

## Western Australia's Southwest – a global biodiversity hotspot.

### What is a biodiversity hotspot?

This phrase comprises two elements – one good, the other not. When put together, the term is not a positive thing to be celebrated.

If we break the term down into its two components we have:

- **Biodiversity** – the variety of all living organisms in a habitat. This includes vascular plants, ferns, mosses, algae, lichens, fungi, mammals, birds, reptiles, insects, arachnids, microbes, bacteria, etc.
- **Hotspot** – an area that is under threat of the loss of this biodiversity.

Looking a bit closer at each term – firstly, **Biodiversity**:

There are three levels of biodiversity:

- **Genetic diversity** – this is the variation of genes within a population or species. This diversity often allows for the development of adaptations to environmental suitability. The higher the genetic biodiversity, the higher the health and resilience of an ecosystem. This is critical in dealing with things like resistance to pests and diseases, climate change, etc.
- **Species diversity** – this refers to the variety of all the species within a habitat or a region. Richness of species is critical as it provides higher stability within an ecosystem – from a plant perspective higher richness in species means being able to support a higher number of other organisms (by providing food, shelter, etc). For example, the Southwest forests have something in flower every season, providing valuable food sources (pollen, nectar,) to a range of pollinators. Thinking of this in contrast to a monoculture (eg vast areas of turf, plantations, etc) it is significantly different.
- **Ecosystem diversity** – Ecosystems are all the living things in a given area and how they interact with each other, as well as how they interact with non-living elements such as soil, climate, etc. This covers the different physical environment, interactions within these ecosystems and the variety of species and processes that shape the structure and function of that ecosystem. The higher the ecosystem diversity, the more species can be supported within.

Now to look at the second term, **Hotspot**. Hotspots arise due to threatening processes, and threats to biodiversity are many and varied. They include (but are not limited to) factors such as:

- Land clearing for agriculture, mining, housing, industrial developments, etc
- Increasing urbanisation
- Introduced pests, diseases and weeds
- Inappropriate fire regimes
- Fragmentation of populations
- Drought
- Salinity
- Changing climate

The concept of **Biodiversity Hotspots** arose in 1988, and there are criteria that determine membership to this increasingly not so exclusive 'club'. To qualify as a global biodiversity hotspot, a geographic region must have two things:

1. **At least 1500 vascular plants as endemic species**
2. **30% or less of its original remnant vegetation remaining**

**Endemism** is when a biological organism is both native to, and restricted to, a defined geographic region. Endemism is an important consideration when looking at conservation and restoration programs but also holds relevance from a horticultural perspective. Trying to cultivate and display certain endemics can be challenging as they are often highly specialised and adapted to certain growing conditions that are not always easy to replicate.

The Southwest of Western Australia qualifies easily for point one. Of the total number of estimated SW species (8-8,500), approximately 50% are endemic.

A note on floral statistics – this is a tricky thing to pin down to a finite number – understandably, as things are in a constant state of change; there are new discoveries, changing taxonomy, taxonomic reviews that either lump or split species, and technological advances find new ways of classifying plants. Regardless of the numbers, one fact remains stable, and that is that SW WA has incredibly high levels of endemism in its flora. Some examples of endemic WA genera include *Anigozanthos* (Kangaroo Paws), *Stirlingia*, *Chamelaucium* (Waxflowers), *Dasypogon* (Drumsticks), *Macropidia* (Black Kangaroo Paw) and *Cephalotus* (Albany Pitcher Plant). The last two are also examples of a monotypic genus – having only one species within the genera.

Unfortunately, SW WA also easily qualifies for the second criteria of having 30% or less of the original remnant vegetation. Mass clearing post-colonisation saw vast areas of vegetation removed for settlements, agriculture, transport routes and then activities

such as mining and other industry. In the wheatbelt region alone, less than 10% of the remnant flora persists, and much of this is centred in allocated reserves, national parks, granite outcrops and roadside verges.

An aligned consequence of the loss of remnant flora (and therefore biodiversity) is the categorisation of areas into **Threatened Ecological Communities (TEC's)**. TEC's are naturally occurring assemblages of organisms that occur in a particular habitat. They provide important levels of genetic, species and ecological diversity.

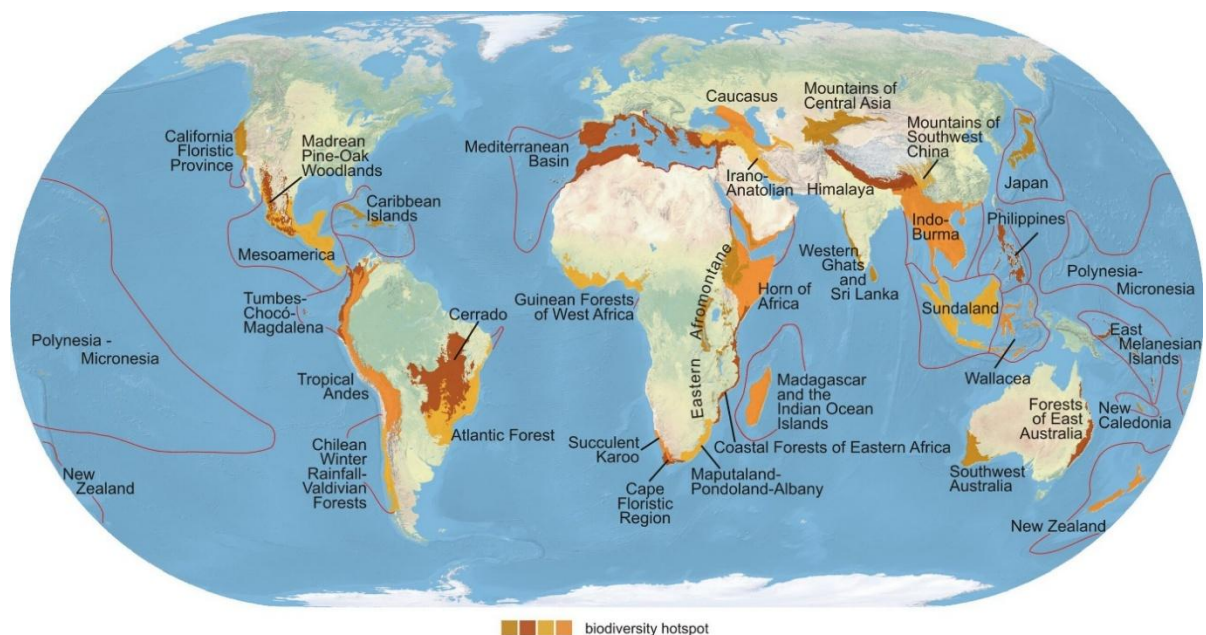
The first listing of TEC's was made under the Biodiversity Conservation Act 2016, and in Western Australia there are currently 5 critically endangered TEC's, 21 endangered and 1 vulnerable. (compared with all of Australia – 109 communities in total; 49 critical, 58 endangered and 2 vulnerable).

The majority of the WA TEC's are in the SW, and include Banksia woodlands of the Swan Coastal Plain, Eastern Stirling Range montane heath and thickets, and the Eucalypt woodlands of the wheatbelt.

### The SW in a global context

There are currently 35 global biodiversity hotspots (covering 142 nations, 422 major cities and significant human population) that collectively support almost 60% of the worlds biodiversity.

Every continent is represented (bar antarctica)



Conservation International (conservation.org) defines 35 biodiversity hotspots — extraordinary places that harbor vast numbers of plant and animal species found nowhere else. All are heavily threatened by habitat loss and degradation, making their conservation crucial to protecting nature for the benefit of all life on Earth.

Image source - Wikipedia

## The Southwest Floristic Region

We all have an appreciation for how special the SW of WA is from a flora and biodiversity perspective, but here are some interesting facts and random statistics:

- Six of the ten richest locations for Eucalyptus diversity are in southern coastal WA where 86-116 Eucalypts per square kilometre can be found
- The SW forests support over 3750 vascular plant species and subspecies/varieties
- Dominant families are Myrtaceae, Proteaceae and Fabaceae
- An estimated 70+% of Proteaceae found in the SW are endemic, and 50% of Myrtaceae in the SW are endemic
- The most represented genus is *Acacia*
- Orchidaceae is the 8<sup>th</sup> largest represented family
- The region supports incredible habitat diversity – leading to highly biodiverse regions. Some examples include Stirling Range National Park (estimated minimum 1500 species recorded, with 87 endemic); Fitzgerald River National Park (1800 species, 62 endemic); Great Western Woodlands (3314 species over 40 million acres); and Lesueur National Park (900 species). In comparison, the UK has 1692 native flora species.

## Why is the SW of WA so biodiverse?

- **The Gondwana link** – this ancient supercontinent that included modern day Australia, South America, Africa, India and Antarctica began to break up around 140 million years ago. Australia split from Antarctica around 50-65 million years ago. This isolation from other land masses explains why Australia is such a megadiverse country.

Other megadiverse countries (ie those with very high level of biodiversity) include Brazil, Colombia, Ecuador, Peru and Mexico (South and central America); Democratic Republic of Congo and Madagascar (Africa); China, India, Indonesia and Malaysia (Asia)



**Image source – [minimuseum.com](http://minimuseum.com)**

Additional to the isolation of the entire country, the SW of WA has evolved in relative isolation from the rest of the continent, separated by oceans and desert.

- **Ancient soils:** WA hasn't experienced significant volcanic, glacial or mountain building activity that has occurred in other parts of the globe – making it relatively stable (and also ancient). It has experienced slow weathering by the elements, which has resulted in a largely flat landscape (compared to other parts of the world) and contributed to leaching of nutrients (that have not been replenished by any geological activity bringing minerals from deep below).

The ancient soils, unchanging landscape and poor nutrients, have led to the flora evolving and adapting to the environment and the associated fauna.

### **OCBILS and YODFELS**

OCBIL theory is a series of hypotheses to explain the evolution and ecology of landscapes. Biodiversity associated with OCBILS is often highly specialised and adapted, and potentially more stable. Think of it in terms of granite outcrops compared with lower lying river systems in valleys. While OCBILS are historically more stable, human encroachment is increasingly putting them at greater risk.

15 of the global biodiversity hotspots – including the SW of WA – are classified as OCBILS – old, climatically buffered, infertile landscapes. The adverse landscape

category is YODFELS – young, often disturbed fertile landscapes. OCBILs are often located on higher ground, YODFELS in lower lying areas, adjacent to water courses with richer soils. Granite outcrops are a good example of an OCBIL.

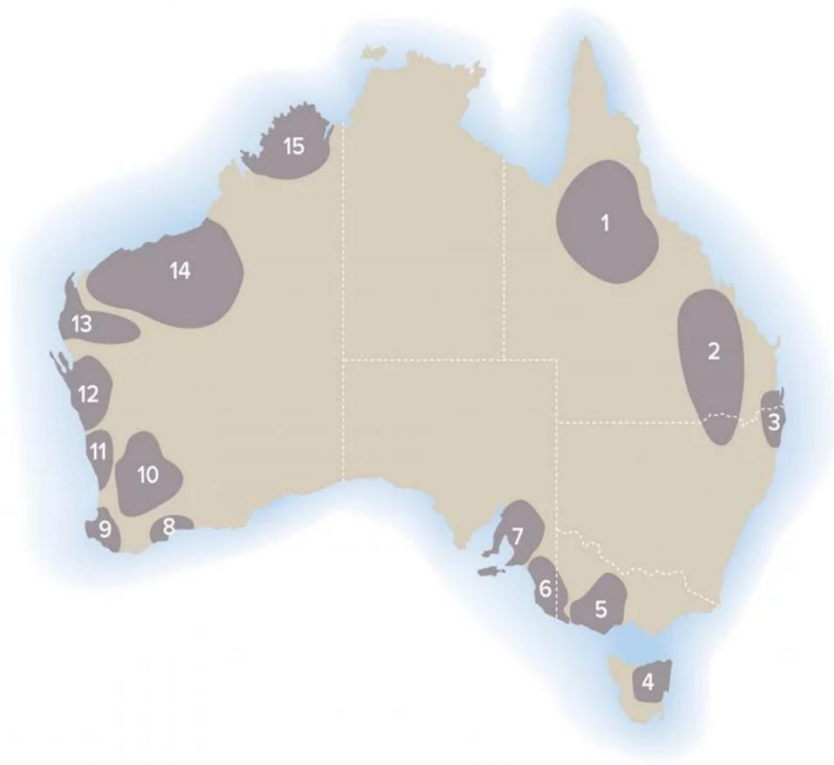
### **Pollinators and adaptations**

Because our flora is highly adapted there is something flowering – and providing pollen and nectar – all year round. The SW region is therefore able to support one of the highest concentration of pollinators in Australia.

### **The next layer**

Australian biodiversity hotspots

WA has 8 of the 15 declared Australian areas of concern



**Image source – wabsi.org.au**

1. Einasleigh and Desert Uplands (QLD)
2. Brigalow North and South (QLD and NSW)
3. Border Ranges North and South (QLD and NSW)
4. Midlands of Tasmania

5. Victorian Volcanic Plain
6. South Australia's South-East/ Victoria's South-West
7. Mt Lofty/Kangaroo Island (SA)
8. Fitzgerald River Ravensthorpe (WA)
9. Busselton Augusta (WA)
10. Central and Eastern Avon Wheatbelt (WA)
11. Mount Lesueur-Eneabba (WA)
12. Geraldton to Shark Bay sand plains (WA)
13. Carnarvon Basin (WA)
14. Hamersley-Pilbara (WA)
15. North Kimberley (WA)

### The WABG context

When conversations started in the late 1950's about establishing a state Botanic Garden in WA there was a vision right from the very beginning to focus on the display, promotion and education of our state's flora. This was a very progressive concept at that time – most Botanic Gardens had been developed along the traditional European model of stamp collections of the world's flora. The concept of the global biodiversity hotspot wasn't proposed until 1988, so the people involved had great foresight – as well as an obvious understanding and appreciation of how unique and important our flora is and how biodiversity is something we can celebrate.

As a result, when the Western Australian Botanic Garden (WABG) opened in 1965 the focus was well and truly on WA flora. While there were also displays of allied flora (Californian, Chilean, Mediterranean, South African and Eastern Australian), these have all been slowly replaced over time or moved to other parts of the parkland and away from the WABG -with the exception of the Eastern Australian collection.

To highlight our biodiversity and conservation purpose, the WABG plant collections are categorised into very distinct thematics. This is usual amongst Botanic Gardens – and in fact one of the definitions of a Botanic Garden is 'institutions that hold themed plant collections that are supported by detailed records for the purpose of scientific research, conservation, display and education'.

Our primary collection themes are taxonomic (eg, *Banksia*, *Acacia*, *Grevillea/Hakea*), ecological (eg Tuart Forest flora, Jarrah Forest flora, Sandplain flora), Geographical (eg

Stirling Range flora, Goldfields), Conservation and Display. We do also have more collections not publicly accessible that are themed around Research and Development.

These themed collections allow the support of research, education and conservation of our states biodiversity – the whole state, not just the SW of WA. This has become even more important since the Southwest’s inclusion on the global biodiversity hotspot list.

### **References, resources and further reading**

- Plant Life of Western Australia (J.S.Beard)
- A sense of place (George Seddon)
- OCBIL theory (Dr Stephen Hopper) - [OCBIL Theory Steve Hopper – YouTube](#)
- The Southwest Australia Ecoregion ‘Jewel of the Continent’
- DCCEEW 2021 State of the Environment report [Australia state of the environment 2021](#)
- DBCA’s website on TEC’s - [Threatened and priority ecological communities | Department of Biodiversity, Conservation and Attractions](#)
- Florabase - [Florabase—the Western Australian flora](#)
- Gondwana Link - [GLink Booklet.indd](#)
- The Western Australian Biodiversity Science Institute - [Home - The Western Australian Biodiversity Science Institute](#)