It's not all about the birds and the bees – Challenges and triumphs of Conservation Seed Orchards at the Royal Tasmanian Botanical Gardens

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Banking on success

One goal of the Tasmanian Seed Conservation Centre, based at the Royal Tasmanian Botanical Gardens (RTBG), is to have all of Tasmania's rare and threatened species and communities secured as long-term collections.

Some major challenges in achieving this are:

- 20% of Tasmania is remote Wilderness World Heritage with limited accessibility on foot, by air or sea.
- Many threatened species occur in remote or inaccessible areas, meaning monitoring for seed harvest can be difficult and very expensive.
- Some species occur in very small populations and/or occur sporadically across large areas making locating and harvesting difficult.

Developing 'Conservation Seed Orchards' often referred to as 'Field Genebanks' can provide a way to overcome some of these obstacles by providing ready access to genetically diverse collections. These are not without their own difficulties however, which can differ for individual sites and species, and need to be recognised and managed accordingly.

Since the RTBG's Nursery Seed Orchard Program began in 2006, 45 orchards have commenced, with 30 completed. The average time to run orchards from cuttings or germinants to a 'good' seed harvest *i.e.,* minimum of 10,000 seeds, is currently 7 years, and costs approximately $7,000 per species (roughly the same amount as one helicopter trip). However as more of the herbaceous or easily propagated species are completed, the cost and time is expected to increase as we move to slower growing and/or difficult to propagate species.

Trials and tribulations

Examples of some issues impacting the success of orchards at the RTBG are:

1. Understanding the biology

Tetratheca gunnii – This endemic Tasmanian species requires buzz pollination by a suitably-sized native bee (European honeybees being too large). Studies by the University of Tasmania (2017), discovered that the RTBG did not have sufficient native bees within its boundaries, primarily due to their short flying distance, lack of habitat, and human disturbance. All of Tasmania's bee species are solitary, unlike some hive-forming mainland species *e.g.,* Stingless Bees, which can be moved around. Hand pollination, with the assistance of volunteers, was attempted but proved ineffectual (Figure 1).

Figure 1. RTBG volunteer Laura Carvalho 'buzz' pollinating *T.gunnii*. Photo: James Wood

Activities to increase habitat and nesting sites within the Nursery and plans to introduce native bees are being enacted (Figure 2), as well as the temporary transportation of the seed orchard to higher bee density areas. Additionally, *Tetratheca* also not only releases seed over many weeks, but the seeds possess elaisomes (a structure composed of protein or fat) to attract ants in an effective dispersal strategy called myrmecochory. Measures to prevent loss of seed (*e.g.,* physical ant barriers) have also been implemented.

Figure 2. Under bench habitat plantings (left) and insect nest augmentation (right) to encourage pollinators to remain within the RTBG Nursery facility. Photos: Lorraine Perrins

2. Thinking outside the box

Azorella macquariensis: An endemic cushion plant on subantarctic Macquarie Island, this critically endangered species is being impacted by a severe dieback (Perrins 2012). The species is highly adapted to the harsh conditions on the island making it extremely difficult and costly to maintain in cultivation in Hobart. Despite several complex logistical challenges, *e.g.,* working on a remote World Heritage subantarctic island where supplies must be shipped via the annual Australian Antarctic Division's (AAD) supply vessel, an *ex-situ* collection/seed orchard has been successfully developed away from the wild populations (Figure 3). The collection is monitored via images sent from Parks and Wildlife Rangers based on the Island. Ten years on, this collection continues to thrive and is testament to the sustained cooperation between Botanic Garden staff, AAD, State Departmental scientists, and Tasmanian National Parks and Wildlife reserve managers.

Figure 3. *Azorella macquariensis ex-situ* conservation collection and seed orchard on Macquarie Island. Photo: Andrea Turbett (TASPWS)

3. Expect the unexpected

Lessons have been learnt that assumptions should not be made on the ease of growing species for a seed orchard. An example of this was with two Tasmanian coastal herbaceous species, *Lepidium flexicaule* and *Veronica novae-hollandiae*. Both proved to be easily propagated and grew rapidly, producing flowers within a few months. However just as rapidly the *Lepidium flexicaule* orchard succumbed to an outbreak of White Rust (*Albugo candida),* a difficult-to-control disease which arrived in Australia in 2001 and affects members of the Brassicaceae family. Disease problems also occurred with the *Veronica novae-hollandiae* orchard, which despite growing in constantly wet environment dune habitat on the West Coast of Tasmania, proved to be very susceptible to Downy Mildew (*Peronospora* spp.). There also appears to be an issue with the fruit capsules of this species not ripening fully in cultivation which is still under investigation.

Some pest issues can seem minor but do need to be monitored. An example is that when the RTBG Seed Orchard Program began 14 years ago, the sparrow population in Hobart had been decimated by disease (Wildlife Health Australia 2018). It is only

relatively recently that numbers of these seed-eating birds have increased to the point that they now severely impact some seed harvests, resulting in extra infrastructure protection being constructed (Figure 4). Good observation and the ability to adapt are key for successful seed orchards.

Figure 4. Bird-proof enclosures for seed orchards with removable sides to facilitate harvesting. Photo: Lorraine Perrins

Additional considerations made prior to the formation of a seed orchard include:

- Ensuring there is sufficient genetic diversity within the seed orchard.
- Ability to provide suitable growing requirements for species *e.g.,* potting media, environmental conditions.
- Ensuring differing species held do not hybridise, impacting the genetic integrity of the collections.
- Maintaining accurate records to monitor potential genetic erosion for longer term seed orchards if conditions favour more robust genotypes.
- Providing disease controls – some species can become more susceptible to diseases when grown artificially.
- Providing pest controls – predation by birds can decimate a crop in a few hours, or damage via from other wildlife *e.g.,* possums, can be a major issue. Pesticide usage to control insect pests may also negatively impact pollinators.
- Understanding the reproductive biology of species to determine effective pollination requirements and harvesting techniques *e.g.,* explosive seed capsules.
- Appreciating the time required for harvesting. Not all species can be bagged after flowering. Many species continue to flower and release seed over many weeks/months, requiring daily or more frequent hand collection, usually during peak summer holiday periods when volunteer assistance can be diminished.
- Understand and plan for the 'end use' of the orchard once complete *e.g.,* not using biological controls or soil inoculants on species that will be used for translocation purposes.

Satisfying rewards

The development of our orchard programs from cuttings or seed to productive, flourishing seed orchards can be challenging, however it has consistently provided much larger quantities of seed than could be collected from the wild populations. Additionally, the benefits of intimately observing and recording specific requirements of each species can reap much more than just the physical rewards.

References

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