HOW MUCH DOES NATIVE SEED COST?

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.

ACKNOWLEDGEMENTS

CONTENTS

EXECUTIVE SUMMARY

Scope

The scope of the project is to identify what information is available on the pricing of native seed nationally. This will list, where available, data on current market rates/prices. It will also examine the suitability of a purity grading system (or other standards) for the relative valuing of seed.

Introduction

This project (Activity 2.13) will identify what information is available on the pricing of native seed nationally and will present a baseline snapshot of pricing to inform the native seed sector and government about pricing issues.

Issues

Several issues were identified during the gathering and preparation of the combined data set:

- There is no available information on the suppliers from which government procures native seed.

- Several native seed suppliers also sell exotic or non-native seeds alongside their native seed lists. Unless specifically identified, it may not be possible to determine whether all species are native.

- Several native seed suppliers listed prices in non-convertible quantities (for example, $ per packet or without a quantities) which were excluded from the data.

- Data scraping relies on standard format price reporting — for example, a scraper which registers '$3.00 per 4 grams' will not recognise '$3.00 per 4g'. In cases where native seed suppliers list in non-standard formats, efforts were made to capture variations, however not all variations have been captured by the data scrapers.

  – In addition to non-standard price reporting, several websites used non-standard html tags — for example, placing 98 out of 100 prices within a table, and the remaining two as free text. In cases where native seed suppliers use multiple web formats, efforts were made to capture variations, however not all variations have been captured by the web scrapers.

- ACIL Allen has relied on native seed suppliers to accurately label their genera and species. Misspelled or mischaracterised species will be recorded as such.

Key outputs

The key outputs from this activity are:

- this report
- the number of unique species = 3,089
- the number of suppliers = 7,430 listings from 13 suppliers
- R script to download and process price data from supplier websites and/or lists of prices in a PDF format.

Outcomes

The outcomes of this project are:

- Review of native seed pricing across the sector credible to government agencies.
- Market stipulations/pricing and relationship to quality.
- Snapshot of national pricing of native seed:
    - 3,089 species analysed for comparative prices
    - 13 sellers included in comparative analysis.
- A data set.
- Associated code to allow for this process to be repeated over time.

Findings

In the absence of any available information on government procurement, the approach taken was to find any publicly available pricing information on native seed in Australia. Twenty-five websites were identified with information that could be used but only 13 had information that could be collected in an efficient manner. This data is credible as the sample contains a large amount of data across species (3,089) and price listings (7,430). It also contains:

- suppliers from around the country and
- a range of different business types from large commercial operations to smaller community suppliers.

This snapshot of pricing information for the native seed sector provides the following findings:

- The number of suppliers with accessible price data nationally is 13. These are split across all states and territories with the exception of South Australia and the Australian Capital Territory.
    - Victoria has the largest number of seed suppliers with publicly available price listings (5), followed by New South Wales (4).
        - Queensland, Western Australia, Tasmania and the Northern Territory have one supplier each.

- New South Wales had the largest number of price listings (3,386 or 45 per cent of listings) followed by Victoria (2,008 or 27 per cent of listings) and Western Australia (1,879 or 25 per cent of listings).
  - ❖ Queensland, Northern Territory and Tasmania account for the remaining 2 per cent of price listings.
- Of the suppliers, 73 per cent are commercial enterprises and 27 per cent are community seed banks. This classification is important as the pricing strategies across the two types of enterprises are quite different.
- The seed price listings cover 580 genus and 3,089 species.
  - the top listed genera are dominated by eucalyptus and acacia.
- Prices range from $0/kg to $715,000/kg with a median price of $450/kg.
  - Tasmania has the highest median price ($880/kg) and Victoria the lowest ($380/kg).
  - genera with the highest average prices per kilogram are hakea, dianella, grevillea, daviesia and lomandra.
- The jurisdictions with smaller numbers of listings (Northern Territory, Queensland and Tasmania) are dominated by the major genera (eucalyptus and acacia).
- New South Wales, Victoria and Western Australia provide a wider range of genus.
- Having access to transparent information on the quality attributes of native seeds allows for:
  - seed collectors/suppliers to price seeds appropriately (i.e. attract price premiums for premium quality seed)
  - seed purchasers to make informed decisions so as to ensure that the seed they purchase is the best value for money for their intended purpose.

As efficient market development requires the provision of transparent information, this database will need to be updated and maintained over time.

> This will require sourcing additional information from a broader range of native seed suppliers and with more frequency. The costs and benefits of sourcing, collecting, collating and promoting this information over time will need to be considered and it may be more practical to incentivise suppliers to provide information rather than sourcing it indirectly.

Evidence

See Appendix A for a how-to guide and an embedded Excel file (a standalone Excel file is also available); Appendix B for the data capture code and Appendix C for the price plotting code.

Recommendations

Key recommendations from this review are as follows:

1. **Repeat this process annually to develop the database over time. Consideration should also be given to broadening the information search to:**

   - capture additional suppliers and genera and

   - gather information on seed stocks.

2. **Promote the information provided in this database and continue to promote it over time as the database is expanded.**

Incentivise disclosure of information direct from seed suppliers to reduce reliance on publicly available information to add reliability, robustness, breadth and depth to the information.

1 INTRODUCTION

1.1 Context

Greening Australia received $5 million under the federal government's $50 million Bushfire Wildlife and Habitat Recovery Package. This funding has been allocated to Project Phoenix, which aims to increase native seed and plant supply in preparation for the restoration of bushfire-affected areas and other valuable habitat.

This aims to support a response to the recent challenges in two main ways: (1) an immediate response to the bushfire impacts; and (2) by developing a longer term vision to address systemic issues in native seed supply in Australia. Project Phoenix will deliver strategic outcomes under eight priorities.

Under Priority 2: Build the capacity of the native seed and nursery industry through coordination of seed collection activities in bushfire-affected areas and other vulnerable landscapes, this activity examines the efforts made in other countries to manage native seed for restoration purposes and to understand the successes and otherwise of these frameworks and assess their applicability to the Australian native seed sector.

1.2 Scope

The scope of the project is to identify:

- A snapshot of national pricing of native seeds capturing the variation of seed pricing across the sector and market stipulations including:
  - # sellers included in comparative analysis
  - # species analysed for comparative prices

- A review of native seed pricing across the sector credible to government agencies.
- The suitability of a purity grading system (or other standards) for the relative valuing of seed.

> This report details a sub-set of suppliers whose data was publicly available on the internet. It is not a complete or comprehensive report of native seed species or price, rather a snapshot based on available information.

1.3 Methodology

The methodology used in this study included a desktop review including identification of pricing information sources, data capture, processing and analysis.

1.3.1 Desktop review

We undertook a desktop review of seed pricing, seed grading and quality standards. This review allowed identification of pricing information sources.

1.3.2 Data capture

Data capture was a HTML-based (and PDF-based) data scraping as many price lists are published online in websites.

There are two categories of information:

- web-page based price data and
- web-hosted PDF based price data.

We used R-based web scraping to access these price lists.[1] Packages/libraries such as rvest, Tidyverse, pdftools allowed for automated access to price information contained in HTML. Plotting was completed programmatically with ggplot2.

Each website was individually coded for, and as a result we prioritised the more easily accessible data first. Data was collected on species (using scientific names), prices, quantities (some species are measured by weight, others by individual seeds), common names (where available), provenance and other relevant information. Each entry was tagged with an identifier to link it with the supplier and state-based information.

A summary of data captured is provided in Appendix A and the code for data capture is provided in Appendix B.

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[1] We use only publicly available freeware to download and process the data. This makes it easy for future iterations of the process.

1.3.3 Data processing and analysis

Data on prices was processed (for example, looking for erroneous results, outliers, or multiple-names for the same species) and species were grouped (by genus, geography, seed/plant type) to allow for better comparison of results.

A clean dataset was built, and from this graphic presentation of the data was produced in a long-format dataframe. This was completed and plotted in R. This process was automated as much as possible to allow adaptation or replication of the exercise in the future. Reported prices were converted to kilogram or 1,000 seed quantities to aid in comparison.[2]

A two-step process to quality assure the dataset was conducted. First, the data was examined for price outliers (for example, if three suppliers report a cost of $30 per kilogram, a price of $350 per kilogram would be an outlier). Outlying price information will indicate that additional information may be required.

Secondly, each extract was manually checked against the originating website or PDF to ensure the information had been collected in a robust manner, and that no error had been introduced through transcription.

> Although every care was taken in this process, it is possible that errors exist including duplicate price and/or species data. A further caveat is that although data was sourced from native seed lists, it is possible that non-native species have been inadvertently captured.

1.4 The rest of this report

The rest of this report is structured as follows:

- Section 2 provides an overview of native seed pricing in Australia.
  - This is supported by a how-to guide and embedded data in Appendix A.
- Section 3 discusses purity grading systems and the impacts these systems may have on pricing in the future.
- Section 4 provides key findings and recommendations.

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[2] Note that lower prices are generally charged for higher quantities — given the focus on government as a large procurer of native seed, examining prices at the per kilogram unit is appropriate.

2 AN OVERVIEW OF NATIVE SEED PRICING

2.1 Background

The native seed sector is a complex sector characterised by several sub-sectors including conservation and restoration (amongst others) which share the interrelated objective of achieving beneficial outcomes for society.

The sector draws on a diverse range of stakeholders to source, store, supply and enable the use of native seed. The diversity of product and uses creates challenges including the provision of market information as well as pricing and quality attributes.

This report aims to go some way to fill the gap in pricing information available in the native seed sector with the aim to consolidate publicly available information,[3] collate it into a single data set, report the results and make observations on what this information may say about native seed pricing and the type of seeds available.

The data used in this study focused on:

- pricing information from 13 seed suppliers nationally
- a total of 7,430 seed price listings for 580 genus and 3,089 species.

All seed prices have been concerted to dollars per kilogram ($/kg) for reporting purposes. A summary of results are presented in Section 2.2 and in more detail in Section 2.3.

2.2 Summary of results

2.2.1 Summary by seed supplier

The suppliers and the number of seed price listings (observations) per supplier and the type of enterprise (commercial or community) are provided in **Table 2.1**.

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[3] Twenty-five sources of seed pricing nationally were identified and explored. Many sources had information provided in ways that were not useful (e.g. $ per packet of seeds where there was no measurement of the weight of seed per packet) so they were excluded from the sample.

TABLE 2.1. PROVIDERS BY NUMBER OF SEED PRICE LISTINGS (OBSERVATIONS)

PROVIDER	LOCATION (STATE)	NUMBER OF SEED PRICE LISTINGS	AS A PROPORTION OF TOTAL LISTINGS	TYPE OF ENTERPRISE
AustraHort	Queensland	508	7%	Commercial
Australian Seed Company	NSW	1,333	18%	Commercial
Ballarat Region Seedbank	Victoria	1,108	15%	Community
Harvest Seeds & Native Plants	NSW	237	3%	Commercial
Nindethana	Western Australia	1,879	25%	Commercial
Murray Mallee Seedbank	Victoria	363	5%	Community
Royston Petrie Seeds	NSW	741	10%	Commercial
Seed World Australia	NSW	334	4%	Commercial
South Gippsland Seedbank	Victoria	450	6%	Community
Top End Seeds	Northern Territory	209	3%	Commercial
Victorian Native Seed	Victoria	73	1%	Commercial
Wildseed Tasmania	Tasmania	181	2%	Commercial
Wimmera Region Seedbank	Victoria	14	0%	Community
TOTAL		7,430	100%	

Type of enterprise

Providers can be defined as commercial enterprises (73 per cent) and community seed banks (27 per cent). This classification is important as the pricing strategies across the two types of enterprises are quite different (see **Figure 2.1** and **Box 1**).

FIGURE 2.1. SEED PRICING BY ENTERPRISE TYPE (WITH FOCUS ON ACACIA MELANOXYLON) (PRICES ARE IN $/KG)
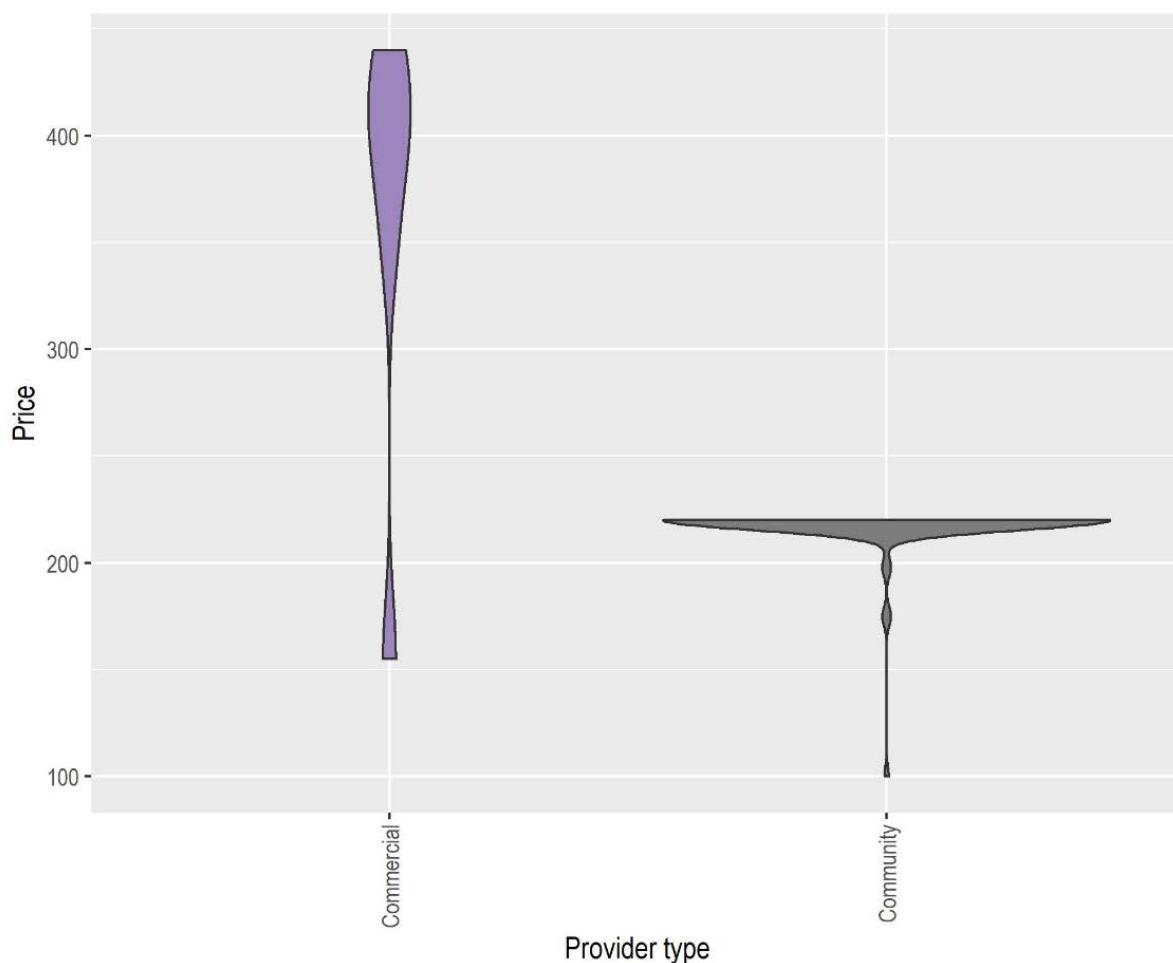
Source: ACIL Allen

Figure 2.1 shows that commercial enterprises have a larger range of prices, with more acacia melanoxylon offered at higher prices, very little between $200/kg and $300/kg and some product in the $150/kg to $200/kg range. The median price charged by commercial enterprises is $397.50/kg.

Community enterprises have a very different price strategy — there is a much lower price ceiling of $220/kg with the bulk of the seed priced at this price point and some seed priced between $200/kg and $100/kg.

Box 1.   Pricing strategies

As part of the Project Phoenix Native Seed Sector Strategy* a series of 14 workshops were run in April–May 2021. Pricing was part of the discussion in some of these workshops under the issue of demand.

One such discussion provided an example to highlight the difference in pricing strategy by seed suppliers providing the same native grass seeds generally used for large-scale restorations in the same state.

- The commercial enterprise was charging a price for seed that was produced in a seed production area and machine harvested.
- The community seed bank was charging ten times the price of the commercial enterprise for seed that was wild harvested by hand from a local seed collector.

There are several factors influencing the prices charged by each enterprise:

- Cost structures:
  - the commercial enterprise could provide the seed at lower cost; the community seed bank needed to pay the seed collector who needed to source and harvest and clean the seed by hand.
    - The seed collector's cost would include licensing and permit costs.
- Market understanding:
  - the commercial enterprise worked with large purchasers who were needing the native grass seed for large-scale projects (parks and roadside verges), so the commercial enterprise was able to price for a bulk market and the potential for future work.
  - the community seed bank is likely to be supplying to smaller scale purchasers for the purpose of local biodiversity projects who are generally more price sensitive but who may also be interested in specific quality attributes.

This in effect suggests that there are multiple markets even for a single species of native seed which in turn means that it will be common to find large differences in prices dependent on the type of native seed, the use of the seed (bulk market or niche), the quality attributes (currently not well signalled by seed suppliers except by price), enterprise objectives (commercial or otherwise), cost structures and market relationships.

* This Report contributes to the evidence base for a ten-year strategy to guide the native seed and landscape sector. The document, which is untitled until endorsement in September 2021, is referred to as the Strategy in all Project Phoenix publications.

Source: ACIL Allen

Provenance

The provenances of seed were only provided for 1,283 listings (17 per cent) across 7 of the 13 suppliers. With the exception of a few listings, nearly all provenance information collected was from the four Victorian community seed banks (Ballarat Region Seedbank, Murray Mallee Seedbank, South Gippsland Seedbank and Wimmera Region Seedbank) as well as Victorian Native Seed and Wildseed Tasmania.

2.2.2   Summary by jurisdiction

The majority of suppliers were based in New South Wales (4) and Victoria (5) with one each in Queensland, Western Australia, the Northern Territory and Tasmania. **Figure 2.2** provides a breakdown of seed price listings by jurisdiction showing that the data is dominated by listings in New South Wales (2,645), Victoria (2,008) and Western Australia (1,879). Other jurisdictions have smaller numbers of listings: Queensland (508), Northern Territory (209) and Tasmania (181).

FIGURE 2.2. SEED PRICE LISTINGS BY STATE
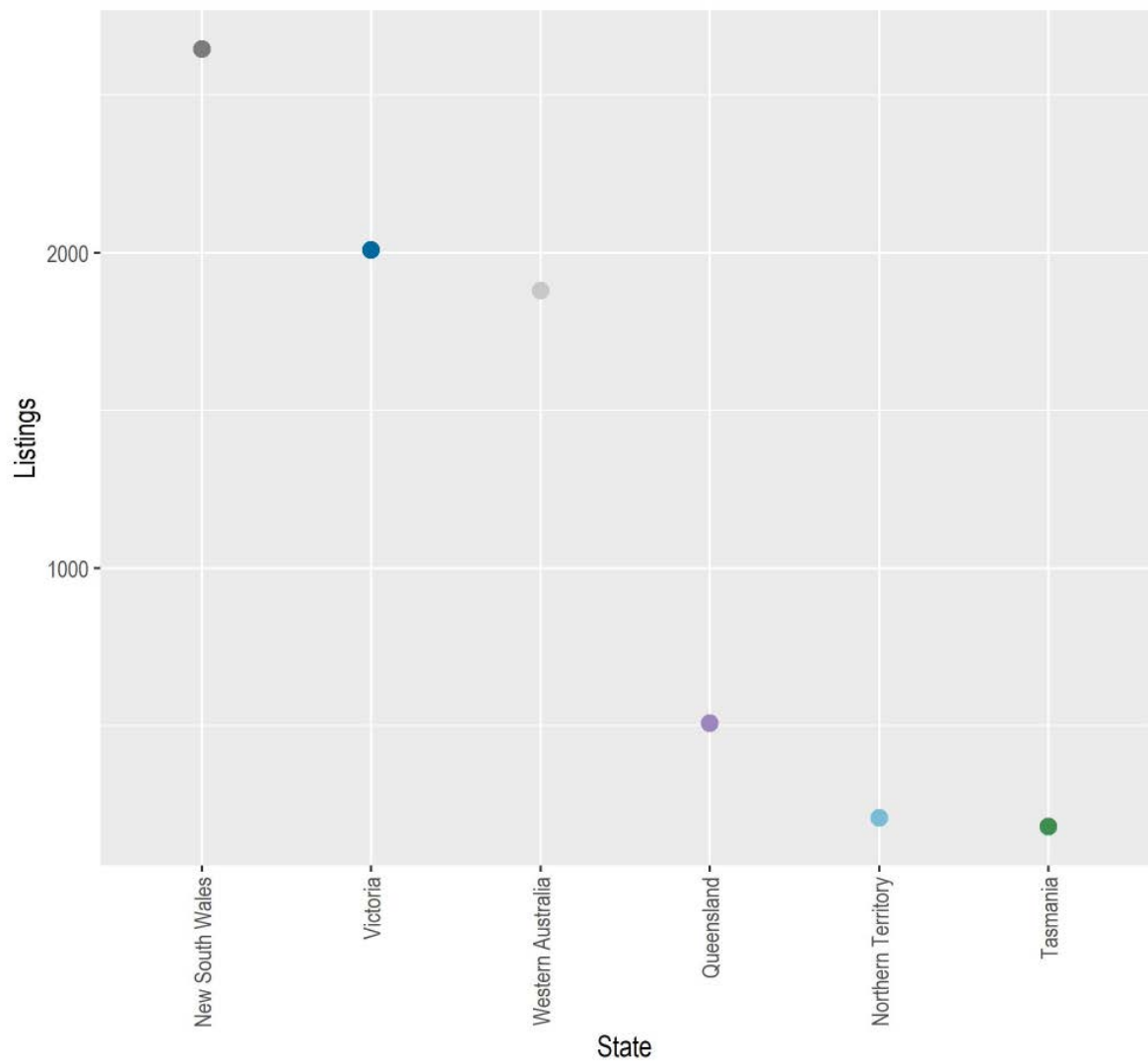
Source: ACIL Allen

2.2.3 Summary by taxa

The seeds price listings cover 580 genus and 3,089 species. The top listed genera are presented in **Figure 2.3** and are dominated by listings of eucalyptus (1,756) and acacia (1,683).

FIGURE 2.3. SEED LISTINGS BY GENUS
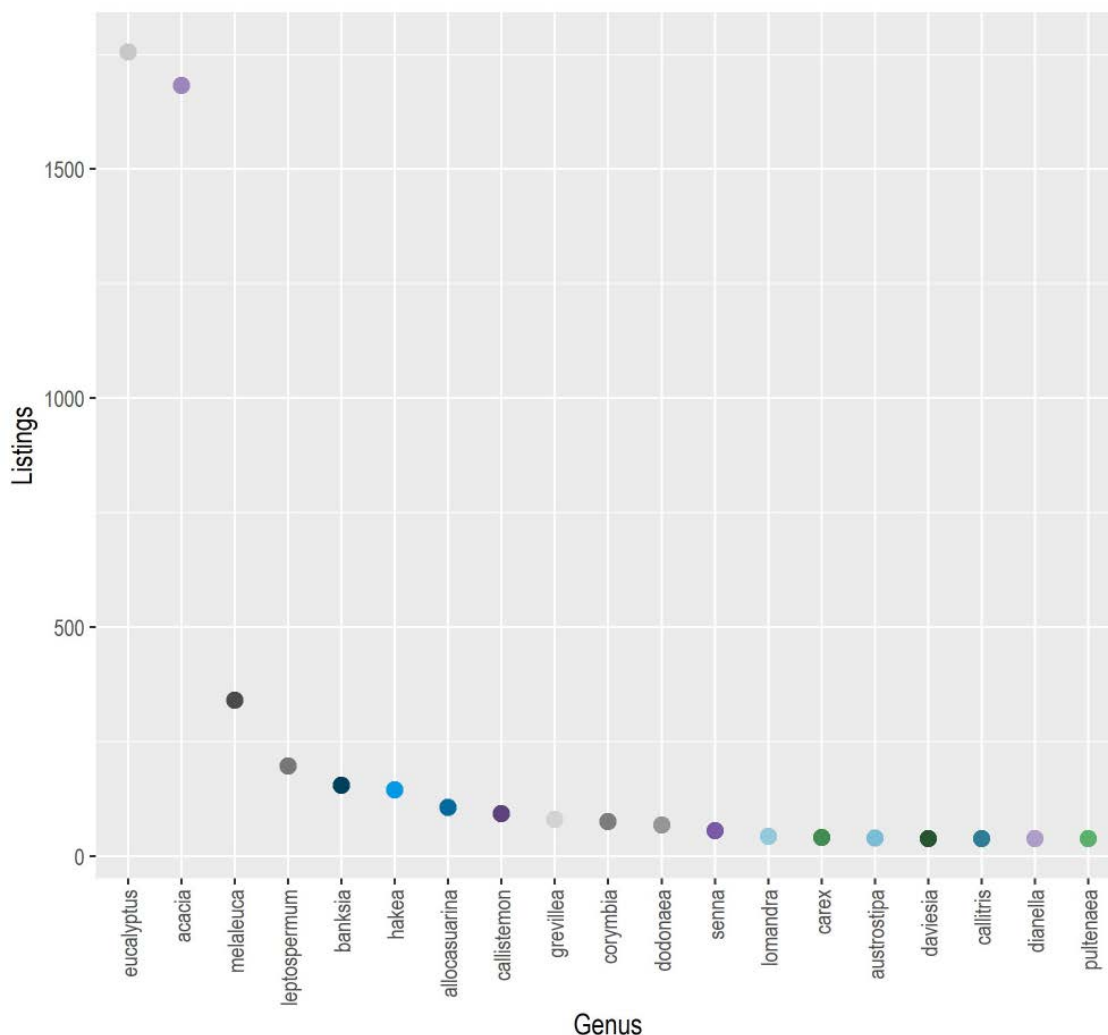
Source: ACIL Allen

Of the 3,089 species, the most commonly listed (greater than 40 listings) are:

- melanoxylon
- camaldulensis
- pycnantha
- obliqua
- longifolia
- continentale and
- ovata.

The top genus and species combinations (greater than 30 listings) are:

- acacia melanoxylon

- eucalyptus camaldulensis

- acacia pycnantha

- eucalyptus obliqua

- leptospermum continentale

- acacia provincialis

- acacia mearnsii

- acacia dealbata

- leptospermum lanigerum and

- eucalyptus aromaphloia.

2.2.4 Summary by price

All pricing information is reported in $ per kilograms. **Table 2.2** presents the minimum, median[4] and maximum prices across all seed price listings and those across the top five genera.

TABLE 3.2. DESCRIPTIVE STATISTICS ACROSS ALL PRICE LISTINGS, BY STATE AND FOR THE TOP TWO GENUS

SAMPLE (SAMPLE SIZE)	MINIMUM	MEDIAN	MAXIMUM
All listings (7,430)	$0/kg	$450/kg	$715,000/kg
Listings with outliers removed (6,846)*	$6/kg	$450/kg	$47,376/kg
New South Wales (2,645)	$9.10/kg	$400/kg	$44,000/kg
Victoria (2,008)	$50/kg	$380/kg	$715,000/kg
Western Australia (1,879)	$30/kg	$750/kg	$30,000/kg
Queensland (508)	$6/kg	$475/kg	$9,000/kg
Northern Territory (209)	$70/kg	$400/kg	$1,600/kg
Tasmania (181)	$308/kg	$880/kg	$18,700/kg
Eucalyptus (1,756)	$6/kg	$440/kg	$43,000/kg
Acacia (1,683)	$22/kg	$360/kg	$715,000/kg

* The outlier prices have been removed at both the minimum and the maximum ends of the spectrum.
Source: ACIL Allen

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[4] The median (the value that splits the individual data into two halves: the (approximately) 50% largest and 50% lowest data in the sample). The median is used rather than the mean (average), and has been reported as there is a very large range of prices ($0 to $715,000/kg) and the mean is impacted by outliers at either end of the spectrum.

Figure 2.4 presents the mean prices by genus. This shows those genera which command a higher average price per kilogram as being hakea, dianella, grevillea, daviesia and lomandra.

FIGURE 2.4. AVERAGE PRICE BY GENUS (PRICES ARE IN $/KG)
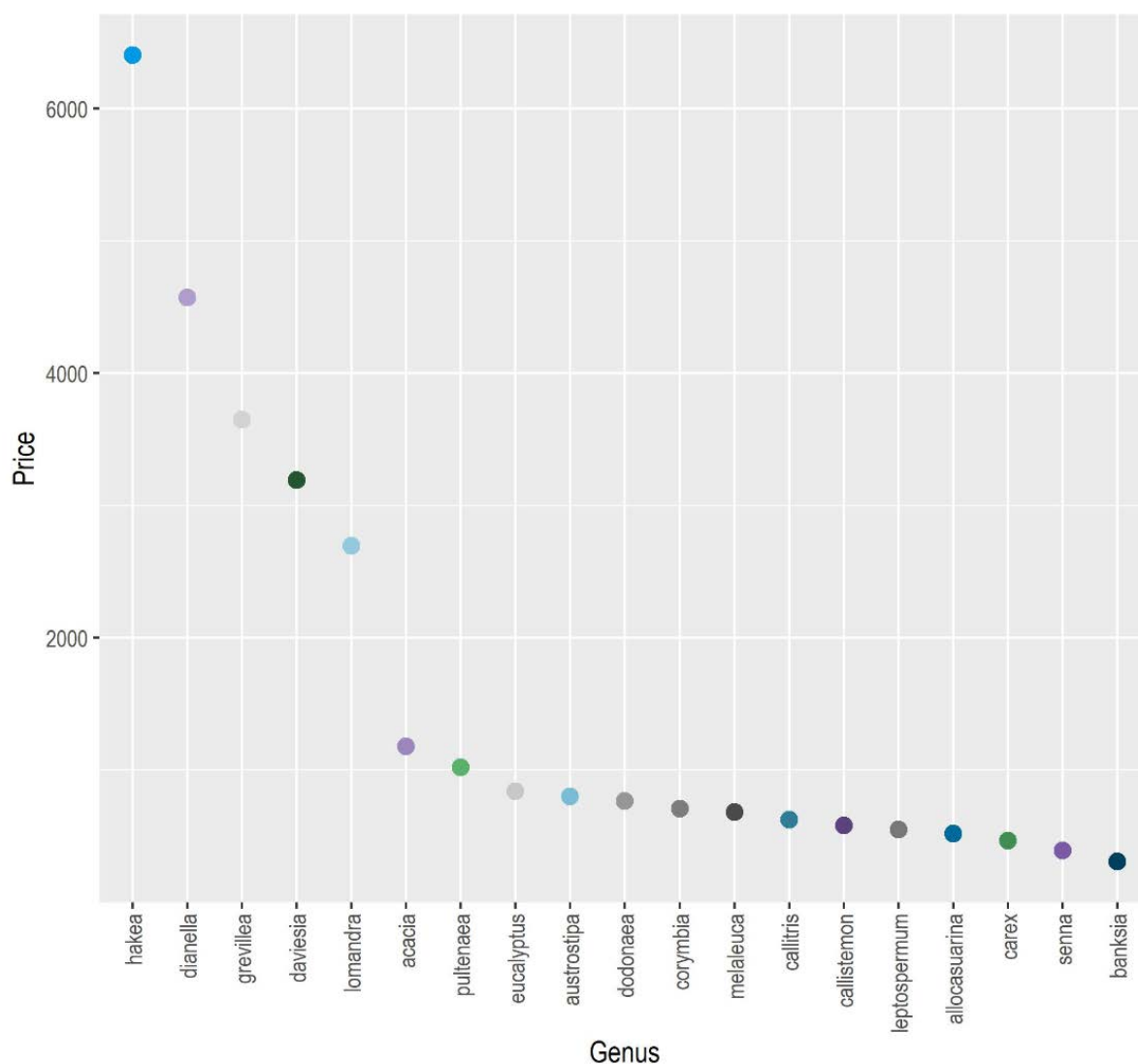
Source: ACIL Allen

Figure 2.5 presents the distribution of prices by jurisdiction.
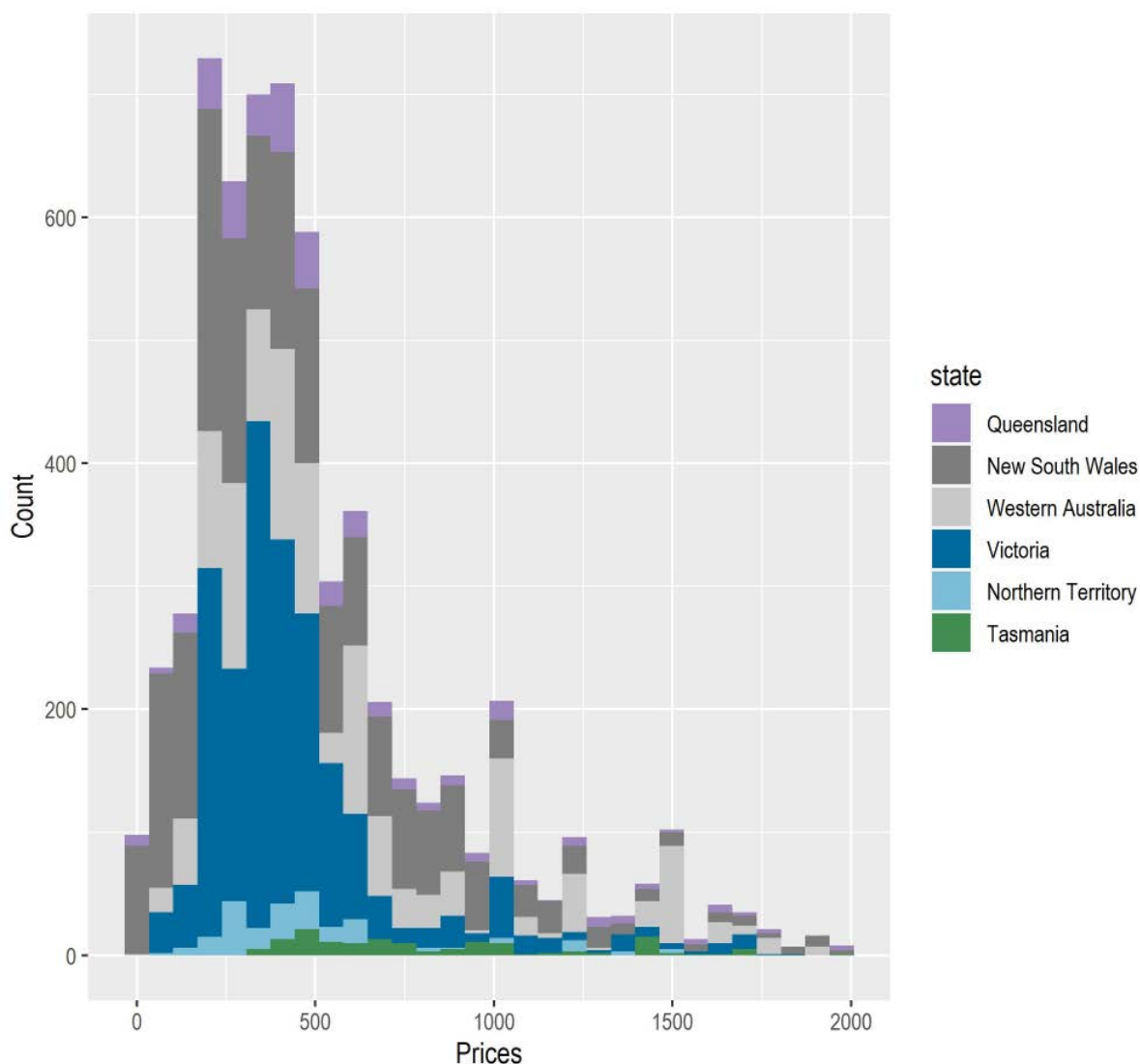
Source: ACIL Allen

2.3 Detailed price results

The graphs presented in this section can be interpreted in a similar way to a histogram (like **Figure 2.5**) where each 'violin' shows the distribution of price by genus. For example, in **Figure 2.6**, most banksia seed are priced below $250/kg with a concentration of listings below $100/kg but some species cost as much as $2,250/kg.

Understanding the variability in prices across genera could assist government and other large procurers of native seed in making more cost effective and/or sustainable purchasing decisions.

The assumptions about why some genera are cheaper than others are likely related to availability and cost of supply (relating to collection methods). If a procurer were focused on sustainable purchasing practices, focus would be best placed on genera that are cheaper and presumably more readily available.

Within genera, the variation is likely related to different species and either its availability and cost of supply and/or the quality of the seed (see Section 3).

Price by genus

The top genera are reported by price in **Figure 2.6**.

FIGURE 2.6. PRICE BY GENUS (PRICES ARE IN $/KG)
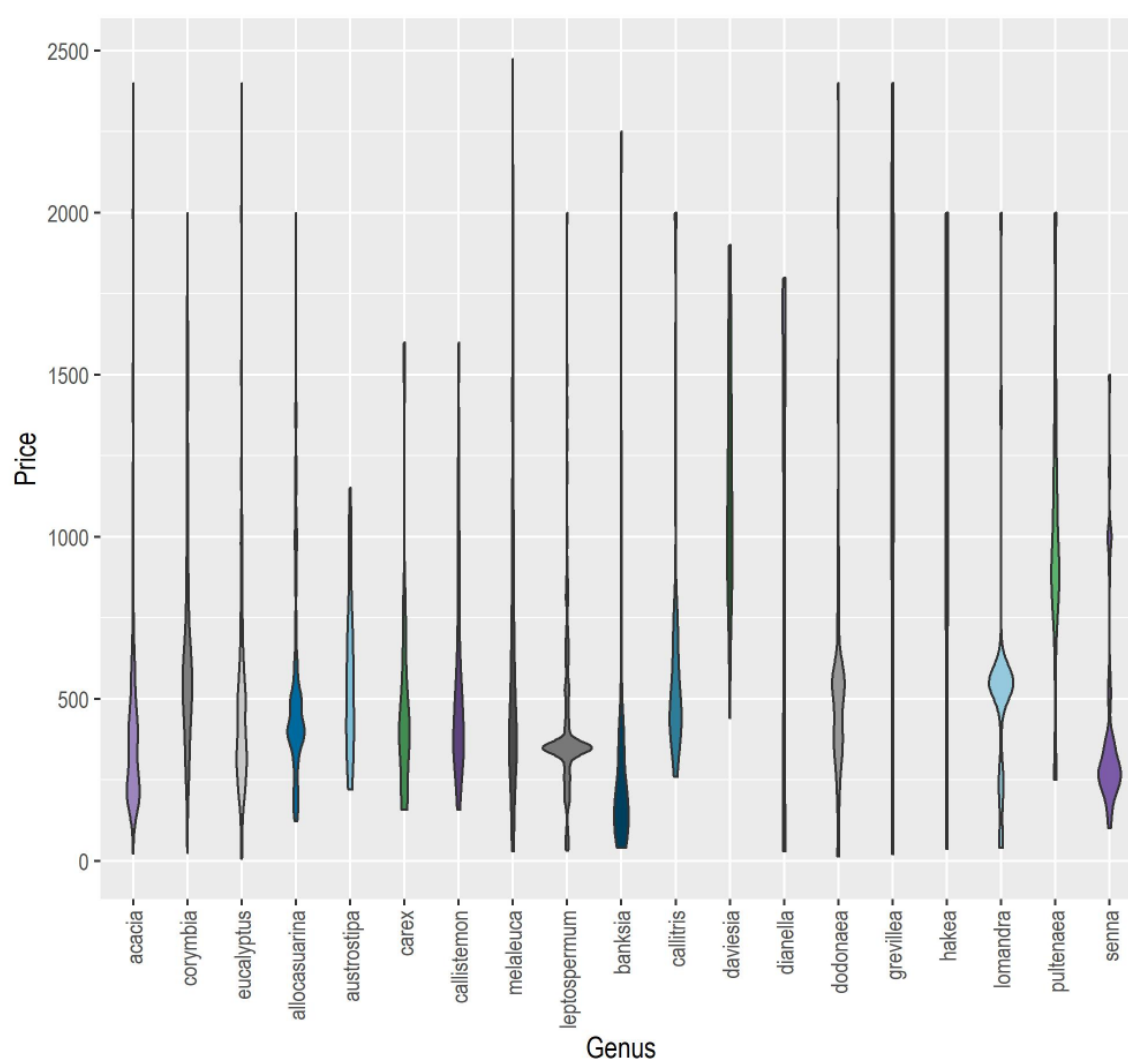
Source: ACIL Allen

2.3.2 Price by genus in each jurisdiction

Prices (in $/kg) are presented for each of the major genus in each jurisdiction (NSW, Northern Territory, Queensland, Tasmania, Victoria and Western Australia in the following figures. These figures show the dominant genus in each jurisdiction and the distribution of prices ($/kg) by genus.

The jurisdictions with smaller numbers of listings (Northern Territory, Queensland and Tasmania) are dominated by the major genera (eucalyptus and acacia), while those with larger numbers of listings (New South Wales, Victoria and Western Australia) provide a wider range of genera. See **Figures 2.7–2.12**.

> With a focus on New South Wales, Victoria and Western Australia (98 per cent of price listings) the following observations can be made based on this snapshot.

New South Wales

In New South Wales (see **Figure 2.7**), if a restoration project requires large quantities of seed at lower price points, procurers may wish to consider species of banksia or brachychiton as these genera have a price point with reasonable supply below the $250/kg mark. Should a broader cross-section of genera be required for a project, procurers could consider a base of these cost efficient genera and mix these seeds in with some genera below the $500/kg price point such as allocasurina, acacia or eucalypt.

Genera to avoid for large-scale price sensitive projects would be melaleuca, grevillea and hakea as these are generally less available and have a higher average price point. Information provided in the full data set would enable procurers to look at pricing at a species level within a genus and across genera.

FIGURE 2.7. PRICE IN NEW SOUTH WALES BY GENUS (PRICES ARE IN $/KG)
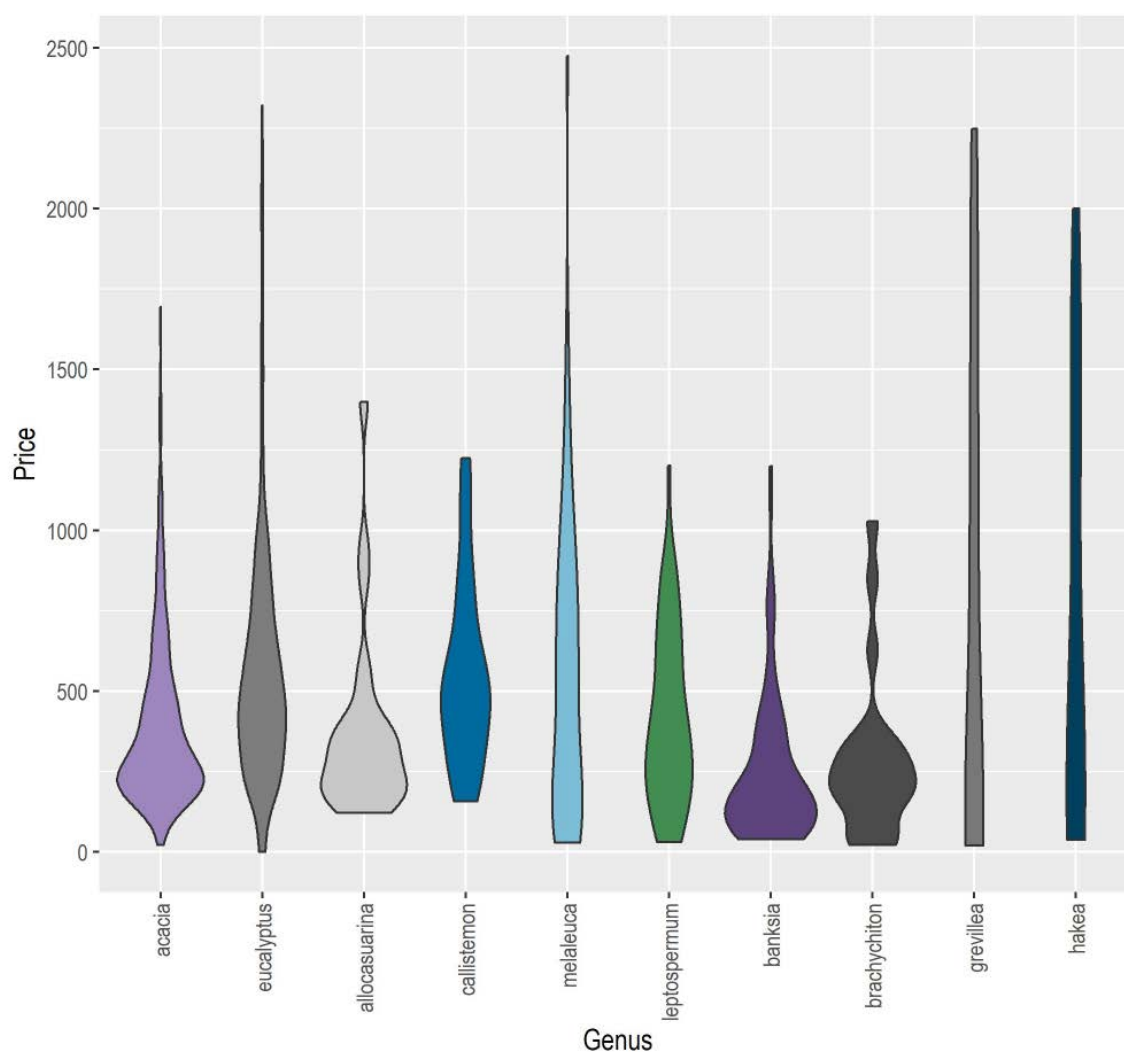
Source: ACIL Allen

Victoria

In Victoria (see **Figure 2.8**), there is less concentrated supply of seed by genus relative to New South Wales. This may be due to the fact that seed price listings in Victoria are dominated by community-based enterprises as opposed to suppliers in New South Wales which are commercially focused. Large-scale procurers of seed in Victoria may consider arrangements with commercial entities.

FIGURE 2.8. PRICE IN VICTORIA BY GENUS (PRICES ARE IN $/KG)
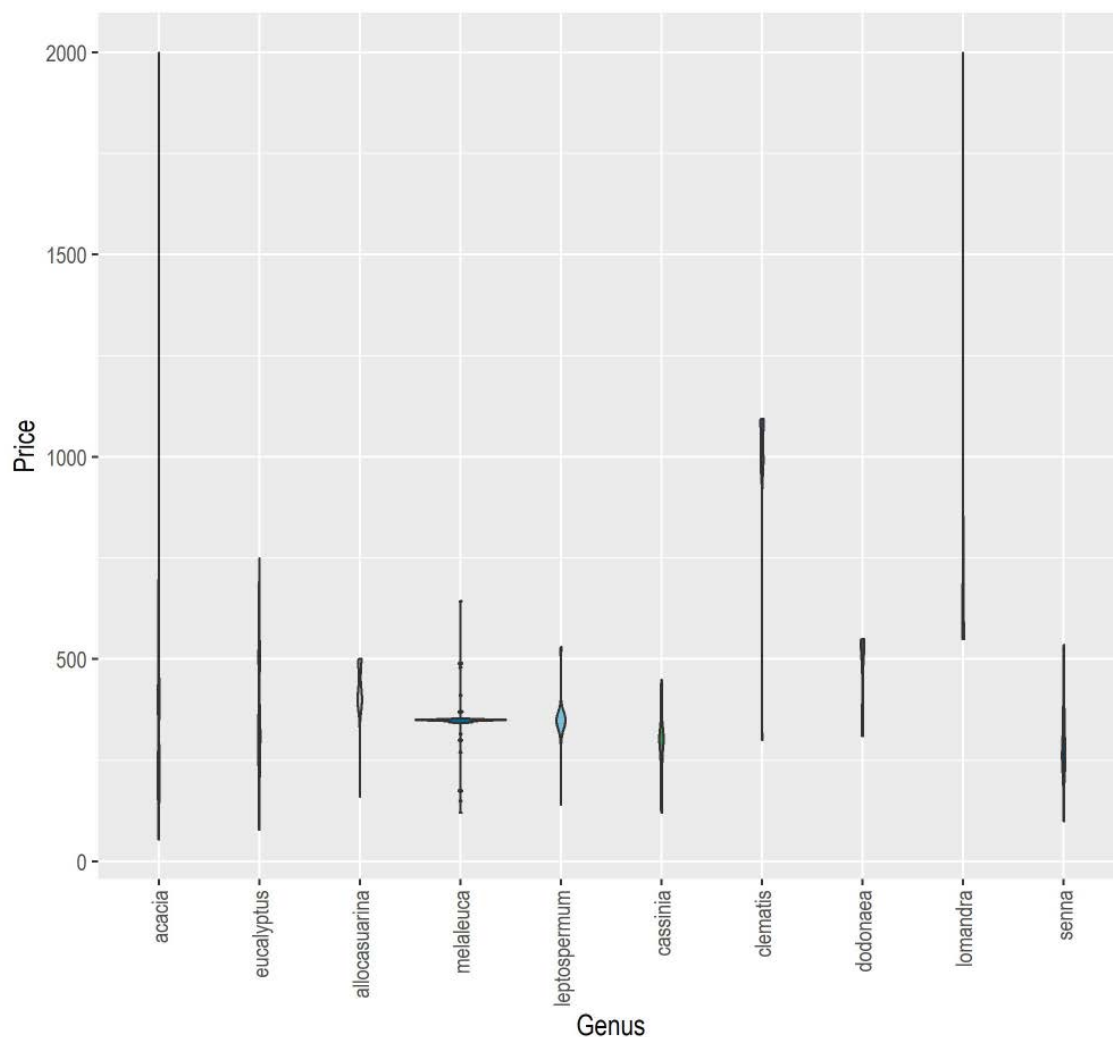
Source: ACIL Allen

Western Australia

In Western Australia (see **Figure 2.9**), if a restoration project requires large quantities of seed at lower price points, procurers may wish to consider species of acacia, banksia or eucalypt as these genera have a price point with reasonable supply below the $250/kg mark. Should a broader cross-section of genera be required for a project, procurers could consider a base of these cost efficient genera and mix these seeds in with some genera below the $500/kg price point such as allocasurina or melaleuca.

Genera to avoid for large-scale price sensitive projects would be grevillea and hakea as these have a higher average price point although there is a reasonably large availability of hakea seeds around the $2,000/kg price point. Information provided in the full data set would enable procurers to look at pricing at a species level within a genus and across genera.

**FIGURE 2.9. PRICE IN WESTERN AUSTRALIA BY GENUS (PRICES ARE IN $/KG)**
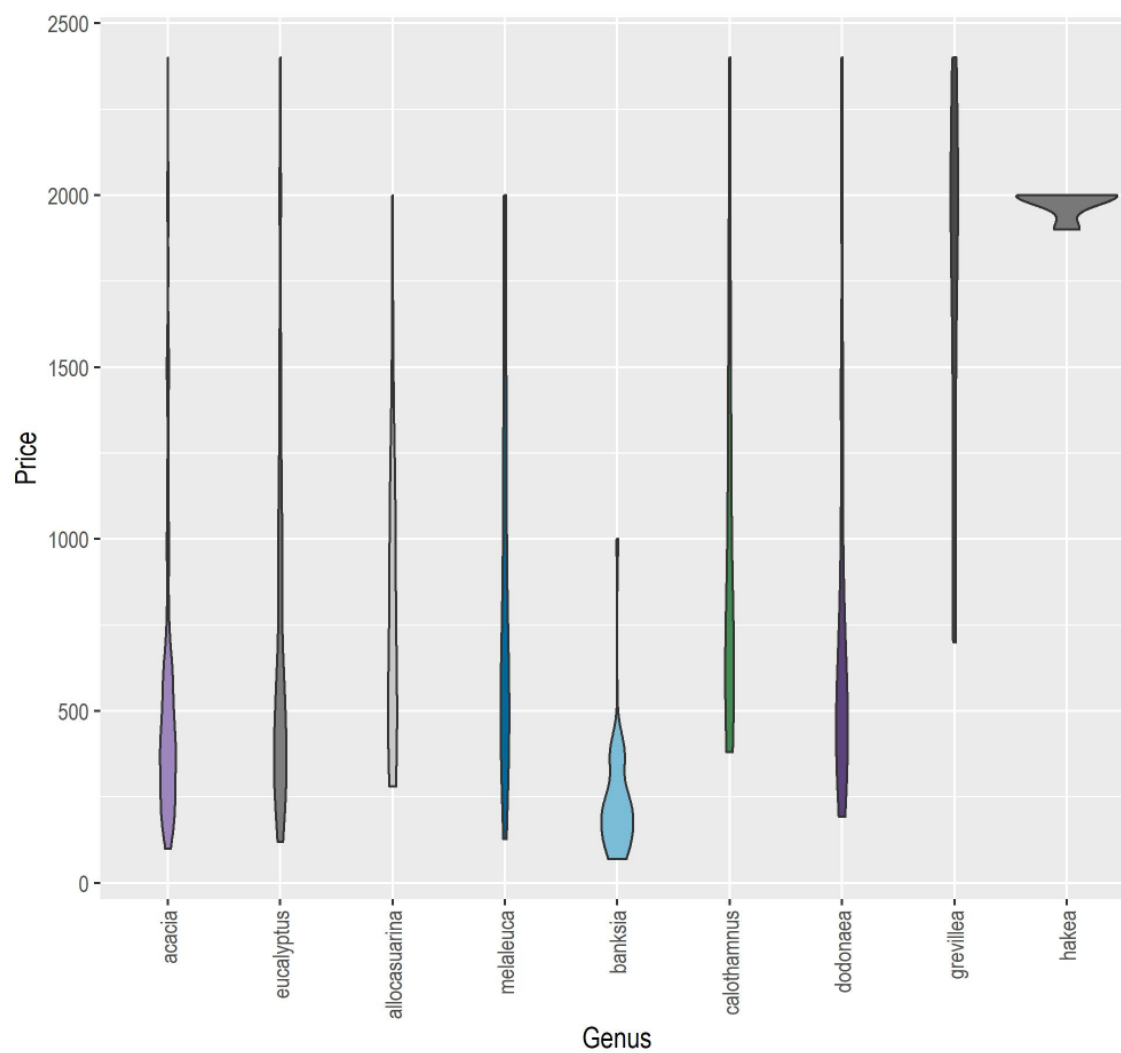
Source: ACIL Allen

FIGURE 2.10. PRICE IN NORTHERN TERRITORY BY GENUS (PRICES ARE IN $/KG)
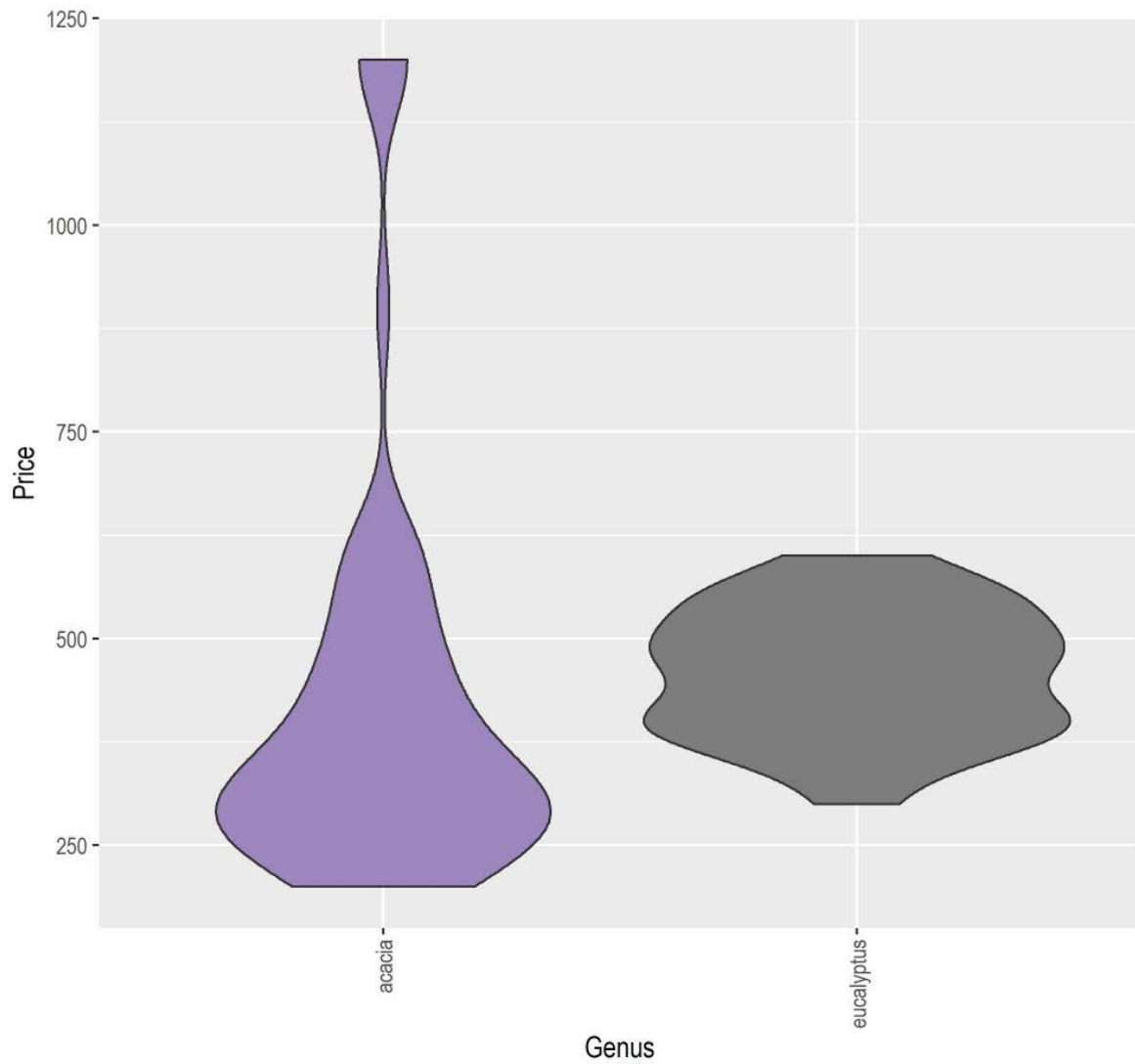
Source: ACIL Allen

FIGURE 2.11. PRICE IN QUEENSLAND BY GENUS (PRICES ARE IN $/KG)
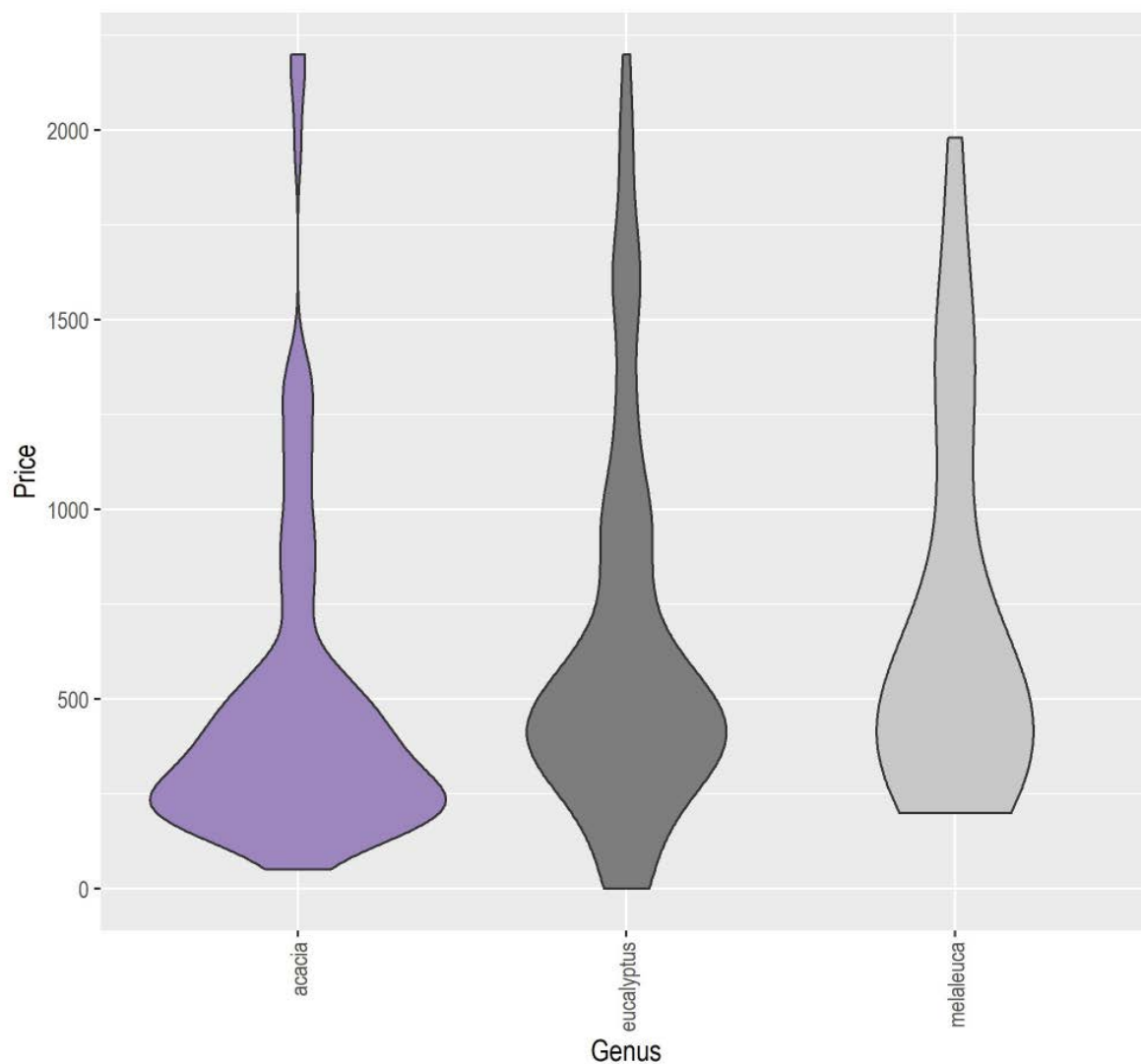
Source: ACIL Allen

FIGURE 2.12. PRICE IN TASMANIA BY GENUS (PRICES ARE IN $/KG)
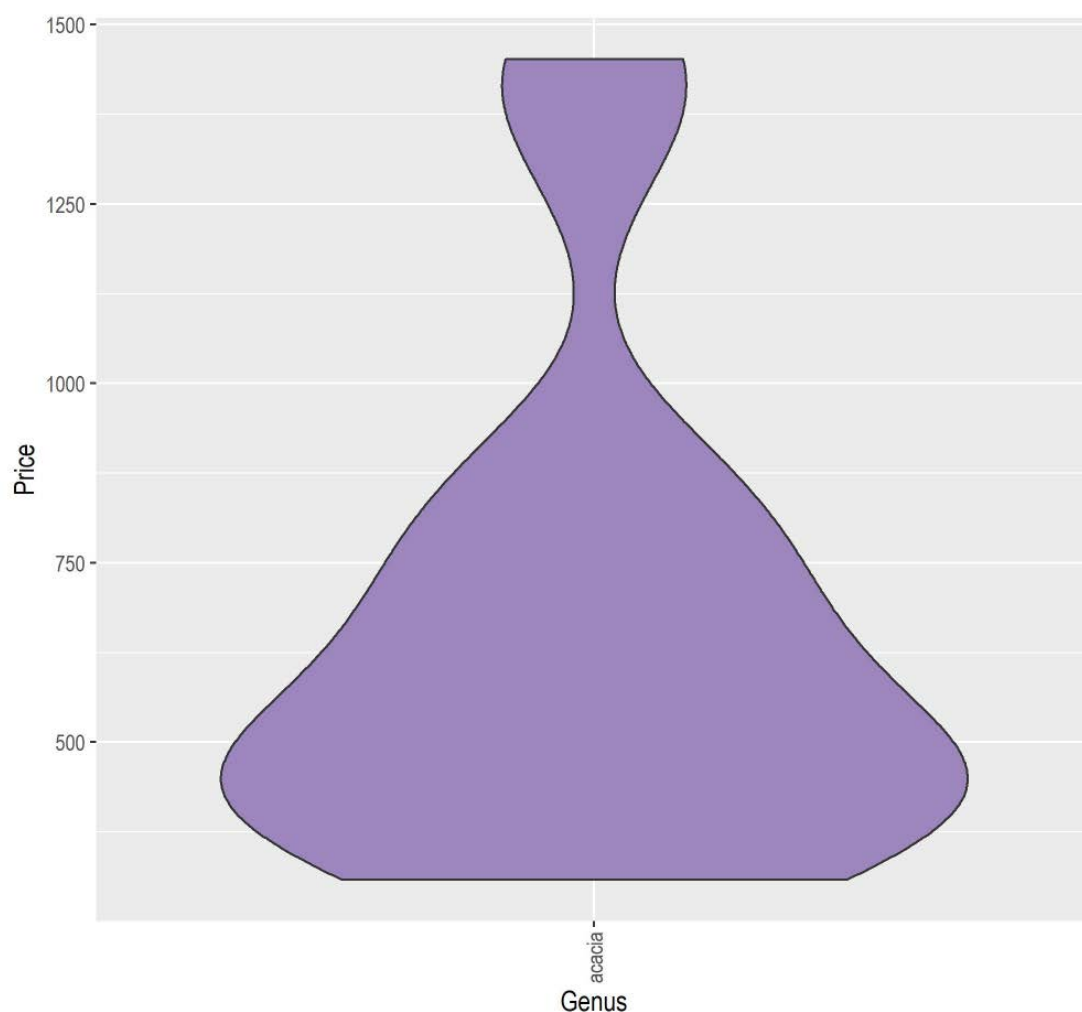
Source: ACIL Allen

2.3.3 Price by jurisdiction

Prices (in $/kg) are presented as a frequency histogram for each jurisdiction (New South Wales, Northern Territory, Queensland, Tasmania, Victoria and Western Australia in the following figures. These figures show the distribution of prices ($/kg). See **Figures 2.13–2.18**.

The characteristics of these histograms do not differ greatly across jurisdictions — essentially there are more listings for native seed below $500/kg in all jurisdictions.

FIGURE 2.13. PRICE IN NSW (PRICES ARE IN $/KG)
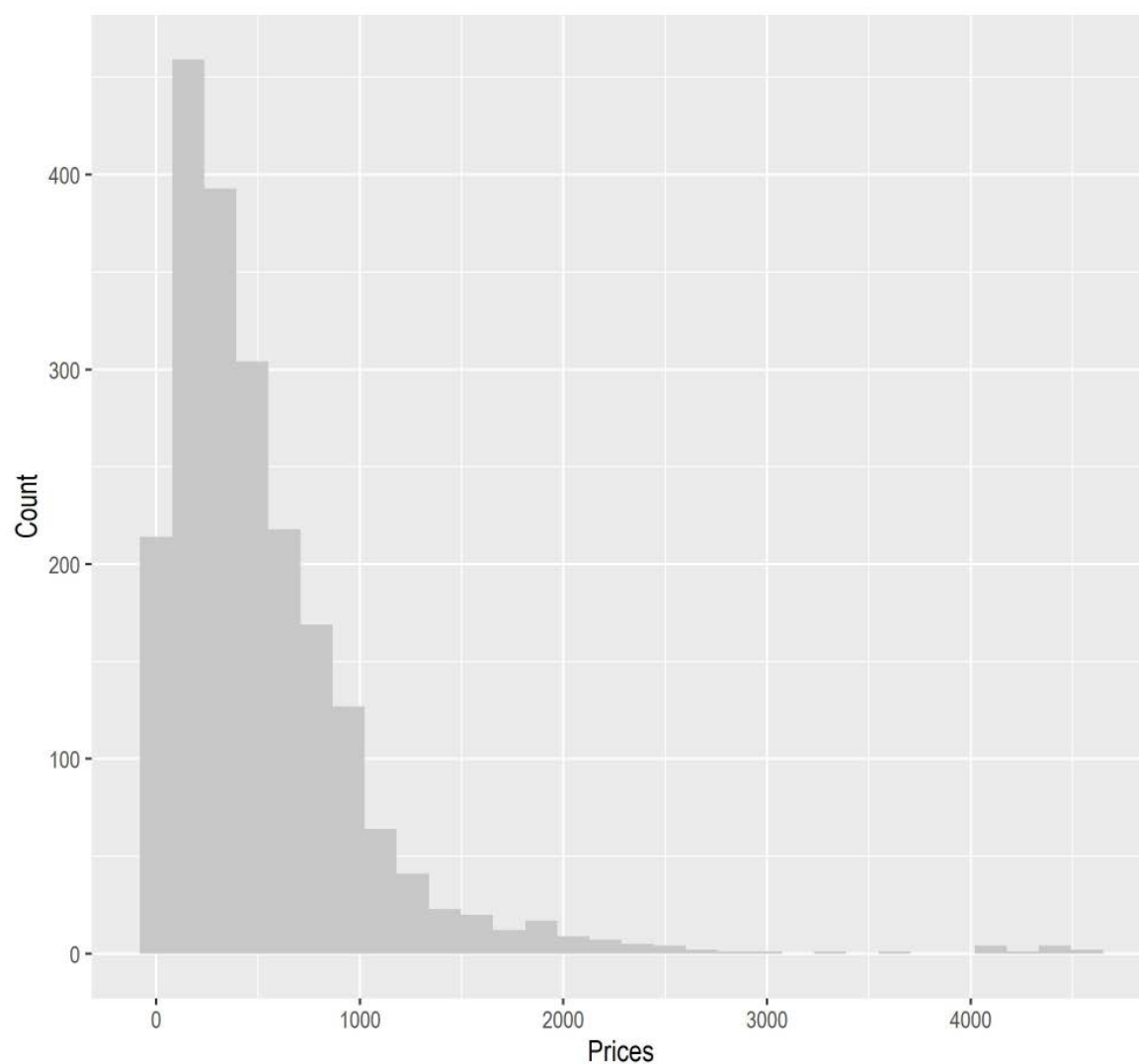
Source: ACIL Allen

FIGURE 2.14. PRICE IN NORTHERN TERRITORY (PRICES ARE IN $/KG)
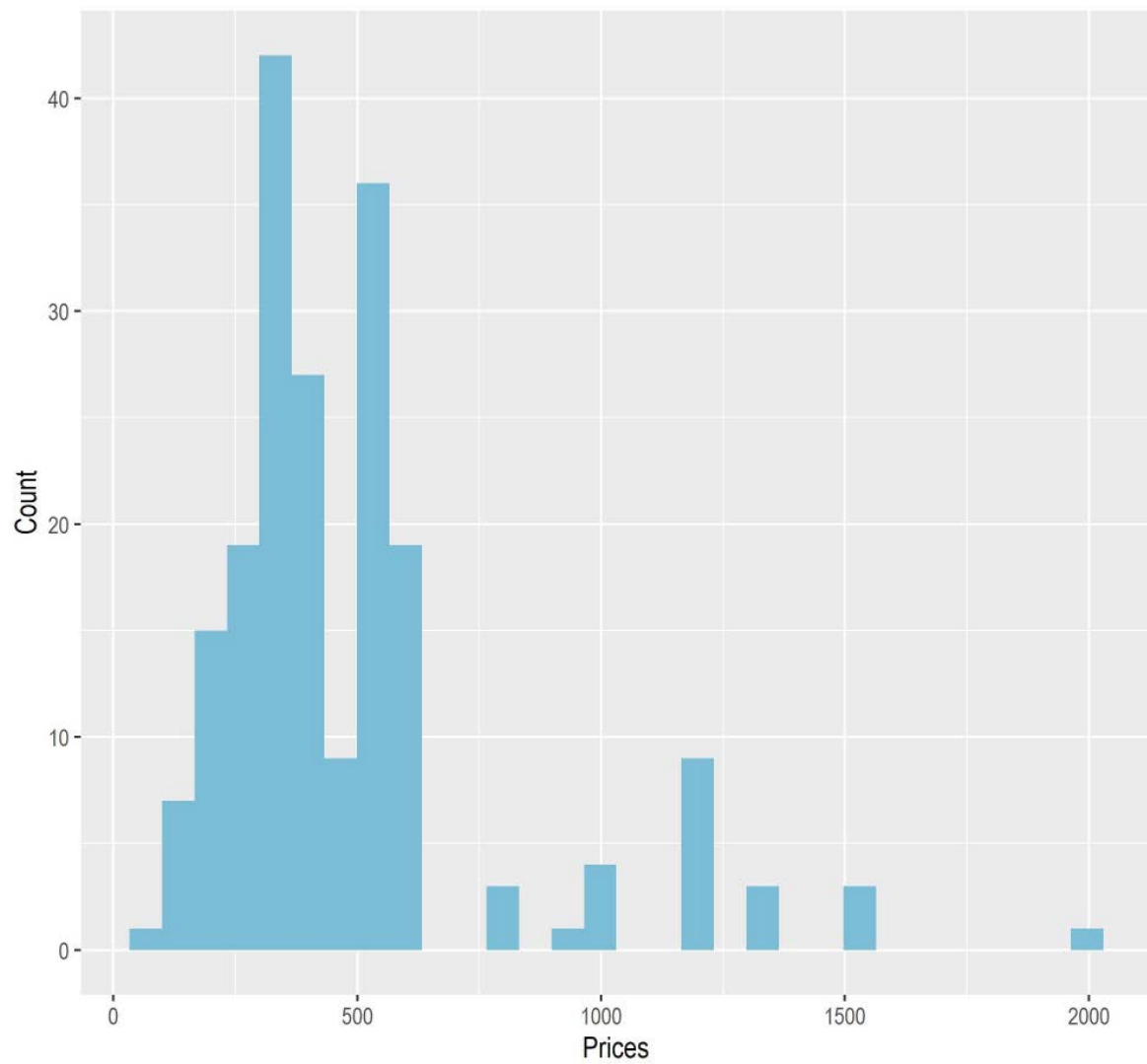
Source: ACIL Allen

FIGURE 2.15. PRICE IN QUEENSLAND (PRICES ARE IN $/KG)
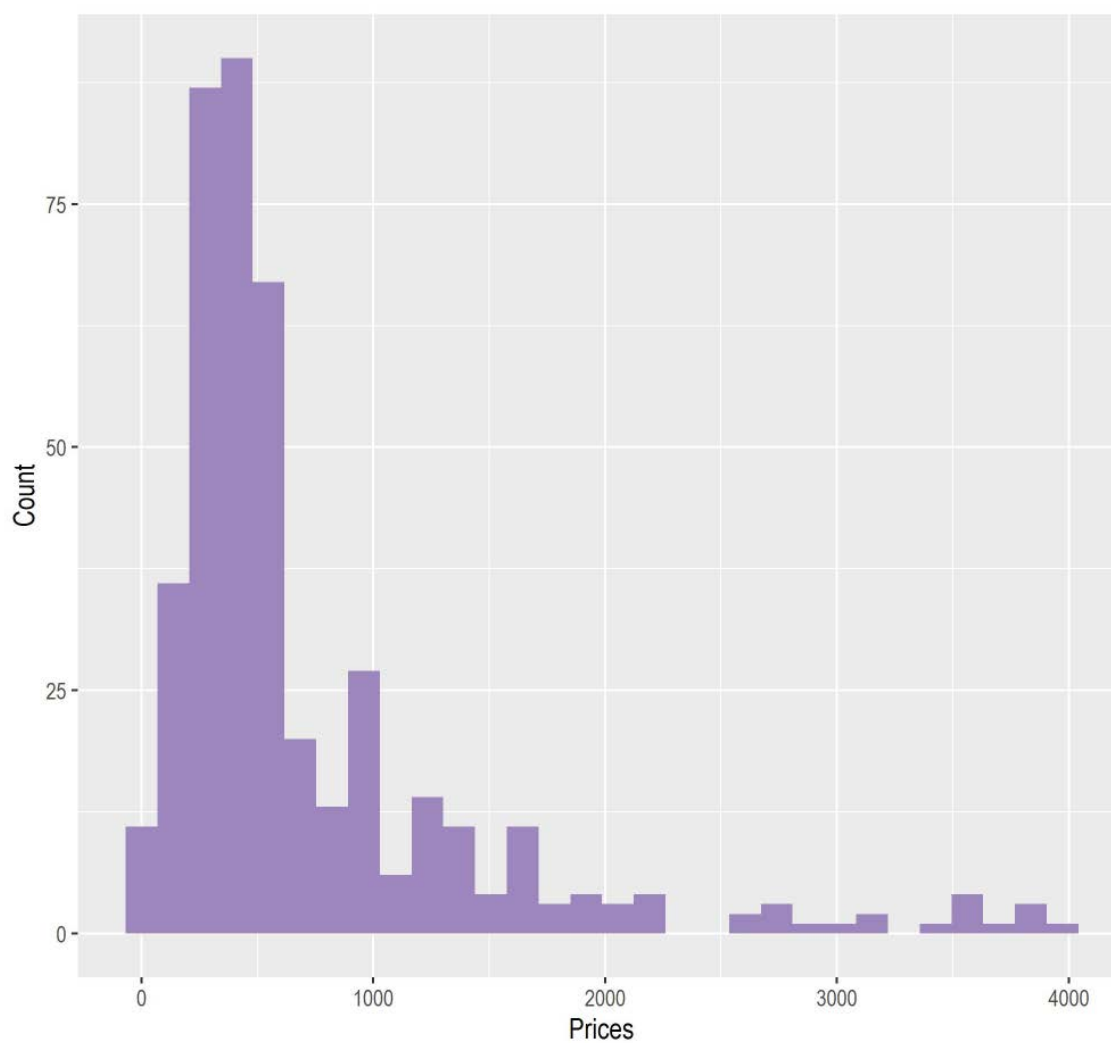
Source: ACIL Allen

FIGURE 2.16. PRICE IN TASMANIA (PRICES ARE IN $/KG)
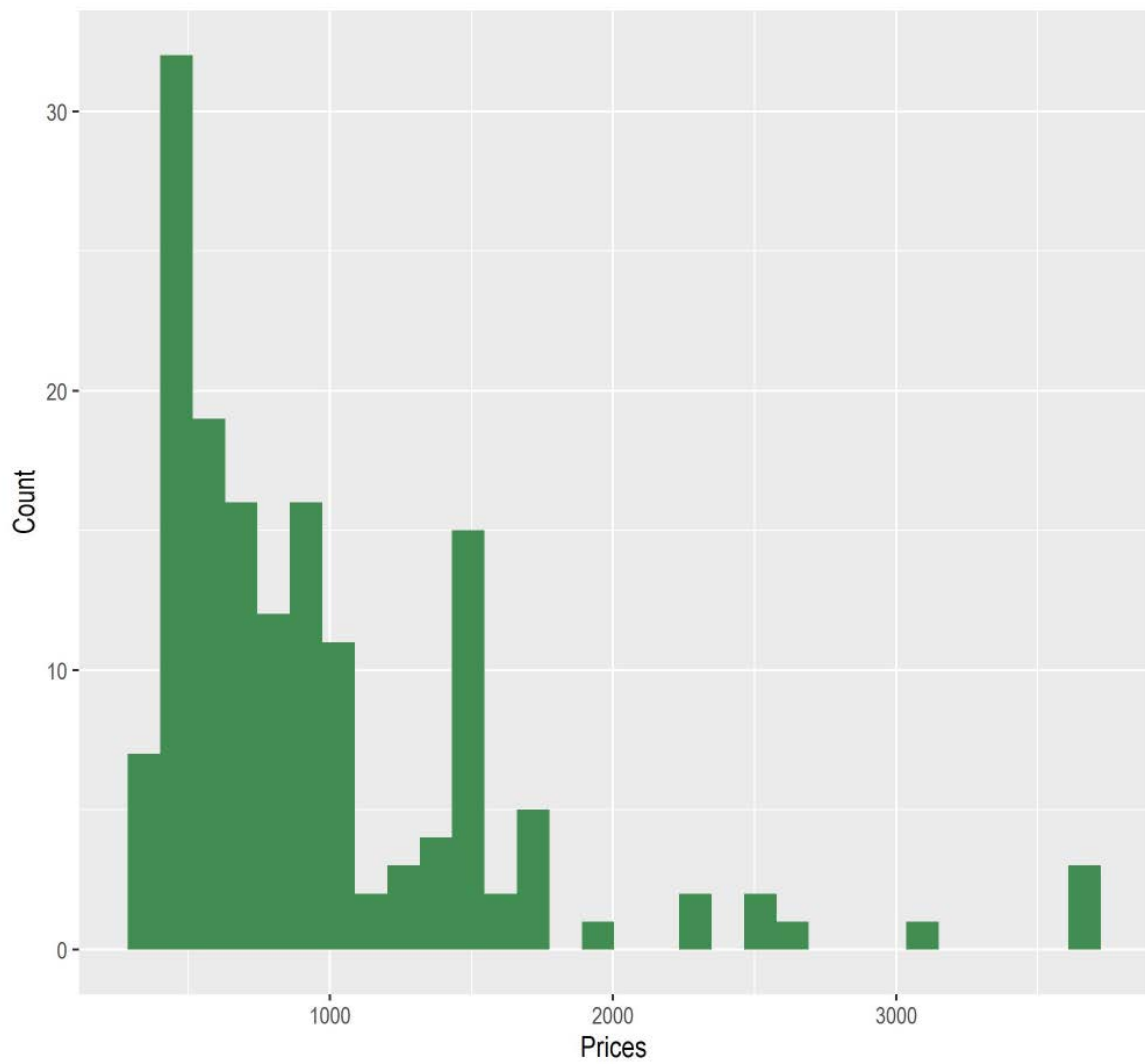
Source: ACIL Allen

FIGURE 2.17. PRICE IN VICTORIA (PRICES ARE IN $/KG)
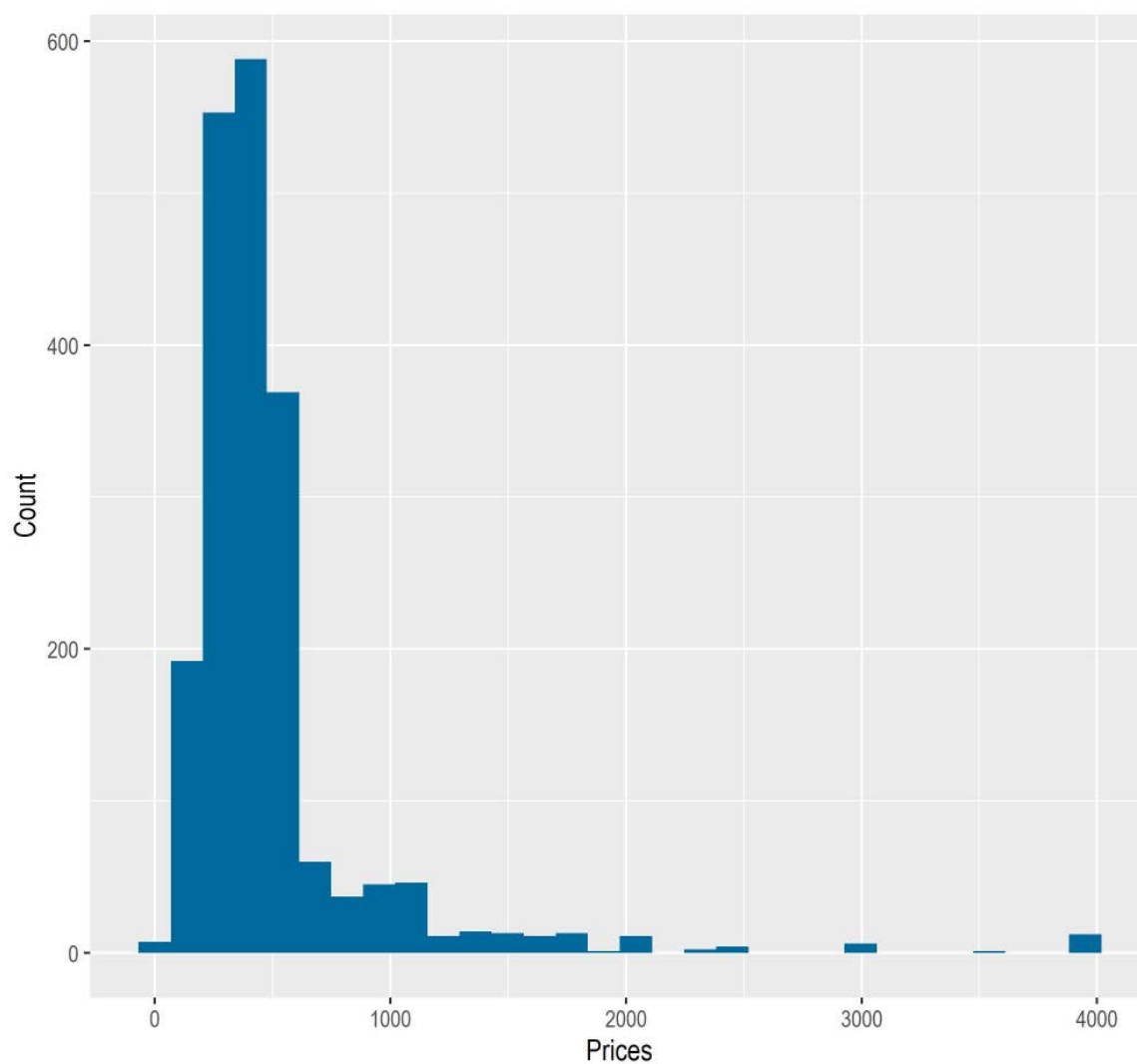
Source: ACIL Allen

FIGURE 2.18. PRICE IN WESTERN AUSTRALIA (PRICES ARE IN $/KG)
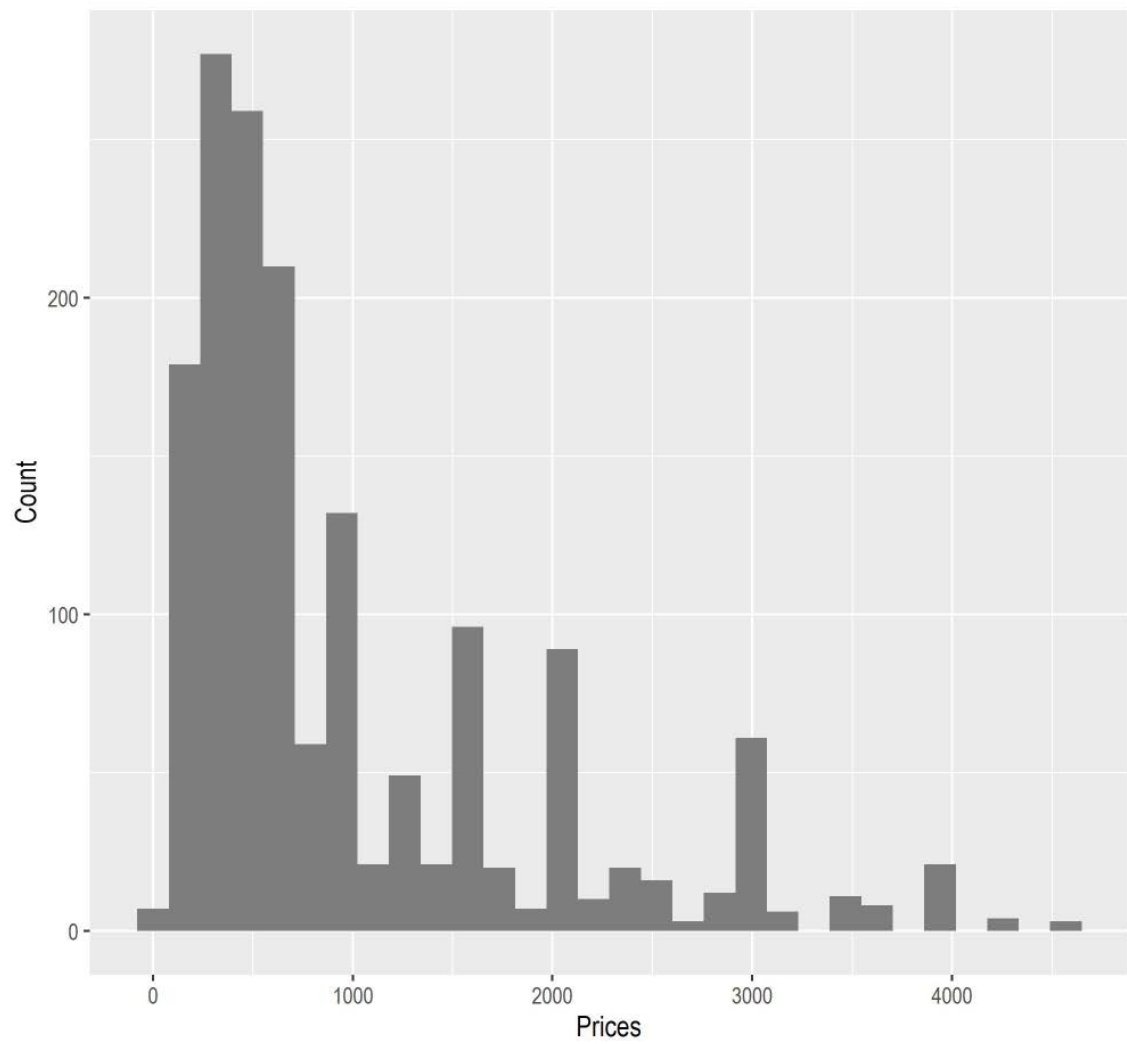
Source: ACIL Allen

3 PRICE AND QUALITY

The price/quality relationship is important for many purchasers as they often rely on high price as a signal of high quality. This is especially true of products where the quality of a product is intrinsic – that is the purchaser is only able to determine the quality of a product by its physical attributes (e.g. look, texture, smell etc).

To overcome the lack of intrinsic information available, price can become the primary signal to purchasers.[5] Extrinsic cues such as provenance can be provided to purchasers to assist them in decision making but this study reports that provenance information is only available for 17 per cent of seed listings.

Empirical studies of the price quality relationship have shown that:

> *'the influence of objective price on perceived quality diminished as the importance and number of intrinsic information cues increases'.*[6]

This suggests that if information about the physical quality of native seeds was provided then purchasers would be less likely to use price as the primary indicator of quality.

Having access to information on the quality attributes of native seeds allows for:

- seed collectors/suppliers to price seeds appropriately (i.e. attract price premiums for premium quality seed) and

- seed purchasers to make informed decisions so as to ensure that the seed they purchase is the best value for money for their intended purpose.

One such way to assess the quality of seed is through grading systems and standards.

3.1   What are purity grading systems and how do they work?

Seed purity — a way to assess seed quality

Seed purity is one quantifiable attribute used to assess the quality of seed. It is defined as: *the composition by weight of the pure clean seed of a species expressed as a percentage of the mass of the whole sample*. The other attributes of seed quality are:

- viability

- germination and

- dormancy state (where applicable).

---

[5] A high price may also be an indicator of scarce supply — so seeds that are hard or costly to source or store or are generally less widely available are also likely to be priced higher than seeds that are in abundance.
[6] Chang T-Z., and Wildt, A.R. (1994) Price, product information and purchase intention: an empirical study, *Journal of the Academy of Marketing Science,* 22(Winter), pp. 280–302.

These attributes can be tested for but there is currently little testing of native seed in Australia due to limitations (Hancock *et al.*, 2020)[7] such as:

- lack of testing facilities[8]

- the costs of independent lab tests are prohibitive and

- no requirements or obligations to test seeds (no mandatory standards and little demand from buyers).

In addition, Australia has a large diversity of species which makes it hard to test and even internationally-accredited facilities may not be able to test all native seeds. This is because the internal seed morphology differs greatly across species and requires a high degree of training and experience to grade.

3.1.2 Grading systems and standards

The *Native Seed Sector Survey Report* (2020) suggests that although approximately 46 per cent of seed purchasers said they would pay extra for seed testing, 13 per cent said that they require testing but they would not be willing to pay extra for it. Several purchasers indicated that they do their own seed testing.

In Australia, there is currently one non-mandatory seed grading system in operation in Western Australia (see **Box 2**). Additionally, there are international standards for seed quality (see **Box 3**) that have been developed for use in Australia and the second edition of the *FloraBank Guidelines* are being developed to include guidelines for seed quality testing.[9]

---

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

[8] In 2016 there were five International Seed Testing Association (ISTA) accredited facilities in Australia and some small non-ITSA accredited labs (Hancock *et al.* 2020).

[9] Under preparation by Dr Lucy Commander.

Box 2. Revegetation Industry Association of Western Australia (RIAWA)

RIAWA has established an exhaustive database (1,309 species) of seed purity and viability database *'setting minimum standards for commercial seed purity and consolidating viability and germination information from a number of sources'*.

The database allows non-members free access to the purity data, and RIAWA members are able to access the full dataset.

RIAWA note that the benefits for seed purchasers include:

- confidence that seed is of specified quality
- ability to compare seeds across suppliers and
- access to a list of RIAWA accredited suppliers.

Benefits for seed collectors and suppliers are:

- industry recognition
- ability to differentiate product by grade and
- being promoted on RIAWA's website.

Source: https://www.riawa.com.au/ and https://www.riawa.com.au/accreditation/purity

Box 3. International standards for native seeds

The Society for Ecological Restoration (SER) published its second edition of *International Principles and Standards for the Practice of Ecological Restoration* in 2019.

In 2020, Pedrini *et al.* developed a framework for International Standards for Native Seeds in Ecological Restoration (Standards) based on SER's Standards.

Pedrini *et al.* (2020) make the case that native seed quality is fundamental to the development of the native seed sector and the restoration sector. Application of quality standards to the native seed sector work across the supply chain.

Pedrini *et al.* (2020) consider the case for nationalising testing and certification but conclude that existing national testing systems and facilities such as those in the US legislated under the Federal Seed Act are not suitable for native seeds. These systems have been established for agricultural seed which is far less genetically diverse and variable than native seeds.

Native seed testing is unique as it requires regional and local knowledge and an assessment of provenance that is often lost at a national level and not necessary for agricultural seed testing. In addition, dormancy is not an attribute that characterises agricultural seed as it has been bred out over time.

Source: S. Pedrini, and K.W. Dixon (2020) and Pedrini *et al.* (2020).[10]

---

[10] Pedrini, S. and Dixon, K.W. (2020). International principles and standards for native seeds in ecological restoration. Restoration Ecology, 28, pp. S286–S303.
Pedrini, S., Dixon K.W. and Cross, A.T. (Eds) (2020). *Standards for Native Seeds. Ecological Restoration.* Special Issue 28:S3, pp. S213–S303.

HOW MUCH DOES NATIVE SEED COST?

3.2 Implications for seed prices

Assessing for seed quality attributes is not a costless exercise and is particularly high for small batches. An indicative cost is $200 per sample (Hancock *et al.*, 2020).

> **If this cost of seed testing were passed on to the seed purchaser, this would suggest an increase in the price per kilogram of tested seed however the magnitude of the price increase would be distributed across species.**

For example, high volume genus and species combinations such as *acacia melanoxylon* or *eucalyptus camaldulensis* would see a very small price increase whereas very rare seeds could see a much larger increase in price.

If native seeds are considered to have price inelastic demand and supply,[11] that is if the price of native seed increases then the demand and supply for native seed is unlikely to be much impacted, then an increase in price due to the cost of testing would likely increase revenue of the seed supplier as the corresponding fall in demand would be very small.

Consideration of price differentiation as a pricing strategy that charges different segments of customers altered prices for the same products may be an option for the sector.

3.3 Conclusion

Government is one of the largest procurers of native seed in Australia. In the absence of government procurement information, a snapshot of native seed prices from across Australia has been presented based on publicly available pricing information from 13 native seed suppliers.

Due to limitations on data availability, credible conclusions can be drawn for native seed pricing by genus in New South Wales, Victoria and Western Australia (with 98 per cent of price listings) but are less reliable for Queensland, the Northern Territory and Tasmania (2 per cent of listings).

This snapshot of market and pricing information suggests that large procurers of native seed (such as government) consider the following:

- Purchasing from commercial rather than community-based entities.
- Purchasing more readily available species (in each jurisdiction).
- An indicator of quality would enable better decision making.

---

[11] (In)elasticity refers to the sensitivity of demand or supply to changes in price.

4 RECOMMENDATIONS

4.1 Key findings

In the absence of any available information on government procurement, the approach taken was to find any publicly available pricing information on native seed in Australia. Twenty-five websites were identified with information that could be used and only 13 had information that could be collected in an efficient manner. This data is credible as the sample contains a large amount of data across species (3,089) and price listings (7,430). It also contains:

- suppliers from around the country and

- a range of different business types from large commercial operations to smaller community suppliers.

This snapshot of pricing information for the native seed sector provides the following findings:

- The number of suppliers with accessible price data nationally is 13. These are split across all states and territories with the exception of South Australia and the Australian Capital Territory.
  - Victoria has the largest number of seed suppliers with publicly available price listings (5), followed by New South Wales (4).
    - Queensland, Western Australia, Tasmania and the Northern Territory have one supplier each.
  - New South Wales had the largest number of price listings (3,386 or 45 per cent of listings) followed by Victoria (2,008 or 27 per cent of listings) and Western Australia (1,879 or 25 per cent of listings).
    - Queensland, Northern Territory and Tasmania account for the remaining 2 per cent of price listings.
- Of the suppliers, 73 per cent are commercial enterprises and 27 per cent are community seed banks. This classification is important as the pricing strategies across the two types of enterprises are quite different.
- The seeds price listings cover 580 genera and 3,089 species.
  - The top listed genera are dominated by eucalyptus and acacia.
- Prices range from $0/kg to $715,000/kg with a median price of $450/kg.
  - Tasmania has the highest median price ($880/kg) and Victoria the lowest ($380/kg).
  - genera with the highest average prices per kilogram are hakea, dianella, grevillea, daviesia and lomandra.
- The jurisdictions with smaller numbers of listings (Northern Territory, Queensland and Tasmania) are dominated by the major genera (eucalyptus and acacia).
- New South Wales, Victoria and Western Australia provide a wider range of genera.

- Having access to transparent information on the quality attributes of native seeds allows for:
  - seed collectors/suppliers to price seeds appropriately (i.e. attract price premiums for premium quality seed) and
  - seed purchasers to make informed decisions so as to ensure that the seed they purchase is the best value for money for their intended purpose.

As efficient market development requires the provision of transparent information, this database will need to be updated and maintained over time.

This will require sourcing additional information from a broader range of native seed suppliers and with more frequency. The costs and benefits of sourcing, collecting, collating and promoting this information over time will need to be considered and it may be more practical to incentivise suppliers to provide information rather than sourcing it indirectly.

4.2 Recommendations

Key recommendations from this review are as follows:

1. Repeat this process annually to develop the database over time.

Consideration should also be given to broadening the information search to:

- capture additional suppliers and genera and
- gather information on seed stocks.

2. Promote the information.

It will be important to promote the information provided in this database and continue to do so over time, as the database is expanded.

3. Incentivise disclosure of information directly from seed suppliers.

This will reduce reliance on publicly available information to add reliability, robustness, breadth and depth to the information made available to the seed sector in Australia.

APPENDIX A A 'HOW-TO' GUIDE AND THE DATA

This is a short step-by-step guide to facilitate future data collection and analysis. An Excel file (.csv) of all data collected for and used in this analysis is embedded below. A standalone Excel spreadsheet file is also available on request.

Step 1: Data capture

- Use Google search to investigate native seed suppliers in Australia.
  - For example, we began with the following search terms: *native seed price list .au.* From this we searched more specifically *'native seed' price list .au* and we also examined sites with supplier listings e.g. http://anpsa.org.au/seedsupp.html
  - Several suppliers do not have publicly available price listing data so were excluded from the analysis.

- Data capture was a HTML-based (and PDF-based) data scraping as many price lists are published online in websites. There are two categories of information:
  - web-page based price data and
  - web-hosted PDF based price data

- Each website was individually coded.

- Free access packages/libraries such as rvest, Tidyverse, pdftools allowed for automated access to price information contained in HTML (See code in Appendix B).

- R-based web scraping was also used to access these price lists (use of R requires both specific software and specific skills, both should be relatively easy to source).

- Data was collected on:
  - species (using scientific names)
  - prices
  - quantities (some species are measured by weight, others by individual seeds)
  - common names (where available)
  - provenance
  - other relevant information.

- Each entry was tagged with an identifier to link it with the supplier and state-based information.

Step 2: Data processing and analysis

- Data on prices was collated and processed
  - For example, we looked for erroneous results, outliers or multiple names for the same species.
- Species were grouped (by genus, geography, seed/plant type) to allow for better comparison of results.
- A clean dataset was built, and from this graphic presentation of the data was produced in a long-format dataframe.
- This was completed and plotted in R. This process was automated as much as possible to allow adaptation or replication of the exercise in the future. Reported prices were converted to kilogram or 1,000 seed quantities to aid in comparison.
- Potting and charts for this report were completed programmatically with ggplot2 (see code in Appendix C).

Step 3: Quality assurance

- A two-step process to quality assure the dataset was conducted:
  - Firstly, the data was examined for price outliers (for example, if three suppliers report a cost of $30 per kilogram, a price of $350 per kilogram would be an outlier). Outlying price information will indicate additional information may be required.
  - Secondly, each extract was manually checked against the originating website or PDF to ensure the information had been collected in a robust manner, and that no error had been introduced through transcription.

APPENDIX B DATA CAPTURE CODE

```
# -------------------------

##

## Script name: Seed price downloader

##

## Purpose of script: Automatically download and clean data on Australian

##              native seed prices

##

## Reference code: J0594

##

## Version: 0001

##

## Author:

##

## Date Created: 2021-04-30

##

##

##

##

## -------------------------

##

## Notes: -

##

##

## -------------------------


## Packages

library(tidyverse)
library(rvest)
library(pdftools)


## -------------------------


## Set up
seed_list <- data.frame(supplier = NA,
            state = NA,
            date_collected = NA,
            genus = NA,
            species = NA,
```

```r
                   common_name = NA,
                   provenance = NA,
                   low_price = NA,
                   high_price = NA,
                   quant_unit = NA,
                   comment = NA)

b_seed_list <- seed_list

## -------------------------

## AustraHort

url_list <- c("https://www.austrahort.com.au/shop/category/1-acacia?page=1",
        "https://www.austrahort.com.au/shop/category/1-acacia?page=2",
        #"https://www.austrahort.com.au/shop/category/2-other-miscellaneous?page=1", - non-native
seeds
        #"https://www.austrahort.com.au/shop/category/2-other-miscellaneous?page=2",
        #"https://www.austrahort.com.au/shop/category/2-other-miscellaneous?page=3",
        #"https://www.austrahort.com.au/shop/category/2-other-miscellaneous?page=4",
        #"https://www.austrahort.com.au/shop/category/2-other-miscellaneous?page=5",
        "https://www.austrahort.com.au/shop/category/3-eucalyptus?page=1",
        "https://www.austrahort.com.au/shop/category/3-eucalyptus?page=2",
        "https://www.austrahort.com.au/shop/category/3-eucalyptus?page=3",
        #"https://www.austrahort.com.au/shop/category/4-flower-seed?page=1", - non native seeds
        #"https://www.austrahort.com.au/shop/category/4-flower-seed?page=2",
        #"https://www.austrahort.com.au/shop/category/4-flower-seed?page=3",
        #"https://www.austrahort.com.au/shop/category/4-flower-seed?page=4",
        #"https://www.austrahort.com.au/shop/category/6-banksia", -
        "https://www.austrahort.com.au/shop/category/7-casuarina",
        "https://www.austrahort.com.au/shop/category/8-native-grass",
        #"https://www.austrahort.com.au/shop/category/9-exotic-grass", - non-native seeds
        "https://www.austrahort.com.au/shop/category/10-callistemon",
        "https://www.austrahort.com.au/shop/category/11-leptospermum",
        "https://www.austrahort.com.au/shop/category/12-melaleuca"#,
        #"https://www.austrahort.com.au/shop/category/13-palm-seed" -
        )

for (i in 1:length(url_list)){
  page <- read_html(url_list[i])

  temp_seed_list <- b_seed_list
  for (n in 1:100){
    temp_seed <- b_seed_list
```

```r
  temp_seed$supplier <- "AustraHort"
  temp_seed$state <- "Queensland"
  temp_seed$date_collected <- Sys.Date()

  seed_info <- page %>% html_element("div.product-list") %>%
    html_element(paste0("div.aproduct:nth-child(",n,")")) %>%
    html_text2()

  temp_seed$genus <- str_extract(seed_info, "[A-Z]{4,}") %>%
    tolower()
  temp_seed$species <- str_extract(seed_info, paste0("(?<=",toupper(temp_seed$genus),"\\s)[a-z]*"))
  seed_prices <- str_extract_all(seed_info, "\\d\\.\\d{0,4}") %>%
    unlist() %>%
    as.numeric()
  temp_seed$low_price <- min(seed_prices) * 1000
  temp_seed$high_price <- max(seed_prices) * 1000
  temp_seed$quant_unit <- "kilograms"

  temp_seed_list <- rbind(temp_seed_list, temp_seed)

 }
 temp_seed_list <- temp_seed_list[!is.na(temp_seed_list$species),]
 temp_seed_list <- temp_seed_list[rowSums(is.na(temp_seed_list)) != ncol(temp_seed_list), ]
 seed_list <- rbind(seed_list, temp_seed_list)
}


## --------------------------

## Australian Seed Company

AusSeedPDF <- pdf_text("Ausseed_Catalogue_2019.pdf")

ASTab <- read_table(AusSeedPDF, skip = 87) %>%
 as.data.frame()

temp_seed_list <- b_seed_list

# Looping over all PDF lines
for (i in 1:nrow(ASTab)){

 # Skip blank lines
 if ((str_detect(ASTab[i,], "See\\s")) & (!str_detect(ASTab[i,],"\\d{1,2}\\sg"))){
```

```
    # A Genus description leads each section
  } else if (str_detect(ASTab[i,], "GST")){

  } else if (str_detect(ASTab[i,], "FAMILY")){
    as_gen <- str_extract(ASTab[i,], "\\w*(?=\\:)") %>%
      tolower()
    quant_scales <- c()
    quant_unit <- c()
  } else if (str_detect(ASTab[i,], "10g    25g")){
    quant_unit <- "kilograms"
    quant_scales <- c(10,25)
  } else if (str_detect(ASTab[i,], "    5g")){
    quant_unit <- "kilograms"
    quant_scales <- c(5)
  } else if (str_detect(ASTab[i,], "     Kg")){
    quant_unit <- "kilograms"
    quant_scales <- c(1000)
  } else if (str_detect(ASTab[i,], "\\d{1,2}\\sg") | str_detect(ASTab[i,], "00\\ssds")){
      if (str_detect(ASTab[i,], "\\d{1,2}\\sg")){
        quant_unit <- "kilograms"
        quant_scales <- as.numeric(unlist(str_extract_all(ASTab[i,], "\\d+")))
        if (str_detect(ASTab[i,], "    Kg")){
          quant_scales <- c(quant_scales, 1000)
        }
      } else if (str_detect(ASTab[i,], "00\\ssds")){
        quant_unit <- "1,000 seeds"
        quant_scales <- as.numeric(unlist(str_extract_all(ASTab[i,], "\\d+")))
      }
  } else if (str_detect(ASTab[i,], "\\d{1,4}\\.\\d{2}")) {
    temp_seed <- b_seed_list
    temp_seed$supplier <- "Australian Seed Company"
    temp_seed$state <- "New South Wales"
    temp_seed$date_collected <- Sys.Date()
    temp_seed$genus <- as_gen
    i_species <- str_extract(ASTab[i,], "[a-z]*(?=\\s[\\-\\(])")
    temp_seed$species <- i_species
    comprov <- str_extract(ASTab[i,], "(?<=\\-\\s)[a-zA-Z\\s\\'\\-\\;]*(?=\\.+)")
    if (is.na(comprov)){
    } else {
      if (str_detect(comprov, "provenance")){
        temp_seed$provenance <- comprov
      } else {
```

```
    temp_seed$common_name <- comprov
  }
 }
 temp_seed$comment <- str_extract(ASTab[i,],"(?<=\\().*(?=\\))")

 # Seed pricing
 if (str_detect(ASTab[i,], "per\\s")){
   e_quant_scales <- c(as.numeric(unlist(str_extract_all(ASTab[i,], "(?<=per\\s)\\d+(?=g)"))),
quant_scales)
   i_prices <- as.numeric(unlist(str_extract_all(ASTab[i,], "\\d{1,4}\\.\\d{2}")))
   temp_seed$high_price <- i_prices[1] * 1000 / e_quant_scales[1]
   temp_seed$low_price <- i_prices[length(i_prices)] * 1000 / e_quant_scales[length(i_prices)]
 }
 i_prices <- as.numeric(unlist(str_extract_all(ASTab[i,], "\\d{1,4}\\.\\d{2}")))
 temp_seed$high_price <- i_prices[1] * 1000 / quant_scales[1]
 temp_seed$low_price <- i_prices[length(i_prices)] * 1000 / quant_scales[length(i_prices)]
 temp_seed_list <- rbind(temp_seed_list, temp_seed)

 temp_seed$quant_unit <- quant_unit
 rm(comprov, i_prices)
 }

}

temp_seed_list <- temp_seed_list[!is.na(temp_seed_list$species),]
seed_list <- rbind(seed_list, temp_seed_list)

## --------------------------

## Harvest Seeds & Native Plants

HSTab <- pdf_text("Harvest seeds.pdf") %>%
 read_table()

temp_seed_list <- b_seed_list

for (i in 1:nrow(HSTab)){
 quant_unit <- c("kilograms")
 quant_scales <- c(25, 1000)
 i_prices <- c()
 if (!str_detect(HSTab[i,],"[A-Za-z]")){
 } else if ((str_detect(HSTab[i,], "[A-Z][a-z]*")) &
       (!str_detect(HSTab[i,],"\\.{2,}")) &
       (!str_detect(HSTab[i,],"Seeds\\/g"))){
```

```
  hs_gen <- str_extract(HSTab[i,],"\\w*") %>%
    tolower()
} else if (str_detect(HSTab[i,], "P\\.O\\.A\\.")){
} else if (str_detect(HSTab[i,], "\\.{2,}")){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Harvest Seeds & Native Plants"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- hs_gen
  temp_seed$species <- str_extract(HSTab[i,], "[a-z]*(?=\\s*)")
  temp_seed$common_name <- str_extract(HSTab[i,], "([A-Z]{1}[A-Za-z\\'\\s]*)(?=[\\;\\.])")
  if (str_detect(HSTab[i,], "0\\/\\d*s")){
    temp_seed$quant_unit <- "1,000 seeds"
    quant_scales <- str_extract_all(HSTab[i,], "(?<=0\\/)\\d*(?=s)") %>%
      unlist() %>%
      as.numeric()
    i_prices <- str_extract_all(HSTab[i,], "\\d{1,4}\\.\\d{2}") %>%
      unlist() %>%
      as.numeric()
    temp_seed$low_price <- max(i_prices) * 1000 / max(quant_scales)
    temp_seed$high_price <- min(i_prices) * 1000 / min(quant_scales)
  } else if (str_detect(HSTab[i,], "(?<=\\/)\\d*(?=g)")){
    quant_scales <- c(as.numeric(str_extract(HSTab[i,],"(?<=\\/)\\d*(?=g)")),quant_scales)
    i_prices <- str_extract_all(HSTab[i,], "\\d{1,4}\\.\\d{2}") %>%
      unlist() %>%
      as.numeric()
    if (length(i_prices) == 1){
      temp_seed$low_price <- i_prices * 1000 / min(quant_scales)
      temp_seed$high_price <- i_prices * 1000 / min(quant_scales)
    }
    temp_seed$low_price <- i_prices * 1000 / max(quant_scales)
    temp_seed$high_price <- i_prices * 1000 / min(quant_scales)
    temp_seed$quant_unit <- quant_unit
  } else {
    temp_seed$quant_unit <- quant_unit
    i_prices <- str_extract_all(HSTab[i,], "\\d{1,4}\\.\\d{2}") %>%
      unlist() %>%
      as.numeric()
    temp_seed$low_price <- max(i_prices) * 1000 / max(quant_scales)
    temp_seed$high_price <- min(i_prices) * 1000 / min(quant_scales)
  }
  temp_seed_list <- rbind(temp_seed_list, temp_seed)
}
```

```
}

seed_list <- rbind(seed_list, temp_seed_list)

## --------------------------

## Native Seeds

## Not suitable


## --------------------------

## Nindethana

url <- "https://www.nindethana.net.au/seed-list-html.aspx"

page <- read_html(url)

temp_seed_list <- b_seed_list
for (n in 1:392){
  nin_table <- html_element(page, "body") %>%
    html_element("div:nth-child(4)") %>%
    html_element(paste0("table:nth-child(",n,")")) %>%
    html_table()

  genus <- html_element(page, "body") %>%
    html_element("div:nth-child(4)") %>%
    html_element(paste0("table:nth-child(",n,")")) %>%
    html_element("thead") %>%
    html_element("tr") %>%
    html_element("th.Genus") %>%
    html_text2()

  # name <- html_element(page, "body") %>%
  #   html_element("div:nth-child(4)") %>%
  #   html_element("table:nth-child(1)") %>%
  #   html_element("thead") %>%
  #   html_element("tr") %>%
  #   html_text2()

  nin_table <- nin_table[,!str_detect(colnames(nin_table),"pkt")]
  nin_table <- nin_table[,-1]
```

```r
  if (sum(str_detect(colnames(nin_table), "1kg"))>=1){
    colnames(nin_table)[colnames(nin_table)=="1kg"] <- "1000g"
  }

  if (ncol(nin_table) == 1){

  } else {
    for (i in 1:nrow(nin_table)){
      if (sum(is.na(nin_table[i,])) == 1){

      } else if (sum(nin_table[i,2:ncol(nin_table)], na.rm = TRUE) == 0) {

      } else {
        temp_seed <- b_seed_list
        temp_seed$supplier <- "Nindethana"
        temp_seed$state <- "Western Australia"
        temp_seed$date_collected <- Sys.Date()
        temp_seed$genus <- tolower(genus)
        if (str_detect(nin_table[i,1], '[\\(\\-\\=\\"]')){
          temp_seed$species <- str_extract(nin_table[i,1],'([a-z\\s\\.]{4,})(?=[\\(\\-\\=\\"])') %>%
            trimws()
        } else{
          temp_seed$species <- nin_table[i,1]
        }
        temp_seed$common_name <- paste(unlist(str_extract_all(nin_table[i,1],'(?<=\\")([A-Za-z\\s]*)(?=\\")')), collapse = "; ")
        temp_seed$low_price <- max(nin_table[i,2:ncol(nin_table)], na.rm = TRUE) * 1000 /
as.numeric(str_extract(colnames(nin_table)[nin_table[i,] == max(nin_table[i,2:ncol(nin_table)], na.rm =
TRUE) & !is.na(nin_table[i,])],"\\d*"))
        temp_seed$high_price <- min(nin_table[i,2:ncol(nin_table)], na.rm = TRUE) * 1000 /
as.numeric(str_extract(colnames(nin_table)[nin_table[i,] == min(nin_table[i,2:ncol(nin_table)], na.rm =
TRUE) & !is.na(nin_table[i,])],"\\d*"))
        temp_seed$quant_unit <- "kilograms"

        temp_seed_list <- rbind(temp_seed_list, temp_seed)
      }

    }
  }
}

seed_list <- rbind(seed_list, temp_seed_list)
## --------------------------
```

```r
rpPDF <- pdf_text("d77fecbd-fb65-4813-bd3c-95a761056722.pdf")

temp_seed_list <- b_seed_list

{
 ## Table 1
 rpTab <- read_table(rpPDF[1], skip = 9, n_max = 46, col_names =
c("genus","species","_","__","___","seedspergram",1,5,10,25,100,250,1000))
 rpTab <- rpTab[,-3:-6]
 for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], tail(unlist(str_extract_all(rpTab[i,],
"\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }

 ## Table 2:
 rpTab <- read_table(rpPDF[2], skip=6, n_max = 49, col_names =
c("genus","species","_","seedspergram","__",1,5,10,25,100,250,1000))
 for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], tail(unlist(str_extract_all(rpTab[i,],
"\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
```

```
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }


  ## Table 3
  rpTab <- read_table(rpPDF[3], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
              col_types = c("cciccccccc"))
 for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
 }
 rpTab <- rpTab[,-3]


 for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }

  ## Table 4

  rpTab <- read_table(rpPDF[4], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram","_",1,5,10,25,100,250,1000),
              col_types = c("ccicccccccc"))
 for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
 }
 rpTab <- rpTab[,-3:-4]


 for (i in 1:nrow(rpTab)){
```

```
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }


 ## Table 5
 rpTab <- read_table(rpPDF[5], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("cciccccccc"))
 for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
 }
 rpTab <- rpTab[,-3]


 for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }
```

HOW MUCH DOES NATIVE SEED COST?

```
## Table 6
rpTab <- read_table(rpPDF[6], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("cciccccccc"))
for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
}
rpTab <- rpTab[,-3]


for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
  temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
  temp_seed$quant_unit <- "kilograms"
  temp_seed_list <- rbind(temp_seed_list,temp_seed)
}

  ## Table 7
rpTab <- read_table(rpPDF[7], skip=5, n_max = 50, col_names =
c("genus","species","_","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("ccicccccccc"))
rpTab <- rpTab[,-3:-5]

for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
```

```
   temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
   temp_seed$quant_unit <- "kilograms"
   temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }


 ## Table 8
 rpTab <- read_table(rpPDF[8], skip=5, n_max = 50, col_names =
c("genus","species","_","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("cciccccccccc"))
 rpTab <- rpTab[,-3:-5]


 for (i in 1:nrow(rpTab)){
   temp_seed <- b_seed_list
   temp_seed$supplier <- "Royston Petrie Seeds"
   temp_seed$state <- "New South Wales"
   temp_seed$date_collected <- Sys.Date()
   temp_seed$genus <- rpTab[i,1] %>% tolower()
   temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
   temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
   temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
   temp_seed$quant_unit <- "kilograms"
   temp_seed_list <- rbind(temp_seed_list,temp_seed)
 }


 ## Table 9
 rpTab <- read_table(rpPDF[9], skip=5, n_max = 50, col_names =
c("genus","species","_","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("cciccccccccc"))
 rpTab <- rpTab[,-3:-5]


 for (i in 1:nrow(rpTab)){
   temp_seed <- b_seed_list
   temp_seed$supplier <- "Royston Petrie Seeds"
   temp_seed$state <- "New South Wales"
   temp_seed$date_collected <- Sys.Date()
   temp_seed$genus <- rpTab[i,1] %>% tolower()
   temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
   temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
```

```
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
    temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }


  ## Table 10
  rpTab <- read_table(rpPDF[10], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
              col_types = c("cciccccccc"))
 for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
 }
 rpTab <- rpTab[,-3]


 for (i in 1:nrow(rpTab)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Royston Petrie Seeds"
  temp_seed$state <- "New South Wales"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- rpTab[i,1] %>% tolower()
  temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
  temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
    temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }


  ## Table 11
  rpTab <- read_table(rpPDF[11], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
              col_types = c("cciccccccc"))
 for (m in 1:nrow(rpTab)){
  genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
  rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
  rpTab[m,1] <- genus
```

```
    }
  rpTab <- rpTab[,-3]

  for (i in 1:nrow(rpTab)){
    temp_seed <- b_seed_list
    temp_seed$supplier <- "Royston Petrie Seeds"
    temp_seed$state <- "New South Wales"
    temp_seed$date_collected <- Sys.Date()
    temp_seed$genus <- rpTab[i,1] %>% tolower()
    temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
    temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
    temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }

  ## Table 12
  rpTab <- read_table(rpPDF[12], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
            col_types = c("cciccccccc"))
  for (m in 1:nrow(rpTab)){
    genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
    rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
    rpTab[m,1] <- genus
  }
  rpTab <- rpTab[,-3]

  for (i in 1:nrow(rpTab)){
    temp_seed <- b_seed_list
    temp_seed$supplier <- "Royston Petrie Seeds"
    temp_seed$state <- "New South Wales"
    temp_seed$date_collected <- Sys.Date()
    temp_seed$genus <- rpTab[i,1] %>% tolower()
    temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
    temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
    temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
```

```
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }


  ## Table 13
  rpTab <- read_table(rpPDF[13], skip=5, n_max = 50, col_names =
c("genus","species","seedspergram",1,5,10,25,100,250,1000),
              col_types = c("cciccccccc"))
  for (m in 1:nrow(rpTab)){
    genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
    rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
    rpTab[m,1] <- genus
  }
  rpTab <- rpTab[,-3]

  for (i in 1:nrow(rpTab)){
    temp_seed <- b_seed_list
    temp_seed$supplier <- "Royston Petrie Seeds"
    temp_seed$state <- "New South Wales"
    temp_seed$date_collected <- Sys.Date()
    temp_seed$genus <- rpTab[i,1] %>% tolower()
    temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
    temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
    temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
      1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }

  ## Table 15
  rpTab <- read_table(rpPDF[15], skip=3, n_max = 50, col_names =
c("genus","species",100,250,500,1000),
              col_types = c("cccccc"))
  for (m in seq(6,2,-1)){
    rpTab[,m] <- rpTab[,m-1]
  }

  for (m in 1:nrow(rpTab)){
    genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
    rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
    rpTab[m,1] <- genus
```

```
  }

  for (i in 1:nrow(rpTab)){
   temp_seed <- b_seed_list
   temp_seed$supplier <- "Royston Petrie Seeds"
   temp_seed$state <- "New South Wales"
   temp_seed$date_collected <- Sys.Date()
   temp_seed$genus <- rpTab[i,1] %>% tolower()
   temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
   temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
   temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
   temp_seed$quant_unit <- "1,000 seeds"
   temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }

  ## Table 16
  rpTab <- read_table(rpPDF[16], skip=3, n_max = 46, col_names =
c("genus","species",100,250,500,1000),
             col_types = c("cccccc"))
  for (m in seq(6,2,-1)){
   rpTab[,m] <- rpTab[,m-1]
  }

  for (m in 1:nrow(rpTab)){
   genus <- unlist(str_extract_all(rpTab[m,1], "([A-Z]*)(?=\\b)"))[1]
   rpTab[m,2] <- as.character(str_extract(rpTab[m,1], paste0("(?<=",genus,"\\s)(.*)")))
   rpTab[m,1] <- genus
  }

  for (i in 1:nrow(rpTab)){
   temp_seed <- b_seed_list
   temp_seed$supplier <- "Royston Petrie Seeds"
   temp_seed$state <- "New South Wales"
   temp_seed$date_collected <- Sys.Date()
   temp_seed$genus <- rpTab[i,1] %>% tolower()
   temp_seed$species <- str_extract(rpTab[i,2], "([A-Z\\s\\.]*)") %>% tolower()
   temp_seed$low_price <- max(as.numeric(rpTab[i,3:ncol(rpTab)]), na.rm = TRUE) *
     1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,],
tail(unlist(str_extract_all(rpTab[i,3:ncol(rpTab)], "\\d*\\.\\d{2}")), 1))])
   temp_seed$high_price <- as.numeric(unlist(str_extract_all(rpTab[i,], "\\d*\\.\\d{2}"))[1]) *
```

```
    1000 / as.numeric(colnames(rpTab)[str_detect(rpTab[i,], unlist(str_extract_all(rpTab[i,3:ncol(rpTab)],
"\\d*\\.\\d{2}"))[1])])[1]
    temp_seed$quant_unit <- "1,000 seeds"
    temp_seed_list <- rbind(temp_seed_list,temp_seed)
  }
}
seed_list <- rbind(seed_list, temp_seed_list)


## -------------------------

## Seed World
url <- c("https://www.seedworld.com.au/product-category/native-and-ornamental-
seeds/?2133_paged=1",
      "https://www.seedworld.com.au/product-category/native-and-ornamental-
seeds/?2133_paged=2")


temp_seed_list <- b_seed_list

for (n in 1:length(url)){
  temp_seed_list <- b_seed_list

  page <- read_html(url[n])

  SWTab <- html_element(page, "body") %>%
    html_element("div") %>%
    html_element("table") %>%
    html_table()

  for (i in 1:nrow(SWTab)){
    if (!str_detect(SWTab[i,3],"[\\d]{2,}[\\.]")){

    } else if (length(unlist(str_extract_all(SWTab[i,3], "[\\d]{2,}[\\.]"))) == 1){
      temp_seed <- b_seed_list
      temp_seed$supplier <- "Seed World Australia"
      temp_seed$state <- "New South Wales"
      temp_seed$date_collected <- Sys.Date()
      temp_seed$genus <- str_extract(SWTab[i,1], "[A-Za-z]*") %>%
        tolower()
      temp_seed$species <- str_extract(SWTab[i,1], "(?<=[^A-Z][\\s])([a-z\\s]*)")
      temp_seed$quant_unit <- "1,000 seeds"
      temp_seed$low_price <- as.numeric(str_extract(SWTab[i,3], "[\\d]{2,}(?=[\\.])"))
      temp_seed$high_price <- as.numeric(str_extract(SWTab[i,3], "[\\d]{2,}(?=[\\.])"))
    } else{
```

```
    temp_prices <- as.numeric(unlist(str_extract_all(SWTab[i,3], "[\\d]{2,}(?=[\\.])")))

    temp_seed <- b_seed_list
    temp_seed$supplier <- "Seed World Australia"
    temp_seed$state <- "New South Wales"
    temp_seed$date_collected <- Sys.Date()
    temp_seed$genus <- str_extract(SWTab[i,1], "[A-Za-z]*") %>%
      tolower()
    temp_seed$species <- str_extract(SWTab[i,1], "(?<=[^A-Z][\\s])([a-z\\s]*)")
    temp_seed$quant_unit <- "kilograms"
    temp_seed$high_price <- temp_prices[1] * 40
    temp_seed$low_price <- temp_prices[2]
  }
  temp_seed_list <- rbind(temp_seed_list, temp_seed)
 }
 seed_list <- rbind(seed_list, temp_seed_list)
}

## --------------------------

## Seeding Victoria

seed_lots <-
"https://www.seedingvictoria.com.au/catalogue.php?action=view_catalogue&type=full&id=" #1-4
url <-
"https://www.seedingvictoria.com.au/admin/ajax/seed_grid.php?use_filters=true&amp;letter=&page_
no=" #1-23
suppliers <- c("Ballarat Region Seed Bank",
        "Murray Mallee Seedbank",
        "Wimmera Region Seedbank",
        "South Gippsland Seedbank")
pages <- c(23,8,1,14)

temp_seed_list <- b_seed_list

for (i in 1:4){
 prov <- suppliers[i]
 s <- session(paste0(seed_lots, as.character(i)))

 for (j in 1:pages[i]){
  sr <- s %>% session_jump_to(paste0(url, as.character(j)))

  table <- sr %>%
    html_element("body") %>%
```

```
    html_element("table") %>%
    html_table() %>%
    try()

  table[,6] <- parse_number(table$`Price does not include GST\r\n\t\t\t\t$ 1kg`)

  for (n in 1:nrow(table)){
    temp_seed <- b_seed_list
    temp_seed$supplier <- prov
    temp_seed$state <- "Victoria"
    temp_seed$date_collected <- Sys.Date()
    genus <- unlist(str_extract_all(table[n,2],"[A-Za-z]{2,}"))[1]
    temp_seed$genus <- genus %>% tolower()

    temp_seed$species <- str_extract(table[n,2],paste0("(?<=",genus,")([A-Za-z\\s\\.]*)"))
    temp_seed$common_name <- table[n,3]
    temp_seed$provenance <- table[n,4]
    temp_seed$low_price <- table[n,6]
    temp_seed$high_price <- table[n,6]
    temp_seed$quant_unit <- "kilograms"
    temp_seed_list <- rbind(temp_seed_list, temp_seed)
  }
 }
 rm(s)
}

seed_list <- rbind(seed_list, temp_seed_list)

## --------------------------

## Top End Seeds

url <- "http://www.topendseeds.com.au/pricelist"

page <- read_html(url)

table <- html_element(page, "body") %>%
 html_element("div") %>%
 html_element("table") %>%
 html_table()

temp_seed_list <- b_seed_list
```

```
table[,3] <- lapply(table[,3],function(x){gsub(",","",x)})
table[,4] <- lapply(table[,4],function(x){gsub(",","",x)})

for (i in 1:nrow(table)){
 temp_seed <- b_seed_list
 if (table[i,1] == table[i,2]){
  genus <- str_extract(table[i,1], "([A-Za-z]*)(?=[\\s\\(]*)") %>% tolower()
 } else if (!str_detect(table[i,4],"\\d*")){
 } else {
  temp_seed$supplier <- "Top End Seeds"
  temp_seed$state <- "Northern Territory"
  temp_seed$date_collected <- Sys.Date()
  temp_seed$genus <- genus
  temp_seed$species <- str_extract(table[i,1],"(?<=\\s)[a-z]*")
  temp_seed$common_name <- table[i,2]
  if (str_detect(table[i,4],"seeds")){
   temp_seed$quant_unit <- "1,000 seeds"
   temp_seed$low_price <- as.numeric(str_extract(table[i,4],"(?<=\\$)([\\d\\.]*)(?=\\/)"))
   temp_seed$high_price <- as.numeric(str_extract(table[i,4],"(?<=\\$)([\\d\\.]*)(?=\\/)"))
  } else {
   temp_seed$quant_unit <- "kilograms"
   temp_seed$low_price <- as.numeric(str_extract(table[i,4],"(?<=\\$)(.*)"))
   temp_seed$high_price <- as.numeric(str_extract(table[i,3],"(?<=\\$)([\\d\\.]*)")) * 40
  }
  temp_seed_list <- rbind(temp_seed_list, temp_seed)
 }
}

seed_list <- rbind(seed_list, temp_seed_list)



## --------------------------

## Victorian Native Seed

url <- "https://www.victoriannativeseed.com.au/catalogue/"

page <- read_html(url)

temp_seed_list <- b_seed_list

for (i in 1:73){
 temp_seed <- b_seed_list
```

```
  seed_name <- html_element(page, "body") %>%
   html_element("div") %>%
   html_element("div") %>%
   html_element("div.vns-content-right") %>%
   html_element("ul:nth-child(3)") %>%
   html_element(paste0("li:nth-child(",i,")")) %>%
   html_element("div.vns-product--right") %>%
   html_element("h3") %>%
   html_text()

  common_name <- html_element(page, "body") %>%
   html_element("div") %>%
   html_element("div") %>%
   html_element("div.vns-content-right") %>%
   html_element("ul:nth-child(3)") %>%
   html_element(paste0("li:nth-child(",i,")")) %>%
   html_element("div.vns-product--right") %>%
   html_element("h4") %>%
   html_text()

  seed_table <- html_element(page, "body") %>%
   html_element("div") %>%
   html_element("div") %>%
   html_element("div.vns-content-right") %>%
   html_element("ul:nth-child(3)") %>%
   html_element(paste0("li:nth-child(",i,")")) %>%
   html_element("div.vns-product--right") %>%
   html_element("table") %>%
   html_table()

  temp_seed$supplier <- "Victorian Native Seed"
  temp_seed$state <- "Victoria"
  temp_seed$date_collected <- Sys.Date()
  genus <- unlist(str_extract_all(seed_name,"[A-Za-z]{2,}"))[1]
  temp_seed$genus <- genus %>% tolower()
  temp_seed$species <- str_extract(seed_name,paste0("(?<=",genus,")([A-Za-z\\s\\.\\-]*)"))
  temp_seed$common_name <- common_name
  temp_seed$provenance <- seed_table$Provenance
  s_price <- as.numeric(str_extract(seed_table$Price,("(?<=\\$)([\\d\\.]*)"))) * 1000
  temp_seed$low_price <- s_price
  temp_seed$high_price <- s_price
  temp_seed_list <- rbind(temp_seed_list, temp_seed)
 }
```

```r
seed_list <- rbind(seed_list, temp_seed_list)

## --------------------------

## Wildseed Tasmania

url <- c("http://www.wildseedtasmania.com.au/acacia.php",
        "http://www.wildseedtasmania.com.au/allocasuarina.php",
        "http://www.wildseedtasmania.com.au/climber.php",
        "http://www.wildseedtasmania.com.au/conifer.php",
        "http://www.wildseedtasmania.com.au/grass_sedge.php",
        "http://www.wildseedtasmania.com.au/hakea.php",
        "http://www.wildseedtasmania.com.au/leptospermum.php",
        "http://www.wildseedtasmania.com.au/melaleuca.php",
        "http://www.wildseedtasmania.com.au/myrtle.php",
        "http://www.wildseedtasmania.com.au/tree_other.php",
        "http://www.wildseedtasmania.com.au/shrub_other_ab.php",
        "http://www.wildseedtasmania.com.au/shrub_other_mo.php",
        "http://www.wildseedtasmania.com.au/succulent.php")

temp_seed_list <- b_seed_list

for (n in 1:length(url)){
 page <- read_html(url[n])

 table <- page %>%
   html_element("body") %>%
   html_element("table") %>%
   html_element("tbody") %>%
   html_element("tr:nth-child(2)") %>%
   html_element("td:nth-child(2)") %>%
   html_element(xpath = "//*[contains(concat( ' ', @class, ' ' ), concat( ' ', 'bgwhite', ' ' ))]") %>%
   html_table() %>%
   tryCatch(silent = FALSE)

 for (i in 1:nrow(table)){
  temp_seed <- b_seed_list
  temp_seed$supplier <- "Wildseed Tasmania"
  temp_seed$state <- "Tasmania"
  temp_seed$date_collected <- Sys.Date()
  genus <- unlist(str_extract_all(table[i,2],"[A-Za-z]{2,}"))[1]
  temp_seed$genus <- genus %>% tolower()
```

HOW MUCH DOES NATIVE SEED COST?

```r
   temp_seed$species <- str_extract(table[i,2],paste0("(?<=",genus,")([A-Za-z\\s\\.\\-]*)")) %>%
str_trim()
   temp_seed$common_name <- str_extract(table[i,2],"(?<=\\')([A-Za-z\\s]*)(?=\\')") %>% str_trim()
   temp_seed$provenance <- str_extract(table[i,2], "(?<=Origin\\:\\s)([A-Za-z\\s\\.]*)(?=\n)") %>%
str_trim()
   temp_seed$quant_unit <- "kilograms"

   price_list <- c()
   for (j in 2:5){
    p_selector <- page %>%
     html_element("body") %>%
     html_element("table") %>%
     html_element("tbody") %>%
     html_element("tr:nth-child(2)") %>%
     html_element("td:nth-child(2)") %>%
     html_element(xpath = "//*[contains(concat( ' ', @class, ' ' ), concat( ' ', 'bgwhite', ' ' ))]") %>%
     html_element(paste0("tr:nth-child(", i, ")")) %>%
     html_element("form") %>%
     html_element("select") %>%
     html_element(paste0("option:nth-child(", j,")")) %>%
     html_text() %>%
     tryCatch(silent = TRUE)
    if (!is.na(p_selector)){
     if (str_detect(p_selector, "gram")){
      price_list <- c(price_list, p_selector)
     }
    }
   }

   if (!is.null(price_list)){
    Price_w <- as.numeric(str_extract(price_list[1], "(\\d+)(?=\\sgram)"))
    Price_p <- as.numeric(str_extract(price_list[1], "(?<=\\$)(\\d+\\.\\d{2})"))
    temp_seed$high_price <- Price_p * 1000 / Price_w
    Price_w <- as.numeric(str_extract(price_list[length(price_list)], "(\\d+)(?=\\sgram)"))
    Price_p <- as.numeric(str_extract(price_list[length(price_list)], "(?<=\\$)(\\d+\\.\\d{2})"))
    temp_seed$low_price <- Price_p * 1000 / Price_w

    temp_seed_list <- rbind(temp_seed_list, temp_seed)
   }
  }
}

seed_list <- rbind(seed_list, temp_seed_list)
```

```
## -------------------------

## Clean and write

seed_list <- seed_list[rowSums(is.na(seed_list)) != ncol(seed_list),]

seed_list2 <- seed_list %>% tidyr::unnest()

dir <- tempdir()
write_csv(seed_list2, "seed_list.csv")

rm(list=ls())
```

APPENDIX C PRICE PLOTTING CODE

```
## --------------------------
##
## Script name: Price plotting
##
## Purpose of script: Plot native seed prices from publicly available price lists
##
## Reference code: J0594
##
## Version: 0001
##
##
##
## Date Created: 2021-05-16
##
##
## Email: k.wakermanpowell@acilallen.com.au
##
## --------------------------


## Packages

library(tidyverse)
library(extrafont)


## Fonts
loadfonts(device = "win")


## --------------------------

AA_col <- c("#9D85BE",
        "#7D7D7D",
        "#C8C8C8",
        "#006A9F",
        "#7BBDD6",
        "#428D52",
        "#5C437E",
```

```
        "#4B4B4B",
        "#787878",
        "#00405F",
        "#307D9A",
        "#285531",
        "#B19DCB",
        "#979797",
        "#D3D3D3",
        "#0099E5",
        "#95CADE",
        "#5AB26D",
        "#7B5BA8",
        "#646464")

## -------------------------

# Read in

seed_list <- read_csv("seed_list.csv",
          col_types = cols(
            supplier = col_factor(),
            state = col_factor(),
            date_collected = col_date(),
            genus = col_factor(),
            species = col_factor(),
            common_name = col_character(),
            provenance = col_character(),
            low_price = col_double(),
            high_price = col_double(),
            quant_unit = col_factor(),
            comment = col_character()
          ))

## -------------------------

# Summary stats

summary(seed_list$supplier)
summary(seed_list$state)
summary(seed_list$genus)
summary(seed_list$species)
summary(seed_list$low_price)
summary(seed_list$high_price)
```

```
seed_list %>%
  group_by(state) %>%
  filter(low_price > 0) %>%
  filter(!is.na(low_price)) %>%
  summarise(mean = mean(low_price),
      median = median(low_price),
      max = max(high_price, rm.na = TRUE),
      min = min(low_price))


seed_list %>%
  group_by(genus) %>%
  filter(low_price > 0) %>%
  summarise(mean = mean(low_price),
      median = median(low_price),
      max = max(high_price),
      min = min(low_price))


## -------------------------

# Plotting

seed_list %>%
  filter(low_price < 90000) %>%
  ggplot(aes(x = low_price)) +
  geom_histogram(fill = AA_col[1]) +
  geom_vline(aes(xintercept = mean(low_price, na.rm = T)),   # Ignore NA values for mean
      color="black", linetype = "dashed", size = 1) +
  scale_fill_manual(values = AA_col) +
  xlab("Prices") +
  ylab("Count") +
  theme(text=element_text(size=12,  family="Arial Narrow"))

ggsave("allprices.jpeg")

seed_list %>%
  filter(low_price < 2000) %>%
  ggplot(aes(x = low_price)) +
  geom_histogram(fill = AA_col[1]) +
  geom_vline(aes(xintercept = mean(low_price, na.rm = T)),   # Ignore NA values for mean
      color="black", linetype = "dashed", size = 1) +
  scale_fill_manual(values = AA_col) +
```

```
  xlab("Prices") +
  ylab("Count") +
  theme(text=element_text(size=12, family="Arial Narrow"))

ggsave("fewerprices.jpeg")

seed_list %>%
  filter(low_price < 2000) %>%
  ggplot(aes(x = low_price, fill = state)) +
  geom_histogram() +
  scale_fill_manual(values = AA_col) +
  xlab("Prices") +
  ylab("Count") +
  theme(text=element_text(size=12, family="Arial Narrow"))

ggsave("pricesbystate.jpeg")

main_genus_list <- c("acacia",
            "corymbia",
            "eucalyptus",
            "allocasuarina",
            "casuarina",
            "astrebla",
            "austrostipa",
            "baloskion",
            "bolboschoenus",
            "bothriochloa")

for (i in 1:length(main_genus_list)){
  seed_list %>%
    filter(low_price < 5000) %>%
    filter(genus == main_genus_list[i]) %>%
    ggplot(aes(x = low_price)) +
    geom_histogram(fill = AA_col[i]) +
    xlab("Prices") +
    ylab("Count") +
    theme(text = element_text(size = 12, family = "Arial Narrow"))

  ggsave(paste0("prices_", main_genus_list[i], ".jpeg"))
}

state_list <- c("Queensland",
          "Western Australia",
```

```r
          "New South Wales",
          "Victoria",
          "Northern Territory",
          "Tasmania")

for (i in 1:length(state_list)){
  seed_list %>%
    filter(low_price < 5000) %>%
    filter(state == state_list[i]) %>%
    ggplot(aes(x = low_price)) +
    geom_histogram(fill = AA_col[i]) +
    xlab("Prices") +
    ylab("Count") +
    theme(text = element_text(size = 12,  family = "Arial Narrow"))

  ggsave(paste0("prices_", state_list[i], ".jpeg"))
}

seed_list %>%
  group_by(genus) %>%
  filter(n() > 28) %>%
  summarise(Price = mean(low_price, na.rm = TRUE)) %>%
  arrange(Price) %>%
  ggplot(aes(reorder(genus, -Price), Price, colour = genus)) +
  geom_point(size = 3) +
  scale_colour_manual(values = AA_col) +
  xlab("Genus") +
  ylab("Price") +
  theme(text=element_text(size=12,  family="Arial Narrow"),
      axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
      legend.position = "none")

ggsave("mean_price_by_genus.jpeg")


seed_list %>%
  group_by(supplier) %>%
  summarise(count = n()) %>%
  arrange(count) %>%
  ggplot(aes(reorder(supplier, -count), count, colour = supplier)) +
  geom_point(size = 3) +
  scale_colour_manual(values = AA_col) +
  xlab("Provider") +
```

```
    ylab("Listings") +
    theme(text=element_text(size=12,  family="Arial Narrow"),
        axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none")

ggsave("seeds_by_supplier.jpeg")

seed_list %>%
  group_by(state) %>%
  summarise(count = n()) %>%
  arrange(count) %>%
  ggplot(aes(reorder(state, -count), count, colour = state)) +
  geom_point(size = 3) +
  scale_colour_manual(values = AA_col) +
  xlab("State") +
  ylab("Listings") +
  theme(text=element_text(size=12,  family="Arial Narrow"),
      axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
      legend.position = "none")

ggsave("seeds_by_state.jpeg")

seed_list %>%
  group_by(genus) %>%
  filter(n() > 28) %>%
  summarise(count = n()) %>%
  arrange(count) %>%
  ggplot(aes(reorder(genus, -count), count, colour = genus)) +
  geom_point(size = 3) +
  scale_colour_manual(values = AA_col) +
  xlab("Genus") +
  ylab("Listings") +
  theme(text=element_text(size=12,  family="Arial Narrow"),
      axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
      legend.position = "none")

ggsave("seeds_by_genus.jpeg")

seed_list %>%
  group_by(genus) %>%
  filter(n() > 35) %>%
  filter(low_price < 2500) %>%
  ggplot(aes(genus, low_price, fill = genus)) +
```

```
   geom_violin() +
   scale_fill_manual(values = AA_col) +
   scale_color_manual(values = AA_col) +
   xlab("Genus") +
   ylab("Price") +
   theme(text=element_text(size=12,  family="Arial Narrow"),
       axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
       legend.position = "none")

ggsave("violin_price_by_genus.jpeg")

for (s in 1:length(state_list)){
 seed_list %>%
   group_by(genus) %>%
   filter(state == state_list[s]) %>%
   filter(n() > 20) %>%
   filter(low_price < 2500) %>%
   ggplot(aes(genus, low_price, fill = genus)) +
   geom_violin() +
   scale_fill_manual(values = AA_col) +
   scale_color_manual(values = AA_col) +
   xlab("Genus") +
   ylab("Price") +
   theme(text=element_text(size=12,  family="Arial Narrow"),
        axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1),
        legend.position = "none")

 ggsave(paste0(state_list[s],"_violin_price_by_genus.jpeg"))

}
```