

Surviving Bushfires

By Emily Ngo

AIM

The aim of this project is to study how Australian native plants have adapted to survive in bushfires. In particular, this project aims to capture and document the seed protection and dispersal techniques of two native plant species through photography. A key objective of this project is to produce a series of photographs which are coherent, artistic and informative.

METHOD

For this project, I identified two Australian native plants to study, and to experiment the effects of heat and smoke on their fruits. The plants that I chose are:

- *Eucalyptus caesia*
- *Banksia serrata*

The materials used in this experiment include:

- Fruits from the selected plants, collected from neighbours' gardens (with permission)
- Firepit, firewood and kindling, available at home
- Dried eucalyptus leaves and fallen plant material to create smoke, collected at school
- iPhone 13 which has a 12MP dual camera system: Main f/1.6 aperture and Ultra Wide f/2.4 aperture with 120° field of view, 2x optical zoom, 5x digital zoom, sensor-shift image stabilisation and Portrait mode for focus and depth control
- Tweezers to extract the seeds

For this experiment, I photographed the fruits of the *Eucalyptus caesia* (gumnuts) and the fruits of the *Banksia serrata* (follicles) before any heat or smoke treatment (Photographs 1 and 2). I photographed my specimens against a natural wood background in soft evening light to enhance their aesthetic qualities. I used portrait mode on the camera app to increase focus on my specimens.

Next I lit a small fire in the firepit. When the fire took hold, I dampened it slightly with leaves, to create smoke. I put the gumnuts directly in the hottest part of the fire. I covered the base of the banksia cone with aluminium foil and placed it atop a smokey bed of burning leaves. Photograph 3 shows the banksia cone engulfed in smoke and its follicles starting to open. A close-up shot with 2x optical zoom was used to showcase this phenomenon.

When all the follicles of the banksia cone were opened, I lifted the specimen out of the fire and extracted some of the seeds. I arranged the seeds and cone, and used soft focus techniques to give the photograph a delicate quality (Photograph 4).

When almost all the material in the firepit had burnt down to ash, I photographed the burnt gumnuts in the firepit itself. The contrast between the burnt gumnuts and the ash provided an aesthetic visual. The remnants in the firepit made the photograph too 'busy' so I used portrait mode to blur out the edges and to maintain focus on the gumnuts (Photograph 5).

A few days after the burning, I observed that valves of the gumnut had exerted, releasing the seeds. I photographed these on a white background to replicate the natural seed dispersal on ash. I used a vignette filter to draw attention to the gumnuts and seeds, and to give the photo a dramatic effect (Photograph 6).

For the final part of the project, I edited the photographs using the Photos app on the iPhone. I cropped the photographs to ensure good composition, and adjusted for brightness, saturation and contrast, for best results.

SCIENTIFIC CONCEPTS

The selected photographs showcase how Australian native plants have adapted over time to be resilient to the bushfires that ravage Australia every year, helping their species survive.

The species studied in this project are:

<i>Eucalyptus caesia</i>	<i>Banksia serrata</i>
Plantae Tracheophyta Magnoliopsida Myrtales Myrtaceae Eucalyptus Caesia	Plantae Magnoliophyta Magnoliopsida Proteales Proteaceae Banksia Serrata

These two species are members of the four families (Proteaceae, Casuarinaceae, Myrtaceae and Cupressaceae) that protect their seeds from fire by holding them in woody fruits.¹

Eucalypts are active pyrophytes. This means that they encourage fire, and need it for their seeds to germinate.² Some eucalyptus species possess a lignotuber, which is a woody swelling of the root crown at the base of the tree, that protects the plant stem from being destroyed by

¹ Auld, Tony. Australian Network for Plant Conservation. How plants cope with fire. (January 2020) pp 4

² Pyrophyte (Updated 25-12-2023)
<https://en.wikipedia.org/wiki/Pyrophyte>
(Accessed: 30-03-2024, 4:20pm)

fire. Lignotubers also contain hidden buds which sprout if the tree is damaged. Other species of eucalypts rely on epicormic buds under the bark to regrow.³

Despite being easily destroyed in fires, Eucalyptus trees have adapted to protect their seeds in order to ensure its survival. Eucalypts encase their seeds in tough woody capsules which can endure the extreme temperatures of bushfires which can reach up to 1600°C. (*Refer to Figure 1*) Its leaves, which are rich with oil, burn quickly, so the capsules are not engulfed in flames for long. Eucalyptus capsules release their seeds for germination when triggered by ash and smoke.⁴ Smoke contains chemicals which can break seed dormancy, a state where seeds are viable but won't sprout even under favourable conditions.⁵ After the fire, eucalyptus seeds that fall on the nutrient-rich ash have a headstart on regrowing and can cover more ground.

Unlike eucalypts, banksias are passive pyrophytes, meaning that they resist fire. Banksia trees not only protect their seeds, but try to defend the tree as well. Banksias have a waxy coating on their leaves. This minimises loss of water through transpiration, and also protects the leaves from heat damage during a fire. Banksias also have thick, fire-resistant bark. This shields and insulates the vital inner tissues of the plant from fire. Similar to the eucalypt, banksias also possess lignotubers and epicormic buds under its bark, which sprout when the tree is damaged.⁶

The majority of banksia species found in areas prone to fire develop woody seed pods, or follicles, which open during or shortly after a fire, dispersing seeds throughout the surrounding area.⁷ Its serotinous cone which holds the follicles is completely resin-sealed, acting as an insulator, and protecting the seeds from the heat of the fire. They can only be released when the resin is melted by fire. Banksias have adapted such that smoke and ash acts as a stimulant, causing the seed pods to germinate in the ash bed.⁸ (*Refer to Figure 2*)

³ Bushfire impact on Australian plants (Updated 21-01-2020)
<https://www.csiro.au/en/news/all/articles/2020/january/bushfire-impact-on-australian-plants>
(Accessed: 27-04-2024, 10:16pm)

⁴ National Forest Learning Centre. Eucalypts and Fire. (2013) pp 1-3

⁵ Fire-released seed dormancy - a global synthesis (Updated 06-04-2022)
<https://onlinelibrary.wiley.com/doi/full/10.1111/brv.12855>
(Accessed: 28-04-2024, 2:40pm)

⁶ Playing with Wildfire: 5 Amazing Adaptations of Pyrophytic Plants (Updated 07-04-2014)
<https://www.britannica.com/list/5-amazing-adaptations-of-pyrophytic-plants>
(Accessed: 30-03-2024, 4:17pm)

⁷ Protecting Offspring Against Fire: Lessons From Banksia Seed Pods (Updated 12-03-2019)
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6424018/>
(Accessed: 28-04-2024, 12:10pm)

⁸ Open University. Fire Ecology. Fire Stimulated Seed Release. (May 6, 2020) pp 20-23

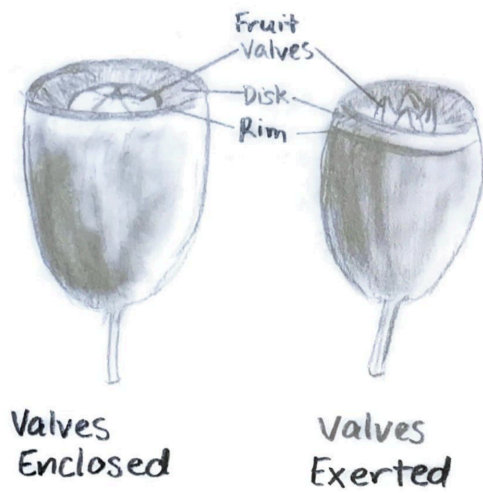


Figure 1: Drawing of a *Eucalyptus caesia* fruit

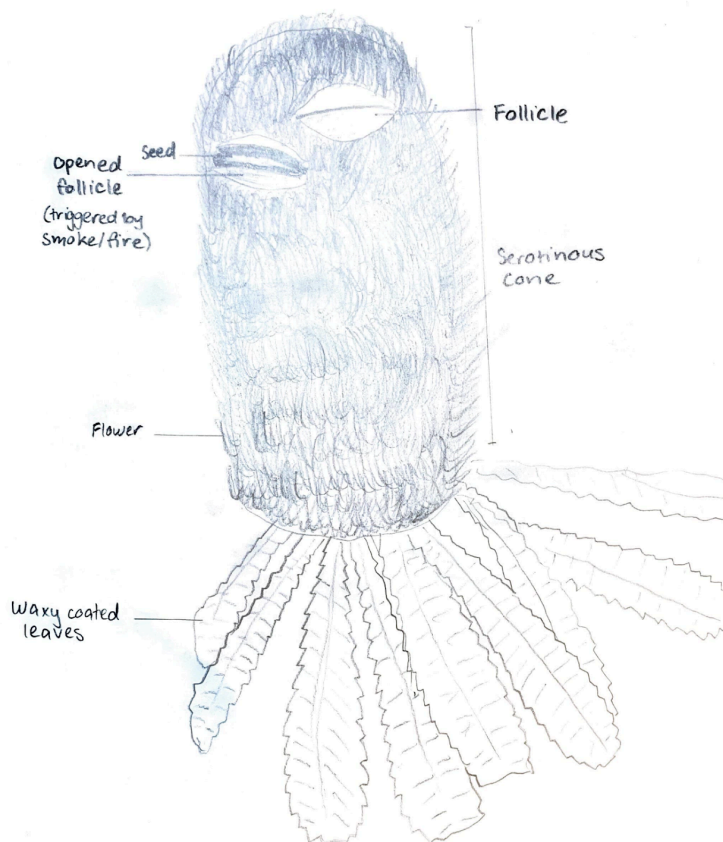


Figure 2: Drawing of a *Banksia serrata* fruit⁹

⁹ Banksia (Updated 02-02-2024)
<https://www.anbg.gov.au/banksia/> (Accessed: 27-04-2024, 11:33pm)

CONCLUSION

This project was able to beautifully showcase the seed protection and dispersal techniques employed by the *Eucalyptus caesia* and *Banksia serrata* in the event of fire. These Australian native plants have successfully adapted to ensure their species survival in a bushfire-prone climate.

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DIGITAL IMAGES - ORIGINAL



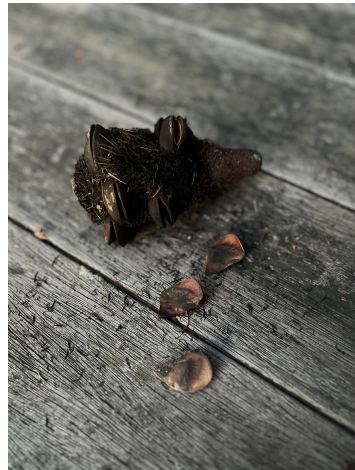
Photograph 1



Photograph 2



Photograph 3



Photograph 4



Photograph 5



Photograph 6

PHOTOGRAPH CAPTIONS



Photograph 1

Unopened gumnuts of the *Eucalyptus caesia*

Emily Ngo
Presbyterian Ladies' College

Eucalypts are active pyrophytes, meaning that they need fire for their seeds to germinate. The gumnuts of the *Eucalyptus caesia* are depicted here with enclosed valves, protecting the seeds within its woody capsule.

Photograph 2

Closed follicles of the *Banksia serrata*

Emily Ngo
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Banksias are passive pyrophytes. This photograph depicts the closed follicles of the *Banksia serrata* in which its seeds are encased and protected from fire.

Photograph 3

Smoke triggering the opening of the follicles

Emily Ngo
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Banksias have serotinous cones. Serotiny means that the banksia retains its non-dormant seeds until exposed to fire. This photograph demonstrates how the chemicals in smoke have stimulated the opening of the banksia's follicles.

Photograph 4

Release of the seeds

Emily Ngo
Presbyterian Ladies' College

The follicles of the banksia are fully opened after the fire, releasing the seeds within. The paper-thin seeds are able to successfully germinate in ash.

Photograph 5

Woody capsule protects the seeds

Emily Ngo
Presbyterian Ladies' College

The gumnuts in this photograph remain closed, despite the heat of the fire, showing how the woody capsule has protected the seeds in order to ensure species survival. When triggered by sufficient heat and smoke, the woody capsules will disperse the seeds onto the nutrient-rich ash for repopulation.

Photograph 6

Capsule releases seeds post-fire

Emily Ngo
Presbyterian Ladies' College

A few days after the fire, the valves of the gumnut are exerted. Though the woody capsule is burnt and blistered, the tiny seeds inside are undamaged. These seeds fall out easily, and are dispersed on the ground post-fire, allowing the species to regenerate.