

The Grampians National Park, Victoria, Australia – Biodiversity Hotspot

The Grampians inherited its common English name from the Grampian Mountains in Scotland; though locally its aboriginal name is Gariwerd. Located 146 miles to the west of Melbourne, the Grampians rise gently from the land around them to a modest highpoint of 1,167m at Mt William, with many smaller summits found across its range. Formed of sandstone the mountain range contains roughly seventy percent of the flora found in the state of Victoria, ranging from small annuals and orchids to eucalypts and grass trees.



Floral abundance

No matter where one is in spring, flowers begin to bloom, with some lasting only days and others blooming throughout the summer. The Grampians are no exception; within an eighteen day period it was possible to see no fewer than 100 species of plants in bloom. They ranged from sundews flowering en masse, as far as the eye could see, to small groups of spider orchids colonising shady areas under tree canopies and near rocks.

One orchid amazed me more than the others; the wax lip orchid (*Glossodia major*). It seemed to grow irrespective of the soil conditions or the aspect of the site. I have, in fact, failed to see another orchid in the wild that is as happy to grow in such a wide variety of conditions (Fig. 1).



Fig. 1 *Glossodia major* in habitat

This report focuses on the pressures the Grampians face and the conservation efforts being carried out to ensure the flora is protected. It also looks at the work done by Botanic Gardens with regards to protecting native Australian flora, the level to which people are made aware of the need for flora protection and conservation and research carried out ex-situ. When it comes to the flora itself I have included an appendix dealing solely with the plants I was lucky enough to see in bloom during my trip.

Natural Pressures on the Grampians

Fire is something to which the flora of Australia is quite accustomed. , In fact much of the endemic flora of Australia would not be able to survive without the rejuvenating effects of fire. It is estimated that 75% of flora found in the Grampians requires fire to grow, flower and germinate. Frequent burning allows many species to occur in a relatively small space. At a mere 160,000 hectares the Grampians supports approximately 975 species, a third of which are found nowhere else. In comparison, the UK has just under 4,000 plant species; to be comparable with the Grampians, species per hectare, the UK would need to have 148,000 species of plants.

Burning creates diversity and also allows plants to reproduce; for example, *Pimelea pagophila* (Grampian's Rice Flower) was known in four locations totalling 70 plants. When the fires of 2006 burnt 48% of the Grampians National Park *Pimelea pagophila* began to germinate and increase its population rapidly, proving its reliance on fire for survival. There is a fine balance that must be adhered to when we become guardians of the natural environment, to prevent fires from destroying property and getting out of hand is understandable, but they must be allowed to take place. The aboriginal tribes of the area have used fire for millennia to clear the land and keep it diverse. By doing this they ensured there was a constant food source and, inadvertently, they also ensured that many plant species got a chance to re-propagate by themselves.

Another species that relies on fire to keep its population healthy and in a reproductive state is one of Australia's most iconic plants, *Xanthorrhoea australis* (Grass Tree). Growing predominantly in sclerophyll forests, they form large colonies and become the dominant plant below the Eucalypts. Due to their heavy reliance on fire to produce flower spikes, the population can sit idle for years. Luckily for the rather large population in the Southern part of the Grampians, the fires of 2009 allowed them to flower en masse (Fig. 2).



Fig. 2 *Xanthorrhoea australis* with remnants of flower spikes

Fires that are not started intentionally for managing the land are taken very seriously in Australia, especially those started by arsonists. Due to the extreme summer temperatures each and every populated area of Australia has fire rating guides (Fig. 3), these are primarily there to advise on whether there is a risk of fires igniting themselves in the bush land, they also advise the public on whether it is OK to light fires in designated areas or not. Due to the current extreme summer temperatures over much of the country a 'total fire ban' is in place, this means that no fires are to be lit by the public, even in designated camp grounds. These measures are vital in ensuring that fires do not get out of control and engulf areas of native bush land or areas populated by people.

Flood waters aren't the greatest friend of mountain slopes, yet the winter of 2011 brought them in abundance, turning bubbling brooks surrounded by groves of tree ferns into scarred landscapes of churned up rock and huge Eucalypt trees lying in pieces on the forest floor. Though I describe an apocalyptic-like landscape, nature prevails in all instances. Walking along the river bed, which is now much wider than before, the bare banks are beginning to rejuvenate with ferns and plants that rarely had a chance to grow under the old canopy of Eucalypt trees.



Fig. 3 Fire rating signs are found throughout the region and Australia as a whole

Bare river and stream banks are not the only results of flood waters. In many places the land became so saturated that it gave way, causing major landslides, taking out roads and hiking tracks and leaving swathes of land bare and vulnerable to further erosion. The National Parks quickly switched into 'Flood Recovery' mode, including clearing the roads and repairing the hiking tracks. Nature quickly followed with plants germinating across the now bare open ground, giving forest floor species a chance to establish before the Eucalypts shoot back up.

Apart from the obvious physical scars on the landscapes, the flood water helped invasive plants spread across large tracks of land. One of the worst invasive plants in the Grampians is the British native *Rubus fruticosus* (Fig. 4), more commonly known as the Blackberry or Bramble, a gardener's nightmare in the UK. Just imagine how rampant and destructive it can become in an environment where it can go undetected.



Fig. 4 *Rubus fruticosus* (Blackberry) spreading near a water course

In-situ conservation

Ever since Australia drifted south and became its own continent it has become drier with every passing millennium, leaving pockets of intense floral diversity stuck on mountain ranges in the middle of dry arid lands. The Grampians is one such area; endemic (found nowhere else) flora has become stranded on the mountains, like the last outpost of a unique civilisation, fighting for survival. There is no opportunity to expand its territory, and with pressure from all sides, it can only sit tight and await its fate.

The above analogy may sound extreme, but often these are the pressures facing plants with limited population distribution, as time goes by localised populations breed amongst themselves within a limited gene pool. It could be said that this is evolution happening before our eyes, plants not able to cope with the changing environment quite simply lose the fight for survival; others will argue the opposite and work to save these plants through ex-situ propagation and re-introduction programmes.

The fauna of a region can also place pressure on the populations of certain plants, for example if water is readily available in the Grampians then the kangaroos and wallabies (Fig. 5) will breed rapidly, which could lead to overgrazing in certain areas and the prevention of small plant species from flowering or even growing.



Fig. 5 Brush Tailed Rock Wallabies are a common site along the roadsides and hiking tracks

Man also has an influence on the populations of flora. The Grampians have many user groups; there are families who like to enjoy camping and walk through the bush, the more serious hikers who take on the longer trails, and the photographers who are after the best fauna, flora and views to photograph. All these people create pressure on the natural environment, not only physically themselves but through requiring roads to drive on, paths to walk on, places to sleep, restaurants to eat in etc.

The National Parks team works tirelessly to provide sufficient hiking tracks, which are well kept and well signposted. Apart from the obvious enhancement of the visitor experience, these measures provide vital protection for the flora of the park. By encouraging people to keep to the designated paths it decreases the amount of off-track walking that occurs, in turn reducing the quantity of flora that gets trampled under-foot and exposed to introduced disease. In many areas throughout the park *Xanthorrhoea australis* (Grass Trees) are dying off. After consideration as to why this may be happening I came to the conclusion it was a fungal disease. My suspicions were confirmed when I came across the sign in Fig. 6. *Phytophthora cinnamomi* is the cause, spread mostly by people as they hike around the park. It is a difficult disease to contain but, if left unchecked, it could quite quickly decimate populations of *Xanthorrhoea australis*, which it seems to use as its main host.

After post visit research I have come across many state and federal documents that suggest *Phytophthora cinnamomi* has become a serious problem in Australia. Several plant genera are highly susceptible and act as host plants, in the Grampians region these are *Xanthorrhoea* sp, *Banksia* sp and *Grevillea* sp. By these plants dying back in a habitat there is a severe knock-on effect for the fauna of the area, especially those that use the fore mentioned plants as a source of food or shelter. Furthermore plant communities tend to have species that compete for space keeping each other in check, when some of these plants are removed from the community the remaining plants no longer have rival species to keep them in check, resulting in an unbalanced ecosystem.

Phytophthora cinnamomi is a difficult pathogen to control, many attempts have been made in Australia with varying results, yet no control method has managed to eradicate the disease completely. Preventative measures can be put in place to stem the spread of the disease, these include restricting the use of areas, for example closing hiking tracks which cut through infected areas, stopping water from affected areas being taken in to non-affected areas, and minimising/eliminating the movement of plant material between affected and non-affected areas.

Visitors don't always think about the limited population range of some plants and the fragility of their habitat. Take for example, *Borya mirabilis* (Grampian's Pincushion-Lily); there was only one known population of this plant comprising only 70 plants. The population was at additional risk from visitor



Fig. 6 Signs like the one above can be found throughout the Grampians warning of the presence of *Phytophthora cinnamomi*

foot-fall, as a hiking track went right by the population; action was required and that's exactly what the National Park staff did. Their first step was to move the track away from the population, by re-routing it to eliminate the possibility of the plants being trampled. Further efforts were made by propagating *Borya mirabilis* ex-situ and re-introducing these plants as a separate population elsewhere in the park.

Invasive plants are a familiar problem no matter what country you visit. Often introduced as attractive ornamentals or reminders of the motherland, these plants quickly get out in the wild and wreak havoc. Two such plants in the Grampians National Park are *Rubus fruticosus* (blackberry/bramble) from the UK and *Zantedeschia aethiopica* (Arum Lily) from South Africa. Both can be found along the rivers throughout the Grampians, extending further down the Mackenzie River footprint to the surrounding plains. The floods of 2011 helped the spread of these plants, Fig. 7 demonstrates the force of the flood waters and how the seeds and plants of these species were able to increase their distribution. The National Parks Authority does not work alone when it comes to controlling invasive plant species, in this instance they work with Wimmera and Glenelg Hopkins Water Catchment Authorities.



Fig. 7 Silverband Falls with the destruction from the 2011 floods in the foreground

In-situ conservation can come in many forms, there are the obvious fore-mentioned; controlling visitor foot fall, re-introduction programs and control of invasive plants species. Fire can be controlled and by doing so natural bush fires will have minimal affect on the landscape. By inhabiting land we inadvertently see it as our responsibility to prevent fires from occurring, but this can be dangerous in many ways. If fires do not get the chance to come through areas frequently, dead wood builds up, forests become dense and vegetation encroaches on urban populated areas.

There are four main ways that the Grampians National Park's Autumn and Spring controlled burns cause the minimal damage and devastation. These are: splitting the park in to fire zones, sometimes with a strip of cleared land and often with a fire watch tower in strategic view point; asset protection burning around areas of population (in particular Halls Gap which is the main tourist accommodation area); ecological burning which ensures fair competition between the native flora (Fig. 8), and last but not least, fuel production burns. This last one is arguably one of the most important, areas that do not burn regularly can have a build up of dead wood which will create a fuel source for any fire that does sweep through the area; without a fuel source fires will sweep across



Fig. 8 Hakea sp. exhibiting re-growth after fire

the land quickly and burn themselves out, with a fuel source they will move more slowly and burn more intensely, causing greater damage to the natural environment and possibly to buildings as well.

Conservation does not have to actively be done with the plants, but can also be achieved through educating the National Parks user groups. The Grampians largest town of Halls Gap is home to the Brambuk Living Cultural Centre, a resource that enhances the experience of any visitor to the Grampians. The centre offers advice on hiking tracks, areas of interests, the do's & don'ts when using the park, a fully stocked book shop offering botanical and fauna resource books along with in-detail hiking maps. Furthermore the centre has a fantastic permanent exhibition (Fig. 9) about the indigenous people of the region and how they have managed the land over the millennia. This was of particular interest to me as with many aboriginal tribes they have a close connection to the land on which they live, knowing its seasons and how best to live in harmony with it, I believe a great deal can be learnt from these locals on how best to manage National Parks.

Jacinta Williamson, who is the Park's planner, very kindly, gave over some of her time to talk to me about the in-situ conservation efforts carried out by the park, guiding me in the right direction when looking at specific species and how the park deals with the day to day running. Jacinta was an invaluable resource when it came to learning more about the 'flood recovery' plans after the 2011 floods, and how the park deals with wild fires. Quite possibly the most interesting and impressive piece of information I gained was, that the park manages to carry out their maintenance responsibilities and its protection on a staff/ranger number of 10 to 20 depending on the season.

Conservation must be enforced by law for it to work and Australia is no different from any other country. Legislation begins at the top with the Federal Government in Canberra, who passed the Environmental Protection of Biodiversity and Conservation Act of 1999. This is the Australian Government's central piece of environmental legislation with all other Acts coming under this umbrella Act. Under this Act, the State Legislation Act for Victoria is the Flora and Fauna Guarantee Act 1988, which can only be altered within the legislation of the main Federal act. National Parks then have their legislation to govern exactly what is done on the ground; this is the National Parks Act 1975.



Fig. 9 Permanent exhibition on the Grampians/Gariwerd at the Brambuk Living Cultural Centre

Ex-situ Conservation

There is always a debate that we would not need ex-situ conservation if we protected the natural environment in the first place. This of course is just one side of the argument; environments can suffer from many varying pressures and not necessarily those caused by man. Over time Australia has most certainly dried up considerably, leaving what would have been smaller islands as inland mountain ranges, such as the Grampians, giving one example how such diversity of flora ended up on such a small sandstone mountain range.

Through visiting the Royal Botanic Garden Melbourne and the Royal Botanic Garden Cranbourne I have been able to see the work done in local Botanic gardens to conserve native flora and the activities they engage in to raise public awareness of the native flora. Though neither Garden deals with flora endemic to the Grampians within their living collections, I was able to gain an insight in to the role both Gardens play in conservation.

Firstly RBG Melbourne; set up in the early pioneer days the Garden occupies a large tract of land next to the Central Business District of Melbourne. Set out to be pleasure grounds, only a small proportion of the gardens are set out phyto-geographically; there is a clear Australia rainforest section and arid lands section, the rest of the garden has a mix of plants from across the globe. Outside the herbarium is a fantastic Information and interpretation area that talks in detail about the need for conservation and the work that is carried out to protect flora and the natural environments that they grow within. Elsewhere in the Garden information and interpretation is limited to individual plants and water conservation (Fig. 10), and it seems that the Garden has become victim to the same financial arrangements as Botanic Gardens in the UK, demonstrating a similar culture of behind-the-scenes research and conservation. Undoubtedly great work is being carried out but there seems to be little or no budget provision to educate, inform and involve the public from what I saw.

Royal Botanic Garden Cranbourne (RBG Cranbourne) is very different in its approach, though it is important to note that RBG Cranbourne is a young garden compared with the 160 year old RBG Melbourne. A new garden such as Cranbourne has had the opportunity to learn from older gardens and design its landscape and philosophy to best serve the public. A unique feature of Cranbourne is that there is very little research done and even that is on display to the public (Fig. 11). Currently this

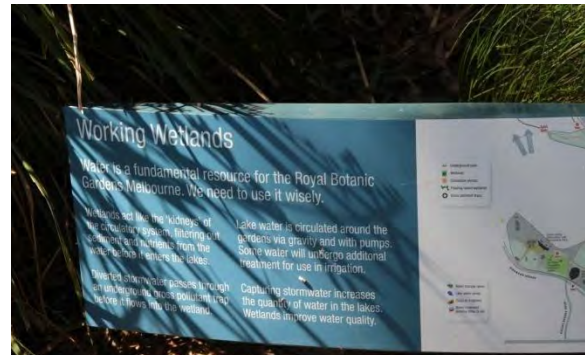


Fig. 10 A typical information sign at the Royal Botanic Garden Melbourne



Fig. 11 Research beds in the public domain, Royal Botanic Garden Cranbourne

research section is being used by a PhD student to study *Brachyscome*'s, a genus from the family Asteraceae where most species are endemic to Australia.

RBG Cranbourne does not strive or pretend to hold a collection of botanical importance, but instead it archives the flora of Australia in an innovative and fascinating way. The Garden has been divided into precincts, each show-casing a natural biome from Australia, a group of plants (such as climbers) or display gardens illustrating what can be done in your own garden, the Garden goes so far as to inform the public of the growing requirements of each plant (Fig. 12). Recently the Garden opened the second phase, an extra eleven precincts taking the Garden up to 15 hectares. I was most fortunate to meet the Head of Horticulture, John Arnott, who gave me a guided walk of the Gardens, explaining as we walked about their philosophy and how it functions. He explained that the Garden was there to act as an environment where people could come and see the flora of Australia in one place.



Fig. 12 Plant labels informing the public on the cultivation requirements of individual plants

There was one part of the new landscaping that John seemed very proud of, and understandably so; this was a lawn area that was intended to be used by many user groups of the garden. I hear you ask what is so special about a lawn, well, a native Australian grass had been used for the first time in creating a lawn, if the area remains functional with the grass in place it could be a major step forward for Australia's turf industry.

Though the Garden is open to the elements, the small but dedicated team of staff manage to maintain it to a very high standard. What is even more impressive is the level of information and interpretation that is located around the garden; this gives every member of the visiting public the opportunity to learn at least one new piece of information about plants, their cultivation or their vulnerability.

The RBG Cranbourne has another unique asset; it is surrounded by an immense nature reserve, protecting it from the vast urban sprawl that occupies so much of the land beyond the reserve. The nature reserve is home to an abundance of fauna and flora, to whom it offers invaluable protection. The Southern Brown Bandicoot (*Isoodon obesulus obesulus* (Fig. 13) is one such resident, in fact this is the only place I was fortunate enough to see this great little marsupial.



Fig. 13 Southern Brown Bandicoot in Royal Botanic Garden, Cranbourne

Native flora in cultivation

After visiting a multitude of nurseries I was disappointed to see the quantity of flora native to the State of Victoria being grown. There was a great deal of native Australian flora being grown, with one plant identifiable from the Grampians, *Xanthorrhoea australis*. What I did see and find very encouraging was the quantity of drought tolerant plants being marketed and sold, in a country where rainfall is limited and unpredictable there is huge importance in ensuring that individual's gardens are not in need of great quantities of water, and this the nurseries did well. At this point I am unaware whether or not research is done in to the viability of growing a proportion of plants from the Grampians commercially, what I am aware of after much hiking is that the sandstone of the Grampians is quite unique and possibly limits the commercial cultivation of many of its plants.

Appendix 1: Flora seen and identified in the Grampians



Acacia myrtifolia

Myrtle Wattle



Acacia oxycedrus

Spike Wattle

Endemic



Acacia paradoxa

Hedge Wattle



Allocasuarina misera

Slender Sheoke



Allocasuarina paludosa

Scrub Sheoke



Amyema pendula

Drooping Mistletoe



Asterolasia phebalioides

Downy Star Bush



Astroloma conostephioides

Flame Heath



Astroloma pinifolium

Pine Heath



Banksia marginata

Silver Banksia



Banksia ornata

Desert Banksia



Blechnum nudum

Fishbone Water-fern



Brachyscome multifida

Cut-leaf Daisy



Caladenia caerulea

Blue Caladenia



Caladenia tentaculata

Mantis Orchid



Callistemon rugulosus

Scarlet Bottlebrush



Callitris glaucophylla

White Cypress Pine



Correa aemula

Hairy Correa



Daviesia leptophylla

Narrow Leaf Bitter Pea



Dicksonia antarctica

Soft Tree Fern



Dillwynia hispida

Red Parrot Pea



Diuris pardina

Leopard Orchid



Drosera glanduligera

Scarlet Sundew



Drosera peltata

Pale Sundew



Drosera whittakeri

Scented Sundew



Epacris impressa – Pink Form

Common Heath



Epacris impressa – White Form

Common Heath



Gazania sp.

Gazania

Non-native



Glossodia major

Wax-lip Orchid



Grevillea alpina

Cat's Claws



Grevillea aquifolium

Variable Prickly Grevillea



Grevillea confertifolia

Grampians Grevillea

Endemic



Grevillea dimorpha

Flame Grevillea

Endemic



Grevillea lavandulacea subsp
lavandulacea

Lavender Grevillea



Grevillea microstegia

Mount Cassell Grevillea

Endemic



Hakea decurrens

Bushy Hakea



Hardenbergia violacea

Purple Coral Pea



Hibbertia fasciculata var. *prostrata*

Bundled Guinea-flower



Hovea corrickiae

Glossy Hovea



Hypoxis vaginata

Sheath Star



Indigofera australis

Austral Indigo



Isopogon ceratophyllus

Horny Cone Bush



Kennedia prostrata

Running Postman



Leptospermum scoparium

Manuka Tea Tree



Leucopogon virgatus

Common Beard-heath



Philotheca angustifolia

Narrow-leafed Wax-flower



Prostanthera rotundifolia

Round-leaf Mint-bush



Pterostylis alpina

Alpine Greenhood



Sedum sp.

Stonecrop



Styphelia adscendens

Golden Heath



Tetratheca ciliata

Pink-bells



Tetratheca labillardierei

Glandular Pink-bells



Thelymitra carnea

Pink Sun-orchid



Thysanotus tuberosus

Common Fringe-lily



Wurmbea dioica

Common Early Nancy

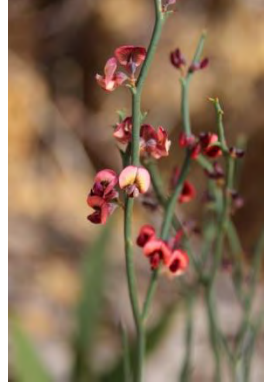


Xanthorrhoea australis

Grass Tree

Appendix 2: Unknown flora – Native





Appendix 3: Unknown Flora – Possibly not native

