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Australian Government



Across all of our Project Phoenix activities and actions we pay respect to the Traditional Owners and Custodians of the lands and waters on which we work. We honour the resilience and continuing connection to country, culture and community of all Aboriginal and Torres Strait Islander people across Australia. We recognise the decisions we make today will impact the lives of generations to come.



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EXECUTIVE SUMMARY

Having a healthy native seed sector is critical for Australia's native vegetation restoration goals. Unfortunately, Australia's native seed sector suffers from a number of issues including:

- low diversity of available species
- genetic bottlenecking and
- perceived future rise in demand for native seed being unable to be met through wild harvest.

Seed Production Areas (SPAs) are areas planted with native plants in order to harvest their seed, and are proposed to address these issues. Despite this, SPAs make up only a small section of our native seed industry.



With demand for seed predicted to grow, understanding SPAs and developing this section of the native seed industry is becoming increasingly important.¹ There is currently little data on SPAs.

As part of the national response to the 2019–20 Black Summer bushfires, Greening Australia received \$5 million dollars in initial funding from the Australian Government to create a tenyear strategic program to build and secure native seed and plant supply going forward.² The program, called Project Phoenix, included a comprehensive national survey on SPAs. The survey has two aims:

- 1. to understand the current capacity of Australia's SPAs and
- 2. to investigate how SPAs might best be supported and developed, as a section of the native seed industry.

Murray Local Lands Services was commissioned by Greening Australia to undertake the survey. This report analyses and presents the results of the survey.

The survey found that SPAs would likely contribute 5.5 tonnes of seed per annum to the native seed sector. Only a portion of this will be available for purchase, with most SPAs using their seed for in-house rehabilitation projects.

¹ Hancock, N., Gibson-Roy, P., Driver, M. and Broadhurst, L. (2020). *The Australian Native Seed Sector Survey Report*. Australian Network for Plant Conservation, Canberra.

² Logan, 2020, Native Seed Collection And Propagation The Next Boom Industry, Research Says ABC News, <u>https://www.abc.net.au/news/2020-10-09/native-seed-collection-and-propagation-the-next-boom-industry/12733242</u> accessed 12 December 2020.



Areas identified for improvement within the SPA sector include:

- increased levels of First Nations Land Management in the SPA sector
- greater access to expertise
- securing long-term funding and
- creating consistent demand to reduce the risk of investment in SPAs.

Other findings include:

- most SPA management was undertaken by not-for-profit organisations
- most SPAs were government funded
- seed sales rarely covered SPA costs
- multi-use SPAs provided alternate sources of funding that covered some SPA costs
- there was an association between SPAs' greater costs in labour and SPAs which produced higher seed yields
- physical maintenance was the most important factor in the success of an SPA
- more SPAs are being planted on government lands due to lack of long-term control over private lands
- the distance to SPAs from management organisations was a surprising factor in their success or failure, with closer SPAs reducing the barriers to monitoring and maintenance.

It is hoped that the findings of this report will assist in informing long-term strategies surrounding Australia's seed sector and SPAs in particular.

SPAs AND WHY WE NEED THEM

Australia's native seed sector suffers from a number of issues including:

- overharvesting of wild stands, exacerbated by a deteriorating natural environment
- low diversity of species in available seed
- debates around local provenance appropriate seed collection ranges
- low genetic diversity in harvested seed (genetic bottlenecking) and
- perceived future rise in demand for native seed being unable to be met through wild harvest.



Issue 1: Overharvesting of wild stands

The Australian native seed industry is heavily reliant on wild stands for much of its seed supply.³ Mortlock suggests that many areas *already* overharvest wild stands.⁴ Broadhurst *et al* identify increased pressures on wild seed supply including:

- the effects of the Millennium drought
- long-term impacts of collecting seed from fragmented populations and
- environmental change more broadly.⁵

Moreover, many in the industry believe that wild stands are not producing the same amounts of seed.⁶ The *Australian Native Seed Survey Report 2020* noted comments such as:

'Over the past 20 years I have seen a significant decline in wild populations in my region'

Australian Native Seed Survey Report 2020, p. 25

Issue 2: Local genetics for revegetation

In addition to overharvesting, best practice restoration guidelines recommend that revegetation programs use seed sourced from local provenances to avoid genetic *out-breeding* of unique genetics of local populations.⁷ Ensuring seeds come from local areas also prevents the spread of diseases such as *Phytophthora* (which causes dieback).

Despite this, seed used in revegetation projects is often purchased from state-wide, interstate and occasionally even international sources.⁸

Issue 3: Genetic bottlenecking

While local provenance is historically considered best practice, there is a growing argument that wild harvesting methods, and very localised provenances from very small ranges, are reducing genetic diversity within species.⁹

³ Broadhurst, L., Driver, M., Guja, L., North, T., Vanzella, B., Fifield, G., Bruce, S., Taylor, D., & Bush, D. 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12148</u>, accessed 19 December 2020; Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*; Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*, pp. 93–101.

⁴ Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*, pp. 93–101

⁵ Broadhurst *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*.

⁶ Hancock *et al.* 2020. The Australian Native Seed Sector Survey Report.

⁷ Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.

⁸ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

⁹ Broadhurst, L., Waters, C., & Coates, D. 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples From the Flora of Southern Australia', *Rangeland Journal*, pp. 487–498; Broadhurst et al. 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*; Hancock et al. 2020. *The Australian Native Seed Sector Survey Report*; Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.



The fragmentation of remnant bushland areas has likely led to the decreased genetic health of wild harvested seed. This is exacerbated by the fact that most wild seed is harvested from especially small and dispersed native vegetation populations: private land and roadsides.¹⁰ In one particularly extreme example of genetic bottlenecking, a revegetation program running for many years sourced seed for one species from a *single* parent plant, consequently narrowing the genetic profile of all seed naturally formed from revegetated areas.¹¹

Issue 4: Seed supply and demand

As well as these issues, the *Australian Native Seed Survey Report 2020* found that most seed purchasers believed there would be an increase in demand in the future. Seed collectors, seed purchasers and SPA owners alike listed **'Future demand for seed will be difficult to meet from wild harvest'** as the single most important issue needing to be addressed by the industry.

While the survey also outlined the fact that this demand was based on limited data and hard to forecast beyond more than two years, revegetation methods are changing to lower their costs, including uses of drones.¹²

The effect of this will increase the volumes of seed required for revegetation programs, and overall demand for native seed.¹³ The rise in popularity of direct-seeding is one factor straining supply.¹⁴ The uptake of participation in carbon markets and biodiversity schemes is also flagged to increase seed demand.¹⁵

Issue 5: Species diversity in revegetation programs

Revegetation programs across Australia suffer from low species diversity.¹⁶ Sixty per cent of seed collectors often received requests for 'less than 20' species. This was contributed to by:

- low species availability
- the cost of assembling species-diverse seed mixes and
- the fact that restoration programs largely focus on tree and shrub layers.

¹⁰ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

¹¹ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

¹² Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

¹³ Ibid.

¹⁴ Logie, S. 2020. Audit of Seed Production Areas in NSW Report; Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.

¹⁵ Hancock et al. 2020. *The Australian Native Seed Sector Survey Report*.

¹⁶ Ibid.



How SPAs help

SPAs are seen to solve many of the above issues. SPAs are an alternative to wild harvesting, and can relieve pressure on remnant populations.¹⁷

By revegetating degraded areas for native seed production, and directing seed collecting pressure away from wild areas, it is hoped that wild populations retain their seed as a continuation of their life cycles and increase the total amount of habitat.¹⁸

The Australian Native Seed Survey Report 2020 found that the statement 'any shortfalls in demand for seed should come from seed production areas rather than wild populations' was the sixth most important issue (among 13 issues) for those in the seed sector.¹⁹

SPAs are also hoped to be a means of increasing gene flow amongst selected populations. Conversely, they can be used to avoid *unintentional* genetic flow.²⁰ By bringing together fragmented gene pools within a local landscape, seedlings that are genetically robust and have unique local genetic profiles are able to be propagated.²¹ They are also thought to enhance disease control by limiting seed sourced from interstate, and increase species diversity.²²

KEY POINTS

SPAs address:

- overharvesting from wild stands
- genetic issues such as low diversity or maintaining unique genetic profiles
- future seed supply shortages
- lack of diversity in seed of species available.

DEFINING SPAs

According to Nevill et al. SPAs are areas that are

'purpose-designed for seed production and can be established as monocultures or species mixtures. They exist at many scales...'.²³

- ¹⁹ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.
- 20 Ibid.

¹⁷ Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*; Gibson-Roy, P., Moore, G., Delpratt, J., & Gardner, J. 2010. 'Expanding Horizons for Herbaceous Ecosystem Restoration: The Grassy Groundcover Restoration Project', *Ecological Management & Restoration*, pp. 176–186; Nevill, P. G., Tomlinson, S., Elliott, C. P., Espeland, E. K., Dixon, K. W., & Merritt, D. J. 2016. 'Seed Production Areas for the Global Restoration Challenge'. *Ecology and Evolution*, pp. 7490–7497; Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*; Logie, S. 2020. *Audit of Seed Production Areas in NSW Report*.

¹⁸ Nevill et al. 2016. 'Seed Production Areas for the Global Restoration Challenge', Ecology and Evolution.

²¹ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

²² Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

²³ Nevill et al. 2016. 'Seed Production Areas for the Global Restoration Challenge', *Ecology and Evolution*.



The Australian Network for Plant Conservation defines them as:

'plant populations established under field or nursery conditions with the primary or secondary objective of seed production'.²⁴

A number of defining parameters to SPAs have been set up for this survey in order to limit the scope of the project. This report defines an SPA as:

- made up of Australian native species
- made up of deliberately planted plants (this could be achieved through various means, e.g. direct sowing, planting seedlings etc.)
- having been established for the purpose native regeneration/restoration
- having known or documented seed origin.

As with Hancock *et al.*, this survey and report distinguish between tree seed orchards, which are designed with commercial considerations in mind, and restoration-focused SPAs, which aim to produce seed reflecting wild genetic diversity.²⁵



Additionally, it was preferred that SPAs were genetically diverse, i.e. plants were sourced from more than one population. Forestry-related SPAs fell out of scope, as their trees are bred for commercial traits.²⁶

DATA ON SPAs

Despite the fact that SPAs are seen as a solution to issues facing the native seed industry, they are relatively uncommon in the Australian landscape. Their contribution to Australia's revegetation seed market has been small, but is growing, with the *Australian Native Seed Survey Report 2020* estimating that 33% of seed purchasers source seed from SPAs.²⁷



There is currently little data on SPAs. There is no data on SPAs available from the Australian Bureau of Statistics and to date, only two surveys have attempted to directly gather large scale data: the *Australian Native Seed Survey Report 2020,* by the Australian Network for Plant Conservation, and the *Audit of the Seed Production Areas in NSW Report,* by Sue Logie (under the auspices of the Australian Network for Plant Conservation).

²⁵ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

²⁷ Logie, S. 2020. Audit of Seed Production Areas in NSW Report, <u>https://www.anpc.asn.au/wp-</u>

²⁴ Australian Network for Plant Conservation, *Guideline 7: Seed Production Areas for Woody Native Plants*, <u>https://whitsundaylandcare.org.au/wp-content/uploads/2020/04/Guideline-7-Seed-Production-Areas.pdf</u> accessed 12 January 2021, p. 3

²⁶ Ibid..

<u>content/uploads/2020/12/Final-Edited-Audit-SPA-NSW-Report-</u> <u>Consortium-Adopted.pdf</u> accessed 21 March 2021; Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*, p. 40.



The following aims to collate information on SPAs derived largely from these two surveys, as well as the broader literature.

Number and location

The Australian Native Seed Survey Report 2020 surveyed 24 SPA growers. It is loosely inferred, but not confirmed, that these were all from separate SPA management organisations. The survey did not find any SPAs in Western Australia, Tasmania or the Northern Territory. However, there has been publicity about SPAs in Western Australia.²⁸ Additionally, over two-thirds of the sample of SPA growers was found in Victoria.

The *Audit of Seed Production Areas in NSW Report* gathered data on three SPA management groups covering 16 SPAs in NSW/ACT.

KEY POINTS

Most SPAs are located in Victoria. No SPAs in Tasmania, the Northern Territory or Western Australia have been identified or surveyed.

Seed demand

SPA growers need consistent and predictable seed demand to justify the investment of creating and maintaining SPAs. However, demand for native seed across the native seed industry is erratic and irregular. This is due to:

- short-term environmental program funding and
- changing priorities in the programs over time.



While there is no known data on the exact amounts of seed used across Australia, demand is greatly affected by 'big users' such as mining companies and government projects. These players use 94% of available seed and greatly outweigh small-scale landholders wishing to revegetate their landscapes.²⁹

Plant type

In 2020, across the native seed industry, tree and shrub seeds were the most in-demand plant types (as a result of restoration programs focusing on these plant types), followed by grasses and wildflowers.³⁰ While revegetation programs continue to focus on trees and shrubs, there is growing desire from the ground-up to include grasses and forbs in revegetated sites.³¹ There is also increasing interest in grasses for agricultural use, though currently no large-scale uptake.³²

²⁸ Ibid.

²⁹ Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.

³⁰ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

³¹ Ibid.

³² Ibid.



It is also thought that demand for wildflower seed could pick up in the future should the technique of interspersing grass seed with wildflower seed become widespread.³³

Surplus

In 2020, there was a small surplus of shrub seed, as it is easier to collect than other plant types. There was also a small surplus of grass seed, despite increasing interest in grass seed not only for revegetation projects, but also for agricultural pastures and roadside vegetation.

Species diversity

While SPAs were seen to increase the diversity of species available to the revegetation market, the *Australian Native Seed Survey Report 2020* found that while some SPAs grew over 100 species, most grew less than 10 species.



SPAs (on the whole) are not currently increasing the number of species available in the native seed market.

Pedrini *et al.* suggest SPAs should grow both easily cultivated species AND those with specific need for restoration, regardless of ease of cultivation.³⁴ Exotic plants are discouraged as they reduce native seed production.³⁵

KEY POINTS

- 94% of native seed is used by mining and government projects.
- Demand for native seed is erratic and project based.
- Shrubs and trees were the most in demand plant type.
- Growing interest in native grasses for agriculture and roadsides, and changes in seeding techniques may lead to increased demand for grass and wildflower seed.
- Most SPAs don't currently add to the market's diversity of species.

Size

Most SPAs across Australia are smaller than 5ha. Only 6% of SPAs were 31–100ha. There were no SPAs above 100ha. These sizes may be compared to the United States (US), where SPAs of 1000+ ha are common. The *Audit of Seed Production Areas in NSW* found that sites smaller than 2ha were too small to be cost effective.

³³ Ibid.

³⁴ Pedrini, S., Dixon, K. W., Cross, A. T., Gibson-Roy, P., Trivedi, C., Galvez-Ramirez, C., Hardwick, K., Shaw, N., Frischie, S., Laverack, G., & Dixon, K. 2020. Collection and Production of Native Seeds for Ecological Restoration. *Restoration Ecology*, <u>https://doi.org/10.1111/rec.13190</u> accessed 16 March 2021.

³⁵ Cook-Patton, S. C., & Agrawal A. A. 2014. 'Exotic Plants Contribute Positively to Biodiversity Functions but Reduce Native Seed Production and Arthropod Richness', *Ecology*, pp. 1642–1650.



SPA systems

Many SPAs used more than one system in growing plants. Eighty-nine per cent of SPAs were field grown cropping systems, followed by in-ground weed-mat systems (50%) and containerbased systems (28%). First Nations communities are also taking the opportunity to re-envision traditional cultivation of native species with a business twist.³⁶

Other SPA design findings

When planting shrub SPAs, rows that were too close together and not pruned resulted in difficult to access seed and an increased amount of derelict SPAs.³⁷ It is suggested that seed should ideally be collected in the early, productive years in order to stock seed banks for future plantations.³⁸

Pre-ordering vs opportunistic purchases

SPA growers sold seed both opportunistically and with purchasers pre-ordering before harvest. In 2020, they had slightly more opportunistic sales than pre-ordered sales. The higher rate of opportunistic purchases is unusual for the seed industry, with most seed being collected to order.

Funding

The *Australian Native Seed Survey Report 2020* found that most small-scale SPAs were established with public funding, and a smaller number of large-scale SPAs were privately financed and operated.

Public vs private land

Sixty-three per cent of SPAs were established on private property, with the remainder having been established on government land of various kinds, though not national parks. Gibson-Roy *et al.* argue long-term outcomes are most reliably met on private land, due to engaged families' strong connection to their land.³⁹ However, the *Audit of Seed Production Areas in NSW Report* found that public land was preferred, as low private landholder commitment contributed to low SPA success.



The report recommended that where SPAs were to be planted on private land, owners showing *a track record of commitment* should be prioritised.

Labour

In 2020, the Australian native seed sector had large numbers of volunteers sustaining it.⁴⁰

³⁶ Pezet, L. 2014. *Indigenous Communities Meeting Demand for Bush Medicine*, ABC Rural. <u>https://www.abc.net.au/news/rural/2014-03-12/growing-bush-medicine/5313118</u> accessed 14 March 2021.

³⁷ Logie, S. 2020. Audit of Seed Production Areas in NSW Report

³⁸ Ibid.

 ³⁹ Gibson-Roy, P., Moore, G., Delpratt, J., & Gardner, J. 2010. 'Expanding Horizons For Herbaceous Ecosystem Restoration: The Grassy Groundcover Restoration Project', *Ecological Management & Restoration*, pp. 176–186.
 ⁴⁰ Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*.



Database use

SPAs in NSW largely used paper-based systems (33%), followed by complex computer database systems such as *Access* (26%) and Excel spreadsheets (22%).⁴¹

SPA cost of establishment vs renovation

For *shrub* SPAs developed in partnership with private landholders (where maintenance is undertaken by landholders), establishment was less expensive than SPA renovations.⁴² For SPAs sized 2–7ha, planted SPA establishments were costed at \$18,850, direct seeded SPA establishments were costed at \$10,500 and SPA renovations were costed at \$21,300. These costings did not take into account future maintenance.

The higher cost for SPA renovation was attributed to the greater variety of tasks, and consequently more coordination, required. It should be emphasised that these costs are specific to these type of SPAs.

KEY POINTS

- SPA sites smaller than 2ha were not cost effective.
- The native seed industry is supported by large numbers of volunteers.
- Establishing shrub SPAs (that are established in partnership with private landholders) is cheaper than renovating existing SPAs.

Barriers for SPAs

Funding shortages

Since the mid-2000s, government priorities have pivoted away from revegetation towards restoration. The resulting funding shortages and inconsistencies are a primary issue affecting Australia's native seed industry.⁴³ Although SPAs represent a more sustainable supply of native seed in Australia, their considerable upfront speculative financial cost and risk require regular funding or market demand.⁴⁴ Lack thereof hampers any prospects of their long-term success.⁴⁵

In the US, there is a strong native seed industry.⁴⁶ Several researchers suggest Australia has not achieved the same level of industry because it has lacked a clear, long-term strategy and failed to commit funding over longer time frames.⁴⁷

⁴¹ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

⁴² Ibid.

⁴³ Logie, S. 2020. Audit of Seed Production Areas in NSW Report; Hancock et al. 2020. The Australian Native Seed Sector Survey Report; Broadhurst et al. 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples from the Flora of Southern Australia', Rangeland Journal, pp. 487–498.

⁴⁴ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

 ⁴⁵ Nevill *et al.* 2016. 'Seed Production Areas for the Global Restoration Challenge', *Ecology and Evolution*.
 ⁴⁶ Gibson-Roy, P. 2018. 'Restoring Grassy Ecosystems: Feasible or Fiction? An Inquisitive Australian's Experience in the USA'. *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12327</u> accessed 12 December 2021.
 ⁴⁷ Broadhurst *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*; Broadhurst *et al.* 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples From the Flora of Southern Australia', *Rangeland Journal*.



Workforce turnover

These funding shortages have led to problems around workforce succession. Knowledge and experience acquired over decades risk being lost as many seed collection staff are approaching retirement age.⁴⁸



For the state of NSW, it was found that lack of ongoing funding and issues with staff continuity have contributed to few actively managed SPAs remaining in the state.⁴⁹

Other barriers

The *Audit of Seed Production Areas in NSW Report* asked SPA growers in NSW what barriers they faced. These included:

- climate change causing seed decline
- access to wild seed stands
- unduly arduous seed collection permit process
- seed purchasers not understanding seed requirements (e.g. harvest times)
- lack of planning, coordination and tracking of restoration works
- funding variability/market demand variability
- retaining staff with skills and expertise
- high risk of investment in SPAs
- access to knowledge
- SPA design.

The audit found that 51% of government agencies and 61% of non-government agencies that collected seed did not have permits to do so. Furthermore, those who did have permits did not always comply with its 'Endangered Ecological Communities' terms. Permit processes were perceived as overly complex, slow, and a waste of time for small amounts of seed.

KEY POINTS

- Lack of funding or consistent market demand makes the investment required to create and maintain SPAs hard to justify.
- Workforce succession and labour are being affected by funding shortages.
- Overly complex seed collection permit processes led to most organisations not having seed collection permits.

⁴⁸ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.
⁴⁹ Ibid.



Limitations of SPAs

While SPAs could solve many of Australia's native seed industry issues, they are not without their disadvantages.

Limited lifespan

The Audit of Seed Production Areas in NSW Report found that many species used in SPA production have a limited lifespan, requiring regular maintenance and replanting/renewal to meet ongoing demand.⁵⁰ However, it is worth noting that since such declines in seed productivity are a natural feature, they also affect remnant populations when they are unable to regenerate due to fragmentation.

The literature suggests that growers undertake judicious pruning or low-intensity burns to stimulate new plant growth.⁵¹

Current price of seed does not cover costs

A major issue identified as affecting the viability of the native seed industry is a market that is currently unwilling or unable to meet the true cost of production and collection.⁵² Additionally, major fluctuations in market demand mean businesses can't invest or plan for the long-term.⁵³

Furthermore, habitat fragmentation and climate change pose significant challenges to the seed industry and future costs will need to account for these factors.⁵⁴

KEY POINT

Seed production areas are limited by the fact that current price of seed does not cover the true costs of production and collection.

Opportunities for SPAs

The NSW Audit on Seed Production Areas identified the following as opportunities for SPAs:

- SPAs established on travelling stock reserves (TSRs) have potential for revenue in a more consistent market and
- revegetation projects could be redesigned as SPAs.

The latter has a better cost-benefit ratio than revegetation projects alone. However, they require increased funds for planning, design, seed collection and database management.

⁵⁰ Logie, S. 2020. Audit of Seed Production Areas in NSW Report

⁵¹ Gibson-Roy, P. 2018. 'Restoring Grassy Ecosystems: Feasible or Fiction? An Inquisitive Australian's Experience in the USA'. *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12327</u> accessed 12 December 2021; Logie, S. 2020. *Audit of Seed Production Areas in NSW Report.*

⁵² Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

⁵³ Ibid; Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

⁵⁴ Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report;* Broadhurst, L., & Coates, D. 2017. 'Plant Conservation in Australia: Current Directions and Future Challenges'. *Plant Diversity*, pp. 348–356, <u>https://doi.org/10.1016/j.pld.2017.09.005</u> accessed 14 December 2020.



Recommendations to support SPAs

The literature has recommended four changes to support SPAs:

- 1. Better identification of the location of 'big users' of native seed, so that their impact on the seed industry can be planned for, and utilised for market demand.⁵⁵
- 2. The national implementation of industry standards and a peak industry body.⁵⁶ The *FloraBank Guidelines* may already function as de facto national standards to some degree, having gained a level of acceptance in the industry since they were first published 20 years ago.⁵⁷
- More research on how to mitigate against climate change and landscape fracturing for native seed production.⁵⁸
- More comprehensive genetic testing and planning in the sector.⁵⁹

Additionally, the *Audit on Seed Production Areas in NSW Report* identified the following as requiring investment:

- regional technical support, training and research
- regional coordination in project development, funding and delivery
- regional SPA development and support funding and coordination
- refining native seed collection permit systems and tracking codes of practice
- investing in high value palatable species.⁶⁰

⁵⁵ Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*

⁵⁶ Nevill *et al.* 2016. 'Seed Production Areas for the Global Restoration Challenge', *Ecology and Evolution*; Broadhurst, L., Waters, C., & Coates, D. 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples From the Flora of Southern Australia', *Rangeland Journal;* Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report.*

 ⁵⁷ Broadhurst *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration;* Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report.* ⁵⁸ Broadhurst & Coates 2017. 'Plant Conservation in Australia: Current Directions and Future Challenges'. *Plant Diversity.*

 ⁵⁹ Broadhurst, L. M., Fifield, G., Vanzella, B., & Pickup, M. 2015. 'An Evaluation of the Genetic Structure of Seed Sources and the Maintenance of Genetic Diversity During Establishment of Two Yellow Box (*Eucalyptus Melliodora*) Seed Production Areas', *Australian Journal of Botany*, *63*(5), 455–466. <u>https://doi.org/10.1071/BT15023</u>, accessed 7 March 2021; Nevill *et al.* 2016. 'Seed Production Areas for the Global Restoration Challenge', *Ecology and Evolution;* Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report.* ⁶⁰ Logie, S. 2020. *Audit of Seed Production Areas in NSW Report.*



METHODOLOGY

Aim

The survey was designed to answer two main questions surrounding Australia's SPAs:

- 1. What is their current capacity?
- 2. How might SPAs best be supported and developed, as a section of the native seed industry?

Sampling

The survey methodology was designed to identify SPA managers and allow as many as possible to participate.

Three methods were employed to identify SPA managers:

- **1.** Each regional NRM body in Australia was emailed or called to discuss likely SPAs or contacts who may know of SPAs. At least two attempts at contact were made.
- 2. Internet searches for seed production areas, seed orchards or native grasslands were undertaken. At least two attempts at contact were made with potential contacts.
- 3. Key industry players were called or emailed for SPA contacts. At least two attempts at contact were made with contacts provided.

A further method was developed during the course of the surveys: asking survey participants if they knew of any other SPAs, and their contact details. This method proved the most fruitful means of getting survey participants, with at least one manager commenting:

'I wasn't going to do the survey, but then I saw the email from [..] so I thought I should.'

Contributor quote

Table 1 shows the amount of contacts and survey participants provided using each method.



TABLE 1. SUCCESS RATES OF METHODOLOGIES IN IDENTIFYING SPA MANAGERS

METHOD	INITIAL CONTACTS	CONTACTS PROVIDED	DUPLICATES	TOTAL COMMUNICATION ATTEMPTS	SURVEY PARTICIPANTS (NOT INCLUDING POTENTIAL PARTICIPANTS WHO COULD NOT BE SURVEYED)	POTENTIAL PARTICIPANTS IDENTIFIED (WHO COULD NOT PARTICIPATE WITHIN THE SURVEY TIME-PERIOD)	SURVEY RESPONSE RATE PER METHOD
Regional NRM body	56	52	10	240	3	1	2%
Internet search	n/a	9	n/a	18	5	1	55%
Key players	5	28	6	40	3	1	11%
Participants	n/a	35	6	30	19	4	65%

Of the methods employed to identify SPA managers, asking current survey participants for contacts proved the most effective, followed by internet searches. Asking key players was useful in identifying initial participants, but became less useful. Asking NRM regional bodies proved to be an inefficient means of identifying SPA managers.

The survey was open between 22 February and 23 March. All surveys were conducted by phone. The management structures of SPAs were complex, and required interviewing multiple participants for an individual SPA, or one participant for many SPAS. For example, one organisation coordinated 16 SPAs, each in partnership with a separate landholder. The interviewer engaged where possible, the coordinator for these SPAs as well as private landholders.

One hundred and thirty SPAs, 32 survey participants, 30 contributions and 17 SPA management organisations were captured in the survey (contributors being the total participants after two managers for the same SPA and their answers were pooled).

A further seven SPA managers from seven SPA organisations were identified but unable to undertake the survey in the survey period.



Location

Postcode data gathered showed the vast majority of SPAs surveyed were located in Victoria (60%) (See **Table 2** and **Figure 1** below). NSW/ACT SPAs were also well-represented (28%). No SPAs were found in the Northern Territory or Tasmania. This is likely due to the small number of NRM authorities in these regions, which limited contact points or 'ins' into SPAs in the area. One SPA was identified in Tasmania but was not available for surveying during the survey period. At least three additional SPAs were identified in WA but they did not respond to requests to complete the survey.

TABLE 2. NUMBER OF SPAS SURVEYED PER STATE

VIC	N S W	SA	WA	QLD	TAS	ΝT
78	36	6	7	3	0	0

The interviewer noted that the terms 'seed production areas' or even 'seed orchards' were less familiar in the northern parts of Australia. This may be due to:

- the greater numbers of wild stands that still exist in northern Australia, making SPAs less necessary than in southern Australia
- increased difficulty of SPAs with rainforest species, as they cannot be dried and stored.⁶¹



FIGURE 1. SPA LOCATIONS

⁶¹ Royal Sydney Botanic Gardens, n.a. *Rainforest and Dryland Seeds*, <u>https://www.rbgsyd.nsw.gov.au/Science/Rainforest-Conservation-Research/Rainforest-Seed-Conservation-Project/Rainforest-Seeds/Rainforest-and-Dryland-Seeds</u> accessed 20th April 2021.



Analysis

This survey deals with two different sample sizes: number of SPAs and number of contributors. Data on SPA capacity was frequently weighted against total number of SPAs, whilst data on opinions (e.g. barriers) was weighted against total number of contributors. This was to avoid contributors' opinions being weighted with the total number of SPAs that they managed (e.g. 16 times when they managed 16 SPAs).

The current total number of SPAs in Australia is unknown. The interviewer conservatively estimated that the survey covered circa 50% of SPAs nation-wide. This was based on:

- numbers and locations of SPAs captured in the Australian Native Seed Survey Report 2020
- conversations with participants (e.g., contacts in Victoria often recommended the same SPAs)
- the seven participants the interviewer was unable to include in the study due to time constraints
- the number of SPA respondents who were contacted but did not participate
- allowing for not having been made aware of some SPAs
- the likelihood that participants who managed larger numbers of SPAs were captured, with SPA managers managing only a few SPAs less likely to be well known.

If it is estimated that 53% of SPAs nation-wide were captured in the survey, the survey sample size (n=130) was statistically significant to a confidence level of 90%, with a margin of error of 5%. A confidence level of 95% (a more commonly used confidence level) required the survey to have captured 67% of SPAs. Findings in this report should be used with caution.



The interviewer conservatively estimated that they had captured circa 50% of contributors from Australia's total population of SPA managers. However, the sample size of n=30 did not produce a statistically significant sample.

For a confidence level of 90%, with a 5% error rate, 50 contributions would have had to have been captured. Therefore, findings on the opinions of contributors should be used with even greater caution, and further surveys should be undertaken before recommendations based on these are acted upon. Given that the population of SPAs across Australia is currently an estimate, the findings of this report should be used with caution.



KEY POINTS

- 130 SPAs were captured in this survey. It is estimated that this is 53% of the total number of SPAs in Australia, making the results statistically significant to a confidence level of 90% and a 5% margin of error.
- Only 30 contributors were captured in this study. Consequently results surrounding barriers, success factors and industry-wide support cannot be considered as statistically significant.

Design

The survey had 31 questions that were organised according to priority of answers determined by Greening Australia. They covered data on location, size, output, costs, types of organisations involved, barriers, success factors, ideas for funding opportunities and means of building capacity. A full version of the questionnaire can be found in Appendix A.

Questions were multiple choice, checkbox or open-ended. Open-ended responses were chosen where possible so as to not prime participants towards a particular answer and allow new ideas to emerge.⁶² Surveys were by phone for maximum participation and to capture additional insights.

Other considerations

Some participants considered Greening Australia (GA) as an SPA competitor, and as a result GA's involvement in the project was perceived as a conflict of interest by some participants. Data of the survey was made unidentifiable to Greening Australia, and the report on the industry will be made public. Other information provided by participants will be securely stored and comply with the Australian Privacy Principles. The data will not be used by Greening Australia except to meet the activity objectives of Project Phoenix. Additionally, it was made clear to all participants that all parts of the survey were voluntary, and they were not obliged to answer any one question or the survey as a whole.

Limitations

The limitations of the survey included:

- ad hoc participant selection
- time constraints
- distrust by potential participants with regard to how the survey information will be used
- small sample sizes.

⁶² Züll, C. 2016. 'Open-Ended Questions'. *GESIS Survey Guidelines*. Leibniz Institute for the Social Sciences. DOI: 10.15465/gesis-sg_en_002.



Participants were selected on the basis that the interviewer knew their SPA, they had sufficient contact details to be contacted, and they had the time to undertake the 30 minute to one hour phone call with the interviewer within the survey period of the project.

The interviewer largely knew about potential survey participants through the methodical search process detailed above. There is a likelihood that some SPA owners remained unknown to the interviewer. Consequently, they were not contacted and their voices are not represented in this study.



The period of the survey was limited to five months between mid-November 2020 and mid-April 2021. This period fell in the seed collection period for SPA managers (January–March), and limited the period in which surveys could be collected. Additionally, many SPA managers were time poor and limited in their capacity to take part in the survey.

Three potential survey participants declined to participate in the study due to Greening Australia's involvement in the project, given GA was viewed as a competitor. Additionally, two survey participants hesitated because of this before participating. It is likely that more SPA managers did not respond to contact by the interviewer for this reason.

RESULTS

All SPAs were deliberately planted or sown with plants of Australian native species. All 130 SPAs, bar one, had known or documented the origin of the plants.

All 130 SPAs, bar two, sourced SPA plants from more than one population. For those two, this was a deliberate choice to retain the unique local genetic identity.

All SPAs, bar two, were established for revegetation purposes. Two SPAs were initially revegetation sites whose origin of the plants had been recorded, and seeds subsequently collected from.

Informal discussions with contributors revealed that many SPAs also had goals surrounding the genetics of their species. For example, many SPAs were created to connect dispersed and shallow gene pools of threatened species, and establish new populations of genetically robust plants. Another SPA manager aimed to grow seed with only local genetics.



Size

FIGURE 2. SPA SIZES (HECTARES)

Size (ha)		No of SPAs	
0-0.99	25		
1-1.99	3	0	20
2 - 2.99	28	0	28
3 - 3.99	3		
4 - 4.99	3		
5 - 5.99	11		
6 - 6.99	0		
7 - 7.99	1		
8 - 8.99	2		
9 - 9.99	0		
10 - 10.99	0		
11 - 11.99	0		
12 - 12.99	0		
13 - 13.99	1		
14 - 15	1		

Seventy-eight of the 130 SPAs recorded their size. The average sized was 2.66ha and median (distribution midpoint) was 2.7ha. Sizes ranged from 0.02–15ha. **Figure 2** shows 71% of SPAs were smaller than 3ha.

Year of establishment

FIGURE 3. YEAR OF SPA ESTABLISHMENT



Figure 3 shows surveyed SPAs were established from 1994, onwards. Each year up to 2018, up to six SPAs were established, after which 12, 13 and 14 SPAs were established each year.



At first glance, it may appear as though SPA establishment has grown in recent years. However, it is likely that many SPAs were previously established and discontinued and therefore were not captured in the survey.

The data shows that 41% of SPAs captured were young SPAs aged 1–3 years. The median year of establishment is 2016.



All SPAs established before 1999 were organised and managed by a single organisation, which was a federal government organisation. Trees were the dominant plant type for all the SPAs established before 1999.

SPA management and ownership

FIGURE 4. SPA MANAGEMENT ORGANISATION TYPE



Figure 4 shows SPA management was undertaken largely by not-for-profits (54%), either on their own or in partnership with private landholders. Government was the next largest managing organisation (42%). Private companies (2%), mining companies (1%), Indigenous Protected Areas (1%) and universities (1%) made up only a small percentage of SPAs.

The private partnerships with both not-for-profits and governments referred to private landholders on whose land SPAs were located. Private landholders managed and maintained these SPAs with varying degrees of involvement.



FIGURE 5. GOVERNMENT SPA ORGANISATION TYPE



Figure 5 shows of the government managed SPAs, 37% were local government, 20% by state government and 43% by federal government.

FIGURE 6. SPA LAND OWNERSHIP



Figure 6 shows more than half of SPAs were located on private land, and circa one-third on government land. Of the latter, the interviewer noted contributors didn't always know which government (e.g. local or state) owned the land.

When cross-tabulated against year established, **Figure 7** shows that of the SPAs surveyed, there are greater numbers of SPAs on government-owned land in recent years.



FIGURE 7. SPA LAND OWNERSHIP PER YEAR ESTABLISHED





Number of species

FIGURE 8. SPA NUMBERS OF SPECIES

Number of Species	
1	33.77%
2	3.90%
3	29.87%
4	1.30%
5	0.00%
6	3.90%
7	2.60%
8	2.60%
9	2.60%
10	1.30%
11	1.30%
12	3.90%
13	0.00%
14	0.00%
15	1.30%
16	1.30%
24	1.30%
30	1.30%
50	1.30%
58	1.30%
60	1.30%
70	1.30%
74	1.30%
120	1.30%
% of Total No	
0.00% 33.77%	

There was an average of 10 species per SPA, a median of three, and a range of 1–120 species. This shows most SPAs have only a few species, but a handful of SPAs have many species. **Figure 8** shows that most SPAs have one or three species.

These numbers pose a snapshot in time, with some SPAs having had to scale back plans, and others intended to expand their SPAs to include more species.

Examples:

- One mining SPA 'had to scale it back as what grows in the SPA and in the mine rehabilitation site aren't always the same'.
- One commercial participant spoke of downsizing the number of grass species to only what was efficient to grow and harvest based on the harvesting machinery.





When analysed against plant types (Figure 9), a slight trend towards larger numbers of grasses and forbs and smaller numbers of tree species can be seen.

Plant types

FIGURE 10. PLANT TYPES GROWN PER SPA



Of the plant types grown, most SPAs grew trees (63%) and shrubs (42%), while forbs, grasses and tubers were 14%, 8% and 1% respectively. Many SPAs grew more than one plant type, explaining that the sum of the percentages is greater than 100%.

OJECT PHOENI



When analysed against year of establishment, older SPAs were trees and shrubs, while SPAs with grasses and forbs began to be planted from 2008 (See **Figure 11**). Tubers were only recently planted in 2019.



It should be noted that trees are slower growing and longer living than shrubs, which in turn are slower growing and longer living than grasses and forbs.

While it may be tempting to conclude SPAs used to only plant trees and shrubs, it is more likely that SPAs of other types planted at the time did not survive to take part in this survey. Indeed one participant mentioned the *Grassy Groundcover Restoration Project*, which was started in 2004 and whose SPAs of grass and other groundcover species have not lasted.⁶³

'A lot of the seed production areas that were set up in the early days fell into disrepair e.g. the grassy groundcover research project — that was set up at 15 separate sites across in Victoria. There weren't enough seeds in the field so they had to set up a SPA but they didn't continue on.'

Contributor quote



FIGURE 11. PLANT TYPE PER YEAR ESTABLISHED

⁶³ Greening Australia, 2008. *Transforming Our Landscapes: Grassy Groundcover Research Project Summary Report:* 2004–2007,

https://www.ccmaknowledgebase.vic.gov.au/resources/Grassy Groundcover Research Project 0407.pdf accessed 14 April 2021.



Weight of seed harvested

Fifteen (12%) SPAs were too young to produce seed. Eleven (8%) were unsure of their annual average seed yield. Twenty-seven SPAs (16%), from two organisations, did not collect seed on an annual basis. These SPAs had adequate quantities in storage and collected on an as-needs basis when purchasers requested particular species. Consequently, twenty-three (18%) SPAs reported 0 as their average annual seed yield.

SPAs whose seed weights were entered had a total of 1793.2 kilograms of seed annually collected. Of SPAs that had a collection recorded, weight of seed ranged from 0.1kg-1200kg. While the average annual yield across all SPAs with known seed harvest was 22kg, the median was 0.3kg, showing there were few SPAs with high seed yields, and many with low seed yields, as shown in Figure 13.



Figure 12 shows most seed collected was from grasses and forbs.

Of those that recorded a harvest, 29% sold their seed and 71% used their seed in-house for their own development, rehabilitation and mining projects.



FIGURE 13. KILOGRAMS OF SEED COLLECTED PER PLANT TYPE

PLANT TYPES	0.1	0.15	0.3	1	2	2.3	3	4	5	5.8	6	8.5	14	15	20	25	50	57.5	100	200	1200	TOTAL	TOTAL KILOS/ PLANT TYPE
Forbs		12																				12	1.8
Grasses																		1	1			2	157.5
Grasses and Forbs												1		1			1	1			1	5	1331
Shrubs				3	1				1	1						1				1		8	240.8
Shrubs and Grasses					1																	1	2
Trees	1		19	1			1	2														24	17.8
Trees and Shrubs						1					1		1									3	22.3
Grasses and Tubers															1							1	20
Total count	1	12	19	4	2	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1	56	1793.2



Database tracking

Of the 17 different SPA management groups, 13 used a complex computer database such as *Access* to track the origin of their plants. These organisations covered the overwhelming majority of SPAs (70%). Two of these organisations had their database custom built. A further two organisations, one a small not-for-profit, the other a community group for their older SPAs, used Excel. One organisation used paper based and oral systems. Only one SPA did not use a tracking system, but relied on the knowledge of the seed collector.

Figure 14 shows a list of database attributes collected for each SPA.



FIGURE 14. PERCENTAGE OF ORGANISATIONS THAT COLLECT EACH ATTRIBUTE

When categorised per organisation, it is found that of those that collect data, species name is the most consistent attribute collected. Participants added the following categories under the provided 'other (please specify)' category:

- spread of the tree
- photo of the tree
- number of plants flowering in the population
- proximity to water
- presence/absence of flowers



- herbarium specimen
- number of individuals collected from the site
- plant community in which the plant was found
- potential threats or contaminants
- tree height and diameter
- revegetation zone
- seed crop timing
- aspect.

The first five of these are only referred to once amongst all the organisations who took part in the survey.

KEY POINTS

- Most SPAs are small at 2.7ha.
- No SPA was bigger than 15ha.
- Most SPAs only had up to 10 species.
- Most SPAs were managed by not-for-profits or government, often in partnership with private landholders.
- Most SPAs planted on average only 10 plants.
- There are larger number of grasses and forbs, and smaller number of tree species.
- 71% of SPAs sold seed in-house.
- A total of 1793.2 kilograms of seed was collected from SPAs annually.

Success factors

SPA managers were asked about what factors contributed to the success of their SPA. It was an open-ended question so as not to prime participants towards any particular answer or area of their SPA. SPA managers named 100 separate success factors, which were categorised under 18 different, though related, themes:

- maintenance
- Iocation
- ongoing funding
- good infrastructure


- design
- commitment from others
- access to expertise
- choosing the right species
- good relationships
- good staff
- good database
- weather
- having clear, achievable goals
- having cultural licence to operate
- connection to Country
- having genetically healthy stock
- being certified
- having a long project lead-time.

Often these categories overlapped. For example, one participant listed 'expert staff' as a success factor and this was subsequently categorised under the themes of both access to expertise and good staff.

The themes were ordered against both the number of mentions and number of contributions who mentioned the theme. **Figure 15** gives a breakdown of the themes against the frequency of mentions. Of these, maintenance was the most mentioned (35 times amongst 19 contributions). Location and ongoing funding were the next most mentioned success factors, with 13 (8 contributions) and 12 mentions respectively (11 contributions).







Maintenance

Maintenance covered a number of areas including:

- the importance of consistency
- the need for watering
- access to labour
- importance of weed control
- access to funding for maintenance
- importance of caring for the plants as they were establishing
- regularly monitoring
- having low maintenance SPAs
- checking guards
- soil maintenance
- fencing maintenance
- maintenance towards protecting the plants from fire.



Figure 16 shows their order of importance against the number of participants who mentioned each item.



FIGURE 16. SUCCESS FACTORS: MAINTENANCE SUB-THEMES

SPA managers who mentioned labour talked largely about how helpful access to labour was to them. They mentioned:

- volunteer labour (3 contributions)
- COVID-19 work programs (1)
- Green Corps/Green Army (1)
- having funding to access labour (1).

COVID-19 work and Green Corps programs were used by organisations who had sporadic funding dedicated to their SPAs, and who were used to doing once-off maintenance projects such as pruning and replacement plantings.

Monitoring was mentioned in two contributions, with one referring to their annual formal monitoring program of all individuals of a threatened species, including those within their SPA. The other referred to the more informal practice of regularly checking the site and plants so as to quickly respond to threats such as pest infestations, wilting plants and broken infrastructure.

Watering covered both hand watering and irrigation.

Guard checking and replacing was considered important in an SPA where kangaroos and wallabies were a problem for young plants and seedlings.



Soil maintenance was only mentioned as a success factor by one participant, in reference to the management of soil bacteria so as to avoid *Phytophthora Cinnamomi*, a pathogen that moves through soil causing root rot and dieback.

Funding

The funding theme covered an array of areas:

- 1. The need for funding for maintenance
- Sources of funding
 - council
 - mining industry
 - grants
 - seed sales
 - other areas of the business.
- 3. Means of getting funding
 - having marketable species for seed sales
 - having the quality of the certified
 - having a recovery plan for threatened species grants
 - having the SPA double as a park so that council park resources can be used to help maintain the area
 - marketing local provenance
 - giving tours of the SPA to encourage seed sales.

Location

Location covered the need for:

- quality soils with no *Phytophthora* and not on the worst part of the farm (3 contributions)
- having appropriate soils matched with the species (3)
- accessibility (3)
- security on public sites (1)
- commitment from landholders for sites that partnered with private landholders in relation to the use of their land (1)
- maintaining long-term control of the SPA by avoiding partnering with private landholders (1).



Design

Design included:

- the need for access to design experts
- having short rows for ease of harvesting (rows) and maintenance (having short, not long rows so that equipment didn't need to be carried far from a single point)
- using direct seeding techniques
- scraping off the top soil to control weeds
- ensuring there is accessibility for machinery in how the plants are planted.

Good infrastructure

Good infrastructure included:

- the need for irrigation (5)
- good quality fencing (2)
- general sophistication of the system (weed mats, irrigation, clear barriers between crops), having access to harvesting machinery (in the case of large trees)
- having adequate seed storage.

Access to knowledge

Access to knowledge included the following phrases by contributors.

FIGURE 17. PHRASES USED BY CONTRIBUTORS DESCRIBING ACCESS TO KNOWLEDGE AS A SUCCESS FACTOR

'Expertise in managing (Having the right contractor skilled, consistent)'

'Skilled/dedicated personnel'

'Access to expertise (Having a group is good — a number of them with lots of skills different- a range. e.g. XXXXX is the geneticist and [there are] a number of ecologists with an interest in the plants. Others know where individuals are. Another one works for trust for nature, XXXXX has good contacts with landholders.'

'Access to expertise for design'

'Access to expert knowledge'

'Having a consultant come in and update all the record keeping'



They covered the importance of having access to skilled staff members, volunteers, consultants and other SPA managers who shared knowledge on:

- SPA design
- local environment and plants ecology
- location of plants
- grant writing
- database development
- genetics
- germination
- individual species
- landholder contacts.

Examples include:



One contributor found it useful to visit another SPA and base a large part of his organisation's design upon it.

Another outlined how they employed a consultant with experience in designing SPAs to design theirs. The consultant, while building their SPA, trained another, separate consultant to become their long-term on-site manager. This was very useful as there had been staff turnover within the organisation and the managing consultant was now the mainstay of the project, helping retain organisational knowledge and continuity in the SPA's management.

Two volunteers who did a three way interview with the interviewer (although only counted as 'one contributor'), discussed with each other how lucky their volunteer group was to have so many experts and to have had the help of many academics in the area.

Commitment from others

Commitments from others covered two main areas:

- 1. means of gaining commitment and involvement from others
- 2. the importance of working with others who are committed.

Examples of the former included:



One SPA manager at a council felt a recovery plan was considered a success factor because it was useful in ensuring the SPA remained a priority for council members and employees as it made the council accountable to the project.

Another held tours to generate personal and financial investment from potential seed buyers.

Another SPA management group felt their specific, achievable goal had been key to attracting volunteers.



Examples of the latter included:



Having a volunteer 'champion' who created and drove the project.

Ensuring sites selected were only with committed landholders.

Having a keen volunteer workforce who shared each other's enthusiasm for the project.

Choosing the right species

Choosing the right species covered two aspects:

- **1.** Choosing marketable species (2)
- Choosing the right species for the area targeted, ensuring their reproductive success (2).

Good relationships

Good relationships referred to those they were in partnership with such as councils and landholders, and the success of having good relationships within the volunteer group so that they enjoyed working with one another and there was a social aspect to the commitment.

Database system

Of those who mentioned the importance of having a **good database system**, one contributor found it helpful that a consultant has come in and fixed their database, another emphasised the importance of it when managing complex data in a professional project in a high-tech SPA, and another mentioned is as part of the larger picture of having good systems to track the origin and transportation of seed.

Cultural licence to operate

The success factor of having cultural licence to operate and connection to Country was referred to in its importance of working with native seed in Australia. There was a need for native seed production to include Story. This contributor felt that a cultural licence to operate was something all SPAs should have and would be the means of ensuring environmental and social outcomes were actually achieved, by moving away from colonial cultural systems.

Other success factors

Only one contributor referred to having a clear purpose as a success factor, not only for attracting volunteers but also to ensure that the project remained simple. They felt the fact that they had targeted only three threatened species was important in limiting the scope of the project, helping make decision-making clearer.

Weather, an uncontrollable factor, was referred to in its obvious importance in making plants grow in a joking fashion by two contributors, particularly in relation to rainfall.



Genetically healthy stock referred to a contributor's experience in collecting genetically diverse seed and its effect on the health of the seedlings and subsequent plant mortality rates once planted.

Having a long-term funding commitment and project lead-time was seen as a success factor for one contributor who was aiming to produce large quantities of seeds for a mining company.

KEY POINTS

- Maintenance, location and ongoing funding were the most mentioned success factors amongst contributors.
- Maintenance required consistency, watering, labour, weed control and funding.
- Funding was an issue for many SPAs.
- Key location factors included:
 - site accessibility
 - having quality soils matched to species
 - ensuring the SPA had longevity with land managers.
- Access to knowledge and skilled staff members were also important in ensuring SPA success.

Barriers

SPA managers were also asked about what barriers they had faced in developing a successful SPA. Themes covered included:

- lack of financial support
- maintenance
- lack of time
- commitment
- finding land
- difficulties sourcing seed
- staff turnover
- vandalism
- accessibility and distance to the SPA
- high establishment costs
- need for labour



- lack of infrastructure
- aging Infrastructure
- lack of knowledge
- weather
- oversupply of seed
- competing environmental vs aesthetic priorities
- propagation difficulties
- bureaucracy
- over-reliance on volunteers.

Of the 20 themes, **lack of financial support** was by far the most cited barrier, with 20 contributors mentioning the barrier 21 times.

Maintenance was also frequently mentioned, at 12 times, by 12 contributors. The following table breaks down the themes with regard to the number of contributors who mention it.



FIGURE 18. NUMBER OF CONTRIBUTORS PER BARRIER THEME



Lack of financial support

Figure 19 shows phrases used to describe the lack of financial support.

FIGURE 19. PHRASES USED BY CONTRIBUTORS DESCRIBING LACK OF FINANCIAL SUPPORT AS A BARRIER

'Not much financial support for business in the industry, compared to the not-forprofits'

'Funding: seed sales don't cover it'

'Lack of resources for maintenance incl. replacement planting'

'Finances'

'Lack of market demand for local provenance'

'Money'

'Support [resources] for record keeping — choosing a record keeping system : user friendly'

'Wrong species that aren't in demand'

'Limited resources'

'Government change of direction'

'Non-continuous funding (Project based funding) e.g. ... The transport department they contributed seed to the project for three years — and then it couldn't keep going but there was no link funding to carry it through to the next project. '

'Project uncertainty'

'Lack of continuous funding: No funding for labour'

'Limited funding'

'Continuous funding'

'Lack of continuous funding'

'Seedbank stretched themselves too thin in the past — the amount of landholders they had'

'Perverse government investment in non-indigenous SPA'

'Government funding with false expectations with Greening Australia and Murray Seedbank (not a money making activity)'

'Cost'

'Price of seed'



These phrases describing lack of financial support can be categorised into five sub-themes:

- **1.** general lack of funding
- 2. funding uncertainty
- 3. inadequate funding from seed sales
- 4. maintenance
- 5. criticism of government funding priorities.

FIGURE 20. NUMBER OF CONTRIBUTIONS PER FINANCIAL BARRIER SUB-THEME



- 1. General lack of funding (6 contributors) referred to general phrases e.g. 'lack of resources', 'limited funding'.
- 2. Uncertainty (5 contributors) referred specifically to the stop-start nature of a lot of funding.

Examples:

One contributor described how they set up an SPA to supply seed for offsets for a traffic development project. The SPA then shut down because the development finished.

'The transport department contributed to funding the seed production area for three years... and then it couldn't be kept going because there was no link [in] funding to carry it through to the next project.'

Contributor quote



Another contributor referred to 'project uncertainty' as a barrier, with only short-term funding priorities available to SPAs and no ability to plan long-term.

3. Lack of market demand from seed sales (5 contributors) referred to two themes.

- The price of seed not covering costs (e.g. the false hope they, as a private landholder going into partnership with a non-for-profit, had been given of potential profits through seed sales)
- The lack of demand for their products
- 4. Maintenance (4) (as a sub-theme within lack of financial support barrier) referred to:
 - record keeping
 - keeping up relationships
 - seed collection with landholder agreements
 - lack of resources for replacement plantings
 - general lack of funding for labour
- 5. Government funding priorities (3) was also a sub-theme, receiving criticism for their changes in funding priorities (away from revegetation after setting up SPAs) and their lack of funding in private businesses and First Nations SPAs, and towards not-for-profits with no cultural licence.

Examples:



Once contributor described annoyance at the discrepancy between financial support for business and not-for-profits in the sector

Another criticised government investment in non-indigenous owned SPAs.



Maintenance



FIGURE 21. NUMBER OF CONTRIBUTIONS PER MAINTENANCE SUB-THEME

Maintenance could be divided into three categories:

- weeds
- pests
- limited funding for maintenance.

Of these, pests included vermin, grazing by kangaroos and insect infestations of SPAs.

Time

Time was an issue for a number of contributors, largely related to finding time to do maintenance.



Contributor quote

Another contributor increased the footprint of their SPA but was struggling to accomplish all the extra maintenance with the same amount of labour. Yet another found finding the time to travel to his SPAs difficult.

Two other areas in which time was a barrier was for:

- applying for grants (for a member of a community group)
- building relationships with landholders.



Commitment

Commitment barriers, as with success factors, covered two areas.

• A lack of commitment from others, including other partners (landholders, council organisations) and funders. Three of the 30 contributors felt this was a barrier.

'Lack of current buy-in from state and federal government. They organised it and then walked away and there has been floods, drought and fire in the meantime with no support.'

Contributor quote

• The effort of convincing people to become committed.

'Convincing people this is a good pathway forward [within my organisation].'

Contributor quote

Staff turnover

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Staff turnover was an issue for four contributors and included private landholders working in partnership with organisations who felt that the person who they were in contact changed too frequently and needed time and energy while they rebuilt relationships and were trained. A large bugbear of contributors was the loss of knowledge, expertise and drive that came with staff turnover.



'...the one passionate person about a project leaves,'

Contributor quote

Finding land

Finding land covered:

- the price of land
- sourcing land with appropriate rainfall and soils
- issues with land zoning (ACT-centric).



Sourcing seed

Sourcing seed included:

• The labour involved firstly two contributors having issues with accessing seed collection permits.

'It took me a year and a half to get an official seed collection permit,'

Contributor quote

- The labour involved in 'sourcing seed properly for the SPA'.
- The labour involved in (in the case of threatened species SPAs), the 'number of individuals we can collect from'.

Vandalism

Vandalism was referred to by two separate contributors, both local councils, who found an unexpected barrier to SPAs on public lands was vandalism of infrastructure, e.g. motorbikes ripping the weed mats or vandalism of signs.

Accessibility

Accessibility and distance to the SPA also proved an unexpected barrier for two contributors. One organisation found that when they audited their SPAs, those closest were where they had been the most proactive. Those which required *'going through 3 gates and across a river in a 4-wheel drive'* dropped in priority.

The second contributor discussed the ease of checking on the plants growing at his regular workplace versus having to 'put aside a whole day to check on an SPA'.

Need for labour

Need for labour revealed the disappointment of one contributor when Green Army labour was no longer available, while the other contributor expressed their frustration at not being able to complete replacement planting.

Lack of infrastructure

Lack of infrastructure was referred to by two contributors who wished they had irrigation. Ageing infrastructure was referred to by two contributors who had to face the fact that their weed mats had disintegrated.

Lack of knowledge

Lack of knowledge (2 contributors) referred to the lack of research on SPAs, and having to come up with systems of management in isolation through trial and error. One contributor also criticised Greening Australia for not sharing knowledge.



Weather

Weather again referred to rainfall. Oversupply referred to a specific instance in which a notfor-profit and government organisation invested into 68 private landholder partnerships, and were then unable to maintain relationships or pay to collect seed on most of these properties. As the manager put it, they had *'stretched themselves too thin in the past'*.

Bureaucracy

Bureaucracy referred to a government takeover of Greening Australia's SPAs, which subsequently came with more bureaucracy.

'Greening Australia was the ideal model — small group of people who were passionate and less government bureaucracy.'

Contributor quote

Competing environmental and aesthetic qualities

Competing environmental and aesthetic qualities referred to an employee working with threatened species who was frustrated at expectations that the SPA be kept neat and tidy, whereas there was environmental value in having something 'semi-wild'.

Propagation

Propagation was mentioned by a contributor in the threatened species space.

KEY POINTS

The largest barriers amongst contributors were:

- lack of financial support
- maintenance
- lack of time
- commitment
- staff turnover
- finding land.

Industry-wide support

SPA managers were asked what industry-wide support would be beneficial to them in an openended question (so as not prime them towards particular topics).



Twenty-one of the 30 contributors gave 51 suggestions covering 16 topics:

- funding
- knowledge sharing
- creating market demand
- research
- government policy changes
- management from organisations managing landholders
- Green Army style labour
- equipment
- guidelines for having people on property for large-scale landholders
- genetic testing
- cultural licence to operate
- First Nations Land Management network
- education
- permit system revisions
- industry body
- enforced seed industry regulation.



FIGURE 22. NUMBER OF CONTRIBUTORS PER IDEA

Funding (12 mentions by 11 contributors) and **knowledge sharing** (12 mentions by 10 contributors) were the most popular ideas generated.



Funding

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Funding fell into five categories:

- **1.** Funds for infrastructure/maintenance (5 contributors).
- 2. Continuous funding for organisations managing landholders, to prevent high staff turnover (3 contributors).

'Continuous funding to Murray Seedbank so staff don't turnover so frequently.'

Contributor quote

3. Federal funding directed into growing market demand for example through tax cuts to businesses (1 contributor) [it should be noted that creating market demand was a category which several contributors mentioned, but only one in relation to government policy].

'Federal funding to go towards growing the market and away from government/not for profit as they have poor outcomes e.g. tax cuts for businesses in the area.'

Contributor quote

- **4.** A general request for '*government funding*' (1 contributor).
- 5. A general request for 'more resources' (1 contributor).



Knowledge sharing

Figure 23 shows following phrases that were used to ask for knowledge sharing.

FIGURE 23. PHRASES USED BY CONTRIBUTORS REQUESTING KNOWLEDGE SHARING

'K	nowledge sharing'
'K	nowledge sharing with other SPA managers'
'K	nowledge sharing (incl. for cost of seed, conferences, network support,
'R	esources to provide proper support to SPA landowners'
'A	ccess to expertise (weed identification, SPAs)'
'C	ourses on species identification'
Έ	xpertise on SPAs'
'K	nowledge sharing'
'K	nowledge sharing (register of spas to collaborate and share info)'
'A	ccess to expertise'
Ĺ	earning opportunities for younger people to learn within organisations'
Έ	hat GA shares the information that they have and don't try to control the market'

Knowledge sharing ideas centred on:

- knowledge sharing amongst SPA managers and SPA expertise through networks.
 - ideas included conferences and network support and it was hoped it would lead to collaborations. Some SPA managers felt they had started their SPA in isolation and had no access to knowledge on how to design or run SPAs, as well as what to charge for seed. Eight contributors independently mentioned the need for information sharing and access to SPA knowledge.
- for Greening Australia to share their knowledge on SPAs (1 contributor)
- learning opportunities for younger people to learn from older people and take on their knowledge of SPAs, so as to avoid lost knowledge as the workforce retired. (1 contributor)
- specific access to weed identification knowledge (1 contributor).

Creating market demand

Creating market demand referred to the need to build more market demand for seed to support SPAs financially from seed sales. It was felt that this financial source was economically more sustainable and continuous than government funding.



One contributor referred to the offset policies in ACT that required greater environmental offsets for developments, and greater demand for seed. Two others felt a focus on revegetation of farms was an important area for developing market demand. Another simply sought greater clarity and predictability in market demand, so as to avoid project based funding.

Research

Research was mentioned by four contributors as being helpful to their operations. They were interested in research on:

- propagation, especially of difficult and threatened species (2 contributors)
- pollination (1 contributor)
- genetics (1 contributor)
- effects of climate change (1 contributor).

The following phrases were used:

FIGURE 24. PHRASES BY CONTRIBUTORS REQUESTING RESEARCH SUPPORT

'Research support'

'Research (pollination of species and genetics guidelines)'

'Research support for propagating threatened species (Some of the seed we can germinate but can't get plants to survive through nursery propagation or translocation into wild sites (But that would be challenging to attract funding/interest as there is no financial incentive/gain)'

'Research (appropriate species with climate change, plant germination on the more difficult species)'

Government policy

Government policy was a related area to requests for support. One contributor suggested *...creating ongoing and stable market for seeds e.g. through incentives for there to be native veg on farmers land'.* Another described the importance of government acknowledgement and support for First Nations systems of land management in the seed industry:

> 'Acknowledgment and management in state and federal organisations to address the inequity of revenue going to non-indigenous organisations in the seed and food sector.'

'Australian recognition of globally important agricultural heritage sites as the UN defines them.'

Contributors' quotes



Coordinating organisations to have more engagement with private landholder partners

Private landholder contributors required more proactivity from organisations that collaborated with landholders. They asked these organisations to have more:

- contact
- seed collection
- maintenance
- management of expectations of new landholders.

One contributor spoke of the disillusionment of having an SPA as an income stream, and felt that managing expectations around finances and species would have prevented this.

Equipment

Two contributors wanted funding specifically for equipment. One of these requested a moveable seed cleaning facility to work within First Nations cultural systems of having seed cleaned within Country. This would allow them to knowledge share.

'A modular seed cleaning area that can be dropped into others' regions so their country's seed can be cleaned.'

Contributor quote

Labour scheme

Two contributors wanted access to Green Army or COVID-19 style work schemes, although one of the contributors specifically mentioned they did not want a work-for-the-dole scheme because they wanted to work with people who were specifically interested in the environment.

Landholder guidelines

Another contributor requested landholder guidelines for managing visitors to their property for large-scale landholders. This person had tried to contact various large corporations but found that the unknown protocol of managing visitors always fell into the 'too-hard' basket, for landholders and was never resolved. As a result they had not been able to set up large-scale SPAs.

Genetic testing

Another contributor requested support for genetic testing of their plants, as they were mixing provenances to prevent inbreeding without genetic tests due to the costs. They had put aside seed for potential genetic testing in the future.



Cultural licence

Cultural licence to operate referred to the need for seed to be linked with First Nations story, and that SPAs require cultural authority or permission to operate. The contributor advanced the fact that very little land management funds went to First Nations organisations, traditional owners, and land managers, as did very few proceeds from the seed industry. The contributor also put forward the idea of a First Nations land management network, and asked for it more specifically in the Tindale Arc, where grinding stones were considered prevalent and grasslands were farmed as grain.

Clarity on regulations for native seed permits

Yet another put forward the need for clarity around native seed licensing requirements, with less obstacles towards obtaining one. The same contributor also put forward enforced seed regulations around native seed standards, labelling and testing. The contributor felt that the industry is currently a 'Wild West' with little accountability concerning seed quality. This contributor also put forward the idea of an industry body for facilitating, networking and coordinating the native seed industry and SPAs in particular.

KEY POINTS

The most requested industry-wide support was funding and knowledge sharing. Knowledge sharing required:

- networks of SPA managers that could share their knowledge with one another
- needing to guard against loss of organisational knowledge by sharing inhouse knowledge with younger generations
- more research into SPA related topics.

Increasing market demand for seed, to support funding priorities, was also a popular request.

Investment

All contributors were asked what main organisation invested in their SPA to get it established. Answers were open-ended and categorised into:

- local government
- partnership of state government and federal government
- federal government
- not-for-profit
- private company
- partnership of state government and not-for-profit partnership



- partnership of state and local government partnership
- mining
- partnership of philanthropic organisation and Federation of Victorian Traditional Owners Corporation.



FIGURE 25. FUNDING SOURCE PER SPA

Figure 25 shows 84% of the SPAs surveyed were created with government funding. Only 3% of the SPAs were solely funded through private businesses.

Opportunities for long-term funding

Half of the contributors did not respond to this question, as they did not foresee any opportunities for long-term funding.





Of those that *did* respond (15), 60% cited the same areas they currently receive funding from.



As outlined In **Figure 26**, the following sources were thought to be where contributors would receive funding from in the future:

- Seed sales [6 of the 15 contributors (40%)] three of these with the hope that government would increase market demand through investment or policy changes.
- Federal and state grants [5 contributors (33%)] one contributor hoped that this would be for at least 3 years, as 1 year was too short a funding cycle.
- Local government funding [2 contributors (13%)] these contributors already had local government as their main source of funding, e.g. through their council environmental levy.
- Philanthropic funding [1 contributor (7%)]
- Solar projects [1 contributor (7%)] this contributor felt native groundcovers were ideal for solar farms, as they reduced temperatures and increased solar panel efficiency.

Of those who responded with seed sales, two contributors had specific marketing ideas:

- the wildflower market
- selling the seed of rare species.

KEY POINTS

Future funding was hoped to come from:

- seed sales (40%)
- federal and state grants (33%).

84% of SPAs were created using government funding.

Only 3% of SPAs were created as private enterprises.

Average plant age

Estimations of the average plant age were provided for 95 of the 130 SPAs. Many of the SPAs had had replacement plantings since they were established, and therefore didn't only have the ages of the plants they were established with.

The average age across all the SPAs was eight years, and ranged from 1 to 27 years. However the median of the plant ages was 2.25. The difference between the average and the median showed that the older plants were both few, and very old, while there were many young plants. This correlates with the fact that most SPAs are under 3 years old.



Running an SPA

Costs

Contributors were asked what the average annual labour cost of running their SPAs was. If they weren't easily able to answer this, the question was framed as '*how many full-time employees would it take to run your SPA*'. Full-time employees were then costed at 8 hours per day at \$48 an hour (\$44/hour + super contributions). This estimate did not include establishment costs or infrastructure costs.

The average cost was \$20,011 per SPA per annum, while the median cost was \$5217 per annum. Again, this meant that there were a few high cost SPAs and many low cost SPAs. Low cost SPAs (below \$5217/annum) were largely those which were in partnership with landholders and were of trees and/or shrubs.

The eight lowest costing SPAs with estimates of \$500 per annum per SPA, were tree SPAs. Some comments surrounding these SPAs were that they '*looked after themselves*'. However, there were also comments by others that because they were not maintained, they became low quality SPAs with infrequent contact with seed collectors.

Another form of SPA that had low running costs was a not-for-profit organisation. This organisation had four SPAs with very little attention paid to offsite SPAs and only the one onsite SPA at the workplace receiving most of the maintenance. SPAs were not a core business activity for this organisation.

The highest costing SPA was \$1,000,000 per annum.

Seventy-eight SPAs were able to have their maintenance costs analysed against harvest yields. After removing one outlier, a small association between maintenance and harvest yields can be seen.





FIGURE 27. ANNUAL COST OF LABOUR VS ANNUAL KILOGRAMS OF SEED PRODUCED

It should be noted that in **Figure 27**, the SPA with an annual cost of \$200,000 was still establishing itself and had an expected small harvest for their first year, with expectations that it would grow.

The top three most productive SPAs were as follows:

- 1.2 tonnes of seed with \$150,000 worth of labour per annum
- 57kg of seed with \$48,888 worth of labour p.a.
- 100kg of seed with \$23,000 worth of labour p.a.

KEY POINTS

- The average annual labour cost of an SPA was \$20,011/annum, but costs ranged from \$500-\$1,000,000. The median cost was \$5,217.
- The lowest cost SPA was a tree SPA that was situated on private landholder land, and collections rarely took place.
- There was a correlation between high harvest yields and SPA labour costs.



Tasks

Of the 130 SPAs, data was given on 110 SPAs on tasks required to run them. This question was multiple choice with the following options (**Figure 28**).

FIGURE 28. MAINTENANCE OPTIONS

Weed control
Pest control
Replacement planting
Pruning
Watering
Fire management
Database tracking
Marketing
Seed quality testing (viability, purity, germinability)
Genetic testing
Seed harvesting
Other (please specify)

Many SPAs gave multiple additional answers in the 'Other (please specify)' option. **Figure 29** shows the percentage of SPAs that undertook each task.



FIGURE 29. TASKS PER SPA



Most SPAs undertook:

- database tracking (95%)
- weed control (74%)
- seed harvesting (61%)
- watering (58%).

Many of those with smaller percentiles were suggested additions in the 'Other (please specify) option'.

The interviewer felt that when they presented the multiple choice options, they were 'jogging the memories' of contributors. Consequently, it is likely there are tasks not recorded. It is also likely that those tasks listed as an option may be over-represented.



When compared against plant types, weed control was not undertaken in the two grass-only SPAs. It was also only undertaken in *one* of the four tree and shrub SPAs. However the sample sizes for these plant types are too small to make any conclusions.



Weed control was also associated with only 25% of the 56 tree-only SPAs. This is likely due to the fact that once trees are established, weeds do not inhibit the growth or seed output of the plant.

Fire maintenance referred to both maintaining fire breaks and undertaking burns. Marketing related not only to marketing seed to the general public, but also marketing SPA activities to potential volunteers, e.g. by uploading photos of volunteer working bees to Facebook.

Traditional maintenance referred to digging sticks and having the necessary women's involvement in certain areas of SPA maintenance. This also included tending to plants that now-extinct animals had previously tended to (e.g. murnong (yam daisy) and the white footed rabbit-rat).

Thirty-one per cent of SPAs had had some genetic testing done, though these were one-off tasks. One contributor in Victoria commented that when the results of the genetic tests came back, they were shocked at the low diversity from even large stands they felt had higher genetic diversity. This caused them to collect seed for their SPA plants from 'as far as possible' rather than their initial targeted geographic region. The largest barrier for many who did not do genetic testing was cost.

When asked what contributors would like to undertake that they currently aren't, only 12 answered:

- more seed viability testing (3 contributors)
- expanding their SPAs (2)
- more frequent replanting (1)
- putting in a shadecloth (1)
- cleaning seed on country for others (1)
- pruning (1)
- soil testing (1)
- more monitoring (1).



Average number of populations





The average number of plant populations (i.e. plants from different habitat fragments) sourced for each species was given for 73 of the 130 SPAs. Seventy of these were less than 10 populations. Across these SPAs, the average was five and the median was three. **Figure 30** shows a range of populations from between one (two SPAs which sought to preserve the genetics of a local population) and 50.

One contributor noted that they had 10–20% of their SPA plants sourced from a region that had a similar climate to that which their local region would face by 2080. They hoped it would increase gene flow from these regions and increase the climate adaptability of the plants.



FloraBank Guidelines

Answers on whether *FloraBank Guidelines* for SPAs are used were provided for 101 of the 130 SPAs with 67 saying no (89%), and 34 (11%) saying yes. Seven of those that said no said they use *FloraBank Guidelines*, but not those for SPAs. A further 50 of the 67 who said no, used CSIRO guidelines instead. Rather, they use the germplasm guidelines for threatened plants. One contributor commented that they had an SPA because they found the *FloraBank Guidelines* for collecting seed in the wild too onerous.

Pre-order vs opportunistically buy

Contributors were asked on a percentage scale of 0 to 100, how many customers opportunistically bought (0) vs pre-ordered (100). Pre-ordered was defined as before harvest.



Only 40% of SPAs actually sold their seed and thus were able to answer this question. The reason answers were not provided for most SPAs (60%) is that they used the seed in-house for their own projects. A further 11% used most of their seed in-house, but sold surplus seed. Fifteen per cent of SPAs did not have an answer to this question because it was not known.

Estimates ranged from 0 (everyone opportunistically bought) to 95 (95% of customers opportunistically bought). An average of 33 showed that 33% of customers pre-ordered, while most 66% were opportunistically bought. The median of this scale was 2%, showing pre-ordering was common for a few SPAs, but most SPAs had seed bought opportunistically.

When developing the survey, this question was asked as it was assumed that having seed preordered would be beneficial to the SPA manager, so that it could be planned for. However, there were two SPA managers across three SPAs who actively discouraged it. This was because the onus then shifted to them to produce the seed, even when weather conditions were not favourable.

As one contributor described,

'Someone has asked to pre-order 100kg of Wallaby grass, we had a bad season, and we could only collect half of that amount.'

For another SPA manager, pre-ordering vs opportunistically buying was not an issue as they had a good storage facility with up to three years' worth of seed stored. Sales therefore could be filled immediately, and the SPA manager only needed to harvest to replenish stocks.



Derelict SPAs

During the course of the survey, it became clear that contributors knew of a number of derelict SPAs, and data on this was recorded. Where it was known that they referred to the same derelict SPAs, data was not recorded.

All up, contributors knew of 71 modern derelict SPAs, with 52 of these being in the Murray NRM region, four in the Sydney Basin, three in South Australia, six in regional Victoria and two in Melbourne, and four whose regions are unrecorded.

Reasons for why they became derelict were also asked. Those in the Murray were largely derelict through oversupply at the time and lack of funding to manage all 68 SPA (17 remain active). Reasons given for the other derelict SPAs were:

- lack of funding (3)
- that it was established for one project and had served its purpose (2)
- limited lifespan of plants (1)
- bushfire (1)
- change of land ownership when a private landholder sold their farm (1)
- private landowner changing their farming priorities (1)
- lack of expertise in designing the SPA
- choosing marketable species (1).

KEY POINTS

- On average, five populations were used to source seed for each species.
- One contributor had 20% of their 10–20% of their seed sourced from a climate projected region, in order to introduce genetics from that climate into local populations and prepare for climate change.
- The most used guidelines for running an SPA were the CSIRO guidelines.
- 60% of SPAs used their seed in-house. 11% used most of their seed inhouse but sold surplus seed.
- Pre-ordered seed was not always preferable to SPA managers.
- Lack of funding was the main factor for making an SPA derelict.



DISCUSSION

Locations

NSW

The 36 SPAs captured in NSW are likely to cover most of the SPAs in the state, with the recent audit finding only 16 active SPAs.⁶⁴ It was estimated 90% of the state's SPAs were captured.

Queensland

Despite only capturing three SPAs in the state, the interviewer estimated that Queensland was likely to have 70% of its SPAs captured in the survey based on the following reasons:

- Many phone calls in the area recommended the same SPA.
- The interviewer noticed that terms such as 'seed production areas' and 'seed orchards' were less familiar in the northern states and regions.
- Informal conversations with seed purchasers painted a picture that the lack of SPAs in Queensland was because there was plenty of habitat to source seed from. While Queensland has experienced high rates of clearing, Queensland still has the largest portion of Australia's forests.⁶⁵
- Rainforest species posed additional barriers to SPAs as seed could not be stored.⁶⁶

Victoria

The dominance of Victoria as an SPA location reflects the make-up of respondents as those surveyed in the latest *Australian Native Seed Survey Report 2020*.⁶⁷ One likely factor in the popularity of SPAs is that Victoria is the most cleared state.⁶⁸ The interviewer estimated they had captured 75% of the SPAs based on two competing facts:

- When identifying SPAs, the interviewer was frequently recommended the same SPAs.
- However, SPAs were common in Victoria and it's likely that some less well-known SPAs were overlooked.

Tasmania

Phone calls in Tasmania revealed that there was one SPA for revegetation purposes, and a number of forestry SPAs. Time constraints meant that the Tasmanian SPA was not able to be interviewed, and forestry SPAs were deemed as out of scope.

⁶⁵ Department of Agriculture and Water Resources, Australia's Forests At A Glance 2017,

https://www.agriculture.gov.au/sites/default/files/documents/ForestsAtGlance 2017 v1.0.0 lr.pdf accessed 12 April 2021, p. 2.

⁶⁴ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

⁶⁶ Royal Sydney Botanic Gardens, n.a. *Rainforest and Dryland Seeds*.

⁶⁷ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.

⁶⁸ Bradshaw, C. 2012. 'Little Left to Lose: Deforestation and Forest Degradation in Australia Since European Colonization', *Journal of Plant Ecology*, 5(1), pp. 109–120, <u>https://doi.org/10.1093/jpe/rtr038</u> accessed 4 April 2021, p. 114.



It is interesting to note that Tasmania still has 46% of its habitat intact.⁶⁹

South Australia

Six SPAs from three managing organisations were from South Australia. The interviewer estimated that South Australia is likely to be underrepresented, as:

- The state had many small SPAs.
- The interviewer did not feel they had come to the end of their search at the end of the surveying period with new recommendations coming forward with each survey, as had been the case in Victoria, Queensland or NSW.

Consequently, it is estimated that only 30% of the state's SPAs were captured in the survey.

Western Australia

Western Australia is also likely to be under-represented in the survey data, due to:

- There are articles on SPAs in the state supplying seed to mining companies.⁷⁰
- Greater perceived competition with Greening Australia in Western Australia led to three people declining to undertake the survey.
- The interviewer made many attempts at contact that did not have any response.

As a result, it is estimated that only 10% of the state's SPAs is represented in the study.

Northern Territory

With only one NRM region in the territory, 'ins' into the area were hard to come by. There may well be SPAs there but if there were, they were not identified. No response was received from the single NRM body that governed the whole region and internet searches did not show any SPAs.

It is interesting to note that the Northern Territory has the highest remaining habitat of all Australian states.⁷¹

Australia

	VIC	NSW	SA	WA	QLD	TAS	ΝT	TOTAL
SPAs captured	78	36	6	7	3	0	0	130
Estimated % captured	75%	90%	30%	10%	70%	0%	0%	53%
Total no. of SPAs	104	40	20	70	4	4	4	246

FIGURE 31. ESTIMATED SPA CAPTURE RATE PER STATE

⁶⁹ Ibid p. 114.

⁷⁰ Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report.*

⁷¹ Bradshaw, C. 2012. 'Little Left to Lose: Deforestation and Forest Degradation in Australia Since European Colonization', *Journal of Plant Ecology*, 5(1), pp. 109–120, <u>https://doi.org/10.1093/jpe/rtr038</u> accessed 4th April 2021, p. 114.



Figure 31 represents a breakdown of the likely total number of SPAs across Australia. Nationwide, it is estimated 53% of SPAs were captured in the survey.

The domination of Victoria and NSW in the survey mean that results are more representative of these states. Consequently, any actions based on this survey should seek feedback in under-represented states before implementation.

KEY POINTS

- Victoria and NSW dominate the surveys, while South Australia, Western Australia and Tasmania are under-represented. Northern Territory remains an unknown. Only a small portion of SPA were located in Qld, but they are likely the majority of the state's SPAs.
- The survey is estimated to have captured 53% of Australia's total SPAs.
- Any actions based on this report should seek further feedback from under-represented states.

Capacity

Seed produced

Of the SPAs surveyed, 60% did not answer the question of seed weight collected. This was due to immature plants, seed stocks not needing replenishing or because they were unsure of how much they collected.

Of the 40% that did, the total sum of all kilograms of seed harvested per annum was 1,793kg.

As many of the SPAs were under three years old, contributors estimated that there would be a further 1100kg added this over the next two years (1000kg of this was from one large-scale project).

Assuming that all SPAs continue to be active, and based on the percentage of SPAs captured in this survey, it was calculated that 5458kg of seed would be contributed to the native seed sector by SPAs each year.

However, only a portion of this will be available for purchase. Of those that recorded a harvest in the survey, 29% sold their seed, while 71% used their seed in-house for their own development, rehabilitation and mining projects.

Australia's demand for seed is not quantified, but it is predicted to rise with increased direct seeding techniques, and SPAs are hoped to meet this demand. With much seed sold in-house, it is likely that any large-scale revegetation works in the future will require specific SPAs to be set up as part of the program.



KEY POINTS

- SPAs will provide 5.5 tonnes of native seed per annum. However, most of this will be for in-house government and private projects.
- Any program requiring large-scale amounts of seed would need to allow time and finances for SPA development.

Species and plant type

SPAs are hoped to increase the number of species available on the market. However, currently most SPAs only grow one or three species. This corroborates the findings of the *Australian Native Seed Survey Report 2020*, which found most SPAs grew fewer than 10 species. As a result, most SPAs in their current capacity do not create a greater diversity of species on the market.



It should be noted however that both in this survey and *Australian Native Seed Survey Report 2020* there were small numbers (five and between 10–20 respectively) of SPAs that produced over 50 species and may contribute to market diversity.

Plant type

The survey captured SPAs of trees, shrubs, grasses, forbs and tubers. The large majority of SPAs captured in the survey were tree and/or shrub SPAs. This is contrary to the *Australian Native Seed Survey Report 2020* findings, which found most SPAs did not grow trees or shrubs. This survey likely captured different SPAs.⁷²

The Australian Native Seed Survey Report 2020 also showed that seed purchasers mainly purchased trees and shrubs, as most revegetation programs focus on them. They did flag however, a likely increase in demand for grasses and wildflowers.⁷³



It should be noted that purchasers' demand is met by both wild seed collectors and SPAs. The *Australian Native Seed Survey Report 2020* also concluded that most tree and shrub seed demand was met by wild harvest and even had a surplus.⁷⁴

Higher yielding SPAs were typically grass SPAs (though not statistically significant), with five of the top six yielding SPAs including grasses. These higher yielding SPAs meant most seed collected was grass and forb seed.

With these factors combined, grass SPAs may have a bright future. However, with 2020 seeing small surpluses in both shrub and grass seeds, SPA development should include further research on market demand for plant types and existing local suppliers.

⁷² Hancock et al. 2020. The Australian Native Seed Sector Survey Report, p. 46.

⁷³ Ibid, p. 26.

⁷⁴ Ibid, p. 26.


Size

Many of the SPAs were 2.7ha. This is deemed close to the limitation of 2ha being too small to be cost effective.⁷⁵ The *Australian Native Seed Survey Report 2020* found 6% of SPAs in Australia that were 31–100ha, showing there are SPAs with larger footprints. However, when compared to the US, where 1000+ hectare SPAs are common, Australia's SPAs are minute.

With one contributor requesting help with large private landholders, and two others outlining aspirations to expand their operations, there is a desire for larger SPAs. SPA size may be limited to finding appropriate sites, with four contributors mentioning that finding land was a barrier due to:

- the price of land
- sourcing land with appropriate rainfall and soils and
- issues with land zoning.

It is also likely that a high risk to low benefit ratio of SPA establishment is limiting investment into larger-scale enterprises. Factors increasing the danger of the already risky undertaking are:

- an unpredictable market
- low prices for seed and
- the importance of adequate ongoing funding to the success or failure of an SPA.

It should be noted that most seed is still recommended to be largely of local provenance. While large-scale SPAs may be desirable, SPAs can only service a limited area. Where largescale SPAs focus on limited species, they may result in the same oversupply of seed and overstretching of resources that brought many SPAs in the Murray NRM region into disrepair.

KEY POINTS

- With most SPAs growing three or less species, SPAs are unlikely to contribute to species diversity on the market.
- The size of Australia's SPAs are not only close to economically unviable, but minute in comparison to international SPAs. An unpredictable market with low returns is likely a factor in this.
- The true plant profiles of Australia's SPAs are unclear, with differing data emerging from this and previous reports, having captured different SPAs.
- SPA development should include further research on market demand for plant types and existing local suppliers.

⁷⁵ Logie, S. 2020. Audit of Seed Production Areas in NSW Report, p. 28.



Infrastructure

Good infrastructure was considered the fourth most popular success factor and a lack of infrastructure was considered a barrier.

No data on infrastructure was formally gathered in the survey. However, conversations revealed the SPAs varied greatly in their level of infrastructure, ranging from plants in fields with little maintenance, to formal SPAs with:

- weed mats
- weed mat borders
- irrigation
- physical separation of sections to stop cross pollination
- sophisticated seed harvesting machinery
- onsite seed cleaning, testing and storage facilities.

Hancock *et al.* mention that SPA infrastructure complexity has increased over time.⁷⁶ In their report, Hancock *et al.* found:

- 89% of SPAs used a field-grown cropping system
- 50% used weed mat systems
- 28% used container-based systems (many SPAs used more than one system, explaining the fact that the total percentage does not equal 100).



Seventy per cent of SPAs use databases more complex than an Excel spreadsheet, with a long array of seed attributes collected. With database tracking the most common activity for SPAs, and a known factor for a successful SPA, this displays a good foundation on which the capacity of Australia's SPAs can grow.

Organisational

Labour for maintenance was the third most important success factor within maintenance, and lack of labour was cited amongst barriers. Four of the 30 contributors mentioned staff turnover as an issue. This was a bugbear for landholders and management organisations alike. For example, landholders felt that with each new staff member they had to 'begin all over again', despite praising the competency of each individual.

⁷⁶ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.



Management organisations felt the loss of knowledge, expertise and drive that came with staff turnover e.g. *'the one passionate person about a project leaves'*. Lack of labour was blamed for the discontinuation of some SPAs.⁷⁷ One contributor asked for training for young people in the industry in order to guard against knowledge loss that came from an ageing workforce about to retire.

With labour, and funding for labour an issue, SPAs are relying on volunteers and labour schemes to fill the gap. Three contributors relied on volunteers, and two relied on work schemes (e.g. COVID Work and Green Corps).

It is also therefore no surprise that commitment from others was an important success factor, as SPA work was often unpaid.

This corroborates findings in the literature that lack of job security, unclear career paths and staff turnover are issues in the native seed industry, in particular the *Audit of Seed Production Areas in NSW Report* finding that retaining staff with skills and expertise is a barrier for SPAs.⁷⁸

The literature outlines issues created by staff turnover, including:

- organisational knowledge loss
- coordination issues
- information flow issues.⁷⁹

Consequently, the current organisational capacity of SPAs is weak. Any actions to develop SPAs across Australia must address the lack of funding and job security in the sector.

Financial

Ongoing funding was the third most popular success factor. Yet it was a major issue faced by most SPAs. Lack of financial support was the most commonly mentioned barrier with 21 of the 30 contributors highlighting it. This validated Hancock *et al.* and Logie's findings that seed production and SPAs are languishing under long-term underfunding.⁸⁰ Phrases included:

- 'Cost'
- 'Money'
- 'Finances'

⁷⁷ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

⁷⁸ Broadhurst, et al. 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration.*

⁷⁹ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.

⁸⁰ Ibid; Hancock et al. 2020. The Australian Native Seed Sector Survey Report.



The following all stemmed from a lack of funding:

- staff turnover
- lack of maintenance
- not maintaining relationships with landholders
- not replacing plants
- not being able to share knowledge
- lack of planning
- lack of genetic/seed viability tests.

As one contributor put it, 'Sometimes you cut corners if the budget doesn't allow it'.

With 55 SPAs becoming derelict due to a lack of funding, the consequences of this are severe. Worryingly, there were few perceived solutions to this problem in the future. Half of the contributors could not perceive long-term funding opportunities. However, some SPAs had innovative funding solutions. Five of the 30 contributors were able to fund at least some parts of running their SPA by having the SPA meet multiple outcomes.

Examples included:



One SPA generated food and had cultural outcomes, and was funded by a philanthropic organisation.

Three local council funded SPAs were also park amenities and had council park funds manage some maintenance (although volunteers and staff were still required).

Yet another SPA was initially a revegetation project for a water management authority that was turned into an SPA. This last example is a successful example of Logie's recommendation that restoration sites double as SPAs.⁸¹

Any action to support the development of SPAs would require funding to be a core issue.

KEY POINTS

- Financial incapacity, and its flow on effects with lack of jobs, is the greatest weakness of Australia's SPAs. Developing the SPA sector will require this issue to be addressed first and foremost.
- SPAs are attempting to develop financial viability by creating multi-use SPAs.

⁸¹ Logie, S. 2020. Audit of Seed Production Areas in NSW Report.



How SPAs might be supported and developed

The following topics outline issues and opportunities for SPAs, and how they might best be acted upon to support and develop the SPA sector of the native seed industry.

Access to knowledge

Access to expertise was an important part of all aspects of SPA development. It was considered the seventh most popular success factor, and lack of knowledge was a barrier for two contributors. Knowledge sharing was also the second most popular form of industry support requested (10 contributors), and research was the fourth most popular (4).

Contributors noted the importance of having access to knowledge of:

- skilled staff members who knew about SPA design
- SPA management
- ecology
- locations of plants
- grant writing
- database development
- genetics
- germination
- individual species
- landholder contacts.

For example, one volunteer-based community group felt the key to its success was having access to so many skilled volunteers in a wide variety of areas.

Lack of knowledge meant a great deal of time and effort had to be devoted to researching and developing knowledge of all aspects of SPAs. A number felt isolated, as they did not know any other SPAs.

Examples were:



One SPA manager described having to research and create a database, knowing what 'database to track the information rather than sitting thinking how to create one that works'.

Another described wanting to 'know what other catchments have in seed production'.

Contributors asked for networking opportunities, so that they might build connections in the industry, share advice and potentially collaborate.



Broadhurst *et al.* and Hancock *et al.* outline the importance of organisational knowledge and expertise, and this is reflected in the *Audit of Seed Production Areas in NSW Report,* with access to knowledge a stated barrier.⁸²

Research

As well as access to current knowledge, contributors also asked that research be conducted in areas where the science is inconclusive. In the example of propagation, two separate contributors dealing with rare species had trouble propagating them in nurseries. Research into these areas was requested, as well as more accessible genetic testing, with cost being a barrier.

Implementing means of increasing knowledge flow, access to expertise and research would support the development of SPAs as a sector of the native seed industry.

Building inclusivity

Of the 130 SPAs, only two (1.5%) First Nations managed SPAs were present. One contributor noted that little of native seed profits or investment goes to First Nations organisations and these findings corroborate this.

This small percentage of First Nations managed SPAs highlights a narrow focus in current native seed investment that ignores its connection to land and the broader community.

First Nations caring for Country is a holistic understanding of land management that addresses the root socioecological problems causing many environmental problems.⁸³ First Nations people hold valuable knowledge about Australian ecosystem landscapes and function.⁸⁴ First Nation managed lands have been shown to have better environmental outcomes than other protected areas.⁸⁵

SPAs cannot ignore the need for First Nations peoples to be involved at multiple levels of decision making. However, not only do First Nation SPAs make up only 1.5% of SPAs, in the barriers section, a contributor spoke of *'systemic racism within Australian government funding model'*, the *'exclusion of First Nations organisations within the SPA network'*.

These comments are not an isolated occurrence. Australian governance regimes consistently either 'upscale' First Nations initiatives into their own neoliberal policy regimes or disregard

⁸² Logie, S. 2020. *Audit of Seed Production Areas in NSW Report;* Broadhurst et al. 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*; Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report.*

⁸³ Maclean, K. Ross, H. Cuthill, M. Rist, P. 2013. 'Healthy Country, Healthy People: An Australian Aboriginal Organisation's Adaptive Governance To Enhance Its Social-Ecological System', *Geoforum*, DOI: 10.1016/j.geoforum.2012.10.005 accessed 5 April 2021, pp. 94–95.

 ⁸⁴ Hill, R. Pert. P. Davies, J. Robinson, C. Walsh, F. Falco-Mammone, F. 2013, *Indigenous Land Management In Australia: Extent, Scope, Diversity, Barriers and Success Factors*, CSIRO, <u>https://www.agriculture.gov.au/sites/defau/lt/files/sitecollectiondocuments/natural-resources/landcare/submissions/ilm-report.pdf</u> accessed 1 April 2021.
⁸⁵ Ibid, p. 1.



them because they 'don't fit', thereby hindering actual environmental and social outcomes.⁸⁶ There is limited acknowledgement and respect for First Nation knowledge and world views.⁸⁷

Ignoring the need to partner with First Nations people in this sector will hinder the achievement of the environmental outcomes that many hope to achieve.

Suggestions of actions in this area within the industry support section include:



Government acknowledgement and financial investment into First Nations systems of land management in the seed industry.

Ensuring SPAs have either cultural authority, or cultural licence to operate.

Acknowledgement and protection of a gricultural heritage sites as the UN defines them. $^{\rm 88}$

KEY POINTS

- Access to knowledge is key to developing the SPA sector of the seed industry. Greater emphasis on networking with experts and other SPA managers, and research support is required.
- As a form of land management seeking environmental outcomes, First Nations land management is key to achieving actual environmental outcomes. The large percentage of SPAs should require cultural authority or cultural licence to operate.

Government policies and priorities

State and federal governments were perceived as powerful players in the SPA sector. As such, they attracted four criticisms in regard to funding priorities:

- One contributor highlighted the fact that the government had changed their priorities away from revegetation and towards habitat protection, after having set up SPAs. This is an example of the 'ad hoc' nature of the government spending in the seed sector as described by Hancock *et al.*⁸⁹ As a result, many SPAs lost seed sales and became derelict.
- 2. As outlined previously, one contributor also criticised the fact that funding around a natural resource wasn't linked to a need for cultural authority.

⁸⁶ Nursey-Bray, M., Palmer, R., Smith, T. F. & Rist, P. 2019. 'Old Ways for New Days: Australian Indigenous peoples and Climate Change', Local Environment, pp. 473-486, DOI: 10.1080/13549839.2019.1590325 accessed 14 April 2021; Adams, M. 2004. 'Negotiating Nature: Collaboration and Conflict between Aboriginal and Conservation Interests in New South Wales, Australia'. *Australian Journal of Environmental Education*, pp. 3–11. <u>http://www.jstor.org/stable/44656376</u> accessed 14 April 2021.

⁸⁷ Hill et al. 2013, Indigenous Land Management In Australia: Extent, Scope, Diversity, Barriers and Success Factors, CSIRO, p. 2.

⁸⁸ Food and Agriculture Organization of the United Nations (n.a.) *Globally Important Agricultural Heritage Systems* (*GIAHS*), <u>http://www.fao.org/3/bp772e/bp772e.pdf</u> accessed 14 March 2021.

⁸⁹ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.



3. The fact that funding went towards building SPAs without building the mechanisms of a strong seed market was criticised. They felt this had not led to many currently active SPAs.

Hancock *et al.* outline the fact that subsidies from government may even negatively impact numbers of SPAs, with government-funded SPAs initially able to outcompete private enterprises, but then disbanded as funding cycles end.⁹⁰

One government employee voiced concerns of this type when pricing their seed. On the one hand, they wished to make the native seed and revegetation projects affordable. On the other, they did not want to undercut commercial seed sellers.

4. This went hand-in-hand with contributors from private enterprises noting that most funding went to not-for-profits to develop SPAs, with businesses missing out.

Contributors suggested government implement tax cuts for businesses, provide incentives for native revegetation on farms, and have regulations requiring new developments to revegetate areas from local seed, as means of supporting the SPA market. Matching demand with supply is important, so as to ensure seed suppliers both have sustainable financial business models, but also that wild stands are not over-harvested when there are sudden demand increases before SPAs are able to be established.

Gibson-Roy surmised that the presence of pessimistic views among some researchers and practitioners may weaken government policy makers' support.⁹¹ Educating policy makers is an important reality in today's world, on both the issues surrounding the native seed industry, and the level and duration of commitment required to achieve environmental restoration.⁹²

⁹⁰ Ibid p. 29.

⁹¹ Gibson-Roy, P. 2018. 'Restoring Grassy Ecosystems: Feasible or Fiction? An Inquisitive Australian's Experience in the USA'. *Ecological Management & Restoration*.

⁹² Broadhurst & Coates, 2017. 'Plant Conservation in Australia: Current Directions and Future Challenges'. *Plant Diversity.*

KEY POINTS

Ensuring both economic and environmental outcomes of SPA development involves the balancing of ever-evolving factors. These include, but are not limited to:

- Ecological outcomes of revegetation vs habitat protection
- Government funding priority changes from revegetation to habitat protection creating a dearth of market demand for seed.
- Lack of incentives in the native seed market
- Lack of support for private enterprise in the SPA market
- SPAs' need for supply to match demand, so as not to overharvest wild stands
- SPAs' need for market demand to be consistent

Any strategy should examine and consider these factors.

Government funding sources

Funding organisations include:

- local government
- state government funding
- federal government funding
- not-for-profit
- private company
- state government and not-for-profit partnership
- state and local government partnership
- mining
- philanthropic organisations
- Victorian Traditional Owners Corporation.

Most SPAs are managed by not-for-profit organisations, with government SPAs a close second. However, government funds most not-for-profits, with 84% of all captured SPAs funded through government funding. SPAs funded by private enterprises made up only 3% of SPAs. This is in stark contrast to the *Australian Native Seed Survey Report 2020*, of which 38% were commercial SPAs.⁹³

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⁹³ Hancock et al. 2020. The Australian Native Seed Sector Survey Report, p. 44.





It is notable that most SPAs had been funded through local governments (39%), followed by state (26%) and federal government (26%). Compared to state and federal governments, local governments have typically the smallest financial budgets and margins, and greatest amount of financial stress.⁹⁴ Yet this reveals that the onus of solving issues around seed has fallen largely to local government, rather than state or federal governments.

However, having SPAs managed at the local level is recommended, though in the Brazilian context (Schmidt et al, 2019). Not-for-profit organisations funded 9% of the SPAs. Only very few SPAs (7%) were funded through other means. This reiterates the lack of money to be made with SPAs, with government and not-for-profit funding currently making up the majority of SPA funding.

It is also notable that the only SPAs captured in this study established before 2007 were managed by a federal government organisation, the level of government with the greatest funding surplus.⁹⁵ This may substantiate the notion that funding is a factor in SPA longevity, although certainly not the only one.

It is advised that a greater financial burden should be taken on by state and federal governments.

Funding uncertainty

Lack of funding is currently a core weakness for the SPA sector and funding *uncertainty* was a key feature of this. Five contributors referred to the stop-start nature of funding as a barrier. Indeed, funding uncertainty resulted in three SPAs becoming derelict. Of those who perceived long-term funding opportunities, one hoped for a three-year rather than a one-year government grant.

Larger scale revegetation projects, while financially viable in the short-term, did not provide funding longevity. Two of the above three derelict SPAs had been set up for specific projects, and after having *'served their purpose'*, were let go after their projects ended.⁹⁶ This is not necessarily a negative thing, but the dynamics of small and large projects need to be understood.

Conversely, long project lead times (with their inherent certainty) was referred to as a success factor for one contributor. In this instance, the SPA project time-line was 25 years, with five years before seed was required.

Any actions addressing funding issues for SPAs should specifically address funding uncertainty.

⁹⁴ Australian Local Government Association, 2007. Productivity Commission; Study Into Local Governments Own-Source Revenue; Australian Local Government Submission, <u>https://www.pc.gov.au/inquiries/completed/local-government/submissions/australian_local_government_association/sub050.pdf</u> accessed 21 March 2021. ⁹⁵ Ibid.

⁹⁶ Logie, S. 2020. Audit of Seed Production Areas in NSW Report; Hancock et al. 2020. The Australian Native Seed Sector Survey Report.



Low income from seed sales

Funding barriers referred not only to a general lack of funding and funding uncertainty, but also inadequate income from seed sales. While seed sales were seen as economically more sustainable and less sporadic than government grants, lack of seed sales and prices hindered contributors. Seed sales were often insufficient to cover costs. Examples include:

- One private producer funded their SPA from other parts of their business, but had decided to wind operations down as seed sales had not covered costs.
- 10 of 11 landholder contributors spoke of the disappointment that their SPA did not generate any income, let alone cover their labour costs. One likened their annual income from the seed sales as 'barely covering a bottle of wine'.

With only a small number of private SPAs, the low number of commercial operators in the space suggests that SPAs are currently and broadly across Australia, unviable with seed sales.

The effects of low seed sale income was articulated by two examples:

- One private SPA manager felt that when it came to choosing between economic viability and environmental outcomes, he would always choose economic viability.
- Three contributors felt in the current system, seed viability testing was a cost they could not always afford.

With authors pushing for SPAs to cover not just commercially viable plants but also species that are hard to grow, this doesn't appear a feasible expectation of private SPAs.⁹⁷ Reasons given for the low income from seed sales were:

- lack of market demand
- choosing the wrong species to sell (marketability)
- the price of seed not covering costs.

⁹⁷ Pedrini, S., Dixon, K. W., Cross, A. T., Gibson-Roy, P., Trivedi, C., Galvez-Ramirez, C., Hardwick, K., Shaw, N., Frischie, S., Laverack, G., & Dixon, K. 2020. Collection and Production of Native Seeds for Ecological Restoration. *Restoration Ecology*, <u>https://doi.org/10.1111/rec.13190</u> accessed 16 March 2021.



KEY POINTS

Of government-funded SPAs, the majority are funded by local government (39%), followed by state governments (26%) and the federal government (26%). Although local management is preferred, local governments have the most stretched resources of all levels of government. Long-term funding for SPAs would be better sourced from the state and federal governments.

Any strategy that addresses funding issues for SPAs should in particular address funding uncertainty.

Seed sales rarely cover costs.

It isn't viable for commercial operators to ensure there is a diversity of hard to grow species.

Market demand

As outlined above, it is clear that seed sales do not cover the costs of establishing and maintaining an SPA. Market demand is a major factor in this. In the literature, Hancock *et al.* call for '*consistent and predictable seed demand to justify investment required to create and maintain SPAs*'.⁹⁸

The literature suggests that decades-long government investment is required to build a robust seed market.⁹⁹ This is reiterated by Gibson-Roy, who considered long-term investment key to developing the US native seed market.¹⁰⁰ Having longer time frames and a clear, long-term framework is also recommended by Broadhurst *et al.* and Broadhurst & Coates.¹⁰¹

Two contributors believed the market demand for seed could be developed by a governmental refocus on revegetation farms. While Mortlock outlines that private landholders are small users with little impact on native seed demand, they could band together to gain the financial power and ability to influence the market.¹⁰² It is possible they could also provide a consistency larger users do not (as larger users are fewer in number).¹⁰³



Additionally private landholders' small demand for seed may also help increase demand without overburdening wild stands.

¹⁰² Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.
¹⁰³ ibid.

 ⁹⁸ Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*. p 31.
⁹⁹ Ibid.

 ¹⁰⁰ Gibson-Roy, P. 2018. 'Restoring Grassy Ecosystems: Feasible or Fiction? An Inquisitive Australian's Experience in the USA'. *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12327</u> accessed 12 December 2021.
¹⁰¹ Broadhurst *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*; Broadhurst & Coates, 2017. 'Plant Conservation in Australia: Current Directions and Future Challenges'. *Plant Diversity.*



Marketability

With market demand low, the need for marketability amongst SPA seed sellers was high. Examples include:

- One commercial SPA noted the need for species to be marketable in order to generate seed sales. The operator mentioned wildflowers as particularly marketable, noting: 'All I needed to do was to post a picture of wildflowers and I'd get 10 times the likes and comments [on Facebook]'.
- One landholder regretted the species they had planted, and felt the reason they rarely sold any seed was that they had not grown marketable species.
- Another contributor emphasised the need to plant rarer species that were hard to access in the wild, saying one SPA had gone derelict because they lacked the 'understanding of supply and demand of what should be grown as they could often meet that through wild harvest'.
- A government operator working to re-establish threatened species populations saw potential long-term seed sales given they were rare plants (however this was a far-off vision that would require a great deal of bureaucracy to protect sites).
- Another contributor generated sales by allowing potential customers to tour their SPA site.

KEY POINTS

- Both revegetation programs and regulations requiring revegetation have a big impact on market demand for native seed.
- Any government strategic investment needs to be decades long.
- Site tours, wildflowers and rare species were perceived as attracting more sales.

Sourcing seed

Another hurdle SPA managers faced was sourcing seed. Two contributors mentioned seed collecting permit systems, in particular the length of time to obtain a permit and the lack of clarity in the system, as a major issue. This validates the same finding within the *Audit of Seed Production Areas in NSW Report*, where the seed industry was described as a *'wild west'*. Broadhurst et al and Frishie *et al.* also corroborate this finding.¹⁰⁴

¹⁰⁴ Frischie, S., Miller, A., Pedrini, S., & Kildisheva, O. 2020. 'Ensuring Seed Quality in Ecological Restoration: Native Seed Cleaning and Testing'. *Restoration Ecology*, <u>https://doi.org/10.1111/rec.13217</u> accessed 12 February 2020; Broadhurst, *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*.



Consequences of the lack of clarity and/or regulation include:

- poor seed quality
- misidentifications
- lack of species diversity
- low seed volumes ready for large-scale restoration
- lack of equipment within the seed industry
- over-reliance on wild harvested seed.

One contributor recommended having an industry body as the first step towards enforceable standards around labelling, standards and testing. This echoes the recommendations of Frischie *et al.*, Neville *et al.*, Broadhurst *et al.* and Hancock *et al.*¹⁰⁵ Neville *et al.* also recommend an accreditation scheme.

Additionally, any increase in regulation should adequately account for the on-ground reality of seed growers and collectors in order to avoid negatively impacting seed supply.¹⁰⁶

As well as having a confusing seed collecting system, contributors were faced with the obvious barrier of trying to collect from limited populations of threatened species.

KEY POINTS

- Seed collecting permit systems were confusing.
- Enforceable seed regulations would increase the quality of seed sold.
- An industry body would be the first step in creating enforceable seed regulations.

Aspects of SPA management and design

In the course of the survey, hard won lessons on SPA management and design were imparted by contributors. With knowledge sharing a key finding of this report, this information is distilled below for use in the SPA community.

¹⁰⁵ Frischie *et al.* 2020. 'Ensuring Seed Quality in Ecological Restoration: Native Seed Cleaning and Testing'. *Restoration Ecology*; Nevill *et al.* 2016. 'Seed Production Areas for the Global Restoration Challenge'. *Ecology and Evolution*; Broadhurst *et al.* 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples From the Flora of Southern Australia', *Rangeland Journal*; Hancock *et al.* 2020. *The Australian Native Seed Sector Survey Report*.

¹⁰⁶ De Urzedo, D. I., Fisher, R., Pina-Rodrigues, F. C. M., Freire, J. M., & Junqueira, R. G. P. 2019. 'How Policies Constrain Native Seed Supply for Restoration in Brazil'. *Restoration Ecology*, <u>https://doi.org/10.1111/rec.12936</u> accessed 4 March 2021.



Location

Location of SPAs needed to take into account several factors:

- matching species to their area, in particular their soil type, for reproductive success
- soil quality
- ability to water plants
- accessibility, in terms of both distance and onsite access for machinery
- land ownership
- land owner commitment
- ensuring that there was not an oversupply of seed to the local area.

Distance to SPA

Distance to the SPA proved a surprising requirement in picking a good SPA location. When one NRM region downsized its SPAs from 68 to 52 SPAs, they found distance had played a key role as to which SPAs had been maintained. Another contributor spoke of an SPA he had at work compared to one off-site, and found the effort of monitoring his work-site SPA to be so reduced compared to his off-site SPA he found it difficult to name it as a task he undertook. Often, upon visiting his off-site SPA, he would *'put aside a whole day to check'* on it.

Private vs government SPA land

Most SPAs were located on private land and one-third on public land. This reflects the findings of the *Australian Native Seed Survey Report 2020*.¹⁰⁷ Only a small minority fall on private company, university or First Nations protected land, again reflecting the concerns previously mentioned; i.e., that the SPA industry is only accessible to a few types of organisations. It is notable that of the SPAs surveyed, recent years show a tendency towards government-owned land, whereas those that were established in earlier years were largely situated on private land. Contributors offered insights into the pros and cons of private land vs government-owned land when reflecting on success factors and barriers.



Despite Gibson Roy's suggestion in 2010 that SPAs are better situated on private land due to 'engaged families' strong connection to their land', situating SPAs on private land had issues of long-term commitment from landholders with the occasional SPA become derelict through selling or changing priorities. Amongst success factors, one contributor advised avoiding private landholders altogether to maintain long-term control of the land and SPA. Landholder commitment was a barrier for those on private land.

¹⁰⁷ Hancock et al. 2020. The Australian Native Seed Sector Survey Report.



It should be noted that despite landholder commitment being an issue, there were also landholders whose consistent commitment to maintaining and managing their SPA was wasted, as a result of their partner organisation becoming underfunded and unable to continue their commitments of collecting and selling seed. Commitment, therefore, required a two-way street.

One contributor also mentioned the desire to partner with large-scale landholders, but was unable to do so as there was no protocol for visiting the farm and beginning the process of such an enterprise.



However, government-owned sites were not without their problems. Two contributors mentioned the need for security on government sites and vandalism as a barrier.

Finally, some government sites required extra effort to be directed towards maintaining the aesthetic of the land, with one council worker expressing frustration at having to convince people of the *'semi-wild aesthetic of [the SPA]'*. A number of council-owned SPAs that required extra mowing and pruning to maintain the area for the public corroborated this. However, this multi-use SPA meant that funding towards maintaining the SPA could come from other areas of council.

These pros and cons of government and private lands showcase the important areas of consideration for anyone starting an SPA.

Other considerations

Locating the SPA where there would be demand for seed species is another consideration required in designing an SPA. In the Murray NRM region, 52 SPAs became derelict after the seed that was harvested did not sell. Mortlock (2000) outlines the need for SPAs to be located near 'big users'.

Land prices and land zoning (within the ACT) hindered finding land that met all the above criteria for an SPA.

Infrastructure

Types of infrastructure required included:

- good quality fencing
- adequate seed storage
- having access to harvest machinery (e.g. cherry pickers for large trees)
- general system sophistication (weed mats, clear barrier between crops)
- irrigation.



However, with infrastructure came not just the establishment costs, but the costs of repairing and replacing it. Repairing irrigation, fencing, weed mats and general infrastructure were all cited among the tasks of running an SPA.

Ageing infrastructure was considered a barrier. This was in particular an issue for weed mats, which had a lifetime of five years.

Irrigation

Irrigation in particular was a coveted piece of infrastructure by two contributors, and a further five attributed the success of their SPA to the fact that they had it. The importance of irrigation is further emphasised by the fact that watering was considered fundamental in the establishment phase.

Plant placement

One survey contributor designed their SPAs to have short rows so that volunteers did not having to carry equipment (e.g. for watering) too far on foot from vehicles.

Species

Many SPAs were set up to generate seeds and genetic diversity for local threatened species. As such, their choice of species was determined prior to choosing to create an SPA. However, some SPA managers selected their species after deciding to establish an SPA. Species choice required weighing a number of factors including:

- marketability
- having an achievable goal
- propagation
- maintenance
- sourcing seed
- time before replacement planting is required
- seed yield
- machinery for harvesting
- Iocation of the SPA
- number of species.

Marketability of species

Two contributors listed marketability of species as a barrier, as they regretted their proven 'unmarketable' species. Contributors' answers to long-term funding showcased one contributor moving away from grasses and towards wildflowers, and another spoke of ensuring that their species were rare, and difficult to harvest from the wild. Both of these were hoping to secure seed sales as a result.



Plant types

Plant type also influenced the cost of running the SPA in the long run. Tree SPAs required little to no maintenance, and were estimated to be \$500 per annum. However, this was estimated by one contributor who had not visited the SPAs over the last few years. However, longevity of the plants and low weeding requirements may also be factors.

Shrub SPAs, on the other hand, required replanting every five years and grass SPAs required re-sowing roughly every two years.

There were two SPAs with a mix of at least three plant types. One contributor spoke of:

'Trying to keep the natural structure of it — lots of little stuff: trees 10% large shrubs 20% and grasses put in.'

Contributor quote

The other was '*re-establishing a 65,000-year-old food system*'. Both of these have aimed to emulate natural ecosystems and have outcomes beyond seed production.

While two SPAs of this structure was too small a sample from which to draw any findings, this is an interesting form of SPA, as it may deliver more than one environmental outcome.

Numbers of species

While small numbers of species was seen as a negative thing when assessing the capacity of the SPA sector, one contributor said that selecting a small number of species (in their case three) was key to ensuring that creating an SPA was achievable and attracted volunteers:

'It's something that grabbed people's attention...because it was a tight focus. People knew from the beginning we can't go too far astray. So it's very easy to measure success. We don't have 10 main objectives. Three species and we just focus on that.'

Contributor quote

Populations and genetic diversity

The number of populations and regions from which to source seed was another key consideration in the designing of SPAs. Contributors sourced on average five populations (different habitat fragments) for their SPA plants, although the median was three.



One contributor (of the following climate projected region example) cited having genetically healthy stock as a success factor. They felt that collecting genetically diverse seed directly influenced the health of seedlings and subsequent mortality rates once planted.



Another contributor undertook genetic testing, and was shocked at the low diversity of all populations of the threatened species they were trying to save, even in populations of 100+. Consequently, they increased the region from only local populations to anywhere they could source the seed from.

Furthermore, one contributor had 10–20 of their SPA filled with plants from their climate projected region.

Running an SPA

Running an SPA, and in particular the physical maintenance of plants, has previously been a vastly underestimated part of having an SPA.¹⁰⁸ Physical maintenance was the most cited success factor by the most amount of contributors and the second most cited barrier. Additionally many other success and barrier themes related to maintenance. Successful maintenance required:

- consistency
- watering
- access to labour
- weed control
- funding
- effort during establishment
- regular monitoring
- reducing maintenance (one contributor happy that their SPA was 'set and forget')
- checking and replacing guards
- testing soil
- repairing fences
- protecting against fire
- good record keeping
- maintaining good relationships
- undertaking seed collection
- need for replacement planting
- pest control
- having time to do maintenance
- having ongoing staff.

¹⁰⁸ Logie, S. 2020. Audit of Seed Production Areas in NSW Report, p. 37.



Database

The most commonly performed task of running an SPA was surprisingly, database tracking. Three contributors mentioned having a good database as a success factor. One of these found it helpful to have a consultant to develop a database, and have their records transferred to the new database. One contributor outlined the burden involved in researching and creating a good database, without access to experiences of other SPAs.

Documentation of SPA plants' origin is an SPA requirement as it is the first step to strategically influencing plant genetics.

Weed control

Weed control was also a very important part of managing SPAs. Techniques for this included:

- weed mats (one contributor warned that these were 'low maintenance not no maintenance' and required replacing every five years — a barrier to two contributors)
- scraping off topsoil before planting
- spraying
- slashing
- hand weeding
- 'Running cattle through to keep the grasses down'.

In one example, a contributor spoke about ending the lease on his land due to the fact that it was 'surrounded by weeds' and weed 'seeds were blowing over when they were harvesting [their crops]'.



In this particular instance, the weed was serrated tussock and the manager felt a responsibility not only to sell quality seed with no weed seed in it, but also not to spread noxious weeds to other areas of the country inadvertently.

There was an association between reduced weed control and tree-only SPAs, once established.

Watering

Watering was also fundamental, particularly in the establishment phase. It was the second most important success factor within maintenance, with 58% of SPAs undertaking watering during establishment and when the weather required.

The importance of watering was corroborated by the two contributors who thanked the last two good years of rain they had, and attributed the success of their SPA to this. Another replanted his SPA the year before, and lost all his plants due to dry weather and no watering plan.

Watering systems, including irrigation systems, are an important consideration in SPA design.



Other maintenance

Fire management (fire breaks and burns) was undertaken in 27% of SPAs. One derelict SPA was lost due to a bushfire. This was especially important for rainforest species, which did not survive fires.

Genetic testing, while undertaken by only five contributors, informed three contributors' choice of plants for their SPAs. For example, one contributor sourced plants from further afield after they found the threatened species had very low genetic diversity.

Seed viability testing was an area which three contributors wanted to do more of. Others mentioned soil testing and monitoring (which was mentioned as an important success factor).

Labour

Costs

SPA labour costs varied between \$500/annum to \$1,000,000/annum. The survey data showed there were many low cost SPAs and a few high cost SPAs. Those which were low cost were of tree and shrub SPAs and were in partnership with private landholders. These SPAs relied on landholders to provide labour in return for a percentage of seed sales and this labour was not always a part of estimated costs. Additionally, many perceived these species as requiring no maintenance once set up (although conversely others felt maintenance of these species was important).

The investment of maintenance was loosely associated with harvest yields, with the top three yielding SPAs averaging 452kg of seed per year, investing an average of \$74,000 per year into maintenance (once outliers were accounted for).

Volunteer labour management

Volunteer labour needed some management, including:

- good relationship management
- involving only people that got along
- directing volunteer working bees
- marketing the group through Facebook posts to attract other volunteers
- having a skilled 'champion' to drive the project.

One contributor considered reliance on volunteers a risk.



KEY POINTS

- Distance to SPA sites played a key role in the success or failure of SPA, with closer ones being more successful.
- Soils should be matched with plants.
- There are pros and cons to SPAs situated on government or private lands. Landholder commitment was an issue for private lands, while security was an issue for public lands.
- Ensuring SPAs are located in regions where there is a gap in seed supply and demand is important.
- Database management, weed control and watering were the three most important things in running an SPA.
- SPA developers should ensure there are adequate watering strategies in place. Placement of plant into short rows to minimise walking distance to vehicles can help with hand watering systems.
- Labour costs for SPAs vary enormously. High labour investment in an SPA is associated with high seed yields. Plant types may influence the cost of running the SPA.



RECOMMENDATIONS

Any actions based on the results of this survey in the under-represented and unrepresented states or nation-wide should seek feedback before implementation.

Suggestions for industry-wide support in this area include:

- 1. Develop a system of collecting and having publicly accessible data on regional seed demand and supply. This will mitigate against some supply and demand risks in SPA development.
- 2. Facilitate communication, networking and information sharing among SPA managers and other stakeholders.
- 3. Establishment of an industry body for SPAs.
- 4. Develop seed regulations and a certification system to ensure seed quality and increase the competitiveness of SPAs.
- 5. Identify current and future native seed demands, match this against current SPA capacity and identify areas for the establishment of SPAs.
- 6. Develop a system that encourages or requires the use of certified native seed in restoration projects.
- 7. Government acknowledgement and financial investment into First Nations systems of land management in the seed industry.
- 8. Increase the percentage of SPAs that have cultural authority or cultural licence to operate.
- 9. Acknowledgement and protection of agricultural heritage sites as the UN defines them.
- **10.** Build long-term financial capacity in the SPA sector by slowly building consistent market demand for native seed, with support for SPA development to match.
- **11.** Support SPA engagement and partnerships with Crown land authorities or private landholders with formal facilitation.
- 12. Ensure there is equal support for private SPA enterprises as well as publicly-funded SPAs.



CONCLUSION

This survey sought to understand the current capacity of Australia's SPAs and how they could best be supported to expand their capacity. The survey captured an estimated 53% of Australia's SPAs. Based on this, and estimates of seed harvested, the survey found that SPAs would likely contribute 5.5 tonnes of seed per annum to the native seed sector. It also found that most of this will be directed towards in-house projects rather than sold commercially.

The financial capacity of Australia's SPAs is fragile at best. This is leading to labour shortages, job insecurity, organisational knowledge loss, and SPA degradation and even disbandment. The low financial viability of Australia's SPAs is likely caused by low seed prices, overall uncertainty and lack of market demand. Their very small sizes (an average of 2.7ha) is likely also a contributor. Some SPAs are multi-use as a means of obtaining funds from other sources.



An analysis of SPA barriers, success factors and industry-wide support ideas found that many SPA managers would benefit from greater access to knowledge, through both networking and access to experts. Research in the area was also desired.

Only 1.5% of SPAs were managed by First Nations managers. With SPAs a form of land management seeking environmental outcomes, First Nation land management is key to achieving these. Any SPA strategy should see the majority of SPAs having cultural authority or cultural licence to operate. This is likely to increase the probability that both specific and broad-scale environmental outcomes will be achieved.

Ensuring both economic and environmental outcomes of SPA development involves the balancing of ever-evolving factors, including:

- ecological outcomes of revegetation vs habitat protection
- government funding programs and regulations surrounding revegetation
- lack of incentives in the native seed market
- lack of support for private enterprise in the SPA market
- SPAs' need for supply to match demand, so as not to overharvest wild stands
- small private landholder seed user versus large-scale corporate or government seed users.



Other findings included:

- 1. Of all government levels, local governments are taking on the most onus for securing seed production, with the greatest amount of government funded SPAs coming from this sector.
- 2. Seed permit systems were deemed confusing.
- 3. Most SPAs used CSIRO guidelines.
- 4. SPAs are unlikely to contribute to a greater diversity of species in the market.

It is hoped that the results of this survey will inform the sector of barriers facing Australia's SPAs and the success factors which help them achieve longevity. Any long-term seed strategy looking to secure the long-term future of the SPA sector, and increase its capacity to ensure Australia's wild native plants remain genetically diverse, should take these factors into account.



REFERENCE LIST

Adams, M. 2004. 'Negotiating Nature: Collaboration and Conflict between Aboriginal and Conservation Interests in New South Wales, Australia'. *Australian Journal of Environmental Education*, 20(1), pp. 3–11. <u>http://www.jstor.org/stable/44656376</u> accessed 14 April 2021.

Australian Local Government Association, 2007. *Productivity Commission; Study into Local Governments Own-Source Revenue; Australian Local Government Submission,* <u>https://www.pc.gov.au/inquiries/completed/local-</u> government/submissions/australian_local_government_association/sub050.pdf accessed

government/submissions/australian_local_government_association/sub050.pdf accessed 21 March 2021.

Australian Network for Plant Conservation, *Guidelines 7: Seed Production Areas for Woody Native Plants*, <u>https://whitsundaylandcare.org.au/wp-content/uploads/2020/04/Guideline-7-Seed-Production-Areas.pdf</u> accessed 12 January 2021.

Bradshaw, C. 2012. 'Little Left to Lose: Deforestation and Forest Degradation in Australia Since European Colonization', *Journal of Plant Ecology*, 5(1), 109–120, https://doi.org/10.1093/jpe/rtr038 accessed 4 April 2021,

Broadhurst, L., & Coates, D. 2017. 'Plant Conservation in Australia: Current Directions and Future Challenges', <u>https://doi.org/10.1016/j.pld.2017.09.005</u> accessed 14 December 2020, pp. 348–356.

Broadhurst, L. *et al.* 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*. 16(1), 29, <u>https://doi.org/10.1111/emr.12148</u>

Broadhurst, L. M., Fifield, G., Vanzella, B., & Pickup, M. 2015. 'An Evaluation of the Genetic Structure of Seed Sources and the Maintenance of Genetic Diversity during Establishment of Two Yellow Box (*Eucalyptus Melliodora*) Seed Production Areas', *Australian Journal of Botany*, 63(5), 455–466, https://doi.org/10.1071/BT15023, accessed 7 March 2021.

Broadhurst, L., Driver, M., Guja, L., North, T., Vanzella, B., Fifield, G., Bruce, S., Taylor, D., & Bush, D. 2015. 'Seeding the Future: The Issues of Supply and Demand in Restoration in Australia', *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12148</u>, accessed 19 December 2020.

Broadhurst, L., Waters, C., & Coates, D. 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples from the Flora of Southern Australia', *Rangeland Journal*, pp. 487–498, <u>https://doi.org/10.1071/RJ17055</u> accessed 7 March 2021.

Broadhurst, L., Waters, C., & Coates, D. 2017. 'Native Seed for Restoration: A Discussion of Key Issues Using Examples from the Flora of Southern Australia', *Rangeland Journal*.

Cook-Patton, S. C., & Agrawal A. A. 2014. 'Exotic Plants Contribute Positively to Biodiversity Functions but Reduce Native Seed Production and Arthropod Richness', *Ecology*, pp. 1642–1650, <u>http://www.jstor.org/stable/43493767</u> accessed 19 March 2021.

De Urzedo, D. I., Fisher, R., Pina-Rodrigues, F. C. M., Freire, J. M., & Junqueira, R. G. P. 2019. 'How Policies Constrain Native Seed Supply for Restoration in Brazil'. *Restoration Ecology*, <u>https://doi.org/10.1111/rec.12936</u> accessed 4 March 2021.



Department of Agriculture and Water Resources, *Australia's Forests at a Glance 2017*, <u>https://www.agriculture.gov.au/sites/default/files/documents/ForestsAtGlance_2017_v1.0.0</u> <u>lr.pdf</u> accessed 12 April 2021.

Food and Agriculture Organization of the United Nations (n.a.) *Globally Important Agricultural Heritage Systems (GIAHS)*, <u>http://www.fao.org/3/bp772e/bp772e.pdf</u> accessed 14 March 2021

Frischie, S., Miller, A., Pedrini, S., & Kildisheva, O. 2020. 'Ensuring Seed Quality in Ecological Restoration: Native Seed Cleaning and Testing'. *Restoration Ecology*, 28, S239–S248 <u>https://doi.org/10.1111/rec.13217</u> accessed 12 February 2020.

Gibson-Roy, P. 2018. 'Restoring Grassy Ecosystems: Feasible or Fiction? An Inquisitive Australian's Experience in the USA'. *Ecological Management & Restoration*, <u>https://doi.org/10.1111/emr.12327</u> accessed 12 December 2021.

Gibson-Roy, P., Moore, G., Delpratt, J., & Gardner, J. 2010. 'Expanding Horizons for Herbaceous Ecosystem Restoration: The Grassy Groundcover Restoration Project', *Ecological Management & Restoration*, pp. 176–186, <u>https://doi.org/10.1111/j.1442-8903.2010.00547.x</u>

Greening Australia, 2008. Transforming Our Landscapes: Grassy Groundcover Research Project Summary Report: 2004–2007,

https://www.ccmaknowledgebase.vic.gov.au/resources/Grassy_Groundcover_Research_Proje ct_0407.pdf accessed 14 April 2021.

Hancock, N., Gibson-Roy, P., Driver, M. & Broadhurst, L. (2020). *The Australian Native Seed Sector Survey Report*. Australian Network for Plant Conservation, Canberra, https://www.anpc.asn.au/wp-

content/uploads/2020/03/ANPC_NativeSeedSurveyReport_WEB.pdf accessed 20 March 2021.

Hill, R. Pert. P. Davies, J. Robinson, C. Walsh, F. Falco-Mammone, F. 2013, *Indigenous Land Management in Australia: Extent, Scope, Diversity, Barriers and Success Factors*, CSIRO, <u>https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/natural-resources/landcare/submissions/ilm-report.pdf</u> accessed 1 April 2021.

Logan, 2020, Native Seed Collection and Propagation the Next Boom Industry, Research Says ABC News, <u>https://www.abc.net.au/news/2020-10-09/native-seed-collection-and-propagation-the-next-boom-industry/12733242</u> accessed 12 December 2020.

Logie, S. 2020. Audit of Seed Production Areas in NSW Report, <u>https://www.anpc.asn.au/wp-content/uploads/2020/12/Final-Edited-Audit-SPA-NSW-Report-Consortium-Adopted.pdf</u> accessed 21 March 2021.

Maclean, K. Ross, H. Cuthill, M., & Rist, P. 2013. 'Healthy Country, Healthy People: An Australian Aboriginal Organisation's Adaptive Governance to Enhance Its Social-Ecological System', *Geoforum*, <u>DOI: 10.1016/j.geoforum.2012.10.005</u> accessed 5 April 2021, pp. 94–95.

Mortlock, B. W. 2000. 'Local Seed for Revegetation', *Ecological Management & Restoration*.

Nevill *et al.* 2016. 'Seed Production Areas for the Global Restoration Challenge', *Ecology and Evolution*.

Nursey-Bray, M., Palmer, R., Smith, T. F., & Rist, P. 2019. 'Old Ways for New Days: Australian Indigenous peoples and Climate Change', *Local Environment*, 24(5), pp. 473–486, <u>DOI:</u> 10.1080/13549839.2019.1590325 accessed 14 April 2021.



Pedrini, S., Dixon, K. W., Cross, A. T., Gibson-Roy, P., Trivedi, C., Galvez-Ramirez, C., Hardwick, K., Shaw, N., Frischie, S., Laverack, G., & Dixon, K. 2020. Collection and Production of Native Seeds for Ecological Restoration. *Restoration Ecology*, S228 <u>https://doi.org/10.1111/rec.13190</u> accessed 16 March 2021.

Pezet, L. 2014. *Indigenous Communities Meeting Demand for Bush Medicine,* ABC Rural. <u>https://www.abc.net.au/news/rural/2014-03-12/growing-bush-medicine/5313118</u> accessed 14 March 2021.

Royal Sydney Botanic Gardens, n.a. *Rainforest and Dryland Seeds*, <u>https://www.rbgsyd.nsw.gov.au/Science/Rainforest-Conservation-Research/Rainforest-Seed-Conservation-Project/Rainforest-Seeds/Rainforest-and-Dryland-Seeds</u> accessed 20 April 2021.

Züll, C. 2016. 'Open-Ended Questions'. *GESIS Survey Guidelines*. Leibniz Institute for the Social Sciences. DOI: 10.15465/gesis-sg_en_002.



APPENDIX A: SURVEY QUESTIONS

Thank you for participating. Your feedback is important. If you have multiple seed production areas (SPAs), please fill out a survey for each area.

This survey seeks to understand:

- 1. What Seed Production Areas (SPAs) look like nationally
- 2. Australia's capacity to upscale supply

Privacy

Collated, *non-identifiable* information from the survey may appear in the public domain as a report, contributing to the knowledge base of Australia's seed sector.

Information provided by participants will be securely stored and comply with Australian Privacy Principles (APP).

Participation

Participation is voluntary and will take about 12 minutes.

For more information, contact Elsie Baker at Murray Local Lands Services at <u>elsie.baker@lls.nsw.gov.au</u>.

Project Phoenix

GreeningAustralia's Project Phoenix aims to support a strong native seed/plant sector for bush regeneration. It is funded by the Federal Government's bushfire response.

Murray Local Land Services has been commissioned by Greening Australia to conduct a survey of Seed Production Areas (SPA) in Australia, as part of Project Phoenix.

For more information: <u>https://www.greeningaustralia.org.au/projects/projectphoenix/</u>



Part	1
1.	Does your seed production area (SPA)? (Tick all that apply)
	Include Australian native species
	Consist of planted or direct-seeded plants
	Have documentation of the origin (provenance) of the plants
	Have plants which were sourced from at least two separate locations per species
2.	Was your SPA established for the purpose of supplying seed for native vegetation regeneration?
	No
	Partially
	Yes
3.	What's the address of your SPA? Postcode only if there are any privacy concerns.
4.	How big is your SPA (in hectares)?
5.	What year was your SPA established?
6.	What type of organisation manages your SPA?
	Individual
	Private company
	Not-for-profit organisation
	Government
	University
	Partnership, private company and government



7.	Who owns the land of your SPA?		
	Individual		
	Private company		
	Not-for-profit	organisation	
	Government organisation		
	University		
	Partnership, private company and government		
8.	How many spec	ties do you estimate are in your SPA?	
9.	What native plant types does your SPA have, in percentages?		
	Trees %		
	Shrubs %		
	Grasses %		
	Forbs %		
10.	Please estimate your average annual seed yield over the last 2 years (in kg)?		
11.	How do you tra	ck and document the origin of your native seed?	
	None		
	Paper-based		
	Spreadsheet e.g. Excel		
	A more complex computer database		
	Other (please specify)		

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12.	What attributes do you collect in the tracking system?
	Location from which seed was collected
	Date collected
	Collector name
	Health of the plant from which seed was collected
	Size of the population from which it was collected
	Timing of flowering event (Early Middle Late)
	Number of individuals collected from
	Genetic information
	Don't use a tracking system
13.	What geographic range were the seeds of the SPA originally sourced from? (i.e. What Region/s)
14.	What factors contribute to your SPA's success? (List up to 5)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	



Part 2. How can you be supported?

15.	What factors are barriers for your SPA?
1.	
2.	
3.	
4.	
5.	
6.	
7	
۶. 8	
o.	
э. 16.	What industry-wide support would be helpful to you?
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8	
17	What main organisation invested in your SPA to get it established?
17.	what main organisation invested in your SPA to get it established?



18. What opportunities for long-term funding for your organisation do you perceive?

19. Describe the setup of the SPA with management

20. What style SPA is it?

Weed mat grasslands Broadacre grasslands Woodland SPA

Enhanced bushland SPA

Part 3. Running your SPA

21. What is the average age of the plants in your SPA (in years)?

22.	What is the estimated annual average cost of labour for your SPA?
23.	What activities do you currently undertake to run your SPA?
	Weed control
	Pest control
	Replacement planting
	Pruning
	Watering
	Fire management
	Database tracking
	Marketing



Seed quality testing (viability, purity, germinability)
Genetic testing
Seed harvesting
Fencing maintenance
Repairing Irrigation
Replacing Infrastructure
Sowing
Repairing Infrastructure
Fertilising
Weed mat maintenance
Seed cleaning

Comment

24. What is the frequency of your activities (e.g. yearly, quarterly, monthly, weekly, daily, through the summer etc)?

Weed control		
Pest control		
Replacement planting		
Pruning		
Watering		
Fire management		
Database tracking		
Marketing		
Seed quality testing		
(viability, purity, germinability)		

PROJECT PHOEN				
Ð	-			_
Genetic testing				
Seed harvesting	5			
Repairing Fence	es			
Repairing Irriga	tion			
Replacement of	f Infrastructure			
Fertilising]
Repairing infras	tructure]
Sowing				
Weed mat mair	ntenance]
Seed cleaning]
25. What act to 5)	ivities would you	like to undertake that yo	ou currently aren't able to? (L	」 ist to up
1				
2.				

3.		
4.		
5.	 	

Part 4. Seeds

26. Do purchasers request seed provenance data?

Always
Mostly
Sometimes
Never


27. On average, how many separate locations did you source seed from for each species planted in your SPA?

(For example, Species A within your SPA may have plants whose seed was originally sourced from 2 different locations)

28. Do you use *FloraBank Guidelines* in how you run any part of your SPA?

	Yes
_	

No

.

Comment

29. Can you estimate how much of your seed do customers pre-order or opportunistically buy?

Opportunistically	50/50	Pre-ordered
0		

30. Comments



31. How many unmanaged/derelict SPAs do you know of?



- 32. If you know of any unmanaged/derelict SPAs, what region are they based in?
- 33. How many SPAs that are currently being developed do you know of?
- 34. Reasons for why the SPA's became derelict

1.	
2.	
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