Increasing Native Grassland Diversity Through A Threatened Species Seed Production Area

Over the past decade, Catchment Management Authorities (CMAs) on the Victorian Volcanic Plain have been running programs to support landholders in the conservation of critically endangered native grasslands. These programs have focused on controlling threats, as well as modifying the disturbance regime to increase plant diversity.

However, there are limitations to these types of disturbance modifying approaches. Victoria's native grasslands typically lack a persistent seed bank, so although a disturbance modification may create the conditions to support increases in plant diversity, the ecosystem lacks the seed resources to realise this opportunity. To address this, Glenelg Hopkins CMA (GHCMA) is coupling a landholder stewardship program with the addition of seed from seventeen plants rarely found on private land.

To limit the pressure of wild seed collection on remnant populations, GHCMA have developed a threatened species Seed Production Area (SPA). This presentation will discuss the process of developing and managing the SPA, as well as working with landholders to establish new threatened plant populations in the field.

Impacts Of Shifting Fire Season On Different Seed Dormancy Types

Fire is a major factor shaping plant communities, and plant species have evolved to persist through a fire regime, broadly characterised by the frequency, intensity, and season of burns typical of their region. However, historical fire regimes are shifting with changing climate and other factors, including increased ignition sources, and implemented fires, producing more frequent burns of varying intensity. As such, seasonality of fire is shifting and despite the effects of fire on plant persistence being well studied, there is still little understanding on the effects of fire season. This study seeks to address this gap by examining the effects of fire season on recruitment success on multiple species with different seed dormancy types from the Mediterranean region of South Australia. The study set up two sites with five treatment areas, including early autumn burn, late autumn burn, early spring burn, late spring burn, and a control. The findings demonstrate that plant responses to fire season varied according to traits, such as seed storage and dormancy type, highlighting the importance of considering fire season in species management decisions aimed at supporting plant persistence.

Empowering Communities And Incentivising Seed Collectors: Addressing Seed Shortages Through Innovative Programs

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Seeding Victoria is a not-for-profit organisation committed to addressing the growing challenges of native provenance seed supply across western and central Victoria. As demand for high-quality native seed rises, barriers such as limited capacity, declining collector numbers, and funding constraints persist. In response, Seeding Victoria has developed innovative strategies to support seed collection and ensure long-term sustainability.

The **Revolving Seed Fund**, launched in 2023 with support from the Natural Resources Conservation Trust and Cassinia Environmental, incentivises seed collectors by offering a 50% upfront payment for seed collected from targeted regions. This initiative encourages collection for priority projects, such as the Bush Bank program, while establishing a reliable seed bank for future restoration. Notably, the seedbank functions as a seed broker, selling seed on commission from collectors who are paid upon sale, creating a financial benefit for collectors.

Building on this, the **Seed Pod Program**, introduced in 2024, strengthens collaboration with local Landcare groups and other partners. This initiative creates sustainable subgroups for flexible seed collection, with Seeding Victoria holding permits and providing educational workshops, equipment, and ongoing support. This model enables wider participation and collection from a diverse range of species and local provenances.

Both programs focus on upskilling community members in seed ecology, collection, and cleaning while addressing critical challenges such as access to provenance seed and the limited capacity of staff and volunteers. By enhancing partnerships, expanding community involvement, and leveraging innovative funding approaches, these initiatives ensure a resilient and diverse native seed supply for restoration and conservation projects.

This presentation will share insights into Seeding Victoria's successes and challenges in navigating funding strategies and partnerships, offering valuable lessons for others addressing similar issues in the native seed sector.

Data Consistency and Curation is Key to Maximise The Value of Conservation Seed Banks: Learnings From The Review of Australia's Seed Bank Programs 2000-2020.

Catherine Offord[1]
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Seed banking for conservation has grown exponentially over the past 25 years, with the establishment of global and national networks of seed collecting institutions. The Australian Seed Bank Partnership (ASBP) is a formal network of conservation seed banks across all Australian states and territories, each collecting, testing and storing local native species to support regional, national and international plant conservation goals.

A review of seed collections banked by the Partnership from 2000 to 2020 across the ten collecting institutions assessed the coverage of Australian flora represented in seed banks, evaluated collection knowledge and functionality, and identified gaps to guide future seed banking priorities and improvements.

The review quantified over 31,000 accessions representing more than 10,000 species, including over 50% of nationally listed threatened plants and 46% of IUCN Red List species. Many listed species had extensive diversity captured, reflecting the significant investment in targeted conservation programs. Australia's largest plant families – Myrtaceae, Fabaceae and Proteaceae – were the most represented in seed banks. Seed collections have primarily been used to advance seed biology and banking methods, as well as to support conservation and restoration projects.

However, the review also highlighted critical gaps in representativeness in collections, and digitized data on seed quality, viability and germinability, with many assessments either unrecorded or unavailable. These gaps reflect the differing purposes and priorities of individual collecting programs. Additionally, collection retesting was extremely low (<2%) and was often limited to specific research or conservation use.

Australia's review provides key insights for establishing conservation seedbanks, underscoring the importance of foundational elements for a true 'conservation collection', including consistent data on provenance, genetic representativeness, and active curation with systematic retesting to monitor long-term seed viability.

Conserving Pollen In A Conventional Seed Bank: A Case Study On A Critically Endangered Hawaiian Species

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Conserving pollen in a conventional seed bank: a case study on a critically endangered Hawaiian species

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Abstract
Storage of pollen facilitates gene exchange between geographically isolated individuals, and for controlled pollination when flowering of staminate and pistillate flowers or individual plants are asynchronous. Therefore, conserving pollen allows for strategic crosses across both space and time. Desiccation of pollen is essential for the retention of high longevity, yet research into pollen storage behavior is infrequently performed, especially in wild species. *Ochrosia kauaiensis* (or Hōlei in the Hawaiian language) is a Hawaiian endemic tree in the Apocynaceae family assessed as critically endangered on the International Union for Conservation of Nature Red List that produces desiccation intolerant (i.e. recalcitrant) seeds. In order to conserve the genetic diversity of *O. kauaiensis* ex situ in a conventional seed bank, we will investigate the germination, storage behavior, and longevity of its pollen. Specifically, in regards to *O. kauaiensis* pollen, we ask; 1) how does sucrose concentration affect germination, 2) how does temperature affect germination niche breadth, and how does 3) desiccation, 4) freezing, and 5) time affect longevity? To answer these questions we will collect pollen from the living collections of the National Tropical Botanical Garden. We will desiccate pollen to international standards (e.g. 15-20% equilibrium relative humidity) at 25°C, hermetically seal, and store at -18ºC, then assess viability via a germination test at each stage. To assess pollen longevity, survival curves will be determined and compared using p_{50} (the time for viability to decrease to 50%). Preliminary results suggest that germination is optimal at 25% sucrose at 25-35°C. Our results will be important for species, land, seed, and gene bank managers and curators. Considering the current rate of plant extinction in Hawai‘i and globally pollen storage is a critical tool for conserving plant diversity.

Safeguarding Seed Longevity: Enhancing Efficiency In The Australian Grains Genebank

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Genebanks are essential for preserving biodiversity which is crucial for environmental sustainability, climate adaptation, and future food security. They store the plant genetic resources used by researchers and breeders in developing new, climate-resilient varieties. The Australian Grains Genebank (AGG) is one of the largest and most diverse grain crop genebanks globally, holding more than 210,000 accessions of temperate and tropical cereals, legumes, and oilseeds. To meet future crop improvement and productivity targets, the availability of high quality, highly viable, germplasm is critical, which can be challenging for large, diverse collections. With regeneration being the costliest genebank activity, it is important that genebanks are taking appropriate measures to increase cost-efficiencies whilst still ensuring germplasm availability into the future. Here I will talk about how the AGG is undertaking a review of initial and periodic seed viability data over time for selected crop groups to better understand observed seed longevity. This data will inform appropriate viability monitoring intervals and ensure timely regeneration of the collection, as well as identify sub-sets of germplasm that require immediate, or more frequent, viability testing and/or are a high priority for regeneration. This information will improve the operational efficiency of both viability testing, and seed regeneration activities of the AGG into the future, leading to greater cost efficiencies and greater germplasm availability to support the Australian grains industry.

Assessing The Storage Potential Of Seed Collections To Inform The Management Of Wild Species Seed Banks

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Seed banking is a key component of global *ex-situ* plant conservation. As standard storage practices have changed over the years, institutions storing seeds for decades may hold older collections that are stored sub-optimally for at least some of their storage. Using banked seed collections at Kings Park and Botanic Garden (Perth, Western Australia), we aimed to assess the relative future longevity of several seed collections of 10 wild Western Australian species. These collections had been stored for 4–34 years. We conducted germination assessments on seeds from 44 collections. For species with multiple accessions retaining similar viabilities (total of 24 accessions across 6 species), we conducted a rapid ageing experiment by subjecting seeds to 60% relative humidity at 45°C to determine their potential remaining longevity. Several collections of *Brachyscome iberidifolia, Myriocephalus gueriniae, Olearia axillaris* and *O. pimeleoides* banked in the 1980s and 1990s displayed 0% germination. Newer collections of *B. iberidifolia, Hyalosperma cotula, O. axillaris, Panaetia lessonii, Podotheca angustifolia* and *Trachymene pilosa* retained similarly high and consistent viability over time in storage. Rapid ageing of these collections showed that the time to 50% loss of viability (*p*50) varied significantly and was not necessarily lowest for the oldest seed collections. We determined that several species and individual collections have lower longevity and therefore need to be prioritised for more frequent viability monitoring, use, or re-collection. This methodology could be used by wild species seed banks globally to make more informed decisions about historical and ageing seed collections.

Changes In Whole-seed Respiration During Seed Aging – A Useful Measure Of Seed Viability And A Predictor Of Longevity?

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Seed banking is an efficient *ex situ* conservation strategy designed to preserve the genetic diversity of crops and wild species. However, for dry seeds stored in the bank, the decline in, and loss of viability is imperceptible, and the event of seed death can only be determined posthumously by monitoring samples of the seed population for viability. Accurate viability monitoring during storage can be challenging for wild species, particularly when seeds are dormant, or germination conditions are unknown. Damage to seed mitochondrial membranes by reactive oxygen species has been associated with aging stress and is thought to impact energy metabolism, and measures of whole-seed respiration have been shown to be useful in assessing seed viability. However, there are few empirical studies that have assessed changes in whole-seed respiration during time in storage. We aimed to quantify any changes in aerobic respiration prior to germination and determine if these changes were correlated with seed viability. Using rapidly aged (at 45°C and 60% RH) seeds of *Triticum aestivum*, and *Brassica napus* subsp. *napus*, we used fluorescence-based closed system respirometry to measure whole-seed oxygen consumption and flow-through respirometry to measure whole-seed carbon dioxide production. We compared these measures of respiration with metrics of seed germination and seedling vigour. Secondly, we measured the oxygen consumption of seeds from collection of wild Western Australian native species stored under conventional seed banking conditions. Our results showed that while respiration may be useful to determine viability, a relationship between seed respiration and longevity is less clear.

Applied Seed Biology For The Conservation And Restoration Of Western Australia's Biodiverse Flora

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The state of Western Australia occupies one third of the continental land mass of Australia, is home to over 16,000 species of plants and fungi and includes an internationally recognised biodiversity hotspot in the south west. Like many ecosystems globally, Western Australia's plant biodiversity is under increasing threat from climate change, land clearing and invasive pests and diseases. As a result, there is an increasing need to preserve our plant biodiversity *ex situ*, and where possible, to return species to the wild, via conservation translocations or ecological restoration. Effective conservation and restoration rely on successful establishment of plants in the field; however, several critical bottlenecks exist that limit success – including the storage behaviour and longevity of seeds when stored *ex situ*, along with variation between species in terms of their seed dormancy and germination requirements. Using a range of examples, including an analysis of seed trait data from almost 300 wild Western Australian native species, we show that an improved understanding of key seed functional traits underpins the development of targeted, species-specific treatments that improve establishment outcomes.

Ex-situ Seed Longevity And The Germination Niche Of Seeds From Western Australia's Wet-dry Tropics

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Ex situ seed storage is integral for the conservation of plant species as it helps to preserve both plant species and their genetic diversity. Understanding the optimal conditions under which to store seeds, their longevity in storage, and how to best maximise germination once seeds exit storage is critical to ensure successful conservation. The Kimberley region of north-western Australia is located within the wet-dry tropics, and distinctly characterised by hot, wet summers and warm to hot, dry winters. Little empirical research has been undertaken on plant species from the region owing to its remoteness and inaccessibility for much of the year. Consequently, knowledge of seed germination requirements and seed storage behaviour and longevity of the regional flora is limited. Many "exceptional" species – those that are not amenable to conventional seed banking due to factors such as insufficient seed availability, non-orthodox or short-lived seed storage behaviour, or complex seed dormancy issues that prevent effective germination and utilisation of collections – are also suspected to occur in the Kimberley. We used seeds of 40 species across a range of families collected from the Kimberley region to: a) understand the desiccation tolerance in seeds of species suspected to be desiccation-sensitive; b) assess comparative seed longevity via rapid aging; and c) understand seed germination traits, including characterising germination temperatures and the ability to germinate under water stressed conditions. the Results from this study will be used to inform future conservation collections for ex situ seed storage from the region. The collections are urgently required given the increasing threats to Kimberley flora posed by shifts in land management, cattle grazing, changing fire regimes, introduced weeds, pests and pathogens, and the compounding effects of climate change.

An Ethical Framework To Manage Demand For Seed

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In 2022, Euroa Arboretum developed a 'Seed Strategy' to address the exponential demand for seed in response to the state government's Biodiversity Plan, 2037. Our Strategy outlined how we would expand seed orchards in the Goulburn Broken catchment. The orchards would focus on commonly collected, direct seeded species, but also species that are observed declining in health and vigour in the landscape.

We have developed a project with Natural Resources Conservation Trust to build a 20 hectare seed orchard at Avenel, Goulburn Valley Water site. Concurrently, with funding from Taungurung Land and Waters Council, we are re-building our irrigated seed orchards and daisy boxes at the Arboretum to supply difficult to harvest daisies and pea species. We have approximately 40 species in seed orchards around the Goulburn Broken catchment with plans for over 100.
We harvest between 100 – 200kg of seed per year currently and have about 250 species represented in the seedbank.
We can not supply the emerging market based programs with wild harvested seed.
We have limited skilled staff capable of coordinating wild harvest of complex, diverse seed collection.
Current cost of harvest and cleaning of seed exceeds the price per kilogram when paying skilled staff to harvest.
Our approach has been to apply a code of ethics to seed harvest – in acknowledgement and respect for our Traditional Owners and the lands we harvest from. We acknowledge as a business that we have a responsibility to demonstrate to each customer that our seed is precious. We are invested in where our seed goes and the purpose it serves in restoration. We sell seed intended for bush food to customers where there is a direct benefit to Traditional Owners. We are scaling down diverse seed collection and will focus on most of our seed being sourced from seed orchards.

Native Seed Supply In South Australia: Challenges, Innovations, And Pathways For Seed-based Restoration

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Native seed supply is fundamental to effective ecological restoration, yet in South Australia, securing sufficient, high-quality, and genetically diverse seed remains a significant challenge. The increasing demand for native seed, driven by large-scale restoration projects, carbon offset initiatives, and biodiversity conservation, has exposed critical limitations in current seed supply chains. Issues such as declining wild seed availability, climate-induced variability in seed production, and the complexity of scaling up commercial seed production hinder restoration efforts.

This presentation will provide an overview of the native seed supply landscape in South Australia, examining the constraints that impact seed collection, storage, and distribution. We will explore innovative strategies to enhance seed availability, including the establishment of seed production areas (SPAs), advancements in direct seeding technology, and the importance of collaborations with Traditional Owners, landholders, and industry stakeholders. Case studies will highlight successful approaches to overcoming supply bottlenecks and ensuring the ecological integrity of restoration projects.

By fostering a more resilient and coordinated native seed sector, South Australia can meet the growing demand for seed-based restoration while maintaining biodiversity and ecosystem function. This presentation aims to spark discussion on the policy, investment, and research required to build a sustainable future for native seed supply in the region.

Negotiating The Regime Complex Of Access And Benefit Sharing Laws And Sustaining Valuable In Situ And Ex Situ Germplasm Collections

Charles Lawson[1]
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Both in situ and ex situ germplasm collections are increasingly subject to access and benefit sharing (ABS) laws according to the United Nations (UN) Convention on Biological Diversity (CBD) and its Nagoya Protocol (NP) and related regimes covering some agricultural plants, some viruses and some marine resources. Valuable collections and the ongoing work of conservation and collection need to engage with this ABS regime complex and its technical requirements for access permits, sample collection and maintenance, monitoring and compliance, consultation with Indigenous Peoples and local communities, benefit sharing, and maintaining the infrastructure and processes to comply with these laws. This talk presents an up-to-date survey of current international law developments at the CBD and NP forums, and the parallel discussions about agricultural plants at the UN Food and Agriculture Organisation (Plant Treaty), viruses and pandemics at the UN World Health Organisation, marine genetic resources at the UN Law of the Seas forum and intellectual property at the UN World Intellectual Property Organisation. Common themes involve monitoring and compliance (including track and trace mechanisms), Digital Sequence Information, Traditional Knowledge, monetary and non-monetary benefit sharing (including technology transfer) and Artificial Intelligence challenges. The talk raises awareness about the reach of these laws and introduces some practical tools to facilitate best practice compliance. The talk concludes with some of our group's thoughts about the future (see, for example, Science, 367(6483): 1200-1202 (2020)).

Keywords: access and benefit sharing, ABS, Convention on Biological Diversity, CBD, Nagoya Protocol, legal regime complex, UN Sustainable Development Goals, SDGs

The Australian Plant Breeder's Rights Act 1994 (cth) And How It Is Used For Australian Native Plants

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With increasing interest in intellectual property relating to plants, it is timely to assess the use of Plant Breeder's Rights (PBRs) in Australia for native plants, with tens of thousands of native plants nearly all of which are endemic and many with known uses. A database of all applications received, accepted, granted and grants expired or withdrawn, refused and rejected for PBRs under the Australian Plant Breeder's Rights Act 1994 (Cth) from 10 November 1994 to 14 December 2022 was assessed including plants native to Australia. The analysis revealed: there are over 9500 applications and over 5180 granted, of which ~10 percent are for native plants; many PBR owners are Australian residents (~50%), but even more so for native plant PBRs (96%); few PBRs last the full term (average duration 6.6 years); and overwhelmingly PBRs of native plants are ornamentals (~92%). There is potential for breeding more native ornamentals, but particularly food crops and medicinal plants. This includes expanding commercial development by Australia's First Nations communities including enterprises based on their 'Indigenous Knowledge'. Further research can help identify why PBRs are not used for breeding more varieties including native food and medicinal plants with potential taxa and uses assessed.

Seed Biology Of 12 Fire-affected Subalpine Herb And Shrub Species Raise Concerns Regarding Their Ex Situ Conservation

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Australia's southeastern subalpine regions were severely impacted by the 2019-2020 bushfires. Some of the plant species most affected are poorly known, with no germplasm secured *ex situ*, generating interest in their biology and conservation. Wild seeds of 12 species were sought across 40+ locations in Namadgi National Park (ACT) between January 2022 and May 2023. *Almaleea capitata* populations were sparse, remote and/or not fruiting, therefore, seeds were collected from cultivated plants. X-ray analysis, the tetrazolium chloride staining test and the imbibition test were used to investigate seed fill, viability and physical dormancy. A full factorial experiment investigated germination response to smoke chemicals, light/dark and the growth hormone Gibberellic acid. Germination phenology was also investigated by moving imbibed seeds through 26 weeks of seasonal temperature regimes. Four species exhibited low seed fill (4 - 45%). Gibberellic acid improved germination of six species compared to the control, suggesting physiological dormancy. However, eight species showed little or no response to Gibberellic acid (0 – 19% germination), despite high viability. Six species were diagnosed with deep dormancy and/or complex germination requirements requiring further investigation, including five species that achieved ≤ 10 % final germination (*Phebalium squamulosum* subsp. *ozothamnoides*, *Leionema lamprophyllum* subsp. *obovatum*, *Damperia fusca*, *Trachymene composita* and Leptospermum namadgiense). Despite rigorous investigation, only four species achieved >75 % germination (*Leptospermum micromyrtus*, *Celmisia*. sp. *Pulchella*, *Viola improcera* and *A. capitata*). In summary, although 11 of the 12 study species now have at least one conservation seed collection in *ex situ* storage, seeds of 11 species were difficult to obtain, low in quality and/or difficult to germinate, raising concerns about genetic representation of species and collection utility in the future. We recommend investigations into factors affecting seed quality and germination of subalpine shrub and herb species, assessment of exceptionality and alternative *ex situ* conservation methods where required.

Seed Germination Re-testing to assess 'real Time' Longevity in Storage: a Six-year Progress Report From The National Seed Bank

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Freya Brown[1] and Gemma Hoyle[1]
[1] National Seed Bank

Seed Germination Re-testing to assess 'real Time' Longevity in Storage: a Six-year Progress Report From The National Seed Bank

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Seed germination re-testing to assess 'real time' longevity in storage: a six-year progress report from the National Seed Bank

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Seed banks are an invaluable resource for the *ex-situ* conservation of plant species. While in long-term storage, seeds face two key threats: loss of viability and lack of knowledge regarding germination requirements. Most species currently stored in seed banks around the world have little to no 'real time' longevity data and/or reliable germination protocols. The Australian National Botanic Gardens has begun to address these gaps for accessions currently stored in the National Seed Bank (NSB). Our 're-testing program' aims to uncover reliable germination protocols of each species stored and periodically re-test each collection to understand on-going collection viability. For the past six years, the NSB has been implementing a program of decadal re-testing while also trialling novel approaches to capturing and analysing resulting data. Collections with initial tests conducted 10, 20, 30+ years ago are re-tested under the same germination test conditions. If a collection achieves 75 % germination, we also estimate viability using the tetrazolium chloride staining test to better understand whether low germination is due to seed dormancy or low viability. Here, we present the NSB's approach to re-testing collections to determine germination requirements and assess 'real time' seed longevity in storage. Data-informed management decisions will be discussed including species identified as potentially short-lived in storage and those requiring more research into dormancy and germination.

Remote And Temporary Seed Banking: Case Studies From The National Seed Bank

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The science and practice of seed banking has evolved markedly over the last 30 years. The process of storing wild collected seed for conservation, restoration and research has become more complex as our understanding of seed biology and physiology for individual species has improved. There are fundamental factors to consider when establishing a remote seed bank or temporarily relocating an established seed bank, primarily the end use of the seed collections. In addition, the level of resources required to establish a restoration seed bank, with high volume and high turn-over of seed collections is different to establishing a conservation seed bank, with the aim of long-term storage of collections. Here, we present two case studies demonstrating different management strategies for effective remote and temporary seed banking. The first case study will explore steps required to establish a new restoration seed bank in a remote location (Norfolk Island), including the critical parameters to consider for seed processing, storage and ongoing technical support. The second case study will describe the temporary relocation of an established conservation seed bank and laboratory including the risks and sensitivities, the logistics and the management of invested interests.

Viola Seed Biology And Ecology: Insights And Oddities

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The genus *Viola* is the largest in the family Violaceae, containing *ca*. 660 species worldwide. Only 16 *Viola* species are native to Australia, all of which occur in southeastern temperate regions. Threats include restricted area of occupancy, increasing fire frequency and a continued decline in area, extent and quality of habitat. *Ex situ* conservation is urgent; however, knowledge of Australian *Viola* seed biology and ecology is severely lacking relative to northern hemisphere *Viola* species. Using 14 seed bank accessions we investigated dormancy and germination of nine Australian *Viola* species varying in distribution (subalpine to riparian) and occurrence (widespread to highly restricted) and including three endemics. Methods included tetrazolium chloride staining, application of exogenous gibberellic acid, seed scarification, scanning electron microscopy and climate-informed pre-treatments. Results suggest that seeds possess physiological dormancy that varies in depth, both within and between species, and includes a mechanical constraint that is related to seed coat thickness. Significant variation in germination strategy between related species suggests local adaptation, while variation within species suggests effects of the maternal environment. In contrast to *Viola* species in the northern hemisphere, species-specific regeneration strategies in Australia include immediate and postponed germination, as well as staggered germination over multiple years. In addition, there is evidence of significant seed viability loss within ten years of seed bank storage. These findings have implications for managing *Viola* conservation collections and the persistence of *Viola* species under climate change. We recommend further investigation into the effects of long-term storage on seed viability and germinability. We also recommend using fresh seeds to investigate germination strategies, maternal effects on dormancy status, seed coat chemistry and how results relate to phylogeny.

Ecophysiology Of Seed Dormancy And Germination Of Hibbertia To Inform Seed Propagation For Ecological Restoration

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Ecophysiology of seed dormancy and germination of *Hibbertia* to inform seed propagation for ecological restoration

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The Jarrah Forest region in Western Australia is a specialised ecosystem that has been mined since the 1960s. Restoration efforts in these mined areas have been made. However, some species have proved challenging, often due to seed dormancy preventing establishment. *Hibbertia* species (Dilleniaceae) are one such group, being important components of the forest understorey, but under-represented in restored communities due to complex dormancy. Seeds of *Hibbertia* are known to possess morphophysiological dormancy. This research investigated the ecology and physiology of seed dormancy and germination of Jarrah Forest *Hibbertia*, including a focus on inter- and intra-specific variation in germination. Ten species of Hibbertia were collected, and dormancy and germination were assessed in relation to light availability, alternating temperatures, and the presence of germination stimulants Karrikinolide (KAR_1) and gibberellic acid (GA_3). The investigations considered the impact of time, geography, and species on the presence and level of dormancy. All species were found to possess MPD with at varying levels. All species showed sensitivity to KAR_1 and GA_3, and some species had significantly deeper dormancy. Temperature played a crucial role in germination, with most species germinating more readily at winter temperatures, and *some* species having increased germination rates when placed in total darkness. There was minimal intraspecies variation, but significant interspecies variation in dormancy depth traits among these *Hibbertia.*

Seed Morphological Traits And Its Relationship With Protein And Starch Content Of Diverse Pea Germplasm

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Abstract

Field peas (*Pisum sativum* L.) are a significant source of plant-based protein, ranking second only to soybeans in food applications. In Australia field pea are primarily used for animal feed but now becoming popular as a plant-based protein source for human consumption and nutrition. Seed morphological traits such as shape, size, and colour, along with seed composition traits like protein and starch content influence nutritional value, consumer acceptability and product preferences. However, the relationships between seed morphological traits and seed composition remains poorly understood. This study investigated the relationship between seed morphological quality and seed composition traits in over 143 diverse pea germplasm accessions, focusing on variation in seed roundness determined by 3D imaging technology. Our aim was to develop and validate a seed roundness scale using 3D image analysis and elucidate relationships between seed morphological traits and nutritional value (protein and starch content). The developed seed roundness scale provided a reliable measure for assessing seed quality traits. This research developed high-throughput trait recognition using image analysis that can be applied to field pea breeding, facilitating the development of new pea varieties tailored for high value food markets.

Seeding Success: Community Collaboration For Plant Conservation.

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Australia is home to more than 23 000 plant species, with almost 10% considered threatened under environmental legislation. Australia's ex situ conservation collections provide plant material and knowledge to better understand and restore native plants. The immense scale and effort required for this task requires close collaboration and strong partnerships to be successful.

The Australian Seed Bank Partnership (ASBP) is a national alliance of conservation seed banks that bring collective expertise and experience to the conservation sector. The ASBP is increasingly working with local groups and landholders to share skills and improve knowledge for plant conservation. Local communities including Indigenous land managers, private landholders, Friends and care groups, have an important role to play in conservating our native species, from ongoing stewardship of priority species and ecosystems, through to collection, processing and propagation of crucial genetic material.

Using case studies from projects facilitated by the ASBP, this poster will focus on the valuable and diverse roles that the community play in plant conservation. Learn about how seeds of the Critically Endangered Chalky Wattle (*Acacia cretacea*) were secured from the single known population on the Eyre Peninsula with the help of a local farmer whose father helped scientists discover this species. Discover how cross-cultural learning is occurring between the Traditional Owners of Uluṟu-Kata Tjuṯa National Park and plant conservation teams at the Australia National Botanic Gardens in Canberra. These exciting collaborations show that plant conservation is more effective when communities play a central role and knowledge is shared and respected.

Seed Morphology and Germination Characteristics of The Root Parasitic Species Exocarpos

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Exocarpos cupressiformis (Cherry Ballart) is a root hemi-parasitic plant in the Santalaceae family, acquiring water and mineral nutrients from nearby host species via haustoria. Cherry Ballart has many uses (e.g. Christmas tree and spearthrowers) and known as a culturally significant plant for Australian First Nations people. However, limited research has been undertaken on this endemic species, especially recruitment and establishment requirements. This is a concern for land managers as once Cherry Ballart is removed from the landscape, it is unknown if it can be reestablished naturally or through translocation due to its hemi-parasitic nature. To address this, we need a holistic approach beginning with an understanding of the seed morphology, seed dormancy type and germination requirements. It is not clear whether successful seed germination and establishment of the Cherry Ballart depends on host species. We conducted imbibition testing, tetrazolium staining and measured embryo size, seed size and seed coat thickness for *E. cupressiformis* and for comparison included *E. nanus* (Alpine Ballart). Seed coat was scarified or fully removed and then germinated alone or with accompanying host species (grass or legume) at a constant 26^{o}C in darkness. Preliminary results indicate intact seeds of Cherry Ballart can absorb water during the imbibition, meaning the seed coat is permeable, although seeds cannot germinate under control conditions. Interestingly, seeds germinated when scarified or total seed coat was removed. The results provide evidence that seed germination of Cherry Ballart does not require a host at its early life stage. This study will provide insight into the germination and establishment of the iconic Native Cherry to ensure its presence and continued survival.

Accelerating And Broadening Seed Conservation Training To Face The Global Biodiversity Crisis

Charlotte Lawrence[1]
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Plant biodiversity threats have increased over recent decades with 2 in 5 plants now threatened with extinction. Political commitments to confront the crises are agreed but rely on skilled practitioners in countries facing the greatest biodiversity loss. The fastest way to support the development of these skills is accessible training, targeted at professionals, delivered in-country, at low cost, to provide relevant practical and theoretical skills, for example, in seed banking for ex situ conservation.

The Millennium Seed Bank Partnership (MSBP) has delivered training to its partners and beyond since its start in 2000. Training courses and technical attachments are provided at the Millennium Seed Bank in the UK, as well as courses delivered in-country, supporting the
application of the MSBP Seed Conservation Standards at any level of available technology.
While successful, with more than 1000 people trained in 20 years, the MSBP has never been able to match global demand for its training.
Responding to travel disruption during the 2020 global pandemic, the MSBP introduced online teaching approaches, enabling new audiences to access MSBP materials. Further innovations are planned, including a digital learning platform providing training and removing restrictions on the number of trainees accessing course materials. Furthermore, a newly launched Trainer Certification Scheme will certify qualified individuals across the globe, to deliver standardised training within a framework of evaluation and assessment tools. This scheme ensures training quality and adherence to the Seed Conservation Standards, independent of delivery location and trainer. This novel scheme will provide more in-country, bespoke training courses, and will strengthen training partnerships with peer organisations.
The new approaches to deliver MSBP training will extend the reach of essential seed banking knowledge. In a second phase the MSBP may extend training to additional topics, ensuring the sharing of relevant conservation practices for another quarter of a century.

Developing A Method For Digitally Counting Seeds And Assessing Their Germination Status In Vitro For Seedbank Viability Testing

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Genebanks play a vital role in conserving the diversity encapsulated in the world's plant populations. However, the capacity of the seed to germinate declines over time and culminates in the loss of viability even under the best long-term storage conditions. Genebanks monitor their seed collections regularly via germination assays to ensure that they remain viable, but methods can be laborious and subjective. The development of automated methods for assessing seed viability, using computer vision, offers the potential to remove subjectivity and improve accuracy.

An experiment was established to test the application of image analysis techniques for quantifying seed numbers and measuring germination rates of seeds grown in petri dishes under typical genebank conditions. Seeds from five species of pulses and cereals were grown in 90 mm petri dishes according to ISTA rules and manually assessed for germination at regular intervals.

We developed an algorithm that analysed binary blobs of the seeds and morphological skeletons of radicles generated from RGB images of seeds in petri dishes. This program was incorporated into a PlantCV image analysis pipeline that measured the size and number of seeds as well as the length and orientation of radicles, using queue-based data structure algorithms to determine germination status. The accuracy of the method was determined against the ground truth obtained from a manual count of the same data.

Measurement values for manual and automated detections of seed numbers and their germination status exhibited correlations as high as 0.99. Our algorithm was able to reliably detect the orientation of radicles and attribute germination to the correct seed.

We envisage that this method, using image analysis, could be further developed to facilitate the high throughput monitoring of seed viability in genebanks.

The Conservation Generation: Raising Rarity And Sowing The Seeds Of Wonder

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Children of present and future generations will bear the cost of climate change and therefore must be involved in decision making through scientific literacy and enquiry. Raising Rarity is a school outreach program which fosters conservation education using a hands-on approach. The program recruits students to grow and care for a threatened plant that occurs (or did so historically) within proximity to their school. This Raising Rarity-school partnership begins with students attending a Discovery Day. Here the students are introduced to the taxonomy and ecology of the species they will grow and care for. Students take this knowledge and plant out their threatened species into raised plots at their school, with the help of the Raising Rarity team. The monitoring phase begins with recording phenological stages, soil pH and moisture levels. These actions are informative for overall plant health, if irrigation is required and observe how species may behave under cultivation. Through careful monitoring, the students harvest seeds and ensure their safe passage to the Victorian Conservation Seedbank. Each year we celebrate each student's achievements with a Celebration Day, held at a botanic garden. The program is building - 6 schools in 2024, 10 in 2025, and 16 schools participating in 2026. The program is unique in its adaptability to different school learning contexts and needs (e.g. rural or urban, early years to young adults, school-based formal or extracurricular initiatives and connections to diverse community partnerships). We work with social science educators to assess student engagement and awareness, and to develop tools in climate literacy education. Through authentic participatory learning coupled with a commitment to conservation outcomes, the Raising Rarity school outreach program aims to increase student botanical knowledge, develop the skills needed to grow and monitor plant health, and contribute to our understanding of caring for plants at risk.

Test

Bridget Brown[1]
[1] Arinex
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Biocultural Heritage Data: Steps Towards New Approaches At The Millennium Seed Bank

Alice Hudson[1]
Elinor Breman[1], Sarah Gattiker[1], Simon Kallow[1], Jennifer Peach[1], India Szigeti[1] and Elianne Lee[1]
[1] RBG Kew

Since the Millennium Seed Bank was developed over 25 years ago, the conservation, societal and policy landscape has changed significantly. A high proportion of the collections stored at the Millennium Seed Bank are done so through a custodianship relationship, often with collections also banked in the country of origin. This creates both an ethical and legal duty of care over these collections. This includes, confirming that the seeds were collected responsibly and transferred legally, that the terms of any material and associated data transfer relating to seed collections are discussed and agreed, including associated indigenous knowledge or biocultural heritage. These terms are usually set out in mutually agreed bilateral agreements made between the Millennium Seed Bank and organisations or government in the country of collection.

As we head into an increasingly open access era for a wide variety of data types, including digital sequence data, we ask whether the current provisions at the Millennium Seed Bank are sufficient? In particular, do these bilateral models and internal data governance procedures adequately protect and support biocultural heritage and Indigenous Data Sovereignty? We review changes to Millennium Seed Bank practice over time to accommodate this and seek to open discussions on current gaps and options for the future.

Leveraging Sensor Technologies For Seed Phenotyping By Genebanks

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Genebanks serve as critical repositories for preserving the genetic diversity of plant species, including crops, forages, and their wild relatives, which is essential for supporting plant adaptation to climate change, enhancing food security, and improving agricultural sustainability. Seed phenotyping, the process of evaluating observable seed traits, plays a pivotal role in characterizing and utilizing this diversity. It enables precise characterization of genetic diversity by analyzing key traits such as size, shape, color, nutrient composition, dormancy, and stress resilience. This data-driven approach enhances genebank efficiency by improving germplasm selection, enhancing conservation strategies and reducing redundancy in seed collections. Traditional phenotyping methods, however, are labour-intensive and inadequate for the vast collections housed in genebanks.

This presentation explores the transformative potential of high-throughput phenomics technologies, leveraging the electromagnetic spectrum—from gamma rays to radio waves—to enable rapid, precise, and non-invasive assessment of seed traits such as size, shape, biochemical composition, and vigour. The highlight is the integration of advanced imaging systems (e.g., hyperspectral, X-ray, and thermal imaging) with genomic data to enrich genebank datasets, facilitating more efficient trait discovery and crop improvement. Despite challenges like cost, scalability, and data standardisation, opportunities arise from collaborative initiatives like the International Plant Phenotyping Network (IPPN), which promote accessible and standardised phenotyping solutions. The presentation will underscore how phenomics can revolutionise genebank operations, ensuring the efficient conservation and deployment of genetic resources to address global agricultural demands.

Successful Seed Germination Of Subalpine Phebalium And Leionema (rutaceae) Species

James Wood[1]
Gemma Hoyle[2]
[1] Royal Tasmanian Botanical Garden
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ASSC
20 min presentation:

Successful seed germination of subalpine *Phebalium* and *Leionema* (Rutaceae) species

Despite their dominance across Australia, seeds of many Rutaceae species are notoriously difficult to germinate *ex situ*. Thus, countless Rutaceae collections stored in conservation seed banks cannot currently be utilised. Following the 2019-2020 bushfires that severely impacted Australia's southeastern subalpine regions, we investigated conservation seed collections of three subalpine Rutaceae species endemic to Australia: *Phebalium squamulosum* subsp. *ozothamnoides*, *Leionema lamprophyllum* subsp. *obovatum* and *L. montanum*. Related species are understood to germinate *in situ* from the soil seed bank following fire. However, preliminary germination tests that included smoke water, heat shock, precision nicking and Gibberellic acid (GA_3) treatments were unsuccessful, and seeds were diagnosed with deep physiological dormancy. We hypothesised that, *in situ*, the effect of warm stratification upon seeds is cumulative over years, priming the seeds for germination prior to a fire event. Indeed, 8 weeks of warm stratification (35°C) followed by smoke water treatment (10% for 24 hours) and16 weeks of cold stratification (4-5°C), elicited 15 to 40 % germination at 20/10°C (12/12 hrs light/dark). To our knowledge, this is the first report of propagation of these species from seed. Collection viability was estimated using the tetrazolium chloride (TZ) staining test and results suggested that significantly more germination was possible. Surprisingly, longer durations of warm stratification (16 and 24 weeks) did not lead to increased germination and in some cases reduced germination suggesting dormancy cycling. Further investigations are underway to investigate the additive effects of leaching and heat shock treatments and implications of results will be discussed.

Comparing Ex-situ Seed Longevity For 24 Victorian Temperate Grassland Species.

Candice Farrugia-Roberts[1]
Gemma Hoyle[2], Joanne Birch[1], Isis Arend da Silva[3] and Rebecca Miller[4]
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Critically endangered grassy ecosystems of south-eastern Australia are a conservation priority, necessitating the storage of seeds in conservation seed banks. Storage in seed banks can significantly extend viability, though seed longevity can vary greatly among species. Despite a general understanding of seed deterioration, little is known about the storage behaviour of most species. Research into relative seed longevity in storage is therefore important to inform the effective management and use of ex situ collections.

This study aimed to characterise relative seed longevity of 25 Victorian temperate grassland species across 9 plant families. Nine species are Endangered or Critically Endangered in Victoria (FFG Act). We used an established controlled ageing method where seeds are stored at 45°C and 60% relative humidity for between 1 and 250 days, and germination is measured to determine the time taken for seed viability to fall by 50% (P50). Seed longevity varied significantly between species and families, with P50 ranging from 4.3 days for *Melicytus dentatus* (Violaceae) to 147 days for *Convolvulus remotus* (Convolvulaceae), with a mean of 44.1 ± 29.3 days across all species. The viability of one species, *Allocasuarina luehmannii* did not decline below 50% after 250 days of ageing, indicating longer-lived seeds, while both *Melicytus dentatus* and *Maireana cheelii* had P50 values below 13.7 days, indicating shorter-lived seeds. Preliminary analysis found significant differences between families, with longer-lived seeds in Myrtaceae and shorter-lived seeds in Asteraceae, as well as correlations between seed longevity and seed mass, and plant lifeform. Findings are discussed with reference to phylogenetic relationships, seed and plant traits and environmental conditions at the site of collection to explore patterns of relative seed longevity at an ecosystem level.

Optimising Lab-based Germination Protocols For 13 Victorian Temperate Grassland Species.

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Joanne Birch[1] and Rebecca Miller[2]
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Critically endangered grassy ecosystems of south-eastern Australia are a conservation priority. The storage of seeds in seedbanks is one important strategy to support the conservation of these ecosystems; however, the benefits of conservation collections can only be maximised if seed dormancy and conditions required to promote germination are characterised. Knowledge of germination requirements also enables seed viability monitoring and longevity analysis, and can further our understanding of grassland species ecology.

This study aimed to characterise optimal germination protocols for 13 Victorian temperate grassland species across 5 plant families. Study species included *Dianella amoena* and *Eriochlamys squamata*, respectively listed as Critically Endangered and Endangered under Victoria's Flora and Fauna Guarantee Act. Since fire-related cues (smoke, heat) are known to promote germination of some species in fire-prone temperate grassy ecosystems of SE Australia, seeds were treated with aerosol smoke and dry heat, alone and in combination. Seeds of hard-seeded species were also scarified. Treated seeds were sown on plain agar and agar containing 250 ppm Gibberellic Acid (GA3), to investigate potential physiological dormancy, and incubated under conditions approximating autumn (20/10°C day/night and 12h/12h light/dark). Germination was measured weekly for 12 - 20 weeks. Tetrazolium was used to determine the percent viability of collections, to which the observed maximum germination was compared. The germination response to treatments varied significantly among species. Four species were non-dormant, while maximum germination in four species was promoted by GA3 (*Eriochlamys squamata*), smoke and GA3 (*Bothriochloa macra* and *Ozothamnus obcordatus*), and smoke and heat (*Schoenus apogon*). Despite significant treatment effects for four further species, low germination relative to viability suggests dormancy was not fully alleviated. *Dianella amoena* was found to have a staggered germination strategy, responding gradually to all treatments. Findings are discussed in relation to grassland species ecology, and the management and use of conservation seedbank collections.

Preventing The Extinction Of Victoria's Threatened Flora

Megan Hirst[1]
Tara Hopley[1], Jo Lynch[2], Alex McLachlan[1], Andre Messina[1], Rebecca Miller[1], Daniel Ohlsen[1], Ryan Phillips[3], Noushka Reiter[1], Linda Riquelme[3], Holden Sayers[1], Laura Simmons[1], Mandy Thomson[1], John Woodward[1] and Hongxiang Zhang[1]
[1] Royal Botanic Gardens Victoria
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The *'Preventing the extinction of Victoria's threatened flora'* program aims to halt the extinction of 24 endangered or critically endangered Victorian plants, with a focus on Gippsland and the Grampians (Gariwerd). This project follows an integrated conservation framework: Populations of each species are surveyed with the community and threats assessed to improve species management. Genetic analyses are conducted to inform seed collections, propagation and the design of translocations. Threatened orchids and Fabaceae are symbiotically propagated with their mycorrhizal fungi and Rhizobia. Pollinators are identified, so translocations sites can be chosen with pollinators present. Genetically diverse plants will then be introduced in large populations to sites with their interacting partners. Our *ex-situ* collections of seed, vegetative plant material, spores, rhizobia and mycorrhiza collections will be maintained in perpetuity at Royal Botanic Gardens Victoria. These *ex-situ* collections will act as long-term insurance populations, sources of material for future reintroductions, and support further research. To maximise knowledge transfer to land managers, we are communicating project knowledge directly to stakeholders and through one-day workshops across Victoria.

Assessing The Genetic Diversity And Representativeness Of Seed Production Areas.

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Maurizio Rossetto[1], Jason Bragg[1], Natasha Lappin[2] and Tricia Hogbin[1]
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<Seed production areas (SPAs) are sites where native plants are grown specifically to harvest seed for restoration. Vast quantities of quality, genetically diverse seeds can be produced in SPAs if designed and managed correctly. SPAs simultaneously increase the native seed supply while reducing the need to collect from wild populations already under pressure. Currently, there are no guidelines to monitor and evaluate the quality and representativeness of seed produced in SPAs to meet the targets of ecological restoration. We are using genomic data to assess the genetic health and representativeness of SPAs of the Murray Local Land Services (MLLS) region. This network of 16 multispecies SPAs provides a unique opportunity to develop, test and apply a new genomic evaluation protocol. To evaluate the genetic representativeness and diversity of SPAs we compare the levels of genetic diversity of the SPA material (plants in the SPA and seed harvested from the SPAs) with a reference genomic dataset, available through the Restore and Renew project, that represents multiple natural populations across a wide distribution of each plant species. Each of the SPAs is evaluated against a range of criteria to provide a quantitative assessment of the genetic quality of the seed produced within the SPA. The results from this multi-species genomic assessment will directly inform management and use of the seed produced in the MLLS SPAs. Here we will discuss our first round of results and will discuss more broadly how the information will guide the development of protocols for improving the design and evaluation of SPAs so that they produce high-quality genetically diverse seed for native plant restoration.>

Effect Of Cold And Smoke Water Pre-treatment On Germination Of 30 Species Of Eucalypt (genera Angophora Cav., Corymbia K. D. Hill & L. A. S. Johnson, And Eucalyptus L' Hér)

Antoinette Portelli[1]
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<Eucalypt trees form a diverse, integral component of many native ecosystems in the Australian environment. Hence, understanding their germination requirements is an important component of both predicting ecosystem-wide responses to future climate conditions, as well as enabling laboratory study of non-cultivated or even rarer native species. Cold and smoke water pre-treatment have been used to break seed dormancy and improve germination in some eucalypts, though the majority of the over 900 described species have not been tested. However, eucalypts often show phylogenetically dependent responses to many abiotic and biotic factors, hence elucidating any phylogenetic patterns in germination requirements has the potential to yield far-reaching results. Here, thirty-five phylogenetically diverse eucalypt species were tested for their responses to 3 weeks of cold moist stratification and smoke water pre-treatment. Germination using the filter paper method over 35 days was characterised using the following metrics: final germination percentage (FG%), mean time to first seed germinated, mean germination time (MGT), and median germination time (t50). Four phylogenetic subgroups were also compared. For the 30 species that showed appreciable germination, cold moist stratification hastened germination overall, but improved the FG% in only one alpine taxon. However, smoke water pre-treatment delayed germination onset, MGT, and t50 overall, and reduced FG% in 6 taxa. Subgenera *Eudesmia* (R.Br) L.A.S.Johnson & K.D.Hill and *Symphyomyrtus* Schauer generally germinated faster than subgenus *Eucalyptus*. Cold moist stratification most strongly hastened germination in subgenus *Eucalyptus*, whereas smoke water most strongly reduced subgenus *Symphyomyrtus* FG%. This demonstrates that a broad range of phylogenetically diverse eucalypt species require no pre-treatment to achieve appreciable germination rates and can be feasibly studied in laboratory settings. Also, phylogenetic patterns are observed in eucalypt germination and responses to both cold and smoke water pre-treatment, indicating subgenus may be a useful characteristic to help select appropriate species.>

Long-term Longevity Of Orthodox Tree Seed Stored For Decades At Room Temperature

David Bush[1]
Sarah Whitfeld[1], Nigel England[1], Bronwyn Clarke[1], Tasha James[1], Richert Ahlers[1] and Emily Harper[1]
[1] CSIRO Australian Tree Seed Centre

The Australian Tree Seed Centre has stored the majority of its seed accessions, a large proportion of which are orthodox *Acacia* and eucalypt taxa, in a constant room-temperature store (20°C) since the early 1960s. Seed viability of new accessions is tested, and re-testing is performed periodically until such time as the seedlot is depleted (ATSC seed is supplied to external users for a variety of purposes) or, more rarely, when zero viability is reached. Accumulated data spanning two or more decades from two representative temperate taxa, *Eucalyptus camaldulensis* subsp. *camaldulenis* and *Acacia mearnsii,* and two tropical taxa, *E. camaldulensis* subsp. *obtusa* and *A. mangium*, are compared and contrasted. The results indicate that room temperature storage does adequately conserve, for practical purposes, many *Eucalyptus* seedlots' viability for at least a decade, while *Acacia* species may survive for considerable lengths of time with only slowly declining viability. However, marked within-species variability is notable, confirming the already-known fact that storage conditions are only one of the variables determining tree seed storage life. We consider the suitability of room temperature storage in the face of the ATSC's evolving role and purpose, which has changed since the 1960s from being a "tree seed clearing house" to a repository of genetic diversity of a wide range of species including a significant number of threatened populations and taxa.

Looming Bottlenecks In Ex Situ Conservation: why We Need To Think Bigger –examples From Myrtle Rust And Other Trending Priorities.

Bob Makinson[1]
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Since arriving in Australia in 2010, the exotic plant disease Myrtle Rust (*Austropuccinia psidii*) now severely threatens 30 to 50 native plant species in family Myrtaceae, with potential for more.

None of these species were comprehensively seed-banked before Rust arrival; many had (and have) no stored seed. For many, Myrtle Rust has reduced fruit and seed set in the wild, sometimes to zero. Many are wet forest species with problematic or unknown seed behaviour and longevity under orthodox storage, gradually being elucidated.

The only practicable approach to recovery for these severely impacted species requires:

- comprehensive germplasm collection (often as vegetative);
- extended ex situ storage (seed, vegetative, and in vitro);
- rigorous genetic and lineage management;
- cyclical production of bulk material to screen for differential Rust tolerance;
- breeding arrays to select for stable, heritable and deep rust-tolerance traits;
- culturally and ecologically appropriate re-wilding.

These together are at least decadal processes. This strategy will require, per species, longer time frames and greater ex situ resources of space and labour, than do more typical ex situ conservation actions like short-turnaround translocations, the demand for which is also rapidly growing. The additional needs imposed by the Myrtle Rust situation, and other urgent priorities (e.g. tropical montane plant rescue), are likely to saturate the capacity of major botanic gardens quite soon, long before adequate progress in recovering these species. Smaller, regional botanic gardens and some other tenures have proven potential for maintaining dispersed metacollections, but they cannot be a basis for all elements of the process.

Overseas examples of dedicated facilities for breeding woody plants for disease resistance and rewilding could be adapted for Australia, as a stand-alone facility, or as a polycentric network linked to (but not necessarily co-located with) major botanic gardens.

Variation In Dormancy Characteristics Among 18 Taxa In The Family Rhamnaceae With Contrasting Distributions Across Victoria

Rebecca Miller[1]
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Physical dormancy, where a hard and water-impermeable seed coat prevents germination when conditions are otherwise suitable, is known in the family Rhamnaceae. Consistent with observed post-fire regeneration from seed, a dry heat treatment has been effective in alleviating physical dormancy in several studies of temperate Rhamnaceae. Whether dormancy and heat response are consistent among species with contrasting distributions in riparian, coastal, alpine/montane, dry and moist ecosystems across Victoria is unknown. This work aimed to characterise dormancy and seasonal temperature requirements for germination of 18 species in Rhamnaceae, including 13 *Pomaderris* and four *Spyridium* species. Twelve species are Endangered or Critically Endangered in Victoria (FFG Act). Seeds were dry heat treated and sown on 1% agar under two seasonal temperature regimes representing autumn (18°C/7°C; day/night) and summer (25°C/15°C; day/night). A period of cold stratification, with and without prior heat treatment, was applied to alpine taxa. Germination was monitored weekly for 16 weeks. Dormancy and germination responses varied among species. One group of species displayed physical dormancy alleviated by heat with high germination under both temperature regimes. Two riparian species showed no apparent dormancy, while alpine species exhibited both physical and physiological dormancy, requiring cold stratification following heat. For several other species, the effect of seasonal temperature on germination following heat treatment was pronounced. Results indicate the influence of climate on germination and dormancy, with implications for the propagation of related threatened species from ex-situ conservation seedbank collections. Findings are discussed in relation to adaptation to fire and species distributions.

How Big Is Your Seed Orchard? - Practical Issues Of Design, Planning And Management For Successful Seed Production.

Richert Ahlers[1]
Nigel England[1], Sarah Whitfeld[1] and David Bush[1]
[1] CSIRO Australian Tree Seed Centre

For three decades, the Australian Tree Seed Centre (ATSC) has been establishing species, provenance and family trials for different purposes (e.g. agroforestry, species conservation, salinity abatement and bioproducts). These are typically converted to seedling seed orchards (SSO) or seed production areas (SPA) and now constitute an important source of seed supply for these applications. The current imperative for ecological restoration is driving heightened interest in transitioning from wild seed harvest to SPAs. However, questions of appropriate scale, genetic diversity and productivity are key determinants of SPA design. How large should SPAs be to produce a practically-useful amount of seed? How much genetic diversity should a SPA capture to provide good quality germplasm that is sufficiently adaptable to cope with future climate change? Can existing environmental plantings be used for seed production, and can new ones be better designed to fulfil this role?

The ATSC's SPA and SSOs are nearly exclusively designed to produce seed for tubestock production. This method of cultivation is highly efficient in terms of seed utilisation and conducive to compact SPA plantings. Using yield data accumulated over many years, we examine the variability of productivity of these orchards, extrapolate the findings to less-efficient modes of deployment (direct seeding, broadcast sowing) and estimate what areas would be required to reliably achieve impactful outcomes. We examine methods of intensive management used in smaller orchards to maximise seed crops and reduce harvest expense and how these would be applied to significantly larger areas or networks of dispersed SPAs.

Seedling Emergence In Grassy Woodlands: Influences Of Microhabitat Conditions

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Microhabitat factors influence seed and seedling exposure to temperature and water availability, shaping their establishment. Predictive models of seedling recruitment must incorporate mechanistic responses to broad and microclimatic conditions to provide reliable estimates of population growth or decline. This study examines the interactive effects of regional climate, canopy cover and leaf litter on seedling emergence and survival of native species in the Cumberland Plain Woodlands in Western Sydney. Based on a study characterizing the germination niche of Cumberland Plain species, eight species with contrasting germination niches were selected. The experiment was conducted at two localities with remnant grassy woodland within the Cumberland Plain to validate the modelled germination climate niches under contrasting conditions. At each locality, four replicate sites were established under closed and open canopy. Within each site, leaf litter levels (litter present vs. litter absent) were manipulated to reflect natural ecosystem conditions. Seeds were planted in PVC rings inserted into the ground in mid-spring and emergence was monitored fortnightly. Soil temperature and moisture sensors, along with rain gauges, were installed to record climatic conditions associated with the locations and treatments. Locality, canopy and litter significantly impacted seedling emergence. A few species emerged in response to summer rainfall, but final emergence was generally low (<20%) with the exception for *Microlaena stipoides* (>75%). Overall, the highest emergence was recorded under closed canopy with leaf litter and emergence was higher at the cooler, wetter locality. Seedling mortality was high across all emerged species (up to 50%) and appeared linked to hot and dry conditions. The outcomes will help refine predictions of seedling establishment under climate change, contributing to the resilience of conservation and restoration efforts in grassy woodlands.

Advancing In Vitro Conservation Of Subtropical Australian Myrtaceae

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Biodiversity conservation is critical for sustaining agriculture and ecosystems as the world faces biosecurity incursions, changing climates, land degradation, and evolving consumer preferences. In subtropical and tropical regions, which house a significant portion of crop and wild species with recalcitrant seed, this calls for complementary tools to conserve genetic diversity critical to food security and species conservation efforts.

Our research is progressing tissue culture and cryobiotechnology for long-term ex situ storage of recalcitrant plants critically important to Australia's ecosystems and industries. This includes avocado, macadamia and a number of native Myrtaceae impacted by pandemic myrtle rust. This talk focuses on our progress in *in vitro* conservation of Myrtaceae species where *in situ* conservation and seed banking is rendered impossible by disease impacts or seed recalcitrance. Tissue cultures have been established for five commercial or endangered species; *Backhousia citriodora*, *Decaspermum strukoilicum*, *Gossia gonoclada*, *Gossia fragrantissima* and *Lenwebbia* sp Main Range. Three species have been successfully multiplied and acclimatised to nursery conditions, with *Gossia fragrantissima* and *Decaspermum strukoilicum* progressed to small scale field plantings. Droplet-vitrification protocols have enabled survival rates between 20% to 100% for cryopreserved shoot-tips, with recovered plants of *G. fragrantissima* transitioned from lab to field. We highlight the importance of scientific innovation and stakeholder partnerships in creating 'frozen collections' to safeguard Australia's industries, nutritional security, cultural heritage and ecosystems. At the same time, we highlight a critical gap in our ability to translate our innovations – lack of a germplasm and cryobank for our subtropical and tropical regions harbouring incredible diversity of recalcitrant plants. This has economic implications for the resilience of Australia's nursery, forestry, botanicals and horticulture industries collectively valued at over $30 Billion AUD.

Learning to Connect Country and People at The National Seed Bank

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Traditionally, western scientific practice has sought to separate People from Country for the purpose of environmental conservation – an approach which has caused significant harm for First Nations Peoples globally. Today, it is increasingly recognised by western scientists that issues of environmental conservation and social justice are intrinsically linked. However, the implementation of this knowledge in fields of western scientific practice, including seed banking, is still in its infancy. The National Seed Bank (NSB) at the Australian National Botanic Gardens, Canberra, is seeking to help address this gap by exploring the following questions:

1. What are the key issues of social justice in conservation seed banking?
2. How do seed banks move towards addressing these issues?

Here, we examine the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). In particular, we highlight articles of significance to seed banks, to help guide us in developing minimum standards for socially responsible seed banking practices. We also present recent collaborations between the NSB and Ngunnawal Peoples (in the Canberra region) and Anangu (in Uluṟu-Kata Tjuṯa National Park and elsewhere), and discuss outcomes, lessons learnt so far, and implications for the ways that we can begin to address issues of social justice across our activities. We conclude that attempts to implement UNDRIP in seed banking activities will need to be case-specific and will inevitably form part of an interactive learning process. There is a necessity to develop and maintain strong relationships and to allow for a significant and sustained investment of time and resources. The potential benefits of adopting UNDRIP into our work are immense, for people and the environment, and are necessary to bring seed banking practices in line with international minimum standards for the recognition, protection and promotion of the rights of First Nations Peoples.

Establishing Genomic Knowledge Infrastructure To Support Seed Sourcing, Seedbank Management And Seed End Use Strategies.

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The UN decade of restoration and carbon markets are stimulating large-scale restoration projects globally. Scientist and practitioners must ensure that resulting outcomes are contributing positively to the conservation and management of biodiversity. Ideally, seed-based resources should support genetically diverse and adaptively resilient nature repair practices. However, without the necessary genetic guidance establishing diverse and resilient seed sourcing, management and use strategies can be challenging, especially when responding to a range of objectives, constraints, and trade-offs.

Following ever increasing efficiencies, it is now conceivable for genomic information to be regularly used to improve the effectiveness of seed management and use. Restore & Renew (https://www.restore-and-renew.org.au/) is project aimed at creating a comprehensive and easy to use webtool supporting sustainable land restoration, and readily accessible to restoration stakeholders (www.restore-and-renew.org.au). This community resource uses genomic analyses and environmental modelling techniques to simplifying access to and use of native seed resources, and improve the long-term viability of land restoration projects. The genetic data is used to identify local neighbourhood boundaries, to reduce relatedness and maximise diversity within specific climate-based scenarios.
Using examples from an increasing number of collaborative experimental trials, I will present a simple, standardized, broadly applicable genomic-based workflows. Interpretative power directly supports on-ground, applied activities while allowing for flexible inputs, the imposition of realistic constraints, and the examination of conflicting goals. Practical conservation and management outcomes included range from local to regional, and practical applications including the establishment of resilient seed production areas, seedbanks, and much more.
I will conclude by exploring future extensions and opportunities that will further empower stakeholders and practitioners.

The Thermal Behaviour Of Lipids In Short-lived Seeds Of Australian Rainforest Species

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Recent studies on the storage behaviour of desiccation-tolerant Australian rainforest seeds revealed a subset of species that were very short-lived in storage. We sought to understand structural changes that might occur in seed cells upon storage at -20°C, particularly from lipid fractions, that could contribute to and aid in predicting such a short lifespan. We used differential scanning calorimetry (DSC) to examine energy transitions during freezing and thawing in dry seed samples of 23 Australian rainforest species. Seed samples and extracted triacylglycerols (TAGs) were cooled to -150°C and rewarmed to 50°C at 10°C min^{-1}; slower and faster rates of cooling/warming were used for a subset of species to examine lipid crystallisation and melting kinetics. Thermograms were analysed for temperature and enthalpy of observed peaks and these were compared with expected values to detect anomalies. Extracted lipids were further analysed using gas chromatography (GC) to characterize fatty acid composition. The thermal profiles of six species were then used to design experiments comparing the impact of storage at -20°C to storage at temperatures outside the range of observed thermal transitions. Thermal activity attributable to TAGs was detected in all samples within the narrow temperature range of -30 and -10°C; activity at broader temperature ranges was also detected depending on species, cooling protocol and fatty acid composition. A profound interaction between DSC parameters and time at low temperature, as well as fatty acid composition, suggested TAG crystallisation rates contribute to low temperature sensitivity. We confirmed that damage from TAG crystallisation could be avoided by storing seeds short-term at temperatures above crystallisation events; storage at cryogenic temperatures (where further structural changes to TAG crystals would be inhibited) improved survival over storage at -20°C but requires further optimisation to maintain pre-storage germination potential.

The Role Of Nutrition In Cryopreservation Of Australian Myrtaceae

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Previous work in our group has found that nutrient requirements for Australian Myrtaceae in tissue culture can differ drastically from commercially available media formulations. Previously we utilised a design of experiments approach to develop a mathematical model of plant response to the various nutrients, which allowed the prediction of a theoretical best medium formulation. This medium significantly increased health scores of *Gossia fragrantissima*. We subsequently found this medium also had significant effects on cryopreservation outcomes for this species. When grown on WPM, a commercially available medium, post cryopreservation regeneration of *Gossia fragrantisimma* meristems increased from 20% to 70% when exposed to a 48h preculture on 0.3M sucrose desiccation medium ($P < 0.05$). However, when meristems were isolated from cultures grown on the optimised medium, optimal regeneration of 100% was achieved at a lower sucrose concentration (0.2M). As well as allowing for an unusually high regeneration rate of 100%, almost more remarkable was that cryopreservation regeneration was higher even in the control treatment (0.09M sucrose, 83.3%) than the optimal achieved in WPM on 0.3M sucrose (70%). This suggests that prior optimisation of nutrition rendered cryopreservation protocol optimisation unnecessary in this species. We also tested whether this principle can be applied across more Myrtaceae species by testing cryopreservation regeneration before and after optimisation of nitrogen, iron, zinc, manganese, and copper levels in tissue culture media for *Decaspermum struckoilicum*, *Gossia gonoclada*, and *Lenwebbia sp*. Main Range. Cryopreservation practitioners typically cease to optimise basal media once the material is multiplying and has no major health problems. However, these results suggest that continuing to optimise basal nutrients past this point may offer even greater dividends than typical cryopreservation protocol optimisation. As cryopreservation protocol development is notoriously time consuming, this potentially has significant implications for the timely development of cryopreservation protocols for other endangered Myrtaceae species.

The Search For Seed: Supporting Forest Seed Collection With A High-resolution Predictive Model

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Fire-sensitive tree species (such as Mountain Ash and Alpine Ash) cannot persist in a landscape if fires are large, intense, and frequent. If the time between two major fire events is less than the time required for these species to reach maturity, they can be effectively eliminated over large areas, causing catastrophic impacts on ecosystem services. Such damaged areas can be at least partially restored through the aerial dissemination of seed collected in previous years, but collecting the necessary quantity of seed is expensive and time-consuming. Current best practice involves combining regional drought assessments, aerial flowering surveys and seed crop forecasting to prioritise of areas for seed collection, but there are still substantial costs involved.

In this study, a mechanistic model is proposed for generating high-resolution seed crop predictions at landscape scales, designed to complement and enhance existing protocols for seed crop forecasting. Starting from a known regeneration event (wildfire or timber harvesting), the model simulates tree growth, self-thinning, seed production and seed bank accumulation in pure forest stands. Regional weather data are combined with a microclimate model to estimate local weather conditions, which are then used to adjust tree growth, tree mortality and seed production.

Using Mountain Ash (*Eucalyptus regnans*) as a case study, climate-sensitive sub-models for tree growth, self-thinning and seed production were calibrated using observations from eastern Victoria. By comparing model predictions with measured seed crops, summer rainfall from three years prior was identified as a key driver of annual seed production for this species. The calibrated model was then used to make high-resolution seed crop predictions for a 15 km x 15 km area within the Victorian Central Highlands, demonstrating the potential for optimising the search for seed collection sites.

The Role Of Snowmelt Timing In Alpine Seed Germination Strategies

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Australian alpine ecosystems are increasingly threatened by rising temperatures, reduced snow cover and earlier snowmelt. Snow is a key ecological driver, shaping plant distributions across the alpine landscape and supporting unique vegetation communities, which include many rare and threatened species. Numerous alpine species require a period of cold stratification, such as overwintering under snow, to overcome physiological seed dormancy, with germination closely linked to snowmelt timing. This project investigated how varying durations of simulated winters affected the germination metrics of four alpine species commonly found in the Australian Alps: *Brachyscome nivalis* (Asteraceae), *Olearia frostii* (Asteraceae), *Luzula acutifolia* (Juncaceae) and, *Poa fawcettiae* (Poaceae). We simulated three snow seasons typical of a heterogenous alpine landscape of six, nine and 12 weeks under snow. Then, we simulated spring through to summer conditions to represent seeds being released from early, middle and late snowmelt zones across the landscape. Germination metrics included final per cent germination, time to first and time to 50 % germination, and germination synchrony. The experiment revealed that the treatment representing the early snowmelt zone provided favourable conditions for seed germination in shrub species *Olearia frostii* but not in other herbaceous species. *Luzula acutifolia* germinated more synchronously with a shorter cold stratification period, while the other species showed no clear patterns. Germination timing varied between species, with some germinating more rapidly under specific overwintering treatments. This suggests responses to snowmelt timing are species-specific, and species may exhibit possible plasticity in regeneration strategies under future snow regimes and earlier snowmelt. Research such as this highlights how shifting climatic conditions leading to changes in snow duration can affect the dynamics of alpine plant regeneration. Furthermore, understanding these responses is crucial for predicting vegetation change in alpine areas where snow cover is rapidly declining.

Relationship Between Embryo Morphology And Germination Characteristics In Selected Endemic & Threatened Species In Australia: Preliminary Findings

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Relationship Between Embryo Morphology and Germination Characteristics in Selected Endemic & Threatened Species in Australia: Preliminary Findings

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Numerous threatened plant species in Australia have germination obstacles and complex dormancy mechanisms, which remain poorly understood. This study aims to examine the relationship between embryo morphology and germination characteristics among a select group of endemic and threatened species from the Victorian Conservation Seedbank at the Royal Botanic Gardens, Melbourne by assessing seed dormancy mechanisms mainly from a morpho-anatomical perspective. Here we report key morphological traits—including embryo position, shape, size, seed coat thickness, seed size and weight—alongside dormancy classification (physical, morphological, physiological, morphophysiological, and combinational dormancy) through imbibition and tetrazolium-based viability tests, and subsequent germination trials. This ongoing study also aims to propose optimize seed germination protocols for conservation and restoration efforts of the selected species.
Plant species from 20 different Families were selected for this investigation was based on taxonomic diversity, seed collection size, and germination history of previous experiments (both successful and unsuccessful). In this study we hypothesize that threatened endemic species with challenging germination characteristics will have undifferentiated or differentiated but underdeveloped embryos (e.g. Linear and Rudimentary embryos) and are more likely to exhibit morphophysiological dormancy (MPD) or combinational dormancy (PY + PD), which impose constraints on germination. By evaluating the suitable dormancy-breaking techniques, findings of this study will contribute to understanding the evolutionary significance of embryo traits in relation to dormancy and inform seed banking and restoration strategies for threatened species.

Restoring Ecosystem Climate Resilience (re-clim)

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Open grassy woodlands are on the brink of ecosystem collapse, with biodiversity loss and diminished ecosystem services leaving regional communities vulnerable to drought. Restoring natural capital is critical for achieving government NetZero and Nature Positive targets for carbon emissions and biodiversity. However, restoration faces major barriers, notably limited supply of diverse seed, barriers establishing ground cover species, and unknown climate resilience of local material under climate change.

“Restoring Ecosystem Climate Resilience (RE-Clim)” is a state-of-the-art research facility testing a diverse array of grass and forb species from local and climate-adjusted provenances to future warmer and drier conditions. 42 seed collections have been precision sown into 24 restoration plots (4m^2) allocated to four climate treatments. Soil warming with heating cables +5C above ambient temperatures combined factorially with soil moisture limitation at 40% field water holding capacity. Over 22,000 seed individually monitored weekly for emergence and survival over the seasons is providing unique insights into climate adaptation. Moving forward this research facility will host researchers exploring plant physiological responses to summer extremes, soil carbon sequestration and nutrient cycling, along with plant interactions and ecosystem dynamics.

“Seeding diverse native ground cover on farms for drought and climate resilience” aims to 1) boost seed supply through targeted collection, banking, and production of genetically diverse native ground cover; 2) demonstrate innovative ground cover restoration techniques, including seeding plant and soil diversity, and alternate (graze, harvest, burn) management practices; 3) build drought resilience by identifying species and provenances tolerant of future climate conditions ; 4) quantify economic incentives for landholders to restore and manage biodiversity and ecosystem services.

The outcomes of this research will build much needed capacity to improve landscape function and resilience, enabling regional communities to better withstand future droughts.

Biocultural Heritage And Potential Applications Of Castanospermum Australe (fabaceae): An Ethnobotanical Review

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Ethnobotany explores the intricate relationships between plants and people, often considering the essential resources provided by plants for nourishment, construction, medicine, spirituality and creative expression. This ethnobotanical review examines the cultural significance, traditional preparation methods and potential contemporary applications of *Castanospermum australe* (Fabaceae). *C. australe* is a large tree commonly occurring along watercourses in tropical, subtropical and coastal rainforests from Cape York Peninsula, Queensland to Lismore, New South Wales, Australia. The species is characterised by hydrochorous and recalcitrant seeds, with all plant components containing the toxic alkaloids castanospermine and australine. Investigations into the cultural significance of the species revealed its presence in a diverse range of Dreaming stories, its role in seasonal gatherings and ceremonies, and its intentional dispersal by Indigenous peoples. However, the species' original distribution and potential ecological impacts resulting from this dispersal remain unknown. Additionally, the seeds of *C. australe* have been consumed as a starchy staple for an estimated 2,500 years, with preparation methods varying among different tribes. The factors influencing these variations and their implications are not well understood. Potential contemporary uses of *C. australe* include its commercialisation as a food product, leveraging its low glycaemic index, however key questions remain regarding its complete nutritional profile, economic viability, and management of its inherent toxicity. Additionally, the species demonstrates promising medicinal properties, including anti-inflammatory, immunosuppressive, analgesic, antiparasitic, antiviral, and glucosidase inhibitory effects, warranting further research. This review highlights the significant cultural value of *C. australe* and its potential contributions to broader society. It emphasises the importance of continued collaboration with Traditional Knowledge Holders and sustained efforts towards biodiversity conservation.

Building Resilience Into Native Seed Supply In A Rapidly Changing World: From Wild Collections To Seed Production Areas

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Addressing the challenges of biodiversity loss and climate change is significantly hampered by the availability of good quality native seed. Alongside sustainable wild collections, Seed Production Areas (SPAs) will likely play an important role in filling the growing gap between seed supply and demand. Yet for both avenues of seed supply there are many knowledge gaps around incorporating climate-ready thinking into seed sourcing decisions and how this integrates into real-world practice. A key goal in seed sourcing for ecological restoration is ensuring that populations have the genetic diversity and adaptive capacity to survive in current and future environments. But, in practice, and especially for wild collections, this leads to many questions: how do we identify and source 'climate ready' seed? How does this relate to provenance and seed collection zones? How does this translate practically to what happens on-ground? Similarly, tor SPAs, there are there are currently many knowledge gaps regarding how to establish SPAs to produce resilient, healthy seed suitable for a changing climate. These include key questions on genetic composition, mating patterns, pollinators and admixture within the SPA. This is especially important for SPAs that include woody species that represent a longer time to flowering and seed set than non-woody ones and therefore are a longer-term investment. These issues are also related to perceptions around the quality and utility of the seed produced, which remains a barrier to broadscale SPA uptake and utilisation. In this talk we discuss some of our strategies and research to see climate-ready principles implemented into practice for native seed for both wild collections and SPAs. By integrating science and research into practice we aim to work towards a better understanding of how to source and produce healthy, genetically diverse native seed for restoration in a rapidly changing world.

Natural Forest Seed Collection For Banking (papua) New Guinea's Least Explored Tree Species

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Papua New Guinea forms the eastern half of New Guinea, known for having the world's richest island flora with 13,634 species and 68% endemic to the island. Our research presents the collection and conservation of seeds on the eastern half of the tropical rainforest in New Guinea, aimed at preserving endemic and endangered species in the rainforest of Papua New Guinea. To date, we have collected 46,792 seeds from 64 tree species (~0.46%) sealed in aluminum envelopes and preserved in a conventional refrigerator (-21^{0}C) conditions. Most seeds in the forest we studied requires careful examination at species level to for fully understand the germination viability, classifications and resilience to desiccations for more than several months to years under conventional seed storage conditions.

Given the limited understanding of tree species phenology in the rainforest of Papua New Guinea, our target for tree species seed collection is based on random scouting in the forest floor to collect seeds. Enhancing seed bank facilities and research capacity at Bulolo Campus presents a significant opportunity to study seed storage behaviour in New Guinean species and improve phenological data collection, ensuring high-quality seed conservation. In collaboration with the Asia-Pacific Seed Preservation and Research Network (SPARK), research on the phenology and seed storage behaviour of *Nothofagus* species will serve as a foundation for these efforts. Bulolo campus students will be trained under the new bachelor of forest research management to collect and germinate seeds to supporting the university arboretums and further implement forest restoration and management as part of the university visions.

The takeaway from the Australasian Seed Science Conference is to learn as much from other experts in seed science worldwide and to develop a seed research network to conserve some of the least explored seeds on the second largest island on the planet.

Can Rain Shelters Improve Harvest Yields In Seed Production Areas

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Seed production areas are critical for seed-based restoration of grassy ecosystems in south-eastern Australia, enabling intensive cultivation of desired seed crops and alleviating harvest pressure on vulnerable remnants. However, tailoring production systems to optimise yield, promote crop resilience and minimise losses associated with pests or abiotic factors create efficiency challenges for management of multi-species crops.

The University of Melbourne's Burnley campus has produced native forb seed for experimental restoration work since the mid-1990s. A recent infrastructure expansion prompted examination of potential benefits from growing crops undercover. Sheltered conditions may reduce premature seed fall, avoid seed decomposition due to waterlogging from rainfall or prevent onset of germination related processes like mucilage production following wetting. Additional benefits include opportunities for wet weather harvesting or delayed collection of fallen seed (e.g. via vacuum) allowing flexible collection scheduling. Dry storage conditions are also important to maintain seed metabolic stasis and viability for many species.

We set up a simple experiment using surface irrigated Nally Solid Megabins (780 L) planted with 19 forb species commonly found in Victoria's natural temperate grasslands. Bins contained base layers of gravel lined with geotextile topped with growing media. Tube stock was planted into overlaid weed mat. One set of bins was located under shelter and a corresponding set placed in an adjacent uncovered location. We measured time spent per gram of seed collected per species over a typical growing season (Spring to Autumn, Melbourne).

We hypothesised differences in harvested seed yield for some species under sheltered conditions due to variable responses to reduced light, soil moisture and ventilation that may be offset by higher yields for some species due to increased collection opportunities (e.g. *Goodenia paradoxa).* Preliminary results suggest variation in seed set (*Rutidosis leptorrhynchoides*), time to ripening (*Calocephalus spp.*), pest/pathogen abundance (*Craspedia, Wahlenbergia spp.*) and survival (*Minuria leptophylla*).

Using Rna Integrity To Inform The Curation Of Wild Plant Seeds In Conservation Seed Banks

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Seed banking is an efficient *ex situ* conservation strategy for the conservation of plant species and their genetic diversity. Successful seed banking relies on seeds remaining viable until required for use in species re-introductions, habitat restoration, or other activities. However, all seeds eventually die in storage and monitoring of collections is required to ensure precious material is not lost. Common methods of assessing seed viability, such as germination testing and tetrazolium staining can be labour intensive and only detect seed deterioration when it can be almost too late to initiate management actions, such as the re-collection or regeneration of seed collections. These issues are exacerbated when germination requirements are unknown, as is the case for many wild species. RNA integrity has been proposed as a new method of assessing seed viability in storage but has only been demonstrated for a small number of agricultural cultivars. Our research examined the utility of the RNA integrity assay to inform the viability of wild Australian species during storage. We studied freshly collected seeds, and stored accessions (8+ years of storage) of native seeds. Total RNA was extracted from dry seed and quantified using an Agilent bioanalyzer to produce an RNA integrity number (RIN).

For five out of nine species assayed, we found a significant, linear decline in RIN values fashion with increasing time in storage. For the remaining four species, we found no relationship between RIN and time in storage. For all species there was no correlation between the RIN integrity and germination percentage, in contrast to research presented for agriculture cultivars. My current research seeks to examine the relationship between seed viability and RNA integrity through controlled ageing experiments of diverse species. We aim to expand the tools available for seed bank management for Australian taxa.

Seed Biology And Ex Situ Conservation Of Western Australian Myrtaceae For Myrtle Rust (austropucciniapsidii) Preparedness

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Myrtle rust is a plant disease caused through infection by the fungus *Austropuccinia psidii* and affects plants in the Myrtaceae family. Since it's introduction into Australia in 2010, myrtle rust has significantly impacted many myrtle species across Australia's east coast, including at least 15 species that have undergone catastrophic decline. The arrival of Myrtle rust (*Austropuccinia psidii)* into the Kimberley region of Western Australia (WA) has caused great concern for it's diverse and endemic Myrtaceous plant communities.

Seed banking is an efficient and cost-effective strategy for plant conservation in the face of unprecedented biodiversity loss, but collection management must be guided by knowledge of seed biology, storage behaviour and longevity. Species-specific knowledge is critical to protect species in case of decline in the wild but is lacking for many Myrtaceous species, particularly from the south-west and wet-dry tropics in WA.

My PhD research aims to expand the tools available for the informed management of rare and priority Australian taxa and allow early intervention of deteriorating seed collections. My project is divided into the following chapters.

1. Determining the germination requirements, seed biology and cold storage behaviour of Myrtaceous species from WA
2. Determining the utility of the RNA integrity assay as a collection management tool
3. Examining the utility of population genetic techniques to support the *ex situ* conservation of *Agonis flexuosa*.
4. Testing the suitability of Kimberley species for conventional seed bank storage

Differential Responses Of Seeds Of Wild Australian Plant Species Under Open Versus Hermetic Rapid Ageing Conditions.

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Seed banking is an important component of *ex-situ* conservation of plant species and their genetic diversity. Understanding seed longevity in storage is crucial for the effective management of banked seeds. Seed longevity is commonly studied through rapid ageing of seeds under conditions of elevated temperature and relative humidity (RH), for example, through the comparative longevity protocol of the Millennium Seed Bank Partnership, which has been widely applied to seeds of wild plant species. Through this protocol, species with relatively longer- or shorter-lived seeds are identified to prioritise viability monitoring. This protocol ages seeds in an open storage environment where oxygen availability is greater than in the hermetic conditions under which seeds are commonly stored for conservation. However, relative longevity between species may vary between each storage system. In this study we examined the longevity of seeds of 13 Australian species at 45°C and 60% RH under both open and hermetic storage conditions. We used probit analysis to model seed survival curves and calculate K_i (intercept of the survival curve), $-1/\sigma$ (slope of the survival curve) and p_{50} (time to 50% germination). Through comparison of the seed survival curves, we found that for five species, there was no difference in longevity between the open and hermetic storage systems. For the remaining species, three had shorter seed longevity in open storage, and four had shorter longevity in hermetic storage. These differential responses to the storage environment may be due to variation in seed composition but additional work is necessary to determine the factors contributing to variation in longevity. This variation between the open storage conditions commonly used for modelling of longevity and the hermetic storage conditions used for seed banking has implications for the management of wild species seed banks.

Tracking Evolutionary Changes In Red Clover: A Collaborative Study Between Bosnia And New Zealand

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In 2022, the Margot Forde Genebank (MFG) and the Institute of Genetic Resources (IGR) at Banja Luka University launched a collaborative research initiative to investigate long-term evolutionary changes in *Trifolium pratense* (red clover). This project builds on historical collections made by the late Margot Forde in 1988, revisiting the same five sites in Bosnia and Herzegovina in 2023 to collect new samples, led by IGR. The study aims to assess potential genetic and phenotypic shifts in red clover populations over 35 years, providing insights into adaptation to environmental and anthropogenic influences.

Phenotypic traits—including growth, morphology, and yield—are being evaluated in replicated trials in Bosnia and Herzegovina and New Zealand, ensuring cross-environmental consistency. The trial work in Bosnia is conducted via a PhD project, while complementary studies are conducted at MFG. Additionally, DNA analysis will be performed to identify genetic variations that may have emerged over time. By integrating historical and contemporary collections, this research offers a unique perspective on plant population dynamics, genetic divergence, and adaptation. The findings will support forage breeding, genetic resource management, and conservation strategies, strengthening the resilience of forage species in the face of global change. This project underscores the value of long-term seed collections at genebanks and international collaboration in understanding and preserving plant biodiversity.

The Evolution And Future Of The Margot Forde Genebank

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The Margot Forde Genebank (MFG) at AgResearch near Palmerston North, New Zealand, was established as a seed bank to support pastoral agriculture. Renamed in 1993 in honour of New Zealand botanist Margot Forde, it is now recognised as a Nationally Significant Collection and Database.

New Zealand's pastoral economy is heavily reliant on exotic pasture species, and MFG plays a crucial role in conserving genetic diversity to address evolving agricultural challenges. The Genebank holds a diverse collection of 175,000 accessions representing 2,500 species across 500 genera and 100 plant families. Annually, MFG distributes 3,000 to 5,000 accessions of commercial and wild forage species, cultivars, breeding lines, and genetic stocks to researchers.

Since 1941, staff have collected 20,000 accessions from New Zealand and abroad, with an additional 19,000 ecotypes introduced from other genebanks, botanical gardens, and universities since 1935. These wild accessions originate from 123 countries and represent 440 genera and 2,000 species.

Records, originally maintained in large ledgers, were digitised in the 1980s. Today, an in-house database tracks holdings and distributions, with a public interface available online. MFG is currently exploring the GRIN-Global platform as a potential replacement for its in-house database, which uses soon-to-be unsupported software. Staff identify and retrieve missing accession data from other databases, collection notes, and geographic sources. Updated records are shared with the international Genesys data repository, enabling researchers worldwide to readily connect with the collection.

As the collection has outgrown its 50-year-old facility, a larger, modern facility is currently under development. While initially focused on forage species, the Genebank now also hosts the New Zealand Indigenous Flora Seed Bank and smaller collections of crops and other plants. We welcome novel genetic resources from various genera and environments, which may help address future challenges to New Zealand's primary production industries.

The Australian Grains Genebank – Next-gen Genebank Management For A Food Secure Future.

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The Australian Grains Genebank (AGG) is one of the world's largest and most diverse genebanks, with over 200,000 accessions of cultivated varieties, landraces, and wild relatives. These genetic resources are essential to global food security and sustainable agriculture, especially amid growing challenges like climate change and emerging threats to crop production. From tropical and temperate cereals to legumes and oilseeds, the sheer scale and complexity of the AGG make efficient genebank management, and strategic use by the grains industry, a formidable task when relying solely on traditional passport data. Finding the right germplasm can often feel like searching for a needle in a haystack.

As pressure on global agricultural systems intensifies, innovative approaches to genebank management have never been more urgent. The AGG Strategic Partnership, a joint investment between Agriculture Victoria and the Grains Research and Development Corporation, is leading the transformation of plant genetic resource management. This future focused initiative is unlocking the full potential of the AGG's collection for Australian grain growers by integrating cutting-edge genomic technologies, dynamic curation protocols, and publicly accessible online bioinformatics tools with traditional genebanking practices.

Through dynamic curation—which merges genomic data with passport and characterisation information—the AGG is optimising the conservation, maintenance, and strategic use of its germplasm. The publicly accessible bioinformatics platforms are empowering breeders and researchers to make faster, more precise, and more informed decisions about the germplasm best suited to their goals.

Here we report how the AGG's implementation of genomic-informed curation is setting a new standard for genebank management. These transformative tools are enabling the grains sector to fully harness biodiversity, accelerate trait discovery, and fast-track the development of climate-resilient, high-performing varieties. In doing so, they offer a powerful path forward to ensure sustainable productivity, economic viability for farmers, and food security in a rapidly changing world.

How Important Is Your Seed? Experiences With Prioritising Value In A Large Seed Collection

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A conservation seedbank is a living plant collection of seeds designed to preserve plant genetic diversity into the future. Seedbanks require careful planning, monitoring and management to ensure their long-term viability and sustainability. The curators of seedbank are often faced with difficult questions, such as which accessions (seed samples) to select for monitoring plant health and regenerating fresh stocks. The decisions are made even more challenging when the collection outgrows available resources (funding and capacity). The Australian Pastures Genebank (APG) has set sustainability-based goals to monitor the health of every accession every 10 years, with flexibility for species known to have short and long lifespans in storage. Seed samples with low stock of <1000 free living seeds should be selected for regeneration, duplicated in storage and made available for distribution. However inadequate past investment and coordination of plant genetic resources in Australia, has resulted in a significant proportion of the collection requiring immediate maintenance. The requirement to test and regenerate a lot of seed samples in an impossible 'now' timeframe resulted in a decision for the APG to prioritise the value of every accession in the collection.

The APG used a team of Australian scientists to review the 2619 species in the collection, and give each a priority rating of 1-5 (1 being commercial highly important and 5 being of no value) for their value to Australian Agriculture. Within species, accessions were also assessed for their level of uniqueness and value, considering factors such as their inclusion into core collections and completeness of passport data. This talk describes the value and future challenges of having an 'Accession Level Prioritisation' score in the APG, explaining how it assists decision making that relates to the maintenance and long-term planning of the collection.

Unlocking 60 Years Of Historic Observation Data In The Australian Pastures Genebank

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The Australian Pastures Genebank (APG) is the national pasture and forage genetic resource centre, amalgamated in 2014 from major state and commonwealth-based collections around Australia. The APG has unlocked a vast collection of historic genetic resource evaluation data spanning over five decades. Collected between 1968 and 2013, these datasets provide continuous and standardised trait observations for annual medics (*Medicago* spp.), clover subterraneum (*Trifolium subterraneum*), and tropical legumes.

The newly available Queensland tropical legume dataset includes 22 observation traits for over 3,500 accessions. The dataset includes observations of agronomically important traits such as biomass yield, persistence, drought tolerance, fire resistance, grazing tolerance, and seed yield. For temperate annual legumes, the APG has uploaded 62 observation traits for 59,680 accessions of subterranean clover and annual medic into the GRIN-Global platform. These datasets feature extensive trait data that include species identification, growth habit, leaf markings, flowering time, isoflavone and hard seed levels, dormancy, and burr / pod production. However, defining trait measurement methods, coded values and units has posed challenges, particularly when working with records dating back up to 55 years. Further challenges relate to identifying institute identifiers and using historic taxonomy to confirm matching records.
To maximise its impact worldwide, APG is making this data publicly accessible through international platforms such as Genesys and the GRIN-Global powered APG website. These datasets enable researchers to identify accessions with desirable traits suited to different environments and farming systems. Finally, digital object identifiers (DOIs) aim to improve future tracking of institute identifiers. By unlocking and sharing this valuable resource, APG supports global efforts in pasture improvement, genetic diversity conservation, and climate-resilient agriculture.

The National Seed Bank's Strategic Priorities, 2025-2035

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The National Seed Bank's strategic priorities, 2025-2035

The National Seed Bank (NSB) is located at the Australian National Botanic Gardens (ANBG) in the ACT. Its purpose is to protect against extinction and build knowledge of Australian plant species through integrated collection, storage and research of plant germplasm. The NSB is uniquely positioned, both geographically and institutionally, providing opportunities and responsibilities at local, national and international scales. Target species include those threatened and significant in the ACT, nearby southeastern bioregion and across Parks Australia's Commonwealth parks and gardens.
Over the coming decade, The NSB's purpose will be achieved through five strategic priorities:

1) Expand seed collections – Grow the NSB collection, targeting greater conservation and research opportunities
2) Improve collection management – Manage and maintain the NSB collection and specialist facilities to international best practice
3) Carry out novel research – Increase knowledge of Australian flora through collaborative and innovative research that explores novel and critical questions for enhanced seed use and conservation
4) Maximise impact – Promote and advance seed banking through national leadership, training, publication, outreach and seed and data supply
5) Prioritise First Nations values and goals – Understand perspectives and priorities around plant conservation and explore opportunities for two-way science and knowledge sharing for culturally responsible seed banking

In collaboration with researchers and conservation practitioners in the ANBG, other seed banks and botanic gardens, universities, government, industry and on Country, the NSB are well placed to make a significant contribution to native seed biology, ecology and plant conservation over the next ten years. Here, we present our key goals, actions and targets in relation to each of the above priorities, and outline how they will be underpinned by critical enabling factors: people, facilities and partnerships.

Towards Smarter Genebank Management: Insights From Genotyping Core Crops In The Australian Grains Genebank

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Abstract:

The world's genebanks contain the genetic diversity needed to generate improved outcomes in crop breeding programs. They are also sources of traits that will be important in the future for developing resilient crop systems. Large germplasm collections, however, are expensive to maintain and it is therefore important that the diversity of germplasm in collections and its associated metadata are accurate and that levels of potential duplication and redundancy are understood.

The Australian Grains Genebank (AGG) Strategic Partnership, a joint investment between Agriculture Victoria and the Grains Research and Development Corporation, aims to unlock the genetic potential of plant genetic resources, making them more accessible to the research and breeding community. The AGG has genotyped several major cultivated crop species in its collection, representing >100,000 accessions, using SNP array technology. Here we present the results of this enormous genotyping effort. We show that the age of seed did not impact the quality of genotype data obtained. We found significant levels of duplication in the collection which allows for the development of dynamic curation protocols. We were also able to use the genotype information to correct passport data fields such as taxonomy and to an extent country of origin. The data has allowed the creation of core sets capturing the diversity within the collection, as well as the identification of collection gaps when compared to other international genebanks, enabling more targeted acquisition. The applied use of genotyping data is a powerful tool for understanding the diversity and composition of germplasm collections, with significant opportunities for more efficient and financially sustainably management and maintenance of these vital resources into the future.

Seed Banking Conservation Ladder: a Framework for assessing Ex Situ Conservation Knowledge Gaps.

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Seed banking is the most commonly applied *ex situ* conservation tool. However, to ensure that a species is effectively 'banked' and protected against extinction there are multiple steps that must be addressed and verified. These include both research and conservation actions. Currently, there is no protocol for determining a species' status in relation to our research knowledge and *ex situ* conservation efforts. This makes it challenging to accurately assess progress towards *ex situ* conservation goals and to identify and prioritise gaps in knowledge.

Using a subset of threatened plant species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), we developed a 'Conservation Ladder' framework to systematically assess the current status of each species. Our work adapts a similar framework being developed for broader conservation assessments (James Watson *et al*., in prep.), to the specific context of seed banking. The seed banking Conservation Ladder consists of four steps, conceptualized as rungs of a ladder, each representing a critical stage in effective *ex situ* conservation:
i) Collection – identifying known collection locations and ensuring adequate availability of germplasm,
ii) Storage – understanding storage behaviour and germplasm longevity in optimal storage conditions,
iii) Utilisation – determining germination and/or propagation requirements, and
iv) Representation – ensuring that a sufficient quantity and quality of germplasm is represented in *ex situ* storage.

This framework can be applied at various levels, from individual species to taxonomic groups, threat listing status, or regional distribution. Using the Conservation Ladder, we have identified and quantified current knowledge gaps and exposed areas of urgent conservation or research priority across 349 threatened flora species. This demonstrates the potential for the seed banking Conservation Ladder to articulate, to both policy makers and practitioners, what is needed to fully meet plant conservation targets.

Germination Requirements Of Australian Temperate Saltmarsh Species

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Coastal wetlands, including saltmarshes, provide key ecosystem services such as carbon sequestration, coastal protection and habitat to support biodiversity. These wetlands experience losses globally due to human development and climate change. Natural revegetation of a degraded coastal wetland can be ineffective even after pressures have been removed due to the difficulty of retaining seeds in bare areas. The dynamic tidal nature of these ecosystems means that active restoration is a key approach for restoring saltmarshes that cannot naturally return on their own. As preparation and deployment of seeds can be labour-intensive, it is important to understand the optimal germination and growth requirements for saltmarsh species to inform best practices for direct seeding, therefore improving establishment success and the cost-benefit of this approach. However, this foundational knowledge is lacking for the diversity of saltmarsh species in Australia. We will present results from germination experiments in laboratory conditions to determine the temperature and salinity requirements for temperate saltmarsh species. We will also discuss how these requirements can be translated to active restoration practices.

Strategies For Collection Of Genetically Diverse Germplasm When Seed Availability Is Limiting. A Case Of Critically Endangered Herb, Ballantinia Antipoda.

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Sourcing seeds for conservation programs from wild populations of rare plants presents many challenges. It is accepted that seed collectors should sample multiple individuals from distinct populations to maximise genetic diversity of the germplasm used in ecological restoration and/or translocation attempts. However, the numbers of seeds that can be sustainably collected without affecting the viability of the local populations will strongly depend on population size and the reproductive strategy adopted by the species (e.g., annual vs perennial plants, obligate seeders vs resprouters). In addition, collection of seeds may be logistically challenging due to remoteness of sites, rugged terrain and/or height of canopy trees, while in some plants seeds may mature and be released in mid-summer when field work is difficult due to risk of bushfires and heatwaves. What avenues are there for conservation practitioners working with rare flora faced with limits to the number of seeds we can collect?

Threatened Species Conservancy is involved in several rare plant conservation projects. In our work we collaborate with nurseries, botanic gardens and universities to enhance our germplasm collections through vegetative propagation from cuttings alongside or instead of seed collection – particularly for threatened species that rarely produce fruit or occur as small populations. In a planned project aimed at safeguarding the critically endangered annual herb, *Ballantinia antipoda*, a limited number of seeds will be collected from the wild plants to not affect population viability. Because previous translocation attempts of *B. antipoda* failed due to low seed germinability—suggesting inbreeding depression—the seeds will be used to establish an ex-situ seed orchard. The plants will be hand-cross pollinated to effect genetic rescue, and the resulting seed crop will be used for population augmentation and reintroduction. Threatened Species Conservancy is keen to collaborate on projects requiring collecting seeds from threatened species and remote sites.

Seed Conservation Of Amorphophallus Titanum (becc.) Becc. Ex Arcang

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Amorphophallus titanum (Becc.) Becc. Ex Arcang is the remarkable inflorescence famous as the icon of many botanic gardens. This Araceae member is endemic as it only occurs in Sumatra Island, Indonesia, in nature. The population of this Aroid in the tropical rainforest in Sumatera has been facing a significant decline due to habitat transformation. Therefore, the ex-situ conservation strategies are required such as seed conservation. The strategies cover the determination of the seed storage characters. Previous research indicated that Aroid seeds are orthodox. This research used the seeds from the inflorescence of *A. titanum* which opened in Bogor Botanic Gardens on 2 February 2012 and pollinated manually using (stored) pollen taken from another plant, which had bloomed on 29 November 2011. The hand cross-pollination was successful and the fruit (infructescence) produced on 22 February 2012 marked the first success for manual pollination of this gigantic aroid in Indonesia. This research resulted in the seed storage behaviour under the categorise of Exceptionality Factor 2 where the seeds are potentially recalcitrant. The best treatment to enhance the seed storage period for conservation purposes was storing in the moist substrates such as moss planting media to maintain the stored seeds viable.

Genetic Variation For Protein Content And Seed Size In Diverse Pulse Germplasm Collections

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Genetic variation for protein content and seed size in diverse pulse germplasm collections

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Global demand for sustainable, plant-based proteins as isolates or concentrates are increasing. Currently there is limited data describing protein content and seed size, range and distribution to benchmark Australian pulse germplasm collections in Australia. Within this research ten thousand pulse grain samples were non-destructively analysed using high-throughput technologies. The traits characterised included protein content and seed size. Nine different collections of diverse germplasm were assessed from the Australian Grains Genebank (AGG) and Australian Pulse Breeding programs. These included 9,046 chickpea, 252 field pea, 578 lentil, and 292 mung bean. The field pea, lentil, and mung bean collections were generally higher in protein content than the chickpea collections. However, within the chickpea germplasm originating from UC Davis there were 65 lines with protein content higher than 26% and conversely 4 chickpea lines were reported to have extremely low protein contents, <11%. High protein chickpea, field pea, lentil, and mung bean lines hold the potential to produce commercial cultivars that may rival protein content of other high protein pulse crops such as soybean. By considering protein content in key Australian pulse crops, non-premium or feed grade pulses could be marketed as a valuable raw protein source for manufacturing plant protein concentrates. This would in turn provide opportunities for higher price returns for growers.

Reinvigorating A National Genebank In Vanuatu For Ex-situ Seed Conservation

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Reinvigorating a National Genebank in Vanuatu for Ex-Situ Seed Conservation

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Vanuatu's rich agricultural biodiversity is critical to food security, climate resilience, and cultural heritage across its islands. However, increasing pressures from climate change, natural disasters, and land use changes threaten the genetic diversity of traditional crop varieties and wild relatives. To safeguard these vital resources, Vanuatu Agricultural Research and Technical Centre (VARTC) is developing a national genebank focused on ex-situ seed conservation. The genebank will provide a secure, centralised facility for the collection, storage, and management of seeds from key traditional and agricultural species. Initial efforts are prioritising high value grain and staple crops such as peanut, food legumes, feed grains alongside important cultivated and wild species of food crops with future breeding potential.

Seed accessions will be collected following international best practices, ensuring high genetic integrity, comprehensive documentation, and long-term viability. Standard operating procedures based on FAO Genebank Standards will underpin seed processing, testing, and storage. The genebank will serve as a foundation for national food system resilience, supporting research, breeding, and community seed distribution programs. Partnerships with regional and international genebanks will enable safety duplication and knowledge exchange, strengthening Vanuatu's capacity to conserve and utilise its plant genetic resources. Through this initiative, Vanuatu will preserve critical biodiversity, empower local communities, and build adaptive capacity to future environmental challenges, ensuring that vital crop diversity remains available for generations to come.

The Development Of A Strategy For The Collection And Storage Of Seed For Species Native Forest Restoration Following Major Repeat Disturbance

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Australasian Seed Science Conference – Horsham, Victoria

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Abstract

The development of a strategy for the collection and storage of seed for species native forest restoration following major repeat disturbance.
Climate change is having an impact on the frequency and severity of bushfires and DEECA is seeking to ensure that suitable stocks of seed are available for native forest restoration after major disturbances for vulnerable forest types.

Native forests are some of Victoria's most highly valued natural assets. 'Ash forests' are composed of fire sensitive species (Mountain Ash and Alpine Ash), and when two severe bushfires occur within 20 years, the species becomes locally extinct due to the inability of immature forests to set seed and regenerate. The 2019/20 fires in Victoria burned 83,000 ha of Ash forest, impacting 25,000 ha of immature ash forest. Of this area, it is estimated 15,000 ha was likely unable to naturally self-regenerate.

DEECA currently holds 12 tonnes of Ash species seed, although provenances are limited as they are associated with areas where timber harvesting was previously a focus.
DEECA is considering options for seed collection and storage for future forest restoration requirements and is developing a seed management strategy to guide this process. This will provide guidance for seed collection and the necessary infrastructure to support the extraction, storage and viability testing.
It is expected that while seed remains available to collect, within available budgets, the Ash species will be a key target for this program. However, we need to consider potential climate change impacts on future disturbance events that will have an impact on these forests and their associated ecology.
We expect the strategy will provide guidance for the next 10 years, however we will need to utilise frameworks such as Resist-Accept-Direct (RAD) to guide how we practically manage these forests into the future. We need to ensure that options open to DEECA include a suite of seed species and provenances that will support future decision making, ideally before significantly further major disturbance occur.

Grounded In Community: Making Provenance Seed Sourcing Work At Scale

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Trees For Life Abstract Submission ASSC 2025

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Grounded in Community: Making Provenance Seed Sourcing Work at Scale
Presented by Mitchell Livingston, Trees For Life

How can revegetation using local provenance species be made accessible, affordable, reliable, and rewarding for landholders across an entire state? Mitchell Livingston shares Trees For Life's community-driven approach to this question, offering practical insights from on-the-ground experience.

Focusing on seed sourcing for large-scale revegetation, this presentation explores how community networks can overcome traditional barriers to effective seed collection—such as access to remnant vegetation, seasonal timing, and genetic diversity. By embedding seed collection and banking within a network of volunteers, landholders, and local observers, Trees For Life demonstrates that building trust and long-term relationships is key to sustainable outcomes.

Case studies will illustrate how community involvement—from monitoring seasonal changes to granting access for collection—creates a robust, flexible system for meeting diverse revegetation needs and capacity to adjust to future challenges such as climate change. The presentation will also share lessons from managing a seed bank of over 450 species, including strategies for maintaining seed quality, dealing with short viability periods, and ensuring supply reliability.

Ultimately, this session will highlight how meeting the growing demand for provenance seed is a collaborative, cultural, and ecological effort—and how empowering communities is essential to restoring landscapes across South Australia.

Using Seed For Restoration In Act Offsets

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Abstract for Australasian Seed Science Conference 2025

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Relevant Conference Theme: Seed Sourcing and End Use

Title: Using seed for restoration in ACT Offsets
Preferred presentation type: Poster
Presenting Author: Emily Sutcliffe (Emily.Sutcliffe@act.gov.au)
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The New Reserves team in the ACT Parks and Conservation Service currently manages 2,309ha of land as environmental offsets for development. Much of this land requires management to restore and maintain ecological values, including critically endangered woodland and grassland ecological communities and threatened species habitat. Key outcomes we aim to achieve, committed to in offset approval conditions, are improving native groundcover and understorey diversity. Sowing native seeds is vital to these goals and we use many strategies to ensure we have enough seed, including seed production areas, buying seed, and developing apps to record seed collection areas and create a digital seed inventory. Our two seed production areas have been set up in degraded areas inside reserves, producing large quantities of seed for 24 forb and grass species. We are also growing species in mobile wicking beds to trial an alternative to establishing forb nodes from tube stock.
In addition, we have been recording restoration actions in a specially designed map and implementing restoration trials. For example, a trial in low-diversity, native dominated grassland in which 15 forb and grass species were sown immediately after an ecological burn in autumn 2021. By spring 2024, some species had established well – such as Lemon Beauty-Heads, Native Flax and Narrow Leaf New Holland Daisy – while 5 were not observed.
Scrapes (topsoil removal) have been used to great effect in the Molonglo area of the ACT however they have been done by a different team and are not presented here.
These strategies have helped (1) ensure we have sufficient native seed for restoration and for revegetation after disturbances such as track installation, and (2) adapt our management by tracking the success of these restoration actions and trials through time.

Acknowledgement of Country
I acknowledge the Ngunnawal people as traditional custodians of the ACT and recognise any other people or families with connection to the lands of the ACT and region. I acknowledge and respect their continuing culture and the contribution they make to the life of this city and this region.

Fragmented Fields and Failing Flowers: Allee Effects in An Iconic Grassland Plant

Susan Kachaniwsky[1]
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Title: Fragmented Fields and Failing Flowers: Allee Effects in an Iconic Grassland Plant
Author: Susan Kachaniwsky (La Trobe University)
Theme: Seed biology and ecology

Abstract:
Habitat fragmentation can disrupt ecological processes essential for reproduction and persistence. Long-lived forb *Ptilotus macrocephalus* (Featherheads) now persists mainly in small, isolated remnants across the Victorian Volcanic Plain (VVP), where low seed production and pre-dispersal seed loss have raised concerns about population persistence. Such populations may be experiencing an extinction debt, where demographic processes delay local extinction following habitat fragmentation. In this context, Allee effects—reductions in individual fitness at low density or small population size—are a key consideration. To evaluate the processes influencing persistence, floral visitation, seed set, seed predation, and recruitment were assessed across 15 remnant populations spanning a range of sizes and densities.
Neither population size nor density predicted seed set. However, seed set was reduced in low-density floral patches, that the presence of nearby conspecific neighbours is important for optimising seed production. Seed predation was lower in larger populations, consistent with a component Allee effect acting through increased seed survival at higher population sizes. Strong recruitment signals were restricted to populations exceeding 120 individuals, suggesting the existence of a population size threshold for regeneration. A controlled pollination experiment did not clarify the breeding system, but floral visitor observations showed a generalist assemblage, with thrips particularly abundant and potentially acting as both pollinators and floral herbivores.
Overall, these findings indicate that reproductive success in *P. macrocephalus* is shaped by both local floral context and population-scale processes, with multiple mechanisms potentially contributing to Allee effects in fragmented grasslands. Conservation strategies should prioritise augmenting small populations, reintroducing the species to sites of local extinction, and increasing floral density within existing patches to improve pollination and seed production. Such measures will be critical for supporting seedling recruitment and persistence in this declining grassland forb.