	3	3	1				1	15
Local government				5	3		9	2	1	20
State government		2	7	3		1	11	8		32
Federal government	1	1								2
University or research	1		2	4	1		1			9
Other business					1		2			3
Revegetation service		3		1	1	2		3		10
Mining				9			1	3		13
Seed collector						1		3		4
Seed merchant		2	1	2	2	2		2		11
Commercial nursery		16		3	4	9	9	3	1	45
Seed testing				2						2
Total	3	74	18	62	44	18	53	47	6	325



Summary findings

The native seed sector

Main seed users

Nationally, indications are that the mining sector uses as much as 70% to 80% of all seed collected for mine site rehabilitation. Almost all the seed they use is either collected or supplied by commercial operators. The next largest users of seed are the revegetation projects of community groups and landholders (including some state government involvement) which consume perhaps 10% to 20% of all seed collected. A large part of this seed is supplied by community collection and storage operations.

Lesser seed users are roadside and reserve revegetation, and forestry and bush food operations, which are also supplied by commercial operators.

At the state level, this ranking of users also occurs in Queensland, New South Wales, Victoria and Western Australia. These are all states in which there are regions (Central Queensland, Hunter Valley, Gippsland, Pilbara and south-west Western Australia respectively) where the mining industry uses native seed extensively. In South Australia and the Northern Territory there is comparatively little mining activity and the community seed sector and bush food operations are the major users. In Tasmania, forestry and the community seed sector are the big users of native seed.

In revegetation, most seed is planted by mining companies using direct seeding methods. However, the area covered is small compared to that covered by revegetation through landcare which, for the most part, still relies heavily on planting seedlings (tubestock). Comparatively little seed but a much larger range of species is typically used by nurseries to produce tubestock. Direct seeding typically uses a limited number of species (usually less than 25) selected for

their site worthiness, availability and ease of establishment.

One implication is that most of the seed collected across Australia represents only a tiny proportion of the total flora and its biodiversity. Another implication is that most seed is consumed in revegetating a small part (mine sites) of the total area revegetated each year. This raises questions about the efficiency of use of an often scarce resource and whether direct seeding and mine site rehabilitation may be affecting the availability of seed. Commercial suppliers commented that seed available on the commercial market is frequently left over from contracts with mining rehabilitation and other large commercial projects.

Commercial seed

Native plant seed of many species is readily available on the commercial market. Commercial seed suppliers have the potential to collect and supply seed from anywhere to anyone. It must be logistically possible and profitable to do so, and there must be adequate prior notice for collectors to find and harvest seed.

The physical quality of seed available commercially (but not necessarily genetic quality and known provenance) is generally good and the prices generally low, considering the cost of collection and storage. There is currently no native seed certification system operating in Australia to regulate or standardise seed quality.

Community operations

Many people in the community collect native seed. The survey indicated that, of these seed collectors:

- most also clean and store seed
- of those who store seed, the primary purpose for storage is either for use in specific replanting projects or to distribute (non-profit) for revegetation

- community operators are much more likely to distribute seed for free than sell it
- community operators distribute seed (in order of importance) to community groups, farmers and landholders, direct seeders and community nurseries
- most are also involved in the use of native seed and raise seedlings for replanting, which most carry out themselves
- about half are also involved in direct seeding and a little more than half in managing natural regeneration.

Where landcare and community revegetation projects continue to create demand, it is very likely that the trend for increased seed collection in the community will also continue unabated. Wherever there is increased effort in revegetation, or a switch from tubestock to direct seeding, increased community seed collection capacity will be required *unless* commercial operators are willing to supply locally collected seed back to that area.

Indigenous seed

Seed that is indigenous to the local area of the user, however, can be much more difficult to obtain commercially. Seed users are increasingly unwilling to use seed of unknown or far-off origins and there is a strong trend in the community to specify local indigenous seed for revegetation. This trend is commendable and should be supported. Indigenous plants are often better adapted to perform in the local environment and it is better practice for conserving biodiversity.

There is frustration among community seed users at the difficulty in obtaining sufficient information about the origins of seed available commercially. This is particularly true of respondents to the questionnaire in Queensland and New South Wales but less so for respondents from Tasmania, South Australia, Northern Territory and Western Australia.

Seed users must trust that the seed purchased from their supplier comes from the locality claimed, for there is no other practical way of determining seed origins.

Commercial suppliers have been quick to respond to tender specifications that increasingly call for indigenous seed collection and supply for projects, for example, roadworks, mining rehabilitation and major infrastructure projects. Commercial suppliers, however, have been slow to respond to the increasing demand for local indigenous seed by community groups and landholders for their revegetation projects. It is very likely to be uneconomic for commercial collectors to collect a range of local indigenous seed for all regions of a state. The logistical and environmental difficulties involved in collecting seed across vast areas are formidable. In addition, the demand in terms of volume of seed may be small and profit margins may be non-existent.

Most commercial suppliers consider that better planning in community projects to provide a longer lead-time for seed collection is essential to improving the commercial availability of local seed. However, this is likely to make a difference only where demand is sufficient to interest commercial collectors in the first place.

Regional availability

Consequently, many community seed users are unable to source any local indigenous seed for revegetation projects (especially small projects). Others have difficulty obtaining a reasonable range of species in the quantities required. The survey indicated that South Australia is the easiest state in which to source local seed (from any source) and the Northern Territory and Queensland are the most difficult.

In most states, indications are that the availability of seed varies from region to region. Indigenous seed is generally available for some regions but not others, and within all regions there are local areas for which little or no local indigenous seed is available. The nearer you are to the collection areas of commercial suppliers, the easier it will be to obtain local indigenous seed commercially. There are still many areas where commercial suppliers simply do not operate or do not supply indigenous seed.

Even where commercial suppliers are willing to collect local indigenous seed, there may be collection difficulties, such as:

- lack of vegetation
- seasonal scarcity of seed
- logistical, climatic and environmental difficulties in seed collection
- the need for constant surveillance of seed set
- the need for good timing for collection when seed is mature.

All these factors may vary greatly between regions and contribute greatly to regional scarcity. Determining exactly which regions experience scarcity of local indigenous seed is a considerable undertaking. While there are some indicators, a definitive assessment of regional scarcity was not undertaken during the survey.

Seed resource

The seed resource available in the bush is poor over large areas of Australia, although good in other areas. There is a lack of remnant vegetation and small numbers of plants left to collect from in many areas. In many remnants the seed resource is all but gone or is inadequate from a genetic viewpoint. This is largely a consequence of the combined effects of human presence, our land use and land management, and general decline of the vegetation, especially the understorey.

We need to better understand the genetic resources of remnant vegetation. As a priority, access to seed should be improved in areas where seed is scarce in the bush, rather than in well-vegetated regions where seed is more abundant. Restricted access to highly diverse bushland reserves and national parks also causes concern to questionnaire respondents, especially where these may be the only sources of seed available in a region.

Provenance

There is a trend in the revegetation sector to specify a desired provenance of seed. Almost always this is simply specified as seed indigenous to the local area. This is especially

evident among some of the big seed users in mining, landcare and government. The definition of 'local' varies but is expressed most often as a distance (for example, a 15-kilometre radius) from the planting site, or in terms of catchment, land system, bioregion or even local and state government boundaries. This sort of approach is a 'best guess' and almost never based on understanding of the actual genetics of plant communities. Another motivation is to collect seed locally for use locally and so that biodiversity may be protected and enhanced.

It is of great importance that more is done to improve understanding and reduce doubt and uncertainty about the provenance boundaries of common plants used in revegetation. How local should 'local' be? A workable system for describing broad provenance areas and promoting it in the community is needed. Such a system may reduce over-zealous or too tight a provenance specification for seed used in revegetation. It may also ensure that adequate provenance specification is used. There are numerous vegetation classifications and existing information on which the development of a rudimentary provenance system could be based. There is also a system of 62 forest provenances developed by Forestry Tasmania and used in Tasmania that may provide a basis for development.

Imported native seed

There were reports of native seed being imported into Australia for revegetation at very low prices from overseas suppliers. While the cost may indeed be lower, there is widespread concern and condemnation in the community and among commercial and government suppliers about this practice. Overseas seed is reported to be inferior and often poorly identified and labelled, or in seedlots where species are intermixed and contaminated with other seed. There are concerns about the genetic origins and hybridisation of such seed, and the possible effects of such introductions on biodiversity and the introduction of plant pathogens as yet unknown. Revegetation seed needs should and can be met from within Australia, with an increasing emphasis on matching known provenance to the area of use.

Seed storage

In general, we store seed to maintain it in a viable condition from the time of collection until the time of sowing. Storage time varies according to the purpose for which you store seed. In revegetation work, for example, seed is generally collected with the aim of sowing it as soon as possible in the next growing season. A storage period of 2 or 3 years is typical, with a maximum storage time of perhaps 5 years. In comparison, the conservation of a species through storage of seed may involve periods in excess of 25 years, over which viability must be maintained. Commonly in Australia, the length of time in storage is classified as short term (up to 5 years), medium term (5 to 25 years) and long term (more than 25 years). Remember that the longer you need to store seed, the more expensive it becomes.

What's difficult about collecting and storing seed?

Anyone can readily collect a few cupfuls of seed from a eucalypt or acacia in their backyard in a matter of minutes and use it to propagate thousands of seedlings. It sounds easy and it is. But to do this on any scale, do it in every season, for a wide range of local plants, and ensure the best quality possible is demanding and not an endeavour to be taken lightly. To do it cost-effectively adds an extra element of difficulty. You can spend a lifetime learning to do it in one region, and only a handful of people can do it for the plants of their whole state or for Australia.

Newcomers must overcome considerable hurdles, such as:

- accurately identifying flora in the field
- understanding seed biology and ecology
- learning when and where to collect seed
- the secrets of germination and viability testing.

Seed drying, extraction, cleaning and storage are technical disciplines in the wider agricultural seed industry in which technicians may spend a lifetime at work. These disciplines are much less well understood for native seed than for agricultural seed. In some cases this

knowledge is hard won and closely guarded by commercial seed collectors, merchants and native plant nurseries.

Collecting seed for long-term conservation purposes adds to this complexity still further, with the requirement for scientific rigour in the way that genetic parentage is understood and documented, seed is handled, treated and stored, and viability is monitored. It is generally only the major academic and research facilities in Australia that are capable of operating long-term low-temperature and cryogenic storage.

Regulations

Frequent concerns were raised at discussion forums and by questionnaire respondents about the problems of regulation, royalty and permit systems and their significant impediment to seed collection. Many expressed concern at the generally counter-productive trend to 'lock up' seed resources and increasingly restrict access to them. There is a recent trend for local authorities to also introduce restrictive seed collection policies on collectors, regardless of their reasons for collection or technical competence.

Considerable differences in regulatory approaches between the states are apparent. Seed collection may fall under the jurisdictions of land management and flora protection legislation, forest production royalty systems, and interstate export and import regulations, requiring that a collector be conversant with many requirements in each state. There are often considerable fees attached to approvals and permits, and anecdotal evidence that these may be restricting collection practice. Royalty systems were criticised for unfairly grouping seed collection with wildflower harvesting and other forest production, resulting in royalties set at too high a level.

Regulatory authorities and some others in the native seed sector increasingly promote certification for native seed collectors. Commercial rather than community collectors appear to be the main target of such moves. Community collectors and seedbank operators can do much to deliver

real improvements in standards of practice and quality control other than through a certification scheme.

Information sharing and awareness

There is little sharing of information in the native seed sector, despite great need.

Individual user groups such as gardeners, mining companies, nursery operators and regenerators share information to some extent within their groups, but seldom between groups. These user groups have considerable technical expertise that is often not written down and there is much to be gained from greater information sharing.

There is a great need for networking among community practitioners about native seed to avoid the prospect of waste and duplication, and to increase cost-effectiveness.

Better promotion and awareness of the value of native seed as a resource and raw material is needed. Much seed is wasted during vegetation clearance operations. Private landholders, local authorities and state governments need to be more aware of their seed resource and allow access to collectors.

The seed people in the community are broadly aware of the issues regarding local provenance and the consequences of using plants from outside local gene pools. However, all face the practical difficulties imposed by strict adherence to provenance and in identifying how far afield one should consider 'local' to be.

The community seed sector

Community seedbanks are facilities established and operated by the community for collecting, storing or distributing native plant seed. A distinction is made between a community 'seedbank' and a 'seedstore'. The distinction draws attention to fundamental and important differences in the scale and purpose of operations.

A **seedbank** is intended as a more *permanent* facility with some commitment to meeting ongoing seed needs – revegetation projects or otherwise – in a region. However, the seedbank role includes services in addition to

supply of seed, including extension, advice, training, information and assistance to the community on seed collection, storage and use. A community seedbank usually contributes to revegetation projects and initiatives, generally in the region in which it is located.

A **seedstore** is a small-scale *temporary* facility with a primary role as a short-term storage of native seed. In most cases, a seedstore services the needs of one or more specific revegetation projects while these projects are in progress. Few resources are required, and storage infrastructure and methods are basic and low cost.

Community seedbanks

Community seedbanks collect by far the majority of seed collected and stored by the community seed sector. The size and scale of a seedbank operation quickly increases in direct proportion to the involvement in direct seeding in a particular region. However, the capacity of community seedbanks is small compared to those in the commercial sector. Only nine seedbanks of 23 that responded to the questionnaire currently store in excess of 50 kilograms of seed. It is estimated that there are less than 50 community seedbanks (storing in excess of 20 kilograms of seed) in total in Australia.

Seedbank roles

Despite their name, community seedbanks often do more than just supply seed. Almost all provide extension, education and training in the community to encourage and develop local capacity for wider use of native seed. They provide assistance, training, coordination and facilitation for seedstore operators and staff or volunteers of local projects that have a seed use component.

Seedbanks perform the vital role of storing seed that may be used during drought or unfavourable seasons when seed is scarce in the bush. This carry-over role allows revegetation initiatives to continue where they otherwise could not.

Seedbank establishment and location

Community seedbanks are typically established through community initiative to take a regional focus for seed supply,

extension, seed storage and multi-project service roles. Often the motivations are that the range of species (and provenances) in demand is not available commercially. A seedbank may rely on a mix of sponsorship, host organisation, volunteers and funding (especially government funding) for resources and to meet operating and major project costs.

Community groups, landcare and catchment management groups, community nurseries and non-government organisations operate seedbanks. Indications were that many are operated under community partnerships rather than by single groups. There are also seedbanks operated by government, primarily in support of community revegetation initiatives. Such seedbanks tend to be managed by steering committees, with representation from many groups, organisations, agencies and businesses in the community.

Some community seedbanks follow a centralised model for storage where seed is contributed from projects, collectors, landholders and others for storage in a central location in the region. Another seedbank operating model is the decentralised model or regional seedbank network. Here a protocol is established for exchanging information about seed holdings of otherwise autonomous seedbanks and seedstores. All members have access to advice, training, extension and other support programs. Members also trade seed for their needs within the region.

Communities will likely choose one or the other model, although both have advantages and disadvantages and may perform equally well.

Seedbank location

Seedbanks operate regionally rather than locally, although what constitutes a 'region' varies. There is not a system of regions recognised or in operation across all seedbanks, and boundaries are often flexible. Most regions do not have a community seedbank and the demand for seed is already sufficient for many more community seedbanks to be established. Currently the density of seedbanks is such that they do not

overlap in jurisdiction and do not duplicate resources. Indeed, even were geographic overlap to occur, the functional roles (and specialisation) of seedbanks may not overlap or duplicate resources. In some regions a number of community seedbanks will almost certainly be required to meet demand.

More than one seedbank may also be required where, for example:

- seedbanks specialise in vegetation types (wetland, forest, grasses), volumes of seed (direct seeding supply), or distribution on a non-profit or profit basis
- geographic isolation or community structure suggests sub-regional coverage.

Seedstore and seedbank roles in any region are generally complementary and may establish independently. Seedbanks do not replace or make redundant the seedstores already located in a region. Nor do they necessarily duplicate resources or create overlap of effort with seedstores.

Community seed collection

The survey indicated that most community seedbanks, community groups and landholders collect most of their seed in the local area or, to a much lesser extent, from within their region. Almost none of their seed comes from outside of Australia. A large proportion of seed comes from natural bush and a much smaller proportion from plantings or plantations. Very little seed comes from uncertain origins or areas established specifically to supply native seed (seed production areas).

The survey indicated that a wide variety of vegetation types are collected, although most operators collect relatively more trees and tall shrubs than low shrubs. The least collected are native grasses and wetland plants.

The survey indicated that community operators, apart from collecting seed themselves, are more likely to acquire seed at no cost from other collectors than to buy seed from commercial seed merchants or collectors. Typically, one to three collectors are used who may be paid people, volunteers, recently trained or part-time collectors or full-time commercial collectors.

The seed needs of a community seedbank may be satisfied through collection by seedbank staff, community group members and volunteers, or through contract collectors and seed merchants. Typically, seedbanks use one to three collectors (not necessarily non-profit), which sets a limit to the amount of seed that may be collected in any season without employing collectors. The involvement of volunteers is an important part of extension programs, but may make it more difficult to maintain quality standards.

The survey indicated that most seed is collected and very little seed is actually purchased, even by seedbanks. Less than half the community operators actually buy seed and those that do buy very little – on average less than 10% of their total requirements.

Many of those consulted in the community only buy seed when they are unable to collect all the seed they need themselves. Some find that the seed they want to use (local indigenous seed) is not available commercially, or not in the quantity needed. In at least one case in north-central Victoria, where local seed is not available, community projects have been postponed rather than buy seed, especially seed not local to the area.

Community collection needs

Indications were that community operators are less confident of their collection practices and have fewer needs than for storage practices. Obtaining viable seed on any regular basis is hampered by the combination of natural factors such as:

- lack of rain and poor seasons
- unpredictable seed maturation and sporadic seed set
- high levels of seed predation by insects before seed is mature
- height of seed in trees
- naturally poor seed viability.

Logistical difficulties were often cited by collectors in the community, including:

- timing collection when seed is mature
- having a naturally short window of opportunity to collect seed

- having insufficient people and resources when it is time to collect
- collecting in sometimes inaccessible, difficult or distant locations
- monitoring seed set in remote areas or for difficult populations or species
- gaining access to mechanical or other harvesting equipment.

These difficulties vary a little between the states but are consistent across community, government and commercial sectors, suggesting the strong influence of logistical and environmental factors.

Consistent themes in the difficulties experienced by community groups and landholders were lack of knowledge and lack of skills and expertise. Many commented that they do not have enough knowledge for correct plant identification, collection timing, understanding what to collect, where and how. There are problems caused by changing and uncertain taxonomy for some species.

The information available to community operators on seed collection and storage is generally inadequate. There has been little research on the collection and storage of the flora, despite recent advances through applied research conducted by mining companies. There are some technical and scientific publications on seed collection and storage. The community generally does not have access to this information and there are only very basic leaflet materials written for community use.

Consequently, the community and, to some extent, commercial collectors experience a lack of species-specific information on key aspects of collection, such as the:

- approximate time of flowering and seed set for even common species across broad climatic zones
- appropriate propagation methods for a species
- reasonable (and broadly accepted) provenance boundaries for species.

There are major bottlenecks in the chain of supply of local indigenous seed, significantly

due to these information gaps. Seed users are often unaware of the seed holdings of many collectors and suppliers. It can be a time-consuming task to search for seed of a certain species. A central clearing house or network for accessing local seed from all sources may be of considerable value to seed users and improve the efficiency of seed use. FloraBank has initiated a seedbank directory and catalogue as part of its web site to address this issue.

Training

Seedbank operators and landcare extension staff currently conduct basic (introductory) training programs in seed collection and use. These programs are almost entirely pitched at community groups and landholders. Training modules have been developed and are currently offered in most states. These modules provide a foundation for delivery anywhere in Australia, although some modifications would be necessary to reflect regional vegetation composition and community needs.

Community seed production areas

There was a lot of discussion about seed production areas among those consulted. Much of the discussion was based on a growing recognition in the community that, if carefully established, seed production areas could be used to supply local indigenous seed to community group and landholder revegetation projects.

The survey demonstrated that very few in the community sector (slightly more in the commercial sector) currently collect seed from seed production areas.

There is great potential for seed production areas, for example:

- where certain local species are in high demand locally
- where genetic rejuvenation of remnant vegetation in an area is needed
- where established as part of wider revegetation or rehabilitation initiatives.

Long-term land tenure, access and management and good quality local seed (genetic quality) are prerequisites for establishing seed production areas. Such

areas may be established and maintained locally by local and state government, landcare groups and landholders. However, there is very little practical guidance or information available on what to do, where and how. This is to be addressed in the current FloraBank project.

Community seed storage

Seedbanks hold most of the seed stored by the community, although most community questionnaire respondents who collect seed also store some seed. Community seedbanks typically store seed for the short (up to 5 years) or medium term (5 to 25 years), although few have been operating for more than 10 years. A small proportion of seed (less than 40%) but a relatively large range of species is stored for more than 5 years.

Seed drying, cleaning and storage practices vary in accordance with size of operation and the length of time that seed is stored. The methods used are, however, usually basic and not conducive to viable long-term storage.

Seed storage is greatly affected by broad climatic differences across Australia and, in particular, is reduced by high heat and high humidity. Much seed can be stored in the short term at room temperature and humidity (or in air-conditioned environments), provided that seed is well dried and sealed in airtight containers. Current community storage practices do not, however, universally achieve this standard of storage. Average ambient seed storage space in community seedbanks is about 20 cubic metres. Where seedbanks have refrigerated storage space they will store the majority of their seed in it. Very few seedbanks have access to more than one or two (ordinary domestic) fridges and few if any surveyed rent storage space in air-conditioned or refrigerated premises.

Seed is typically air-dried and cleaned by hand before storage. Many community operators do not clean seed at all, though all seedbanks surveyed do. Over half of all community seed operations do not use any pest control. Many store seed in a mixture of containers – most of which are not airtight.

It is good collection practice to record basic information about seed collected (species, location, date and collector). Such information is essential to label seed of a certain locality or provenance. It is also important when undertaking subsequent collections, in making accurate species identification, and in understanding the local seed resources. Yet many community sector operators who responded to the questionnaire do not record such basic information for seed collected. Most seedbanks do record basic collection information but do so by hand rather than using a computer. A point may be reached in the development of a seedbank (perhaps 20 to 50 kilograms of seed or 50 to 100 seedlots turnover per annum) where the scale of operation justifies the use of a computer in seedbank operation and management.

Community storage needs

Generally, needs were more clearly expressed for collection than for storage, perhaps because many community operators simply do not store much seed for long. These operators are typically involved in revegetation and perhaps not overly concerned at difficulties they experience with storage, whereas difficulties in collection may directly restrict revegetation effort.

Many community questionnaire respondents listed difficulties with storage, including, in order of frequency:

- attack by vermin, insects and fungal agents
- the loss of seed viability and the short shelf life of many species in storage
- lack of available storage space and equipment, poor equipment and equipment failures
- understanding technical aspects of storage and overcoming problems with temperature and humidity.

While these difficulties confront all those who store seed, overcoming them depends greatly on the knowledge of the operator and the resources at their disposal. Seedstore operators have fewer resources but not necessarily less knowledge than do seedbank operators.

Technical advice, training courses and, to a lesser extent, information on storage were considered inadequate by over half of respondents. The only other needs listed by respondents were advice on data handling on computers and access to seed storage facilities.

The community experiences a lack of species-specific information on key aspects of storage, including:

- approximate natural viability of species
- best-bet storage regimes for species
- approximate expected shelf life of species under major storage regimes
- expected viability of species after storage
- seed cleaning techniques for species.

Community seedbanks are typically ill-equipped and lack essential resources and support services. Respondents indicated a need for all forms of equipment except computers. Most do not have adequate drying, fumigation and bagging equipment, such as electronic balances, heat sealing equipment and better seed drying facilities. In particular, there is a need for temperature and humidity control and monitoring equipment, air-conditioning and refrigeration in many seedbanks.

There are a number of services to the horticultural and agricultural seed industries that are not universally used or available to community seedbanks. Such services include contract:

- seed drying and extraction
- seed cleaning
- seed moisture content determinations
- seed viability and germination testing.

That community seedbanks do not all use such services may in part be due to the as yet limited exposure of service providers to community seedbanks, and vice versa. Not all such services are provided in every region, however, most are available on a state basis. These services use equipment and cover areas of expertise that may be beyond many (but not all) community seedbanks and their operators. Greater access to commercially

available services at market rates may be a better short-term strategy than investing in high levels of training and equipment for community seedbanks to be self-sufficient in these respects.

Training

Some structured training at a more advanced level suitable for seedbank operators is available, but not in every state. There are a variety of horticultural courses that include seed collection, storage and use offered by TAFE campuses throughout Australia. The Australian Network for Plant Conservation and the Threatened Flora Seed Centre (Department of Conservation and Land Management in Western Australia) run germplasm conservation training programs on a national basis approximately annually. There is a great lack of suitably qualified people to conduct advanced training.

Information and networking solutions may be more effective than advanced training programs in improving seed collection among seedbank operators. These issues are to be addressed in the current and proposed FloraBank project.

Community involvement in flora conservation

The large range of indigenous species collected makes the holdings of community seedbanks of considerable interest to conservation. This is especially true of seedbanks in highly biodiverse regions or where the flora is disappearing or under threat. Community seedbanks may be viewed as a collection network for local indigenous species from a region. Reference collections from each seedbank may be cleaned, dried and stored at a high standard by government-operated seedbanks in each state. To a small degree this already occurs in some states.

There appears to be growing awareness of genetic quality issues and interest in flora conservation in the community. However, this level of awareness could be improved.

Some community seedbank operators do wish to contribute more to conservation than their revegetation focus currently allows. Many seedbanks could store seed for longer periods were they to have better resources, adopt better practices or make use of rented storage options. Some seedbanks are looking for longer term storage options for reference collections and for species conservation purposes. A surprisingly large number (24%) indicated that species conservation was the primary purpose (or one of the primary purposes) for storage.

Seed production areas could also contribute to flora conservation if carefully established and maintained.

PART TWO

A NATIONAL VIEW OF RESULTS

Across Australia, demand for native seed has increased significantly over the last decade. This increase is generally attributed to changing attitudes in the wider community and growing awareness and greater effort in replanting native species. Landcare is a prominent agent of change. So, too, are changes in planning, mining, forestry and development legislation that affect standards of land management and rehabilitation practice.

The rise of direct seeding practices and, to a lesser extent, mass planting techniques using seedlings (tubestock) accounts for a lot of this increased demand.

Seed is the major raw material used for propagating native plants in Australia. It is the seed that creates new growth and dictates much of the outcome of our planting work, whether we are motivated by production and profitability, habitat construction, or landscape healing and stability. It is generally only where seed is not available that other plant materials are used for propagation. While 53% of respondents to the questionnaire nationally use propagation materials other than seed to propagate native plants, consultation suggested the amount used is small. In addition, only 16% store, sell or distribute these materials. Seed is the cheapest and most suitable means for large-scale establishment of native plants.



The native seed sector

This report uses the term *native seed sector* to include all people who have an interest or involvement in native seed collection, storage or use.

Looking nationally at this sector, consultation with key seed suppliers

suggested that the greatest demand (and the greatest increase in demand) for seed now comes from mining companies using native species for rehabilitation of mined areas. Probably next most important are the revegetation projects of individual landowners, landcare groups and agencies,

followed by the revegetation activities of state and local authorities on roadsides and reserves. Lesser seed users are forestry and collection for bushfood.

It was not possible in this survey to arrive at definitive national estimates for the quantity of seed used by these groups. Indications are that in the order of 70% of all seed collected (by weight) is used by mining companies in rehabilitation. Of the remainder, perhaps 20% is used on private land revegetation and landcare projects. Much of the rest is used by state and local authorities on roadsides and reserves. A few per cent of all seed collected is used about equally by forestry operations, as bushfood, and by commercial nurseries. Collection for bushfood is difficult to place in these rankings because few people in the community have a big picture view of what is happening in bushfood collection.

The native seed sector is further subdivided into commercial, government and community sectors. There are considerable differences between these sectors nationally and among the states in regard to the scale, role and practices of collection and storage operations.

The commercial sector

The commercial sector is the major supplier of native seed in Australia and has grown in recent years to meet increased demand. This sector includes commercial seed collectors, contractors and merchants as the main seed suppliers, and commercial nurseries. The big commercial seed users are also included, as are seed testing laboratories, seed cleaning and other service industries.

The native seed industry mostly comprises small businesses operating from home in the rural and urban fringe areas of Australia. However, there are large seed merchants based in south-eastern and south-western Australia. It is a vastly smaller industry than the larger city-based commercial agricultural (pasture, cereal crop and horticulture) seed sector. The native seed industry operates efficiently on much lower levels of investment in capital, equipment and infrastructure than does the agricultural seed

sector. It has traditionally relied on technology, research and development from its larger cousin, although this situation is changing. The native seed industry is not specifically regulated by government (although seed collection is) and functions through systems based on trust rather than certification or accreditation.

The government sector

There are many native seed collection and storage operations of Commonwealth and state governments throughout Australia. CSIRO is the main Commonwealth agency operating large seedbanks. The Australian Tree Seed Centre, operating from Canberra, is perhaps the largest CSIRO seedbank. It is a national focus for the collection of seed from Australian trees and shrubs and sets standards in methods of collection and documentation. There are also smaller collections held by agricultural and research areas of CSIRO throughout Australia.

The Australian National Botanic Gardens operates a seedbank as part of its living collection.

In most states there are very large seedbanks operated by the various forestry departments and crown land managers. Those typically responsible for the seed needs of state forestry operations concentrate on forest tree species. Whereas once these were wholly owned and operated by the state, these seedbanks are now partly or wholly commercial operations in most states. Seed is generally collected and sold at commercial rates and a very limited range of other services are provided on a user-pays basis.

National parks and other crown land management agencies also collect and store some seed. However, the amounts are usually much smaller than those involved in forestry.

The community sector

The term *community sector* allows for comparison with commercial and government sectors even though, at the broadest level, the latter are very much part of our wider community. There are also commercial and government interests and

sponsorships in some community-based seed operations.

Individuals and groups in the community are collecting, storing and using more seed than ever before – especially in landcare revegetation initiatives. The quantity of seed collected and stored by the community-based seed operations is only a small fraction of the total annual seed turnover of the commercial and government native seed sectors. Consultation indicated that all the landcare and revegetation activities undertaken by community groups and individual landholders may only use about 20% of all the seed collected nationally.

Although a considerable amount of seed is collected for specific revegetation projects and stored briefly in seedstores, the majority of seed used by the community appears now to come from community seedbanks.

Community seedbanks

Community seedbanks are recent phenomena. They have started popping up all over Australia, run by community groups, landcare and catchment management groups, community nurseries and non-government organisations. Indications are that many are operated under community partnerships rather than by single groups. Greening Australia Limited manages, or is a partner in, about half of the community seedbanks in Australia. There are also seedbanks operated by government, primarily in support of community revegetation initiatives; for example, Capricorn Seedbank Project at Livingston Shire (Qld) and Native Plant Seedbank at Central Queensland University.

Most, if not all, community seedbanks operate at the regional level. Indeed, many seedbanks are specifically created through community initiative to take a regional focus for seed supply, extension, seed storage and multi-project service roles. Many are managed by steering committees that include representatives from many groups, organisations, agencies and businesses in the regional community.

Community seedbanks arise for complex reasons but there are some common motivations:

- Seed of a range of species in demand is not available commercially or, if available commercially, is of inappropriate provenance, limited quantity or too high a cost.
- The community wishes to better understand its local species and to promote revegetation or landcare to the wider community.
- The community wishes to increase the use of local native seed in revegetation projects in the region and especially in direct seeding operations.

While legislation and state government policies create some of the context in which seedbanks operate, community sector seedbanks appear to arise primarily in response to our stewardship of the land. They are also greatly affected by other regional variants such as the vegetation type, climate and agricultural mix.

There are many fewer community seedbanks than seedstores. It is estimated that no more than 50 community seedbanks (that store in excess of 20 kilograms of seed) currently operate in Australia. Appendix 3 contains a list of those currently operating in Australia. There were 23 respondents to the questionnaire who store more than 20 kilograms of seed. Recently, Environment Australia and FloraBank estimated the number of community seedbanks currently funded under the Natural Heritage Trust and Bushcare program at 24 nationally. There are, however, a further 20 initiatives (at least) to set up community seedbanks.

Western Australia and Tasmania each has only one or perhaps two community seedbanks while the Northern Territory and Queensland each has three or four. Victoria has about six community seedbanks, South Australia has eight and New South Wales has twelve. Even in New South Wales, there are not community seedbanks in all regions, though there is arguably the need. Map 1 shows the location of respondents to the survey questionnaire and indicates seedbanks

separately to seedstores and collectors. All known seedbanks are shown on the map. Clearly, over much of Australia there are no community seedbanks at all, though the factors that give rise to seedbanks are in evidence.

Different seed for different purposes

One can only make sense of the big picture if one keeps constantly in mind the purpose for which various people collect, store and distribute native seed. These purposes can be very diverse – as different as agroforestry is from ornamental art or native grass pasture establishment near Alice Springs is from aerial seeding over rehabilitated mining areas in Cape York. Seed is sold locally, interstate and overseas and it is also distributed free.

Different purposes may demand seed in vastly different quantities and of quite different quality characteristics – even in seed of the same species. This, in turn, sets different standards for seed collection, storage and distribution practices. The approach to collection and storage, and considerations of seed availability and quality are all very different for long-term conservation purposes than they are for revegetation.

In general, we store seed to maintain it in a viable condition from the time of collection until the time of sowing. Storage time varies according to the purpose for which you store seed. In revegetation work, for example, seed is generally collected with the aim of sowing it as soon as possible in the next growing season. A storage period of 2 or 3 years is typical, with a maximum storage time of perhaps 5 years. By comparison, the conservation of a species through storage of seed may involve periods in excess of 25 years over which viability must be maintained. Commonly in Australia, the length of time in storage is classified as short term (up to 5 years), medium term (5 to 25 years) and long term (more than 25 years). The longer that seed must be stored, the more expensive it becomes.

Standards of practice

The survey found three broad standards of practice for seed handling and storage operations commonly used in the native seed sector. These standards are not necessarily an indicator of seed quality, for other factors such as collection practices are also vitally important.

A *basic standard* is commonly practised by many of those who keep seed for their own use, or distribute it free. These include those involved in small-scale revegetation, most smaller community groups, some commercial native nurseries, and those who use seed quickly rather than storing it.

An *intermediate standard* is practised by many who sell their seed, keep seed for 3 years or more, or store larger quantities. Better collection and storage practices than those of the basic standard help to minimise risk, guarantee quality and standard of product, and contribute to more reliable germination. All commercial seed merchants and most community seedbanks visited operate at an intermediate standard – some more advanced than others.

An *advanced standard* is described in the Australian Network for Plant Conservation's *Germplasm Storage Guidelines for Australia*. Government germplasm storages and forestry seed suppliers (including recently commercialised government seed supply centres) practise this standard almost entirely. A few commercial seed suppliers also practise this level of storage, but probably not this level of collection. The resources and equipment required for this standard of collection and storage are beyond most community seedbanks.

What's difficult about collecting and storing seed?

Anyone can readily collect a few cupfuls of seed from a eucalypt or acacia in their backyard in a matter of minutes and use it to propagate thousands of seedlings. It sounds easy and it is. But to do this on any scale, do it in every season, for a wide range of local plants, and ensure viability and the best quality possible is demanding and not an

endeavour to be taken lightly. To do it cost-effectively adds an extra element of difficulty. You can spend a lifetime learning to do it in one region, and only a handful of people can do it for the plants of their whole state or for Australia.

Newcomers must overcome considerable hurdles, such as:

- accurately identifying flora in the field
- understanding seed biology and ecology
- learning when and where to collect seed
- learning the secrets of germination and viability testing.

Seed drying, extraction, cleaning and storage are technical disciplines in the wider agricultural seed industry in which technicians may spend a lifetime at work. These disciplines are much less well understood for native seed than for agricultural seeds. In some cases this knowledge is hard won and closely guarded by commercial seed collectors, merchants and native plant nurseries.

Collecting seed for long-term conservation purposes adds to this complexity still further with the requirement for scientific rigour in the way that genetic parentage is understood and documented, seed is handled, treated and stored, and viability is monitored. It is generally only the major academic and research facilities in Australia that are capable of operating long-term, low-temperature and cryogenic storage.

Many native species are quite readily propagated even though they require some pre-treatment to encourage germination. However, there are also many native plants that are not easily germinated and cultivated. The environmental conditions for germination may not be appropriate. Many species have naturally low viability or germinate only within a certain restricted window of environmental conditions. Even where suitable environmental conditions prevail, seed may still fail to respond due to some dormancy mechanism. Unlike cultivated plants which possess little or no dormancy, we find that about one-third of native species require pre-treatment such as

immersion in boiled water or seed scarification (scratching of the seed coat) to break dormancy mechanisms.

Compounding these problems is that our flora is highly endemic (restricted to Australia) and is little researched.

Revegetation: The majority of seed is used quickly

Indications are that, nationally, the majority (perhaps 70% or more by weight) of seed collected is used in rehabilitation after mining. Of the remainder, most is used in re-establishing native vegetation on degraded lands and in the revegetation projects of landcare groups, landowners and businesses. Some state agencies also use a large amount of seed in revegetation projects, especially on roadsides and other crown lands.

Lesser seed users are roadside and reserve revegetation, forestry and bushfood operations, which are also supplied by commercial operators.

At the state level, this ranking of users also occurs in Queensland, New South Wales, Victoria and Western Australia. These are all states in which there are regions (Central Queensland, Hunter Valley, Gippsland, Pilbara and south-west Western Australia respectively) where the mining industry uses native seed extensively. In South Australia and the Northern Territory there is comparatively little mining activity and the community seed sector and bushfood operations are the major users. In Tasmania, there is comparatively little mining activity and forestry and the community seed sector are the big users of native seed.

Greater variation again occurs at the regional level, where, for example, mining and revegetation by direct seeding may not be present at all.

Universally in revegetation, seed is collected over summer and stored only until the next growing season: generally the next winter (late) or spring. Storage is generally short term and only necessary because use of seed is delayed by a poor growing season(s). Some seed may also be held as insurance against

seasonally poor or infrequent seed crops or, to a lesser extent, to cover contingencies such as last minute project requirements, species selection trials and other small-scale work.

In revegetation, by far the greater amount of seed is planted by mining companies using direct seeding methods. Direct seeding is a less expensive establishment technique than using seedlings. It typically uses a limited number of species (usually less than 25) selected for their site worthiness, availability and ease of establishment. The area covered is, however, small compared to that covered by revegetation through landcare which, for the most part, relies on planting tubestock. Tubestock planting is a more efficient user of seed in terms of the number of plants established per unit of seed used. So comparatively little seed, but a much larger range of species, is typically used by nurseries to produce tubestock.

One implication is that the greater bulk of seed collected across Australia represents only a tiny proportion of the total flora and its biodiversity. In Western Australia, for example, it is estimated that the mining industry might use seed of approximately 500 (Sean Bellairs, pers. comm.) of the 12,540 indigenous species at last census in that state.

Another implication is that most seed is consumed in revegetating a small part (mine sites) of the total area revegetated each year. This raises questions about the efficiency of use of an often scarce resource and whether direct seeding and mine site rehabilitation may be affecting the availability of seed. Commercial suppliers commented that seed available on the commercial market is frequently left over from contracts with mining rehabilitation and other large commercial projects.

Long-term storage: Little seed is stored for long periods

The 'ideal way to conserve rare and threatened species is to reserve relatively healthy populations in their natural environments, that is – *in situ*'. However, 'germplasm collections can store very large

quantities of genetic material efficiently and reliably over very long periods' (Morse et al. 1993). Such collections are nationally significant for flora conservation.

Germplasm storage has a role in the protection of rare and threatened species and in species recovery.

Seed is frequently the plant material chosen for germplasm collections because it involves relatively low-cost and compact storage options. By comparison with revegetation, only an extremely small quantity of seed is collected and stored for long-term conservation purposes in Australia.

Typically, in germplasm collections only a few hundred grams (or less if that is all that is available) are collected and stored for any particular provenance or species.

However, a large range of native species are typically stored. Often, rare or threatened species are a key component of these collections.

A 1993 study of the status and prospects for *ex-situ* germplasm conservation of rare and threatened Australian plants found that excellent genebank facilities operated in Australia. Facilities existed in all states and operated at all levels of sophistication and size. The study further found that, with some limitations, 'these facilities between them possess the appropriate expertise, equipment, capacity and interest to undertake the task of conserving the germplasm of Australia's rare and threatened flora' (Morse et al. 1993). The following three main types of germplasm collections were described from the 101 responses to the survey:

- collections of germplasm of agricultural and other species useful to humans for characterisation, breeding and research
- collections of native species in botanic gardens for propagation, conservation and exchange
- small specialised, mostly ephemeral, collections in university departments for specific research projects.

One further category of collection was the 'small ephemeral collections ... held by community and other groups around the country to support local and regional

planting projects'. However, these collections were not considered in detail by the study because they 'possessed few of the features required for *ex-situ* germplasm conservation'. The study did, however recognise the role of these groups and their collections in 'identification, *in-situ* conservation, collection, propagation and re-introduction of widespread, rare and threatened plants' (Morse et al. 1993).

FloraBank was not set up to review the findings of this 1993 study or the implementation of its recommendations. The FloraBank survey found that germplasm storage continues to take place almost entirely in sophisticated seedbanks operated by the botanic gardens of Australia and Commonwealth and state government agencies (eg. CSIRO, Department of Conservation and Land Management in Western Australia). Overall, the status of mainstream germplasm storage facilities for rare and threatened Australian plants seems little changed in the last 5 years.

In respect of germplasm collections, a primary focus of the FloraBank project was to describe the current germplasm storage practices of the community and other groups not covered in the 1993 study. FloraBank also sought to describe the potential for involvement of these groups in germplasm storage.

Germplasm storage in the community

Seed storage facilities operated by community and other groups have increased in capacity and technical competence to undertake germplasm storage since 1993. There is now a network of seedbanks established with the capacity, enthusiasm and knowledge to be an important player in germplasm storage and flora conservation in Australia. Some seedbank managers expressed an interest in cooperating with better equipped germplasm storage facilities at the state level, but few interviewed had done so. Indeed, some seedbank managers wanted access to cryogenic and other germplasm storage facilities as centralised repositories for reference collections of the important seed holdings (and other plant materials) in their seedbank. Foremost of the

requirements for germplasm storage is a commitment to long-term maintenance of the facility – through budget, staff and resources. These are not characteristics that community seedbanks generally possess.

Currently, some community seedbanks keep seed of regionally rare or important species in medium-term storage for revegetation and, in some cases, conservation purposes.

Twenty-four per cent of community respondents to the questionnaire indicated that species conservation was a primary purpose for storing seed – 29 of 125 respondents who answered this question. On a state basis, 32% of respondents in South Australia, 25% in New South Wales, Queensland and Victoria, 7% in Western Australia and 0% in other states indicated that species conservation was a primary purpose for seed storage.

About 13% of community respondents who store seed (21 out of 162) keep seed for more than 5 years and indicated that this would comprise 40% or less of the total in storage. It is of great significance that a range of local indigenous species will be represented in these collections. There appears to be great potential for coordinated programs between government and community for increasing the amount of material and range of species and provenances held in germplasm collections. Well-documented collections of seed from indigenous species might be gained through community collectors and seedbanks.

The Australian Network for Plant Conservation

The Australian Network for Plant Conservation brings together people who are interested in helping to protect Australia's native plant heritage. Experts from science, industry and community groups advise the network in its activities. Members include government and private organisations, community groups and interested individuals. Greening Australia, the CSIRO Australian Tree Seed Centre and the Australian National Botanic Gardens are members of the network.

The Australian Network for Plant Conservation members contribute to the development of plant conservation in Australia by participating in regional plant conservation groups; working groups to establish standards for plant conservation activities; training courses; recovery projects; conferences and workshops.

The Australian Network for Plant Conservation locates and brings together information on integrated plant conservation activities and provides access to this information for members. Members receive and share information via, among

other things: *Danthonia*, the network's quarterly newsletter; publications such as the National Endangered Flora Collection; and guidelines for plant conservation activities.

The Australian Network for Plant Conservation has also produced *Guidelines for Translocation of Threatened Plants in Australia* and *Germplasm Conservation Guidelines for Australia*. It has established the National Endangered Flora Collection to provide information on endangered plants being grown by members. The collection is used for recovery projects, research, education, display and general horticulture.



Availability and quality of seed

A national picture of the availability and quality of native plant seed is of great importance. Everyone consulted by FloraBank (without exception) believes that the general trend for increased seed use will continue. Many of those consulted believe that there will be even greater increases in demand from mining, landcare, agroforestry and greenhouse carbon sink initiatives. Where will the seed needed to meet this demand come from and what will the quality of the seed be?

The availability and quality of native plant seed are now critical concerns for landcare, sustainable agriculture and the management of reserves and natural lands generally. They will also be critical concerns for those involved in planting carbon sinks (global greenhouse gas emission management) and in agroforestry initiatives.

A complex and sometimes quirky picture of seed availability and quality has emerged through the FloraBank survey. The quantity and quality of seed available varies from region to region across Australia. As with any raw material, the quantity of seed available is relative to the extent of the resource for harvesting and the system of supply and demand. Harvesting of the resource should be managed in a sustainable and

environmentally responsible manner, which may also limit availability.

Considerations of seed quality include as a minimum its cleanliness and viability but often extend to how genetically representative seed is of its parent population. Increasingly, revegetation workers are concerned with the natural suitability of plants to local climatic and soil conditions, tolerance to drought, salinity, insect attack, and more. Species selection trials, varieties and provenances of seed have long been an integral part of forestry, cereal cropping, pasture establishment, horticulture and so many other aspects of primary production. But only recently have the species, origin and quality of seed become critical concerns in native revegetation.

Availability of seed

A small number of large commercial seed merchants dominate seed supply in each state and across Australia. There are many (usually smaller) seed merchants who are also collectors – and personally collect all or part of the seed they sell. Larger seed merchants employ collectors or buy seed from freelance collectors. Typically, merchants pay a collector by weight for the seed they collect up to 50% of the catalogue price of seed. Any

of the above may put in for tenders for collection and supply of native seed for specific projects advertised by government agencies, mining and some other organisations.

In deciding whether to collect and supply seed of any particular species, commercial suppliers must juggle such complex factors as:

- demand and how quickly it is increasing
- the range of species and provenances sought
- the size of the market for seed in a region
- the market price for seed of any particular species
- the presence of other commercial collectors
- the cost of collecting seed of any particular species
- the extent of the seed resource in the bush
- their knowledge of that species as a natural resource, its collection, storage and viability.

Different users may have very different and often quite localised seed requirements representing niche markets for seed. While mining companies contract seed collection and supply work in advance, many community users 'shop around' for seed as they need it. Some seed suppliers are better placed (located) to take advantage of these niche markets than others. It may be simply unprofitable for any supplier to do so. There are not commercial seed suppliers based in every region – although many do operate between regions, states and even nationally.

Insufficient lead-time for seed collectors to find and collect seed is often cited as one of the biggest problems with the demands of seed users. Even with sufficient lead-time, collectors face the difficulties of identifying and locating populations, and of being present at seed set to effect a harvest. In remote regions it is often the tyranny of distance or lack of knowledge about the vegetation that limits the ability to meet demand for the range of species needed.

Not all species produce viable seed, may reasonably be collected, or can be stored and germinated. Not all seasons are conducive to seed collection. Inevitably, conditions vary and can result in poor or non-existent seed production. In general, last year was a poor year for seed collection across much of Australia due to hot, dry weather conditions.

It is no small consideration that commercial collectors must overcome all these difficulties and harvest seed at a profit.

Demand and supply

Commercial seed supply is widely considered to be largely demand-driven. However, supply is complicated by many factors, as noted above. It is clear that not all demand is currently met by commercial suppliers and many in the community source seed from community suppliers or collect it themselves. Few community respondents to the questionnaire actually buy seed from commercial suppliers. Over half (57%) of the community respondents do not purchase any seed from commercial suppliers. Of those who do buy seed, most (8%) purchase less than 10% of their seed requirements from commercial suppliers. Although you would expect such a result from a sample of people of whom most collect their own seed, many have wider seed needs than they can or are able to collect for.

The survey found that there are regions of Australia where the demand outstrips supply, which in some cases critically restricts regional revegetation efforts in the community, for example, in south-western, central and western New South Wales, north-west and north-central Victoria. Typically, in such areas recent increases in the volume of direct seeding have increased demand for seed. Coincidentally, in these areas the vegetation is poor and the seed resource is small. There is often competition for the small resource among collectors. Seed production areas are considered an answer to supply rare or highly sought after seed in such regions.

In other regions, such as the central Queensland coast and the north coast of

New South Wales, it is reportedly difficult to get any local native seed.

In yet other regions, there appears to be sufficient seed resource to meet foreseeable demand, for example, throughout the well-vegetated northern (tropical) parts of the Northern Territory and much of coastal Queensland. However, this does not mean that seed is harvested and therefore readily available. Natural regeneration rates are high in sub-tropical and tropical areas and the use of seed in revegetation work (especially direct seeding) is less common than in temperate areas. Markets are smaller and do not support as many local collectors and seed merchants as temperate areas. Some of the larger commercial seed suppliers in the southern states sell tropical material on the domestic and international market.

A more comprehensive survey of regional availability of seed is needed.

Quantity of seed handled among sectors

The survey does not provide definitive national estimates for the quantity of seed used by the commercial, government and community sectors. There are considerable variations at the state and national levels.

The comparative figures in Table 3 indicate the amount of seed and numbers of species collected, stored and distributed among these sectors. Table 4 shows further comparison between the larger categories within these sectors.

All sectors dispatched more seed than they collected in the last year. This highlights the role of seedbanks in supplying carry-over of seed supply in poor seasons. Last year was generally considered a poor season for seed collection.

The data in Table 3 indicate that the commercial sector is dominant in collection and distribution of seed. Commercial operators collect, on average, 324 kilograms of native seed, far more than do their government (151 kilograms) and community (33 kilograms) counterparts. Not surprisingly, within the commercial sector, it is commercial seed suppliers and collectors who collect the greatest amount of

seed. They collect, on average, 814 kilograms of native seed, which is far more than their state government (277 kilograms) and community group counterparts (43 kilograms) (see Table 4).

However, in terms of the quantity and the range of species in storage, the government sector appears to be dominant in storage of seed. This sector also dispatched, on average, only slightly less seed by quantity than did the commercial sector last year, although of much fewer species, on average.

The data indicate that the community sector has a much lesser role in collection, storage and distribution than the other sectors. Community operators, on average, collect, store and distribute about one-tenth of the *quantity* of seed handled by their commercial and government counterparts.

However, the data also point to an important characteristic of community seed operations – their concentration on species diversity rather than quantity. Indeed, community groups, on average, dispatch a comparatively large range of 104 species, even though they collect and store comparatively very small quantities of seed (see Tables 3 and 4).

Agricultural Census data

Another indicator of seed use in the community sector is provided in the 1995–96 and 1996–97 Agricultural Census conducted by the Australian Bureau of Statistics.

Nationally, only 521 respondents to the Agricultural Census had sown tree or shrub seed in 1996, which is less than half of 1% of those contacted (see Table 5). In 1997 about 11% of farmers nationally indicated that they had planted tree or shrub seedlings.

The total quantity of tree and shrub seed sown by respondent Australian farmers for all purposes during the year ended 31 March 1996 was 38 tonnes over an area of 21,204 hectares (1.8 kilograms per hectare). In 1997 it was less (likely due to drought), at 27 tonnes over an area of 15,034 hectares (1.8 kilograms per hectare) (see Table 5).

The number of seedlings planted for all other purposes besides ‘timber and wood pulp

production' by respondent Australian farmers was 10,113,460 seedlings over an area of 25,511 hectares (396 seedlings per hectare) in 1996 (see Table 5). In 1997 nearly twice this number, 20,726,061 seedlings over 71,862 hectares (288 seedlings per hectare), were planted (see Table 6).

A very rough estimate of the total seed used by respondent Australian farmers is in the order of 50 to 75 tonnes of native seed, assuming a generous consumption of 1 kilogram of seed to produce the seedlings required for each hectare planted.

The data presented in Tables 5 and 6 are interesting, if inconclusive, from the perspective of the debate over the use of seedlings versus direct seeding for establishing vegetation. The data do not

separate natives from non-natives nor account for seasonally poor growing conditions. However, the number of respondents who planted seedlings and the number of seedlings planted in both years is much larger than the number of respondents who used seed and the amount of seed sown. The scale of effort in planting 10 to 20 million seedlings among 5 to 16 thousand people in 1996 and 1997 is *far* greater than that involved in the direct seeding undertaken by the much fewer people involved – 500 to 600 people. Yet the total area vegetated in each year is similar for seedling and direct seeding methods.

Table 3: Average collection, storage and distribution of seed, by operators in each sector

Sectors	Number of responses	Seed collected in last year		Seed currently in storage		Seed dispatched in last year	
		Average kilograms	Average number of species	Average kilograms	Average number of species	Average kilograms	Average number of species
Commercial	88	324	13236	295	170	472	137
Government	70	151	59	466	248	361	47
Community	167	33	44	31	64	48	71

Table 4: Collection, storage and distribution of seed, by key groups

Key groups within sectors	Number of responses	Seed collected in last year		Seed currently in storage		Seed dispatched in last year	
		Average kilograms	Average number of species	Average kilograms	Average number of species	Average kilograms	Average number of species
Commercial seed suppliers	23	814	262	547	219	690	220
State government	32	277	24	954	42	421	61
Commercial nurseries	45	30	77	16	164	31	34
Local government	20	15	34	55	77	6	20
Greening Australia	15	34	23	43	31	23	19
Community, landcare & ICM groups	110	43	50	38	82	67	104

Table 5: Agricultural Census data for tree and shrub seed sown, and seedlings planted, 1996

	Tree and shrub seed sown in year ending 31 March 1996			Tree and shrub seedlings planted in year ending 31 March 1996*		
	Weight (kg)	Responses	Area (hectares)	Number of seedlings	Responses	Area (hectares)
NSW	3,714	85	1,038	1,632,035	1,222	4,157
Vic	15,441	204	13,195	1,032,366	1,427	3,383
Qld	12,923	21	2,702	290,522	195	788
SA	1,125	89	947	795,340	614	1,767
WA	4,537	108	3,225	6,247,156	1,235	15,159
Tas	225	12	94	113,342	103	244
NT	0	0	0	1,000	1	1
ACT	39	2	3	1,700	4	12
Australia	38,003	521	21,204	10,113,460	4,801	25,511

Compiled from data provided by the Australian Bureau of Statistics to Environment Australia, 3/11/98.

* For all purposes other than timber and wood pulp production.

Table 6: Agricultural Census data for tree and shrub seed sown, and seedlings planted, 1997

	Tree and shrub seed sown in year ending 31 March 1997			Tree and shrub seedlings planted in year ending 31 March 1997*		
	Weight (kg)	Responses	Area (hectares)	Number of seedlings	Responses	Area (hectares)
NSW	5,677	112	2,491	3,731,190	4,811	17,890
Vic	8,133	249	5,627	2,569,185	4,819	10,093
Qld	6,049	38	2,688	534,349	769	2,084
SA	2,142	127	1,647	2,289,164	2,226	8,074
WA	4,615	127	2,530	11,343,092	3,195	33,021
Tas	417	22	52	250,864	308	513.2
NT	0	0	0	457	6	4.6
ACT	0	0	0	7,760	20	182.4
Australia	27,032	675	15,034	20,726,061	16,154	71,862

Compiled from data provided by the Australian Bureau of Statistics to Environment Australia, 3/11/98.

* For all purposes other than timber and wood pulp production.

Quality of seed available

Seed quality is highly variable and very dependent on collection practices. Some of those consulted considered that, in general, seed quality tends to be less of a concern than quantity in the commercial sector. However, very few seed users had any concerns with the physical quality (cleanliness and viability) of

commercial seed. Rather, their concerns were about the genetic quality of seed and the appropriateness of its provenance. Indeed, it would appear that most seed merchants sell seed of good physical quality.

There is no practical means to determine the genetic quality of seed. This is entirely a matter of trust between seed supplier and

seed user. Similarly, there is no practical means to determine what location seed comes from. The claims of seed suppliers about the collection location must also be taken on trust. Some influential seed merchants actively promote the provenance or location of seed in their catalogues to increase trust.

Many respondents to the questionnaire experienced difficulty in obtaining seed of the right provenance for use in their local area – usually local indigenous seed. This may be due as much to the availability of that seed as to difficulty in establishing the provenance of seed. More than one-third of respondents (across all sectors) indicated that commercial suppliers usually provide enough information about the origins of the seed they sell. However, another 40% of respondents indicated that commercial suppliers rarely or never provide enough information about the origins of the seed they sell. The responses to these key questions are examined in more detail below. In particular, the response from the community sector, as distinct from other sectors, is analysed in the next section.

Physical quality is concerned with the cleanliness and viability of the seed. Basic cleaning to remove chaff, stones and other impurities can often be accomplished using a simple set of hand sieves and winnowing in a light breeze. Most seed available is cleaned as a minimum to this standard. This standard is adequate in revegetation where seed is used quickly; for example, in direct seeding or with fleshy tropical species known to perish quickly. Cleaning large amounts of seed requires the use of machinery.

Acceptable viability for seed of many species may also be achieved without difficulty provided that seed is collected when it is mature, dried well and stored briefly in a cool dry place. The longer that seed must be stored, the more critical are standards of practice. The same is true for seed sold commercially, where customer satisfaction must be considered, or where seed is of a species known to lose viability quickly.

Expected germination rates are increasingly required (and provided) for seed sourced

from the commercial sector. However, few community or commercial seedbanks routinely test the germination rate of seed on entry and exit to their seedbank. Rather, they rely on feedback from customers where expected germination rates are not met. All community seedbanks visually inspect seed but few rise above this very basic standard to carry out basic viability tests such as cut tests, float tests and chemical staining.

Direct seeding may mask physical seed quality, and increased sowing rates may be used as insurance against poor quality.

Genetic quality is concerned with how representative a seedlot is of its parent population. The genetic make-up of a plant population and of an individual plant or seed from are active scientific disciplines. Unlike cutting material, seed contains an unpredictable amount of genetic variation and may not reproduce their parent plants exactly.

A variety of different recommendations about genetically valid collection practices are made to the community in pamphlets and other literature on seed collection. These recommendations typically specify the number and density of parent plants to collect from, for example, 'collection from five or more plants which are spread preferably at least 100 meters apart' (Native Seed Savers Network 1998). However, the source of such recommendations is unclear and rarely cited.

These recommendations are probably based on published guidelines (eg. Brown & Briggs 1991, Centre for Plant Conservation 1991) for the conservation of rare and threatened plants as discussed in the Australian Network for Plant Conservation's *Germplasm Conservation Guidelines for Australia*. Such guidelines seek to avoid collection of seed from situations where there may be too narrow a genetic base (too few plants) or intermixing with other species. However, they apply to plant conservation and set a higher standard than may be appropriate to those who collect for revegetation. It is important for sustainability in revegetation that material with a broad genetic base is used.

From a practical viewpoint, no guidelines can cover all species in all situations. Considerations include not only the number of plant populations of that species, but also the number of source plants per population and the number of seeds from each plant taken.

Consultation indicated that the pressure on commercial collectors and suppliers is such that few would have time for genetic

parentage considerations such as the number and density of parent plants. Rather, commercial collectors would be more inclined to use collection strategies that maximise seed return for effort, that is, the maximum seed from the minimum of parent plants.

Again, the genetic quality of seed is entirely a matter of trust between suppliers and seed users.



Provenance

Provenance is usually defined as the geographic place of origin of a population of seed or plants, or as the population of plants growing at a particular geographic location (Turnbull & Griffin 1986). A provenance is adapted to a particular set of environmental conditions, often much better adapted to these conditions than other provenances of the same species (Harwood 1990).

In revegetation work, provenance considerations are most often expressed simply as a requirement for seed that is 'indigenous to the local area'. This is based on the assumption that local plants are better adapted to local conditions rather than any specific knowledge of desirable growth characteristics. Many seed users have practical experience that seed from local plants performs better than that from further afield. Another motivation is to collect seed locally for use locally so that biodiversity may be protected and enhanced.

The definition of 'local' varies but is expressed most often as a distance (eg. a 15 - kilometre radius) from the planting site, or in terms of catchment, land system, bioregion or even local and state government boundaries. This sort of approach is a 'best guess' and almost never based on understanding of the actual genetics of plant communities.

In revegetation, so many species are planted for which we know very little about their genetically inherited characteristics. The best

we have is a broad understanding that some species grow better under certain conditions. For example, River Red Gum (*Eucalyptus camaldulensis*) has been studied in relation to its growth rate, water use and salt tolerance. However, there are only a handful of native species for which we understand the important characteristics of provenances.

The practice of specifying local indigenous seed has become widespread in the revegetation sector in the last 5 years, especially among some of the big seed users in mining, landcare and government. There is an increasing trend for community groups and individuals to specify local collection and to regard seed from outside the local area as a poor substitute – if not poorer quality.

Provenance seed collection for land rehabilitation, although generally accepted as desirable, poses a number of potential problems, particularly in terms of the difficulty and cost in collecting adequate quantities of viable seed from a relatively small and restricted area (Coates & van Leeuwen 1997).

It is argued by commercial and community seed collectors that expectations of provenance are often unrealistic and frequently far more restricted than they need to be. Many argue that we need to look regionally for a workable solution to provenance issues and that such limited views of provenance are not supported by

science and are unworkable in the short and long term.

The whole subject of provenance is complex, controversial and troubled by taxonomic uncertainties and lack of genetic data. There are difficulties in defining provenance and the area it is considered to cover. In particular, the question of how far afield seed collected from one location may justifiably be used in revegetation causes much debate.

Availability of provenance seed

Seed of the wrong provenance is considered of poor quality even though it may be of good physical and genetic quality. It was reported during consultation that some landholder and community group projects have been postponed where a supply of seed of suitable origins cannot be found. The extent to which the lack of available seed of suitable provenance limits revegetation activities is unclear.

The questionnaire response suggested that most seed is now collected in the 'local area'. Across some 300 questionnaire respondents (from all sectors) who answered questions on origins of seed they collected, 35% said they collected seed from within their local area *all* of the time and a further 33% *most* of the time. This tells us that most seed probably comes from where the collectors live. However, the survey does not tell us if the seed is supplied back to that local area. Very likely, it is not. Map 1 shows that even community seed suppliers are concentrated in southern Australia. In the commercial sector, 80% of respondents (87) said that *all* of their seed, and a further 40% that *most* of their seed, was collected in *their* 'local area' – again mostly across southern Australia or wherever commercial collectors and suppliers live.

It is a widespread criticism of commercial seed collectors and merchants that they do not provide sufficient information about the origins of seed they sell. Only 14% of respondents (208) considered that commercial seed suppliers *usually* provide enough information about seed origins. Most said commercial seed suppliers *never*

(16%), *rarely* (27%) or only *sometimes* (43%) provide sufficient information.

Broadly, this response supports the claim by many of those consulted that they have difficulty in obtaining local seed for use in their area. Across all questionnaire respondents, 14% *usually* and a further 43% *sometimes* experienced difficulty in obtaining seed of the right provenance for use in their local area. Some of those consulted could not obtain *any* seed local to their area. Nor could they source some key species found in their area, regardless of collection location. Some reported regularly obtaining seed of key species for revegetation from interstate suppliers, collection origins unknown.

Some find it easier and less expensive to collect seed locally themselves rather than buy it. Others do not have the time, expertise or resources to do this.

Provenance specification has created niche markets for commercial collectors and merchants to supply indigenous seed to more areas than was ever previously the case. However, not all of these markets are supplied. The nearer you are to the collection areas of commercial suppliers, the easier it will be to obtain local indigenous seed commercially. There are still many areas where commercial suppliers simply do not operate or do not supply indigenous seed.

It is widely considered uneconomic for commercial collectors and seed merchants to supply all areas of Australia with 'local' seed. Even where commercial suppliers are willing to collect local indigenous seed, there may be collection difficulties, such as:

- lack of vegetation
- seasonal scarcity of seed
- logistical, climatic and environmental difficulties in seed collection
- the need for constant surveillance of seed set
- good timing for collection when seed is mature.

All these factors may vary greatly between regions and contribute to regional scarcity. Determining exactly which regions

experience scarcity of local indigenous seed is a considerable undertaking. While there are some indicators, a definitive assessment of regional scarcity was not undertaken during the survey.

Abuse of the trust system

Since there is no simple way to tell what provenance a seed is by its appearance, the supply of provenance seed is based on a system of trust between supplier and seed users. The system is open to abuse. Reports of abuse of trust between collectors, suppliers and customer were disturbingly common during consultation, especially in New South Wales, and especially in reference to smaller operators.

For example, some collectors pointed to prices accepted under tender for supply of 'local' seed being so low (less than half the cost of collection) that the collector could not possibly recover costs – much less make a profit – if they actually collected the seed. Even where collect and supply contracts specify collection from a certain 'local' area, there is a temptation to spend little or no time in the field collecting. Instead, an indigenous seed order may simply be

supplied with (or bulked up with) seed from storage, which may be of different or unknown origins.

The customer will be none the wiser until seed has germinated and grown, and only then if there is monitoring in place.

At the extreme, it is reported that significant quantities of cheap native plant seed of unknown provenance continue to be imported into Australia (from India, Africa and Asia). There are reported to be fast profits for 'here today gone tomorrow' operators who pass imported seed off as local provenance. Apart from the dangers of genetic contamination, such practices pose the significant risk of introducing as yet unknown pathogens into native gene pools.

Among questionnaire respondents, from zero to 11% (by state) indicated that *some* of the seed they acquired came from outside Australia. In most states the figure was 3 or 4%, with Victoria 0% and the Northern Territory 11%. The only respondent to indicate that most of their seed comes from outside Australia was the CSIRO Quarantine Centre in Canberra, which has an obvious role in this respect.



Cost of seed

The cost of seed is different for each species and may range from \$100 a kilogram to well over \$1,000 a kilogram. While this may seem high, the component cost of seed for each seedling produced in a nursery may only be a few cents. A kilogram of seed, for example of most acacias or eucalypts may produce 10,000 or 20,000 seedlings through nursery propagation. At planting densities of up to 1,000 plants per hectare, the kilo of seed may produce enough seedlings to cover 10 or 20 hectares. Those undertaking direct seeding and typically applying seed at up to 2 kilograms per hectare find the cost of seed more significant, particularly where other establishment costs are low.

The price of seed is a result of very complex and interrelated factors, including:

- cost of collection, drying, extraction and cleaning
- cost of storage and packaging to the customer
- cost of viability or germination testing
- availability of seed, subject as it is to seasonal and regional variation
- scarcity of seed from species poorly represented in the bush
- market demand and market price for seed
- who the customers are and whether or not they use seed in bulk

- whether seed is supplied from stock and if that stock is old or new in storage
- whether the seed is part of a collect and supply contract
- the price a merchant pays a collector or another supplier for the seed.

All commercial seed merchants produce seed catalogues listing available stock and prices. Most agree that these prices are not a good indication of the actual cost of collecting seed. Very few catalogues list the provenance of seed. Merchants are keenly aware of market prices for seed of different species and of the competitiveness of their own pricing.

Many smaller seed suppliers (including those community seedbanks that sell seed) use the catalogues of larger merchants as a benchmark for establishing prices, often regardless of provenance. This practice has profound effects on the availability and cost of seed.

Further, although there is increasing demand for seed of a specified provenance of a species, the market currently pays little if anything extra to a merchant (let alone a collector) for a specific provenance than for seed without provenance information. Some smaller collectors commented that they apply a flat rate percentage premium (up to 40%) to the sale price for seed with provenance information supplied. However, this seems by no means common practice.

PART THREE

COMMUNITY SEED OPERATIONS

As explained earlier, a distinction is made between a community *seedbank* and a community *seedstore*. The distinction draws attention to fundamental and important differences in the scale and purpose of operations (see box on page 4).

A **seedstore** is a small-scale *temporary* facility for short-term storage of native seed. Seedstores service the needs of one or more specific revegetation projects. A **seedbank** is a more *permanent* facility with some commitment to meeting ongoing seed needs – revegetation projects or otherwise – in a region.



Community seedstores

The survey has shown that there are three times as many seedstores in the community as seedbanks. Currently there are probably in the order of 200 to 300 seedstores nationally. Many community operators store seed from time to time but would not consider their operation to be a seedbank. There were 65 respondents to the questionnaire who store less than 20 kilograms of seed, and a further 60 who store seed but did not indicate exactly how much. Most, if not all, of these respondents are seedstores. Map 1 shows the location of these respondents.

You find seedstores maintained by ‘friends of groups, schools, landcare groups and centres, catchment management groups and centres, individual landholders, environmental groups, small community nurseries, local government offices, societies for growing Australian plants, Men of the Trees branches, and many others.

Seed is typically stored for later use in nursery propagation of seedlings for specific revegetation or garden projects. Projects do include direct seeding, and large quantities of seed may be temporarily stored until sowing. Seedstores typically store up to 50 indigenous species.

There is considerable variation in the standard of collection and storage practices, and technical understanding of key issues such as maintenance of biodiversity and provenance. Most seedstores operate from a very small financial base (often entirely voluntary) and a reliance on funding to meet the costs of major projects. There may be little extension, training or coordination provided to the community, even at the local level.

The project and local area focus means that there is little obvious duplication of resources or overlap of effort between seedstores in the community. Project seed needs may be satisfied through local collection by group members or volunteers, through contract collectors, through purchase from seed merchants or through a community seedbank in that region.



Community seedbanks

Community seedbanks are facilities for collecting, storing or distributing native plant seed established and operated by the community. They are a recent phenomena but are responsible for the majority of seed collected and stored by the community seed sector. Seedbanks have many roles besides storing seed but, for the purposes of this report, a seedbank is an operation that stores in excess of 20 kilograms of seed.

Distribution of community seedbanks

It is estimated that no more than 50 community seedbanks currently operate in Australia. Appendix 3 contains a list of 38 known community seedbanks currently operating in Australia. Twenty-three seedbanks, located mostly in south-eastern Australia, responded to the questionnaire (see Map 1). Recently, FloraBank and Environment Australia tallied the number of community seedbanks currently funded as seedbanks under the Natural Heritage Trust and Bushcare program at 24 nationally. There are, however, at least a further 20 initiatives to establish community seedbanks currently not funded. There are also seedbanks established under funding for other landcare projects.

Most of the 38 known community seedbanks currently operating are located in New South Wales (12), South Australia (8)

and Victoria (7), including most of those three years or older (there are 10 of these). All of these seedbanks have come into being in the last 10 years. The dominance of the south-eastern states seems to reflect a longer history of landcare, a greater use of direct seeding, and historical preference for using indigenous species. Greening Australia operates or is in partnership with the operators of most of these seedbanks.

Known distribution in other states is on a much smaller scale. There are four in each of Queensland and the Northern Territory, most of which are just establishing. There is one seedbank in each of Western Australia, Tasmania and the Australian Capital Territory.

The size of seedbanks and the scale of operation quickly increase in direct proportion to their involvement in revegetation in that region, and in particular in direct seeding or major replanting projects. Seedbanks rely on government, sponsorship, host organisations and volunteers for funding and resources, and to meet operating and major project costs.

Currently, the capacity of community seedbanks is typically small compared to those in the commercial and government sectors. Only 9 seedbanks of the 23 that responded to the questionnaire currently store in excess of 50 kilograms of seed.

Seedbank roles

The community seedbank is a recent phenomenon that is yet to find its full potential. Viewed as a whole, there is arguably a 'critical mass' to be reached before some of the potential roles for a seedbank network are realised, or even known; for example, those related to supply of seed through networking. One gets the solid impression that there are nowhere near enough seedbanks currently operating.

Some community seedbanks appear to be viewed by their operators as an adjunct, although a necessary one, to the main game – revegetation. However, it is also the impression that many seedbanks are dedicated attempts by the community to step up the pace of revegetation, by building capacity and supplying essential raw materials in a region.

Even so, there needs to be many more seedbanks, all better resourced, supported and promoted for there to be a widespread benefit. Seedbanks should be given a thorough trial and their roles evaluated.

Current roles

Seedbanks perform the vital role of storing seed that may be used during drought or unfavourable seasons when seed is scarce in the bush. This carry-over role allows revegetation initiatives to continue where they otherwise could not. Only a small proportion of seed is stored for longer than 5 years.

Despite their name, community seedbanks often do more than just supply seed. Almost all perform the following roles, with about equal importance, throughout their region:

- Provide extension, education and training in the community to encourage and develop local capacity for wider use of native seed.
- Provide assistance, training, coordination and facilitation for seedstore operators and staff or volunteers of local projects that have a seed use component.
- Supply seed to a wide range of users for propagating plants in nursery situations,

or direct seeding for specific revegetation projects – including seedstores.

They promote and develop an understanding of the local flora and seed collection from it. Seedbanks quickly become involved in revegetation initiatives generally in a region and may have important strategic roles, such as coordination of seed collection and supply.

In comparison to seedstores, seedbanks collect and store larger amounts of seed of a greater range of species from a region. Although standards of collection and storage practice do vary, they are generally of a higher standard than for seedstores.

Seedstore and seedbank roles in any region are generally complementary and may establish independently. Seedbanks do not replace or make redundant the seedstores already located in a region. Nor do they necessarily duplicate resources or create overlap of effort with seedstores.

Seedbank establishment

Community seedbanks typically establish through community initiative to take a regional focus for seed supply, extension, seed storage and multi-project service roles. Often the motivations are that the range of species (and provenances) in demand is not available commercially.

Community groups, landcare and catchment management groups, community nurseries, and non-government organisations operate seedbanks. Indications are that many are operated under community partnerships rather than by single groups. There are also seedbanks operated by government, primarily in support of community revegetation initiatives. Such seedbanks tend to be managed by steering committees, with wide representation from the community.

Some community seedbanks follow a centralised model for storage where seed is contributed from projects, collectors, landholders and others for storage in central location in the region. A further seedbank operating model is the decentralised model or regional seedbank network. Here a protocol is established for exchanging

information about seed holdings of otherwise autonomous seedbanks and seedstores. All members have access to advice, training, extension and other support programs. Members also trade seed for their needs within the region.

Communities will likely choose one or the other model, although both have advantages and disadvantages and may perform equally well.

Geographic coverage

Community seedbanks operate regionally rather than locally, although what constitutes a *region* varies. There is not a system of regions recognised or in operation across all seedbanks. Greening Australia generally divides each state into administrative regions for which its seedbanks also have jurisdiction. Typically, seedbanks established by landcare and other community groups cover approximately the jurisdiction of these groups, which may recognise flexible boundaries that do not necessarily follow any recognised system, natural or administrative.

Most regions of Australia do not have a community seedbank. Demand for indigenous seed is already sufficient in some regions of Australia that more community seedbanks could be established, for example,

south-west New South Wales, south-east Queensland. Currently, the density of seedbanks, even in southern Australia, could be increased.

In some regions a number of community seedbanks will almost certainly be required to meet demand. More than one seedbank may also be required where, for example:

- seedbanks specialise in the vegetation types (wetland, forest, grasses), volumes of seed (direct seeding supply), or distribution on a non-profit or profit basis
- geographic isolation or community structure suggests sub-regional coverage.

There was no evidence from the survey of overlapping seedbank jurisdictions or that resources are duplicated or wasted. Indeed, were geographic overlap to occur, the functional roles and specialisations of seedbanks may not overlap, nor necessarily would resources be wasted.

Seedstore and seedbank roles in any region are generally complementary and may establish independently. Seedbanks do not replace or make redundant the seedstores already located in a region. Nor do they necessarily duplicate resources or create overlap of effort with seedstores.



Community sector operations

Overview

A general description of the operations of the community sector has been provided. This section provides a detailed analysis of the operations, practices and needs of the community sector. This analysis is not presented for the response from commercial and government sectors, although some comparisons are made with these sectors below. In general, the variation in operations, practices, needs and issues evident from the questionnaire responses is

greater between the states than between commercial, government and community sectors. The next part of this report compares the survey findings and questionnaire responses from each state in turn.

General operations

Almost all (93%) community respondents collect seed and, in line with the national trends, 62% also clean and 72% store seed (see Figure 1). That less respondents clean seed than store seed does not necessarily

mean that a proportion of operators store relatively dirty seed. Some seed is at this time difficult or impossible to clean (native grass seed) and some is universally not cleaned (fleshy seed).

Of those who store seed, 73% indicated that the primary purpose for storage was for use in specific replanting projects rather than to distribute (non-profit) for revegetation (32%) (see Figure 2). A surprising 24% indicated that species conservation is the primary purpose, or one of the primary purposes, for storage. This response is larger than is accounted for by the community botanic gardens and arboretums as a component of the response.

Community respondents are much more likely to distribute seed for free (46%) than to sell seed (7%), this being a more pronounced trend than for other sectors or the national average for respondents. Not surprisingly, 55% distribute seed to community groups, 43% to farmers and landholders, 19% to direct seeders and 17% to community nurseries (see Figure 3).

Far from being specialist occupations, seed collection and storage is for most community respondents part of a wider involvement in revegetation. Eighty-three per cent of respondents raise seedlings and 78% carry out replanting, 54% are involved in direct seeding and 62% in managing natural regeneration. Sixty-one per cent of community respondents advise others on matters about seed collection, storage and distribution.

This is a key finding of the survey. Such wide contribution to revegetation activities would surely make many of those who collect and store seed valuable people in their local revegetation community – for their contribution as well as their knowledge and skills.

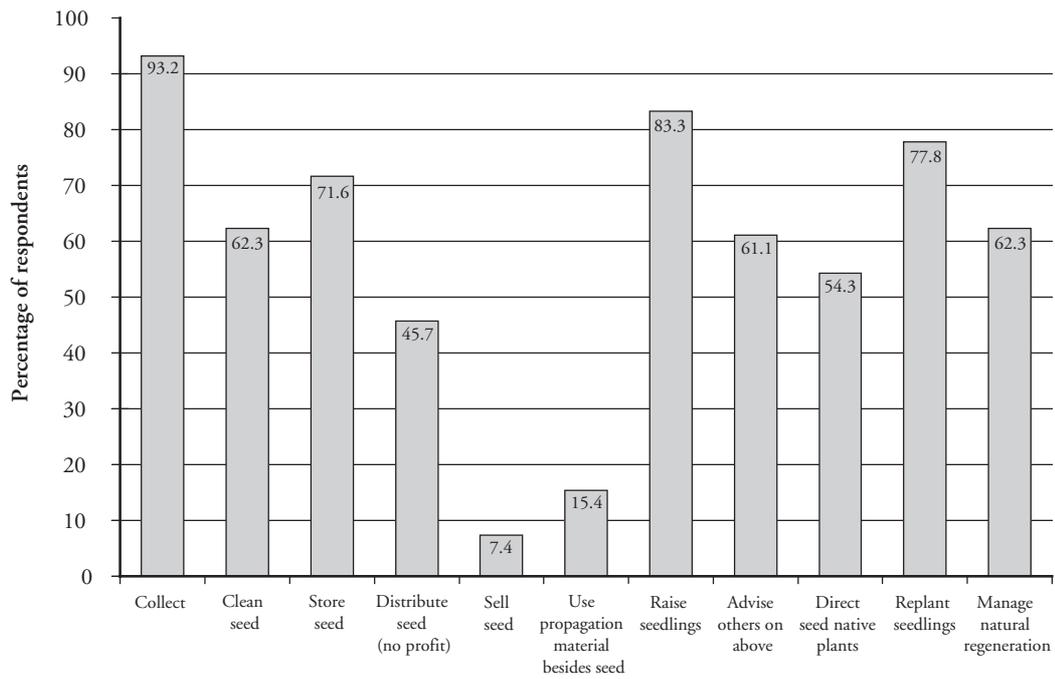
Operations of community seedbanks and seedstores compared

There were 88 community respondents who gave clear answers on quantities of seed collected, stored and dispatched. Defining community seedbanks as those operations that currently hold in excess of 20 kilograms of native seed in storage and seedstores as those holding up to 20 kilograms, the following profile emerges (see Table 7).

Respondent community seedbanks, in total, collect 2,727 kilograms (2.7 tonnes), store 2.4 tonnes and dispatch 1.9 tonnes of seed. Community seedstores, in total, manage about one-tenth of these amounts – collect 309 kilograms (0.3 tonne), store 0.24 tonne and dispatch 81 kilograms or 0.08 tonne of seed. These figures are presented for comparative purposes and are not considered reliable estimates of actual total collection, storage and dispatch in the community.

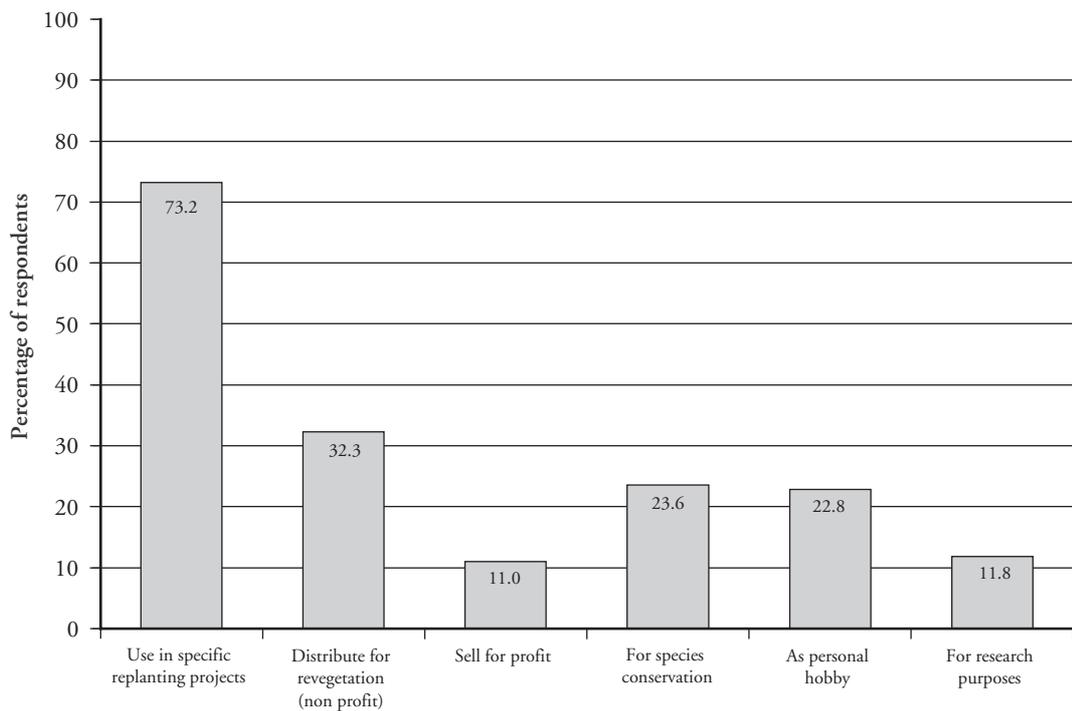
Respondent community seedbanks, on average, collect 130 kilograms, store 105 kilograms and dispatch 130 kilograms of seed. Respondent community seedstores, on average, manage much smaller amounts – collect 6 kilograms, store 4 kilograms and dispatch 4 kilograms of seed.

Figure 1: Operations of the community sector in Australia



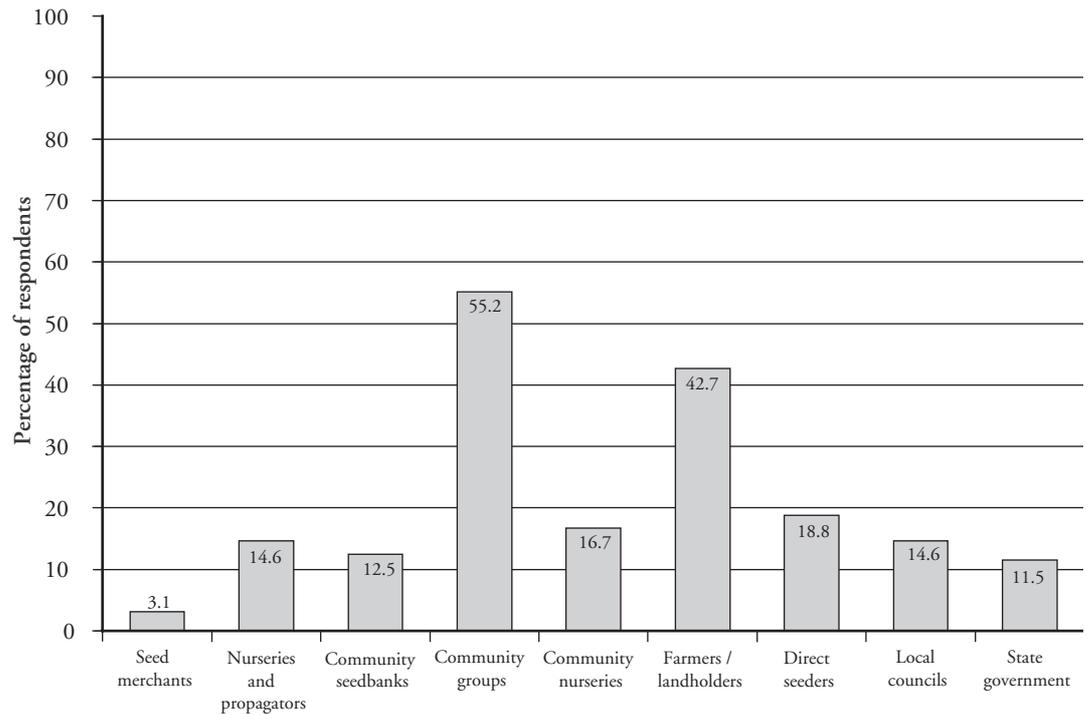
Sample size = 162 community sector respondents nationally.

Figure 2: Primary purpose for seed storage by the community sector



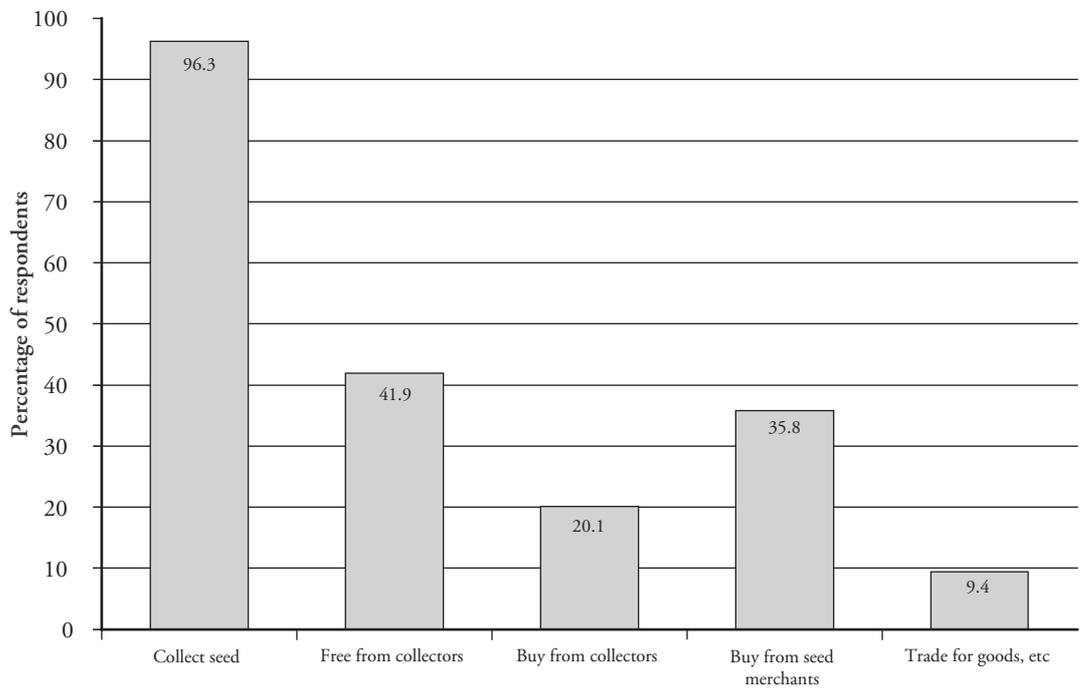
Sample size = 127 community sector respondents nationally.

Figure 3: Seed distribution by the community sector



Sample size = 96 community sector respondents nationally.

Figure 4: Seed acquisition by the community sector



Sample size = 160 community sector respondents nationally.

Table 7: Collection, storage and dispatch, by seedbanks and seedstores

Quantity of seed	Community seedbanks	Community seedstores	Commercial seed merchants and collectors
Number in sample	23.0	65.0	20.0
Collection			
Total seed collected (kg)	2,727.0	309.0	16,287.0
Average seed collected (kg)	129.9	5.8	814.0
Average no. species collected	35.9	55.6	270.0
Storage			
Total seed in storage (kg)	2,408.8	240.0	11,494.0
Average seed in storage (kg)	104.7	3.7	547.0
Average no. species in storage	94.0	46.1	226.0
Dispatch			
Total seed dispatched (kg)	1,943.0	81.0	11,737.0
Average seed dispatched (kg)	129.5	3.7	690.0
Average no. species dispatched	55.5	83.0	220.0

In terms of species range, community seedbanks, on average, collect 36 species (seedstores 56 species), store 94 species (seedstores 46 species) and dispatch 56 species (seedstores 83 species) of seed.

This profile highlights the much greater average capacity of regional seedbanks to collect, store and distribute seed in large amounts. It also indicates that seedstores, on average, collect and dispatch a wider range of species, although they do not hold these in storage. This may be a consequence of the strong project focus of seedstores and, in particular, their relationship to local plant propagation activities.

The capacity of community seedbanks is small compared to commercial sector seedbanks. Only nine respondent community seedbanks currently store in excess of 50 kilograms of seed, and five store in excess of 100 kilograms. (These considerably affect the average storage figures cited above.) The largest community seedbanks are the Victoria River District Conservation Association native grass seedbank in Katherine (NT), which stores about 600 kilograms of seed, and the

Hindmarsh Island Landcare Group Seedbank at Goolwa in South Australia, which stores about 800 kilograms of seed.

By comparison, the capacity of commercial sector seedbanks is much greater. There were 20 commercial seed merchants and collectors who gave clear answers on quantities of seed collected, stored and dispatched (see Table 7). These respondent commercial seedbanks, in total, collect 16.3 tonnes, store 11.5 tonnes and dispatch 11.7 tonnes of seed – about five times the capacity of community seedbanks (above) for a similar sized sample. Similarly, these commercial seedbanks, on average, collect 814 kilograms (of 270 species), store 547 kilograms (of 226 species) and dispatch 690 kilograms (of 220 species) of seed. These figures are all many times the capacity of respondent community seedbanks.

Seed origins

The responses concerning the origin of seed collected by the community sector respondents are presented in Tables 8 and 9. The important findings are as follows.

- Most seed is collected locally: 43% of community respondents collect *all* and a further 35% *most*, while only 6% collect *none* and 15% *some* of their seed in their local area.
- Almost no seed is imported: only 2.6% of community respondents source *some* seed from outside Australia.
- A large proportion of seed comes from natural bush: 31% of community respondents collect *all*, and 35% *most* seed from natural bush. A much smaller proportion comes from plantings or plantations (*all* 7%, *some* 41%), seed orchards (*all* 1.3%, *some* 10%) and uncertain origins (*most* 0.6%, *some* 14%).
- Most community respondents collect at least *some* of every vegetation type.
- Trees and tall shrubs are most collected: 10% of community respondents collect *all* and 29% *most* seed from trees, and 4% collect *all* and 20% *most* seed from tall shrubs.
- Low shrubs, native grasses and wetland plants are the least collected (in that order) of all the vegetation types.

Given the small sample sizes, much of the variation in the data among the sub-categories of community respondents is not considered significant. However, the *all* and *none* answers are mutually exclusive statements about collection practice and do tell a story about the practice of some sub-categories.

- Community nurseries appear to specialise in seed collection much more, say, than does Greening Australia or other non-government organisations, or community botanic gardens. One (different) community nursery respondent collects *all* their seed of each of the vegetation types (trees, shrubs, wetland plants and native grasses). By comparison, no

Greening Australia respondents collect *all* of any vegetation type.

- Almost no-one uses seed orchards for seed collection and those that do use them only for some seed.
- More community collectors use plantings and plantations than seed orchards as a seed source and the botanic gardens (*most* 25%) do so in particular.

Seed acquisition other than collection

Almost all community respondents collect seed themselves. This reduces the need and affects how they might acquire seed by other means. Other than through collection, 42% of community respondents source seed from other collectors at no cost, 36% buy seed from commercial seed merchants and 20% buy seed from collectors (see Figure 4).

As might be expected, commercial sector counterparts are far more likely to buy seed – 47% buy from commercial seed collectors and 73% from commercial seed merchants. Only 10% acquire seed for free.

The FloraBank survey strongly indicated that very little seed is actually purchased by the community sector. An unexpected survey finding is just how few community respondents actually buy seed and how little seed they buy. Only 45% of the 167 community sector respondents buy any seed from commercial suppliers and the average amount bought is 9% of their total requirements. The great majority (88%) of those who buy seed buy less than 10% of the total seed used and only 5% buy more than 50% of requirements. It is logical that not all respondents, of whom 93% collect seed, will buy seed. But many of the groups and organisations who responded would have wider seed needs than one assumes could be met by their own collection activities alone.

The most likely motivations for not buying seed are that:

- community respondents are unable to afford the cost of seed available commercially
- seed available commercially is of unsuitable species or provenance for local use
- seed cannot be found commercially or is not available in the quantities required.

Many of those consulted in the community only buy seed when they are unable to collect all the seed they need themselves. Some find that the seed they want to use (local seed) just is not available commercially, or not in the quantity needed. In some areas, such as north-western Victoria where direct seeding creates considerable demand, local seed is often just not available. Although seed is bought, some projects are postponed rather than buy seed, especially seed not local to the area (or region) (pers. comm., David Millsom, Lower Avoca Loddon Campaspe Regional Facilitator, Greening Australia).

Table 8: Origins of seed obtained by the community sector, by categories

	Percentage of respondents							
	Community sector in total (sample = 159)	Community botanic garden/ arboretum (sample = 8)	Community group (sample = 50)	Landcare /ICM group (sample = 51)	Community nursery (sample = 10)	Greening Australia (sample = 15)	Non-government organisation (sample =7)	Individual (sample = 26)
Seed from within your local area								
All seed	43.4	12.5	39.1	55.3	60.0	26.7	0.0	53.8
Most seed	35.2	37.5	37.0	27.7	20.0	53.3	85.7	26.9
Some seed	15.1	37.5	17.4	8.5	20.0	20.0	0.0	15.4
No seed	6.3	12.5	6.5	8.5	0.0	0.0	14.3	3.8
Seed from within your region								
All seed	30.6	12.5	26.1	42.2	20.0	40.0	57.1	15.4
Most seed	15.9	25.0	17.4	15.6	30.0	20.0	0.0	7.7
Some seed	23.6	37.5	23.9	17.8	20.0	13.3	28.6	34.6
No seed	29.9	25.0	32.6	24.4	30.0	26.7	14.3	42.3
Seed from within Australia								
All seed	44.2	62.5	47.8	42.2	20.0	40.0	71.4	40.0
Most seed	4.5	25.0	2.2	0.0	10.0	6.7	0.0	8.0
Some seed	6.4	0.0	4.4	6.7	10.0	0.0	14.3	12.0
No seed	44.8	12.5	45.6	51.1	60.0	53.3	14.3	40.0
Seed from outside Australia								
Some seed	2.6	0.0	2.2	0.0	10.0	6.7	0.0	4.0
No seed	97.4	100.0	97.8	100.0	90.0	93.3	100.0	96.0
Seed from natural bush								
All seed	30.6	25.0	23.9	45.7	10.0	46.7	0.0	24.0
Most seed	35.0	12.5	32.6	28.3	60.0	46.7	85.7	28.0
Some seed	17.2	50.0	26.1	8.7	20.0	0.0	0.0	20.0
No seed	17.2	12.5	17.4	17.4	10.0	6.7	14.3	28.0
Seed from plantations / plantings								
Most seed	7.1	25.0	13.0	4.4	10.0	0.0	0.0	0.0
Some seed	41.0	37.5	45.7	31.1	70.0	26.7	57.1	44.0
No seed	51.9	37.5	41.3	64.4	20.0	73.3	42.9	56.0
Seed from native seed orchards								
Most seed	1.3	0.0	0.0	0.0	10.0	0.0	0.0	4.0
Some seed	10.3	0.0	13.0	6.7	30.0	6.7	14.3	8.0
No seed	88.5	100.0	87.0	93.3	60.0	93.3	85.7	88.0
Seed from unknown origins								
Most seed	0.6	12.5	0.0	0.0	0.0	0.0	0.0	0.0
Some seed	13.5	12.5	19.6	15.6	0.0	13.3	0.0	8.0
No seed	85.9	75.0	80.4	84.4	100.0	86.7	100.0	92.0

Table 9: Types of seed collected by the community sector, by categories

	Percentage of respondents							
	Community sector in total (sample = 159)	Community botanic garden/ arboretum (sample = 8)	Community group (sample = 50)	Landcare /ICM group (sample = 51)	Community nursery (sample = 10)	Greening Australia (sample = 15)	Non-government organisation (sample = 7)	Individual (sample = 26)
Tree seed collected								
All seed	10.2	0.0	8.9	19.6	10.0	0.0	0.0	7.7
Most seed	29.3	37.5	17.8	34.8	20.0	46.7	28.6	30.8
Some seed	55.4	62.5	68.9	39.1	70.0	53.3	57.1	53.8
No seed	5.1	0.0	4.4	6.5	0.0	0.0	14.3	7.7
Tall shrub (middle storey) seed collected								
All seed	3.8	0.0	2.2	8.7	10.0	0.0	0.0	0.0
Most seed	20.4	12.5	20.0	17.4	30.0	53.3	0.0	11.5
Some seed	66.2	87.5	68.9	58.7	60.0	40.0	85.7	80.8
No seed	9.6	0.0	8.9	15.2	0.0	6.7	14.3	7.7
Low shrub (ground storey) seed collected								
All seed	3.8	0.0	2.2	8.7	10.0	0.0	0.0	0.0
Most seed	14.6	12.5	15.6	13.0	20.0	13.3	14.3	15.4
Some seed	64.3	87.5	68.9	50.0	70.0	73.3	57.1	69.2
No seed	17.2	0.0	13.3	28.3	0.0	13.3	28.6	15.4
Wetland plant seed collected								
All seed	2.5	0.0	2.2	2.2	10.0	0.0	0.0	3.8
Most seed	1.9	12.5	2.2	0.0	0.0	0.0	0.0	3.8
Some seed	35.0	50.0	44.4	17.4	40.0	40.0	85.7	26.9
No seed	60.5	37.5	51.1	80.4	50.0	60.0	14.3	65.4
Native grass seed collected								
All seed	3.8	0.0	2.2	6.5	10.0	0.0	14.3	0.0
Most seed	2.5	0.0	0.0	4.3	0.0	6.7	0.0	3.8
Some seed	45.9	75.0	62.2	21.7	90.0	53.3	57.1	26.9
No seed	47.8	25.0	35.6	67.4	0.0	40.0	28.6	69.2

Table 10: Aspects of seed acquisition by the community sector, by categories

	Percentage of respondents							
	Community sector in total	Community botanic garden/ arboretum	Community group	Landcare /ICM group	Community nursery	Greening Australia	Non-government organisation	Individual
Have you experienced difficulties in obtaining provenance seed for your local area?								
	(sample = 149)	(sample = 7)	(sample = 45)	(sample = 45)	(sample = 9)	(sample = 12)	(sample = 7)	(sample = 24)
% Never	18.8	0.0	20.0	24.4	22.2	8.3	0.0	20.8
% Rarely	30.9	14.3	31.1	37.8	11.1	25.0	28.6	33.3
% Sometimes	34.9	57.1	35.6	26.7	44.4	33.3	57.1	33.3
% Usually	15.4	28.6	13.3	11.1	22.2	33.3	14.3	12.5
Sufficient information provided by commercial suppliers about the origins of seed?								
	(sample = 97)	(sample = 5)	(sample = 24)	(sample = 31)	(sample = 6)	(sample = 9)	(sample = 5)	(sample = 17)
% Never	23.7	100.0	20.8	9.7	16.7	44.4	20.0	23.5
% Rarely	25.8	0.0	29.2	25.8	0.0	11.1	40.0	41.2
% Sometimes	18.6	0.0	16.7	16.1	33.3	33.3	20.0	17.6
% Usually	32.0	0.0	33.3	48.4	50.0	11.1	20.0	17.6
Have you experienced difficulties in collecting seed?								
	(sample = 149)	(sample = 7)	(sample = 45)	(sample = 42)	(sample = 9)	(sample = 14)	(sample = 7)	(sample = 25)
% Never	14.8	0.0	15.6	14.3	44.4	7.1	14.3	12.0
% Rarely	28.9	57.1	26.7	33.3	11.1	28.6	28.6	24.0
% Sometimes	45.6	28.6	51.1	45.2	22.2	64.3	28.6	44.0
% Usually	10.7	14.3	6.7	7.1	22.2	0.0	28.6	20.0
Percentage of seed bought from commercial seed suppliers?								
	(sample = 159)	(sample = 8)	(sample = 48)	(sample = 45)	(sample = 10)	(sample = 15)	(sample = 7)	(sample = 26)
Number who buy seed	45.3	50.0	33.3	48.9	50.0	53.3	57.1	50.0
% of seed bought	9.2	7.5	8.0	12.0	4.6	12.4	2.75	8.3
How many collectors do you usually obtain seed from?								
	(sample = 154)	(sample = 8)	(sample = 47)	(sample = 45)	(sample = 10)	(sample = 12)	(sample = 6)	(sample = 26)
% Myself only	29.2	37.5	23.4	24.4	30.0	25.0	33.3	46.2
% Up to 3	43.5	50.0	27.7	57.8	40.0	41.7	50.0	46.2
% 3 to 10	18.8	0.0	29.8	11.1	30.0	33.3	16.7	7.7
% More than 10	8.4	12.5	19.1	6.7	0.0	0.0	0.0	0.0
How often is species, location, date and collector recorded for seedlots collected?								
	(sample = 153)	(sample = 8)	(sample = 45)	(sample = 43)	(sample = 10)	(sample = 14)	(sample = 7)	(sample = 26)
% Never	11.1	25.0	8.9	11.6	0.0	0.0	14.3	19.2
% Rarely	9.8	12.5	4.4	16.3	0.0	0.0	0.0	19.2
% Sometimes	30.7	12.5	40.0	39.5	0.0	21.4	57.1	15.4
% Always	48.4	50.0	46.7	32.6	100.0	78.6	28.6	46.2

Collection practices

Number of collectors

The number of collectors used by community respondents gives some idea of collection capacity, and is also an indicator of how many collectors there may be in the community. Twenty-nine per cent of community respondents only collect seed themselves and a further 44% obtain seed from up to 3 collectors. Only 19% use 3 to 10 collectors and 8% more than 10 collectors (see Table 10). In particular, all Greening Australia and other non-government organisations and the majority of landcare and catchment management groups who responded obtain seed from less than 10 collectors, most from 3 collectors or less. These respondents operate nearly all of the community seedbanks, and this finding implies that many of these seedbanks have a limited collection capacity. The three or so collectors are usually a single seedbank manager, community group members or volunteers. There is a limit to the amount of seed that could be so collected in any season without employing contract collectors. Although some seedbanks are successful in mobilising volunteers to collect seed, others find that in time and as the volume of collection increases, it becomes more difficult to maintain quality standards among an ever-changing group of volunteers with varying skill levels.

Community groups, landcare and catchment management groups and community botanic gardens are the only categories of community respondent who obtain seed from more than 10 collectors.

Cleaning and handling

Clearly, from the survey and questionnaire, a basic standard of practice in seed cleaning is evident among community seed operations. Almost all community respondents (91%) dry seed in the open air and either clean seed by hand (78%) rather than using a machine (4.6%) or do not clean seed at all (35%) (see Figure 5). About half use no form of pest control and of the 46% that do, most use chemical controls.

Almost all in the community clean seed by hand using a set of commonly available hand sieves. This is labour-intensive and unsuited to cleaning seed in large quantities. However, improving on this standard or practice need not be costly or require training. Only the largest seed merchants in Australia use more than the equivalent of a single vibrating seed cleaner and mechanical winnower. Very few community seedbanks could afford a vibrating seed cleaning machine (Kimseed or Boddington Clipper, costing up to about \$10,000). Even fewer operators would have sufficient experience to properly operate such a machine. Some community seed operations use a mechanical winnower or *blower* which separates seed from chaff and dirt by regulating forced air in a system of transparent pipes or in a vertical air column. Several such machines are available commercially and some very economical and functional home-made versions were inspected during the national tour. Cost-effective mechanical winnowing offers much scope for improving the seed cleaning capacity of community seedbanks.

Information recorded

Recording basic information about seed collected (species, location, date and collector) is good collection practice and essential to understanding of locality and provenance, to accurate species identification, to the ease of subsequent collection, and a host of other important issues. It is an important finding of the survey that the community operators appear less likely to *always* and more likely to *never* record such information than their counterparts in the commercial and government seed sectors (see Table 11). This finding is supported by data from another part of the questionnaire. One-third of community respondents indicated that they keep no records of seed collected (see Figure 5).

It would seem this is not the case across all sub-categories of the community. Greening Australia, community nurseries and community botanic gardens are better at keeping collection records – 71% of Greening Australia and all the community

nurseries respondents *always* record such information (see Table 12). Similarly, 78% of seedbanks *always* and only 4% *never* record basic information, which is also better than for seedstores (46% *always*, 14% *never*). However, from 9% to 25% of the remaining community sector respondents *never* and as low as 29% *always* record basic information.

Only 17% of community respondents keep these records on computer and 58% keep records by hand. Interestingly, these are very similar, perhaps a little worse, figures than for the commercial sector (29% *no records*, 58% *by hand*, 29% *by computer*) or those of all respondents (26% *no records*, 57% *by hand*, 28% *by computer*).

These figures indicate that at least one cause for difficulty experienced in obtaining information from commercial suppliers about the origins of seed is that there may be too few written records. But this argument would be just as valid for community suppliers for about the same standard of record-keeping exists in both the community and commercial sectors.

Collection difficulties

In line with national trends, many questionnaire respondents (11% *usually*, 46% *sometimes*) experience difficulty in collecting seed (see Table 10).

Obtaining viable seed on any regular basis is hampered by the combination of natural factors such as:

- lack of rain and poor seasons
- unpredictable seed maturation and sporadic seed set
- high levels of seed predation by insects before seed is mature
- height of seed in trees
- naturally poor seed viability.

Of all the difficulties raised, the logistical difficulties were most cited by the community. They include, in particular:

- timing collection when seed is mature
- taking advantage of the naturally short window of opportunity to collect seed

- having sufficient people and resources when it is time to collect
- collecting in sometimes inaccessible, difficult or distant locations
- monitoring seed set in remote areas or for difficult populations or species
- access to mechanical or other harvesting equipment.

These difficulties vary a little between the states but are consistent across commercial, government and community sectors, suggesting the strong influence of logistical and environmental factors.

Obtaining local provenance

Community respondents were no more or less likely than other respondents to experience problems in obtaining seed of the right provenance for use in their local area (see Table 10). About half the community respondents indicated that they experienced difficulties (15% *usually*, 35% *sometimes*).

The reasons given by respondents for these difficulties were again very similar to those for all respondents and differed most between states than sectors (see Figure 9). The response was unclear on whether respondents find that commercial seed suppliers provide sufficient information about seed. However, that 24% of respondents considered commercial suppliers *never* provide sufficient information and 26% of respondents considered commercial suppliers *rarely* provide sufficient information may be a significant reason for difficulty experienced in obtaining local seed (see Table 10).

Storage practices

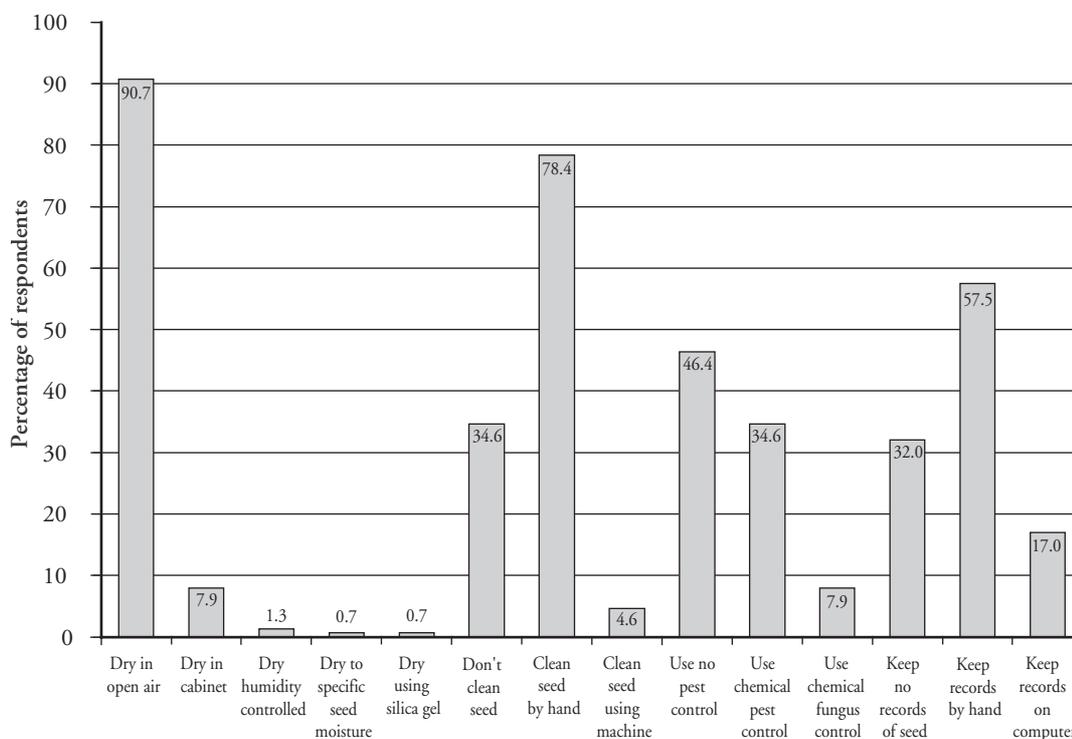
Most nurseries only store and use small amounts of seed for plant propagation. Even among the 33 commercial nurseries that responded, average seed in storage was 29 kilograms (in winter 1998). However, direct seeding revegetation operations may involve storage of hundreds of kilograms of seed. Storage practices also vary in accordance with scales of operation and the length of time that seed is stored.

Containers

On the seedbank visits, seedbank operators were observed using a great mixture of containers for storing seed, often using recycled containers. Among the 167 community respondents, only 5 indicated

that they use heat sealing laminated bags and these respondents store less than 40% of their seed in them. Eighty-eight community respondents use *airtight* containers and 73 respondents use containers that are *not airtight*. Some may use a mixture of both.

Figure 5: Seed cleaning and handling, by community sector respondents



Sample size = 151 to 153 community sector respondents nationally.

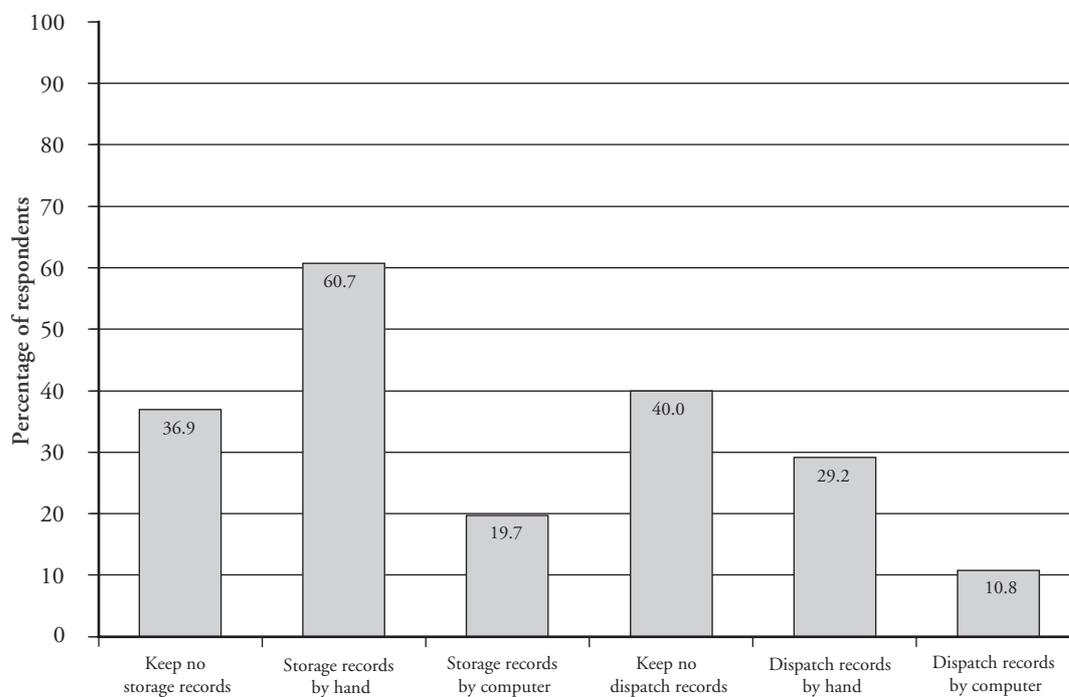
Table 11: Frequency of recording of basic information about seed, by sector

	Percentage of respondents who record basic information about seed collected			
	Commercial sector	Community sector	Government sector	All responses
Always	53.7	48.4	75.4	55.7
Sometimes	26.8	30.7	18.5	27.0
Rarely	11.0	9.8	4.6	9.0
Never	8.5	11.1	1.5	8.3

Table 12: Recording of basic information about seed, by community operators

	Percentage of respondents						
	Community botanic garden/ arboretum	Community group	Landcare /ICM group	Community nursery	Greening Australia	Non-government organisation	Individual
Collection records							
(sample = 153)	(sample = 7)	(sample = 47)	(sample = 43)	(sample = 10)	(sample = 14)	(sample = 7)	(sample = 25)
Keep no records	43	28	42	0	7	57	40
Keep records by hand	43	60	58	60	71	43	52
Keep records on computer	43	21	7	50	29	0	4
Storage records							
(sample = 121)	(sample = 7)	(sample = 35)	(sample = 32)	(sample = 10)	(sample = 13)	(sample = 6)	(sample = 18)
Keep no records	42.9	37.1	43.8	10.0	7.7	83.3	44.4
Keep records by hand	28.6	71.4	65.6	60.0	69.2	33.3	50.0
Keep records on computer	42.9	20.0	6.3	50.0	38.5	0.0	5.6

Figure 6: Seed storage practices, by community operators



Sample size = 18 to 122 community sector respondents nationally.

Table 13: Storage practices of community operators

Storage practices	Number of responses	Percentage of respondents who store > 80% of seed	Percentage of respondents who store 41 to 80% of seed	Percentage of respondents who store 21 to 40% of seed	Percentage of respondents who store 1 to 20% of seed
Percentage of seed stored in containers not airtight	73	79	33	4	7
Percentage of seed stored in airtight containers	88	36.4	17	5.7	26
Percentage of seed stored in heat sealed containers (bags)	5	20	0	40	40
Percentage of seed stored in ambient storage: room temperature & humidity	97	95	3.1	1	1
Percentage of seed stored in controlled temperature	24	75	12.5	0	12.5
Ambient storage space in cubic metres	61	3.3	6.6	9.8	82
Percentage of seed stored up to 1 year	106	40.6	37.7	9.4	17
Percentage of seed stored 1 to 5 years	86	16.3	41.9	12.8	34.9
Percentage of seed stored for more than 5 years	21	4.8	14.3	23.8	57

Respondents were also asked what percentage of their seed is stored in different containers. The response suggests that 79% of community operators store the greater percentage of their seed (81 to 100% of their seed) in containers that are *not airtight* and tend to store smaller amounts in *airtight* containers (see Table 13).

Temperature and humidity

Similarly, 97 community respondents (167) store seed at room temperature and humidity (ambient storage) (see Table 13). The response also tells us that among these 97 respondents:

- almost all (95%) store more than 80% of their seed in ambient conditions
- almost all (80%) have less than 20 cubic metres of storage space.

Some 24 community respondents store seed at controlled temperatures (in refrigerators) but none use controlled humidity (although some do use air-conditioning). Among the 24 respondents who store seed in

refrigerators, 75% store more than 80% of their seed in this way (see Table 13).

Storage times

Of the 167 community respondents, 106 indicated that they store some seed for up to a year, 86 from 1 to 5 years, and only 21 for more than 5 years. The ratio of how much of their seed is stored for these periods varies. The main finding is that a community operator is likely to store the majority of their seed for less than 5 years. If they store for longer, and few do, they will likely store less than 40% for more than 5 years.

Information recorded

As with collection records, the keeping of accurate records of seed storage is, for similar reasons, good practice. It is an important finding of the survey that 37% of community respondents do not keep seed storage records (see Figure 6). Very likely, these are the same one-third of respondents who also do not keep collection records.

By the same argument, two-thirds of respondents do keep collection and storage

records. Almost 61% of those who keep storage records keep them by hand and only 20% keep records on computer – many of whom would also keep records by hand.

Looking at the categories of respondents in the community sector in Table 12, Greening Australia and community nurseries (but not community botanic gardens) appear again to be better at keeping storage records.

Similarly, only 9% of seedbanks keep no records and 43% indicated they used a computer, in addition to the 78% who keep records by hand. This is a better standard than for seedstores (43% *no records*, 61% *by hand*, 11.5% *by computer*) (sample = 23 seedbanks and 61 seedstores).

Again, comparing practice to the commercial sector respondents (29% *no records*, 59% *by hand*, 28% *by computer*) or those of all respondents (29% *no records*, 57% *by hand*, 27% *by computer*), we find very similar practices.

Use of computers and the Internet

During consultation, many people encouraged FloraBank to use the Internet as the main means of extension of information and guidelines on seed collection and storage. While many considered that paper-based information should also be available, the strong focus and the trend for the near future was thought to be the Internet. Subsequently, in response to this encouragement, FloraBank developed a much more advanced web site than was previously envisaged.

The questionnaire also asked whether respondents had access to computers or the Internet. Of 159 community respondents who answered these questions, 80% have access to a computer and 47% have access to the Internet. These figures are only slightly less than for the total response from 312 respondents, of whom 86% have access to a computer and 53% have access to the Internet. It is a special feature of the native seed sector that there are quite large numbers of people who have access to technologically advanced communication and networking tools.

Storage difficulties

In line with national trends, community sector respondents experienced less difficulty in storing seed than collecting seed. Some 41% of community respondents *rarely* and 20% *never* experience storage difficulties. However, 36% *sometimes* do experience difficulty and frequently during consultation there were community members who expressed (unsolicited) problems with storage that they thought FloraBank could assist with.

It is somewhat confounding that the questionnaire did not find more concern about these issues among community respondents.

One interpretation is that many community respondents do not really store enough seed, or are more concerned with revegetation or other activities, to be overly concerned at the difficulties they have with storage. Indeed, the response does indicate that seedbanks experience greater difficulty with storage than do seedstores. In a sample of 23 community seedbanks and 64 seedstores, 8.7% of seedbanks *usually*, 43.5% *sometimes*, and 26% *rarely* experienced difficulty compared to 1.6% *usually*, 34% *sometimes* and 44% *rarely* for seedstores.

Many community questionnaire respondents listed difficulties with storage, including, in order of frequency:

- attack by vermin, insects and fungal agents
- the loss of seed viability, and the short shelf life of many species in storage
- lack of available storage space and equipment, poor equipment and equipment failures
- understanding technical aspects of storage and overcoming problems with temperature and humidity.

While these difficulties confront all those who store seed, overcoming them depends greatly on the knowledge of the operator and the resources at their disposal. Seedstore operators have fewer resources but not necessarily less knowledge than do seedbank operators.

There were many difficulties – indeed most – listed by respondents that reflect on the awareness of operators to the causes of problems. Far more of the difficulties listed by respondents may be regarded as addressing the symptoms. For example, many listed difficulties in their response, such as ‘seed eaten by insects’ or ‘seed goes mouldy’. Few listed their difficulties in terms

of causal agents, such as ‘pest control is inadequate’ or ‘seed is too wet in storage’. While this is perhaps overly harsh on respondents, it is indicative of a general lack of awareness and technical understanding about seed storage in the community.

The response from seedbanks demonstrated better awareness of causes.



Identification of community needs

The tour program in each state enabled FloraBank to question managers of seedbanks visited about their needs. The questionnaire also specifically asked about needs. These are ‘felt’ or ‘expressed’ needs. FloraBank also researched how needs are actually demonstrated by the actions of collectors, seedbanks and seed users. Anecdotal evidence forthcoming during visits also allowed comparison between what operators said. There is very little third party information available on native seed in Australia.

During consultation, strong unprompted support was frequently expressed for the approach and role of FloraBank across all community sectors. Some expressed the view that FloraBank is addressing real needs that are long overdue for attention.

Collection needs

Indications are that community operators are less confident of their collection practices than their storage practices.

Consistent themes that emerged as difficulties experienced by community groups and landholders in collecting seed were lack of knowledge and lack of skills and expertise. Many commented that they do not have enough knowledge for correct plant identification, collection timing, understanding what to collect, where and how. There are problems caused by changing and uncertain taxonomy for some species.

The information available to community operators on seed collection and storage is generally inadequate. There has been little research on the collection and storage of the flora, despite recent advances through applied research conducted by mining companies. There are some technical and scientific publications on seed collection and storage. The community generally does not have access to this information and there are only very basic leaflet materials written for community use.

Consequently, the community and, to some extent, commercial collectors experience a lack of species-specific information on key aspects of collection, such as the:

- approximate time of flowering and seed set for even common species across broad climatic zones
- appropriate propagation methods for a species
- reasonable (and broadly accepted) provenance boundaries for species.

There are major bottlenecks in the chain of supply of local indigenous seed, significantly due to these information gaps. It is apparent that seed users are not aware of the seed holdings of many collectors and suppliers. It can be a time-consuming task to search for seed of a certain species. A central clearing house or network for accessing local seed from all sources may be of considerable value to seed users and improve the efficiency of seed use.

The needs commonly expressed by stakeholders (not in priority order) include:

- immediate delivery of targeted information on all aspects of seed collection and storage, but especially in regard to best management practices, codes of practice, techniques and technical information
- immediate technical support for existing regional initiatives to establish seed production areas, seedbanks and herbaria
- raising awareness of the need to protect seed supplies for harvest where clearing, roadworks or construction projects take place
- more streamlined and sensible government legislation and policy regarding seed collection
- greater access to crown lands for seed collectors
- access to national parks for seed collection under certain circumstances
- establishment of better communication and networking between seedbanks
- basic training and in some cases certification of competence in seed collection and storage.

In the questionnaire, respondents were asked to indicate *yes*, *no* or *unsure* for each of the needs listed in Figure 7. The responses are self-explanatory and are not discussed in detail here. In general, the data support the findings of consultation listed above. In particular, seed cleaning equipment, collection equipment and training courses were the most highly rated of these needs. Technical advice and, to a lesser extent, information on collection were considered inadequate, although not as strongly as was expected, by 22% to 37% of respondents (with 13% to 17% unsure). Respondents listed no other needs.

Storage needs

Consultation indicated that the community experiences a lack of species-specific information on key aspects of storage, including:

- approximate natural viability of species
- best-bet storage regimes for species
- approximate expected shelf life of species under major storage regimes
- expected viability of species in storage
- expected germination percentages for species in storage
- seed cleaning techniques for species.

Community seedbanks are typically ill-equipped and lack essential resources and support services. Most do not have adequate drying, fumigation and bagging equipment, such as electronic balances, heat sealing equipment and better seed drying facilities. In particular, there is a need for temperature and humidity control and monitoring equipment, air-conditioning and refrigeration in many seedbanks.

There are a number of services to the horticultural and agricultural seed industries that are not universally used or available to community seedbanks, such as contract:

- seed drying and extraction
- seed cleaning
- seed moisture content determinations
- seed viability and germination testing.

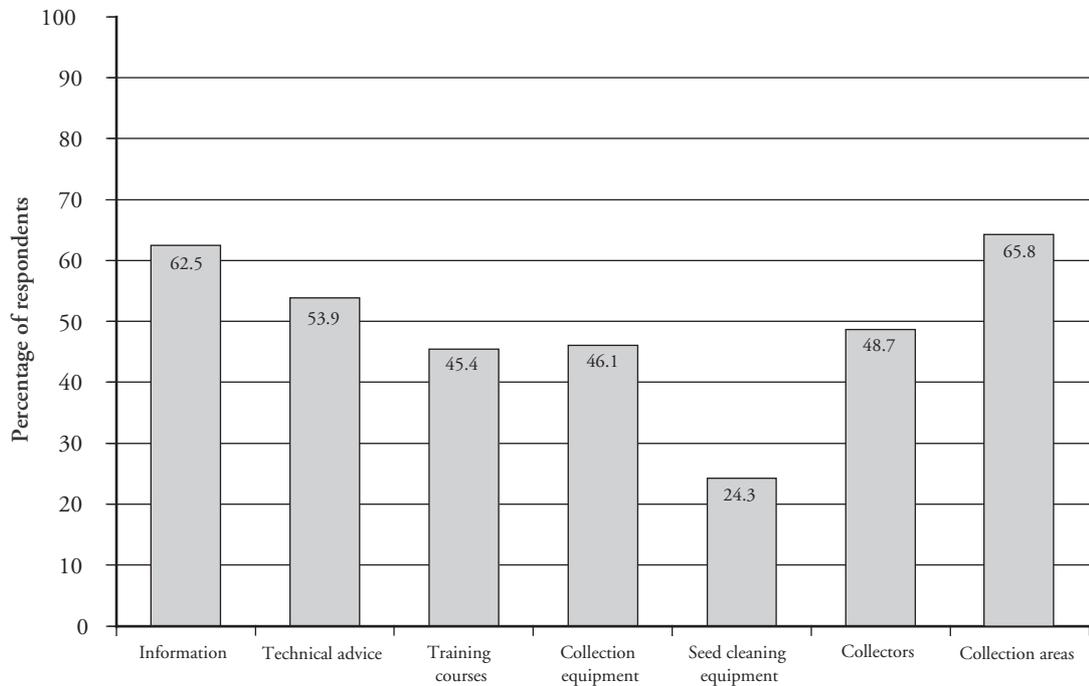
That community seedbanks do not all use such services may in part be due to the as yet limited exposure of service providers to community seedbanks, and vice versa. Not all such services are provided in every region, however, most are available on a state basis. These services use equipment and cover areas of expertise that may be beyond many (but not all) community seedbanks and their operators. Greater access to commercially available services at market rates may be a better short-term strategy than investing in high levels of training and equipment for community seedbanks to be self-sufficient in these respects.

The needs commonly expressed by stakeholders (not in priority order) include:

- research into storage regimes, storage life, germination and viability of a much broader range of native species

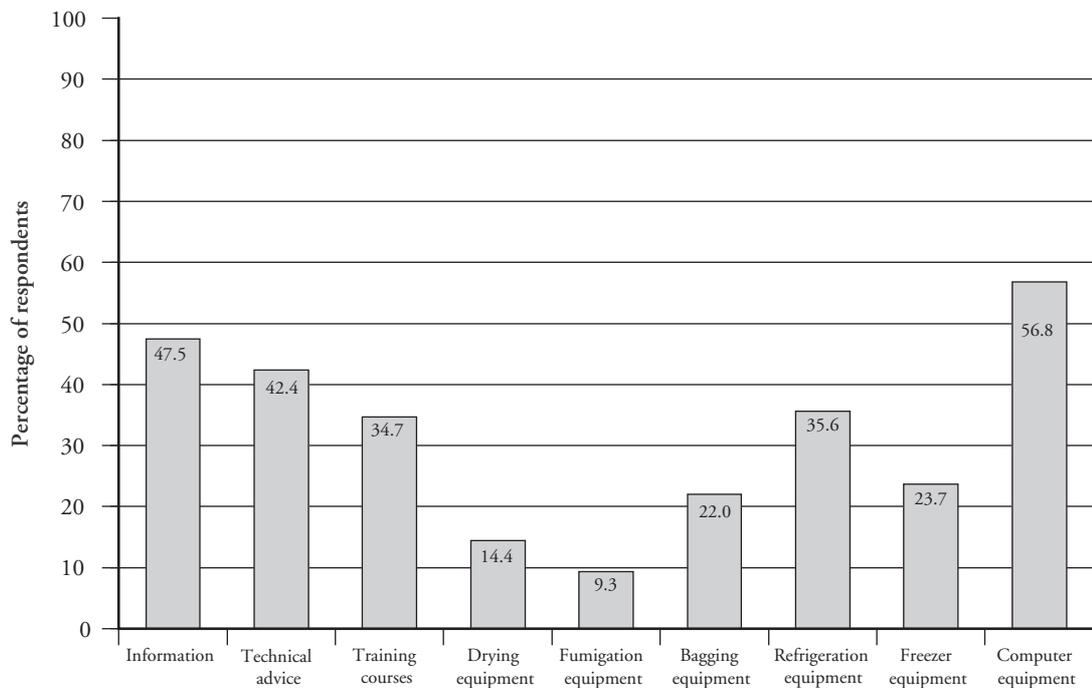
- contract seed cleaning services or facilities in each state accessible to the community at reasonable rates
- contract storage arrangements for difficult or long-term seed storage involving expensive equipment that is beyond the resources of community operators.

Figure 7: Collection needs of community operators



Sample = 152 respondents.

Figure 8: Storage needs of community operators



Sample = 118 respondents.

Generally, needs were more clearly expressed for collection than for storage, perhaps because many community operators simply do not store much seed for long. These operators are typically involved in revegetation and perhaps not overly concerned at difficulties they experience with storage, whereas difficulties in collection may directly restrict revegetation effort.

In the questionnaire, respondents were asked to indicate *yes*, *no* or *unsure* for each of the needs listed in Figure 8, for which the responses are also self-explanatory.

Technical advice, training courses and, to a lesser extent, information on storage were considered inadequate by over half of respondents.

Respondents indicated needs for all forms of equipment except computers. Most respondents do not have adequate drying, fumigation and bagging equipment, which strongly supports the difficulties encountered with these aspects of storage noted above. The only other needs listed by respondents were advice on data handling on computers; software; and access to seed storage facilities.

Training

Seedbank operators and landcare extension staff currently conduct basic (introductory) training programs in seed collection and use. These programs are almost entirely pitched at community groups and landholders. Training modules have been developed and are currently offered in most states. These modules provide sufficient foundation for delivery anywhere in Australia, although some modifications would be necessary to reflect regional vegetation composition and community needs.

Some structured training at a more advanced level suitable for seedbank operators is available. There are a variety of horticultural courses that include seed collection, storage and use offered by TAFE campuses throughout Australia. The Australian Network for Plant Conservation and the Threatened Flora Seed Centre (Department of Conservation and Land Management in Western Australia) run germplasm conservation training programs on a national basis approximately annually.

There is a great lack of suitably qualified people to conduct advanced training on collection and storage practice for revegetation. Information and networking solutions may be more effective than advanced training programs in improving practices among seedbank operators.

PART FOUR

AROUND THE STATES



Introduction

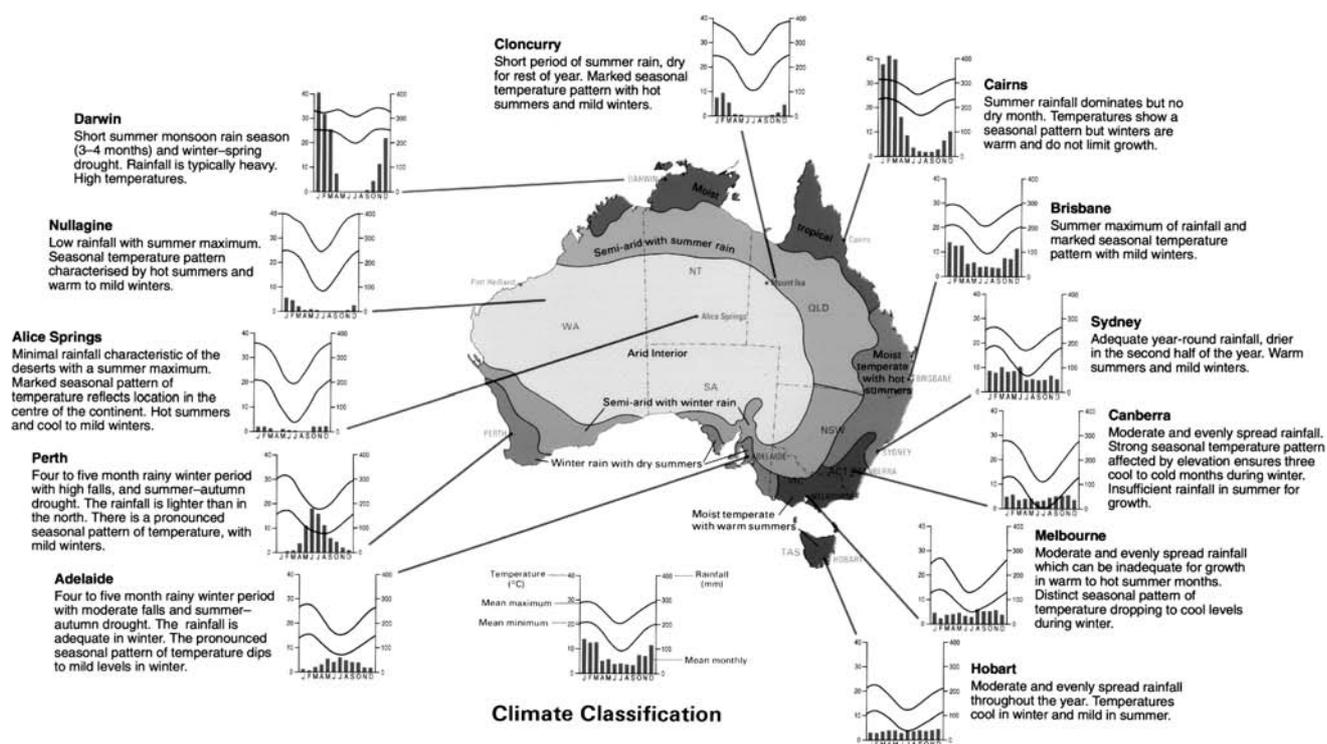
This part of the report provides a brief description of the native seed sector in each state in terms of its biogeographical context, seed users, operations, obtaining seed, quantity and quality of seed available, and collection and storage difficulties. It is based on consultations conducted during the national survey, augmented with some analysis of questionnaire responses. The responses are analysed as an entire data set for each state and also broken into commercial, government and community sectors for analysis. The respondents to the questionnaire in each state are also described in terms of these sectors and by category of respondent.

There are considerable differences in the native seed sector among the states: in the scale and nature of operations, in the respective roles of the commercial, government and community sectors, and in collection and storage practices. Perhaps the most important factors in all these differences are those of the natural environment. The biogeography of a region has a profound effect on how and why we collect or store native seed and how difficult these activities are.

Indeed, the way we collect, store and use native plant seed responds much more to boundaries of *major* climatic zones and their influence on vegetation, agriculture and population than it does to state or other administrative boundaries. The climatic classification of AUSLIG is used as a reference for this report (AUSLIG 1992). This relatively simple climatic zonation is presented in Map 2. It describes:

- the humid tropical areas of northern Queensland, Northern Territory and the Kimberley region of Western Australia
- the northern semi-arid summer rain belt inland of the humid tropics
- the arid interior of central Australia
- the southern semi-arid winter rain belt
- the coastal areas of south-western Western Australia and south-eastern South Australia that have winter rain and dry summers
- the moist temperate areas with warm summers
- the moist temperate areas with hot summers.

Map 2: AUSLIG climatic zones



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Table 14: Operations of respondents, by state

	Percentage of respondents							National
	NSW	NT	QLD	SA	TAS	VIC	WA	
Number of respondents	76	18	61	41	18	52	45	311
Operations carried out								
Collect seed	95.9	94.4	80.3	87.8	77.8	82.7	91.1	87.7
Clean seed	68.5	88.9	54.1	63.4	66.7	63.5	64.4	64.6
Store seed	82.2	77.8	59.0	78.0	83.3	75.0	64.4	73.1
Distribute seed free	41.1	72.2	32.8	43.9	11.1	25.5	24.4	34.9
Sell seed	17.8	22.2	4.9	14.6	22.2	5.9	24.4	14.3
Sell, store or distribute other plant propagation material	23.3	27.8	16.4	12.2	5.6	9.8	11.1	15.6
Raise native seedlings from seed	83.6	72.2	77.0	85.4	77.8	64.7	64.4	75.6
Advise others on the above	63.0	72.2	50.8	51.2	22.2	48.1	60.0	54.2
Direct seed native plants	50.7	66.7	41.0	68.3	16.7	46.2	64.4	51.3
Replant using native seedlings	82.2	72.2	75.4	82.9	61.1	67.3	66.7	74.4
Manage natural regeneration	60.3	55.6	52.5	75.6	27.8	55.8	60.0	57.8

Note: There were no respondents who answered that they were unsure to Question 2.

Table 15: Distribution of seed, by state

	Percentage of respondents							
	NSW	NT	QLD	SA	TAS	VIC	WA	National
Number of respondents	47	13	28	29	6	25	31	179
Seed distributed to								
Seed merchants	9.1	7.7	10.7	10.7	50.0	4.0	16.1	11.4
Nurseries/propagators	27.3	15.4	14.3	21.4	66.7	20.0	12.9	21.1
Community seedbanks	15.9	7.7	3.6	21.4	16.7	0.0	6.5	10.3
Community groups	54.5	61.5	53.6	46.4	50.0	48.0	35.5	49.1
Community nurseries	11.4	15.4	14.3	14.3	33.3	12.0	12.9	13.7
Farmers/landholders	45.5	38.5	35.7	42.9	33.3	20.0	35.5	37.1
Direct seeders	34.1	23.1	25.0	21.4	66.7	12.0	25.8	26.3
Local councils	18.2	15.4	17.9	14.3	33.3	8.0	22.6	17.1
State government	15.9	38.5	3.6	25.0	66.7	26.9	9.7	19.3

Note: There were no respondents who answered that they were unsure to Question 22.

Table 16: How respondents obtain native seed, by state

	Percentage of respondents							
	NSW	NT	QLD	SA	TAS	VIC	WA	National
Number of respondents	76	18	61	41	18	52	45	311
How respondents obtain seed								
By collection	95.9	94.4	80.3	87.8	77.8	82.7	91.1	87.7
Free from collectors	33.3	44.4	44.3	30.0	11.1	22.9	17.8	30.5
Buy from collectors	26.4	27.8	21.3	35.0	47.1	29.2	24.4	27.9
Buy from seed suppliers	55.6	22.2	42.6	47.5	70.6	22.9	57.8	45.8
Trade for goods or services	12.5	27.8	3.3	7.5	0.0	2.1	0.0	6.7

Note: There were no respondents who answered that they were unsure to Question 3.

Table 17: Origins of seed obtained by respondents, by state

		Percentage of respondents							
		NSW	NT	QLD	SA	TAS	VIC	WA	National
<i>Number of responses</i>		73	18	61	40	18	46	44	300
Source of native seed	Amount of seed obtained								
Within your local area	All seed	30	17	30	45	0	51	45	35
	Most seed	44	33	33	23	33	26	34	33
	Some seed	20	22	31	23	39	15	16	23
	No seed	7	28	7	10	28	9	5	10
Within your region	All seed	32	50	18	31	28	30	32	29
	Most seed	21	11	20	10	44	15	23	19
	Some seed	28	22	30	23	28	24	20	26
	No seed	18	17	33	36	0	30	25	25
Within Australia	All seed	51	39	52	36	50	41	52	47
	Most seed	4	6	7	8	0	4	5	5
	Some seed	11	6	11	8	17	0	7	9
	No seed	33	50	30	49	33	54	36	39
Outside Australia	All seed	0	0	0	0	0	0	0	0
	Most seed	0	0	0	0	0	0	0	0
	Some seed	1	11	3	5	6	0	5	4
	No seed	99	89	97	95	94	100	95	96
From natural bush areas	All seed	21	33	25	38	28	29	30	28
	Most seed	49	28	34	33	50	22	43	38
	Some seed	16	11	20	15	22	33	18	19
	No seed	14	28	21	15	0	16	9	15
From plantings or plantations	All seed	3	0	0	3	0	0	0	1
	Most seed	6	11	2	0	6	11	5	5
	Some seed	54	17	41	33	61	49	36	43
	No seed	38	72	57	64	33	40	59	51
From native seed orchards	All seed	1	0	0	0	0	0	0	0
	Most seed	0	6	0	3	0	2	2	1
	Some seed	14	0	8	26	28	11	23	16
	No seed	84	94	92	72	72	86	75	83
From unknown origins	All seed	1	0	0	0	0	0	0	0
	Most seed	0	6	2	0	0	0	0	1
	Some seed	29	11	8	8	17	12	11	15
	No seed	70	83	90	92	83	88	89	84

Note: 1. NSW data exclude ACT data.

2. Data are the number of responses in each origin category in each state, expressed as a percentage of the total response for that category in that state.

Table 18: Type of native seed obtained by respondents, by state

		Percentage of respondents							
		NSW	NT	QLD	SA	TAS	VIC	WA	National
<i>Number of responses</i>		73	18	60	39	18	49	45	302
Source of native seed	Amount of seed obtained								
Trees	All seed	10	11	15	15	6	12	9	12
	Most seed	44	22	33	28	28	16	27	30
	Some seed	44	44	45	56	61	67	60	53
	No seed	3	22	7	0	6	4	4	5
Tall shrubs (middle storey)	All seed	4	6	5	10	0	8	7	6
	Most seed	27	11	13	23	28	8	18	18
	Some seed	63	44	67	64	72	76	71	67
	No seed	6	39	15	3	0	8	4	9
Low shrubs (ground storey)	All seed	4	6	5	10	0	4	7	5
	Most seed	10	11	13	18	22	14	24	15
	Some seed	69	50	55	56	61	69	67	63
	No seed	17	33	27	15	17	12	2	17
Wetland plants	All seed	0	0	3	5	0	4	7	3
	Most seed	3	0	3	0	6	2	4	3
	Some seed	38	39	37	54	44	37	36	40
	No seed	59	61	57	41	50	57	53	55
Native grasses	All seed	1	17	7	8	0	6	4	5
	Most seed	3	22	2	3	6	6	2	4
	Some seed	46	39	57	62	67	63	29	51
	No seed	49	22	35	28	28	24	64	39

Note: 1. NSW data exclude ACT data.

2. Data are the number of responses in each origin category in each state, expressed as a percentage of the total response for that category in that state.

Table 19: Use of propagation material other than seed, by state

		Percentage of respondents							
		NSW	NT	QLD	SA	TAS	VIC	WA	National
<i>Number of respondents</i>		72	17	49	38	17	48	44	285
Use material other than seed to propagate native plants		54.2	47.1	53.1	60.5	41.2	64.6	38.6	53.0
<i>Number of respondents</i>		73	18	61	41	18	51	45	307
Store, sell or distribute native plant material other than seed		23.3	27.8	16.4	12.2	5.6	9.8	11.1	15.6

Table 20: Quantity of seed collected, stored and distributed by respondents, by state

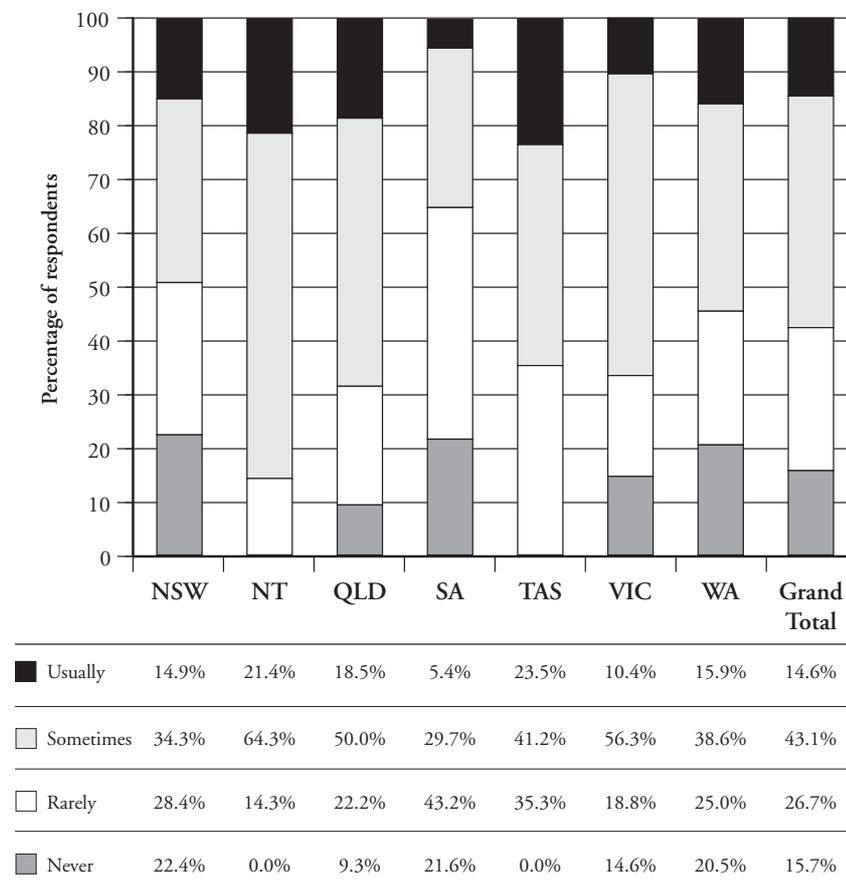
State average seed operations		All sectors	Commercial sector	Community sector	Government sector
ACT (3 respondents)	Collected last year (kg)	203.0	na	na	203.0
	Collected last year (number of species)	240.0	na	na	240.0
	In storage (kg)	na	na	na	na
	In storage (number of species)	2,300.0	na	na	2,300.0
	Dispatched last year (kg)	96.0	na	na	96.0
	Dispatched last year (number of species)	100.0	na	na	100.0
NSW (74 respondents)	Collected last year (kg)	70.1	167.1	15.8	10.0
	Collected last year (number of species)	121.7	273.6	39.4	100.0
	In storage (kg)	49.4	60.4	20.0	750.0
	In storage (number of species)	161.1	154.0	62.5	1,507.5
	Dispatched last year (kg)	77.6	232.2	16.5	5.0
	Dispatched last year (number of species)	56.0	83.1	40.2	7.5
NT (18 respondents)	Collected last year (kg)	228.0	500.0	538.3	11.9
	Collected last year (number of species)	52.8	150.0	16.3	62.6
	In storage (kg)	123.9	500.0	163.0	35.2
	In storage (number of species)	80.4	na	10.0	115.7
	Dispatched last year (kg)	231.1	na	401.5	4.0
	Dispatched last year (number of species)	15.5	na	20.0	11.0
QLD (62 respondents)	Collected last year (kg)	200.8	633.4	6.9	294.1
	Collected last year (number of species)	40.4	40.5	31.7	71.4
	In storage (kg)	211.5	348.6	4.7	405.6
	In storage (number of species)	75.5	123.1	54.9	64.3
	Dispatched last year (kg)	319.2	312.5	7.3	800.5
	Dispatched last year (number of species)	130.0	263.3	59.0	147.5
SA (44 respondents)	Collected last year (kg)	114.1	707.8	11.5	7.8
	Collected last year (number of species)	119.9	245.0	93.5	113.8
	In storage (kg)	267.5	1,203.8	52.9	116.3
	In storage (number of species)	137.7	298.8	50.2	253.8
	Dispatched last year (kg)	267.5	1,133.3	7.0	11.0
	Dispatched last year (number of species)	227.6	250.0	232.3	150.0
TAS (18 respondents)	Collected last year (kg)	475.2	379.3	5.0	2,000.0
	Collected last year (number of species)	54.3	60.8	5.0	25.0
	In storage (kg)	816.1	76.7	5.0	10,500.0
	In storage (number of species)	139.3	136.8	205.0	40.0
	Dispatched last year (kg)	892.3	713.3	1.0	2,500.0
	Dispatched last year (number of species)	31.7	20.0	80.0	30.0

continued

Table 20: Quantity of seed collected, stored and distributed by respondents, by state

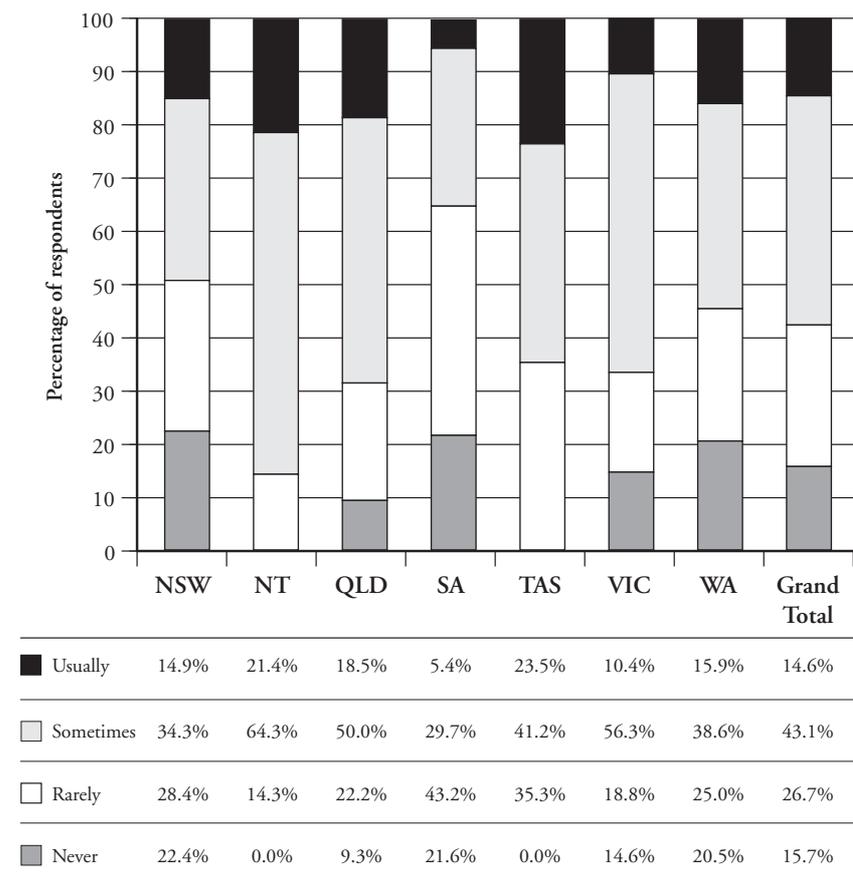
VIC (53 respondents)	Collected last year (kg)	52.3	10.3	6.9	121.7
	Collected last year (number of species)	39.2	79.4	39.5	14.2
	In storage (kg)	98.8	10.9	21.9	238.6
	In storage (number of species)	116.0	235.7	102.8	48.1
	Dispatched last year (kg)	65.0	2.0	13.2	165.0
	Dispatched last year (number of species)	21.9	25.0	18.4	27.5
WA (47 respondents)	Collected last year (kg)	176.4	391.9	6.7	25.1
	Collected last year (number of species)	40.4	64.1	29.3	26.3
	In storage (kg)	278.9	590.3	5.2	16.8
	In storage (number of species)	113.8	174.5	34.1	86.3
	Dispatched last year (kg)	285.3	526.6	5.8	31.3
	Dispatched last year (number of species)	116.9	199.4	43.4	43.8
National (319 respondents)	Collected last year (kg)	318.4	31.9	147.5	143.4
	Collected last year (number of species)	130.2	44.1	58.3	72.4
	In storage (kg)	290.2	30.1	490.6	204.7
	In storage (number of species)	169.6	63.7	249.4	136.9
	Dispatched last year (kg)	472.3	48.3	272.9	235.0
	Dispatched last year (number of species)	137.0	70.9	49.3	87.6

Figure 9: Difficulty in obtaining provenance seed, by state



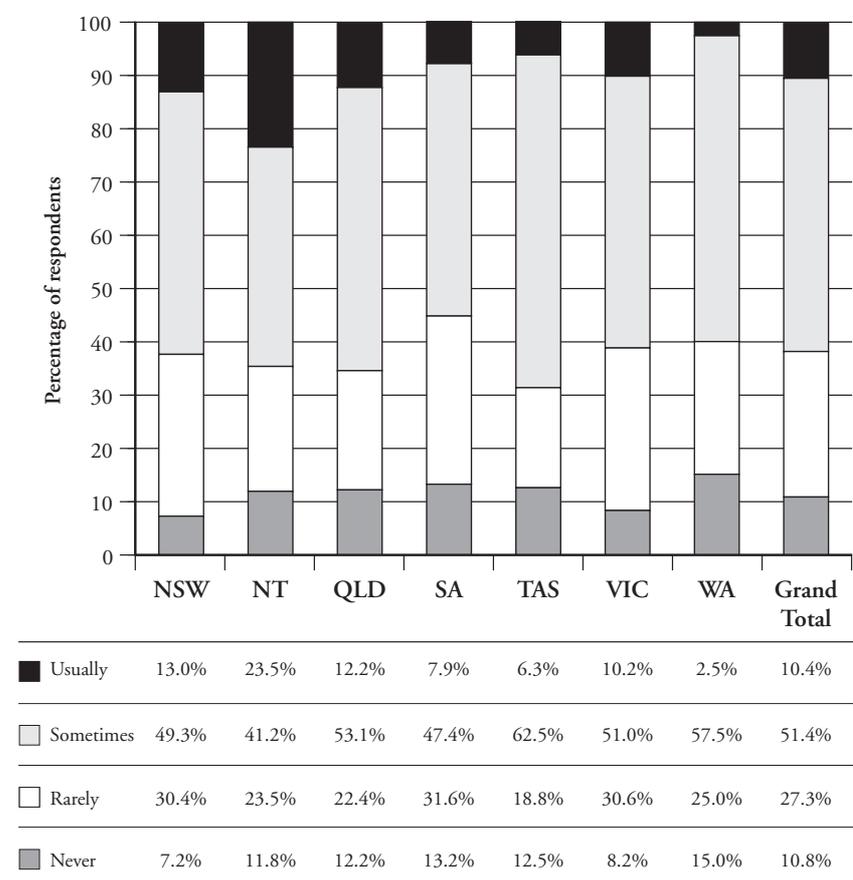
Number of responses = NSW 69, NT 14, Qld 55, SA 37, Tas 17, Vic 48, WA 44.

Figure 10: Adequacy of information provided by commercial suppliers, by state



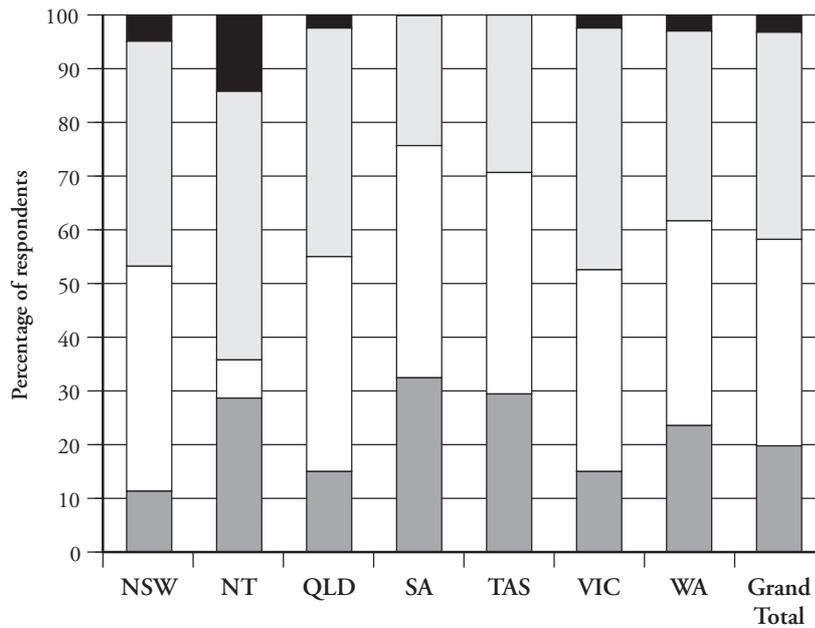
Number of responses = NSW 54, NT 9, Qld 38, SA 27, Tas 14, Vic 25, WA 37.

Figure 11: Difficulty experienced in collecting seed, by state



Number of responses = NSW 72, NT 17, Qld 49, SA 38, Tas 16, Vic 49, WA 40.

Figure 12: Difficulty experienced in storing seed, by state



■ Usually	4.8%	14.3%	2.5%	0.0%	0.0%	2.5%	2.9%	3.3%
▒ Sometimes	41.9%	50.0%	42.5%	24.3%	29.4%	45.0%	35.3%	38.5%
□ Rarely	41.9%	7.1%	40.0%	43.2%	41.2%	37.5%	38.2%	38.5%
■ Never	11.3%	28.6%	15.0%	32.4%	29.4%	15.0%	23.5%	19.7%

Number of responses = NSW 65, NT 14, Qld 40, SA 37, Tas 17, Vic 40, WA 34.



Tasmania

Biogeographical context

Tasmania shares the moist temperate climate with warm summers experienced by much of southern Australia (see Map 2). About half the state remains covered in forest or remnant vegetation, with the notable exception of the midlands and the north-east, where some land degradation is seen on the scale of the mainland. Forestry Tasmania has mapped 62 forest provenance zones across Tasmania, which are recognised and used by those involved in the native seed sector. Extensive tree decline has occurred in a north-south corridor through the lower rainfall areas of central Tasmania. The most extensive tree decline is in the midlands, where regeneration and revegetation techniques are adopted by landowners to combat the problem.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the relatively small area of the state and the small proportion that is under settlement
- the dominance of forestry operations in the native seed sector
- the ready availability of seed of a core group of species for revegetation in most areas
- the greatly restricted access resulting from isolation or rugged and difficult terrain
- the location of much of the vegetation for seed harvest on public lands, where the permission of relevant authorities is required for collection activity.

Questionnaire response

The response rate to the questionnaire from Tasmania was about average (18%) (see Table 1). Most of the main operators from each of the commercial, government and community sectors were either consulted

directly, took part in the Hobart forum or responded to the questionnaire. The questionnaire responses were dominated by responses from the commercial (14 of 18 respondents) rather than community (3 respondents) and government (1 respondents) sectors. In particular, there was a strong response from commercial nurseries (9 respondents) and little response from community groups (see Table 2).

Seed users

Consultation indicated that seed use in Tasmania follows very different trends from those described nationally and for other states. Tasmania is small. It has a small and self-reliant native seed sector catering for many fewer users of seed in large quantities in the state.

The biggest seed users in Tasmania are the forestry operations of Forestry Tasmania on public land, probably followed by those of the private foresters. Almost all of the seed used by these foresters would come from commercial collectors or suppliers, much of it as bulk collections of native hardwood forestry species. Following far behind forestry, the next major users are the landcare projects of community groups and landholders. Forestry, with its demand for large quantities of a few commercially important hardwood species, contrasts with landcare which uses a much larger range of species in much smaller quantities.

Although mining companies do engage in rehabilitation, the demand from them is to meet sporadic rehabilitation requirements of mining projects and is not as consistent or significant as elsewhere in Australia. As for mining, the demand for government agency and roadside revegetation projects is sporadic and small.

Operations

The operations of respondents follow a similar pattern to those in the mainland states. Most respondents collect (78%), clean (67%) and store (83%) seed (see Table 14).

Two-thirds of Tasmanian respondents dispatch seed to nurseries and propagators, state government (most likely forestry operations rather than revegetation) and direct seeders. Half of respondents dispatch seed to seed merchants and community groups (50%) (see Table 15). Only one-third of respondents dispatch seed to local government, farmers and landholders, and community nurseries. This is a quite different distribution pattern from the mainland states and indicates the differences in not only the respondents but also the seed sector in Tasmania.

Respondents are more likely to sell seed (22%) than distribute it free (11%) (see Table 14).

Many respondents (78%) also raise native seedlings from seed.

Fewer respondents advise others on the above matters than in the other states (22%, national average 55%).

Many fewer respondents carry out direct seeding in Tasmania (17%) than for the national average (51%) (see Table 14). Consultation indicated that while outside of forestry (which uses mostly direct or aerial seeding) most seed is currently used in nursery production of tubestock and much less for direct seeding, this situation is changing.

Though respondents are involved in raising seedlings from seed, comparatively fewer than in other states are involved in replanting or in managing natural regeneration (28%, national average 58%).

While 41% of respondents use propagation material other than seed to propagate native plants, consultation suggested that the amount used is small. In addition, only 6% store, sell or distribute these materials. In common with Western Australia, these are the lowest use and handling rates for

propagation material other than seed for any state (see Table 19).

Obtaining seed

The responses from Tasmania include major commercial and non-commercial seed suppliers, but relatively fewer respondents who are both users and collectors of seed, as is the case in other states. This suggests that, despite the intensity of distribution of landcare groups in Tasmania, few if any currently collect much native seed. Further, the responses indicate that most seed users obtain seed from suppliers.

Indeed, apart from collecting seed themselves, respondents do acquire seed quite differently from those in the mainland states. They are much more likely to buy seed from collectors or a seed merchant than obtain seed for free: 47% compared to the national average of 28%, and 71% compared to the national average of 46% respectively (see Table 16).

Tasmanian respondents appear to specialise less in seed collection than do their counterparts in the mainland states. Firstly, respondent seed collectors collect *most* or *some* of their seed across most broad vegetation types (tree, shrub, wetland and grass species), with only one seed merchant indicating that all of the seed collected is from one type only (trees) (see Table 18). Secondly, although 33% collect *most* and 39% *some* of their seed in the local area, no respondents collect *all* of their seed in the local area, and the highest number of any state (28%) collect *none* of their seed in the local area (see Table 17).

In line with national trends, a large proportion of respondents collect seed from natural bush (28% *all*, 50% *most*). Plantations or plantings are the second most significant source of seed for Tasmanian respondents (6% *most*, 61% *some*). More seed comes from seed orchards and uncertain origins than in most other states (28% *some*, 17% *some* respectively) (see Table 17).

Availability of seed

Native seed collection and storage is dominated by forestry operations which deal with seed in tonnages of a few species, compared to landcare, which tends to operate in kilograms or tens of kilograms of a wider range of species.

Looking at all questionnaire responses in Tasmania, the average respondent in the last year collected 475 kilograms, stored 816 kilograms and dispatched 892 kilograms of seed (see Table 20).

The figures in Table 20 are dominated by responses from large government seedbanks and commercial seed merchants in Tasmania. Consequently, they show relatively large average quantities of seed by national standards. In the last year a much greater average number of species were stored (205 species) and dispatched (80 species) by the community sector compared to the commercial (137 and 20 species) and government (40 and 30 species) sectors, even though there were only two community respondents. This is quite unlike the response in other states.

At the forum of key seed people in Hobart there were mixed opinions on the current demand for native seed and whether demand is increasing. Perhaps the only increase in demand for seed in Tasmania in recent years has been from landcare projects funded by the National Heritage Trust.

Availability of indigenous seed

The limited market in Tasmania encourages high standards of seed quality and high levels of trust between suppliers and seed users. There were no concerns expressed about seed quality or provenance issues at the forum of key seed people in Hobart. Generally, seed available in Tasmania is provenance seed and the use of recognised forest provenances (Forestry Tasmania mapping) adds considerably to the understanding and certainty of supply of provenance seed. Commercial seed merchants are generally also collectors who collect seed widely from across Tasmania.

This would suggest that any provenance order could be filled commercially on request, given the appropriate lead-time. However, in line with national trends, many respondents indicated that they experience difficulty in obtaining seed of the right provenance for use in their local area (24% *usually*, 41% *sometimes*) (see Figure 9). No respondent *never* experienced difficulty. Yet commercial collectors in Tasmania are comparatively better than in other states at supplying information about the origins of seed. No respondents indicated that commercial suppliers *rarely* or *never* provide sufficient information about the origins of seed bought, which was the lowest number of all states (see Figure 10).

Even in Tasmania, it appeared that local indigenous seed is not available for all areas. Common problems identified by respondents in obtaining seed of the right provenance for use in the local area are:

- seasonal availability of seed in one provenance versus another
- lack of remnant vegetation to collect from, and tree decline
- need for more (12 months) notice for provenance seed orders
- lack of commercial or other suppliers for the respondent's local area.

Collection and storage difficulties

Tasmanian respondents indicated that they experience more difficulty in collecting than storing seed. In line with national trends, 6% *usually* and 63% *sometimes* have difficulty with collection (see Figure 11) whereas none *usually* and 29% *sometimes* have difficulty with storage (see Figure 12).

Collection difficulties raised by respondents include:

- natural factors such as the height of forest trees, poor seasons, unpredictable seed maturation and sporadic seed set
- logistical difficulties such as access to sites, especially highly diverse sites (access to national parks, government lands, World Heritage areas), timing collection

when seed is mature, and new rules and regulations for contractors

- the 'poor reputation of seed collectors' and their 'unwillingness to collect specific and rare species'
- bureaucratic problems and concerns about current legislation applying to seed collection.

Storage difficulties raised by respondents include:

- loss of seed viability
- attack by vermin, insects and fungal agents
- problems with storage equipment.

The cold conditions in winter are conducive to storage, with the biggest difficulties likely to be in drying seed in higher rainfall areas.



Northern Territory

Biogeographical context

The Northern Territory climate is mostly influenced by the north-west monsoon, with a summer wet season and winter dry season. It may be divided into arid, semi-arid and humid zones. The arid zone includes the whole of the southern half of the Territory to just north of Tennant Creek. The semi-arid zone is between Katherine and Tennant Creek, while the humid zone extends along the coast and southward to about Katherine (see Map 2).

'In general there is a north/south gradation in vegetation, associated with rainfall, from eucalypt to acacia dominated communities and from open forests through woodlands to open shrublands or hummock grasslands' (Wilson et al. 1990).

There has been relatively little change to the natural vegetation as a result of land use and much of the humid zone remains covered in forest or remnant vegetation.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the relatively large area of the territory and the small proportion that is under settlement
- the dominance of pastoral and mining operations as productive land uses
- the large number of species, even entire plant communities, about which we know very little

- the small areas of monsoon forest which contain species with fleshy seed that do not store well, if at all
- the relatively large areas where the original vegetation was scattered trees or shrubs over native grassland (or no trees at all)
- the greatly restricted access resulting from isolation, rugged and difficult terrain, and the wet season – many monsoon forest species set seed just prior to or during the wet season
- difficulties created by the wet season for forecasting seed use and, consequently, collection for predicted demand; planting and sowing is timed to take advantage of the wet season and the harvest of native grass seed also partly depends on a good wet season
- the hot, dry conditions of the central arid areas, which greatly facilitate drying of seed but do not necessarily prolong storage life
- difficult seed drying and storage conditions created by the humid wet season.

Questionnaire response

The response rate to the questionnaire from the Northern Territory was about average (18%) (see Table 1). All of the main operators from each of the commercial, government and community sectors were

either consulted directly, took part in the Darwin or Alice Springs forums, or responded to the questionnaire. The questionnaire response was dominated by 11 government and 6 community respondents of the 18 respondents (see Table 2). In particular, there was a strong response from territory government agencies and botanic gardens.

Seed users

Northern Territory, like Tasmania, has a very small native seed sector catering for the many fewer users of seed (in large quantities) in the territory. Consultation suggested that seed use in the territory follows approximately those trends described nationally and for most other states. Overall, seed use seems much smaller compared to other states, with the exception of seed used for bushfood, which is possibly greater than in other states.

It appeared that the biggest seed users in the territory are mining companies engaged in rehabilitation. It was estimated at the Darwin forum (which included all major seed sector representatives) that in the order of 80% or more of the quantity of seed collected in the territory is used by the mining industry. It was also estimated that mining typically uses 95% trees and shrubs, with about 5% native grasses. It was difficult to establish how much of this seed comes from commercial collectors, contractors or suppliers. The smaller commercial sector in the territory suggests that much less seed is used in mining rehabilitation than in other states.

Following far behind mining, the next major users are the landcare projects of community groups and landholders. These projects involve direct seeding and the use of significant amount of native grass seed. The demand for tubestock seedlings from nurseries for landcare is also greater than for garden and ornamental plants. However, forum participants considered that a large proportion of the seedlings produced by territory nurseries are grown from cuttings rather than seed.

It is difficult to place bushfood seed collection in order of importance by scale of use. It is likely to be a bigger user than landcare projects but not as large as mining use. Much bushfood collection appeared to be carried out by specialist collectors and contractors (or Aboriginal pickers) rather than the mainstream seed merchants.

Seed use by forestry, government agency and roadside revegetation projects is relatively insignificant and related to sporadic project requirements. Outside settled areas, roadsides are often well vegetated in the territory.

These observations are supported by responses to the questionnaire.

Operations

The operations of respondents also generally follow a similar pattern to those in other mainland states. Most respondents collect (94%), clean (89%) and store (78%) seed (see Table 14).

Almost two-thirds of territory respondents dispatch seed to community groups, 39% to farmers and landholders, and 23% to direct seeders. Only 15% of respondents dispatch to local government or commercial and community nurseries (see Table 15). Although territory respondents are more likely to dispatch to community groups, this is a similar distribution pattern to other mainland states.

Territory respondents are just as likely to sell seed but far more likely to distribute seed free than are respondents in other states: 72% distribute free compared to the national average of 35% (see Table 14). This is the reverse of the Tasmanian situation and suggests that most respondents both sell and give away seed. While commercial suppliers clearly sell the bulk of their seed, it is likely that community and government operators sell little and give most seed to users or trade it.

Most (72%) respondents also raise seedlings and substantially more respondents (72%) advise others on the above matters than do respondents in other states. About half

(national average) of the respondents also manage natural regeneration.

The Northern Territory, like South Australia, experiences relatively higher rates of involvement in direct seeding among respondents than occurs in other states (see Table 15). Some 67% of territory respondents carry out direct seeding, compared to the national average of 51%. This is an indication of the number of people carrying out direct seeding rather than the area direct seeded.

Obtaining seed

Apart from collecting seed themselves, territory respondents obtain their seed quite differently from those in other mainland states. They are much more likely to acquire seed for free from collectors or to buy from them than to buy from a seed merchant: 44% obtain seed free from collectors (national average 31%), 28% buy from collectors, and 22% buy from a seed merchant (national average 46%) (see Table 16). Almost 28% also trade goods or services for seed, making them more likely to do so than respondents in any other state (national average 7%).

Though 33% collect *most* and 22% *some* of their seed in the local area, fewer respondents collect *all* of their seed in the local area (17%), and the highest number of respondents from any state collect *none* of their seed in the local area (28%) (see Table 17).

In line with national trends, a large proportion of respondents collect seed from natural bush (33% *all*, 28% *most*). Plantations or plantings are much less used as a source of seed (11% *most*, 17% *some*). Only 6% of territory respondents source any seed from seed orchards or uncertain origins (see Table 17).

A relatively large proportion (11%) of seed comes from outside Australia, which is the highest of any state (see Table 17).

The responses suggested that territory respondents specialise in the vegetation types collected, with a few collecting only native grasses. Respondents in the Northern

Territory are easily the most likely of respondents from any state to obtain no tree, shrub or wetland plant seed (see Table 18). They obtain relatively more native grasses than is typical in other states: 17% of respondents collect *all* (national average 4%) and 22% *mostly* (national average 2%) native grasses in the territory (see Table 18). Fewer appear to collect wetland plant seed than in any other state, with only 39% collecting *some* wetland plant seed.

Some 47% of respondents use propagation material other than seed to propagate native plants and consultation suggested that the amount used may be larger than in other states. In addition, 28% store, sell or distribute these materials, which is the highest handling rate for propagation material other than seed of any state (see Table 19).

Availability of seed

In the Northern Territory the commercial seed sector that supplies mining companies, bushfood and, to some extent, direct seeding operations operates alongside the much smaller community and government suppliers who distribute seed freely to users in landcare and to landholders. By quantity, much of the latter is native grass seed distributed to a small number of pastoralists.

Commercial seed merchants, particularly in the arid zone, considered that supplying native seed is only marginally profitable to uneconomic in the Territory. They reported that there is simply not enough demand for native seed, that it is often erratic, that collection costs are high and most orders are small.

Demand is widely considered to have been steady or marginally increasing over the last 10 years, with the most notable increases coming from community groups involved in landcare and from bushfood users. Although there has always been demand for native grass seed, it has increased over the last 3 or 4 years. A small number of pastoralists are collecting native grass seed themselves and are not seen as a key market for commercial suppliers.

The Northern Territory is unique in having large numbers of highly skilled Aboriginal pickers available to undertake picking by hand. Mining companies are reportedly reluctant to tender for collect and supply rehabilitation contracts because there are not the commercial operators to vie for such contracts. Some negotiate arrangements for Aboriginal pickers (or Australian Trust for Conservation Volunteers) to collect for rehabilitation operations and so establish self-sufficiency in seed supply. Aboriginal pickers also figure prominently in the collection of bushfood such as *Acacia victoriaii*.

Bushfires (many deliberately lit) in the Northern Territory were widely regarded as clashing with seed collection, often resulting in lack of available local provenance seed for projects in areas where bushfires are prevalent. Fuel reduction burning regimes also came in for criticism, although these may be less damaging to the seed resource.

Looking at all questionnaire responses for the Northern Territory, the average respondent collected 228 kilograms, stored 124 kilograms and dispatched 231 kilograms of seed in the last year (see Table 20).

The average community sector operator collected (538 kilograms), stored (163 kilograms) and dispatched (402 kilograms) a considerably greater quantity of seed, although no greater number of species, than was the case in any other state. It was also equal to the commercial sector and considerably more than the government sector in the territory. These community sector averages are the result of the comparatively large native grass seed operations conducted by community respondents in what is a small number of responses.

A lot of seed that would be useful in community revegetation work is not collected in the Territory. A large number of species, let alone indigenous species, are untried. With such a small commercial sector, it is unlikely that the supply of indigenous seed will be economic over large areas of the territory. If people are to be encouraged to use a greater variety of seed in revegetation projects, then there is a

considerable effort required to make that seed available or to assist the community to collect the seed themselves.

Quality of seed

The Northern Territory experiences problems in seed collection and storage in common with Queensland and northern Western Australia. Climatic conditions are not conducive to maintaining quality in collection or storage practice. These difficulties begin with the remote, harsh and difficult climate and natural environment in which seed is collected. It is difficult to time collection so there will be a tendency to collect immature seed. It is difficult to dry seed in the humid north and refrigerated storage can be costly in the high heat – refrigerator compressors burn out and power cuts leave stock quickly vulnerable. There are considerable complexities in monitoring quality and understanding viability in such diverse and poorly understood vegetation communities as those in the territory.

Lack of knowledge about seed from the vegetation affects any assessment of physical seed quality. Seed viability and expected germination rates are not known for many species. In some cases, the difficulties presented are easily overcome, for example, by sending seed of rainforest (or other) species that do not store well straight from collector to grower. However, other difficulties present a series of obstacles that require high levels of training and knowledge to overcome and are a considerable deterrent for newcomers.

Availability of indigenous seed

The Darwin forum noted that very few seed users specified provenance of seed up until the last 2 years. Like Tasmanians and Queenslanders, territory respondents are more likely to experience difficulty in obtaining seed of the correct provenance for use in their area: 21% *usually* and 64% *sometimes* experience such difficulty (see Figure 9). As in Tasmania, no respondents *never* experience difficulty.

Slightly more than 44% of respondents also indicated that commercial suppliers *rarely* and 11% *never* provide sufficient information about the origins of seed (see Figure 10). This is more like the response in other mainland states, rather than the unique situation in Tasmania.

Common problems identified by respondents in obtaining seed of the right provenance for use in the local area are:

- availability of seed is very dependent on seasonal factors (rain), bushfire and predation by fauna
- lack of commercial or other suppliers for the respondent's local area
- lack of people, resources and expertise
- restrictions on access to parks and Aboriginal lands.

Collection and storage difficulties

More territory respondents experience difficulty in collecting seed than elsewhere in Australia: 24% *usually* compared to the national average of 10% (see Figure 11). Similarly, more territory respondents also indicated greater difficulty in storing seed: 14% *usually* and 50% *sometimes*, compared to the national average of 3% and 39% respectively (see Figure 12).

Collection difficulties raised by respondents are very similar to those difficulties experienced in obtaining local indigenous seed, for example:

- the combination of natural factors such as lack of rain, unpredictable seed maturation and timing, heavy predation by birds and loss to bushfires
- logistical difficulties, in particular, mobilising sufficient people and resources to gather seed, and accumulating the technical expertise and competence to undertake the task.

During the forums in Alice Springs and Darwin, and in other consultations, some commented on the considerable deterrent that royalties charged by the Northern Territory Government on seed collected present to commercial collection. Many felt

that the royalties are unrealistically high or inappropriate and push otherwise lawful collectors into unlawful practice. They cited the limited demand and poor profit margin for seed collection in the territory, and the small impact of seed collection on the natural resource. They argued that the small monies collected pay for administration of the system only and are counter-productive.

The fuel reduction burning program of the Bushfires Council was also frequently criticised for the degree of burning. Some areas are continuously burnt, leaving little or no seed available for harvest and very probably affecting the long-term biodiversity of these environments.

Storage difficulties raised by respondents include:

- the loss of seed viability and the short shelf life of many species in storage
- attack by vermin, insects and fungal agents
- lack of available storage facilities and problems with storage equipment
- understanding the technical aspects of storage and overcoming problems with temperature and humidity.



Queensland

Biogeographical context

Queensland is a diverse area in landform, climate, settlement pattern and land use (see Map 2). Over large areas of Queensland (especially northern and coastal areas), natural vegetation cover is more extensive, species diversity is often higher, and natural regeneration rates are greater than in Australia's temperate areas. This diversity is reflected in differing stewardship of land and differing approaches to landcare and revegetation in Queensland, including the use of native plant seed. There are important characteristics of native vegetation in Queensland (as with parts of the Northern Territory and Western Australia) that present complications for collection and storage of seed that are not generally present in temperate areas of Australia.

Perhaps the most significant biogeographical features for seed collection and storage are:

- the large number of humid zone species that do not store well, if at all
- the large number of species, even entire plant communities, about which we know very little – distribution of the species, natural seed viability, storage practices, how to germinate, recognition of provenances
- some entire plant communities (eg, brigalow) contain few of the common (eucalypts and acacias) species that are the mainstay of seed used in other areas
- the relatively large areas where the original vegetation was scattered trees or shrubs over native grassland (or no trees at all)
- the hot, dry conditions of the central arid areas, which greatly facilitate drying of seed but do not necessarily prolong storage life

- greatly restricted access resulting from isolation, rugged and difficult terrain, wet season seed set, and so on.
- difficult seed drying and storage conditions created by humid wet season conditions.

Questionnaire response

The response to the questionnaire from Queensland was one of the highest of all the states (see Table 1). Respondents were well spread across commercial (17), community (33) and government (12) sectors and across most categories within these (see Table 2). Of note was the relatively large response from mining (9), non-government organisations (9) and community groups (12). However, there were fewer responses than might be expected from commercial seed suppliers (3) and landcare or catchment management groups (6).

Seed users

Consultation suggested that the biggest seed users in Queensland are mining companies engaged in rehabilitation. Perhaps 80% or more of the quantity of seed collected in Queensland is used by the mining industry, and almost all of this seed would come from commercial collectors or suppliers.

Indications are that mining sector seed use will increase further in the near future, with mines in the large Bowen Basin coalfield now ending productive life and scheduled for rehabilitation.

Following mining, the other major users are government agency and roadside revegetation projects, landcare and community revegetation projects, forestry and agroforestry.

A forum of key people involved with seed in Brisbane considered that roadside revegetation in Queensland occurs on a much smaller scale than in New South

Wales. The very small number of questionnaire respondents (3.6%) who indicated that a majority of their seed is dispatched to state government supports this observation (see Table 15).

The Brisbane forum also indicated that landcare groups and individual landowners are much smaller users of native seed by quantity than in other states.

Other notable users are bushfood operations and native grass seed for use in pasture establishment. Fox Tail Palm seed and Black Bean seed are two recent examples of fleeting but considerable demand for particular species.

Operations

Most Queensland respondents collect seed (80%) though relatively fewer respondents than in other states clean (54%) or store seed (59%) (see Table 14).

The survey response provides an indication of where the majority of seed collected outside of the commercial native seed industry is dispatched. Almost 54% of Queensland respondents dispatch seed to community groups, 36% to farmers and landholders, 18% to local government and 14% equally to community and commercial nurseries (see Table 15).

Queensland respondents, like those in most states, are far more likely to distribute seed for free (33%) than to sell it (4.9%) (see Table 14).

Many respondents (77%) also raise native seedlings from seed.

Fewer respondents (51%) than in other states advise others on the above matters.

Many respondents are also involved in replanting using native seedlings (75%) and about half manage natural regeneration.

The 41% of respondents who carry out direct seeding is a little less than the national average of 51%. Consultation indicated that most seed is currently going to nursery production of seedling stock and much less to direct seeding, but that this situation is rapidly changing. For example, a big increase

in direct seeding over the last 3 years is reported by Greening Australia Queensland. Greening Australia estimates a 10-fold increase in direct seeding through its West End Office in Brisbane, going mostly to local councils and large companies rather than landholders in rural areas (G. Borschmann, pers. comm.).

About 53% of respondents use propagation material other than seed to propagate native plants, but consultation did not confirm the amount used. As in the Northern Territory, it may be higher than for other states because of the propagation of tropical species. Some 16% store, sell or distribute these materials, which is about the national average for handling propagation material other than seed (see Table 19).

Obtaining seed

Apart from collecting seed themselves, Queensland respondents are equally likely to obtain seed free from collectors (44%) as to buy it from a seed merchant (43%) (see Table 16). These figures and other data on seed acquisition for Queensland respondents are close to national averages.

About one-third of respondents collected *all*, *most* or *some* of their seed in their local area (see Table 17).

Respondent seed collectors collect *all*, *most* or *some* of their seed across all broad vegetation types (tree, shrub, wetland and grass species) at about national average rates (see Table 18).

Similarly, 25% acquire *all* and 34% *most* seed from natural bush (see Table 17). Very few respondents acquire any seed from other sources, with 2% acquiring *most* and 41% *some* seed from plantations or plantings. Only 8% obtain *some* seed from seed orchards.

Availability of seed

The commercial seed merchants and collectors supply most of the seed used in Queensland, mainly to mining companies for rehabilitation. The Centre for Mined Land Rehabilitation at the University of

Queensland estimates that few mining companies collect their own seed, most preferring to buy through seed merchants (S. Bellairs, pers. comm.). However, there appear to be fewer commercial seed suppliers in Queensland compared to other parts of Australia. Seed suppliers based in Western Australian are reportedly winning tenders to collect and supply seed for mine site rehabilitation in Queensland.

The Department of Primary Industries and Forestry is the largest of the state government seed operations. The department now sells seed on a fully commercial basis through centres such as its Beerwah Forestry Centre. It is expanding into the mining and rehabilitation industry based on foundation sales (to forestry, nurseries and the general public) and marketing of quality in seed.

Native seed collection is not new to the Queensland community but the scale of collection and storage in the community is much smaller than in other states. It supplies nursery propagation rather than direct seeding operations.

Looking at all questionnaire responses in Queensland, the average respondent collected 201 kilograms, stored 212 kilograms, and dispatched 319 kilograms of seed in the last year (see Table 20).

Commercial and government sector operations collect and store much larger quantities of seed, on average, than do their counterparts in the community sector. In the last year the average community sector operator collected, stored and dispatched considerably smaller quantities of seed than respondents in most other states, with 7 kilograms collected (national average 148 kilograms), 5 kilograms stored (national average 491 kilograms) and 7 kilograms dispatched (national average 273 kilograms) (see Table 20).

Despite the small quantities of seed handled, the number of species collected, stored and distributed was about average nationally.

Quality of seed

There is a different attitude to seed quality and provenance issues in Queensland due, in large part, to the diverse mosaic of the vegetation. Although all would recognise the importance of seed quality and provenance, many point to the complexities of monitoring quality and understanding provenance in such diverse vegetation communities as are present in Queensland.

Lack of knowledge about seed from the vegetation of Queensland (as in the Northern Territory) affects any assessment of physical seed quality. Seed viability and expected germination rates are not known for many species. This is an important issue for all seed users and suppliers. A seed testing laboratory reported that much seed submitted to their laboratory had been incorrectly harvested.

In some cases the difficulties presented are easily overcome, for example, by sending seed of rainforest (or other) species that do not store well straight from collector to grower. However, other difficulties present a series of obstacles that require high levels of training and knowledge to overcome and are a considerable deterrent for newcomers.

Availability of indigenous seed

There were mixed opinions on the current demand for provenance seed and whether this aspect of demand is increasing.

During consultation some seed users reported frustrations with Queensland seed suppliers, resulting in the need to source seed from interstate, and therefore obviously outside of provenance considerations. It was reported, for example, that even in south-east Queensland commercial nurseries cannot supply enough plants of the right provenance. Greening Australia is currently trying to establish a seedbank network for greater Brisbane, concentrating on targeting revegetation with local provenance species in the community arena.

In rural Queensland, users commented that local seed is not available commercially or is in very limited supply.

The questionnaire responses supported these observations, with 19% of respondents *usually* and 50% *sometimes* experiencing difficulty in obtaining seed of the right provenance for use in their local area. These are only slightly above average figures nationally. However, in addition, 9% of respondents *never* experience difficulty, a comparatively lower number than for other states (see Figure 9).

Respondents also indicated that in Queensland, commercial suppliers do not provide information about the origins of seed as readily as in other states. With the largest number of respondents from all states, 35% consider that commercial suppliers *never* and 27% *rarely* provide sufficient information about the origins of seed bought (see Figure 10).

Small commercial seed merchants cannot afford to collect seed widely from across Queensland. Large commercial operators rely on easy picking and common species to cross-subsidise collection of the difficult or obscure species. Seed merchants complained that seed users cannot expect local seed orders to be met from stock, but that these orders could be filled if only sufficient lead-time were given for collections to be made. Education of purchasers is for them a key issue in promoting more advance planning for seed collection.

Collection and storage difficulties

Queensland experiences problems in seed collection and storage in common with the Northern Territory and northern Western Australia. Climatic conditions are not conducive to maintaining quality in collection or storage practice. There are also similar and considerable complexities in monitoring quality and understanding viability in the very diverse and poorly understood vegetation communities of Queensland.

Responses indicated that Queenslanders are generally more confident of storage than collection of seed. In line with national trends, 12% of respondents *usually* and 53% *sometimes* experience difficulty in collecting

seed (see Figure 11). Also in line with national trends, 2.5% of respondents *usually* and 43% *sometimes* experience difficulty in storing seed (see Figure 12). However, only in New South Wales did fewer respondents *never* experience difficulty with storage.

Collection difficulties include:

- natural factors such as the height of forest trees, poor seasons, unpredictable seed maturation, and sporadic seed set
- logistical difficulties such as access to sites, especially highly diverse sites, available time to collect, making sure that seed is collected before vegetation is cleared, and insufficient supply of endemic (local) seed
- lack of information, especially viability and germination information for species.

Many commented on bureaucratic problems and concerns about current legislation applying to seed collection (*Nature Conservation Act 1992*) in Queensland. Participants in the Brisbane and Rockhampton forums commented that there were too few checks in place on seed collection and use in Queensland. The Department of Environment manages a system under the Nature Conservation Act that protects 'protected' flora (1,200 plants) by requiring that a permit be granted for a person wishing to take seed from protected plants in the wild. A further permit is required to take or sell (trade for commerce, including barter and exchange) seed from some 300 'restricted' plants of the 1,200 protected plants.

The forums and questionnaire responses indicated that there are problems for seed collectors with this system, including:

- constant changes to schedules
- difficulties in understanding and interpreting such legislation in the field
- correct identification of species
- incorrect or aberrant listings of species in their region.

Some community collectors commented that they have stopped collecting because of these difficulties.

Common difficulties raised with storage include:

- loss of seed viability
- attack by insects and fungal agents

- storage of difficult (recalcitrant) seed.

The difficulties of dealing with high humidity were raised and, linked to this, the need for reliable cold storage facilities.



Western Australia

Biogeographical context

Western Australia, like Queensland, is a large land area with diverse landforms, climate, settlement pattern and land use. Over large areas of the north-west, Kimberley and Gascoyne regions, natural vegetation cover is more extensive, species diversity is often higher, and natural regeneration rates are greater than in arid areas. The climate varies from high winter rainfall and dry summers in the south-west corner to the semi-arid wheatbelt with its winter rain, the arid rangelands, and the semi-arid and moist tropical Kimberley region (see Map 2).

In general, there is a south to north gradation in vegetation associated with rainfall – open sclerophyll forests in the south-west through woodlands to mallee scrub in the wheatbelt, mulga, and then spinifex and desert communities. There has been great change to the natural vegetation as a result of land use.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the relatively large area of the state and the small proportion that is under settlement
- the dominance of agricultural, pastoral and mining operations as productive land uses
- the relatively large areas where the original vegetation was scattered trees or shrubs over native grassland (or no trees at all)
- the large number of species about which we know very little – distribution of the species, natural seed viability, storage

practices, how to germinate, recognition of provenances

- greatly restricted access resulting from distance, isolation, rugged and difficult terrain, wet season seed set, and so on
- complications caused by the wet season in the north
- the large number of humid zone species that do not store well, if at all
- hot, dry conditions of the central arid areas which greatly facilitate drying of seed but do not necessarily prolong storage life.

Questionnaire response

The response rate to the questionnaire from Western Australia was about average (19%) (see Table 1). Many of the main operators from each of the commercial, government and community sectors were either consulted directly or responded to the questionnaire. A week of direct consultation with operators, groups and merchants was undertaken, but a forum similar to those in Brisbane, Darwin and Hobart was not held. The 47 questionnaire responses included 10 from the government sector, 23 from the community and 14 from the commercial sector. In particular, there was a strong response from community and landcare or catchment management groups, and from state government.

Seed users

Western Australia has a large native seed sector catering for the many seed users (in large quantities) in the state, interstate and internationally. Consultation suggested that

seed use in Western Australia follows trends described nationally and for most other states. The biggest seed users are large compared to other states such as the Northern Territory and South Australia. The quantity of native seed collected and stored in Western Australia is very probably higher than in any other state.

The biggest seed users in Western Australia are mining companies engaged in rehabilitation. It was estimated by commercial seed merchants and other suppliers that in the order of 70% to 80% of the quantity of seed collected in Western Australia is used by the mining industry, and almost all of this seed would come from commercial collectors or suppliers.

Perhaps 15% of the remaining seed is used in the landcare and revegetation projects of community groups and landholders. These projects involve direct seeding and the use of large numbers of tubestock from nurseries specifically catering to this market.

The remainder is probably equally divided between seed use for forestry (7%) and the revegetation projects of government agencies on reserves and roadsides (7%). Supply to nurseries and other minor uses account for about 1%.

It is again difficult to place bushfood seed collection in order of importance by scale of use. It is likely to be a user on a scale similar to forestry.

Operations

The activities of respondents follow a similar pattern to those in other mainland states. Most respondents collect (91%), clean (64%) and store (64%) seed (see Table 14).

About one-third of respondents dispatch seed to community groups and farmers and landholders, 26% to direct seeders, 23% to local government, and between 10% and 16% to commercial and community nurseries, state government and seed merchants (see Table 15).

Respondents are about equally likely to sell seed as to distribute seed free, with 24%

selling seed and distributing seed for free (see Table 14).

Slightly more than 64% of respondents raise native seedlings from seed.

Many respondents (60%) advise others on the above matters.

About 67% of respondents are also involved in replanting using native seedlings and 60% manage natural regeneration. Western Australia experiences a relatively high rate (64%) of involvement in direct seeding, compared to the national average of 51%.

Only 39% of respondents use propagation material other than seed to propagate native plants, which is the lowest of any state. Some 11% store, sell or distribute these materials, which is also less than the national average for handling propagation material other than seed (see Table 19).

Obtaining seed

Apart from collecting seed themselves, respondents in Western Australia (like those in Tasmania) are more likely to buy from a seed merchant (58%) and less likely to acquire seed for free from collectors (18%) than in other states (national average 46% and 31% respectively). Some 24% of respondents also buy from collectors and none trade goods or services for seed (see Table 16).

A relatively high proportion of respondents (45%) collect *all* their seed in the local area, as is the case in South Australia and Victoria. Only 5% collect *no* seed in the local area – the lowest number of any state. A further 34% indicated that they collect *most* and 16% *some* of their seed in the local area (see Table 17).

Respondent seed collectors collect *all*, *most* or *some* of their seed across all broad vegetation types (tree, shrub, wetland and grass species) at about national average rates (see Table 18). Specialisation appeared to exist among collectors, with more respondents indicating they collect *all* or *most* seed from low shrubs and wetland plants than in other states. Relatively less native grasses may be collected than is typical

in other states, with 64% of respondents collecting *no* native grasses, more than in any other state (national average 39%) (see Table 18).

In line with the national averages, 30% of respondents acquire *all* and 43% *most* seed from natural bush, and 5% acquire *most* and 36% *some* seed from plantations or plantings. However, as in Queensland and South Australia, 23% obtain *some* seed from seed orchards, which is more than in other states (see Table 17).

Availability of seed

In Western Australia, supply and demand are complicated by the number of active users and suppliers in the market and the variety of uses for which native seed is sourced. The scale of mining industry projects generally means that operators in the large commercial seed sector tender for competitive contracts and meet company requirements for rehabilitation seed. This also makes surplus seed available for wider use.

All report a trend for increasing sophistication and increasing requirements for indigenous seed in the collect and supply contracts let by mining companies. None of those consulted considered that supplying native seed is only marginally profitable to uneconomic as it is considered in the Northern Territory. Indeed, Western Australian commercial seed suppliers tender for contracts across Australia and are some of the biggest suppliers in the country.

Demand is widely considered to have been steadily increasing across all users over the last 10 years. The trend in mining demand varies regionally with the proximity of mining, the number of open cut compared to underground mines, and their rehabilitation practices. Federal government funding programs generate demand by stimulating the revegetation activities of community groups and landholders. Commercial suppliers commented that there is never enough lead-time to collect seed for these programs, even though they can usually afford to purchase their seed requirements.

Commercial suppliers also commented that more and more community groups and landholders are collecting their own seed. There were mixed opinions about the impact of increasing capacity to collect seed in the community. Some commercial suppliers are reluctant to lose market share to anyone, while others agreed with the notion that community seedbanks will very likely increase demand yet further. Increasing capacity for community collection directly affects demand in regional areas. It may erode the commercial viability of supplying seed to regional areas and, in turn, the availability of seed. This is especially the case where mining rehabilitation activity or other commercial markets are not present in a region to stimulate collection and make local indigenous seed more available.

Community seed collection seems mostly to target increased availability of a greater range of species and, in particular, of species local to the area for use in revegetation work. The commercial suppliers, on the other hand, seem to be more concerned with supplying larger quantities of common species used more in revegetation.

Seed was generally considered to be available in the bush but concerns were widely expressed about restrictions on access to the seed. In some areas the seed resource is too badly degraded to support viable collection, because, for example, pollinators or understorey species are absent or plants are under too much pressure from land use.

Looking at all the questionnaire responses in Western Australia, the average respondent collected 176 kilograms, stored 279 kilograms and dispatched 285 kilograms of seed in the last year (see Table 20).

Community and government sector operators collected, stored and distributed much less than these average figures, which are weighted heavily by the response from the commercial sector.

Community sector respondents, on average, collected 7 kilograms, stored 5 kilograms and dispatched 6 kilograms. The lesser role of the community sector is similar across Australia, although quantities of seed handled are even smaller in the west than in other states

(except Tasmania and Queensland). Again, the comparison is not the same for numbers of species, which are about equal to those collected and distributed by the government sector.

Quality of seed

In common with Queensland and the Northern Territory, the humid northern parts of Western Australia experience climatic conditions that are not conducive to maintaining quality in collection or storage practice. These difficulties were discussed for the Territory and Queensland, but apply equally to the north of Western Australia.

Lack of knowledge about seed from the vegetation affects any assessment of physical seed quality. Seed viability and expected germination rates are not known for many species in the highly diverse vegetation communities of Western Australia. These difficulties present a series of obstacles that require high levels of training and knowledge to overcome, and are a considerable deterrent for newcomers.

There were reports that mining companies are increasingly demanding higher quality seed and an upfront guarantee of seed viability in collect and supply contracts. Some government agencies have adopted similarly strict tender requirements and very narrow views of provenance (local) collection requirements. This market pressure helps keep the general quality of seed high and favours the larger commercial suppliers who market on quality and consistency over weekend collectors and those who cut corners to gain contracts.

Several commercial suppliers commented that the expectations of some government agencies are highly unrealistic and uneconomic in relation to provenance. It is also increasingly difficult for smaller operators to remain competitive where guaranteed viability is required.

Availability of indigenous seed

Only a fraction of the biodiversity of Western Australia (12,540 species at last census) is included in revegetation work. A

large number of species are untried. A lot of seed that would be useful in community revegetation work is not collected in Western Australia.

On the surface, the data in Table 20 imply that the community sector is not yet supplying the range of species offered by the commercial sector. However, a high proportion of community operators are collecting and supplying seed of 30 to 45 *local* species. Viewed as a whole, this contributes greatly to the diversity of species available to the local community. Conversely, the 175 to 200 species dispatched, on average, by the relatively fewer commercial suppliers may or may not make available indigenous species in a particular region. Much depends on where these species were collected.

Despite the larger seed sector in Western Australia, no fewer respondents indicated that they experience difficulty in obtaining local indigenous seed than did respondents in other states, with 16% *usually* and 39% *sometimes* having difficulty (see Figure 9).

Respondents were somewhat polarised, although generally favourable, in their assessment of the adequacy of information about seed provided by commercial suppliers. In common with Tasmanian respondents, 57% of respondents consider that commercial suppliers *usually* and 11% that commercial suppliers *sometimes* provide sufficient information about the origins of seed. Unlike Tasmanian respondents, 22% of respondents consider that commercial suppliers *rarely* and 11% that commercial suppliers *never* provide such information (see Figure 10).

Common problems identified by respondents in obtaining seed of the right provenance for use in the local area are:

- seed of local species is often unavailable in the small amounts often required
- community groups often lack people, resources and expertise, or do not have the time to collect
- the availability of seed is very dependent on seasonal factors and their impact on seed set and maturation

- the difficulty and complexity in obtaining permission from authorities (eg, Department of Conservation)
 - restrictions on access to parks and Department of Conservation and Land Management lands, especially where local provenance seed is otherwise difficult or impossible to source
 - lack of understanding of the concept of provenance and more work needed to determine 'correct' provenance
 - plant populations in some areas (eg, the wheatbelt) are very fragmented and often too small to collect from, or seed is no longer viable.
- reserves) in otherwise poorer areas, and timing collection when seed is mature
 - bureaucratic problems and concerns about requirement for permits to collect in state forests
 - difficulties in mobilising sufficient people and resources to gather seed and having the technical expertise and competence to undertake the task
 - the ever-changing taxonomy of plants and the need for publicly accessible updates.

Storage difficulties raised by respondents include:

- the loss of seed viability and the short shelf life of many species in storage
- attack by vermin, insects and fungal agents
- lack of available storage facilities and problems with storage equipment
- understanding technical aspects of storage and overcoming problems with temperature and humidity.

Collection and storage difficulties

Western Australian respondents experience less difficulty collecting seed than those in other states. Only 2.5% of respondents *usually* and 58% *sometimes* experience difficulty in collecting seed and 15% *never* do (see Figure 11). However, respondents were close to average nationally in the difficulty they experience in storing seed. This suggests that Western Australians are generally more confident of collection than storage of seed and more confident of collection than their counterparts elsewhere in Australia.

Collection difficulties raised by the one-third of respondents who experience them are similar to those experienced in obtaining provenance seed and include:

- Obtaining viable seed on any regular basis is hampered by the combination of natural factors such as:
 - lack of rain, poor seasons
 - unpredictable seed maturation and sporadic seed set
 - high levels of seed predation by insects before seed is mature
 - height of seed in trees
 - poor natural seed viability
- logistical difficulties such as access to sites, especially highly diverse sites (access to national parks, government lands,



South Australia

Biogeographical context

Much of South Australia is arid or semi-arid and experiences hot, dry summers and winter rains (see Map 2). Only a few per cent of the natural vegetation that existed prior to settlement remains. There are a number of zoning systems for vegetation currently in use in the state, and the flora is well described in comparison to other states. These zoning systems generally recognise a pastoral region (although some subdivide this region further) covering the northern two-thirds of the state, including the Nullarbor, Lake Eyre, salt lake country and deserts. In the southern third of the state the Yorke and Eyre Peninsulas are one region, as are the Flinders Ranges, Northern Lofty Ranges, Adelaide and its hills, and Kangaroo Island. The south-east is generally divided north and south. The coastal influence promotes vegetation growth over many of these southern regions.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the relatively small area of the state that is well vegetated and the small proportion that is under settlement
- the dominance of pastoral and agricultural operations, and urban areas as the major land uses
- the hot, dry conditions of the central arid areas, which greatly facilitate drying of seed but do not necessarily prolong storage life
- the ready availability of seed of a core group of species for revegetation in most areas
- the comparatively good knowledge and understanding of the vegetation in South Australia
- the relatively large areas where the original vegetation was scattered trees or

shrubs over native grassland (or no trees at all)

- the important role of roadside and remnant vegetation as a seed source.

Questionnaire response

The response rate to the questionnaire from South Australia was about average (21%) (see Table 1). Most of the main operators from each of the commercial, government and community sectors were either consulted directly or responded to the questionnaire. The questionnaire response was dominated by 31 community respondents out of 44, compared to 8 commercial and 5 government sector responses. In particular, there was a strong response from community groups, catchment management groups and landcare groups (24 respondents) (see Table 2).

Seed users

South Australia has a small self-reliant native seed sector catering for relatively fewer users of seed in large quantities than in most other states. Demand is supplied locally by a small group of seed merchants located around the state and operating mostly from home. Revegetation is comparatively well promoted and the revegetation industry well organised in the state. The native seed sector largely caters for nursery propagation of seedlings and tubestock rather than direct seeding, although this situation is rapidly changing due to the promotion of direct seeding and development of techniques in recent years.

Consultation suggested that seed use in South Australia is very different to that described nationally and for most other states. Rather than mining, the biggest seed user in South Australia is likely to be the bushfood industry – although details of the amounts harvested are sketchy. Much of this appeared to be collected by contractors who

specialise in this area, rather than the mainstream seed merchants. A number of those consulted reported that bushfood harvesting contracts for 1 or 2 tonnes are frequent, if not common, making the total amount harvested very likely to exceed that of the second major user – the landcare and revegetation activities of landcare groups, landholders and government agencies.

Combined, these revegetation activities would account for about two-thirds of seed used outside of bushfood operations. They use large numbers of tubestock, far more than are used, for example, by nurseries to supply demand for garden and ornamental plants. For example, Trees for Life is a major non-profit group dedicated to revegetating South Australia. They mobilise the community to raise seedlings, which are planted in all areas of the state – over 16 million seedlings to date. It was estimated during consultation that Trees for Life produces 1 to 1.5 million seedlings per year, slightly more than the state Flora Scheme (1 million for general use and 1 million for forestry) and all other nurseries combined (perhaps another 1 million seedlings). The State Flora Centres at Bellair and Murray Bridge are run by Primary Industries South Australia and provide quality seedlings cheaply to growers.

Direct seeding has also become a major technique for landcare revegetation activities and is quickly becoming a large user of seed.

The remaining one-third of seed goes mostly on roadside rehabilitation undertaken by the Department of Transport and by local councils. Following far behind in terms of quantity used are forestry operations. Forestry, with its demand for a few commercially important species, contrasts with landcare, for which a much larger range of species is in demand.

Demand from mining is comparatively insignificant and arises to meet sporadic rehabilitation requirements of the few mining projects operating mostly in the pastoral areas of the state.

Questionnaire results tended to support the above observations about relative seed use.

Operations

The operations of respondents follow a similar pattern to those in other mainland states. Most questionnaire respondents collect (88%), clean (63%) and store (78%) seed (see Table 14).

Some 46% of South Australian respondents dispatch seed to community groups, 43% to farmers and landholders, 25% to state government and 21% to direct seeders, community seedbanks and nurseries and propagators (see Table 15). Of much less significance are community nurseries, seed merchants and local government. This is a quite different distribution pattern to those of other states and is an indication of the differences in not only the respondents but also the seed sector in South Australia.

Respondents were more likely to distribute seed for free (44%) than in most states and much more likely to do so than to sell seed (15%) (Table 14).

About 85% of respondents raise native seedlings from seed, which is the most respondents of any state.

About half of the respondents (51%) advise others on the above matters.

More respondents in South Australia are involved widely in revegetation activities than in any other state. In addition to those who raise seedlings from seed, 83% replant using native seedlings, 76% manage natural regeneration and 68% carry out direct seeding. These are all higher figures than for other states or national averages (see Table 14).

Some 61% of respondents use propagation material other than seed to propagate native plants, which is second only to the rate for Victoria. However, the amount used is likely to be small and restricted to those species which do not propagate well from seed. About 12% store, sell or distribute these materials, which is about the national average for handling propagation material other than seed (see Table 19).

Obtaining seed

Apart from collecting seed themselves, respondents in South Australia are more likely to buy seed from seed merchants (48%) or from collectors (35%) than to obtain it for free from collectors (30%) (see Table 16).

As in Western Australia and Victoria, a relatively high proportion of respondents (45%) collect *all* of their seed in the local area. Only 10% collect *no* seed in the local area and 23% indicated that they collect *most* or *some* of their seed in the local area (see Table 17).

Respondents collect *all*, *most* or *some* of their seed across all broad vegetation types (tree, shrub, wetland and grass species) at generally higher than national average rates (see Table 18). Specialisation appeared to exist among collectors, with more respondents indicating that they collect *all* or *most* seed from trees, tall shrubs and low shrubs than collectors in other states. Slightly more respondents collect native grasses (8% *all*, 3% *most*) than wetland plants (5% *all*, 0% *most*) although more respondents collect these vegetation types than respondents in most other states (see Table 18).

In line with the national averages, 38% of respondents acquire *all* and 33% *most* of their seed from natural bush, 3% acquire *all* and 33% *some* of their seed from plantations or plantings. More seed is obtained from seed orchards than in most other states, with 3% obtaining *most* and 26% obtaining *some* seed from seed orchards (see Table 17).

Availability of seed

Demand is widely considered to have been steadily increasing in landcare, revegetation and bushfood over the last 10 years. The demand for seed for revegetation work by community groups and landholders in large part arises through federal government funding programs. Suppliers reported that there is never enough lead-time to collect seed for these programs, even though they can usually afford to purchase their seed requirements.

Roadside and reserve rehabilitation is a product of changing attitudes and policy in government.

More community groups and landholders were reported to be collecting their own seed. Community seed collection seems mostly to target increased availability of a greater range of species or of species local to the area for use in revegetation work. This is also an important market for commercial suppliers. In South Australia, more so than in other states, community collection takes market share and directly affects the commercial sector – for whom landcare is the main market.

Those commercial suppliers consulted were not concerned (most encouraged) at the prospect of increasing capacity to collect seed in the community, and considered that community seedbanks will very likely increase demand yet further through wider community education and awareness. However, some argue that there is a point at which the scale of community collection begins to erode the commercial viability of supplying seed to regional areas. Others argued that government support for community collection operations should be conditional on there being no current commercial supplier providing indigenous seed in the region.

Seed was generally considered to be available in the bush, but this is related to demand. There are always a few species in poor supply in every area. Concerns were expressed about the availability of many species around Adelaide and the Adelaide Hills. In some rural areas the seed resource is too badly degraded to support viable collection because, for example, pollinators or understory species are absent, or plants are under too much pressure from land use.

Increased direct seeding is likely to escalate the demand for seed in coming years, but those consulted thought that planning ahead for seed needs should enable demand to be met from the resource. Seed production areas were raised by some as an important means of guaranteeing supply of seed, especially of those few species that are usually difficult to obtain in the bush.

Looking at all questionnaire responses from South Australia, the average respondent collected 114 kilograms, and stored and dispatched 268 kilograms of seed in the last year (see Table 20).

The community and government sector operators collected, stored and distributed much less than these average figures, which are weighted heavily by responses from the commercial sector. In South Australia, community sector respondents, on average, collected 12 kilograms, stored 53 kilograms and dispatched 7 kilograms, making it the smallest sector in quantity terms. However, in South Australia, the average community operator collects (94) and distributes (232) a greater number of species than their counterparts in most states and the national averages (see Table 20). Each of these community operators, on average, collects and distributes 100 to 230 predominantly local species.

Quality of seed

There were no specific problems or concerns expressed about physical or genetic quality of seed, however, there were concerns expressed about seed provenance.

Availability of indigenous seed

All respondents reported a trend for much greater emphasis on provenance and the use of understorey species over the last 10 years. The State Flora Centre is currently not able to satisfy demand for tubestock of understorey species (Phil Collins, pers. comm.). There is an increasing trend for community groups and individuals to specify local collection and to regard seed from outside the local area as a poor substitute, if not of poorer quality.

Several commercial suppliers commented that the expectations of some government agencies are highly unrealistic and uneconomic in relation to provenance.

South Australia, Victoria and Western Australia are easier states in which to obtain local provenance seed than others. Only 5% of respondents indicated that they *usually* (national average 15%) and 30% *sometimes*

(national average 43%) had difficulty in obtaining local provenance seed. Some 43% indicated that they *rarely* and 22% *never* experience difficulty in obtaining seed of the right provenance for use in their local area (see Figure 9).

In addition, about 48% of respondents considered that commercial suppliers *usually* and only 7% *never* provide sufficient information about the origins of seed (only in Tasmania and Western Australia were figures better) (see Figure 10).

Common problems identified by respondents in obtaining seed of the right provenance for use in the local area were somewhat unique to the South Australian situation. There was a general trend to report difficulties more in urban than in country areas, and for difficult, rare or limited vegetation types such as wetlands and coastal vegetation. Specific difficulties cited include:

- availability of seed is very dependent on seasonal factors and their impact on seed set and maturation
- other unlicensed collectors
- some species are in greater demand than supply in bush
- healthy remnant vegetation is often rare or non-existent, or on private lands for which access is restricted
- taller, more difficult to collect, seed is always in more demand than can be supplied
- the low fertility or viability of some seed
- some species no longer grow in the outer urban area
- lack of availability and poor knowledge of native plants on coastal areas.

Collection and storage difficulties

South Australian respondents indicated that they experience more difficulty in collecting than in storing seed. In line with national trends, 8% *usually* and 47% *sometimes* have difficulty with collection (see Figure 11), whereas none *usually* and 24% *sometimes* have difficulty with storage (see Figure 12).

Collection difficulties raised by respondents include:

- natural factors such as the height of forest trees, poor seasons, unpredictable seed maturation, and sporadic seed set
- logistical difficulties, including timing collection when seed is mature and having the people and resources to take advantage of a narrow window of opportunity to collect
- the lack of remnant vegetation and small numbers of plants left to collect from that have a good seed resource, and restricted access to highly diverse bushland reserves
- bureaucratic problems and concerns about the varying policies and requirements of local governments

applying to seed collection, and their perceived favouring of community over commercial collectors

- traffic on roadsides.

Storage difficulties are experienced *rarely* (43%) or *never* (32%) by respondents, making South Australia more confident of storage than any other state (Tasmania was not far behind) and considerably more so than is typical in Australia.

All the difficulties raised are concerned with infestations of seed or attack by vermin, insects and fungal agents. The cold conditions in winter are conducive to storage, with the biggest difficulties likely to be in drying seed in higher rainfall areas.



Victoria

Biogeographical context

Victoria is small in area, with comparatively limited variation in climate and vegetation. The climate is moist temperate with hot, warm summers, drier and having winter rain only in the western and north-western parts (see Map 2). The eastern half of the state includes extensive crown land areas of forest, with some woodland in the lower altitudes and towards central Victoria. Much of the western half is woodland south of Horsham, with the exception of forested areas along the southern coast and in the central Victorian hills. North of Horsham, the vegetation is predominantly mallee scrub and heath.

There is a dense settlement pattern and land use, resulting in great change to the natural vegetation. Victoria has perhaps the highest density and greatest coverage of landcare groups of any state. These groups address dryland and wetland salinity, tree decline, erosion, catchment management and a host of other land management concerns, as do many individual landholders.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the relatively small area of the state and large proportion that is under settlement
- the great variety of land uses, from agricultural to mining, and the intensity of land management
- the ready availability of seed of a core group of species for revegetation in most areas
- our comparatively good knowledge and understanding of the vegetation in Victoria
- the important role of roadside and remnant vegetation as a seed source
- the location of much of the vegetation for seed harvest on public lands, where the permission of relevant authorities is required for collection activity.

Questionnaire response

The response rate to the questionnaire from Victoria was about average (18%) (see Table 1). Many of the main operators from each of the government and community sectors were either consulted directly or responded to the questionnaire.

Consultations were held across Victoria and issues raised at forums in regional areas. The 53 questionnaire responses included 21 from the government sector, 20 from the community sector, and 12 from the commercial sector. In particular, there was a strong response from community and landcare or catchment management groups, and from the state government.

Seed users

Consultation suggested that seed use in Victoria follows trends described nationally but with major users on about equal footing. However, the survey did not gain as clear a picture of seed use in Victoria as in other states.

It appeared that the biggest seed users in Victoria are mining companies engaged in rehabilitation, but that this is likely to be less than the 80% of seed used in some other states. All of this seed would come from commercial collectors or suppliers on a contract basis. Mining demand arises principally from the open cut coal mining projects operating in the east of the state, and the central goldfields area.

Following mining, the next major users are the landcare and revegetation activities of landcare groups, landholders and organisations. These are thought to use more seed than the revegetation activities of government agencies on reserves and roadsides. Roadside rehabilitation undertaken by the Department of Transport and by local councils is a large user.

These revegetation activities use large numbers of tubestock. In addition, direct seeding is an established technique for landcare revegetation activities in Victoria and is a large user of seed.

Following in terms of quantity of native seed used are forestry operations. A large user is the Department of Natural Resources and Environment, which, on the questionnaire results alone, collects from 3 to 5 tonnes of seed annually for departmental use, mostly in forestry. Forestry, with its demand for large quantities of a few commercially important species, contrasts with landcare, which produces a demand for a much larger range of species.

It is again difficult to place bushfood seed collection in order of importance by scale of use. It is likely to be a relatively minor user in Victoria, on a scale less than forestry.

Operations

The operations of respondents follow a similar pattern to those in other mainland states. Most questionnaire respondents collect (83%), clean (64%) and store (75%) seed (see Table 14).

Questionnaire respondents dispatch the majority of seed more narrowly than do respondents in other states. Some 48% dispatch seed to community groups, 27% to state government, and 20% to farmers and landholders, and nurseries or propagators. Smaller numbers dispatch to community nurseries (12%) and direct seeders (12%) (see Table 15).

Respondents are much more likely to distribute seed free (26%) than to sell seed (6%), which likely reflects the small number of commercial operators who responded and community sector practice (see Table 14).

Almost 65% of respondents raise native seedlings from seed, which, along with Western Australia, represents the least respondents of any state.

About half of the respondents (48%) advise others on the above matters.

Respondents in Victoria are generally not as involved in revegetation activities as those in other states, except those in Tasmania. In addition to those who raise seedlings from seed, 67% replant using native seedlings, 56% manage natural regeneration and 46% carry out direct seeding. These figures are all

lower than those of other states or national averages (see Table 14).

Almost 65% of respondents use propagation material other than seed to propagate native plants, which is more than in any other state. However, the amount used is likely to be small and restricted to those species which do not propagate well from seed. Some 10% store, sell or distribute these materials, which is less than the national average for handling propagation material other than seed (see Table 19).

Obtaining seed

Apart from collecting seed themselves, slightly more respondents in Victoria buy seed from collectors (29%), acquire seed for free from them (23%) or buy seed from seed merchants (23%). Almost no respondents indicated that they trade seed (see Table 16).

As in Western Australia and South Australia, a relatively high proportion of respondents (51%) collect *all* of their seed in the local area. Victorian respondents are clearly the most likely to do so of respondents in any state (national average 35%). Only 9% collect no seed in their local area and 26% indicated that they collect *most* and 15% *some* of their seed in the local area (see Table 17).

Respondents collect *all*, *most* or *some* of their seed across all broad vegetation types (tree, shrub, wetland and grass species), and generally indicated that they collect *some* seed at higher than national average rates. This indicates that there is likely to be less specialisation than in some other states (see Table 18).

In line with the national averages, 29% of respondents acquire *all* and 22% *most* of their seed from natural bush, 11% acquire *most* and 49% *some* seed from plantations or plantings, and 2% obtain *most* and 11% *some* seed from seed orchards (see Table 17). No respondents source seed from outside Australia, the lowest rate of any state, and very few source seed of unknown origins (see Table 17).

Availability of seed

Demand from revegetation activities of community groups and landholders is constant or increasing in many areas, and strongly for indigenous seed. Across Victoria, the quantity of seed collected by the community sector is related to the amount of direct seeding undertaken in that area or region, and the effect of recent poor seasons on demand. Where direct seeding takes place, it quickly overtakes the demand for other uses.

In the north-west, demand currently outstrips supply by a considerable margin and there is frustration at the lack of available seed. Greening Australia reported that considerably more direct seeding could take place in the north-central and north-western districts with improved seasonal conditions, but that the shortage of seed and lack of suppliers (of local indigenous seed) severely limits the amount of direct seeding likely to take place.

In the south-west and towards Ballarat, those consulted reported that dry seasons and a lack of money in the agricultural sector have reduced the demand for seed in the last 2 or 3 years. Commercial operators in the south-west commented that seed collection and sale has been, on the whole, marginal or uneconomic in recent years in response to the level of demand. There was some doubt as to whether the scale of increased demand predicted through Bushcare funding programs can be met in the south-west. Lead-time to collect seed for these programs will be an important planning requirement. Another concern was the availability of seed, with commercial operators in the south-west commenting that seed is no longer available in the bush, especially in the quantities needed for direct seeding.

Throughout Victoria most community seedbanks are being established to target increased availability of a greater range of species and, in particular, of species local to the area for use in revegetation work.

Looking at all questionnaire responses from Victoria, the average respondent collected 52 kilograms, stored 99 kilograms and

dispatched 65 kilograms of seed in the last year (see Table 20). These are the lowest figures for quantity of seed handled of any state and reflect a commercial sector response dominated by commercial nurseries. The data also indicate that collection for direct seeding is still less common in the state than collection for tubestock production.

Community sector respondents, on average, collected 7 kilograms, stored 22 kilograms and dispatched 13 kilograms. The lesser role of the community sector is similar across Australia, however, these are comparatively small quantities by comparison with most states (see Table 20). Again, however, the comparison is not the same for numbers of species, which for collection and storage in the community sector are about double those for the government sector. On the surface, the data imply that the community sector is able to supply a reasonable range of species that are local to their area.

Quality of seed

There were no specific problems or concerns expressed about physical or genetic quality of seed, however, there were concerns expressed about seed provenance.

Availability of indigenous seed

All respondents reported a trend for much greater emphasis on provenance and the use of understorey species over the last 10 years. There is an increasing trend for community groups and individuals to specify local collection and to regard seed from outside the local area as a poor substitute, if not of poorer quality. This dramatically affects demand and availability of seed in Victoria. As with most states, there were comments by suppliers that the expectations of some government agencies are highly unrealistic and uneconomic in relation to provenance.

According to the questionnaire results, Victoria is the second easiest state (after South Australia) in which to obtain local indigenous seed. Only 10% of respondents indicated that they *usually* and 56% *sometimes* experience difficulty in obtaining

seed of the right provenance for use in the local area (see Figure 9).

In addition, most respondents considered that commercial suppliers *usually* (40%) or *sometimes* (20%) provide sufficient information about the origins of seed (see Figure 10). These are about average figures.

Common problems identified by respondents in obtaining seed of the right provenance for use in the local area include:

- availability of seed being very dependent on seasonal factors and their impact on seed set and maturation leading to scarcity of (mature seed of) many species
- some species being in greater demand than supply in the bush; scarcity of unusual or locally rare species, those that set seed spasmodically, and those that are just unobtainable from seed sources
- healthy remnant vegetation (especially with indigenous understorey) often being rare, non-existent or located on public lands
- restricted access for collection on public lands and the need to obtain a permit, with permits to collect in national parks and some other crown land areas being difficult to obtain
- uneconomic to travel far to collect seed and the distant location of remnants
- commercial suppliers not stocking local seed for all areas
- poor planning leading to insufficient lead-time for collectors to fill orders before seed has matured
- the issue of local provenance and its importance being misunderstood and over-rated
- logistical problems with allocating time to collecting, having enough seed collectors, or labour not being available at time when seed is ready, long distances to travel to seed source.

Collection and storage difficulties

Victorian respondents indicated that they experience more difficulty in collecting than in storing seed. In line with national trends, 10% *usually* and 51% *sometimes* have difficulty with collection (see Figure 11) whereas 2.5% *usually* and 45% *sometimes* had difficulty with storage (see Figure 12).

Responses indicated that Victorians, like most Australians, are generally more confident of storing than of collecting seed.

Collection difficulties raised by respondents include all those noted for obtaining local seed above, but especially highlighted:

- obtaining viable seed on any regular basis being hampered by a combination of natural factors such as:
 - lack of rain, poor seasons
 - unpredictable seed maturation and sporadic seed set
 - high levels of seed predation by insects before seed is mature
 - height of seed in trees
 - poor natural seed viability
- logistical difficulties, including:
 - timing collection when seed is mature
 - having the people and resources to take advantage of a narrow window of opportunity to collect

- collecting in sometimes inaccessible, difficult or distant locations
- having the people to monitor seed set in difficult populations or species
- lack of remnant vegetation and the small numbers of plants left to collect from that have a good seed resource
- restricted access to highly diverse bushland reserved (some seed only occurs in national parks) and the difficulties in collecting from environmentally sensitive areas
- not having enough knowledge for correct plant identification, timing collection, understanding what to collect
- not having enough seed collectors in the area.

In line with the national trends, storage difficulties raised by respondents include:

- the loss of seed viability and the short shelf life of many species in storage
- attack by vermin, insects and fungal agents
- lack of available storage facilities and problems with storage equipment
- understanding technical aspects of storage and overcoming problems with temperature and humidity.



New South Wales and the Australian Capital Territory

Discussion of the New South Wales seed sector includes the Australian Capital Territory (ACT). This is primarily because the small number of questionnaire responses from the ACT does not allow for separate discussion. The data from the ACT response are also dominated by the larger Federal Government seedbanks that have national roles.

Biogeographical context

There are four broad climatic zones (see Map 2) in New South Wales, moving westward from the moist temperate coast and ranges, with hot summers in the north-east and warm summers in the south-east, to the semi-arid plains and arid western corner. Vegetation follows a similar zonation, from the forested coast and ranges to the woodlands of the slopes to a mosaic of mulga, mallee and semi-desert vegetation west of Cobar in the north and Deniliquin in

the south. There are sub-tropical rainforests on the north coast.

The pattern of settlement and land use is intense along coastal areas and progressively less dense westward. As in Victoria, there has been great change to the natural vegetation as a result of land use. Similarly also, New South Wales has perhaps the most landcare groups of any state. These groups address dryland and wetland salinity, tree decline, erosion catchment management and a host of other land management concerns, as do many individual landholders.

Perhaps the most significant biogeographical features that affect seed collection and storage are:

- the large area of the state and large proportion that is under settlement and land use
- the great variety of land uses, from agricultural to mining, and the intensity of land management
- the ready availability of seed of a core group of species for revegetation in most areas
- the important role of roadside and remnant vegetation as a seed source
- the location of much of the vegetation for seed harvest on public lands, where the permission of relevant authorities is required for collection activity
- the relatively large areas where the original vegetation was scattered trees or shrubs over native grassland (or no trees at all)
- greatly restricted access resulting from distance, isolation, rugged and difficult terrain, wet season seed set, and so on
- the presence of sub-tropical species that do not store well, if at all
- the hot, dry conditions of the central arid areas, which greatly facilitate drying of seed but do not necessarily prolong storage life.

Questionnaire response

The response rate to the questionnaire from New South Wales was one of the highest (25%) (see Table 1). Many operators from each of the government, commercial and community sectors were consulted directly or responded to the questionnaire. A regional forum was held in Armidale and regional meetings with community seedbank operators were also held. The 74 questionnaire responses included 5 from the government sector, 48 from the community sector, and 21 from the commercial sector. There was a strong response across the board from the community and, in particular, the catchment management and landcare groups. The commercial sector response was dominated by commercial nurseries.

Seed users

Consultation suggested that seed use in New South Wales follows trends described nationally, though the survey did not gain as clear a picture of seed use in New South Wales as in other states. New South Wales has a very large native seed sector catering for the many seed users (in large quantities) in the state, interstate and internationally. The biggest seed users are large compared to other states such as the Northern Territory and South Australia. Indeed, the quantity of native seed collected and stored in New South Wales is very probably higher than in most other states and second only to that in Western Australia.

The main seed users in New South Wales are mining companies engaged in rehabilitation and some 70% or more of seed collected is thought to be used in mining rehabilitation work. Much of this seed would come from commercial collectors or suppliers on a contract basis. Mining demand arises principally from coal mining projects operating around Sydney.

Following mining, the next major users are the landcare and revegetation activities of landcare groups, landholders and organisations. These are thought to use more seed than the revegetation activities of government agencies on reserves and

roadsides. Roadside rehabilitation undertaken by the Department of Main Roads and by local councils is a large user.

These revegetation activities use large numbers of tubestock and direct seeding is also an established technique and a large user of seed.

Following in terms of quantity of native seed used are the forestry operations of state agencies and increasingly those of private and commercial forestry. Forestry, with its greater use of tubestock and demand for large quantities of a few commercially important species, contrasts with the demand from landcare, which uses a much larger range of species and undertakes more direct seeding.

It is again difficult to place bushfood seed collection in order of importance by scale of use. It is likely to be a small user on a lesser scale than forestry.

These observations are generally supported by responses to the questionnaire.

Operations

The operations of New South Wales respondents follow a similar pattern to those in other mainland states. Most questionnaire respondents collect (96%) and clean (69%) seed, and more also store (82%) seed than respondents in all other states except Tasmania (see Table 14).

Questionnaire respondents in New South Wales dispatch seed broadly across the community. About 55% dispatch seed to community groups, 46% to farmers and landholders, 34% to direct seeders, and 27% to nurseries or propagators. Smaller numbers dispatch to local councils (18%), state government and community seedbanks (16%) (see Table 15). This response highlights the greater role of community seedbanks in New South Wales, as is also the case in Tasmania and South Australia. More respondents distribute direct to farmers and landholders than in any other state (South Australia is not far behind). Similarly, more respondents distribute to direct seeders than in other states (except Tasmania).

Respondents are much more likely to distribute seed free (41%) than to sell seed (18%), which likely reflects the small proportion of commercial seed suppliers who responded and community sector practice (see Table 14).

Some 84% of respondents raise native seedlings from seed, which is second only to South Australia.

A large number of respondents (63%) advise others on the above matters.

Respondents are involved widely in revegetation activities, more so than in other states except South Australia. In addition to those who raise seedlings from seed, 82% replant using native seedlings, 60% manage natural regeneration and 51% carry out direct seeding (see Table 14).

Some 54% of respondents use propagation material other than seed to propagate native plants. A comparatively large number (23%) store, sell or distribute these materials (see Table 19).

Obtaining seed

Almost all the respondents in New South Wales collect seed. However, over half also buy seed from seed merchants and one-quarter from commercial collectors. The relative amounts collected and bought are not known, but the response indicated that many community seed collectors do also buy seed from collectors and merchants. One-third obtain seed for free from collectors and a larger number than in most states also trade goods and services for seed (see Table 16). This pattern of acquisition is most like that in Western Australia and South Australia, only a little more pronounced.

In line with national trends, 30% of respondents in New South Wales collect *all* and 44% *most* of their seed in the local area. Only 7% collect *no* and 20% *some* seed in the local area (see Table 17).

Respondents collect *all*, *most* or *some* of their seed across all broad vegetation types (tree, shrub, wetland and grass species) approximately in line with the national average figures. Most collect relatively more

trees (10% *all*, 44% *most*) and tall shrubs (4% *all*, 27% *most*) than low shrubs (4% *all*, 10% *most*). Slightly more native grasses (1% *all*, 49% *none*) were collected than wetland plants (0% *all*, 59% *none*) (see Table 18).

In line with national trends, a large proportion of seed comes from natural bush (21% *all*, 49% *most*) and a much smaller proportion from plantings or plantations (3% *all*, 6% *some*), seed orchards (1% *all*, 0% *most*) and uncertain origins (1% *all*, 0% *most*) (see Table 17).

In line with the national averages, 21% of respondents acquire *all* and 49% *most* of their seed from natural bush, 3% acquire *all* and 6% *most* seed from plantations or plantings, and 1% obtain *all* and 14% *some* seed from seed orchards (see Table 17). Only one respondent sources *some* seed from outside Australia, the lowest of any state except Victoria. However, 29% source *some* seed and only 70% *no* seed from unknown origins (see Table 17).

Availability of seed

Those consulted considered that demand from community groups and landholders for their revegetation activities is increasing in many areas, and increasing for indigenous seed. Currently, the demand for seed comes mostly from the eastern half of the state, with the exception of the south-west, where direct seeding and revegetation programs are big users. There are reported to be few commercial suppliers who provide 'local' seed in the south-west. Seed was also considered very scarce in the limited stands of remnant vegetation, many of which are in poor condition. The same situation would exist in the north-west of New South Wales but for the handful of smaller commercial suppliers.

In New South Wales the quantity of seed collected by the community sector is proportional to direct seeding activity in that region and the effect of recent poor seasons on demand. Where direct seeding takes place in community revegetation, it quickly overtakes the demand for other uses.

Throughout New South Wales there are seedbanks operated by the community.

There was some doubt among operators of these seedbanks that the predicted demand through Bushcare funding programs can be met without upgrading extension effort and seed production capability. Lead-time to collect seed for government-funded community landcare programs will be an important planning requirement. Another concern was the availability of seed, with operators in the south-west commenting that seed is no longer available in the bush, especially in the quantities needed for direct seeding.

Around Sydney and in the south-east there are many commercial seed merchants offering a considerable range of species and provenances at high seed quality. Many of these merchants operate with integrity, reliability and trust.

However, in all Australia, the commercial native seed industry is no more criticised by seed users than it is in New South Wales, and in particular around Sydney. Anecdotal reports of unscrupulous practice were all too common. Seed users reported a considerable lack of trust in specific seed merchants and collectors. Inevitably this reflects on the native seed sector in general.

It is therefore not surprising that New South Wales has the most organised and productive community seed collection infrastructure, capacity and networks of any state. Nor is it surprising that these seedbanks and networks are based in much the same areas (though not exclusively so) as the commercial suppliers. The establishment of community seedbanks is motivated by increasing demand for seed from the local area in which it will be used and the perception that greater availability of indigenous seed is required to complement increased revegetation extension effort. Consequently, community seed collection not only targets increased availability of a greater range of species, but also much greater quantities of indigenous seed.

Looking at all questionnaire responses from New South Wales, the average respondent

collected 70 kilograms, stored 49 kilograms and dispatched 78 kilograms of seed in the last year (see Table 20).

The community sector operators collect, store and distribute much less than these average figures, which are weighted heavily by response from the government and commercial sectors. The lesser role of the community sector is similar across Australia. In New South Wales, community sector respondents, on average, collected 16 kilograms, stored 20 kilograms and dispatched 17 kilograms. In addition, the numbers of species collected, stored and distributed by the community sector, on average, are much less than for the commercial sector and, in all but distribution, for the government sector also.

The data imply that the community sector is not yet able to supply the range of species that the commercial sector does. However, each of these community operators collects and supplies 20 to 40 *local* species.

Quality of seed

There were concerns expressed about physical and genetic quality of seed among seed users consulted in New South Wales. Most of the concerns related to the guarantee of seed provenance and the unfortunate lack of trust in the industry in New South Wales noted above. However, as seed users are becoming more skilled and demanding, the physical quality (especially viability) of seed is also increasingly scrutinised.

Availability of indigenous seed

All report a trend for much greater emphasis on provenance and the use of understorey species over the last 10 years. There is an increasing trend for community groups and individuals to specify local collection and to regard seed from outside the local area as a poor substitute, if not of poorer quality. As in some other states, this dramatically affects demand and availability of seed in New South Wales.

Small commercial seed merchants cannot afford to collect seed widely from across New South Wales. Large commercial operators

rely on easy picking and common species to cross-subsidise collection of the difficult or obscure species. Seed merchants complain that seed users cannot expect local seed orders to be met from stock, but that these orders could be filled if only sufficient lead-time were given for collections to be made. Education of purchasers is for them a key issue in promoting more advance planning for seed collection.

It appears that commercial operators may not be able to supply indigenous species for a range of local areas economically.

Commercial operators considered that customers are unwilling to pay premiums for indigenous collection. As in most states, there were comments from suppliers that the expectations of some government agencies are highly unrealistic and uneconomic in relation to provenance. In New South Wales some commercial suppliers consider that seed users in the community generally also have some unrealistic expectations in regard to provenance.

During consultation, it was difficult to separate frustrations felt by those consulted with commercial seed suppliers from perceptions about the commercial availability of indigenous seed. Despite the larger seed sector in New South Wales, no fewer respondents indicated that they experience difficulty in obtaining local indigenous seed than respondents in other states. Respondents were polarised on the availability of indigenous seed from all sources. While 15% of respondents *usually* and 34% *sometimes* experience difficulty in obtaining seed of the right provenance for use in their local area, 22% of respondents *never* and 28% *rarely* do. These are average figures nationally (see Figure 9).

Respondents also indicated that in New South Wales commercial suppliers do not provide information about the origins of seed as readily as in other states. Some 27% of respondents consider that commercial suppliers *never* or *rarely* provide sufficient information about the origins of seed (see Figure 10).

Common problems identified by respondents in obtaining seed of the right provenance for use in the local area include:

- availability of seed being very dependent on seasonal factors (especially recent drought) and their impact on seed set and maturation leading to scarcity of (ripe seed) many species
- some species being in greater demand than supply in the bush;
- the scarcity of many species, especially unusual or locally rare species, those that set seed spasmodically, and those that are just unobtainable from seed sources
- healthy remnant vegetation (especially with indigenous ground flora) being often rare, fragmented, non-existent or located on public or private lands to which access is limited
- competition between collectors, and many remnants being now located too far away
- commercial suppliers not stocking local seed for all areas or not specifying collection location
- poor planning leading to insufficient lead-time for collectors to fill orders before seed has matured
- restricted access for collection on public lands and need to obtain permits, with permits to collect in national parks and some other areas being difficult or impossible to get
- uneconomic to travel far to collect seed or insufficient demand to justify commercial collection
- the issue of local provenance and its importance being misunderstood and over-rated.

Collection and storage difficulties

New South Wales respondents indicated that they experience more difficulty in collecting than in storing seed. In line with national trends, 13% *usually* and 49% *sometimes* have difficulty with collection (see Figure 11), whereas 4.8% *usually* and 42% *sometimes* have difficulty with storage (see Figure 12).

Respondents in New South Wales, like most Australians, are generally more confident of storing than of collecting seed.

Collection difficulties raised by respondents included all those noted for obtaining local seed above, but especially highlighted:

- obtaining viable seed on any regular basis being hampered by the combination of natural factors such as:
 - lack of rain, poor seasons
 - unpredictable seed maturation and sporadic seed set
 - high levels of seed predation by insects before seed is mature
 - height of seed in trees
 - poor natural seed viability
- logistical difficulties, including:
 - timing collection when seed is mature
 - having the people and resources to take advantage of a narrow window of opportunity to collect
 - collecting in sometimes inaccessible, difficult or distant locations
 - having people to monitor seed set in difficult populations or species
- lack of remnant vegetation and small numbers of plants left to collect from that have a good seed resource or adequate samples of gene pools
- road builders clearing bush before seed can be collected
- restricted access to highly diverse bushland reserves, with some seed only occurring in national parks where permits are needed
- not enough knowledge for correct plant identification, timing collection, understanding what to collect
- not enough seed collectors in the area
- taxonomic uncertainty for some species
- access to mechanical or other harvesting equipment.

Storage difficulties cited by the half of respondents who experienced them include:

- lack of knowledge, understanding technical aspects of storage and overcoming problems with storage regimes, temperature and humidity
- loss of seed viability and the short shelf life of many species in storage
- attack by vermin, insects and fungal agents
- lack of available storage facilities and problems with storage equipment
- difficulty in drying seed of rainforest species and their short shelf life in storage.



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Appendix 1: FloraBank Survey Tour Consultation

Discussion Forums

Forum	State	Participants	Date
Armidale	NSW	12 local seed collectors, nurserymen, seed merchants and GA staff	16/4/98
Newcastle	NSW	Sessions conducted at Greening Australia forum including 18 GA NSW managers and extension officers	1/4/98
Hamilton	VIC	2 seed merchant/collectors & 3 GA staff	20/4/98
Hobart	TAS	2 Forestry Commission, 3 seed merchants, 2 others, 3 GA staff	23/4/98
Brisbane	QLD	12 participants from all community sectors	5/5/98
Rockhampton	QLD	8 people: Central Qld seed collectors, SGAP, Council, community reps	7/5/98
Alice Springs	NT	10 participants from all community sectors	1/6/98
Darwin	NT	18 participants from all community sectors	3/6/98
Nhill	VIC	Sessions conducted as part of Greening Australia Direct Seeding Workshop with 24 GA revegetation officers and others	16–19/6/98
Adelaide	SA	3 participants from GA, Trees for Life, ATCV	14/7/98
Burrendong	NSW	Sessions conducted at Greening Australia Workshop on seedbanks including representatives (13) from all NSW community regional seedbanks	13–14/8/98

Consultations

Establishment	Town	State	Contact	Date
Australian Network for Plant Conservation	Canberra	ACT	Coordinator J Mill	4/98
Australian Tree Seed Centre	Canberra	ACT	Tim Vercoe	3/98
Greening Australia VIC seedbank discussion	Melbourne	VIC	CEO & extension staff	21/4/98
GA VIC South Gippsland Regional Facilitator	Leongatha	VIC	Kate Walsh	22/4/98
GA TAS seedbank discussion	Hobart	TAS	CEO & extension staff	24/4/98
GA QLD meetings with seed staff	Brisbane	QLD	CEO, G Borschmann	4/5/98
Australian National Botanic Gardens Management team	Canberra	ACT	Director, Curator, and other staff	5/98
Australian Network for Plant Conservation	Canberra	ACT	Coordinator J Mill	5/98
GA NSW Seedbank Coordinators Induction	Deniliquin	NSW	5 new seedbank staff	5/98
Royal Botanic Gardens seedbank discussion	Mt Annan	NSW	Director, curator, others	21/5/98
GA WA seedbank discussion	Perth	WA	CEO & extension staff	26/5/98
Main Roads WA Great Southern Region	Albany	WA	Max Hoadacre	29/5/98
Hams Seed Collectors for Landcare	Cranbrook	WA	Bert & Betty Hams	29/5/98
Olive Pink Botanic Gardens	Alice Spring	NT	Colleen O'Malley	1/6/98

Consultations

Establishment	Town	State	Contact	Date
GA Alice Springs Office Seedbank	Alice Spring	NT	Jenny Atkins	1/6/98
Central Land Management Association	Alice Spring	NT	Bob Millington	2/6/98
Greening Australia NT seedbank discussion	Darwin	NT	CEO & extension staff	3/6/98
Parks and Wildlife seedbank discussion	Katherine	NT	NT Govt extension officers	4/6/98
Jawoyn Association Landcare	Katherine	NT	Kerri Watkins	4/6/98
GA SA seedbank discussion	Nhill	VIC	Seedbanks team	18/6/98
State Flora Centre	Murray Bridge	SA	Phil Collins	15/7/98

Seedbank Visits

Establishment	Town	State	Contact	Date
Australian Tree Seed Centre	Canberra	ACT	Tim Vercoe	3/98
Aust National Botanic Gardens Seedbank	Canberra	ACT	Susan Walker	3/98
GA ACT and SE NSW Nursery and seedstore	Canberra	ACT	Brian Cumberland	19/3/98
CSIRO Plant Introductions and Quarantine Unit	Canberra	ACT	Gary Orr	7/4/98
Rural Conservation Service	Canberra	ACT	Gary Orr	7/4/98
Native Seedsavers Network	Hawkesbury	NSW	Dave Watson	4/98
GA Dorrigo Farm Forestry Seedstore	Dorrigo	NSW	Mark Harrison	15/4/98
GA Armidale Seedstore	Armidale	NSW	David Carr	16/4/98
Armidale Community Tree Group Seedbank	Armidale	NSW	Mike O'keefe	16/4/98
Portland Regional Seedbank	Portland	VIC	Dave Warne	20/4/98
Ballarat Regional Seedbank	Ballarat	VIC	Trish Kevin	21/4/98
Melbourne Indigenous Seedbank	Melbourne	VIC	Manager	21/4/98
South Gippsland Regional Seedbank	Leongatha	VIC	Kate Walsh	22/4/98
Fish Creek Landcare Group	Leongatha	VIC	T & J Flemming	22/4/98
Tasmanian Regional Seedbank	Hobart	TAS	Alan Gray	23/4/98
Tasmanian Seed Centre	Perth	TAS	Elaine Page	24/4/98
Yates Seeds P/L	Sydney	NSW	Managers & staff	28/4/98
Royston Petrie Seeds P/P	Sydney	NSW	Mr R Petrie Mgr	29/4/98
Harvest Seeds P/L	Sydney	NSW	Manager	29/4/98
GA Nursery The Gap	Brisbane	QLD	Nursery Mgrs, staff	4/5/98
DPI Forestry Seed Centre	Beerwah	QLD	Mgr D Goshnick	5/5/98
CSIRO Tropical Forages Genetic Resource Cntr	Samford	QLD	Mgr John Donnelly	5/5/98
Redland Shire Council Bushcare Prog. Seedstore	Cleveland	QLD	GA / Council Officer	5/5/98
Central Qld Seedbank and Database	Rockhampton	QLD	Dr. N Ashwath	7/5/98

Seedbank Visits

Establishment	Town	State	Contact	Date
Royal Botanic Gardens (Mt Annan) Seedstore	Mt Annan	NSW	Various staff	21/5/98
Threatened Flora Seed Centre	Perth	WA	Anne Cochrane	25/5/98
Kimseed P/L	Perth	WA	Greg Hill Manager	25/5/98
APACE AID Nursery and Seedbank	Perth	WA	Greg Reid Manager	26/5/98
Kings Park Botanic Gardens	Perth	WA	Seedbank Manager	26/5/98
Wildflower Society Eastern Hills Branch	Perth	WA	J. Seabrook, others	26/5/98
Landcare Services P/L	York	WA	Mgr G Cockerton	27/5/98
Men of the Trees Nursery	Perth	WA	Mgr and staff	27/5/98
ALCOA Marinup Nursery and Seed Store	Marinup	WA	Sue Taylor	28/5/98
Southwest Native Seeds P/L	Donnybrook	WA	M &S Piggot Mgrs	28/5/98
Bridgetown Greenbushes Landcare Centre	Bridgetown	WA	J Dewing C Hamenc	28/5/98
Nindethana Seeds P/L	Albany	WA	Mgr P Luscombe	29/5/98
Hams Seed Collectors for Landcare	Cranbrook	WA	Bert & Betty Hams	29/5/98
Tangentyere Landcare Nursery	Alice Spring	NT	Mgr.Bill Pechy, others	1/6/98
Desert Park Seedstore/ herbarium/ nursery	Alice Spring	NT	Mark Richardson	1/6/98
Horner Seeds P/L	Alice Spring	NT	Mgr Rod Horner	2/6/98
Central Land Management Association	Alice Spring	NT	Bob Millington	2/6/98
Darwin Botanical Gardens Seedbank	Darwin	NT	Manager	3/6/98
Katherine GA Seedbank	Katherine	NT	Frank Marshall	4/6/98
Greening Australia SA seedbank	Adelaide	SA	Neville Bonney	14/7/98
Greening Australia SA Flaxley Seedbank	Flaxley	SA	Neville Bonney, Alan Loftus	14/7/98
Bremer Barker Catchment Centre Seedbank	Flaxley	SA	Peter Miles	14/7/98
Trees for Life Seedbank	Adelaide	SA	Bruce Smith	14/7/98
Provenance Seeds	Exeter	SA	Peter & Dave Hemmings	15/7/98
Blackwood Seeds	Murray Bridge	SA	Max Merckenschlager	15/7/98



Appendix 2: Survey of the collection and storage of native plant seed in Australia

Do you collect or store native plant seed? Do you use native plant seed to propagate plants for revegetation work? Whether you are a commercial or amateur, a member of a community group or from government, if you use, collect, store or distribute native plant seed, please take the time to read and complete this survey.

The information gained from this survey will greatly assist in understanding how we collect, store, and distribute native seed in Australia. It will identify the needs and issues before those who do collect and store seed.

FloraBank promotes the establishment of a network of regional seedbanks across Australia linked to the larger state and national seedbanks. FloraBank proposes to support this network with technical advice, information, management support, and training. It will establish a national register of seedbanks and a national catalogue of seedbank holdings.

A Fact Sheet about FloraBank is attached.

The questionnaire should take you about 10 to 15 minutes to complete. If you complete the questionnaire on behalf of your organisation or group, you may also wish to respond as an individual (e.g. if you collect native seed individually) on a separate questionnaire.

Please photocopy this questionnaire to pass on to others you think may be interested.

You may return the questionnaire in the postage paid envelope provided or to the address below. Surveys should be returned by Monday 15 June 1998, however, late returns will be included in published results where possible.

Although you need not supply your name and address, we encourage you to do so. Providing your contact details helps us to interpret the survey and allows us to contact you to discuss your answers. We are also able to invite you to join a growing national network of people interested in native plant seed and its use.

For more information, contact:

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FloraBank Co-ordinator

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Yarralumla ACT 2600

Ph: 02 6281 8585
Fax: 02 6281 8590
Email: greenaus@ozemail.com.au

Please start here

1. Are you completing this questionnaire as an individual or on behalf of someone?

Tick the box or write below

As an individual

On behalf of the group, society, government or non-government organisation, association, company or business named here:

.....

2. Which of these activities do you or your organisation, company or group carry out?

Tick any number of boxes

'Native' means: indigenous to Australia

- Collect native plant seed
- Clean native plant seed
- Store native plant seed
- Distribute native plant seed (non-profit)
- Sell native seed for profit
- Store, sell or distribute native plant propagation materials other than seed
- Raise native seedlings from seed
- Advise others on any of the above
- Direct seeding of native plants
- Replanting using native seedlings
- Manage natural regeneration

3. How do you or your organisation, company or group obtain native plant seed?

Tick any number of boxes

- You collect seed
- You obtain (free) seed from collectors
- You buy seed from collectors
- You buy seed from seed suppliers
- You trade seed for goods or services
- Other species (specify)

4. How many seedlots did you obtain from all sources in the last year?

Approximate number of seedlots

5. Where are the native seedlots you obtain collected from?

Circle to answer on each line

- Within your local area *All / Most / Some / None*
- Within your region *All / Most / Some / None*
- Within Australia *All / Most / Some / None*
- Outside Australia *All / Most / Some / None*
- From natural bush areas *All / Most / Some / None*
- From plantings or plantations *All / Most / Some / None*
- From native seed orchards *All / Most / Some / None*
- From unknown origins *All / Most / Some / None*
- I am not sure *All / Most / Some / None*

6. What sort of local native seed do you collect, obtain, or buy from all sources?

Circle to answer on each line

- Trees *All / Most / Some / None*
- Tall shrubs (middle storey) *All / Most / Some / None*
- Low shrubs (ground storey) *All / Most / Some / None*
- Native wetland plants *All / Most / Some / None*
- Native grasses *All / Most / Some / None*

7. Have you experienced difficulty in obtaining seed of the right provenance for use in your local area?

'Provenanccce' means: the geographic origin of seed from a population of plants, or a population of plants growing at a site.

Circle to answer

Usually Sometimes Rarely Never

Please list difficulties

.....

8. What percentage of the seed you use is bought from commercial seed suppliers?

Approximate % of seed bought..... %

9. Do commercial seed suppliers provide you with sufficient information about the origins of the seed you buy?

Circle to answer

Usually Sometimes Rarely Never

Seed collection

10. How many seed collectors do you usually obtain native seed from?

Tick a box

Myself only

Up to 3 collectors

From 3 to 10 collectors

More than 10 collectors

11. How often is all of the following information recorded for each seedlot collected: species, location, date, and collector?

Circle to answer

Always Sometimes Rarely Never

12. How much native seed do you collect?

Indicate the approximate number:

Total native seed collected last yearkg

Total native seedlots collected last year.....

Total native species collected last year

13. Which of the following best describes how you typically prepare seed collected?

Tick any number of boxes

Drying

Dry seed in open air (under cover or in sun)

Dry seed using drying cabinet or oven

Dry seed in controlled humidity room

Dry seed to specific moisture content

Dry seed over silica gel

Cleaning

Do not clean, seed used quickly

Clean seed by hand

Clean seed using machines

Pests and fungal

Do not control pests / organisms in seed

Control pests using chemical treatment

Control fungus using chemical treatment

Other (specify)

Collection Records

Do not keep records of seed collected

Keep hand written records of seed collected

Keep records on computer of seed collected

Other (specify)

14. Thinking about your native seed collection activities, do you have adequate access to the following?

Circle to answer

Information yes / not sure / no

Technical advice yes / not sure / no

Training courses yes / not sure / no

Collection equipment yes / not sure / no

Seed cleaning equipment yes / not sure / no

To native seed collectors yes / not sure / no

To seed collection areas yes / not sure / no

15. Have you experienced difficulties in collecting native seed?

Circle to answer

Usually Sometimes Rarely Never

Please list difficulties

.....

.....

Seed storage

If you do not store native plant seed skip to question 22.

16. What is the primary purpose for which you store native seed? Tick one box only

To use in specific replanting projects

To distribute (non-profit) for revegetation

To sell (for profit) to others

For the conservation of species

As a personal hobby

For research purposes

Other (specify)

17. How much native seed do you store?

Indicate the approximate number:

Total native seed now in storage =kg

Total native seedlots now in storage =

Total native species now in storage =

18. How do you typically store seed?

Containers

Indicate the approximate % of seed stored in:

Containers or bags not airtight..... %

Air tight containers or bags..... %

Heat sealed plastic or foil bags..... %

Under vacuum in heat sealed bags..... %

Other (specify)

Temperature and humidity

Indicate the approximate % of seed stored:

At room temperature and humidity..... %

At controlled humidity..... %

What Relative Humidity %RH is used?

At controlled temperature..... %

What Temperature(s) degrees C is used?

Other (specify)..... %

Storage capacity

Indicate the approximate cubic meters of dedicated seed storage you currently have access to:

At room temperature and humidity..... m³

At controlled humidity..... m³

At controlled temperature..... m³

Other (specify)..... m³

Duration

Indicate the approximate % of seed stored:

For up to one year..... %

From one to five years..... %

More than 5 years..... %

Storage Records

Tick any number of boxes

Do not keep records of seed stored

Keep hand written records of seed stored

Keep records on computer of seed stored

Dispatch Records

Tick any number of boxes

Do not keep records of seed dispatched

Keep hand written records of dispatches

Keep records on computer of dispatches

19. Thinking about your seed storage activities, do you have adequate access to the following?

Circle yes or no to answer

Information Yes / No

Technical advice Yes / No

Training courses Yes / No

Drying equipment Yes / No

Fumigation equipment Yes / No

Bagging equipment Yes / No

Refrigeration equipment Yes / No

Freezer equipment Yes / No

Computing equipment Yes / No

Other (specify).....

20. Have you experienced difficulties in storing native seed?

Circle to answer

Usually Sometimes Rarely Never

Please list difficulties

.....
.....
.....

Dispatch and distribution

21. How much native plant seed did you dispatch (including profit and non-profit) in the last year?

Indicate the approximate number:

Total native seed dispatched =

Total native seedlots dispatched =

Total native species dispatched =

22. To which of the following groups did you dispatch the majority of your seed?

Tick any number of boxes

- Commercial seed houses
- Commercial nurseries / propagators
- Community seedbanks
- Community groups (Landcare or similar)
- Community nurseries
- Farmers and landholders
- Direct seeding operations /contractors
- Local councils
- State government land managers
- Other (specify)

23. Do you use native plant materials (e.g. root and stem cuttings) for propagation of native plants?

Circle to answer

Yes / Not sure / No

If you answered yes, in what ways do you use these plant materials?

Write here or attach a separate sheet

.....

.....

.....

.....

.....

.....

.....

.....

24. Do you have access to a computer?

Circle to answer

Yes / Not sure / No

25. Do you have access to the Internet?

Circle to answer

Yes / Not sure / No

26. Please provide your contact details:

Name

.....

Organisation, company or group

.....

.....

Contact address

.....

.....

.....

Postcode:.....

Telephone: Fax:.....

Email.....

Thankyou very much for completing this questionnaire

Do you wish to be placed on the mailing list for information regarding the results of this survey and the national network of seedbanks?

Circle to answer: Yes / No



Appendix 3: Known community seedbanks operating in Australia

Location	Organisation	Seedbank title	State
Canberra	Greening Australia	Upper Murrumbidgee Seedbank	ACT
Albury	Greening Australia	Albury Regional Seedbank	NSW
Armidale	Greening Australia and Armidale Tree Group	North-west Regional Seedbank	NSW
Coolah	STIPA Native Grass Association	Seedbank	NSW
Deniliquin	Greening Australia NSW	Murray Indigenous Seedbank	NSW
Dorrigo	Greening Australia NSW	North Coast Regional Seedbank	NSW
Glenbrook	Australian Plant Society	Seedbank	NSW
Griffith	Greening Australia	Griffith Regional Seedbank	NSW
Maitland	Greening Australia NSW	Hunter Regional Seedbank	NSW
Molong	Greening Australia NSW	Central West Regional Seed Bank	NSW
Wagga Wagga	Greening Australia NSW	Wagga Regional Seed Bank	NSW
Walcha	GRO Landcare Group	Seedbank	NSW
West Sydney	Greening Australia NSW	Native Seed Savers Network	NSW
Alice Springs	Tangentyere Council Inc. and Greening Australia	Alice Springs seedbank	NT
Alice Springs	Centralian Land Management Association Inc.	Seedbank	NT
Darwin	Greening Australia	Darwin Seedbank	NT
Katherine	Victoria River District Conservation Association	Seedbank	NT
Greenbank	Society for Growing Australian Plants	Seedbank	QLD
Rockhampton	Central Queensland University	Native Plant Seedbank	QLD
Brisbane	Greening Australia - Queensland Inc	Brisbane Seedbank	QLD
Yeppoon	Livingston Shire Council; Remnant Vegetation Study Group	Capricorn Seed Bank Project	QLD
Adelaide	Trees for Life Inc	Trees for Life Seedbank	SA
Flaxley	Greening Australia SA/Trees for Life/ Nature Conservation Society SA	Flaxley Regional Seedbank	SA
Goolwa	Hindmarsh Island Landcare Group	Seedbank	SA
Loxton	Greening Australia SA/Trees for Life/ Nature Conservation Society SA	Loxton Regional Seedbank	SA
Murray Bridge	Rockleigh - Mypolonga Native Vegetation Assn	Seedbank	SA
Parndana	Kangaroo Island Landcare	Kangaroo Island Landcare Seedbank	SA
Port Lincoln	Greening Australia SA/Trees for Life/ Nature Conservation Society SA	Eyre Peninsula Community Seedbank	SA

Location	Organisation	Seedbank title	State
Strathalbyn	Northern Lake Alexandria & Angus Bremer Landcare Group	Seedbank	SA
Hobart	Greening Australia (Tasmania) Inc	Tasmanian Regional Seed Supply Service	TAS
Bamawm	Lockington Landcare Group	Seedbank	VIC
Bendigo	Parks Victoria	Seedbank	VIC
Creswick	Ballarat Environment Network (BEN)	Ballarat Region Indigenous Seedbank	VIC
Dimboola	NRCL - Wail Nursery	Seedbank	VIC
Mildura	Greening Australia Victoria	Mallee Indigenous Seed Collection	VIC
Portland	ALCOA and Greening Australia	Portland Regional Seedbank	VIC
Swan Hill	Greening Australia	Swan Hill Regional Seedbank	VIC
North Fremantle	Apace Aid Inc.	Seedbank	WA