

Report to the Arcadia Fund

The Rainforest Conservation Project - Year 3 of 5

Reporting Period: November 2014 - October 2015

Year 3 Progress

This year we consolidated our capacity to collect and conserve seeds of rainforest species. The excellent field collecting conditions noted in Year 2 continued this year, allowing us to exceed collection targets. An expansion of our contacts with external seed collectors, restoration practitioners and interested public also led to the collection of several threatened species that would otherwise have been next to impossible to obtain.



Members of the Australian PlantBank team.

Work on understanding the seed storage behaviour of the collected species also continued. These investigations can take some time to complete for each individual species; however, we are gradually building up our knowledge of which species can be successfully stored in the seedbank and which species require alternative or supplementary measures. We can now direct our efforts to the tissue culture and cryopreservation of difficult-to-store species and this will be a focus of our research over the next two years. In anticipation of this work, a number of species have already been successfully initiated into tissue culture. Conditions for successfully growing, rooting and transferring plants back into pots were established for seven species this year; with these conditions established, work on cryopreservation of the species can now commence.

Achieving outcomes

Outcome 1:

The Royal Botanic Gardens and Domain Trust (the 'Trust') aims to study 50 rainforest species from Eastern Australia each year in order to predict the optimal ex situ conservation options. The Trust will prioritise species that face imminent risk of extinction targeting a small number (around 3-5) each year for intensive study. The Rainforest Seed Collection Project (the 'Project') will ensure that species currently under threat in the wild are safeguarded in an ex situ collection or that they have the potential to be conserved ex situ should the need arise. The Trust's long-term target is to conserve 75% of threatened species from rainforest habitats in New South Wales ex situ by 2020.

The rainforests of New South Wales are the most varied in Australia and include subtropical, warm temperate, cool temperate, littoral and dry rainforest types. During field trips this year, we collected from the full spectrum of rainforests found in the region, from the subtropical rainforests of Northern NSW, to littoral rainforests near Byron Bay and the dry rainforest of Toonumbar National Park to the west of Kyogle.

This collection strategy gave us a broad range of seed types to work with in the laboratory and will help us to better understand the effect of different rainforest habitats on the relative storability of seeds. It will also provide an insight into the evolutionary history of Australian rainforests and how they might respond under future climate change.

An additional part of our collection strategy for this third year was to bolster the diversity of our collections of threatened species. For example, we were able to make collections of the extremely rare rainforest margin species *Senna acclinis* from six different populations across its natural distribution. This ensures we have a good representation of the genetic diversity of the species in the seedbank. Collaboration with staff from the Office of Environment and Heritage and bushcare workers from Northern NSW have also enabled us to collect and germinate seed from several populations of the critically endangered tree *Fontainea oraria*.

This year we also improved our collection of seed from rainforest climbers such as *Tylophora grandiflora*. Many rainforest climbers are not prolific seed producers; however, by growing plants from cuttings under controlled conditions we have been able to greatly improve the quality and quantity of seed produced.



Senna acclinis (left) – an endangered species from NSW and Queensland and *Tylophora grandiflora* (right) – a climber with poor seed production.



Fontainea oraria – a critically endangered tree species from NSW – fruit (left) and germinating seed (right).

Outcome 2

The program will also include commonly occurring species, and it is anticipated the program will result in a total of 250 new rainforest seed collections held at the NSW Seedbank (including threatened species), which will be available for research purposes.

Consolidating our collections

A number of more commonly occurring rainforest species have been added to the National Seedbank collection this year, which has contributed to achieving the targets of the Global Tree Conservation Project and the Global Strategy for Plant Conservation (Table 1). Those species with seed unsuitable for seedbanking were grown on and added to the living collection of rainforest species held at the Australian Botanic Garden Mount Annan.

Plants in the living collection are being used for a variety of purposes including planting out into our rainforest dedicated gardens at the Australian Botanic Garden Mount Annan, and sharing with other botanic gardens and conservation agencies. The plants are also used as a source of material for our research into the potential for tissue culture and cryogenic storage of threatened rainforest species.



Rainforest plants growing in the Australian Botanic Garden, Mount Annan nursery are used for a variety of purposes.

Through this project we are greatly increasing the sum of knowledge available on rainforest seeds and how best to conserve them. Though this information has been amassed using Australian species, it is relevant and transferrable to other floras such as the tropical rainforests of south-east Asia. The information will be particularly useful for the conservation of crop wild relatives, an action that is becoming increasingly important as the impact of climate change on food security becomes more apparent. This year we were invited to author a chapter on seed biology for an international book on the effects of climate change on crop wild relatives – this was an excellent opportunity to summarise existing knowledge on the topic and to transfer that data to a wider audience. We also increased our efforts to collect and study Australian crop wild relatives growing in rainforests such as those in the cucurbit family – the native cucumbers.



Native cucumber species – *Diplocyclos palmatus* (left) and *Trichosanthes subvelutina* – new additions to our collection.

Outcome 3

The Rainforest Seed Conservation Project will enable significant advances in the area of rainforest biodiversity conservation and collaborative ecological restoration.

Seed longevity in storage

An important component of seedbanking is knowing how long the seed is likely to stay viable in storage. This year, we commenced testing seed longevity for 12 rainforest species by conducting a rapid aging test on the seeds. Eight of those species were relatively short-lived at -20°C so further experiments were undertaken to determine whether the seed would tolerate cryopreservation. This research will be continued in 2016 to determine which seeds can be safely stored in the freezer for long periods and which seeds will require much colder temperatures.



Rainforest seeds found suitable for seedbanking were artificially aged (left) to determine how long they were likely to survive in storage. Species found to be short-lived were placed in cryopreservation (right) to see if they could survive the colder temperatures.

Difficult-to-store species

One option for conserving species not suitable for seedbanking is the cryopreservation of buds or shoot tips. An essential first step of this process is to initiate the species into tissue culture and find the optimum conditions for the production of shoots and roots. Material from the young plants in our living collection of rainforest species has now been used to initiate over 50 species into tissue culture. Seven of these – including the endangered *Elaeocarpus reticulatus* and the myrtle-rust susceptible *Rhodamnia rubescens* – have been successfully multiplied, rooted and transferred out of sterile culture and back into pots. Work on cryopreservation of these species can now commence and will be a focus of our research in 2016.



Species successfully initiated into tissue culture, multiplied and returned to potted culture: *Syzygium australe* (top left & right), *Cryptocarya microneura* (bottom left) and *Rhodamnia rubescens* (bottom right).

Knowledge transfer

This year saw the near completion of a database that will help us to analyse and collate information on our extensive rainforest seed germination program. The database has been developed in collaboration with the SeedBank of the Royal Botanical Garden Tasmania. When fully operational it will allow the transfer of summary data to our publicly accessible PLANTnet database as well as the Atlas of Living Australia (ALA) and the Seed Information Database (SID – Kew). As soon as we can make it possible, the information will therefore be publically accessible.

Outcome 4:

Ongoing and new collaborations with organisations will be developed in the Asia-Pacific region including training and upskilling opportunities for the Trust's counterparts.

Asia-Pacific Capacity Building

Our capacity-building work in the Asia-Pacific region continued this year, with training on seed collecting delivered to 13 staff from 4 National Park authorities and 2 NGO agencies in Vietnam. As part of the training, each attendee was provided with a seed collecting kit including collecting book, hand lens, secateurs and collecting bags. The training was delivered over 3 days at Bidoup Nui Ba National Park and was successful in encouraging networking among the attendees that will hopefully enable the establishment of a coordinated seed conservation program within Vietnam. At the conclusion of the training, our staff travelled to Singapore to meet with colleagues at Singapore Botanic Garden and discuss the potential for future training/capacity building partnerships.



Trainer Graeme Errington teaching staff from various National Park authorities and NGOs in Vietnam together with Heidi Zimmer (foreground).

International Collaboration

In addition to providing training in seed collection in Vietnam, this year we expanded our work in developing international collaborations by sharing research results at two international conferences and by attending an international workshop on seed longevity.

Dr Karen Sommerville attended the Association for Tropical Biology Conservation (Asia-Pacific) Conference in Phnom Penh, Cambodia, in March 2015 and gave a talk on the conservation of rainforest plants. This resulted in collaboration with scientists from Xishuangbanna Tropical Botanic Garden in China to write a review on the ex situ conservation of tropical plant species worldwide.

Dr Cathy Offord attended the International Protea Research Symposium in Perth, Western Australia in September 2015 and shared techniques developed for the tissue culture of *Persoonia* species – a group that includes some rainforest species that have, till now, been very difficult to cultivate.

Technical Officer Graeme Errington participated in a workshop on seed longevity held at IPK Gatersleben, a plant research centre in Germany. His presence at the workshop allowed him to discuss research results from the Rainforest Conservation Project with several international scientists also working on the conservation of difficult seeds and may lead to future collaborations.

Our PhD student Heidi Zimmer continued to work in Hanoi on a related project looking at sustainable use of tropical forests. She also submitted her PhD on the ecology of the iconic Australian rainforest species *Wollemia nobilis* (Wollemi pine) and published two papers on the results of her research.

In addition to the above, this year we began to negotiate a joint application for funding from the Australian Research Council (ARC) with scientists from Curtin University and Kings Park and Botanic Garden (the only other facility in Australia currently working on the cryopreservation of Australian and SE Asian species). This project will focus on understanding the effects of cryopreservation on plant cells and will expand our regional capacity to cryopreserve difficult species.

Outcome 5:

Throughout the project, scientific findings will be collated and synthesised to achieve greatest impact and practical application. These findings will be made available free of charge to the widest audience.

We continued to publish in peer-reviewed journals and general community-focussed publications on rainforest-related work. Articles published this year included the following (also attached):

Book chapters

- Ashmore SE, Martyn A, Sommerville K, Errington G, Offord CA (2015) Seed Biology. In: Redden et al. (eds.) *Crop wild relatives and climate change*. John Wiley and Sons. DOI: 10.1002/9781118854396

Peer-reviewed articles

- Errington G, Offord CA, Catterall C (2015) Maximising the value of seed collections for horticulture and conservation. *Acta Horticulturae* 1101: 55-62. DOI: 10.17660/ActaHortic.2015.1101.9
- Offord CA, Rollason A, Frith A (2015) Tissue culture of *Persoonia* species for horticulture and restoration. *Acta Horticulturae* 1097: 149-154. DOI: 10.17660/ActaHortic.2015.1097.17
- Sommerville K, Offord CA (2015) Ex situ conservation techniques for Australian rainforest species. *Acta Horticulturae* 1101: 75-80. DOI: 10.17660/ActaHortic.2015.1101.12
- Zimmer HC, Meagher PF, Auld TD, Plaza J, Offord CA (2015) Year-to-year variation in cone production in *Wollemia nobilis* (Wollemi Pine). *Cunninghamia* 15:79-85.
- Zimmer HC, Auld TD, Hughes L, Offord CA, Baker PJ (2015) Fuel flammability and fire responses of juvenile canopy species in a temperate rainforest ecosystem. *International Journal of Wildland Fire* 24:349-360. DOI: 10.1071/WF14054

General articles

- *The Gardens* (Summer 2015-2016) Scholarships - The winners for 2015.
- *Your Gardens* (Feb 2015) From garden labourer to seed scientist – a rainforest journey.
- Foundation and Friends Newsletter (2015) Rainforest Conservation Project Field Trip, Feb 2015.

Measuring Impact

Collection	Target	Outputs	Outcomes
Total number of species to collect.	50	92 collections** (77 species)	Contributed to the Trust's 2025 target. **includes multiple collections from different populations for several species.
Number of threatened species collected.	20	24 collections** (16 species)	Contributed to the Trust's 2025 target **includes multiple collections from different populations for several species.
Data collection on public databases.	50	92	Information was uploaded to PlantNET and the Atlas of Living Australia
Collect herbarium vouchers.	50	92	Contributed to the collections of The National Herbarium of NSW.
Research			
Diagnostic evaluation of species for orthodox seed storage. Number of species.	50	90	This process requires a series of consecutive tests that can take a long time to complete. For these 90 species, either the first test, or the next test in the series, commenced in 2015.
Investigate storage longevity for orthodox species	30 by end of project	12 completed	Eight species found short-lived in storage (5 very short-lived).
Investigate alternative conservation options for recalcitrant species.	15	10 initiated into tissue culture 7 progressed to deflasking stage	Alternative protocols for storage are being developed. Seven species now ready for cryopreservation research.
Priority species targeted for intensive study resulting in effective conservation ex situ.	4	8	Short-lived seeds, and seeds only partially tolerant of drying and freezing, were tested for tolerance of cryopreservation.
Enable collaboration on ecology, genetics and other biological research.	4	1 PhD study 1 honours project 2 collaborations	Maximising the potential uses of the collections. Collaborated with Dr Alison Wee and Prof Richard Corlett of Xishuangbanna Tropical Botanic Garden on a review of conservation of tropical species; commenced discussions for joint grant application with Dr Eric Bunn of Kings Park and Botanic Garden and Prof Ricardo Mancera of Curtin University.
Germplasm Storage			
Store orthodox seeds.	35*	47 collections** (43 species)	Contributed to target outlined in the 'collection section'. **includes multiple collections from different populations for several species.
Store species in tissue culture, cryogenics or living collection.	Up to 15	25 added to living collection	Contributed to target outlined in the 'collection section'.
Contribute duplicate orthodox seed collections to the MSB. Number of species.	35	56*	Contributed to the global seedbank partnership. *Includes collections made in 2014 but not sent to MSB till 2015 and not previously reported.

Explore Trusts potential to duplicate collections from other parts of Australia.	Strategy in place by 2016/17	Initiated discussions with the Australian National Tropical Seedbank (Agricultural species and crop wild relatives), and two other botanic gardens at Bidoup Nuba (Dalat - Vietnam) and Pha Tad Ke (Luang Prabang – Laos).	Increased ex situ conservation.
Training			
Deliver intensive training as part of the Trust's Asia-Pacific Capacity Building program.	2 trainees for one month	13 trainees x 3 days.	Share and develop knowledge in Asia-Pacific; build linkages with and assist capacity of like organisations.
Deliver undergraduate training and work experience (days).	10	11	Raise awareness of issues with conservation.
Deliver training to post-graduate students and academics.	4	4	Raise awareness of issues with conservation.
Integrate rainforest conservation issues into post-graduate thesis projects.	3	3	Conduct rainforest species research.
Communication			
Conference presentations.	1	2	Communicated project results to peers, and exchanged ideas and knowledge.
General publications.	2	3	Gain recognition of the value of research and communicate scientific findings.
Interpretation.		Australian PlantBank rainforest interpretation successfully delivered.	Raise public awareness and buy-in.
Website on the project.	Construct.	Revised 2016.	Information delivery. New trust website launched in November. Rainforest Seed pages are currently being worked on.
Social media.		Australian Botanic Garden Facebook page: Likes : 7,041 Total Reach: 1,300,336 Total Engagement: 92,192.	Raise public awareness of seedbanking and conservation.

Partnerships and collaborations			
Support the Australian Seedbanking partnership.	Represent on the National committee.	Representation continued.	Establish the Trust as the centre of excellence for rainforest germplasm.
Maintain seedbanking partnerships with the Millennium Seed Bank (MSB).		Continued engagement Funding received from MSB for the Global Tree Project focusing on rainforest species.	Build and maintain linkages with the global native seed repository; capacity building for both organisations.

Impact Highlights

Impact 1:

Having mapped storage potential of NSW rainforest species by 2018 predictions for conservation actions can be shared with seedbanking institutions worldwide.

A major initiative of the Trust this year has been the development of the first National Seed Science Forum which will be held at the Australian PlantBank in March (14-16) 2016. Attendees at this forum will be presenting the latest results of internationally significant seed research. A particular focus of the Forum will be the biological principles underlying recalcitrance in rainforest seeds. One of the keynote speakers is Dr Christina Walters, a preeminent authority on storage of difficult-to-store species. We will be giving a number of presentations and conducting meetings on these topics with the region's top seed biologists. The Forum presents an excellent opportunity for networking and development of collaborations.

In addition to preparing for next year's Seed Science Forum, this year our scientists shared the results of their work at two international conferences: the Association for Tropical Biology Conservation (Asia-Pacific) Conference held in Phnom Penh, Cambodia, in March 2015, and the International Protea Research Symposium held in Perth, Australia, in August 2016. A presentation on the rainforest project was also given to restoration practitioners at the Linnaeus estate in northern NSW during a workshop conducted by the commercial ecological restoration company Envite Environment.

Impact 2:

By making well-researched information and high quality documented plant material available, the Trust hopes to make a significant impact on plant conservation globally.

This year, information was made available in both general interest and peer-reviewed publications. A particular focus of our communication strategy was the redevelopment of our website material. The RBG website was re-launched on a new and more user-friendly platform on the 27 November 2015. The new and greatly improved rainforest pages will go live in early 2016.

The presentation of preliminary results of our research at the Association for Tropical Biology Conservation Conference (Asia-Pacific) created a greater awareness of the utility of ex situ conservation for conserving tropical plant species and led to collaboration with a Chinese conservation facility – Xishuangbanna Tropical Botanic Garden.

Research published by our PhD student Heidi Zimmer contributed to a re-evaluation of the conservation status of the temperate rainforest species *Wollemia nobilis* and resulted in the declaration of the species as Critically Endangered in NSW. This, in turn, will lead to increased efforts to conserve the species.

Impact 3:

By providing roadmap information and support, the Trust hopes to positively influence other biodiverse countries to invest in conservation initiatives.

We continue to build influence in the region through all of the various programs outlined above. This is evidenced by our capacity to now hold the National Seed Science Forum which will be attended by many local and international scientists and restoration practitioners. <http://www.seedpartnership.org.au/seedscienceforum>

In 2016 the Trust will be employing its first dedicated science communicator. The Rainforest Conservation Project will be a focal subject for their program and the next Science Week activities of the Trust (August 2016) will focus on rainforest conservation.

Impact 4:

By offering training and sharing expertise, the Trust hopes to provide strong leadership for plant conservation in the Asia-Pacific region.

Our training focus this year has been on the development of the Seed Science Forum at which there will be many students and restoration practitioners from across the region. A Masterclass on seed storage will be delivered at the Forum by the world leader in this field.

Several lectures and other presentations on seed conservation were given to various groups throughout the year including science undergraduates at Macquarie University, and restoration practitioners on the North Coast of NSW. Expertise has also been shared throughout the year with visiting academics, post-graduate students, volunteers and work experience students participating in the rainforest project.

Financial Information

2014 – 2015: Projected Expenses vs Actual Expenses (in AUS\$)

EXPENDITURE	PROJECTED	ACTUAL	COMMENTS
Salaries (including on-costs)	303,395	291,579	Slightly lower projected staff costs, including on costs. Scientist (Training & Communications) position employed on a part time temporary basis.
Travel	15,600	7,429	Reduced travel requirement for project for this period and some field collecting costs covered by recurrent funding
Laboratory & Other Fees	5,200	754	Reduced expenditure due to Australian PlantBank lab now fully operational.
Asia-Pacific Capacity Building	10,000	3,595	Travel costs for collector to conduct Seed Conservation Workshop in Vietnam.
Total	334,195	303,357	
INCOME			
Arcadia Fund	118,098	150,621	
Private Donations	112,324	91,700	
Corporate Support (TransGrid & HSBC)	103,773	61,036	
Total	245,685	303,357	

2015 – 2016: Projected Budget (in AUS\$)

INCOME SOURCE	BUDGET ITEM	YEAR 4
Arcadia Fund	Scientist	111,340
	ACB	10,000
	Subtotal	121,340 (approx.)
Foundation & Friends and Private Donations (including funds already pledged from donors)	Collector	91,612
	Travel	10,400
	Scientist	22,268
	Subtotal	124,280 (approx.)
Corporate Support (HSBC and TransGrid)	Technical Officer	75,346
	Laboratory	5,200
	Travel	5,200
	Subtotal	85,746 (approx.)
TOTAL PROJECT COSTS		331,366