Interim Report on Propagation Trials conducted by Nature Glenelg Trust's Cross-border Community Nursery

Report to Department of the Environment

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Cover photos (left to right)

Ixodia achillaeoides ssp. *arenicola*, *Kunzea pomifera* seedlings, *Lotus australis*, *Scaevola calendulacea, Leucopogon parviflorus, Adriana quadripartita*, *Acacia enterocarpa* (Peter Tucker).

All photos taken by R. Thompson, unless otherwise noted.

Disclaimer

This report was commissioned by the Australian Government's Department of the Environment, and produced under the *Growing our future: Cross-border community nursery and seed collections project.* Although all efforts were made to ensure quality, it was based on the best information available at the time and no warranty express or implied is provided for any errors or omissions, nor in the event of its use for any other purposes or by any other parties.

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- Andrea Kodym – University of Melbourne
- Arborline Nursery
- Seawinds Nursery

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List of Abbreviations

ANSPA	Australian Native Plant Society (Australia)
CB	Cape Bridgewater
CP	Conservation Park
DPCP	Douglas Point Conservation Park
NA	Not applicable
No.	Number
NFR	Native Forest Reserve
NGT	Nature Glenelg Trust
SA	South Australia
SASCC	South Australian Seed Conservation Centre
SE	South East
sp./spp.	One species/multiple species
ssp.	subspecies
var.	variety

1. INTRODUCTION

1.1. *Project background*

Nature Glenelg Trust (NGT) is a mission-driven, not-for-profit organisation that believes in positive action, and working with the community and our partners to achieve real results on the ground. NGT is involved in a wide range of biodiversity related projects in the South East of South Australia and South West of Victoria to benefit our environment and local communities.

NGT's Cross-border Community Nursery (Figure 1) was established in 2013 with an aim of working in partnership with local groups and practitioners to both facilitate a more diverse range of native species in local revegetation projects and to increase a general awareness of native flora.

The Community Nursery has a focus on understorey, rare, and threatened plants as many such species tend to be uneconomical for commercial nursery production and are therefore currently unavailable. Reasons for commercial non-viability stem primarily from difficult seed collection (e.g. isolated populations or species where seed is released quickly) or complex dormancy and propagation difficulty i.e. the germination cues (dormancy breaking triggers) are unknown or only poorly understood. Hence, increased knowledge and sharing to overcome some of these inherent difficulties will lead to some of these species becoming more commercially viable and therefore accessible for the nursery industry, landholders, and natural resource managers involved in revegetation. Thus it is an imperative of the Community Nursery project to:

1. fill knowledge gaps,
2. share information, and
3. support existing local practitioners (e.g. native plant growers, direct seeding contractors, seed collectors, landholders, and others involved in native plant management).

Figure 1: Cross-border Community Nursery in February 2015

A large number of propagation trials have been undertaken to date to develop practical propagation techniques for some of these traditionally difficult to grow or rare species and the findings of these trials are presented in this report. A number of workshops covering native plant related topics around the South East of South Australia and South West of Victoria have also been run along with the establishment of eight native plant display gardens around the region. Further information on these educational aspects is provided in section 4.3.

2. COMMMUNITY NURSERY

2.1. Nursery set-up

The following section outlines the design, layout and underlying operation of the Community Nursery.

Watering system

For most of the year, the nursery is watered twice per day using an automated system (Holman Pro 46). The growing area is divided into two parts, or stations.

Station 1 is set to run twice per day (at 11:05am and 4:05pm) for three minutes at high pressure as a fine mist. This area is used as an outdoor germination for those species which require such conditions, and is also used for species which have high water requirements. This system was found to give complete water overage.

Station 2 also runs twice per day for three minutes (at 11:25am and 4:25pm) with a lower pressure spray.

After some experimentation this timing has proven most useful and efficient – it avoids watering at night which can foster mould growth, and ensures plants are watered and remain moist throughout the hottest part of the day. As staff are generally present at the nursery at these times, malfunctions in the watering system can be detected without delay.

At times it was necessary to water by hand, using a hose and spray nozzle. On hot (generally considered over 35˚C) and/or windy days extra watering was carried out to ensure plants did not dry out.

During late autumn and winter (May to August) the automated watering system is switched off and hand watering occurs if rainfall is insufficient to retain soil moisture.

Glasshouse

All cuttings and seedling trays were placed in the glasshouse (Figure 2) for several weeks to promote germination and root development.

The watering system in the glasshouse is independent from the outdoor irrigation system, and includes two battery operated Aqua System tap timers running on separate taps.

Tap 1 is a sprayer set to go on for one minute every four hours from 5am to 5pm in the warmer months (~October to March), and one minute every six hours in the cooler months (~August, September, April and May).

Tap 2 sprays a fine mist from the roof of the glasshouse and is used during periods of warm weather (above approximately 28^0C) for one minute per three hours between 5am and 5pm.

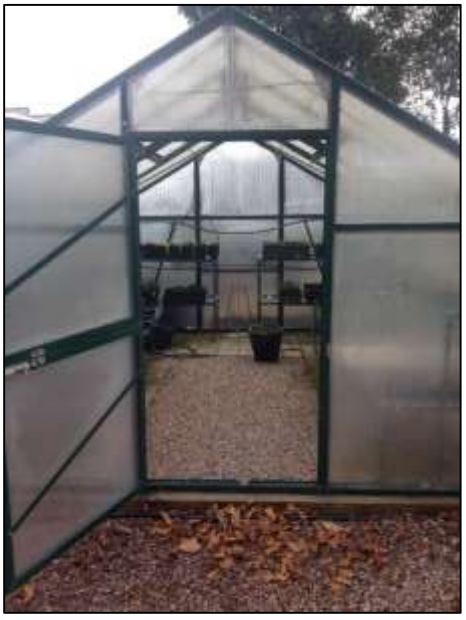


Figure 2: The Community Nursery glasshouse

During the coolest months (~June and July) the automatic irrigation system was switched off, and gentle hand watering occurred.

The glasshouse watering system runs on rainwater or town supply depending on availability.

This irrigation system was not always reliable and several failures were experienced, due to moisture in the tap timers or battery expiration.

2.2. Materials

Native seed raising mix

The primary growing medium used at the Cross-border Community Nursery is a soil-less low phosphorus seed raising mix especially formulated by Van Shaick's Biogro to suit the needs of Australian native plants. This medium was used in when propagating from seed, for cuttings in forestry tubes, and repotting, unless otherwise noted, and is hereafter referred to as native mix.

Experimentation with three parts native mix to one part river sand for coastal plants, and three parts native mix to one part grey loam for inland plants produced little difference to straight native mix.

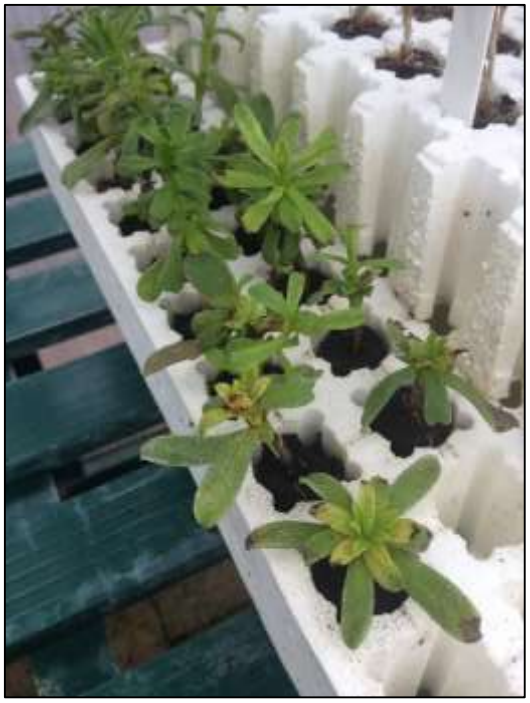


Figure 3: Sand Ixodia cuttings growing in Jiffy Preforma plugs

Plugs

Jiffy Preforma plugs (Figure 3) and polystyrene trays are used for a large proportion of cuttings. The substrate of these plugs allows for rapid root development, decreases the likelihood of rot, and maintains good moisture levels. Cuttings planted in these plugs may be transplanted directly into forestry tubes filled with native mix without damage to delicate root systems. These plugs have been found to substantially increase success of cuttings in most cases.

Seasol

Seasol is a commercially available liquid seaweed concentrate. While not a fertiliser, it provides plants with small amounts of nutrients and trace elements. It is used in the Cross-border Community Nursery to promote healthy root growth and decrease shock to seedlings and cuttings after pricking out, planting, or transplanting. Seasol is generally used in this nursery at a ratio of ten millilitres per nine litre watering can.

Pots

A number of different plastic pot sizes and shapes are used in the nursery, depending on the purpose and the species planted.

Forestry tubes (Figure 4) are the standard size pot used in seedling production and measure approximately 50 millimetres x 50 millimetres x 125 millimetres (depth).

Short forestry tubes are approximately 50 millimetres x 50 millimetres x 70 millimetres.

Super tubes are approximately 67 millimetres x 67 millimetres x 160 millimetres.

Figure 4: Forestry tubes are the most commonly used pot size in the nursery

Square pots are in fact slightly rectangular, and measure approximately 85 millimetres x 95 millimetres x 85 millimetres.

140 millimetre pots are round with a depth of 140 millimetres, and a diameter of 125 millimetres.

Hormone gel

Yates Clonex Rooting Hormone Gel was used in on all cuttings to promote root development. Cuttings were snipped at an angle using secateurs and dipped in the gel and then immediately placed in the growing medium (either native mix or plugs).

2.3. Procedures

The following section provides a description of key steps undertaken during propagation trials undertaken at the Cross-border Community Nursery.

Seed viability testing

If a sufficient amount of seed was available, a cut test was performed to ascertain the viability of the seed. Generally if less than 30 seeds were available a cut test was not undertaken.

The cut test was performed by first selecting a random sample of seed, assumed to be representative of the seedlot. Each seed in the sample was cut in half, lengthways using a scalpel and examined under a microscope. This process revealed if the seed was healthy and filled; or empty, shrivelled, predated, or damaged, thereby indicating the assumed overall viability.

Seed viability testing helps guide sowing when a particular number of seedlings are required; for example, a cut test revealing five out of 20 seeds damaged, or 75% viability, indicates that at least 25% more seed should be sown than the eventual required number of seedlings for orders and projects with specific numbers.

If only a small amount of seed is available, seed viability testing is not carried out.

Stratification

Stratification is the process of simulating winter to break seed dormancy. At the Community Nursery this is achieved by storing seed in a sealed petri dish in the fridge (4^0C) or freezer (0^0C). The period of time for which stratification took place varied in each case.

Seed sowing

Seeds were usually sown into 275 mm x 335 mm x 55 mm seedling trays filled to within 10 mm of the top with native mix. Seeds were sprinkled on top and then covered by a thin layer of fine (sieved) seed raising medium. In the case of species where different media or methods were employed, a specific explanation is provided.

For species which take a long time to germinate, perlite was added to the seed raising medium to hold moisture around the seed.

Pricking out

When seedlings are of sufficient size they are pricked out from seedling trays in to individual forestry tubes, or other pots. Before beginning, all instruments and work benches to be used are sterilised. Seedlings, usually around six leaf stage are gently prised out of seedling trays using a chopstick or similar implement, taking care not to damage or snap roots.

By holding the seedling by the leaves (to avoid touching the roots,) the length of the roots and any kinks may be trimmed by up to one-third to ensure they grow straight down in the pot. The pot is filled with semi-compacted (so as not to inhibit root development) native mix and a hole is created using either a finger or dibble stick. The seedling is lowered in to the hole, with the roots kept straight, and planted at the same level as it was in the seedling tray. Extra medium is added to backfill the hole and light pressure is applied to firm the seedling into place. Newly pricked out seedlings are watered with Seasol solution to stimulate new root development.

Cutting procedure

New growth tips were snipped from either healthy wild plants or nursery stock using sterilised secateurs to ensure a clean cut and minimise damage to the parent plant. Cuttings were collected from as large a number of parent plants as possible to maximise genetic diversity. Cuttings collected from the wild were kept cool (out of the sun) and transported to the nursery in plastic bags with moisture in order to minimise shock.

Cutting material was kept cool and moist in ziplock plastic bags in the fridge at 4^0C and processed as soon as possible.

Cuttings were trimmed to a suitable length and excess leaves were removed so that usually only six leaves remained, and the bottom two leaves were also usually trimmed in half. Cuttings were dipped in hormone gel to promote root development and were placed either directly into native mix forestry tubes or into peat plugs.

Pest treatment

Pest insects were either removed by hand or treated using ready-to-use Multicrop Eco-pest Oil (paraffinic oil).

Collection of plant material

When planning for native plant propagation, it is imperative that the methods employed result in a net environmental gain. In particular, seed collection should not negatively affect individual plants, a particular population, or the species as a whole. With this in mind, both seed and cutting material were collected from as many parent plants as possible to both increase the genetic diversity of the propagated plants and decrease the likelihood of harming natural recruitment in the wild population.

Appropriate permits were obtained from the relevant state departments for the collection of plant material from public land in South Australia (from Department of Environment, Water and Natural Resources) and Victoria (from then Department of Environment and Primary Industries).

In Victoria, NGT has been granted permission to collect plant material under the Flora and Fauna Guarantee Act 1988 and the National Parks Act 1975. In South Australia, permission has been granted under the National Parks and Wildlife Act 1972.

The movement of plant material across state borders into South Australia is regulated by Biosecurity SA – Primary Industries and Regions (PIRSA). NGT is a registered importer under the Plant Health Act 2009 to import four consignments of material per year into the state. Soil is removed from plant material and equipment at the site of collection to decrease the chance of the importation of pests into South Australia. A Green Snail *(Cantareus apertus)* declaration also accompanies each consignment. Similarly, to avoid the spread of Myrtle Rust (*Puccinia psidii)*, species of the Myrtaceae family are not brought into South Australia.

3. PROPAGATION TRIALS

To date, propagation trials have been conducted on a total of 31 species from the South East of South Australia and South West of Victoria. Trials using seed were conducted for 20 species, while 15 species were trialled by cutting, including four trials which involved propagation by both methods. Trials were conducted on five nationally threatened species and a further twelve state-listed species (either South Australia or Victoria).

Propagation trials were carried out using either seed or cuttings, or both (Table 1). Seed trials often included the use of several different seed treatments in order to ascertain which method would produce the best results.

Growing certain species by cuttings was also trialled, either because seed was not available or to compare results to seed trials. Trials using cuttings particularly focussed on questions of timing i.e. when to collect cuttings and how much growing time was necessary to produce plants of a sufficient size for planting in the winter season.

Propagation trials were informed by previous work undertaken by the South Australian Seed Conservation Centre (SASCC), and by recommendations in published literature.

Specific information about germination and propagation trials by species can be found in the following sub-sections under the species name. However, the overall results have been presented below.

Growing plants from seed creates a more viable future for the species by increasing genetic diversity and resilience to pests or other influences (for example, drought). Therefore, seed propagating is the preferred method in environmental restoration.

The seeds of many species have complex inbuilt dormancy, meaning that several triggers are required for germination to take place. Natural triggers (for example, season change or digestion by a bird) can be mimicked in a nursery setting using techniques such as stratification and scarification, and materials such as gibberellic acid and smoke-water. In some cases a combination of treatments is required (Ralph 2009). Ralph (2009) provides information on the germination requirements of many Australian genera. Because of the extra time and labour involved in the propagation of such species they are often left out of revegetation projects.

Seed trials in the Community Nursery focussed on these hard-to-grow species (Table 2). In some trials the number of seeds used was not recorded, usually because the tiny seeds made counting impractical; a percentage result (total germinants from seed sown) is not available in these cases and these trials are not shown in the below table.

Table 1: Propagation Trials

Name	Common name	Status*			Material	
		Aust.	SA	Vic.	Seed	Cuttings
Acacia enterocarpa	Jumping-Jack Wattle	E	e	e	✓	
Acrotriche cordata	Coast Groundsel			r	✓	✓
Acrotriche serrulata	Honey-pots				✓	✓
Adriana quadripartita	Coast Bitter-bush			e		✓
Astroloma conostephioides	Flame Heath				✓	
Beyeria leschenaultii	Pale Turpentine Bush					✓
Bursaria spinosa ssp. *spinosa*	Sweet Bursaria				✓	
Calectasia intermedia	Blue Tinsel-lily		v		✓	✓
Callitris rhomboidea	Cypress Pine				✓	
Cassinia rugata	Wrinkled Cassinia	V		v		✓
Daviesia ulicifolia	Gorse Bitter-pea				✓	
Dianella callicarpa	Swamp Flax-lily		e	r	✓	
Einadia nutans	Climbing Saltbush				✓	
Gahnia filum	Chaffy Saw-sedge				✓	
Gahnia radula	Thatch Saw-sedge		r		✓	
Gahnia sieberiana	Red-fruit Saw Sedge				✓	
Grevillea aquifolium	Holly Grevillea		r	e		✓
Ixodia achillaeoides ssp. *arenicola*	Sand Ixodia	V	e		✓	✓
Kunzea pomifera	Muntries				✓	
Leucopogon parviflorus	Coast Beard-heath				✓	
Logania ovata	Oval Logania			r	✓	
Melicytus dentatus	Tree Violet			k	✓	
Olearia pannosa ssp. *pannosa*	Silver Daisy Bush	V	v			✓
Pimelea glauca	Smooth Rice-flower					✓
Pomaderris halmaturina ssp. *halmaturina*	Kangaroo Island Pomaderris	V	v		✓	
Pomaderris obcordata	Pimelea Pomaderris			p		✓
Pomaderris paniculosa ssp. *paralia*	Coast Pomaderris				✓	
Pultenaea canaliculata	Coast Bush-pea			r		✓
Pultenaea sp.					✓	
Scaevola calendulacea	Dune Fan-flower		v	v		✓
Stackhousia spathulata	Coast Stackhousia			k		✓
Tetratheca ciliata	Pink-bells					✓

*V/v = vulnerable, E/e = endangered, r = rare, p = presumed extinct, k = poorly known

Table 2: Propagation trials by seed

Name	Provenance	Result (%)*	Viability (%)
Acacia enterocarpa	Arberdour CP	36	Not tested
Acrotriche serrulata	Carpenter Rocks CP	44	50
Bursaria spinosa ssp. *spinosa*	Warrnambool Botanic Garden	30	Not tested
Calectasia intermedia	Calectasia CP	0.5	20
Callitris rhomboidea	Eaglehawk Waterhole Restoration Reserve	57	5
Gahnia sieberiana	Honan NFR	14	Not tested
Logania ovata	Unknown	20	Not tested
Pultenaea sp.	Unknown	58	70

* Overall result (percentage of germinants from number of seed sown), or best result if more than one treatment was applied.

Where possible, seed viability testing is a valuable step in the process of seed propagation, as it gives the grower the ability to plan for loss and still meet target numbers. For example, if sowing seed with a viability of 50% at least twice as much seed as desired plants must be sown. Although in the case of these trials a desired number of plants was not a factor, seed viability information helps create a more complete picture of the trials conducted. For example, the trial on *Pultenaea* sp. germinated 58% of seeds sown, a very high result given seen viability was tested at 70%. In other words, nearly all viable seed germinated in this trial. Similarly, 44% of seed germinated in the trial on *Acrotriche cordata* which is another very high result as seed viability was found to be only 50%. In this case the trial illustrated the responsiveness of this species to smoke-water.

A similar percentage of *Bursaria spinosa* ssp. *spinosa* seed germinated from Tantanoola and Warrnambool provenances, indicating a similar level of seed viability in these two locations.

Other results may have been influenced by timing of sowing, timing of seed collection, seed viability, or weather conditions, as well as the treatments applied.

Growing plants by cuttings is a valuable technique in cases where the species is difficult to propagate by seed, or if seed is unavailable or unviable. However, as outlined above, propagation by seed is preferable in environmental restoration work as it increases genetic diversity and resilience. Conversely, propagation of cuttings creates genetic clones of the parent plant, and therefore reduces genetic diversity and resilience of the species as a whole. Reintroducing large numbers of genetic clones to wild populations may 'flood' the genetic makeup of the natural population, further negatively affecting the species, its adaptability, and potential survivorship.

Results in cutting trials varied between species ranging from 0% (*Pultenaea canaliculata*) to 100% (several species; Table 3). In the majority of cases, two-thirds of planted cuttings formed roots and put on growth.

One species, *Olearia pannosa* ssp. *pannosa*, was trialled twice using plant material from the same source at different times. The results varied considerably between these trials, probably as a result of timing, weather or pests. However, while the success rate was lower in the second trial, it was still a positive result.

Ixodia achillaeoides ssp. *arenicola* cutting material was collected from two provenances and results were vastly different between these sources. A much higher success rate and general plant vigour were produced by the Cape Douglas material than the Cape Bridgewater material. This finding

supports existing knowledge that the Cape Douglas population is known to be more vigorous than the Cape Bridgewater population (C. Dickson, pers. comm. 2015).

Table 3: Propagation trials by cutting

Name	Common Name	Provenance	Result (%)*
Acrotriche cordata	Coast Ground-berry	Carpenter Rocks CP	66
Acrotriche serrulata	Honey-pots	Carpenter Rocks CP	21
Adriana quadripartita	Coast Bitter-bush	Beachport CP	100
Beyeria leschenaultii	Pale Turpentine Bush	Douglas Point CP	123
Calectasia intermedia	Blue Tinsel-lily	Calectasia CP	37
Cassinia rugata	Wrinkled Cassinia	Cobboboonee NP	96
Grevillea aquifolium	Holly Grevillea	Carpenter Rocks CP	93
Ixodia achillaeoides ssp. *arenicola*	Sand Ixodia	Cape Douglas CP	80
Ixodia achillaeoides ssp. *arenicola*	Sand Ixodia	Discovery Bay Coastal Park	10
Olearia pannosa ssp. *pannosa*	Silver Daisy Bush	Adelaide Botanic Gardens	100
Olearia pannosa ssp. *pannosa*	Silver Daisy Bush	Adelaide Botanic Gardens	60
Pimelea glauca	Smooth Rice-flower	Piccaninnie Ponds CP	100
Pomaderris obcordata	Pimelea Pomaderris	Beachport CP	68
Pultenaea canaliculata	Coast Bush-pea	Douglas Point CP	0
Scaevola calendulacea	Dune Fan-flower	Piccaninnie Ponds CP	93
Stackhousia spathulata	Coast Stackhousia	Douglas Point CP	75
Tetratheca ciliata	Pink-bells	Calectasia CP	0

* Overall result (percentage of successful plants from number of cuttings planted), or best result if more than one treatment was applied.

Detailed results of the propagation trials for each species follow in alphabetical order by botanical name.

3.1. *Acacia enterocarpa Jumping-Jack Wattle*

Status Endangered (Aust., SA, Vic.)

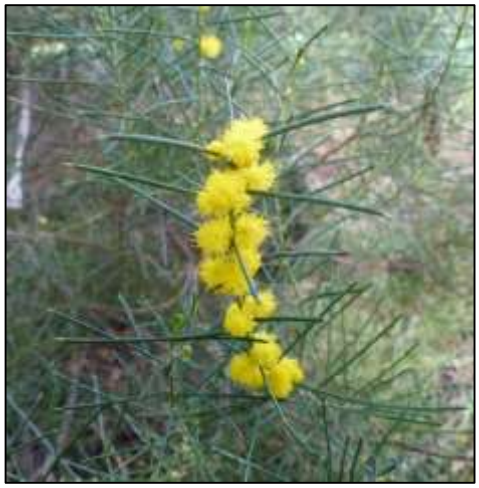


Figure 5: Acacia enterocarpa (B. Haywood)

The SASCC has found *Acacia enterocarpa* (Figure 5) seed viability to be generally very high, between 85% and 90%, and germination requires breaking the seeds' physiological dormancy either by nicking or softening the seed coat (SASCC 2015). Seed viability testing has been carried out on seed from two South East South Australia sites and, while seed was found to be viable, no natural recruitment has been observed for many years (Moritz & Bickerton 2011; Johnson & Dickson 2009). It is thought that given the high seed viability it is primarily the lack of disturbance and high level of both seedling and seed predation, by herbivores and ants respectively, which are suppressing natural recruitment in the South East of South Australia (Johnson & Dickson 2009).

The seed used in all of the following trials was collected in 2007 at Aberdour Conservation Park, indicating the seed was at least eight years old at the time of trial.

Provenance Aberdour Conservation Park, South Australia
Material Seed

Seed viability was confirmed by testing which revealed filled and healthy seed. Two trials were conducted using hot water soaking, altering the length of time the seeds soaked. Good success was experienced by immersing the seed in hot water and allowing it to soak for one hour.

Provenance Aberdour Conservation Park, South Australia
Material Seed

Seed viability testing revealed 100% filled and healthy-looking seed, and 50 seeds were sown with three different treatments, including smoke-water treatment, pressure treatment and no treatment. Pressure treatment was conducted by pumping a pressure bottle containing the seed in rainwater 100 times, in an attempt to soften the seed coat. Only one germinant was produced as a result of these treatments from the smoke-water treatment.

Provenance Aberdour Conservation Park, South Australia
Material Seed

Seed was covered in hot water (80^0C) and soaked for one hour to soften the seedcoat. Germination in this trial occurred in just over one month. The seed used in this trial was eight years old and resulted in 14% germination (Table 4).

Table 4: Germination trials for Acacia enterocarpa

	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Date collected	2007	2007	2007	2007	2007	2007
Viability (%)	Healthy, filled	Healthy, filled	100%	100%	100%	Not tested
Number of seeds sown	50	50	50	50	50	50
Date Sown	20/12/13	21/12/13	27/2/2014	27/2/2014	27/2/2014	1/9/2014
Medium	Native mix	Native mix	Native mix	Native mix	Native mix	Native mix
Treatment	Hot water, soak one hour	Hot water, soak 24 hours	Soaked in smoke-water	Pumped in pressure bottle x 100 with rainwater	No treatment	No treatment
Time of first emergence	Not recorded	NA	NA	Not recorded	NA	24/10/14 (7 weeks)
Maximum emergence	1/9/2014 (nine months)	NA	NA	Not recorded	NA	21/11/14 (11 weeks)
Result (no.)	18 (36%)	0	0	1 (0.5%)	0	7 (14%)

Recommendations

The first five treatments undertaken were sown either in December or February, an unusual timing for *Acacia* species. Only one of the first five treatments recorded any successful germination and it was very slow to reach the maximum emergence of 36%. Germination was rapid in the final trial conducted, which had an early spring sowing time. It is likely this sowing time replicates the natural time of germination *in-situ* and demonstrates the importance of timing when undertaking propagation in the nursery. Good success was experienced in the first trial by soaking seed in hot water for one hour. Combining these techniques (timing and treatment) is likely to result in even higher numbers of germinants, a known treatment for *Acacia* species with a hard seed coat. Recommendations for germination of *Acacia enterocarpa* are outlined in Table 5.

Table 5: Treatment recommendations for Acacia enterocarpa

Acacia enterocarpa – Jumping-Jack Wattle	
Seed collection time	Late November to early December
Cleaning technique	Dry pods then rub to dislodge seeds. Sieve to remove unwanted material (SASCC 2015)
Age of seed at sowing	Old seed may germinate
Sowing time	Spring
Most successful NGT treatment	Hot water treatment
Recommended treatment	Nicking or soaking to soften seedcoat (SASCC 2015)
Future trial suggestions	Compare effectiveness of soaking and nicking techniques, combine with ideal timing

3.2. *Acrotriche cordata Coast Ground-berry*

Status Rare (Vic.)

Acrotriche cordata is known to be difficult to grow from seed due to complex dormancy (a combination of thick drupes, chemical inhibitors, and possibly immature embryos; Ralph 2009, SASCC 2015). A number of treatments have been tried with no or limited success and Ralph (2009) suggests that a combination of natural weathering, smoke and heat treatment may be worth trialling. Sparrow (2013) states that this species may be grown, with great difficulty, from cuttings.

Provenance Carpenter Rocks Conservation Park, South Australia
Material Cuttings

New growth tip cuttings were collected in January 2014. Stems were nicked twice, dipped in hormone gel and planted in a mixture of equal parts peat, perlite, and native mix. These cuttings grew well and 66% had survived by late February.

Provenance Carpenter Rocks Conservation Park, South Australia
Material Seed

Seed was collected from the ground underneath *Acrotriche cordata* shrubs and was therefore presumed to have been naturally weathered (exposure to sunlight, wind). Seed viability testing revealed 50% viability. Two treatments were trialled focussing mainly on different propagation media.

In Treatment 1, naturally weathered seed was propagated in native mix with a layer of soil taken from beneath the parent plants during seed collection place on top. In late February 2014 just two seedlings had germinated.

In Treatment 2 seed, naturally weathered seed was propagated in a mix of equal parts peat, native mix and perlite, with a layer of soil from beneath the parent plants and local gravel placed atop. This treatment was then watered in with smoke-water. Twenty-two seedlings emerged in this treatment by late February 2014, more than ten times as many seedlings as treatment 1.

The difference in results between these treatments indicates that one or more of the additional treatments applied in the second treatment were beneficial to the germination of this species; that is, either the media used in Treatment 2 was more suitable, smoke-water stimulated increased germination, or a combination of both factors.

Early results in this trial were favourable, however the trial was prematurely terminated when the seedlings died in a period of hot weather in late February 2014. A summary of treatment results is outlined in Table 6.

Table 6: Treatment results for Acrotriche cordata

	Cuttings	Seed treatment 1	Seed treatment 2
Date collected	10/1/2014	10/1/2014	10/1/2014
Viability (%)	NA	50	50
Number of seeds/cuttings	24	Not recorded	Not recorded
Sown	11/1/2014	11/1/2014	11/1/2014
Medium	Equal parts peat, perlite, and native mix	Native mix topped with parent plant soil	Equal parts peat, native mix, and perlite, topped with parent plant soil. Smoke water
Treatment	Stems nicked, hormone gel	Natural weathering	Natural weathering
Time of first emergence	NA	Not recorded	Not recorded
Maximum emergence	NA	25/2/2014 (6.5 weeks)	25/2/2014 (6.5 weeks)
Final number	16 (66%)	2 (4%)	22 (44%)

Recommendations

Either smoke-water or the growing media greatly improved germination of naturally weathered seed in Treatment 2. Future trials should determine which factor was influential in this case, and could also look at a combination of smoke treatment and heat treatment. Recommendations for this species are outlined in Table 7.

Table 7: Treatment recommendations for Acrotriche cordata

***Acrotriche cordata* Coast Ground-berry**	
Seed collection time	Feb – Mar (Ralph 1994)
Cleaning technique	Remove flesh by rubbing berries in bucket of water, then allow seed to dry (SASCC 2015)
Age of seed at sowing	Fresh (Bonney 2003)
Sowing time	Autumn
Recommended treatment	Natural weathering, smoke water, and mixed media (local gravel and topsoil, plus equal parts peat, native mix and perlite)
Future trial suggestions	Isolate influence of media and smoke-water. Combination of natural weathering, smoke water, and heat treatment suggested by Ralph (2009)
Cutting techniques	Reportedly difficult by cutting (Sparrow 2013), however, reasonable success (66%) in this trial using hormone gel, nicked stems in pearlite, peat, native mix.

3.3. *Acrotriche serrulata Honey-pots*

As stated above, *Acrotriche* spp. are difficult to grow from both seed and cuttings (Ralph 2009; Sparrow 2013). While SASCC has not published information specifically about *A. serrulata* they have similarly found *Acrotriche* spp. to have complex germination requirements and have a morphophysiological dormancy (SASCC 2015).

Provenance Carpenter Rocks Conservation Park, South Australia
Material Cuttings

New growth tip cuttings were collected in August 2014. Cuttings were dipped in hormone gel and placed in plugs. After 2.5 months 62% were transplanted into forestry tubes, but to March 2015 most had not grown any further. Of the original number one-fifth appear to have put on new growth tips, varying in length and leaf number.

Provenance Carpenter Rocks Conservation Park, South Australia
Material Seed

Seed was collected in September 2014 and sown in November 2014. Seed was given a heat treatment in hot water (80^0C) for 30 minutes, and then watered in with smoke-water. At the time of publishing no germination had taken place (Table 8).

Table 8: Treatment results for Acrotriche serrulata

	Cutting Treatment	Seed Treatment
Date collected	15/8/2014	20/9/2014
Viability (%)	NA	Not tested
No. of seeds/cuttings	240	1 teaspoon
Date sown/planted	18/8/2014	24/11/2014
Medium	Plugs	Native mix
Treatment	Hormone gel	Hot water, then smoke water
Time of first emergence	NA	-
Maximum emergence	NA	-
Result	50 (21%)	0 (0%)

Recommendations

Further trials could be undertaken with seed collected during peak season (January to March). A combination of treatments is likely to be required for this species as outlined in Table 9.

Table 9: Treatment recommendations for Acrotriche serrulata

***Acrotriche serrulata* Honey-pots**	
Seed collection time	Jan – Mar (Bonney 2003)
Cleaning technique	Rub to remove fruit (Bonney 2003)
Age of seed at sowing	Fresh (Bonney 2003)
Sowing time	Autumn (Bonney 2003)
Recommended treatment	No success from seed in this trial
Future trial suggestions	*Acrotriche* spp. are known to have complex physiomophological dormancy (SASCC 2015; Ralph 2009). A combination of treatments likely to be required. Bonney (2003) suggests planting fresh seed with soil from beneath parent plants.
Cutting techniques	New growth tips, but difficult from cutting (very slow)

3.4. *Adriana quadripartita Coast Bitter-bush*

Status Vulnerable; Endangered (Vic.)

Figure 6: Coast Bitter-bush seedlings

Adriana quadripartita may be grown easily from seed without pre-treatment (Sparrow 2013), and has been successfully used in broadacre revegetation programs (Bonney 2003) (Figure 6). Conversely, other sources state that due to physiological dormancy germination without treatment may be poor and note that smoke treatment is not helpful (Ralph 2009; SASCC 2015). This species has been germinated with reasonable success (48% - 60%) in a laboratory setting using gibberellic acid in agar germination medium (SASCC 2015). Seed should be sown in winter, within six months of collection (Ralph 2009). This species may also be grown by cutting (Ralph 2009; Sparrow 2013).

Provenance Beachport Conservation Park, South Australia
Material Cuttings

Cutting material was collected in September 2014 and planted directly into forestry tubes. The cuttings grew well, and all survived (Table 10). The plants needed to be transplanted into super tubes in March 2015.

Table 10: Treatment results for Adriana quadripartita

	Cutting Treatment
Date collected	3/9/14
Date sown/planted	4/9/14
No. of seeds/cuttings	20
Medium	Native mix
Treatment	Hormone gel
Final number	20 (100%)

Recommendations

Six months growing time is required for this species to reach a plantable size, therefore cuttings should be planted in approximately January for winter planting. This timing will avoid the extra labour involved with repotting and weeding plants for a longer period of time. Recommendations for this species are outlined in Table 11.

Table 11: Treatment recommendations for Adriana quadripartita

***Adriana quadripartita* – Coast Bitter-bush**	
Seed collection time	Feb – March (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	< 6 months (Ralph 2009)
Sowing time	Mid- to late winter (Bonney 2003; Ralph 2009)
Recommended treatment	No seed trials were undertaken for this species during this period
Future trial suggestions	Sources differ in opinion, but propagation by seed may require treatment to break dormancy (*cf* Sparrow 2013 and Ralph 2009, SASCC 2015). Gibberellic acid treatment has resulted in reasonable success (SASCC 2015).
Cutting techniques	Grows well from cutting; requires 6 months growing time

3.5. *Astroloma conostephioides Flame Heath*

Emu Scat Case Study 1

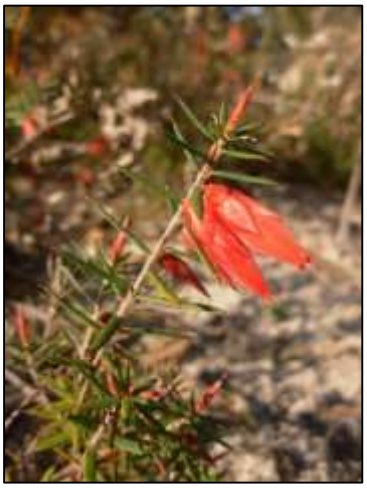


Figure 7: Flame Heath in flower

Following the success of the first emu scat trial (see 3.19 *Kunzea pomifera*), it was with enthusiasm that nursery staff looked for seed-filled droppings on subsequent outings. An emu scat was collected in Penola Conservation Park in December 2014 as it appeared to be full of the fruit of *Astroloma conostephioides* (Figure 7), a species with complex dormancy (Ralph 2009; Sparrow 2013; SASCC 2015).

Ralph (2009) provides a long list of treatments which have been trialled unsuccessfully on *Astroloma* spp., and suggests that a combination of natural weathering, heat and smoke treatment may provide results. In trials by the SASCC a number of seed treatments (involving hydrogen peroxide, gibberellic acid, soaking in water, heat treatment) produced no to very little results (SASCC 2015). *Astroloma* spp. collected from emu scat have been germinated in other trials (Ralph 1994).

The scat was crumbled, and watered in with smoke-water on December 2014. It was hoped that the seed dormancy would have been broken during the digestion process, however to date no germination has occurred (Table 12). Germination may yet occur in the winter 2015.

Seed, and soil from below parent plants, were also collected on the same day for use in future trials.

Table 12: Treatment results for Astroloma conostephioides

	Seed Treatment
Date collected	16/12/2014
Viability (%)	Still viable, seed full
Number of seeds sown	Not recorded
Date sown/planted	18/12/2014
Medium	Native mix
Treatment	Emu ingestion
Time of first emergence	-
Maximum emergence	-
Final number	0 (0%)

Recommendations

The dormancy-breaking triggers of this species remain unknown. A combination of treatments is likely to be required (Table 13).

Table 13: Treatment recommendations for Astroloma conostephioides

***Astroloma conostephioides* – Flame Heath**	
Seed collection time	Nov – Mar (SASCC 2015)
Cleaning technique	Soak in water and rub to remove flesh (SASCC 2015)
Age of seed at sowing	After 3 months cold storage (*Astroloma* spp.; Ralph 1994)
Sowing time	Unknown, but winter likely
NGT recommended treatment	Emu ingestion not successful in this trial
Future trial suggestions	Further research into combinations of natural weathering, heat treatment, and smoke treatment is recommended (Ralph 2009).
Cutting techniques	Difficult by cutting; firm, young growth produces the best results (Ralph 2009)

3.6. *Beyeria leschenaultii Pale Turpentine Bush*

Status Rare; Poorly Known (Vic.)

Beyeria spp. are difficult to germinate as they have morphophysiological dormancy (SASCC 2015). Fresh seed, less than six months old, should be used (Ralph 2009). Sparrow (2013) states that seed of this species requires no pre-treatment and this species may also be grown by cutting.

Provenance Douglas Point Conservation Park, South Australia
Material Cuttings

Cuttings were collected in August, 2014 and planted within three days. The cuttings appeared to be doing well initially with 83% surviving at 11 weeks. The cuttings were repotted into forestry tubes at 12 weeks, and this seems to have had a negative effect on their survivorship. Shortly thereafter at 14

weeks approximately half the cuttings had perished and the cuttings continued to decline until just 3 remained in June 2015 (Table 14).

Although the seed collection time for this species has been recorded as January to February (Ralph 1994), ripe seed was collected in December 2014 following a period of warm weather, for use in future trials.

Table 14: Treatment results for Beyeria leschenaultii

	Cutting Treatment
Date collected	15/8/2014
Viability (%)	NA
Number of cuttings	24
Date Sown/planted	18/8/2014
Medium	Plugs, then transferred to native mix at 14 weeks
Treatment	Hormone gel
Time of first emergence	NA
Maximum survivorship	83% - 24/10/2014 (11 weeks)
Final number	3 (12.5%)

Recommendations

It is recommended that cuttings be placed directly in forestry tubes as this species appears to be negatively affected by root disturbance.

Seed cleaning may be undertaken in a time efficient manner, by placing harvested branches in a large paper bag in the sunshine, and allowing the seedpods to pop in the warmth.

The effects of heat, cold, and smoke treatments could form the basis of future germination trials of *Beyeria leschenaultii*. Recommendations for this species are outlined in Table 15.

Table 15: Treatment recommendations for Beyeria leschenaultii

***Beyeria leschenaultii* - Pale Turpentine Bush**	
Seed collection time	Jan - Feb (Ralph 1994; Bonney 2003), Dec in 2014 in SE SA
Cleaning technique	Rub to remove carpel, sieve to remove unwanted material (Bonney 2003)
Age of seed at sowing	< 6 months
Sowing time	Late autumn (Bonney 2003)
Recommended treatment	Cover with fine gravel, kept moist in sunny position (Bonney 2003)
Future trial suggestions	Heat, cold, or smoke treatment
Cutting techniques	Requires 6 months growing time

3.7. *Bursaria spinosa ssp. spinosa Sweet Bursaria*

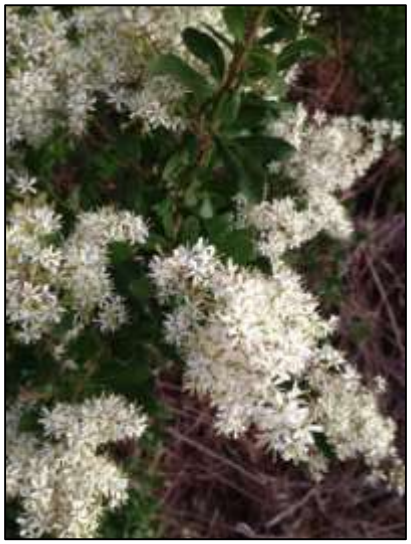


Figure 8: Sweet Bursaria in flower

Extensive research has taken place into the germination triggers of *Bursaria spinosa* (Figure 8). It is now known that germination requires cold temperatures, and this slow-growing species is best sown in winter and allowed to grow for one full year before planting out.

Bird and Aldridge (1994) and Bird (2004) conducted extensive research into the germination of *Bursaria spinosa* ssp. *spinosa* in the 1990s and early 2000s. It was found that seed sown in April and May will germinate in June and July, but seed sown later in the year (September) will not germinate that year. Furthermore, seed in damp storage in at 2-4^{0}C for one month and then sown in May germinated sooner than those stored at room-temperature (Bird 2004). Although the ultimate percentage of germinants was the same in each treatment, this finding has implications for nursery production (ensuring seedlings are of plantable size in the winter planting season).

In a nursery setting, *Bursaria spinosa* ssp. *spinosa* was found to only germinate following the first heavy frost, usually in June or July (Bird 2004). It was found that placing the seed in the freezer for one night was enough to simulate the frost required to trigger germination, and resulted in 30% germination.

Additionally, cold storage (2^{0}C to 5^{0}C) was found to prolong seed storage life at a higher viability percentage (up to at least two years) compared to room temperature storage (Bird & Aldridge 1994). Germination could not be achieved in spring, summer or early autumn following spring or summer sowing (Bird 2004).

The SASCC (2015) have reported on the results of two *Bursaria spinosa* ssp. *spinosa* germination trials. The first, which took place in 2005 resulted in 60% germination, with the first seedlings appearing within 23 days, and the majority within 41. The seeds in this trial were not pre-treated in any way. The second trial took place in 2007, and resulted in 48% germination after seeds were stored at -18^{0}C for one year. Seeds in this trial germinated after 35 days. In both trials seeds experienced a temperature pattern in the laboratory of 12 hours at 10^{0}C and 12 hours at 22^{0}C.

Figure 9: Sweet Bursaria seedlings

Ralph (2009) notes that *Bursaria spinosa* should be grown using fresh seed sown in winter after cold treatment at 2-4^{0}C for three to four weeks. Seed will normally germinate within six weeks, although results can be unreliable. As this species is sensitive to repotting, it should be planted directly into tubes. It is slow growing and prone to damping off.

Anecdotally, it has been observed that seed viability seems to decrease as the season goes on (R. Scheel, pers. comm. March 2015). Fresh seed should be harvested in February to April, and three

weeks stratification is generally sufficient to simulate winter, with the seed then sown in late autumn (N. Bonney pers. comm. March 2015).

Provenance Laslett Heritage Agreement, Mount Schank, South Australia
Material Seed

This trial involved two stratification treatments, one at 5^{0}C and the other at 0^{0}C, both for a little over nine months. Stratification at 5^{0}C produced approximately twice as many seedlings, although overall numbers in this trial were small (nine and five seedlings, respectively) (Figure 9). Seedlings emerged within two to four weeks.

The length of time for which these seeds were in cold storage was not ideal and the seed was of unknown age when sown. Both of these factors may have influenced germination.

Provenance Portland Seedbank, Victoria
Material Seed

This trial involved two stratification treatments, as above, however neither temperature treatment produced germinants. The failure of this seed may have been due to its age, which was unknown.

Provenance Warrnambool Botanical Garden, Victoria
Material Seed

Cold stratification at 5^{0}C for an unknown period of time produced 30% success rate, the same as after one day in the freezer in Bird's experiment (Bird 2004). Seeds were sown in August directly into forestry tubes (two per tube) to avoid the need to prick out later, as this species prefers minimal disturbance. Germination began within six weeks, and finished two months later.

Provenance Tantanoola township, South Australia
Material Seed

Seed was collected mid-season in late-March 2014, and was then given a two week stratification treatment at 5^{0}C. Germination was good with an assumed 29% emerging.

A summary of treatment results is outlined in Table 16.

Table 16: Treatment results for Bursaria spinosa ssp spinosa

	Laslett 1	Laslett 2	Portland 1	Portland 2	Warrnam-bool	Tantanoola
Date collected	Unknown	Unknown	Unknown	Unknown	Unknown	25/3/2014
Viability (%)	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested
Number of seeds sown	Unknown	Unknown	Unknown	Unknown	100	Assumed 200
Date Sown	12/8/2014	12/8/2014	12/8/2014	12/8/2014	7/8/2014	16/4/2014
Medium	Native mix	Native mix	Native mix	Native mix	Native mix	Native mix
Treatment	Stratifica-tion at 0^{0}C, 7.5 months	Stratifica-tion at 5^{0}C, 7.5 months	Stratifica-tion at 0^{0}C, 7.5 months	Stratifica-tion at 5^{0}C, 7.5 months	Stratifica-tion at 5^{0}C, unknown period	Stratifica-tion at 5^{0}C, 2 weeks

	Laslett 1	Laslett 2	Portland 1	Portland 2	Warrnam-bool	Tantanoola
First emergence	22/10/2014	10/10/2014	NA	NA	23/9/2014 (6 weeks)	Not recorded
Maximum emergence	22/10/2014	10/10/2014	NA	NA	11/11/2014	23/9/2014
Final number	5	9	0	0	30 (30%)	58 (assumed 29%)

Recommendations

The total number of seeds sown from provenances Portland Seedbank (zero germinants) and Laslett Heritage Agreement (14 germinants total) were not recorded so it is not possible to determine overall germination percentage and compare trials accurately. Seed from these provenances was subjected to cold storage for more than seven months, and the Warrnambool seed was cold stored for an unknown period of time presumed to be the same.

Bird (2004) found that seed viability did not decrease in up to a year of cold storage, and therefore the differences in germination between provenances may be due to inherent differences in seed viability at each site.

Interestingly, these trials were able to produce germinants in spring, while Bird (2004) was unsuccessful. It is possible that this was a result of temperature difference between the two locations, however average spring temperatures in Mount Gambier, South Australia and Hamilton, Victoria are nearly identical (between 0.1 and 0.5^{0}C difference in September to November).

Germination rates in the trials where the number of seed sown is known or assumed (Warrnambool and Tantanoola provenances) were roughly the same at about one-third, which was identical to Bird's results (Bird 2004).

These trials suggest that cold storage at 5^{0}C is more successful than cold storage at 0^{0}C, supporting existing literature. Recommendations for this species are outlined in Table 17.

Table 17: Treatment recommendations for Bursaria spinosa ssp spinosa

***Bursaria spinosa* ssp. *spinosa* – Sweet Bursaria**	
Seed collection time	Late Jan – late May (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Fresh (Ralph 1994; Bonney 2003), or may be refrigerated for up to two years with no loss of viability (Bird 2004)
Sowing time	Soon after harvest (i.e. ~March – May), after stratification for 2-4 weeks (Bonney 2003)
Recommended treatment	Sow in desired pots to avoid need to transplant. Cold treatment is known to stimulate germination.
Future trial suggestions	Unnecessary as germination trigger known
Cutting techniques	Semi-hardwood, current seasons growth (ANH 2014)

3.8. *Calectasia intermedia Blue Tinsel Lily*

Status Vulnerable (SA)

This species may be grown from fresh seed, although little fertile seed is produced each season (Sparrow 2013). Propagation is notoriously difficult, with no known successful trials in South Australia. Recruitment is rarely seen *in situ,* other than post-fire (C. Dickson, pers. comm. May 2015).

Provenance Calectasia Conservation Park, South Australia
Material Seed

As expected, seed viability was found to be low (20%) when testing was carried out. Flowers were poked into the growing medium, imitating the way they were seen to land naturally in situ, and watered in with smoke-water. One germinant was transplanted into a six inch pot to grow on, but was later be confirmed not to be the target species. No *C. intermedia* germination has occurred to date.

Seed was sown in December, although the recommended time is autumn (Ralph 2009) which may explain the lack of germination.

Provenance Calectasia Conservation Park, South Australia
Material Cuttings

Cutting material was collected in September 2014 and planted directly into forestry tubes. At two weeks one-quarter of the cuttings were given a smoke-water treatment (two squirts of smoke-water diluted at 1:10), which initially appeared to give those cuttings a boost, but at two months no noticeable difference was discernible between trays.

After four months, about one-third of cuttings showed signs of root development, however growth was very slow. The trial is ongoing and these plants may take another year or more to develop to plantable size.

Provenance Calectasia Conservation Park, South Australia
Material Cuttings

A second batch of cutting material was collected in late November 2014, and planted in plugs to compare whether this medium would be more or less successful for this species. To date, around half of the original cuttings retain some green leaves, while the other half appear to have perished. At this stage it appears a better success rate has been experienced in plugs, although cuttings planted in native mix also retained green leaves for some time before declining.

This species does not appear to grow well from cuttings and it is uncertain how long it will take these cuttings to reach a plantable size as no new growth has occurred (Table 18).

Table 18: Treatment results for Calectasia intermedia

	Seed Treatment	Cutting treatment 1	Cutting treatment 2
Date collected	28/11/2014	7/9/2014	26/11/2014
Viability (%)	20%	NA	NA
Number of seeds/cuttings	50	200	46
Date sown/planted	1/12/2014	9/9/2014	28/11/2014
Medium	2 parts grey loam, 1 part native mix	Native mix	Plugs
Treatment	Watered in with smoke-water	Hormone gel	Hormone gel
Time of first emergence	-	NA	NA
Maximum survivorship	0	21/11/2014	Not recorded
Number to be planted out	0	5 (2.5%)	23 (50%)

Recommendations

This species requires a two-year growing period in the nursery before planting out. Sowing in autumn may increase germination. Recommendations for this species are outlined in Table 19.

Table 19: Treatment recommendations for Calectasia intermedia

***Calectasia intermedia* – Blue Tinsel Lilly**	
Seed collection time	Summer
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	< 6 months
Sowing time	Autumn (Ralph 2009)
NGT recommended treatment	Ralph (2009) recommends sowing *Calectasia* spp. in autumn
Future trial suggestions	Sow in autumn
Cutting techniques	Possible from cuttings, but slow in this trial

3.9. *Callitris rhomboidea* Cypress Pine

Ralph (2009) states that *Callitris* spp. should subjected to cold treatment for two to four weeks, and that smoke-water also improves germination. Seed should be used within one year, or within two if placed in cold storage in an airtight container (Ralph 2009). *Callitris rhomboidea* seed can be collected any time of year (Ralph 1994).

Provenance Eaglehawk Waterhole Restoration Reserve, South Australia
Material Seed

Seed was collected mid-July and dried for three weeks until seedpods opened; it was sown six weeks after collection. Seed viability was tested and found to be very low (5%).

Treatment with just smoke-water produced the best result, with germination occurring earlier (three weeks), and more seedlings produced (33% germination) than in the stratification with smoke-water treatment. The germination result is higher than expected given the seed viability testing results (Table 20).

Table 20: Treatment results for Callitris rhomboidea

	Seed treatment 1	Seed treatment 2
Date collected	19/7/2014	19/7/2014
Viability (%)	5	5
Number of seeds sown	21	21
Date Sown	16/9/2014	2/9/2014
Medium	Native mix	Native mix
Treatment	Stratification at 2-4^{0}C for 2 weeks, watered in with smoke-water	Watered in with smoke-water
First emergence	21/11/2014 (9 weeks)	23/9/2014 (3 weeks)
Maximum germination	21/11/2014	12/10/2014
Final number	1 (0.5%)	7 (33%)

Recommendations

The current literature recommends stratification to prompt germination (for example Bonney 2003, Ralph 2009), however in this trial stratification appeared to negatively affect both the rate of emergence and final number of germinants. This trial should be repeated to ascertain whether this result is reliable (Table 21).

Table 21: Treatment recommendations for Callitris rhomboidea

***Callitris rhomboidea* - Cypress Pine**	
Seed collection time	Year round. Cones are grey-brown when mature, in the second year after formation (Ralph 2009; Bonney 2003)
Cleaning technique	Allow cones to dry and open, and then sieve to clean (Bonney 2003)
Age of seed at sowing	Fresh (Bonney 2003)
Sowing time	Mid-winter to early spring (Ralph 2009)
NGT recommended treatment	Smoke-water treatment with no temperature stratification
Future trial suggestions	Replicate this trial comparing smoke-water with stratification.
Cutting techniques	Unknown

3.10. *Cassinia rugata Wrinkled Cassinia*

Status Vulnerable (Aust., Vic.)

The management of *Cassinia rugata* is governed by a National Recovery Plan, an objective of which is to identify key biological functions, including seed germination and vegetative reproduction requirements (Carter & Walsh 2006).

Ralph (2009) states that most *Cassinia* spp. have good seed viability, and high rates of seed set, with some species requiring after-ripening. It is recommended to sow seed fresh as the length of time seed remains viable varies greatly between species (Ralph 2009). Germination may be stimulated by red light (Ralph 2009), or fire (Sparrow 2013).

The National Recovery Plan states that while no natural recruitment has been observed in the field, seed produced is viable and has been germinated at Melbourne's Royal Botanic Gardens (Carter and Walsh 2006). No studies have investigated the ecology or biology of *Cassinia rugata*, and germination cues are unknown (Carter and Walsh 2006).

Provenance Cobboboonee National Park, Victoria
Material Cuttings

Cutting material was collected from the Portland Native Plant Display Garden (original provenance Seawinds Nursery) for use in display gardens in October 2014 and planted into plugs and then placed in the glasshouse. Vigorous root systems developed within one month, and plants were then transplanted to forestry tubes. The cuttings continued to grow well and by late January had outgrown the forestry tubes, and were repotted into super tubes. At this time the plants were also trimmed back to encourage a bushier habit.

This species appears to be highly susceptible to lack of water, and is the first to droop in the nursery if the irrigation system fails.

Cassinia rugata also appears to be prone to insect attack with both white fly and lime green caterpillars affecting these plants, which were treated with Eco Oil on three occasions. A summary of treatment results is outlined in Table 22.

Table 22: Treatment results for Cassinia rugata

	Cutting Treatment
Date collected	2/10/2014
Viability (%)	NA
Cuttings planted	24
Date planted	3/10/2014
Medium	Plugs
Treatment	Hormone gel
First emergence (weeks)	NA
Maximum survivorship	21/10/2014
Final number	23 (96%)

Recommendations

An additional trial is also underway on *Cassinia longifolia,* which has displayed the same vigour as *C. rugata*, to determine the ideal planting time for these species. It is hoped that planting cuttings later in summer (January) will produce plants of acceptable size for winter planting, while avoiding the pests present in December and the need to pot up to larger tubes. Recommendations for this species are outlined in Table 23.

Table 23: Treatment recommendations for Cassinia rugata

***Cassinia rugata* – Wrinkled Cassinia**	
Seed collection time	May – June
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Fresh
Sowing time	Summer/autumn
Recommended treatment	Cuttings were successful in this trial. Future trials will utilise seed.
Future trial suggestions	Germination of *Cassinia* spp. is enhanced by red light (provided by very light cover of medium; Ralph 2009) Germination cues of this species remain unknown, but may be related to fire events increasing light to the soil surface (Carter and Walsh 2006)
Cutting techniques	Collect material in spring and treat with hormone gel

3.11. *Daviesia ulicifolia* Gorse Bitter-pea

As is the case with many genera of the *Fabaceae* family, *Daviesia* spp. have a hard seed coast and usually require heat treatment to germinate (Ralph 2009; Bonney 2003). To soften the seedcoat the seed should be immersed in hot water for 30 seconds, and then placed in cold water where it can soak for an additional few hours (Bonney 2003). Seed may germinate without this treatment, but the process will take longer (Bonney 2003). Scarification can also be used, but will result in damage to some seed (Bonney 2003).

A study on the effects of smoke and heat treatments of topsoil found that *Daviesia ulicifolia* was significantly stimulated by heat treatment alone without smoke treatment (Read et al. 2000).

Provenance Laslett Heritage Agreement, Mount Schank, South Australia
Material Seed

Seed was collected in 2013 and sown in December of that year. Pre-treatment of hot water and soaking for 24 hours resulted in 176 seedlings one year later (Table 24).

Table 24: Treatment results for Daviesia ulicifolia

	Seed Treatment
Date collected	2013
Viability (%)	Not tested
Number of seeds sown	Not recorded
Date sown	24/12/2013
Medium	Native mix
Treatment	Hot water, soak 24 hours
First emergence	Not recorded
Maximum survivorship	23/9/2014
Final number	176

Recommendations

Hot water treatment was found to successfully stimulate germination of this species. Recommendations for this species are outlined in Table 25.

Table 25: Treatment recommendations for Daviesia ulicifolia

***Daviesia ulicifolia* – Gorse Bitter-pea**	
Seed collection time	Dec – Jan (Bonney 2003); Nov – Jan (Ralph 1994)
Cleaning technique	Seedpods will pop open as they dry; sieve to remove unwanted material
Age of seed at sowing	< 1 year in this trial
Sowing time	Late winter – spring (Bonney 2013)
Recommended treatment	Immerse in near boiling water, then soak in cold water several hours (this trial, Bonney 2003, Ralph 2009)
Future trial suggestions	Not required
Cutting techniques	Possible by cutting, but slow and may not produce vigorous root systems (ANSPA 2010)

3.12. *Dianella callicarpa* Swamp Flax-lily

Status Endangered (SA), Rare (Vic.)

A number of seed treatments are suggested for *Dianella* spp. by Ralph (2009), including smoke treatment, gibberellic acid, nicking, peeling, and soaking in soapy water. Sparrow (2013) states that this species may be grown by fresh seed, or by division.

Provenance Maam Water Reserve, Allansford, Victoria.
Material Seed

Seed was collected in early 2014 from an individual garden plant, which itself was propagated from a rhizome collected at Maam Water Reserve in 2013. No extra treatment was given to the seed, and as the same seedlot and treatment were used for both trials it can be assumed that seed viability and germination percentage were the same in each case.

Provenance Maam Water Reserve, Allansford, Victoria.
Material Seed

Seed approximately six months of age was found to have 40% viability, and was subsequently sown in July 2014. The seed received no special treatment and was sown in native mix and placed in the glasshouse. The germination percentage of 29% indicates a high proportion of filled (assumed viable) seeds germinated (Table 26).

Table 26: Treatment results for Dianella callicarpa

	Seed treatment 1	Seed treatment 2
Date collected	Early 2014	Early 2014
Viability (%)	Not tested	40
Number of seeds sown	Not recorded	85
Date sown	23/4/2014	25/7/2014
Medium	Native mix	Native mix
Treatment	No extra treatment	No extra treatment
First emergence	Not recorded	Not recorded
Maximum survivorship	56	25
Final number	56	25 (29%)

Recommendations

This species grows well from fresh seed with no extra treatment required (Table 27).

Table 27: Treatment recommendations for Dianella callicarpa

***Dianella callicarpa* – Swamp Flax-lily**	
Seed collection time	Summer
Cleaning technique	Soak to remove fruit
Age of seed at sowing	Fresh (Sparrow 2013)
Sowing time	Late summer – early spring (Ralph 2009)
Recommended treatment	No treatment necessary
Future trial suggestions	Not required
Cutting techniques	By division in autumn to early winter (Ralph 2009)

3.13. *Einadia nutans* Climbing Salt-bush

This species may be grown by seed (Ralph 2009), or cuttings (Sparrow 2013). Fresh seed should be used, and germination occurs with weeks (Ralph 2009).

Provenance Frances Common, Victoria
Material Seed

The seed was sown within six months of collection, with fleshy pericarp still intact. A summary of treatment results is outlined in Table 28.

Table 28: Treatment results for Einadia nutans

	Seed treatment
Date collected	26/11/2012
Viability (%)	Not tested
Number of seeds sown	Not recorded
Date sown	May 2013
Medium	Native mix
Treatment	Sown with pericarp intact
First emergence	Not recorded
Maximum survivorship	Not recorded
Final number	28

Recommendations

Einadia nutans grows from seed without the fleshy pericarp being removed, however germination may be increased if pericarp removed (Table 29).

Table 29: Treatment recommendations for Einadia nutans

Einadia nutans **- Climbing Salt-bush**	
Seed collection time	Dec – early Jan (Ralph 1994)
Cleaning technique	Soak to remove flesh
Age of seed at sowing	Fresh
Sowing time	Late autumn – early winter (Ralph 2009)
Recommended treatment	Sow fresh, directly in desired tubes (Ralph 2009)
Future trial suggestions	Compare cleaned seed with pericarp intact
Cutting techniques	May be grown by cutting (Sparrow 2013)

3.14. *Gahnia filum* Chaffy Saw-sedge

Although some *Gahnia* spp. are known to be difficult to propagate and require lengthy after-ripening *G. filum* germinates readily from seed (Ralph 2009).

Provenance Bool Lagoon Game Reserve, South Australia
Material Seed

A seed viability assessment indicated that the collected seed was filled and presumed viable. Seed was collected in mid-April and sown two days after collection. Two treatments were carried out in this trial comparing smoke-water treatment with no treatment.

After more than one year just one germinant had been produced and the trial was discontinued(Table 30).

Table 30: Treatment results for Gahnia filum

	Seed treatment 1	Seed treatment 2
Date collected	15/4/2014	15/4/2014
Viability (%)	Healthy and filled	Healthy and filled
Number of seeds sown	Not recorded	Not recorded
Date sown	17/4/2014	17/4/2014
Medium	Native mix	Native mix
Treatment	24 hour smoke-water soak	No treatment
First emergence	NA	Not recorded
Maximum survivorship	NA	Not recorded
Final number	0	1

Recommendations

The seed collecting period for this species has been recorded as January to February, with ripe seed dropping within two weeks. It is possible that the seed used in this trial had a lower viability than expected as it was collected late; that is, although seed appeared to be filled it may not have been viable. The trial could be repeated with seed collected at peak season (Table 31). Ralph (2009) states that this species grows readily from seed.

Table 31: Treatment recommendations for Gahnia filum

Gahnia filum **- Chaffy Saw-sedge**	
Seed collection time	Jan to Feb (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Fresh
Sowing time	Soon after collecting
Recommended treatment	Collect seed at peak time; no treatment required
Future trial suggestions	Collect at peak season
Cutting techniques	By division

3.15. *Gahnia radula* Thatch Saw-sedge

Status Rare (SA)

Gahnia radula seed collection should take place in January (Ralph 1994), however low or no fruit production is a wide-spread problem and even fruits which appear filled when collected may not be viable (Kodym & Delpratt 2010). *Gahnia radula* is difficult to grow by seed (Ralph 2009) and transplantation is a suggested alternative method (Sparrow 2013). However, reproduction by conventional vegetative methods (cuttings/division) is slow (Kodym & Delpratt 2010).

The species has been successfully germinated in vitro and established in restoration projects (Kodym et al. 2014). Germination was greatly increased through the use of smoke-water soaking. The seedlings grown in vitro were then used as material for tissue culture propagation to create clones, a process known as micropropagation. Seedlings were transferred from the propagation medium to potting mix, and grew for five to six months before being planted in the field where survival rates were high (Kodym et al. 2014).

Figure 10. Stocking bagging of SA G. radula p*opulations Nov 2013. (K. Baker)*

Bags were placed over the inflorescences of several *Gahnia radula* individuals in the South East of South Australia and Mount Clay in south-west Victoria in December 2013 (Figure 10). Multiple seed collections were made in mid- to late December 2013. The collections were sent to Dr. Andrea Kodym of the University of Melbourne for cleaning and viability assessments and it was found that only the Victorian population had full and potentially viable seed. Given the low number and source, seed was returned to the Community Nursery for this trial. To date no South Australian *G. radula* seed collections have included viable seed (A. Kodym, pers. comm. June 2014).

Provenance Mount Clay State Forest, Victoria
Material Seed

The 30 filled seeds were returned from the University of Melbourne in June 2014. No additional seed viability testing was carried out due to the small amount of material available. Seed was divided equally between all three treatments which compared the effect of smoke-water, dry heat, different substrates and bog method watering.

As of June 2015 no germination had been observed (Table 32).

Table 32: Treatment results for Gahnia radula

	Seed treatment 1	Seed treatment 2	Seed treatment 3
Date collected	Dec 2013	Dec 2013	Dec 2013
Viability (%)	Filled; presumed viable	Filled; presumed viable	Filled; presumed viable
Number of seeds sown	10	10	10
Date sown	16/9/2014	16/9/2014	16/9/2014
Medium	Native mix	Native mix	Native mix
Treatment	Sown on smoke-water impregnated vermiculite, covered with fine sand	Dry heat (50^0C) 10 min, watered in with smoke-water	Watered in with smoke-water, bog method
First emergence	NA	NA	NA
Maximum survivorship	NA	NA	NA
Final number	0	0	0

Recommendations

Low viable seed production is known to be common with this species and filled seed drops early in the season while non-viable seed remains on the inflorescence (Kodym & Delpratt 2010). Therefore it is possible that although seed used in this trial was full it was not viable.

The small numbers involved in this trial make conclusions difficult, and it is recommended that further trials combine heat and smoke treatment if sufficient seed for viability testing is available (Table 33).

Table 33: Treatment recommendations for Gahnia radula

Gahnia radula - Chaffy Saw-sedge	
Seed collection time	Jan (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Fresh
Sowing time	Soon after collecting
Recommended treatment	No treatments successful in this trial; smoke-water found to be useful (Kodym et al. 2014)
Future trial suggestions	Collect at peak season; heat and smoke treatment
Cutting techniques	By division

3.16. *Gahnia sieberiana* Red-fruit Saw-sedge

Provenance Honan Native Forest Reserve, South Australia
Material Seed

Some Gahnia spp. grow readily from seed, while others, including *G. sieberiana* require a full year of after-ripening in dry storage (Ralph 2009). Ralph (2009) states that smoke treatment improves germination of *G. sieberiana*, and suggests that heat treatment may also promote germination particularly of older seed. Sparrow (2013) suggests that this species is easy to grow by seed; however germination in all treatments in this trial was low.

This trial is ongoing but early results indicate that this species is most successfully germinated when sown on a 15 millimetre layer of vermiculite soaked in smoke-water and then covered in native mix (14% germination to date). Other treatments trialled were immersion in hot water, immersion in hot smoke-water, soaking in cold water for one hour, and no extra treatment (Table 34).

Table 34: Treatment results for Gahnia sieberiana

	Seed treatment 1	Seed treatment 2	Seed treatment 3	Seed treatment 4	Seed treatment 5
Date collected	7/12/2012	7/12/2012	7/12/2012	7/12/2012	7/12/2012
Viability (%)	Not tested	Not tested	Not tested	Not tested	Not tested
No. of seeds sown	50	50	50	50	50
Date sown	30/9/2014	30/9/2014	30/9/2014	30/9/2014	30/9/2014
Medium	Native mix	Native mix	Native mix	Native mix	Native mix
Treatment	Hot water (55^0C), 15 min	Hot smoke-water (55^0C), 15 min	Cold water soak, 1 hour	No additional treatment	Sown on smoke-water impregnated vermiculite, covered with native mix
First emergence	4/4/2015 (27 weeks)	15/1/2015 (15 weeks)	15/1/2015 (15 weeks)	4/4/2015 (27 weeks)	15/1/2015 (15 weeks)
Maximum survivorship	4/4/2015	4/4/2015	4/4/2015	4/4/2015	4/4/2015
Final number	1 (2%)	4 (8%)	2 (4%)	2 (4%)	7 (14%)

Recommendations

Further trials could investigate the potential of a combination of dry heat and smoke treatments (Table 35).

Table 35: Treatment recommendations for Gahnia sieberiana

Seed collection time	Oct – Mar (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	12 months (Ralph 2009, Sparrow 2013)
Sowing time	After storage for 12 months
Recommended treatment	Smoke treatment recommended by Ralph (2009), and most successful in this trial
Future trial suggestions	Repeat smoke treatment, and trial dry heat
Cutting techniques	By division

3.17. *Grevillea aquifolium* Holly Grevillea - prostrate coastal form

Status Rare (SA); Endangered (Vic.)

Propagation of *Grevillea aquifolium* is usually by cutting (Sparrow 2013) (Figure 11). The growth habit of this species is variable and this trial was conducted with material from the prostrate form which grows in limited range along the Lower South East coast in South Australia, and around Portland in Victoria.

Figure 11: Holly Grevillea

Many *Grevillea* spp. have high seed viability but low or staggered germination over a long period of time (Ralph 2009). Germination of *Grevillea* spp. is increased particularly when smoke-water treatment is combined with other treatment such as nicking, removing the seed coat, or hot water soaking (Ralph 2009). Local experts and growers have identified that is it difficult to obtain consistent results when propagating this species by seed (Peter Feast, pers. comm. Feb 2015; Neville Bonney, pers. comm. Mar 2015).

Provenance Carpenter Rocks Conservation Park, South Australia
Material Cuttings

A large number (110) of cuttings were collected in August 2014, and were placed in two different planting regimens. Approximately half the cuttings were planted directly into forestry tubes (Treatment 1), while the other half were planted into peat plugs (Treatment 2).

Seed was collected in November 2014 for use in future trials.

A summary of treatment results is outlined in Table 36.

Table 36: Treatment results for Grevillea aquifolium

	Cutting treatment 1	Cutting treatment 2
Date collected	15/8/2014	15/8/2014
Viability (%)	NA	NA
Number of seeds sown	50	60
Date sown	18/8/2014	18/8/2014
Medium	Native mix	Plugs
Treatment	Hormone gel	Hormone gel
Maximum survivorship	23/9/2014	23/9/2014
Final number	4 (8%)	54 (90%)

Recommendations

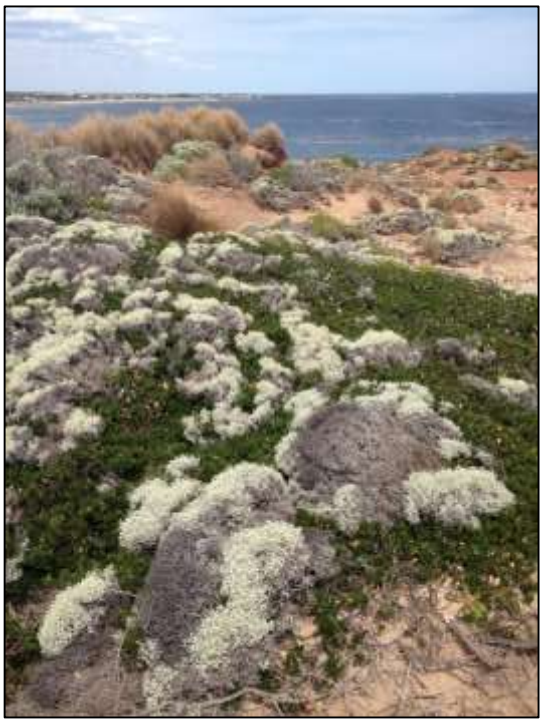
This trial found that the coastal prostrate form of *Grevillea aquifolium* was much more successful by cutting in peat plugs than in native mix, presumably because the drainage properties of this medium more closely match the sandy soil it is found growing in naturally. Therefore, peat plugs are recommended for cuttings of this form of the species. Further trials would be necessary to determine the suitability of this method for other forms. Recommendations for this species are outlined in Table 37.

Table 37: Treatment recommendations for Grevillea aquifolium

***Grevillea aquifolium* – Holly Grevillea, prostrate coastal form**	
Seed collection time	Dec – Apr (Bonney 2003)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Fresh
Sowing time	Late winter - spring
Recommended treatment	No pre-treatment necessary, but stratification may be useful (Bonney 2003)
Future trial suggestions	Undertake seed trials and compare no treatment with stratification
Cutting techniques	Plugs more successful than native mix in this trial

3.18. *Ixodia achillaeoides* ssp. *arenicola* Sand Ixodia

Status Vulnerable (Aust., Vic.); Endangered (SA)



Although smoke is known to stimulate germination of *Ixodia achillaeoides* ssp. *alata*, its role in the lifecycle of *Ixodia achillaeoides* ssp. *arenicola* is less certain (Carter 2010). It is thought that soil moisture and soil temperature cues, as well as wind scarification of seed may play important roles in the germination of *Ixodia achillaeoides spp. arenicola* (Carter 2010) (Figure 12 & **Figure 13**).

Sparrow (2013) states that this sub-species requires dry heat treatment (100^0C) for 30 minutes, or smoke treatment to germinate. Ralph (2009) states that I*xodia achillaeoides* (in general, no specified sub-species) has a six to nine month after-ripening period, after which germination is increased with smoke-water treatment.

Ixodia achillaeoides ssp. *arenicola* is easily grown from cuttings at any time of year (Sparrow 2013).

Figure 12: Sand Ixodia growing with Cushion Bush

Provenance Douglas Point Conservation Park (DPCP), South Australia
Material Seed

The seed used in this trial was collected opportunistically in August 2014 on an outing to collect cutting material. The ideal time for seed collection is between March and May, when seed is set and viability is at its highest. The seed came from deep within the bushes, on the leeward side protected from the strong coastal winds.

The seed had been insect predated, and seed viability was found to be very low (5%) which is likely to be highly influenced by the time of collection, six months after the seed had set. The required after-ripening period occurred while the seed was still on the bush, so the seed was dried for just one week before sowing.

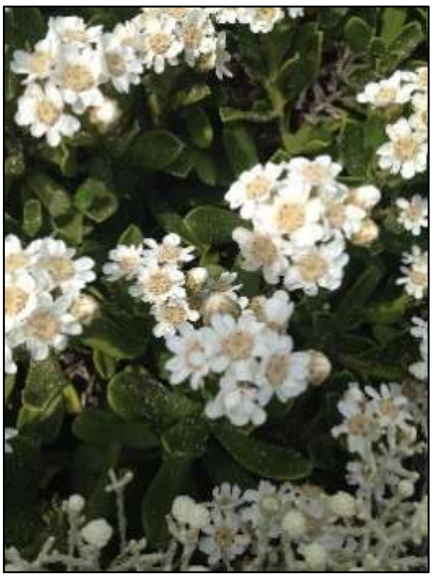


Figure 13: Sand Ixodia

Because of the low viability, seed was sown very thickly. It was then lightly covered with sieved propagation media and watered in with smoke-water. Germination began within one week and continued for two months resulting in 174 plants in November 2014 (from several thousand seeds).

Those plants which were pricked out into forestry tubes became tall and spindly, while those transplanted into 4" square pots became rounded, clumping, and nicely formed; this species thrives with a little extra space. The plants needed to be transplanted into larger pots in March 2014 (forestry tube plants into super tubes, 4" square pot plants into 140 millimetre round pots) in order to avoid being pot bound for winter planting.

Provenance Douglas Point Conservation Park (DPCP), South Australia
Material Cuttings

Cutting material was collected in August 2014, and 120 tip cuttings were planted into plugs and then placed in the glasshouse. The cuttings grew quickly, and within four weeks root systems were visible outside the plugs, indicating the cuttings' readiness for transplanting. As this species grows naturally on the coast, one part sand was added to two parts native mix to more closely match the natural substrate.

Seeds sown in the same month as the initial cuttings have produced seedlings the same size as those from cuttings, indicating no benefit in terms of timing to growing cuttings over using seed if available.

After seven months seedlings were becoming potbound, and were transplanted into 140 millimetre pots in March, 2015 to avoid the loss of these plants. This species benefits from larger pots, rather than tubes, and forms a more natural growth habit.

Further cuttings from this stock were taken in January 2015 to test whether later plantings would allow enough growing time before winter planting. It was determined that six months is adequate time to allow seedlings to grow to a plantable size.

Provenance Cape Bridgewater (CB), Discovery Bay Coastal Park, Victoria
Material Cuttings

Cutting material was collected in October, 2014 and 84 tip cuttings were planted into plugs then placed in the glasshouse. At 6.5 weeks only eight showed good root development and were transplanted into forestry tubes.

This timing produced plants of a more useful size for winter planting, however, overall material from this provenance did not perform as well as material from Cape Douglas Conservation Park. This may

have been due to the Cape Bridgewater population being less vigorous than South Australian, or heat in the early summer may have negatively affected the cuttings before they were able to establish.

This species was susceptible to white fly and was sprayed twice with Eco oil.

A summary of treatment results is outlined in Table 38.

Table 38: Treatment results for Ixodia achillaeoides *ssp*. arenicola

	Seed treatment	DPCP cuttings	CB cuttings
Date collected	15/8/2014	15/8/2014	3/10/2014
Viability (%)	5	NA	NA
Number of seeds/cuttings	~3500 (estimated from viability testing and final number)	120	84
Date sown	27/8/2014	16/8/2014	4/10/2014
Medium	Native mix	Plugs	Plugs
Treatment	Watered in with smoke-water	Hormone gel	Hormone gel
First emergence	4/9/2014 (1 week)	NA	NA
Maximum survivorship	3/11/2014	10/10/2014	21/11/2014
Final number	174	96 (80%)	8 (9.5%)

Recommendations

As a result of these trials it is recommended to sow seed in January to have plants ready to plant out in winter. This timing will allow seedlings to grow to sufficient size, while avoiding unnecessary transplanting and weeding labour. A white fly problem which occurred in November would have also been avoided with this timing. Recommendations for this species are outlined in Table 39.

Table 39: Treatment recommendations for Ixodia achillaeoides *ssp*. arenicola

***Ixodia achillaeoides ssp. arenicola* – Sand Ixodia**	
Seed collection time	Mar – May (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	< 2 years (Ralph 1994)
Sowing time	6-9 months after collection (Ralph 2009)
Recommended treatment	Stratification for 6-9 months at 4^0C then sown on smoke impregnated vermiculite is the treatment recommended by Ralph (2009)
Future trial suggestions	Compare watering in with smoke-water and method suggested by Ralph (2009)
Cutting techniques	Cuttings in plugs may be successful, but depends on population

3.19. *Kunzea pomifera* Muntries

Emu Scat Case Study 2

Figure 14: Muntries in fruit

There has been extensive research into how digestion by vertebrates, in particular birds, aids germination of certain plant species. A study on the effect of digestion by emus of the Nitre Bush (*Nitraria billardieri*) berries found that germination was increased from just 6% to 62% comparing hand-picked to emu-ingested seed, as a result of the removal of the saline fleshy fruit (pericarp) (Noble & Whalley 1978). The digestive process can break physical dormancy, either by through chemical reaction or by scarification (Ralph 2009).

An additional factor to consider, is that animals feed on fruit at peak ripeness, which ensures both high quality of seed collected, and generally single-species dominated scats. Therefore, scat harvesting can be seen as a time and resource efficient way to target and collect large amounts of seed from species which are known to benefit from digestion.

With this background information in mind, an emu scat full of unidentified seed was collected in the Bangham district in the Upper South East on 21 July 2014. The scat was divided into four pieces and a different treatment was applied to each as shown below. The seed was not separated from the scat, but was sown either in slurry form (treatment 1), or crumbled dry and added to the growing medium (treatments 2, 3, and 4). A summary of treatment results is outlined in Table 40.

Table 40: Treatment results for Kunzea pomifera

	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Date collected	21/7/2014	21/7/2014	21/7/2014	21/7/2014
Viability (%)	Not tested	Not tested	Not tested	Not tested
Number of seeds sown	Not recorded	Not recorded	Not recorded	Not recorded
Date sown	30/7/2014	30/7/2014	1/9/2014	30/7/2014
Medium	Native mix	Native mix	Native mix	Native mix
Treatment	Emu ingestion. Soaked in warm water for one hour. Slurry spread over media.	Emu ingestion. Crumbled onto soil, lightly covered with sieved media, watered in with smoke-water	Emu ingestion. Stratification at 5^0C for three weeks. Crumbled and mixed into native mix.	Emu ingestion. Control – no additional treatment. Crumbled and mixed into native mix.
First emergence (weeks)	1/9/2014	1/9/2014	23/9/2014	Not recorded
Maximum survivorship	Not recorded	Not recorded	Not recorded	Not recorded

	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Final number	~19160	~15660	Not measured	~13810
Average height (mm)	69.8	94.0	Not measured	Not measured

All four treatments resulted in prolific germination, with overcrowding becoming an issue as the seedlings grew (Figure 15 & 16). Fifty seedlings were pricked out in spring to speed their growth and subsequent identification. It was eventually determined that this hungry emu had been feeding almost exclusively on Muntries (*Kunzea pomifera*), with only three other seedlings (all exotic grasses) emerging within the four seedling trays. Another common name of this species is Emu Apple – it is easy to see why!

Figure 15: Thousands of Muntries seedlings emerged from the emu scat

Although seedlings numbers were higher in Treatment 1 (warm water), Treatment 2 (smoke-water) prompted earlier germination and resulted in more vigorous seedlings. It is possible that the higher number of germinants in Treatment 1 had a negative effect on their growth, although given that both treatments produced such a high number of seedlings it is hard to gauge the extent of this effect.

Seedling numbers were calculated in February 2015 after approximately seven months of growth. Four square centimetres of media were cut out of each remaining seedling tray, and the seedlings within this media counted (including dead seedlings). An average number of seedlings per centimetre square was used to calculate the total number of seedlings in each tray by multiplying this number by the area of the seedling tray. A conservative estimate of total seedlings produced from this one individual emu scat is 60, 000.

Average heights were calculated in March 2015 by measuring the heights of ten seedlings per tray, adding these figures, and dividing by ten.

The SASCC (2015) carried out germination trials on *Kunzea pomifera* in 2005 and 2007 with more than 70% success in each. In one trial no pre-treatment was undertaken and germination began at 47 days. In the second trial, seed had been stored at -18^{0}C for one year and germination was slower, beginning at 63 days. In each case propagation media experienced 20 hours per day at 15^{0}C, and four hours at 5^{0}C (SASCC 2015).

Other research found that the species germinates within three weeks at 20-25^{0}C, and that semi-ripe wood cuttings may be taken at any time of year (Lethbridge 1997 in Ahmed & Johnson 2000).

Figure 16: Pricking out Muntries

Muntries is a species that is generally propagated vegetatively, as a result of the difficulty of harvesting seed compared to ease of striking cuttings.

Recommendations

Although high success rates have been seen in laboratory trials, this species has proven difficult to propagate in a nursery setting and therefore the species is usually grown from cuttings (P. Feast, pers. comm. 2015; R. Sheel, pers. comm. 2015). The emu scat method trialled here certainly proved to be an efficient way to collect and germinate this species.

As the Community Nursery was uncertain on the identity of the seedlings for many months, pricking out was not undertaken until summer 2014/2015; this timing was borderline sufficient for adequate root development before planting out in winter 2015. Pricking out much earlier, at the six leaf stage, is recommended as a result of this trial, that is, pricking out should occur in spring.

Fruit was collected in April 2015 to undertake further trials. Recommendations for the treatment of *Kunzea pomifera* are outlined in Table 41.

Table 41: Treatment recommendations for Kunzea pomifera

***Kunzea pomifera* - Muntries**	
Seed collection time	Feb – Apr (Bonney 2003)
Cleaning technique	Dry berries then snip or allow seed to fall out (R. Sheel, pers. comm. 2015; Bonney 2003).
Age of seed at sowing	Fresh
Sowing time	Mid-winter – spring (Bonney 2003). Prick seedlings out in spring to allow for root development before June planting.
NGT recommended treatment	Collection and propagation of seed found in emu scat was highly successful in this trial. All treatments produced thousands of seeds.
Future trial suggestions	Replicate smoke water treatment, heat treatment, and no treatment comparison
Cutting techniques	By cutting is the usual method of propagation currently

3.20. *Leucopogon parviflorus* Coast Beard-heath

Seagull Scat Case Study

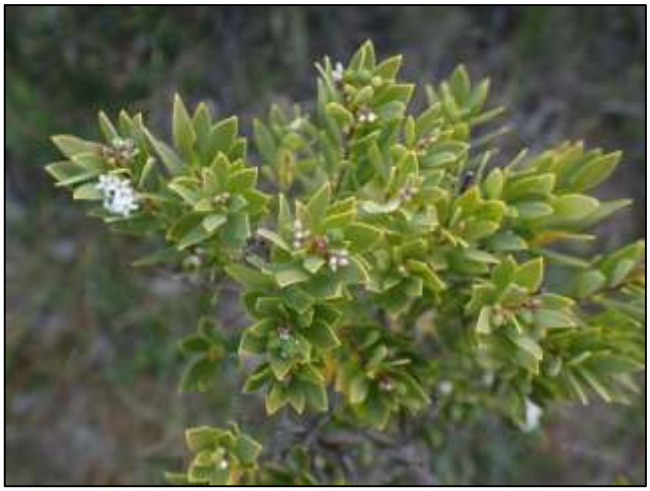


Figure 17: Coast Beard-heath

A seagull scat which appeared to be full of seed was collected at Piccaninnie Ponds Conservation Park in August 2014. The seed was determined to be *Leucopogon parviflorus* Coast Beard-heath (Figure 17), which is known to germinate at higher rates after chemical treatment or bird ingestion (Sparrow 2013). Seed of this species has morphophysiological dormancy, meaning that it has under-developed embryos as well as physical impediments to germination (SASCC 2015). Germination of *Leucopogon parviflorus* can be sped up by stratification of the seed; germination may otherwise take 3-12 months (Bonney 2003). Untreated *Leucopogon* spp. seed produces very low germination, which may be improved by smoke treatment, natural weathering, dry storage or a combination of these treatments (Ralph 2009).

A number of germination trials have been carried out by the SASCC between 2006 and 2013, with the greatest success using a combination of hydrogen peroxide, smoke-water, and gibberellic acid (SASCC 2015); the acid treatment is believed to mimic the digestion process.

Two different types of seedlings developed within two months which were then determined to be weeds. This trial determined that seagull ingestion alone was not sufficient to trigger germination, with no germinants produced (Table 42). The experiment was discontinued in October 2014 after two and a half months.

Table 42: Treatment results for Leucopogon parviflorus

	Seed treatment
Date collected	3/8/2014
Viability (%)	Not tested
Number of seeds sown	Not recorded
Date sown	8/8/2014
Medium	Native mix
Treatment	Bird ingestion
First emergence (weeks)	NA
Maximum survivorship	NA
Final number	0

Recommendations

Recommendations for this species are outlined in Table 43.

Table 43: Treatment recommendations for Leucopogon parviflorus

***Leucopogon parviflorus* - Coastal Bearded-heath**	
Seed collection time	Jan – Feb (Bonney 2003)
Cleaning technique	Dry berries and remove flesh
Age of seed at sowing	Fresh (Bonney 2003)
Sowing time	April – mid-winter (Bonney 2003)
Recommended treatment	Add soil from parent plants, allow up to 12 months to germinate or stratify. Bird ingestion alone insufficient to trigger germination
Future trial suggestions	Retain trial longer; compare stratified with unstratified ingested seed
Cutting techniques	Not grown by cutting

3.21. *Logania ovata* Oval-leaf Logania

Status Rare (Vic.)

Logania spp. are difficult to grow from seed and may take three months to germinate. Germination can be increased in some species by moistening seed in water, and by using soil from beneath parent plants (Ralph 1994; 2009).

Provenance Unknown
Material Seed

Figure 18: Oval Logania seeding

This trial began in spring 2014 with seed of unknown age or provenance. Treatments which involved immersion in either hot or cold water for one hour did not produce germinants, but moderate success was experienced with no pre-treatment. The growing medium used in this trial included river sand, added for extra drainage. A solid layer of perlite was added to hold moisture around the seeds, followed by a layer of fine (sieved) native mix on top.

The seedling tray was placed in the glasshouse and watered using the bog method so as not to disturb the seeds and distribute water evenly. Germination began nine weeks after sowing with approximately one-fifth of seed eventually germinating (Table 44).

Table 44: Treatment results for Logania ovata

	Seed treatment 1	Seed treatment 2	Seed treatment 3
Date collected	Unknown	Unknown	Unknown
Viability (%)	Not tested	Not tested	Not tested
Number of seeds sown	~50	~50	~50
Date sown	30/9/2014	30/9/2014	30/9/2014
Medium	Two parts native mix, one part river sand, topped with a layer of perlite and finally a layer of sieved native mix	Two parts native mix, one part river sand, topped with a layer of perlite and finally a layer of sieved native mix	Two parts native mix, one part river sand, topped with a layer of perlite and finally a layer of sieved native mix
Treatment	Immersion in hot water, one hour	Immersion in cold water, one hour	No additional treatment
First emergence	NA	NA	21/11/2014 (9 weeks)
Majority emergence	NA	NA	20/12/2014 (13 weeks)
Final number	0	0	10 (20%)

Recommendations

This species is quite slow growing and it is recommended to sow in spring to have ensure plants are ready for winter planting. Soaking in both hot and cold water negatively affected germination in this trial, and is therefore not recommended for this species (Table 45).

Table 45: Treatment recommendations for Logania ovata

***Logania ovata* – Oval-leaf Logania**	
Seed collection time	Jan – Mar (Bonney 2003)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Effect of age unknown
Sowing time	Autumn or spring (Bonney 2003)
Recommended treatment	Seed with no additional pre-treatment was most successful in this trial
Future trial suggestions	Replicate this trial with seed of known age and provenance
Cutting techniques	Possible by cutting

3.22. *Lotus australis* Austral Trefoil

Status Poorly known (Vic.)

Figure 19: Lotus australis

As is the case with many species in the *Fabaceae* (pea) family, *Lotus australis (*Figure 19) seed may require heat treatment to stimulate germination (Sparrow 2013). Smoke treatment and darkness have also positively impacted upon germination. However, there is a great deal of variation in treatment required by seed of different provenances, with seed from southern Victorian grassland being found to not require treatment (Ralph 2009)

Provenance Long Swamp, near Nelson, Victoria
Material Seed

Seed was collected in January 2014, and sown later that year. Three seeds were sown in each cell (total 120), and germination began in less than two weeks. Germination peaked within a month, and 65 individuals were pricked out, demonstrating more than 50% germination (Table 46).

Table 46: Treatment results for Lotus australis

	Seed treatment
Date collected	14/1/2014
Viability (%)	Not tested
Number of seeds sown	120
Date sown	5/11/2014
Medium	Native mix
Treatment	No treatment
First emergence (weeks)	15/11/2014
Majority emergence	1/12/2014
Final number	65 (54%)

Recommendations

This species is quite slow growing and it is recommended to sow in spring to have ensure plants are ready for winter planting. Recommendations for this species are outlined in Table 47.

Table 47: Treatment recommendations for Lotus australis

***Lotus australis* – Austral Trefoil**	
Seed collection time	Jan – Mar (Ralph 1993)
Cleaning technique	Allow pods to release seed; sieve to remove unwanted material
Age of seed at sowing	Fresh
Sowing time	Spring
Recommended treatment	No treatment required for seed of this provenance
Future trial suggestions	Not necessary for seed from this provenance, however, trials on seed from other provenances should aim to determine necessity of treatment
Cutting techniques	Not grown by cutting

3.23. *Melicytus dentatus* Tree Violet

Status Poorly known (Vic.)

Sparrow (2013) states that this species may be grown by seed, but is very slow to germinate. This species formerly belonged to the genus *Hymenanthera* which Ralph (2009) states may be grown by seed, but results can be unreliable. Cold treatment for three to four weeks will improve results and old seed should be soaked in a weak acid solution (Ralph 2009).

Trials by the SASCC undertaken in 2006 involving stratification and hydrogen peroxide treatment produced no germinants (SASCC 2015).

Provenance Hopkins Falls Scenic Reserve, Cudgee, Victoria
Material Seed

The seed underwent a pressure treatment using a two litre spray bottle, containing one-half litre of water pumped 200 times, followed by soaking in water for ten minutes, and finally soaking in smoke-water for ten minutes.

Provenance Boston Reserve, Naracoorte, South Australia
Material Seed

Seed from this provenance underwent stratification at 4^0C for an unknown period and was apparently sown at a rate of one per forestry tube, to a total of 50.

Seed from other provenances was also trialled, with each provenance being subjected to 0^0C and 4^0C stratification. Recorded data is unfortunately missing and incomplete, but it was recalled that 4^0C stratification produced germinants, while 0^0C appeared to damage seed and germination did not occur or was much lower (Y. Riley, pers. comm., June 2015). Provenances trialled include Boston Reserve, Portland Seedbank, and Naracoorte Range. Seed from Boston Reserve was by far the most successful with two to three times as many germinants produced (Table 48). The success of the Boston Reserve trial is thought to be due to the use of fresh seed, which has been recommended by P. Tucker (pers. comm. Jan 2015).

Table 48: Treatment result for Melicytus dentatus

	Hopkins Falls	Boston Reserve
Date collected	March 2014	Feb 2015
Viability (%)	Not tested	Not tested
Number of seeds sown	Not recorded	50
Date sown	Not recorded	Unknown
Medium	Native mix	Native mix
Treatment	Pressure pump, then soaked in smoke-water 10 min	4^0C stratification for unknown period
First emergence	NA	Unknown
Majority emergence	NA	Unknown
Final number	0	~20 (~40%)

Recommendations

Future trials may combine stratification and smoke treatment (Table 49).

Table 49: Treatment recommendations for Melicytus dentatus

Melicytus dentatus – *Tree Violet*	
Seed collection time	Jan – Apr (SASCC 2015)
Cleaning technique	Pick ripe fruit, clean by rubbing by hand in bucket of water (SASCC 2015)
Age of seed at sowing	Fresh
Sowing time	Winter or after stratification
Recommended treatment	Stratification, and stratification and acid treatment by SASCC were unsuccessful in producing germinants (SASCC 2015). Pressure and smoke-water was also unsuccessful in this trial. Stratification of fresh seed at 4^0C produced results, but germination varied greatly between seed of different provenances
Future trial suggestions	Fresh seed and stratification
Cutting techniques	Not grown by cutting

3.24. *Olearia pannosa* ssp. *pannosa* Silver Daisy-bush

Status Vulnerable (Aust., SA)

The management of *Olearia pannosa* ssp. *pannosa* is guided by a National Recovery Plan (see Obst 2005), and in the South East of South Australia by a Regional Action Plan (see Johnson 2005). A considerable risk to the survival of Silver Daisy-bush in the South East is that many populations are ageing, declining, and show no sign of natural recruitment (Johnson 2005), mirroring the nation-wide trend (Obst 2005). In addition, several populations have experienced seed predation.

According to the National Recovery Plan, certain native plant propagation and revegetation businesses have been able to successfully grow this species from both seed and cuttings, however their methods are not known (Obst 2005).

Olearia pannosa ssp. *pannosa* grows well from seed in a laboratory as there is no inbuilt dormancy (SASCC 2015). A variety of treatments were trialled in 2012 including different temperature scenarios, gibberellic acid, and potassium nitrate. The most successful treatment mimicked winter conditions with seed exposed to 5^0C for four hours per day and 15^0C for the remainder; this treatment resulted in 82% germination (SASCC 2015).

Provenance Bray, South Australia
Material Seed

Fresh seed was sown in native mix in late 2014; one seedling emerged but was identified not to be the target species. No other germination occurred (Table 50).

Provenance State Flora, Adelaide Mount Lofty Ranges, South Australia
Material Cuttings

Five cuttings were taken from two nursery stock plants (original provenance Adelaide Botanic Garden) in July 2014 for display gardens only and planted directly into forestry tubes. All cuttings survived and grew well despite the presence of aphids and white fly in October 2014 (Table 50).

Provenance State Flora, Adelaide Mount Lofty Ranges, South Australia
Material Cuttings

Forty cuttings were planted in plugs and soon showed signs of rotting. The remaining 24 cuttings were saved by transferring to forestry tubes in January 2015. By March 2015 all 24 cuttings were surviving (Table 50). This trial provided ideal timing for winter planting in display gardens.

Table 50: Treatment results for Olearia pannosa ssp pannosa

	Seed treatment	Cutting treatment 1	Cutting treatment 2
Date collected	20/11/2014	July 2014	January 2015
Viability (%)	Not tested	NA	NA
Number of seeds/cuttings	Not recorded	5	40
Date sown	4/12/2014	July 2014	January 2015
Medium	Native mix	Native mix	Plugs
Treatment	No pre-treatment	Hormone gel	Hormone gel
First emergence	15/1/2015 (6 weeks)	NA	NA

	Seed treatment	Cutting treatment 1	Cutting treatment 2
Majority emergence	0	NA	NA
Final number	0	5 (100%)	24 (60%)

Recommendations

This species grows better if planted directly into forestry tubes rather than into plugs. Recommendations for this species are outlined in Table 51.

Table 51: Treatment recommendations for Olearia pannosa ssp pannosa

***Olearia pannosa* ssp. *pannosa* – Silver Daisy-bush**	
Seed collection time	Oct – Dec (SASCC 2015)
Cleaning technique	Rub flowerheads with fingers to dislodge seeds (SASCC 2015)
Age of seed at sowing	Fresh
Sowing time	Germinates best in winter, but will also germinate at other times of year
Recommended treatment	Most successful in trials by SASCC when subjected to no pre-treatment and winter conditions (SASCC 2015)
Future trial suggestions	Known to germinate readily with winter sowing
Cutting techniques	Grows well from cuttings; better results if placed directly in native mix rather than plugs

3.25. *Pimelea glauca* Smooth Rice-flower

Pimelea spp. are very difficult to grow using untreated seed, and although some *Pimelea* spp. are stimulated by smoke treatment *P. glauca* does not respond to this (Ralph 2009). The species may be grown by cutting which are slow to take (Ralph 2009; Sparrow 2013).

Provenance Piccaninnie Ponds Conservation Park, South Australia
Material Cuttings

These cuttings were planted in December 2014, and the trial is ongoing. This trial saw some cuttings planted into plugs, and some directly into forestry tubes, in order to determine the best method for this species. At three weeks approximately one-quarter showed good root development. (Table 52)

Table 52: Treatment results Pimelea glauca

	Cutting treatment 1	Cutting treatment 2
Date collected	20/12/2014	20/12/2014
Viability (%)	NA	NA
Number planted	240	60
Date sown	20/12/2014	20/12/2014
Medium	Plugs	Native mix
Treatment	Hormone gel	Hormone gel
First emergence	NA	NA
Majority emergence	NA	NA
Final number	94 (39%)	0

Recommendations

Cuttings of this species grew much better when planted in plugs, likely because of increased drainage capacity. Recommendations for *Pimelea glauca* are outlined in Table 53.

Table 53: Treatment recommendations for Pimelea glauca

***Pimelea glauca* – Smooth Rice-flower**	
Seed collection time	Nov – Dec (Ralph 1994)
Cleaning technique	Rub over wire mesh to remove unwanted material (Ralph 1994)
Age of seed at sowing	Remains viable for long period (Ralph 2009)
Sowing time	Mar – Apr (Understory Network 2015)
Recommended treatment	Cuttings in plugs successful in this trial
Future trial suggestions	A combination of smoke and heat treatment
Cutting techniques	Slow from cuttings, but this is the usual propagation technique (Sparrow 2013). Use barely firm young growth and do not strip bark (Understorey Network 2015)

3.26. *Pomaderris halmaturina* ssp. *halmaturina* Kangaroo Island Pomaderris

Status Vulnerable (Aust., SA)

Pomaderris spp. seed normally has high viability and requires heat treatment for germination, which can be achieved by using either hot water or dry heat. Germination can be further improved with smoke-water treatment, or scarification (Ralph 2009; Ralph 1994). Dry heat treatment is specifically recommended for this species by Ralph (2009).

The SASCC have conducted three trials on this species with limited success. The most successful treatment produced 38% germination, and involved hot water (90^0C) treatment for ten minutes, followed by sterilising the seed. The trial was conducted with 14 hours of light per day, daytime temperature of 18^0C and overnight temperature of 10^0C. This species has also been successfully propagated by the Kangaroo Island Nationally Threatened Plant Project, although their methods are not known (Haby & Klein 2012).

Provenance Unknown, thought to be Carpenter Rocks Conservation Park, South Australia

Material Seed

The seed used in this trial was of unknown age and unknown provenance, stored still on its branches in a paper bag. Half of the seed was separated from its hard coating by rubbing between fingers, while the other half received heat treatment. No germination took place in either treatment (Table 54), but seed has been collected for further trials testing the effect of dry heat at different temperatures.

Table 54: Treatment results for Pomaderris halmaturina ssp. halmaturina

	Seed treatment 1	**Seed treatment 2**
Date collected	Unknown	Unknown
Viability (%)	Healthy, mostly filled	Healthy, mostly filled
Number planted	2 tablespoons including chaff	2 tablespoons including chaff
Date sown	30/9/2014	30/9/2014

	Seed treatment 1	Seed treatment 2
Medium	Two parts native mix, one part river sand	Two parts native mix, one part river sand
Treatment	Rubbed with fingers to remove most of hard coating	Dry heat
First emergence	Not recorded	Not recorded
Majority emergence	Not recorded	Not recorded
Final number	0	0

Recommendations

Possible factors influencing the lack of success include the low genetic diversity of the seed (maximum two parent plants), drainage of the growing media (may have been too sandy), and heat treatment may have been too hot. Recommendations for *Pomaderris halmaturina ssp. halmaturina* are outlined in Table 56. Seed was collected in December 2014 for further trials.

Table 56: Treatment recommendations for Pomaderris halmaturina ssp. halmaturina

***Pomaderris halmaturina* ssp. *halmaturina* - Kangaroo Island Pomaderris**	
Seed collection time	Jan – Feb (Ralph 1994; Bonney 2003)
Cleaning technique	Rub against wire mesh (Ralph 1994)
Age of seed at sowing	Unknown
Sowing time	Unknown
Recommended treatment	Further trials necessary
Future trial suggestions	Hot water treatment, dry heat (different temperatures), scarification, more genetically diverse seed, different growing media
Cutting techniques	Possible from cuttings (Ralph 2009)

3.27. *Pomaderris obcordata* Pimelea Pomaderris

Status Presumed Extinct (Vic.)

Seed of *Pomaderris* spp. usually has good viability and requires heat treatment to stimulate germination (Ralph 2009). Either dry or wet heat treatment may be used, and results may be further increased by adding smoke treatment as well (Ralph 2009).

Provenance Beachport Conservation Park, South Australia
Material Cuttings

Cutting material was collected in September 2014 and tip cuttings were directly planted into native mix in short forestry tubes, and then placed in the glasshouse. At two months the plants had produced vigorous root systems and were repotted into regular-sized forestry tubes. This species grew well in this trial and 68 per cent survived (Table 57).

Table 57: Treatment results for Pomaderris obcordata

	Cutting treatment
Date collected	3/9/2014
Viability (%)	NA

Number of cuttings	25
Date sown	4/9/2014
Medium	Native mix
Treatment	Hormone gel
First emergence (weeks)	NA
Majority emergence	NA
Final number	17 (68%)

Recommendations

Recommended planting time for cuttings is approximately January to allow sufficient growing time before winter, while avoiding the need to repot (Table 58).

Table 58: Treatment recommendations for Pomaderris obcordata

***Pomaderris obcordata* – Pimelea Pomaderris**	
Seed collection time	Dec – Feb (Bonney 2003)
Cleaning technique	Rub against wire mesh (Ralph 1994)
Age of seed at sowing	Unknown
Sowing time	Autumn or spring (Bonney 2003).
Recommended treatment	Hot water treatment, dry heat, or smoke-water treatment
Future trial suggestions	As for *Pomaderris halmaturina* ssp. *halmaturina*
Cutting techniques	Allow 6 months for sufficient growth before planting out

3.28. *Pomaderris paniculosa* ssp. *paralia* Coast Pomaderris

As stated above, germination of *Pomaderris* spp. is improved using heat and smoke treatment (Ralph 2009).

A study into the dormancy of six Western Australian Rhamnaceae species found *Pomaderris paniculosa* to have high seed viability (Turner, Merritt, Baskin, Dixon & Baskin 2005). The hard seed coat was found to be permeable following just very short burst of hot water treatment (15 seconds at 88-92^{0}C). Germination of this species was greatest with a daily temperature regime of 7^{0}C/18^{0}C (Turner et al. 2005).

Provenance Enchanted Forest, Discovery Bay Coastal Park, Victoria
Material Seed

Seed was collected and sown in January 2014. In Treatment 1, the seed received hot water and soaking. In Treatment 2 no pre-treatment was applied, before sowing the seed in forestry tubes and covering lightly with course gravel. A summary of treatment results is outlined in Table 59.

Table 59: Treatment results for Pomaderris paniculosa ssp. paralia

	Seed treatment 1	**Seed treatment 2**
Date collected	14/1/2014	14/1/2014
Viability (%)	Not tested	Not tested
Number planted	100+	100+
Date sown	25/1/2014	25/1/2014
Medium	Native mix	Native mix

	Seed treatment 1	Seed treatment 2
Treatment	Hot water treatment, soak	No pre-treatment. Sown and covered lightly with gravel
First emergence (weeks)	Not recorded	23/9/2014
Majority emergence	23/9/2014	23/9/2014
Final number	67	1

Recommendations

Germination may be further increased by combining heat and smoke treatment in future trials (Table 60).

Table 60: Treatment recommendations for Pomaderris paniculosa ssp. paralia

***Pomaderris paniculosa ssp. paralia* – Coast Pomaderris**	
Seed collection time	Summer months
Cleaning technique	Rub to remove unwanted material
Age of seed at sowing	Unknown
Sowing time	Unknown
Recommended treatment	Heat treatment
Future trial suggestions	Scarification may further increase germination. Compare dry heat and hot water treatments
Cutting techniques	Possible from cuttings (Ralph 2009)

3.29. *Pultenaea canaliculata* Coast Bush-pea

Status Rare (Vic.)

Ralph (2009) states that dry heat treatment has produced very good results with several Pultenaea species, while other sources more specifically recommends treating with hot water for 30 seconds followed by rapidly cooling the water and soaking for several hours (Sparrow 2013, Bonney 2003). This method has worked for several Pultenaea spp. and they can now be used in direct seeding programs (Bonney 2003).

Provenance Douglas Point Conservation Park, South Australia
Material Cuttings

Cutting material was collected in August 2014. The majority of cuttings were planted into plugs (132), with 40 planted directly into forestry tubes to determine whether an advantage might be gained by either method. Unfortunately, the cuttings failed to develop root systems over a period of four months, and both methods were deemed unsuccessful in this trial (Table 61).

Contributing factors may have been that the plants were about to flower when cutting material was collected; a white fly problem occurred in the nursery in November which may have negatively impacted upon the cuttings' ability to thrive; the environment in the glasshouse may have been too moist for this species; or this species may not reproduce well from cutting.

Seed was been collected during summer 2014/2015 for trials at a future date.

Table 61: Treatment results for Pultenaea canaliculata

	Treatment 1	Treatment 2
Date collected	15/8/2014	15/8/2014
Viability (%)	NA	NA
Number planted	132	40
Date sown	16/8/2014	16/8/2014
Medium	Plugs	Native mix
Treatment	Hormone gel	Hormone gel
Final number	0	0

Recommendations

Cuttings may be more successful if material is collected at a more ideal time of year. Recommendations for *Pultenaea canaliculata* are outlined in Table 62.

Table 62: Treatment recommendations for Pultenaea canaliculata

***Pultenaea canaliculata* -Coast Bush-pea**	
Seed collection time	Oct – Feb (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Unknown
Sowing time	Sept – Apr (Understorey Network 2015b)
Recommended treatment	30 second hot water treatment, followed by rapid cooling and soaking
Future trial suggestions	Compare dry heat and hot water treatment
Cutting techniques	Cuttings were not successful in this trial

3.30. *Pultenaea* sp.

As mentioned above, *Pultenaea* spp. seed responds to heat treatment (Ralph 2009; Sparrow 2013).

Provenance Unknown
Material Seed

A cut test revealed high seed viability (70%) and a trial was devised with four treatments involving dry heat, hot water treatment, and smoke-water treatment. As expected, a short burst of hot water treatment followed by rapid cooling and soaking, produced the best result (Table 63), supporting the current accepted practice. The germination percentage in this treatment was nearly as high as total seed viability, indicating that nearly all viable seed in this treatment germinated.

Germination began around seven weeks, with the majority germinated within ten weeks of sowing.

Table 63: Treatment results for Pultenaea sp.

	Seed treatment 1	Seed treatment 2	Seed treatment 3	Seed treatment 4
Date collected	2013	2013	2013	2013
Viability (%)	70	70	70	70
Number planted	60	60	60	60
Date sown	30/7/2014	30/7/2014	30/7/2014	30/7/2014
Medium	Native mix	Native mix	Native mix	Native mix

	Seed treatment 1	Seed treatment 2	Seed treatment 3	Seed treatment 4
Treatment	Dry heat (80^0C) for 20 minutes	Control – no additional pre-treatment	Hot water (70^0C) for 30 seconds, followed by cold water (20.5^0C) for four hours	Soaked in room temperature smoke-water for four hours
First emergence	8/9/2014 7 weeks	8/9/2014 7 weeks	8/9/2014 7 weeks	8/9/2014 7 weeks
Majority emergence	10/10/2014 10 weeks	10/10/2014 10 weeks	10/10/2014 10 weeks	10/10/2014 10 weeks
Final number	11 (18%)	9 (15%)	35 (58%)	12 (20%)

Recommendations

Good germination is ensured by pre-treating with hot water, then soaking in cold water. Recommended treatment of *Pultenaea sp.* is outlined in Table 64.

Table 64: Treatment recommendations for Pultenaea sp.

Pultenaea sp.	
Seed collection time	Oct – Feb (Ralph 1994)
Cleaning technique	Sieve to remove unwanted material
Age of seed at sowing	Ideal unknown, but seed in this trial was less than two years old, and retained high viability
Sowing time	Sept - Apr
Recommended treatment	Hot water treatment, followed by soaking in cold water produced very high success rate in this trial.
Future trial suggestions	Compare to dry heat seed treatment recommended by Ralph (2009)
Cutting techniques	Not grown by cutting

3.31. *Scaevola calendulacea* Dune Fan-flower

Status Vulnerable (SA, Vic.)

Figure 20: Dune Fan-flower

Scaevola calendulacea (Figure 20) will grow from untreated seed sown in winter, and germination may improve with the use of smoke-water (Ralph 2009); it can also be grown by cutting (Sparrow 2013). This species requires winter conditions (cold, dark) before germination (Bonney 2003).

Provenance Piccaninnie Ponds Conservation Park, South Australia

Material Cuttings

This species grows easily by cuttings, with the majority surviving in this trial (Table 65) although root development was slow. Cuttings were planted in August 2014 and required repotting in March 2015 to avoid becoming root-bound.

Table 65: Treatment results for Scaevola calendulacea

	Cutting treatment
Date collected	3/8/2014
Viability (%)	NA
Number planted	75
Date sown	4/8/2014
Medium	Native mix
Treatment	Hormone gel
First emergence	NA
Majority emergence	NA
Final number	72 (93%)

Recommendations

A growing time of six months is recommended to reach ideal planting size, and avoid the need to repot; cuttings should therefore be planted in summer (Table 66).

Table 66: Treatment recommendations for Scaevola calendulacea

***Scaevola calendulacea* – Dune Fan-flower**	
Seed collection time	May – June (Ralph 1994, Bonney 2003)
Cleaning technique	Remove flesh, but may be sown in bony endocarp (Bonney 2003)
Age of seed at sowing	Within two years of collection (Ralph 1994)
Sowing time	Winter
Recommended treatment	Use well-draining sandy media or soil from beneath parent plant (Bonney 2003). Sow in winter.
Future trial suggestions	Compare untreated seed with smoke-water treatment
Cutting techniques	Grows easily from cuttings

3.32. *Stackhousia spathulata* Coast Stackhousia

Status Poorly Known (Vic.)

Stackhousia spp. are difficult to propagate from seed, however, smoke treatment or scorching may produce results (Ralph 2009). The seed of this species is not easy to collect, as it ripens over a long period; furthermore seed viability is often low (Understorey Network 2015c). *Stackhousia spathulata* is known to grow from cuttings (Sparrow 2013).

Provenance Douglas Point Conservation Park, South Australia
Material Cuttings

Cuttings were collected in mid-August 2014 and planted into plugs three days later. This trial was highly successful, with 75% of cuttings surviving (Table 67).

Table 67: Treatment results for Stackhousia spathulata

	Cutting treatment
Date collected	15/8/2014
Viability (%)	NA
Number planted	12
Date sown	18/8/2014
Medium	Plugs
Treatment	Hormone gel
Final number	9 (75%)

Recommendations

This species appears to be slow growing as cuttings collected in August will not need repotting before winter planting. Recommendations for this species are outlined in Table 68.

Table 68: Treatment recommendations for Stackhousia spathulata

***Stackhousia spathulata* - Coast Stackhousia**	
Seed collection time	Summer
Cleaning technique	Unknown; not grown by seed
Age of seed at sowing	Unknown; not grown by seed
Sowing time	Unknown; not grown by seed
NGT recommended treatment	Cuttings successful in this trial
Future trial suggestions	Smoke treatment or scorching
Cutting techniques	Usually grown by cuttings

3.33. *Tetratheca ciliata* Pink-bells

This species may be grown by cutting or seed, although seed production is not reliable (Sparrow 2013; Gardiner 2002). Seed may be sown in autumn or spring and the use of soil from beneath the parent plants aids germination (Bonney 2003, Sparrow 2013). Trials on other *Tetratheca* spp. have used a large variety and combination of treatments with little success (Ralph 2009). This species may also be grown by cuttings (Bonney 2003).

Provenance Calectasia Conservation Park, South Australia
Material Cuttings

Cutting material was collected in September 2014 and planted directly into forestry tubes. At six weeks half of the cuttings were surviving but their condition continued to decline until three months when the last perished (Table 69).

Further cutting material was collected in late-November 2014 and planted in plugs and then placed in the glasshouse. This trial is ongoing, but very few of the plants appear to be doing well or putting on root growth.

Table 69: Treatment results for Tetratheca ciliata

	Cutting treatment
Date collected	7/9/2014
Viability (%)	NA
Number planted	31
Date sown	9/9/2014
Medium	Native mix
Treatment	Hormone gel
Final number	0 (0%)

Recommendations

Cuttings of this species performed much better when grown in peat plugs; possibly indicating a preference for well-draining substrate (Table 70). Further trials may use a native mix medium with added sand.

Table 70: Treatment recommendations for Tetratheca ciliata

***Tetratheca ciliata* – Pink-bells**	
Seed collection time	Jan – Feb (Ralph 1994, Bonney 2003)
Cleaning technique	Sieve to remove unwanted material (Ralph 1994)
Age of seed at sowing	Unknown
Sowing time	Autumn or spring (Bonney 2003)
Recommended treatment	Use of soil from parent plant recommended by Ralph (1994) and Bonney (2003), or if not, sandy soil (Bonney 2003)
Future trial suggestions	Collect cutting material at different time of year
Cutting techniques	May be grown by cuttings (Bonney 2003), although not successful in this trial

4. DISCUSSION

4.1. *Propagation trials (seed)*

Propagation by seed is the preferred method when the plants are intended for environmental restoration works because of the importance of maintaining genetic diversity. However, if growing for display gardens or propagation is required for a rare species where seed is not available (for example, because of fluctuations in seed production, changes in pollinator behaviour, weather etc.) or germination cues are unknown, vegetative reproduction from cuttings or division becomes a potential option. In the vast majority of cases where cuttings were used in the NGT Community Nursery the plants were propagated for use in display gardens within local towns. Cuttings for revegetation or reintroduction purposes were taken from as many individuals as possible and no more than 5% of the parent plant was collected as cutting material

Seed trials aimed to determine the species specific dormancy-breaking cues, while trials using cuttings focussed on identifying the ideal materials and timing; see Appendix 1 for a summary table of findings. The trials conducted by the Community Nursery have generated a substantial amount of new knowledge, as well as results that support existing knowledge. In some cases the research presented here has implications for seed collection and storage as the data show older seed may still germinate readily (*Ixodia achillaeoides* ssp. *arenicola*).

The findings of several trials support the methods currently known in the literature. For example, it is common practice to soften the seedcoat of species with hard seeds using hot water and then soaking the seed (*Acacia enterocarpa* and *Pomaderris paniculosa* ssp. *paralia*), and heat treatment is known to stimulate germination of *Daviesia ulicifolia*. Similarly, stratification of *Bursaria spinosa* ssp. *spinosa* seed is known to promote germination; smoke-water treatment has been shown to increase germination of *Gahnia sieberiana* and *Ixodia achillaeoides* ssp. *arenicola*; and no treatment is necessary for *Dianella callicarpa* seed.

The results of some trials suggest successful seed pre-treatments (for example, smoke-water treatment for *Acrotriche cordata*), while a number of other trials which were not successful in producing germinants are valuable by means of eliminating non-useful techniques. Future research can build on the knowledge created by such studies.

Particularly interesting is the emu scat *Kunzea pomifera* case study which has demonstrated an innovative new method by which to grow this species. By replacing several time-consuming steps (collecting Muntrie berries, drying the fruit, seed cleaning) with just one (scat collection), the process of growing this species by seed becomes more attractive and attainable to growers. The scat method is even more time-efficient than growing by cuttings, which is the method currently most often employed. Given that emus may travel some distance to feed, and only select the ripest fruit, it can be assumed that genetic diversity of seed contained within the scat is high. This adds another benefit to this propagation method.

Conversely, emu ingestion did not aid the germination of *Astroloma conostephioides* seed, although the seed appeared to remain viable. While ingestion semi-removed the fleshy fruit, which may act as an inhibitor, further treatment or a combination of treatments are required to break the dormancy of this complex species.

Several more emu scat germination trials have been established, with scats collected in either summer 2014/2015 or late autumn 2015 at different locations. Each scat contains seed from only one species

indicating that emus feed exclusively on one food source at a time. The results of the recently initiated trials containing *Kunzea pomifera*, suspected *Hibbertia* sp., and suspected *Acrotriche* sp. will be available in the following interim report on the Community Nursery's propagation trials (mid-2016). It is hoped that these trials will identify other species which may be successfully grown using this method.

Future trial recommendations have been made for each species. Where results indicated new knowledge, these trials should be replicated to increase certainty of the findings. In cases where germination did not occur, or only limited success was experienced, as yet untested methods and seed pre-treatments have been suggested.

Seed of the same species from several provenances were trialled to give an idea of whether differences in seed quality was a factor between provenances. It is known that *Lotus australis* seed may require heat treatment to germinate depending on its provenance (Ralph 2009; K. Sparrow, pers. comm. May 2015). However, our trial determined that seed collected from the south-west coast of Victoria did not require pre-treatment for good germination, indicating that it is has similar germination requirements to plants found in southern Victorian grasslands (Ralph 2009). Similarly, seed of *Bursaria spinosa* ssp. *spinosa* from several provenances was trialled as physical characteristics of this species may differ from region to region. The trial included seed from individuals of the previously separate variety *Bursaria spinosa* var. *macrophylla*, which is now included in *Bursaria spinosa* ssp. *spinosa*. The difference in germination rates between provenances may have also been a result of age of the seed, or other unknown factors.

Trials on *Melicytus dentata* found great variability in germination between provenances, which may have been a result of population robustness, seed viability, collection time, or other unknown factors.

4.2. *Display Gardens and Propagation trials (cuttings)*

Apart from propagation trials themselves, another key aim of the Community Garden project has been to establish eight native plant display gardens around the South East of South Australia and the South West of Victoria, with the idea that these gardens will help local communities to become more aware of their local flora and that they would be community resources into the future. Partnering with different local community groups, schools, and local councils in each case has allowed a strong sense of ownership to be established, and the use of interpretive signage and webpages for each increase the effectiveness of the gardens as an educational tool. As the Community Garden project was still in its early stages, a comprehensive seedbank had not yet been established by the time display garden planning came about; the large number of plants required for these gardens (up to 1000 in initial plantings, plus subsequent top up plantings) necessitated the use of cuttings in many cases.

When collecting cuttings destined for the display gardens, thought was given to provenance and material was generally collected from a source near to the final destination. Once established, community groups will be able to harvest seed and cutting material from their gardens, learning about locally indigenous common, rare and threatened species without negatively impacting upon wild populations.

However, provenance was determined to be less important in the case of these gardens than it is in environmental restoration works and some flexibility was used. For example, *Grevillea aquifolium* was established in a vertical garden in Warrnambool, Victoria despite the nearest records of this species being near Portland. It was decided that owing to the combination of the suitability of the plant for

this type of garden (prostrate shrub in a vertical setting), the attractiveness of the species, the rarity of the species, and the interest in threatened plants, the inclusion of this plant was worthwhile.

Cuttings were collected from a large number of parent plants to maintain genetic diversity. Each species grown by cutting grew at different rates; thus the trials undertaken by cutting resulted in increased knowledge on timing i.e. when to collect material and how long cuttings need to reach a plantable size. A great deal of difference was highlighted in these trials with fast-growing species such as *Ixodia achillaeoides* ssp. *arenicola* only requiring four months growing time, compared to slower growing species such as *Grevillea aquifolium* which need nine months to reach a plantable size. Cutting trials have been used to establish a valuable reference calendar for the nursery and local growers.

Trials of cuttings found that in most cases the use of plugs is preferable to straight native mix with more cuttings surviving in this medium. For example, *Grevillea aquifolium* had an 8% survival rate in native mix compared to 90% in plugs. The plugs allow for easier root development and better drainage, while also decreasing the impact of weeds and avoiding the need for excessive handling in the pricking out process.

4.3. *Community Nursery*

The Cross-border Community Nursery has now been in operation since June 2013 at Vansittart Park in Mount Gambier, South Australia. Its primary aim is to work collaboratively with local native nurseries and growers, direct seeding contractors, government and non-government Natural Resource Management (NRM) organisations, community groups and members. The Community Nursery aims to share knowledge about propagation techniques, while being practical and acknowledging all the hard earned information that already exists among the nursery and NRM industries.

4.3.1. Display gardens

Since the establishment of the Community Nursery, we have worked with a number of different communities around the South East of South Australia and the South West of Victoria to prepare, plant and maintain eight native display gardens. Multiple working bees have been held at several of these sites with the following section outlining statistics relating to the initial or main planting events.

Portland, Victoria

Portland Native Plant Display Garden	
Project partners	• Portland Community Garden • Friends of Community Nursery
No. of attendees at planting day	40
No. of plants	1200
No. of species	42
No. of national/state threatened or rare species	10

Figure 21: A sea of tree guards (July 2014)

Figure 22: Looking over a patch of Chrysocephalum apiculatum *towards the wetland (July 2015)*

Port Fairy, Victoria

Port Fairy Native Plant Display Garden	
Project partners	• Port Fairy Consolidated School
No. of attendees at planting day	90
No. of plants	765
No. of species	31
No. of national/state threatened or rare species	6

Figure 23: Carpobrotus rossii*, Puuyuupkil, was included due to significance to local Indigenous peoples*

Warrnambool, Victoria

Ozone Lane Vertical Garden	
Project partners	• Warrnambool City Council • The F Project • Envirofit • Warrnambool Art Gallery • State Government of Victoria • RMIT University • Friends of Community Nursery
No. of attendees at planting day	Planted by professional with required vertical garden expertise (Envirofit)
No. of plants	100
No. of species	14
No. of national/state threatened or rare species	5

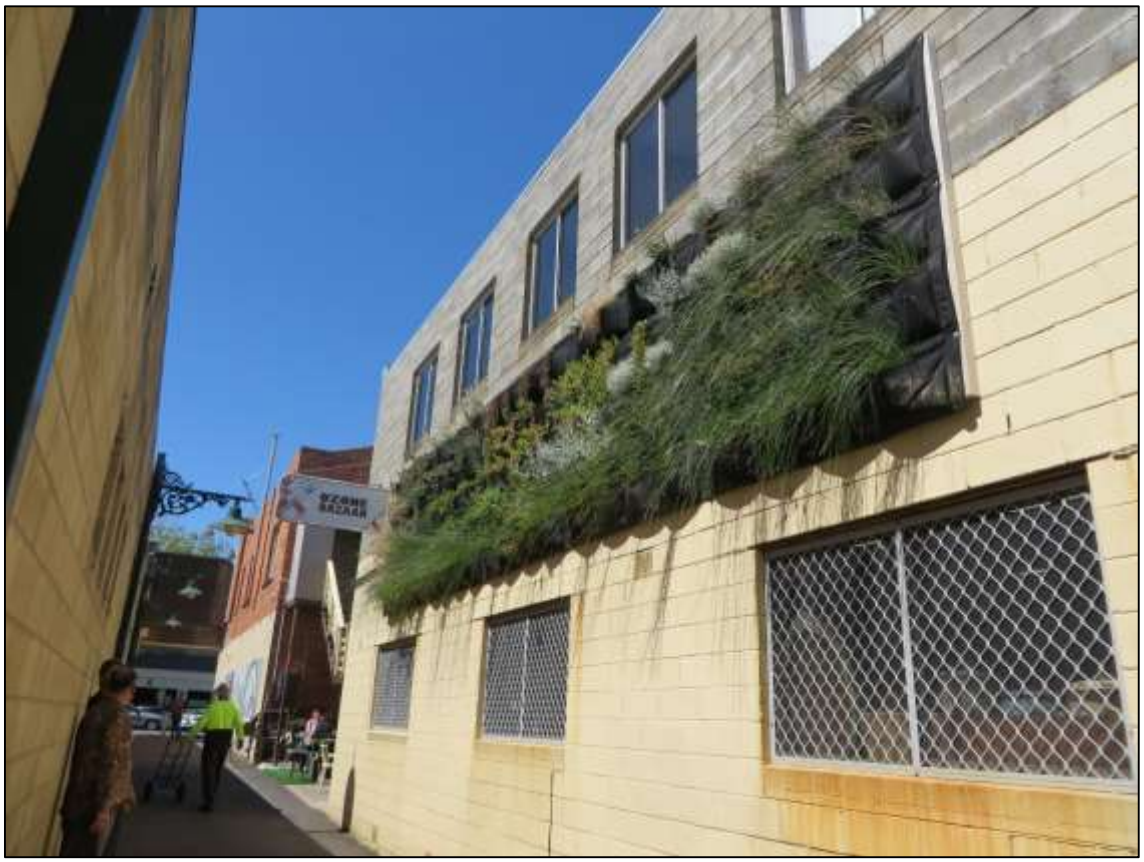


Figure 24: Ozone Lane Vertical Garden after six months growth (Nov 2014)

Swan Reserve Biodiversity Bed	
Project partners	• Warrnambool City Council • Australian Plant Society – Warrnambool and Districts
No. of attendees at planting day	7
No. of plants	97
No. of species	26
No. of national/state threatened or rare species	7

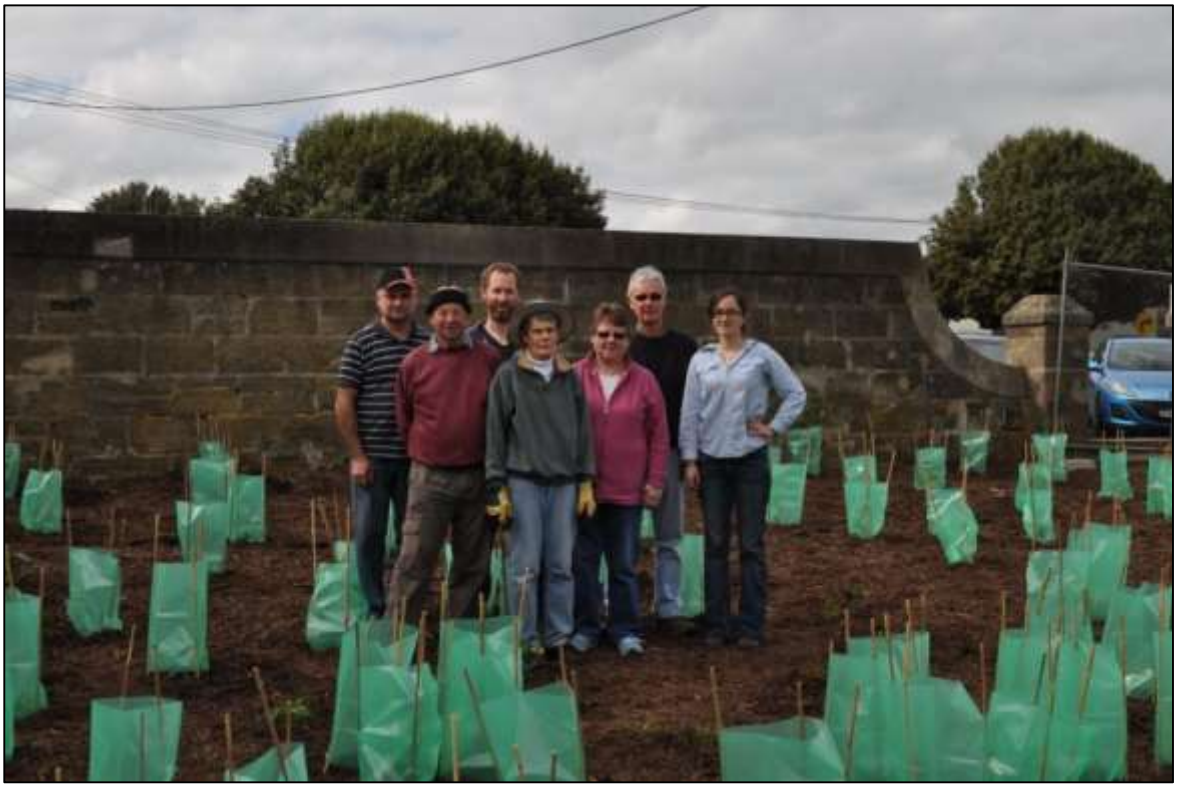


Figure 25: Australian Plant Society members and NGT staff at Swan Reserve

Mount Gambier, South Australia

Plants of the South East Display Garden	
Project partners and groups involved	• Natural Resources South East • Tenison Woods College • TAFE Horticulture students • Green Army • Friends of Community Nursery
No. of attendees at planting day	30
No. of plants	700
No. of species	42
No. of national/state threatened or rare species	9

Figure 26: NGT and NRSE staff with horticulture students (July 2014)

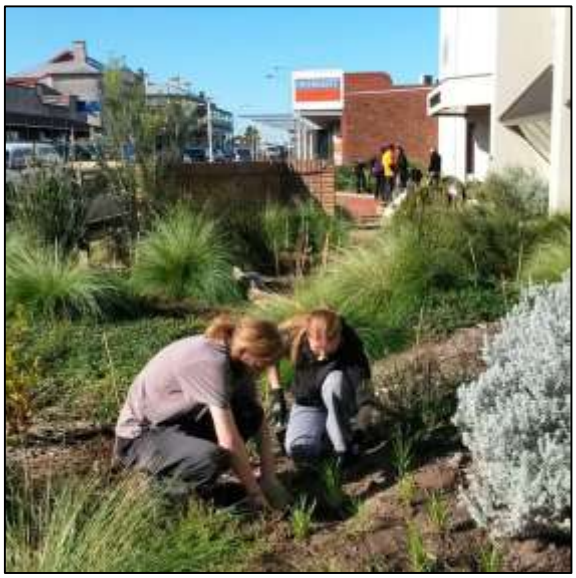


Figure 27: Friends volunteers at working bee June 2015

Ecosystems of the South East Display Garden	
Project partners	• Mount Gambier City Council • South East and South West Homeschoolers • Friends of Community Nursery
No. of attendees at planting day	17
No. of plants	1020
No. of species	38
No. of national/state threatened or rare species	10

Figure 28: Home-school students and parents assisted with planting (June 2015)

Figure 29: Over 1000 shrubs, herbs, and sedges were planted (June 2015)

Naracoorte, South Australia

Naracoorte Native Plant Display Garden	
Project partners	• Naracoorte Lucindale Council • Naracoorte Scout troop • Friends of Community Nursery
No. of attendees at planting day	33
No. of plants	960
No. of species	31
No. of national/state threatened or rare species	7

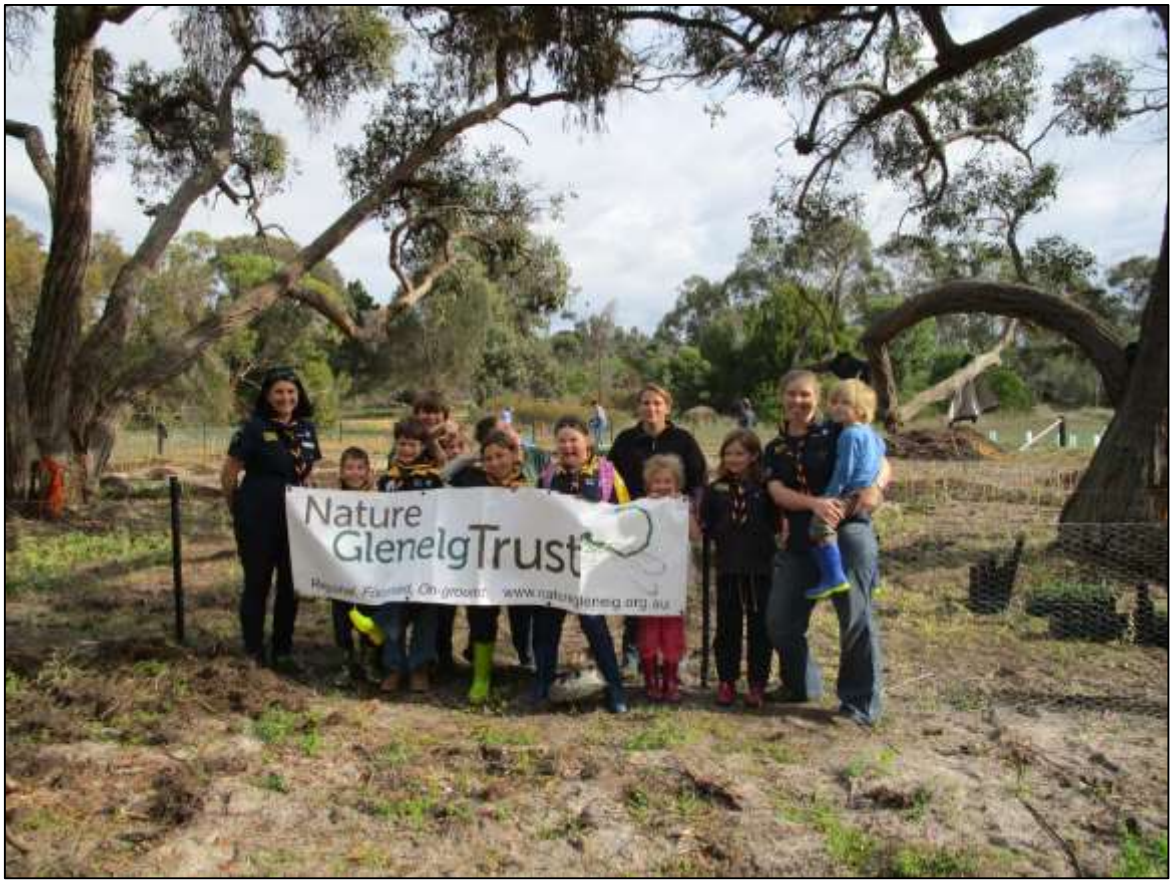


Figure 30: Naracoorte Scout troop will use the garden in future activities

Beachport, South Australia

Beachport Coastal Display Garden	
Project partners	• State Government of South Australia • Natural Resources South East • Wattle Range Council • Murlong M'rradine Coastcare • Millicent High School • Beachport Primary School • Friends of Community Nursery
No. of attendees at planting day	35
No. of plants	450
No. of species	18
No. of national/state threatened or rare species	1

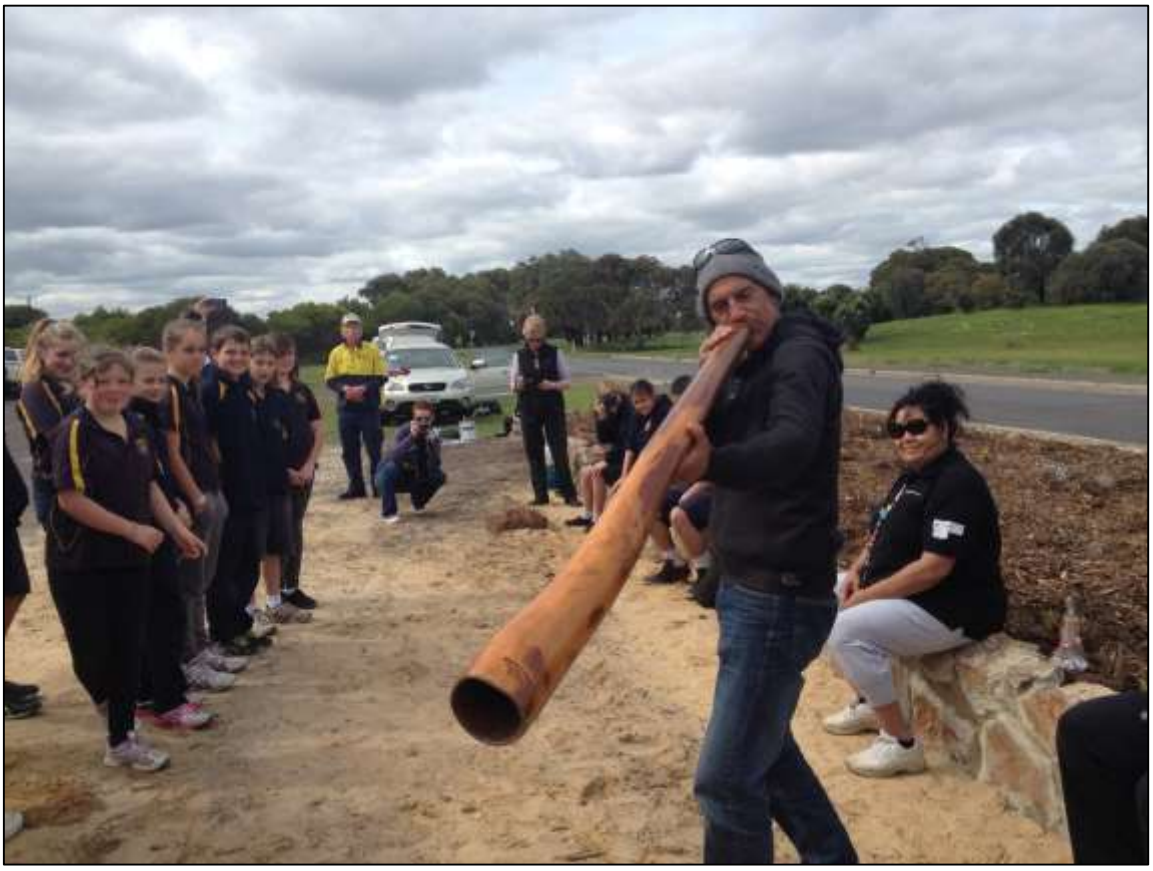


Figure 31: Students were given a traditional thank you for caring for Country

4.3.2. Workshops

The Community Nursery has also worked hard to undertake meaningful workshops that facilitate expanding our local community's knowledge about plant propagation, revegetation and general biodiversity. Table 71outlines the workshops which have been held since commencement of the Community Nursery

Table 71: Community Nursery workshops held since commencement

Workshop	Speakers	Partners	Venue
Seed collection	Neville Bonney	• Natural Resources South East • TAFE SA	Struan, SA; Carpenters Rocks, SA
Seeds of Success – full day event	Multiple speakers	• Greening Australia • CSIRO Plant Industry • Millennium Seedbank Project • Neville Bonney	Hamilton, Victoria
Growing Media	Kevin Handreck		Mount Gambier, SA
Plant identification	Neville Bonney		Mount Gambier, SA
Botanical illustration	Yvonne Riley		Mount Gambier, SA
What weed is that?	Chris Brodie	• State Herbarium of South Australia • Natural Resources South East	Mount Gambier, SA
How to create a butterfly garden	Bryan Haywood; Yvonne Riley		Mount Gambier, SA
Seed collection	Neville Bonney		Eaglehawk Waterhole Restoration Reserve, near Frances, SA
How to create a butterfly garden	Bryan Haywood; Yvonne Riley	• Natural Resources South East	Naracoorte, SA
Native Plant Propagation	Kevin Sparrow	• Portland Community Garden	Portland, Victoria

4.3.3. Volunteers

The nursery has also been a hub for volunteers who form the Friends of Community Nursery group. Volunteers are involved in all aspects of nursery operation, from setting up and monitoring propagation trials, general cleaning, weeding, pricking out, re-potting and assisting at events. Friend's group members are usually longer-term volunteers who spend several hours or multiple days per week at the nursery. The Community Nursery has also joint-hosted (with other NGT projects) a high school work experience student, and has shorter-term or once-off volunteers.

5. CONCLUSIONS

Undertaking the Community Nursery project has provided many insights into the revegetation and restoration industry. Key insights learnt along the way include:

- The nursery industry is a labour of love! The hours invested in the steps between seed collection and planting out (seed cleaning, sowing, monitoring, pricking out, weeding, and re-potting) may not be adequately reflected in current price structures, however there is a trade-off between cost-effectiveness and affordability.
- Some of the key reasons behind the lack of diversity in the revegetation projects is not the lack of want or knowledge about the propagation techniques but the time involved, for example:
    - Seed may be very hard to collect, require many consecutive visits for optimal ripening, or existing populations may be isolated;
    - The seed of certain species is time consuming to either collect or clean, for example, Pultenaea stricta, P. dentata, Astroloma spp.
- Certain species that have been successfully grown by the Community Nursery may remain absent from revegetation projects, simply because of the time consuming nature of propagating them. For example, new trials on *Grevillea aquifolium* have indicated a good germination rate after a treatment of smoke-water and nicking each seed (results will be formally reported in next edition).
- Understorey plants may be missing from revegetation projects as growers do not feel such a strong market demand for these; that is, shrubs and trees are valuable in revegetation as well as in farm shelter belts.
- Relationships between research, growers, and land managers should continue to be fostered and strengthened.

This project aims to improve communication between management organisations and growers; this must remain a focus into the future and beyond the life of this project. The Community Nursery is committed to helping share information and increase knowledge about propagation techniques that will assist to improve revegetation and flora knowledge with industry partners and our local community into the future.

6. RECOMMENDATIONS

The trials conducted by the Community Nursery have resulted in a range of new knowledge, which informs the recommendations listed here. For specific information for each species please refer back to the previous sections.

- The use of plugs in polystyrene trays produced great results for some species. The advantage of using these plugs is that roots become visible outside the plug indicating the plant's readiness for transplanting, which can be carried out with no root disturbance as the entire plug is transplanted into native growing medium.
- Clumping plants (for example, *Ixodia achillaeoides* ssp. *arenicola*) or spreading plants (such as, *Scaevola calendulacea*) perform better in square pots rather than tubes.
- Mass propagation of *Kunzea pomifera* can be achieved in a cost-effective time-efficient manner by collecting seed filled emu scat.
- Timing is everything. This relates to seed collection, sowing, pricking out, and planting. Each species has different requirements, but often mimicking conditions found in their natural environment will assist in germination and propagation. By planting at the correct time, species appear to be less susceptible to pests and maintain their health during their time in the nursery.
- The Community Nursery has enjoyed strong relationship with local experts and growers, which have informed and provided direction for the trials undertaken. A key aim of this project is to foster these relationships and knowledge sharing, leading to better outcomes for the community and the environment. It is recommended that these links continue to be forged and strengthened.

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8. APPENDIX

Table 72: Summary of propagation trial findings

Species	New knowledge	Supports existing knowledge	Contrary to existing knowledge
Acacia enterocarpa		Hot water and soak to soften seedcoat	
Acrotriche cordata	Seed treatment of smoke-water, and mixed growing media successful. Good result with cuttings: hormone gel, nicked stems, peat/perlite/native mix		
Acrotriche serrulata		Heat treatment unsuccessful	
Adriana quadripartita		May be grown easily from cutting	
Astroloma conostephioides	Ingested seed has not germinated to date. Ongoing trial		
Beyeria leschenaultii	Cuttings unsuccessful in plugs		
Bursaria spinosa ssp. *spinosa*		Similar results to Bird and Aldridge (1994), Bird (2004) – 30% germination after stratification	
Calectasia intermedia	Very slow by cutting	Seed viability low	
Callitris rhomboidea		Fresh seed	Expected higher germination after stratification rather than smoke-water treatment
Cassinia rugata	May be grown easily by cutting		
Einadia nutans	May be sown without removing seed from flesh		
Daviesia ulicifolia		Heat treatment effective	
Dianella callicarpa		Fresh seed with no extra treatment	
Gahnia filum			Germinates readily, but not in this trial
Gahnia radula	Smoke-water successful elsewhere, but no germination in this trial to date. Ongoing trial.		
Gahnia sieberiana		Smoke-water improved germination	
Grevillea aquifolium	Plugs vastly more successful than native mix	Easy to grow via cutting	
Ixodia achillaeoides ssp. *arenicola*	Germinated prolifically from old, predated seed. Did not require stratification.	Easy to grow via cutting. Successful with smoke-water	
Kunzea pomifera	Emu ingested seed germinated prolifically.		

	Smoke-water produced earlier germination, vigorous seedlings		
Leucopogon parviflorus		May take months to germinate	
Logania ovata		No additional treatment most successful in this trial, but numbers were low. Additional research required (Bonney 2003)	
Lotus australis	Good germination from southern Victorian coastal seed		
Melicytus dentatus	Pressure pump, smoke-water produced no result		
Olearia pannosa ssp. *pannosa*	Cuttings do better in native mix than in plugs	Grows well from cuttings	
Pimelea glauca		Grows well from cuttings	
Pomaderris halmaturina ssp. *halmaturina*			Dry heat unsuccessful in this trial
Pomaderris obcordata	May be grown by cutting		
Pomaderris paniculosa ssp. *paralia*		Hot water treatment successful	
Pultenaea canaliculata		Does not grow well from cutting	
Pultenaea sp.		Hot water treatment provides good result	
Scaevola calendulacea		Grows well from cuttings	
Stackhousia spathulata		Grows well from cuttings	
Tetratheca ciliata	Cuttings unsuccessful in native mix		