

# Seed banking the cloud forests

## Urgent *ex situ* conservation of Australian tropical mountaintop flora

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1. National Seed Bank, Australian National Botanic Gardens, ACT  
3. Australian Tropical Herbarium, James Cook University, QLD

2. The Australian PlantBank, The Royal Botanic Gardens and Domain Trust, NSW

## Tropical mountain cloud forests

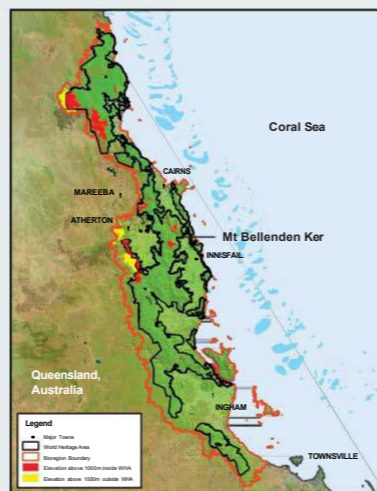
Globally, tropical mountain cloud forest (TMCF) is recognised as critically threatened by climate change.

In Australia, TMCF is restricted to the Wet Tropics World Heritage Area of northeast Queensland and contains over 70 threatened, endemic plant species.

The application of seed banking is expanding to species that were previously assumed too challenging to conserve *ex situ*, and to habitats that are currently under-represented in seed bank collections.

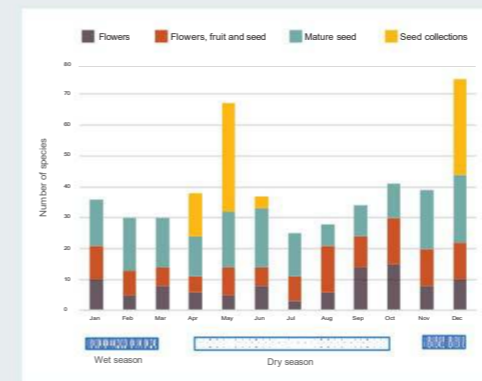
We explored the application of *ex situ* seed banking to mitigate species extinction in Australia's TMCF.

We synthesised current knowledge from seed literature from similar plant communities around the world, and our own preliminary studies.



Map of the Wet Tropics bioregion. Mt Bellenden Ker (1,593 m) is the wettest place in Australia. Mean annual rainfall measures 8,100 mm. Most of the rain falls during the 'wet' season, however, vegetation strips the clouds of moisture during the 'dry' season which evens out seasonality. Air temperatures range from 4 - 30 (mean 14 ± 3) °C.

## Seed collecting



We have identified 73 target plant species endemic to the Wet Tropics bioregion. This figure shows the number of species bearing flowers and/or mature seed each month.

Seed collecting in Australia's TMCF presents significant challenges:

- Populations of target species are often only accessible by foot.
- Fruiting doesn't follow seasonal predictability as in temperate climates.
- Obtaining permission and permits to search for seeds can be time-consuming.

Despite the challenges, mature seed has been sourced and > 90 collections have been made to date, mostly during dry season expeditions.

With viable, genetically diverse seed collections, seed banking becomes a possible *ex situ* conservation tool.

## Seeds and fruits of Australia's wet tropics



*Rhodamnia longisepala*  
Myrtaceae

*Pittosporum rubiginosum*  
Pittosporaceae

*Aceratium doggrellii*  
(in a cassowary poo)  
Elaeocarpaceae

*Lomatia fraxinifolia*  
Proteaceae

*Mischocarpus macrocarpus*  
Sapindaceae

*Myrsine subsessilis*  
Primulaceae

*Mischocarpus Lachnocarpus*  
Sapindaceae

## Tropical seed storage

Conventional seed banking techniques are appropriate for 'orthodox' seeds that can tolerate drying to low moisture content and storage at -20°C.

The assumption that most tropical species produce dessication sensitive seeds has previously excluded many tropical plant communities from seed banking. In fact, the majority of Australian TMCF species have not yet been tested for seed storage behaviour.

Physical characteristics such as seed coat permeability, fresh seed moisture content, seed dry weight and seed coat ratio can be used to predict the likely response to drying.

Of the 57 Australian target TMCF genera;

- Species in up to 21 genera are potentially suitable for seed banking.
- Species in nine genera are likely to be sensitive to drying.
- Data is currently lacking for 27 genera.

## Seeds and fruits of tropical forests



*Pittosporum sp.*

*Lenbrassia Australiana*

*Aglaia sapindina*

*Denhamia fasciculiflora*

*Laccospadix sp.*

## A Tropical Mountain Plant Science Project

We argue that *ex situ* conservation presents a relevant and worthwhile approach to conserving this vulnerable plant community.

Our multi-organisational project, funded by the Ian Potter foundation, aims to:

'...secure the future of Australia's climate-threatened tropical mountaintop plants... by building a multi-strategy, *ex situ* conservation reserve to 'backup' at-risk wild populations, and supporting research, display and education.'

For Australian TMCF flora, we aim to:

- Classify seed storage behaviour.
- Diagnose and classify dormancy types.
- Define germination temperature thresholds.
- Investigate light requirements for germination.
- Investigate seed physiological temperature thresholds.
- Investigate population genetics.



## Ex situ germination

Seed banking requires reliable techniques to germinate stored seed. Studies on tropical montane flora overseas have estimated that 75% of species exhibit dormancy.

Preliminary studies suggest that we can germinate Australian TMCF seed *ex situ*:



*Lenbrassia australiana*  
(Gesneriaceae)

- >80 % germination
- Light requirement
- Non-dormant



*Gahnia sieberiana* (Cyperaceae)

- >90 % germination promoted by scarification and GA<sup>3</sup>
- No light requirement
- Dormancy



*Melastoma malabathricum*  
(Melastomataceae)

- >80 % germination
- Light requirement
- Non-dormant

## In situ seed ecophysiology

We know very little about what regulates the regeneration from seed of Australian TMCF *in situ*.

Studies overseas have reported:

- Seeds beneath a canopy gap germinated more than those beneath the forest canopy.
- After a gap had been colonized, shading by vegetation prevented seeds of some species from germinating.
- The ratio of red to far-red light (R:FR) influenced germination of tropical seeds: the bigger the seeds, the greater the R:FR needed for germination.

Light quality and quantity varies enormously within a TMCF, depending on canopy density, leaf litter and cloud immersion.

## Further reading

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- Seed Information Database, Kew. <https://data.kew.org/sid/>
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- Raich & Khoon (1990). *Journal of Tropical Ecology*, 6: 203-217.
- Tiansawat & Dalling (2013). *Plant Ecology*, 214: 751-764.
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