PROJECT PHOENIX

IN THE FIELD AND LAB WITH THREATENED SPECIES MANAGERS

PROJECT SUMMARY

JUNE 2021

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

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Greening Australia (National Office)
Level 3, 349 Collins Street
Melbourne VIC 3000
Tel: 1300 886 589
Email: phoenix@greeningaustralia.org.au
Website: www.greeningaustralia.org.au

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Author: Damian Wrigley, National Coordinator, Australian Seed Bank Partnership, Australian National Botanic Gardens
Title: In the field and lab with Threatened Species Managers

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About the project

The Australian Seed Bank Partnership (ASBP) is Australia's leading ex situ seed conservation collaboration for the long-term storage and research into Australia's threatened native species. This project will see rapid flora assessments, seed collections, germination trials, reintroductions and long-term storage of seed from threatened and bushfire-affected species across Australia.

Scope

This project involved seven ASBP partners across seven states and territories, and included the following activities:

- Rapid flora assessments for 76 taxa in New South Wales, Queensland, South Australia, Tasmania and Victoria.
- Multi-provenance seed collections for 108 taxa in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia.
- Development of germination protocols for 20 taxa collected through this project.
- Development of germination protocols and retrials for 38 taxa already held in seedbanks.

The extent of the 2019–20 bushfires has been well documented by government agencies and academia. These unprecedented fires burnt peatlands, rainforests and alpine habitats, with many of the most adversely impacted areas having never experienced fires before or, if they had, not with such intensity (as much as recent records can identify). The long-term effects of the fires on these sensitive areas and their native species are only now becoming better understood, with much more still to be determined. The task of assessing the impact and implementing actions to support habitat recovery across millions of hectares is crucial.

Supported by funding from Project Phoenix, the ASBP undertook rapid flora assessments, germplasm capture, and germination trials across six states and one territory. To determine target species, the ASBP undertook extensive analysis of the information held by seedbanks, botanic gardens and herbaria, including new data gathered by these institutions following the fires. This information was considered in concert with new bushfire impact and prioritisation data released by governments and academics following the bushfires.

Consultations also occurred with the Department of Agriculture, Water and the Environment, the Threatened Species Bushfire Recovery Expert Panel and Dr Rachel Gallagher to determine high priority actions at the national level.

The prioritisation of species at both the national[1] and regional levels assisted seedbanks to target their efforts and secure germplasm and bushfire response data that are already supporting future bushfire preparedness. In time, it is hoped these collections and data will assist with bushfire responses.

[1] Gallagher RV. (2020). *National prioritisation of Australian plants affected by the 2019-2020 bushfire season*, Report to the Commonwealth Department of Agriculture, Water and Environment. https://www.environment.gov.au/biodiversity/bushfire-recovery/priority-plants

Introduction

Rapid flora assessments

Surveys of target areas help to ascertain vegetation condition, species abundance, population size, and pests and disease presence and impact. ASBP partners monitored flowering, fruiting and seed production to ensure that the timing of collecting trips coincided with optimum seed availability.

These flora surveys also provided seed banks and conservation agencies with data on the impact of fires and species recovery post fire, enabling the future prioritisation of seed collecting across the surveyed areas and informing bushfire response and management. The data will also be uploaded to botanic garden databases and made available to those involved in research, conservation and bushfire recovery.

Seed collections

New germplasm collections made through the project provide insurance for Australia's native taxa against future loss from environmental crises such as bushfires. Collections ensure the genetic material is represented and secured in long-term ex situ conservation seed banks, providing opportunities for future proactive conservation and research. If a species is threatened in future years, actions can be taken to reverse species decline in the wild by utilising collections to bolster populations.

Part of this work involved the collection of data on seed abundance, quality and viability, as well as lodgement of botanical specimens with relevant jurisdictional herbaria. This will improve knowledge of species distribution and inform future threat assessments and management.

Germination trials

Trials provide scientists with the knowledge of collection viability and unveil the process by which they can germinate plants from seeds. Each species has specific cues that stimulate them to germinate. Some may only require moisture, while others may require physiological treatments such as heat, scarification, or even chemical treatments such as smoke or acid baths. Seeds may also require prolonged day/night temperature cycles to stimulate germination. It is therefore critical that, following collection, germination protocols are developed and documented for each species.

ASBP partners undertook germination trials for both new and existing collections to test collection viability and document species germination protocols. In the future this will allow seed banks to germinate as many of the seeds as possible if required for restoration and management of bushland areas.

Issues

Weather conditions

- In the Australian Capital Territory and New South Wales, the latter part of the collection season was impacted by unfavourable weather conditions for the higher altitude collecting trips. Associated delays meant that not all collection sites could be reached before seed had dispersed.
- Additionally, a flooding event in New South Wales in early March 2021 meant that access to key target areas in the Deua and Wadbilliga Wilderness Areas, and Blue Mountains World Heritage Area, was restricted and planned fieldwork was delayed.
- However, the flexibility to draw target species from the High Priority List as well as regional priorities meant that alternative targets could be planned in autumn 2021 to avoid flooded areas, resulting in the completion of additional collections and assessments (see Key outputs section).

Germplasm availability post-fire

- Given this project focused on threatened taxa that were heavily impacted by the 2019–20 bushfires, many ASBP partners discovered that mature populations of target species could not be located in the landscape (e.g., *Acacia cognata*, *Dampiera purpurea* and *Ozothamnus adnatus* in Victoria), or that populations were too young or small to allow for seed collection (e.g., *Eurychorda complanata* and *Lepyrodia valliculae* in South Australia).
- Additionally, the timing of the project was not suitable for seed collection of all species, as some seed had not matured enough (e.g., *Andersonia axilliflora* in Western Australia), or seed had dropped before the commencement of the project. Recovery of species after the bushfires has modified the timing of historically regular flowering/seeding events of some target taxa (e.g., *Tetratheca subaphylla* and *Ranunculus lappaceus* in New South Wales).
- To counteract these issues, several opportunistic seed collections of other priority or rare/threatened species were made, and some of these have been used as replacement species for seed collection where targets could not be collected.

COVID-19

- Ensuring compliance with organisational COVID-19 protocols significantly impacted some ASBP partners' ability to initiate their activities, and to quickly respond to favourable environmental conditions and seeding events. Approvals to undertake field trips took additional time and placed limits on the number of staff per vehicle, meaning more planning and resources were required than usual.
- Delays in starting the project and limited access to resources (such as vehicles through fleets or hire car companies) meant that peak seeding was missed for some target taxa (e.g., *Ranunculus anemoneus* and *Caltha introloba* in the Australian Capital Territory) and resulted in minimal or no seed being collected.

Comments

The scope of this project allowed work critical to the management of *ex situ* seed collections and germination testing to be conducted by ASBP partners across seven states and territories. The impact of the bushfires continues to influence the work of the ASBP across multiple projects and Project Phoenix will continue to contribute to the full suite of bushfire recovery work delivered by Australia's conservation seed banks.

Further analysis of these collections will occur throughout 2021–22 to help us to further understand the representation of Australian flora across the families, genera and species that exist throughout Australia. This work will enable further prioritisation of flora conservation and, in concert with information collected and developed through this project, will lead to better preparedness and response to future bushfires.

Pending the availability of funding, it is recommended that further analysis be undertaken to ascertain which species secured through this project are currently utilised by the restoration sector, including which of these have been identified as priorities for landscape restoration by funders, land managers, developers or business (i.e., mining).

This analysis may be useful in understanding the interactions and alignment that may have resulted between the conservation and restoration sectors as they have responded to the impacts of the bushfires. As conservation seed banks in Australia aim to secure the entirety of the Australian flora in seed banks (as seed or other germplasm) it is likely that those species not currently identified as immediate priorities for the restoration sector may become so in future years.

Key outputs

Table 1: ASBP outputs and ongoing activities for Project Phoenix

Activity	Target Number	Number complete at 21 May 2021	Number ongoing at 21 May 2021
Total rapid flora assessments	**76**	**192 (90 taxa)**	**0 (0 taxa)**
Total seed collections	**108**	**120 (103 taxa)**	**11 (10 taxa)**
New seed collections of native taxa	54	29 (28 taxa)	2 (2 taxa)
Genetic diversity seed collections of native taxa	41	65 (54 taxa)	6 (5 taxa)
Duplicate collections/bulking up of native taxa	13	26 (21 taxa)	3 (3 taxa)
Total germination trials	**58**	**53 (42 taxa)**	**31 (21 taxa)**
Germination of existing collections of native taxa	38	49 (38 taxa)	16 (7 taxa)
Germination of new collections of native taxa	20	4 (4 taxa)	15 (14 taxa)

Note:
The table values indicate the number of assessment, collection and trial activities for the number of taxa indicated in brackets

Ongoing activities

As indicted in **Table 1**, some germination trial and seed collection activities remain ongoing. Germination trials also continue as some experiments commenced in April–May 2021 and require additional time to determine the best treatments for breaking seed dormancy and stimulating germination. In addition, seed collection activities remain ongoing for several reasons related to environmental conditions and plant biology.

ASBP partners reported that some germplasm material has been bagged in the field but was not yet mature enough to be collected at the time of this report. Additionally, some collections require taxonomic identification to be confirmed before a species can be attributed to the project, and this process continues. Lastly, some species had poor seed set during the 2020–21 collecting season due to the impacts of the bushfires and have been prioritised for collection in the years ahead. Activities that are finalised before September 2021 will be reported to the Project Phoenix team as an addendum, while activities made in future years will be reported through relevant online seed bank databases. In addition to the outstanding activities, the addendum will include updates to outstanding data such as seed weights after cleaning etc.

Discussion of outputs

For two of our three overarching project activities (rapid flora assessments and seed collections), the ASBP exceeded the project targets, delivering 192 rapid flora assessments for 90 taxa, and 120 seed collections for 103 taxa. As germination trials for some species are still underway, the target of 58 trials has not yet been met. At the time of reporting only 53 germination trials have been completed for 42 taxa. A total of 31 germination trails that commenced before the end of the project period are yet to be completed.

The ASBP did not meet the targets for two sub-activities (‘*new seed collections’* and ‘*germination of new collections of native taxa’)* due to the issues described in the Issues section. Given the impacts of COVID-19, weather and germplasm availability, ASBP partners reported challenges related to locating and collecting fruit or seeds from new species.

The lack of available germplasm meant that the proposed germination of these targeted new collections could not be conducted. However, the ‘new collections’ were supplemented by an over-delivery of other collection types (see Table 1) resulting in the ASBP meeting its overarching collection target. Once the 31 ongoing germination trails are completed, the target for total germination trails will be met and exceeded.

Outcomes

Given project activities are still ongoing, the anticipated long-term outcomes of this work are discussed below.

Improved insurance

Project Phoenix supported the ASBP to complete 29 collections of 28 previously unbanked species (or 'new species'), providing a long-term ex situ insurance policy for priority flora in the event of future threats. While the focus of seed conservation funding is often to bank collections of previously unbanked species, improving the genetic diversity and size of banked species is also crucial.

Collecting from multiple populations across a species range is the primary way of capturing genetic diversity for ex situ conservation and may help to conserve new and novel genes present within a species. The ASBP completed 65 collections of 54 previously banked species for this purpose. Furthermore, recollecting from a target population to duplicate existing collections of a species will help to increase the number of seeds held in seed banks from specific populations, ensuring a sufficiently large 'conservation collection' is securely stored and providing greater insurance against species loss.[2] Through Project Phoenix ASBP secured 26 collections from 21 taxa to duplicate or bolster the size of collections already stored in seed banks.

Capturing diversity across taxonomic families is one way of evaluating the representation of Australia's unique and diverse flora in seed banks that is available for future use. Project Phoenix enabled the ASBP to bank seed from 44 plant families. These families were represented across the three activity areas (collecting, germination & RFAs) as follows:

- 19 families were represented across all three activity areas
- 9 families were represented across two activity areas
- 16 families were represented in one activity area.

The information collected through the three areas of collecting, germination and rapid flora assessments is yet to be finalised as some activities are still underway. The representation across genera will be provided in the addendum to this Project Summary following the completion of these activities. This information will contribute to efforts by seed banks to prioritise under-represented families, genera and species for subsequent germplasm capture, storage and research.

[2] Offord, CA and Meagher, PF. (2009). *Plant germplasm conservation in Australia: strategies and guidelines for developing, managing and utilising ex situ collections*. Australian Network for Plant Conservation Inc., Canberra.

Information for future recovery

For this project, the ASBP completed 53 germination trials of 42 species.

Development of species-specific germination protocols is of great benefit for recovery response to future threats, as seedlings can be quickly germinated for restoration and seed of threatened species is not wasted through repeat trials or by application of inappropriate treatment methods.

Similarly, the data gained from the 192 rapid flora assessments under this project can be utilised in concert with other bushfire response studies to inform and adapt management decisions in the event of future bushfire events.

Together this information can also be used to improve public awareness of the importance of ex situ conservation collections in the response to threats such as bushfire events.

Findings

This section describes the findings for the seven ASBP partners contracted under this project. Completed activities are as at 21 May 2021. Further discussion of quantitative results can be found in Key outputs section.

National Seed Bank, Australian National Botanic Gardens

The National Seed Bank at the Australian National Botanic Gardens (ANBG) targeted collection areas within Kosciuszko National Park, focusing on the fire impacted areas in Mt Jagungal Wilderness and Bimberi Wilderness Areas.

The collecting activity occurred from February through to May 2021, targeting priority alpine and sub-alpine taxa. The ANBG completed 22 collections of 17 species, with four collections of three species ongoing.

The collections involved taxa from both the ANBG's primary target and expanded target lists, as four target species had been impacted by fires or other threats and were not present or were not producing seed.

For example, *Utricularia monanthos* was not detected in target sites due to fire impacts and herbivory and trampling by wild horses.

Queensland Herbarium, Department of Environment and Science, Queensland (DESQ)

The Queensland Herbarium completed project fieldwork from late 2020 until early 2021 in fire-impacted areas of the South East Queensland and Central Mackay Coast Bioregions, Cooloola-Sunshine Coast and the New England Tablelands. Seed collected by the DESQ will be banked at the Brisbane Botanic Gardens seed bank. DESQ completed 14 seed collections of 14 taxa and 15 flora assessments for 12 taxa as originally planned.

The response of target species to fire was generally positive with many species observed to be resprouting and some showing early evidence of recruitment. For example, individuals of *Allocasuarina rupicolais* were observed to be resprouting in areas where cool burns occurred.

South Australian Seed Conservation Centre, Botanic Gardens and State Herbarium (BGSH)

Project activities were completed between September 2020 and April 2021 and included five field trips to Kangaroo Island to conduct post-fire flora assessments, seed collections and germination trials for target taxa.

BGSH completed 27 flora assessments for 21 taxa, observing that six taxa recovered after fire by resprouting from rootstocks/tubers and 15 taxa recovered from seeds.

BGSH also completed 22 seed collections of 16 taxa, including genetic diversity collections for 11 taxa. Two taxa (*Grevillea lavandulacea* subsp. *rogersii* and *Lepyrodia valliculae*) were not located during surveys and will be collected in 2022. With field work on Kangaroo Island continuing through to June 2021, the majority of germination experiments are still underway, with trials for 17 taxa ongoing with four complete as at May 2021.

The Western Australian Seed Centre, Kensington, Department of Biodiversity, Conservation and Attractions (DBCA)

DBCA undertook reconnaissance field trips to the bushfire impacted Stirling Range National Park in October 2020, targeting threatened species for future collection to improve genetic diversity and size of collections held in the seed bank.

The bagging of fruit for seed collection began in November and seed collection activities continued until April 2020. Throughout the period, 13 seed collections of nine threatened plant taxa were undertaken. An additional species (*Andersonia axilliflora)* has also been bagged, however the seed has not yet been collected due to the late seed set of this particular species.

In November 2020, germination testing commenced for fire impacted species of conservation significance in Western Australia. To date, 45 germination tests have been completed for 34 species, with an additional 14 trials for four species continuing.

Germination for most completed trials (30) was high (> 75%). Nine trials had low germination (< 50%) with the germination appearing to be due to low seed viability rather than seed dormancy.

Additionally, testing of *Sphenotoma drummondii* was delayed until May 2021 so that germinants could be grown on to produce seedlings that will be used for planting into a seed production area in 2022.

The Australian PlantBank, Australian Botanic Garden, Royal Botanic Gardens and Domain Trust (RBGDT)

The RBGDT completed fieldwork from August 2020 until May 2021 focusing on rapid flora assessments and conservation seed collections for bushfire affected target flora across New South Wales, including in the Nandewar Ranges, New England Tableland, the Sago Plateau and the Newnes Plateau.

The RBGDT were able to locate most target species and complete assessments and seed collections using existing population datasets. Project targets for this partner were exceeded with 27 seed collections for 23 taxa secured and 30 flora assessments for 24 taxa completed.

For some species of conservation concern, the 2019–20 bushfires stimulated regeneration and recruitment, with some species found to be recovering in far greater numbers than previously recorded.

For example, in Werrikimbe National Park, patchy burns have seen known populations of *Chiloglottis anaticeps* increase from a few hundred individuals to greater than 50,000 individuals. Some species however (such as *Prasophyllum caricetum* from the Southern Tablelands and *Asterolasia rupestris* subsp*. rupestris*, were not located at any previously recorded locations. These species are now being considered for further conservation management and/or potential threatened species listing.

The Victorian Conservation Seed Bank, Royal Botanic Gardens Victoria (RBGV)

Rapid flora surveys and seed collection of rare and threatened plants were undertaken by RBGV in bushfire affected regions across eastern and north-eastern Victoria from December 2020 through to the end of March 2021.

Where target species were able to be located, individuals were generally observed to be responding well to the fires and subsequent rains.

In total, target plants were successfully located at 37 of the 49 survey sites. Some target species could not be located and as such, other priority species were surveyed in their place. For example *Acacia phasmoides* and *Grevillea parvula* were not located due to poor location data, while *Goodenia macmillanii* and *Correa lawrenceana* subsp. *genoensis* may have been obscured by dense regrowth in survey areas. Despite this, a total of 49 flora assessments were conducted for 27 taxa, exceeding RBGV's target of 20. Additionally, 11 seed collections were made for 10 taxa. In many instances it was not possible to locate mature, unburnt populations, making it impossible to collect seed this year. For these taxa, return visits to their localities will be undertaken in future field trips following the completion of Project Phoenix.

Tasmanian Seed Conservation Centre, The Royal Tasmanian Botanical Gardens (RTBG)

In Tasmania, rapid flora assessments were undertaken in six fire impacted areas beginning in late October 2020 and continuing through to mid-February 2021. Seed collection activities were also undertaken across two of these target areas in mid-December 2020. In total, 70 rapid flora assessments were conducted for four taxa and 11 seed collections were secured for eight taxa.

The two priorities for the Tasmanian activities were the endangered *Eucalyptus gunnii* subsp. *divaricata*, and *Cardamine tryssa*, a poorly known herb that was recently rediscovered in Tasmania. A fire at Marlborough Road impacted over a third of the already stressed Eucalyptus populations and proved to be the final stressor for older trees.

Presently no seed collection could be secured for *Eucalyptus gunnii* as very little fruiting material could be located. However, the winter rains of 2020 have encouraged good flowering and the RTBG is planning to harvest seed next season. For *Cardamine tryssa,* surveys showed that this species recovers well after a fire, which was further confirmed through the collection of 45,000 seeds this season.

Evidence

Output evidence can be found in the following places:

- Rapid Flora Assessment data — ASBP Project Phoenix Activity Data Spreadsheet
- Germination Trial data — ASBP Project Phoenix Activity Data Spreadsheet
- Seed Collection data — ASBP Project Phoenix Activity Data Spreadsheet

RECOMMENDATIONS

RECOMMENDATIONS

1

Having alternative options for target taxa and target sites was crucial to the success of delivering the project. Several times ASBP partners switched focus to a different species due to seed availability, changed weather conditions or because sites were inaccessible due to fire damage. Having flexibility built into project planning allowed targets to be met despite these challenges.

The ASBP recommends that flexibility built into project planning should be considered as a critical element of on-ground seed collecting activities to complement primary target species and to mitigate the risk of null returns from expended funds.

2

Given the relatively short time between fire events and site visits (due to the project time frame), ASBP partners had issues with locating mature plants capable of producing fruits or seeds for some species. While some species may be available in the first-year post-fire, it is important to allow sufficient time for regeneration to occur for other species, especially for plants that are slower to reach maturity or refruit, or where fire impacts were greatest.

Expanding project timeframes after bushfire events would be a way to resolve this issue.

3

Defining clear timeframes for milestones and reporting is important for service delivery organisations to undertake planning. Changing timeframes late in the project results in unexpected overdue milestones, and incomplete reporting that requires additional effort and time to amend in the future.

We recommend defining clear due dates for reporting in grant agreements, with the potential to acknowledge the time necessary for service delivery organisations to coordinate and prepare reporting on project activities.

WANT TO KNOW MORE?

Related projects

- *Bushfire impacts — A national model for assessing local landscape restoration priorities*
- *Bushfire impacts — How much seed will I need?*
- *Bushfire impacts — Where will the seed come from?*

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


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