

# Western Australia

exploring the flora of the south-west

Catherine Cutler

August 24<sup>th</sup> – September 24<sup>th</sup> 2016



## Author

Catherine Cutler is currently the supervisor of the Mediterranean biome at the Eden Project, Cornwall. She has worked at Eden since 2000, initially as supervisor of the tropical biome planting and establishing the collection, then creating and developing a horticultural display team. Prior to this she worked at the Royal Horticultural Society's Rosemoor Gardens and with both private and international landscape/garden centres groups. She has spent time working, on research projects and studying flora in Borneo, Malaysia, the Caribbean, California, India and France. Her formal training was as a BSc. In Horticulture at Wye College, London University and she is currently studying towards a MSc. in Environment and Human Health with Exeter University.

All photographs copyright to Catherine Cutler. Plants have been identified and labelled to best of ability but are not verified as being correct.

Cover page: *Eucalyptus macrocarpa* at Western Australia Botanic Garden

# Contents

## Introduction

- 1 Author biography
- 2 Contents
- 3 Acknowledgements
- 4 Introduction
- 5 Study trip aim & objectives
- 6 Map

## Overview of places visited

- 7 Araluen Botanical Park
- 8 Lake Clifton Thrombolites (Yalgorup National Park)
- 9 Preston Beach Road (fire ecology)
- 10 Ambergate Reserve (Swan River coastal plain)
- 12 Nigili Cave (geology and soil)
- 13 Wardan Aboriginal Centre
- 14 Protea cut-flower farm
- 15 Contos (banksia-jarrah woodland)
- 17 Boranup Drive (karri forest)
- 18 Karri forest trail
- 19 Cape Leeuwin (coastal heath)
- 20 Blackwood river inlet
- 21 Walpole treetop walkway (tingle forest)
- 22 The Banksia Farm
- 25 Ninedethana WA seed supplier
- 26 Betty's Beach (kwongan)
- 29 Quaakup Homestead at Fitzgerald River National Park (kwongan)
- 32 Wave Rock (wheatbelt)
- 33 Badgingarra National Park (kwongan)
- 36 Lake Thetis Stromatolites
- 37 Pinnacles National Park (geology and soil)
- 38 Mt. Lesueur National Park (kwongan)
- 40 Jurien Bay Marine Park
- 41 The Darling Ranges
- 43 Western Australia Botanic Garden (WABG) at Kings Park (KP), Perth
- 45 Coalseam National Park, Depot Hill and surrounding area
- 51 KP Bold Park

## Overview of work placement at Kings Park

- 52 Introduction to KP and WABG
- 54 Nursery production of WA natives
- 56 Garden cultivation of WA natives
- 58 KP science, conservation and research activities
- 60 WA commercial plant development
- 62 Public interpretation and education
- 64 How best to interpret and present WA habitats in the UK

## Conclusion

- 67 Conclusion and future plans
- 69 Personal reflections and recommendations to others
- 70 Budget breakdown
- 71 References/Bibliography
- 73 Appendices

## Acknowledgements

Many thanks go to the following for making this study trip possible,

For generous financial support:

The RHS Coke Trust Bursary Fund  
The RHS Jimmy Smart Memorial Bursary Fund  
The SCI David Miller Travel Bursary Award

For the giving of time:

Western Australia Botanic Garden at Kings Park (Perth, Western Australia)  
The Eden Project (Cornwall, UK)

.....  
With thanks to the following individuals who have encouraged and assisted in making this trip possible.

Dina Gallick (Enclosed Biome Manager, Eden Project)  
Jane Knight (Landscape Architect, Eden Project)  
Paul Stone (Team Manager, Eden Project)  
Dr. Alistar Griffiths (Director of Science and Collections, Royal Horticultural Society)

And in particular for enthusiastic giving of time, knowledge and support from:

Grady Brand (Senior Curator, Kings Park)  
Amanda Shade (Nursery Curator, Kings Park)  
Alison Smith (Horticulturalist, Kings Park)

.....  
In addition, I would like to thank the numerous staff of Kings Park who have been so welcoming and informative and who showed great interest in this trip, and to staff in the Mediterranean Biome at Eden for covering my absence in the UK

## Introduction

The south-west of the state of Western Australia (WA) has a Mediterranean climate. The flora of this region is some of the most diverse on the planet, with over 12,500 species recognised so far (including at least 4000 endemic to the state). The diversity is a result of relatively little disturbance in the area for millions of years; no volcanic activity, no tectonic activity, no glaciation; and a result of isolation; having the ocean to the south and west and deserts to the north and east. As a result plants have evolved and intensely diversified on ancient, poor soils. Plants show adaptations to the impoverished soil, the climate (notably the hot summers), to fire and in their pollination strategies with the unique fauna. As a result, many of the incredible plants are entirely different to those familiarly grown in the northern hemisphere.

The Eden Project's Mediterranean Biome houses plant collections from California, South Africa and the Mediterranean basin. It has long been hoped to extend the collection to include WA and that is to become a reality in spring 2017. In preparation for this development, Eden has been working with the experts at the Western Australia Botanic Garden (WABG) at Kings Park (KP), Perth. Plans are to showcase the kwongan ecosystem, the banksia-jarrah woodland and to devote an area to a showy seasonal flowering display. A study visit to WA was therefore highly desirable to observe these plants in their natural habitat.

Time at KP and the WABG was clearly essential for horticultural learning on the study visit. Discussion with the experts at KP, colleagues at Eden (who had previously visited the region) and internet research resulted in a selection of other highly pertinent locations across WA. National Parks and regions were selected to give best opportunity to study kwongan (Fitzgerald River National Park for southern kwongan, Badgingarra and Mt. Lesueur National Parks for northern kwongan), banksia-jarrah woodland (the Margaret River region) and WA flora (The Darling Ranges). The route between these key destinations gave opportunity to explore other WA ecosystems (Swan River coastal plain, coastal heath, karri forest, tingle forest and wheatbelt). The study visit was undertaken from mid-August to mid-September 2016. Being early spring in WA, this was the optimum time for visiting as it is the state's peak flowering time and coincides with WABG's annual spring flower show.

Appendix 1 details the itinerary followed for the 29 day visit

## **Study aim**

To develop familiarity with diverse WA flora

## **Study objectives**

- 1) Be immersed in WA flora for a significant timespan:
  - WA flora in the labelled plant collections at WABG
  - WA national parks
  - WA flora whilst touring between key destinations
  
- 2) Become acquainted with natural landscapes and ecosystems found in WA:
  - studying kwongan ecosystems in the south and north of the region
  - visiting banksia-jarrah woodland
  - experiencing other ecosystems in south west WA
  - exploring the ecosystem beds at WABG
  
- 3) Learn best practise on cultivation of WA flora:
  - work placement time in WABG nursery
  - work placement time in WABG garden
  - work placement time in KP science centre
  - visiting The Banksia Farm.
  
- 4) Build relationships between UK and WA:
  - spending time and building rapport with team members at WABG
  
- 5) Gain understanding of the Noongar people's (WA Aboriginal) relationship with the land and plants:
  - join guided walk at Wardan Aboriginal Centre
  - explore interpretation centre at Wardan Aboriginal Centre
  - follow Noongar trail at WABG
  - be receptive to Noongar stories and influences in areas visited
  
- 6) On completion of the visit, to share and inspire:
  - informal conversation and presentations with colleagues
  - formal presentations
  - writing magazine articles
  - media input linked to Eden's exhibit development

## Map of destinations on study trip



- |    |   |    |                                       |
|----|---|----|---------------------------------------|
| 1  | Araluen Botanical Park                  | 15 | Ninedethana WA Seed Supplier          |
| 2  | Lake Clifton Thrombolites               | 16 | Betty's Beach (kwongan)               |
| 3  | Preston Beach Road (Fire Ecology)       | 17 | Quaalup Homestead at Fitzgerald River |
| 4  | Ambergate Nature Reserve                | 18 | Wave Rock (Wheatbelt)                 |
| 5  | Nigili Cave                             | 19 | Badgingarra National Park (kwongan)   |
| 6  | Wardan Aboriginal Centre                | 20 | Lake Thetis Strombolites              |
| 7  | Protea cut-flower farm                  | 21 | Pinnacles National Park               |
| 8  | Contos banksia-jarrah woodland          | 22 | Mt.Lesueur National Park (kwongan)    |
| 9  | Boranup Drive (karri forest)            | 23 | Jurien Bay Marine Park                |
| 10 | Karri trail                             | 24 | The Darling Ranges                    |
| 11 | Cape Leeuwin (coastal heath)            | 25 | WABG at KP                            |
| 12 | Blackwood River                         | 26 | Coalseam National Park and region     |
| 13 | Walpole treetop walkway (tingle forest) | 27 | Bold Park, KP                         |
| 14 | The Banksia Farm                        |    |                                       |

Source: <https://www.google.co.uk/maps/>

## Overview of places visited

### 1) Araluen Botanical Park

Araluen presented itself as a gentle introduction to Australian flora on arrival. The fourteen hectare historic garden is set within a sheltered, moist cool valley of deep, rich loamy soil, surrounded by native WA bushland. In spring the park prides itself on displays of tulip (*Tulipa*) cultivars and camellias, followed through the year by a succession of other botanical focuses.

The garden had some notable plant specimens, providing first glimpses of iconic Western WA flora. However, travelling from Europe with its long ornamental horticultural heritage, the en-masse tulip plantings were unimpressive. The incredibly wet winter weather experienced by the region this year partly explained the seemingly inappropriate tulip plantings in wet, shady stream-side conditions. However, elegant, towering tree ferns (*Cyathea*) thrived in these frost free stream-side locations whilst wild native wisteria (*Hardenbergia comptoniana*) cloaked gum trees (*Eucalyptus* spp.) wattles (*Acacia* spp.) in the native surrounding bushland.



*Banksia* sp.



*Hardenbergia comptoniana*

## 2) Lake Clifton Thrombolites (Yalgorup National Park)

These lakes provide habitat for ancient 'living fossils' seen only in a few places in the world. Tiny photosynthetic micro-organisms, which resemble the earliest life forms on our planet 650 million to 3,500 million years ago, have built the calcium carbonate structures, the thrombolites, seen in the shallow waters. Each ancient structure is coated with a thin film of the microbes, at a density of 3000 organisms per m<sup>2</sup>. This ecosystem reflects a core narrative in understanding WA flora, the underlying stability experienced in WA over recent millennia, unlike other areas that have undergone glacial or volcanic action.



Lake Clifton thrombolites

### 3) Fire ecology at Preston Beach Road

Recommended by the Yalgorup National Park ranger, the approach road to Preston Beach showed the WA flora response to a mid-summer (January) fire. Slow growing grasstrees (*Xanthorrhoea*) had full heads of foliage, gum trees were dense with re-sprout, native wisteria (*Hardenbergia comptoniana*) were observed in full flower whilst patches of open ground were covered in annual wildflowers.



Native plant fire response at Preston Beach road

#### 4) Ambergate Reserve

Within the coastal belt, which was extensively cleared historically for agriculture and development, lies this seventy five acre remnant of the Swan Coastal Plain native bush. The reserve is considered to have outstanding conservation value, featuring a range of ecosystems: banksia (*Banksia* spp.), jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) woodland, winter wet scrubland and saline scrubland, across a range of soil types including heavy soils and clay pans. Eighty percent of the reserve hosts threatened ecological communities.

The reserve is managed under a burning regime, with each of the four blocks being burnt at eight to sixteen year intervals. As with all natural areas visited, die-back (*Phytophthora cinnamomi*) poses a constant and serious threat to plant health. This devastating fungal disease affects numerous WA plant species including banksia, gums and grasstrees. Consequently foot baths and boot scrubbers must be used when entering and departing the reserve, as in other national parks.

Ambergate reserve provided a great introduction to a range of habitats, comparable by their close proximity. Particularly notable in the marri woodland were the unbranched drumstick grasstrees (*Kingia australis*) which towered overhead, indicating the longevity of this bushland. Somewhat surprisingly the 'regular' grasstrees (*Xanthorrhoea preisii*) were more common in the wetter areas. Fallen grasstrees allowed for observation of the trunk's structure; a pithy centre surrounded by a thin skin of living material protected by a 5-10 cm thick, fire resistant outer made up of densely packed leaf bases. The decorative blueboy (*Stirlingia latifolia*) was seen in large quantities; and incidentally was seen sold as a cut flower at a later date.

Appendix 2 lists plants identified from photographs and/or observations at Ambergate



Winter-wet scrubland with orange flowering *Adenanthos obovatus* in foreground



*Kingia australis* in marri woodland



*Stirlingia latifolia* in open woodland

## 5) Nigili Cave

When the ancient land mass of Gondwana divided Australia drifted north and slowly dried. The ancient rock was low in nutrients, and with no glaciation or volcanic activity to expose fresh layers of rock (and nutrients), Australia's thick crust remained in place. Over millennia the soil became severely weathered and leached of nutrients. Now the very old soils across WA are incredibly low in nutrients, intensely so in the kwongan. Nitrogen has been repeatedly removed from the soil by fire. Phosphorous is in particularly short supply and is a limiting factor across WA. In lateritic soils, as found under jarrah woodland, phosphorous is tightly bound. Throughout WA these impoverished soils have given rise to huge plant diversification, with survivors typically highly specialised for nutrient assimilation (eg insectivorous, nitrogen fixing, hemi-parasitic plants and specialised proteoid roots).

Throughout the Margaret River region (Bussleton to Augusta) there are numerous cave networks. Here the rock is soft, calcium rich limestone which arose from many thousands of years of consolidation of ancient sand dunes. Acidic water dissolved the rock to form chambers, and further action of water leaching through the soil and surface rock above into the chambers, depositing calcium carbonate en-route, has created a beautiful underground landscape. An array of dramatic cave formations including stalagmites, stalactites and shawls are visible today in these cave chambers, which are thought to be 500,000 years old.

Nigili cave is also of import to the Noongar Wardani peoples. The traditional stories told there give the Noongar history of the area, with good and bad spirits caring and harming for the people; providing insight into their storytelling tradition.



Nigili cave formations

The impoverished soil above sandstone in Margaret River region is pictured page 16

## 6) Wardan Aboriginal Centre

Aboriginal elders at the centre provided insight into the ways, understandings and lifestyle of the Wardani people. Through a guided bushwalk (under steady rain) the bounty of the native plants in a small section of banksia-jarrah woodland was revealed. Numerous practical traditional uses of grasstrees were discussed including for thatching rooves, using the resin exudate when making axes, tools and jewellery and for making warm beds. It was apparent that the native plants are able to provide an array of medicinal uses and were once valuable for house building, making rope and containers and carrying fire. Plentiful food and drink was found within the bush, some needing careful preparation and others being an 'acquired' taste. The Aboriginal six season annual calendar guides the hunting and gathering throughout the year to ensure on-going populations for future years i.e. sustainable harvesting.

Appendix 3 lists aboriginal plant uses identified whilst in WA



Bull banksia (*Banksia grandis*). The cones (pods) are used to carry hot embers from place to place, a technique the Wardani used to safely transport fire

## 7) Protea cut-flower farm

Beautiful Proteaceous cut flowers have been grown on this two hundred acre farm since 1988. The frost free temperate climate, high light levels and low soil phosphorous content make this region of WA is very suitable for South African flora. Indeed most of the persistent weed species in WA are of South African origin.

Appendix 4 lists prevalent weed species in WA noting South African species



*Leucospermum cuniflorae* ready for shipping



Field grown cut flower crop of *Protea cynaroides* with native WA woodland behind

## 8) Banksia-jarrah woodland at Contos

Recommended by individuals in both the UK and in Australia, this pristine banksia-jarrah woodland is easily explored by the two km trail from Contos Campsite to Lake Cave, and lived up to expectations. Throughout the peaceful woodland of *Banksia attenuata* and *B. ilicifolia* were clusters of grasstrees, some of which exuded fresh pillar-box red resin and many of which had maroon globules of previously exuded resin. Jaw-dropping grasstrees of such ancient standing that their crowns, many metres high, held up to fourteen separate branches were not uncommon; a quite remarkable sight considering they grow only a few cm annually. Many grasstrees had large skirts of old foliage and the sporadically sparse woodland floor was covered in a dense layer of dry leaves and large quantities of dead wood, indicating the lack of fire in recent years. Recent burrowing activity exposed the 'soil', pure sand. The particularly cold and wet weather of the 2016 winter (which was still ongoing, e.g. 5°C the previous night) limited the amount of spring colour, however a number of winter and early spring flowering species were admired, interspersed with low growing cycads (*Macrozamia riedlei*).



Contos banksia-jarrah woodland



Ancient grass tree *Xanthorrhoea preissii*

Top row plants: *Templetonia retusa*; *Hibbertia* sp.

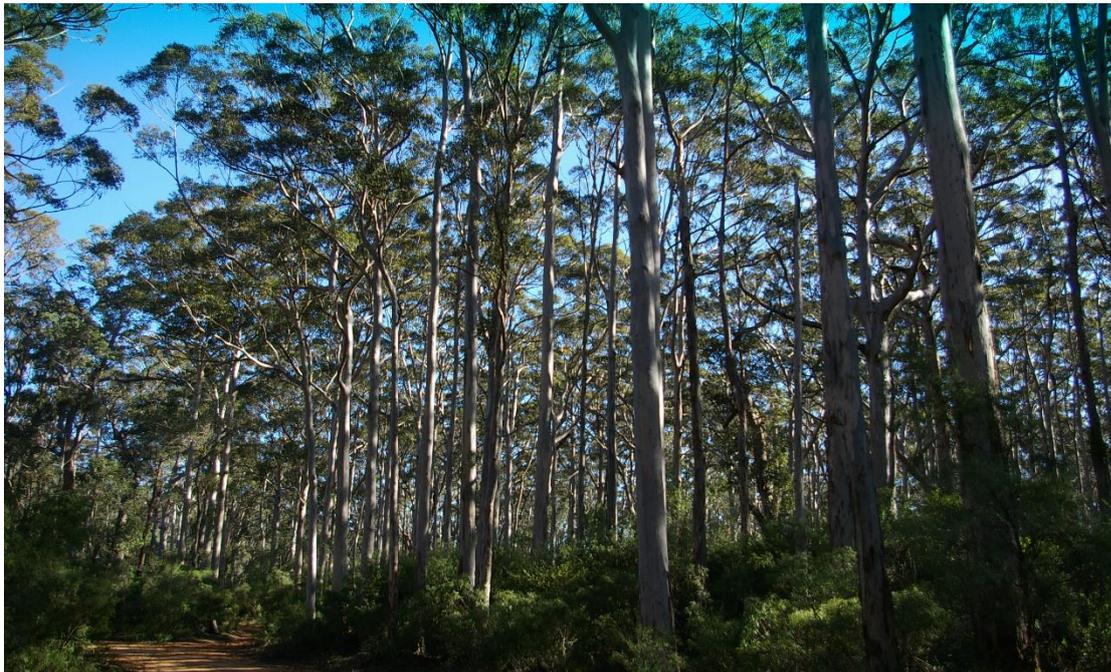
Bottom row plants: *Hovea chorizemifolia*; *Andersonia caerulea*



Impoverished, sandy soil in banksia-jarraah woodland

## 9) Boranup Drive

Majestic karri (*Eucalyptus diversicolor*) trees create an exquisitely serene forest. The trees establish only in areas of high rainfall typically over 1100mm /annum. Their white barked trunks reach to heights of up to 60m, whilst roots penetrate the nutrient equally as far searching out nutrients in the poor conditions. Their unusual airy shape was somewhat like small cotton-wool clouds dotted at the end of branches. There is no choice but to travel the 13.5km dirt road slowly, enjoying the scent of gums, the native bird song and the tranquillity. However the forest is not an original stand, it is regrowth after extensive logging around the start of the 20<sup>th</sup> century and remains an outlier to the main karri forests further south and east.



## 10) Karri trail

Although karri forests are one of the less botanically diverse habitats in WA they are feature a dense, lush and soft understorey; quite different to other WA habitats. Along the trail strongly scented peppermint trees (*Agonis flexuosa*) were common as the karri forest's secondary layer, alongside karri oak (*Chorilaena quercifolia*) and karri hazel (*Trymalium floribundum*). Native wisteria was also abundant, and the forest floor below home to a range of herbs and shrubs including tassel flower (*Leucopogon verticillatus*), cocky's tongue (*Templetonia retusa*), flame pea (*Chorizema* sp.) cut-leaf hibbertia (*Hibbertia cuneiformis*), winged acacia (*Acacia alata*), tremandra (*Tremandra stelligera*), the parasitic dodder laurel (*Cassytha* sp.) and many ferns and grasses. In comparison to banksia-jarraah forest cycads and grass-trees were not at all common.



*Chorizema* sp.



*Tremandra stelligera*

## 11) Coastal heath at Cape Leeuwin

This highly exposed cape is the most south-westerly point of the Australian mainland and part of the Leeuwin-Naturaliste National Park. Unsurprisingly in such an exposed location the tapestry of vegetation comprised tough heathland and scrub. This coastal heath made for a dense, pretty much impenetrable habitat. Plants seen included wattles (*Acacia* spp.) peppermint (*Adonis flexuosa*) parrot bush (*Banksia sessilis* var. *cordata*), basket bush (*Spyridium globulosum*) and the lovely coast beard-heath (*Leucopogon parviflorus*) in full flower. All these shrubs are pruned low by salt-laden winds; growing quite differently to their habit if seen in less exposed habitats. Climbing native wisteria and clematis (*Clematis* sp.) weaving through the shrubs. Alongside the beaches, (where typical pale sand was seen side-by-side with black and burgundy coloured sands), dune plants eked out an existence in the weathered limestone.



Coastal heath close by Cape Leeuwin

## 12) Blackwood River

A brief exploration of the Blackwood River inlet before commencing a long drive provided an unexpected opportunity to see a number of paperbarks (*Melaleuca* spp.) in the perennially damp ground alongside the waterways. This habitat was in close juxtaposition to heathland and to disturbed jarrah woodland where a number of radiant wattle (*Acacia* spp.) were in full flower; a real mix. The lower reaches of the Blackwood River and its tributary system are recognised as being nationally important wetlands.



*Acacia* sp.



*Melaleuca* sp.

### 13) Walpole Treetop walkway

The swaying treetop walkway ensured an alternative, and exhilarating, viewing platform to explore the evocatively named tingle forest. Here, where the rainfall tops 1m per annum and as there have been no major climatic changes for many millions of years, grow the world's only natural population of red tingle trees (*Eucalyptus jacksonii*). This giant of a tree has spongy cedar-red bark, grows to 75m and can have a girth of 20m around its enormous buttressed trunk. However, it is the towering karri, the third tallest tree in the world, which grow larger here than anywhere else on earth, emerging above all other species at a staggering 90m. The forest is also home to yellow tingle (*Eucalyptus guilfoylei*), an altogether more diminutive tree 'only' reaching 40m and without buttresses, rates tingle (*Eucalyptus brevistylis*) and numerous karri she-oak (*Allocasuarina decussata*), small trees with distinctive thick, corky, reddish bark and needle like leaves.

A boardwalk below enables exploration of the forest floor without being shredded by the copious sword grass (*Lepidosperma effusum*), and brings one face-to-face with the enormous buttressed trunks. Many of the trees are so old and large their trunks are now hollow, a result of fungal infection, insect attacks and fire. These blackened hollows can often be walked, or occasionally driven, straight through or provide shelter from the rain. The open understorey is home to other typical karri forest species such as karri oak (*Chorilaena quercifolia*) and the bizarre, bamboo-esque tassel flower (*Leucopogon verticillatus*), which grows vigorously in the moist conditions.



*Allocasuarina decussata*  
& *Lepidosperma effusum*



*Eucalyptus jacksonii*



Tree-top walkway

#### 14) The Banksia Farm

Kevin and Kathy Collins have worked tirelessly since 1984 to build and create The Banksia Farm homestead and the world's only complete banksia arboretum. They have travelled Australia extensively searching and describing *Banksia* spp., are authors and world authorities on the *Banksia* genus and generously shared time, expertise and enthusiasm on all things banksia.

Although the majority of banksia, 68 species, hail from the south of WA banksia come from diverse habitats across the Australian continent. All grow in the cool temperate climate of The Banksia Farm and there are species in flower throughout the year, with autumn being the most floriferous season. Kevin showed the diversity within species, explaining how plants maybe low and ground hugging in coastal areas or upright in form inland, and showcased the wide variability of flower colour that can be seen within one species; but with little sub-species recognition. Kevin highlighted the controversial taxonomic move which places all *Dryandra* spp. in the *Banksia* genus and highlighted the differences he sees between the two.

*Banksia* ecology was discussed; the bird pollination, the complex dormancy and germination strategies, seed distribution and the amazing proteoid roots through which plants mine phosphorous and iron. Traditional Aboriginal uses of banksia were overviewed and the horticultural management of banksia discussed. Propagation is preferably from seed with species dropping fresh seed needing light and species retaining seed in the cone needing fire to germinate. A thick mulch should be retained to protect surface roots. Pruning annually after flowering and removing thin growth is recommended, as is feeding with low phosphorous slow release fertiliser.



Kevin Collins



Fruity scented flowers of *Banksia solandri*



*Banksia menziesii* pink form



*Banksia menziesii* orange form



*Banksia spinulosa*



*Banksia epica*



Left: *Banksia robur* flowering directly from lignotuber



Right: Creeping *Banksia blechnifolia*



*Banksia serrata* cone



*Banksia candolleana* cone



*Banksia tricuspis* cone



*Banksia formosa*  
Previously *Dryandra formosa*



*Banksia rufa* subsp. *rufa*  
Previously *Dryandra ferruginea* subsp. *ferruginea*



*Banksia obtusa*  
Previously *Dryandra obtusa*

## 15) Ninedethana

Specialists in native Australian flora seed, this seed merchant has been supplying seed since the 1940s. Now based in WA the operation is owned by the not-for-profit organisation Greening Australia whose mission is to protect and restore the unique Australian landscapes, and are actively working towards this goal with communities and business. Ninedethana also provide seed for export and have recently been supplying the Eden Project.



Ninedethana seed storage facilities include walk in cold storage

## 16) Betty's Beach

In an abrupt change from the woodlands and forests of previous days, Betty's Beach is welcoming with azure blue waters and soft white sand. Visually the backdrop of rugged heathland with granite tors is reminiscent of Dartmoor, but only on closer inspection is the astounding diversity of flora appreciated. This is the very south-western edge of the heath habitat known as kwongan. The remarkable kwongan is found on deep, impoverished, free draining 'soil' which in reality is virtually pure sand, indeed the word means 'sandy plain' in Aboriginal. Kwongan is renowned for its exceptionally diverse plant life and plant composition can vary immensely over distances of only a few kilometres, with only the subtlest soil and geological changes. Here close to Betty's Beach small areas of wet ground were also observed lying over granite.

Thriving in this exposed wind-swept position were an array of low growing early spring flowering plants, flowering from only 30mm high to 70cm. Dotted between these were woody shrubs to 1.5m and drumstick grass-trees (*Kingia australis*). The most eye-catching shrub was the iconic scarlet banksia (*Banksia coccinea*) a species grown commercially for the cut flower trade.

Appendix 5 lists plants identified from photographs and/or observations at Betty's Beach



Kwongan heathland with *Hakea elliptica* in foreground



*Banksia coccinea*



*Hakea cucullata*



*Conospermum caeruleum*



*Anthoceris viscosa* subsp. *viscosa*

Along the roadside leaving Betty's Beach was a most unexpected and fantastic botanical sight. One of the largest hemi-parasitic plants in the world the Christmas tree (*Nutysia floribunda*), which typically flowers in December, beginning to flower.



Roadside *Lechenaultia biloba*



Above left and above: *Nutysia floribunda*

## 17) Quaalup Homestead at Fitzgerald River National Park

Due to the heavy, prolonged and on-going winter rain, the risk of spreading the water borne die-back (*Phytophthora cinnamomi*) via vehicles and people was too great to keep Fitzgerald River National Park (the Fitz) open, it was closed in its entirety. The large park covers nearly 300,000 hectares, is of global significance as a biodiversity hotspot, and is currently one of the least die-back affected parks in WA. Fortuitously, the privately owned Quaalup Homestead Wilderness Retreat alongside the park remains open, providing 40 acres of similar conserved kwongan to explore. To date 1883 plant species have been identified within the Fitz (for comparison, the UK is home to approximately 1400 native plant species).

Although relentless rain hindered all day hiking many incredible plants were seen when walking a couple of the shorter Quaalup trails and driving to/ from Quaalup. Most notable were the startling royal hakea (*Hakea victoriae*) endemic to the Fitz, and the elegant qualup bell (*Pimelea physodes*) endemic to the region. The qualup bell have large and long-lived colourful bracts protecting small flowers. The diversity of the small area explored was astounding, to the extent that plant compositions change every twenty metres or so along trails, presumably with the most subtle changes in soil. Patches of shrubby growth, even low woodland, including banksia and gums gave way to swathes of plants no more than knee-high. Dominant species in one short section may not be seen again further along the trail eg cauliflower hakea (*Hakea corymbosa*).

Appendix 6 lists plants identified from photographs and/or observations at Quaalup



*Hakea victoriae*



*Pimelea physodes*



Sparse shrub at Quaalup



*Petrophile longifolia*



*Philotheca nodiflora*



*Banksia attenuata*



*Lambertia inermis*



*Chamaelaucium* sp.



*Eucalyptus preissiana*  
subsp. *preissiana*



*Hovea pungens*



*Banksia baxteri*



*Hakea nitida*

## 18) Wave rock

The inland wheatbelt region was extensively cleared for agriculture by Europeans but granite outcrops like Wave Rock are common and these provided safe havens for plants. On and amongst the rocks are niche, seasonally-wet, growing habitats where sundews and orchids abound. Naturally occurring saline pools are also found in this region. However, as a result of the historic clearing for agriculture which caused rising of the water table, many lakes and approximately 10% of the agricultural land has been contaminated with salt.



Niche habitat atop Wave Rock with (inset) the unusual cormous *Wurmbea graniticola*



Selection of orchids observed within Wave Rock area



Contaminated salt lake and ground close to Wave Rock

## 19) Badgingarra National Park

The kwongan on the northern sandplains is as diverse as the south. The incredibly rich flora contains numerous rare species, with high probability that many more are yet to be discovered. In the summer the flora is parched and shrivelled, with fire a constant threat, and to protect the park a double fire break is in place alongside the main highway. But in the spring, the area comes alive with colour, with patches of land covered by a multitude of tiny flowering plants. For a horticulturalist from the UK, seeing this for the first time was completely bewildering, exhilarating and exhausting; attempting to absorb the plethora and diversity of plants, barely knowing which way to turn for the sheer botanical delight.

Badgingarra National Park's particular onus is to protect the iconic black kangaroo paw (*Macropidia fuliginosa*). Despite knowing this, finding a specimen in the wild in all its fully flowering glory was an amazing experience, an exciting highlight of the time spent exploring WA. Other exceptional plants in Badgingarra included the trigger plants (*Stylidium* spp.) which can be triggered by stroking the lower petals, at which the flowers flip their stamen under and up, expecting to deposit and/or collect pollen on an insect's back, the multitude of colourful clumps of diminutive cats paws (*Anigozanthos gracilis*), the immensely showy scarlet featherflower (*Verticordia grandis*), dramatic against charred remains, and a range of insectivorous plants.

Appendix 7 lists plants identified from photographs and/or observations at Badgingarra



Badgingarra National Park grasstrees *Xanthorrhoea* and *Kingia*



*Macropedia fuliginosa* in the field



*Verticordia grandis*



*Tripterococcus brunonis*



*Johnsonia pubescens*



*Conostephium pendulum*



*Stylidium* sp. (two flowers on upper left have triggered)



*Darwinia speciosa*



*Calectasia hispida*



*Anigozanthos gracilis*



*Petrophile* sp.



*Conospermum boreale*



*Drosera* sp.

## 20) Lake Thetis Stromatolites

Similar to thrombolites, these marine microbial communities which resemble the very earliest life forms have built rock like structures in the lake's shallow waters by depositing calcium. The structures are one of the world's oldest life forms and have been dated at around 3370 years old. Sampire (*Halosarcia doleiformis*), typically a beachside plant, was seen thriving at the lakeside. The lake is fed by groundwater and loses water only through evaporation, and thus is saline. Due to high rainfall the stromatolites were submerged in cloudy water.

## 21) Pinnacles National Park

In this desert of nearly 200 hectares are thousands of limestone 'pinnacles'. The dearth of flora is in sharp contrast to the floristically rich national parks close by. The pinnacles were formed by rain water carrying and depositing calcium into dune sand, which solidified into soft limestone cores. Over time plants established and soil built up above. The lowest consolidated soil layer hardened into a cap over the soft limestone but plant roots eventually broke through the cap into this soft stone. As the climate then dried over time the wind stripped away the plants, the soil, and sand, leaving intermittent columns of untouched soft limestone with hard protective caps – the pinnacles.



## 22) Mt. Lesueur National Park

The park has numerous habitats, including woodlands and salt lakes but is primarily home to yet another bewildering array of kwongan species. With over 900 species identified, and the park expected to provide home to about 10% of WA's known flora, this is the greatest biodiversity hotspot in WA; in an area only 24 miles across. In any 10m<sup>2</sup> plot there may be up to 120 different species, and it is common to record 60-70 different species. Some plants endemic to the park and many more endemic to the region are protected here, making this one of the most important conservation areas in WA. Incredibly the park was only formed in 1992 when threat from coal mining met with intense public disapproval. And, sadly in the 1960's land owners in the area were obliged by government regulations to clear the land for agriculture. Although access is via a ten kilometre dirt road, upon reaching the park an 18.5km tarmacked loop, the Lesueur Scenic Drive, has been laid to reduce the risk of dieback spread.

As to be expected, magnificent flora was viewed in the park. Highlights included WA's state flower, the jolly red and green kangaroo paw (*Anigozanthos manglesii*) contrasting with swathes of wispy smoke bush (*Conospermum* sp.) and pretty wax flowers (*Chamaelaucium* sp.). Waxes are one of the few plants from WA well-known internationally, a result of its importance in the cut-flower trade. Many different Proteaceae and enormous slow-growing cycads (*Macrozamia fraseri*) are a reminder that these are ancient landscapes.

Appendix 8 lists plants identified from photographs and/or observations at Mt. Lesueur National Park



*Anigozanthos manglesii*



Ancient *Macrozamia fraseri*



Typical kwongan ecosystem with the flat topped Mt.Lesueur in the background



*Caledenia* sp.



*Hybanthus calycinus*



*Philotheca spicata*



*Diplolaena* sp.



*Hakea neurophylla*



*Petrophile brevifolia*

### 23) Jurien Bay Marine Park

The exceptional diversity seen in WA's terrestrial flora is also displayed in marine plant life (and marine animal, fish and bird life). As for plants on land, the very long-term stability of the area and long period of isolation has been of paramount significance, and at Jurien Bay this is enhanced by a number of factors. There are no rivers bringing silts or nutrients into the ocean, the area is sheltered by a number of off-shore islands and reefs and here is where the warm tropical current from the north and cool Antarctic waters from the south meet. The diversity of seagrass is greater here than anywhere else on earth.



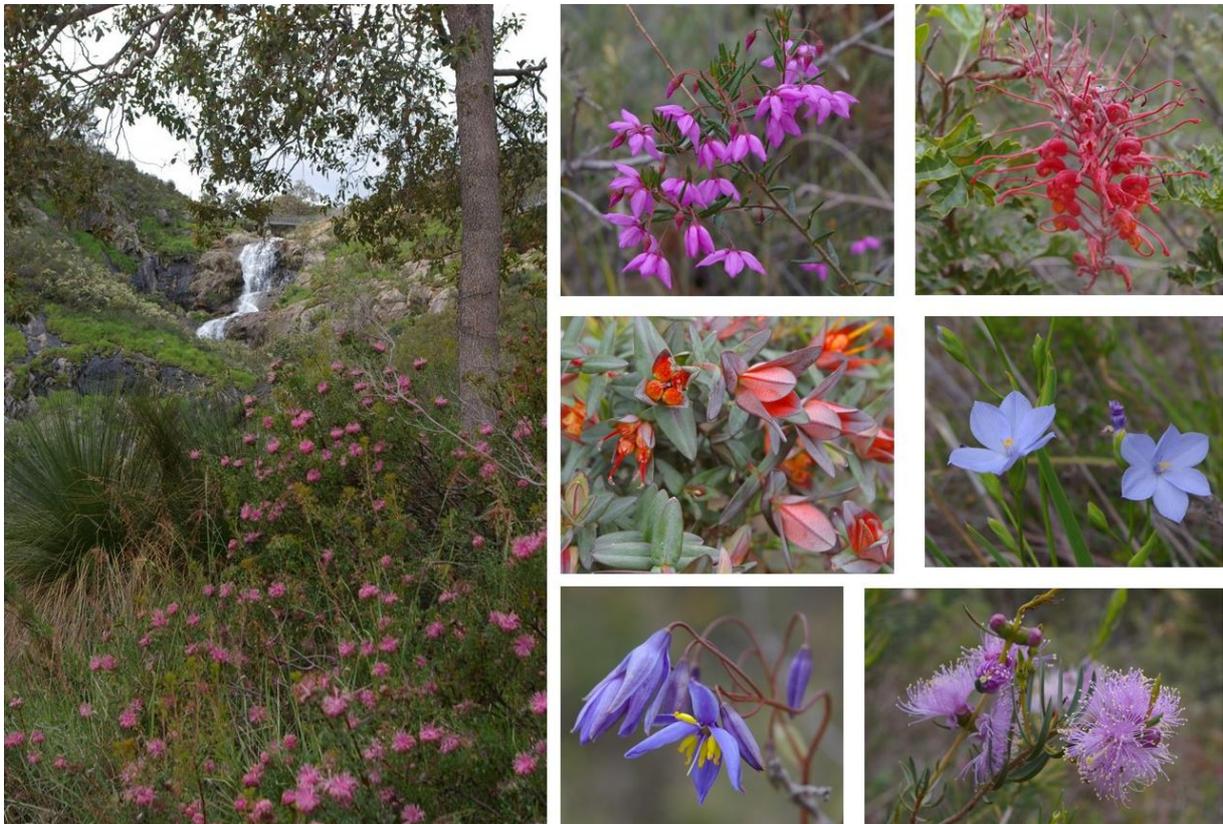
Sandy Cape at Jurien Bay Marine Park, with Australian sea lion (*Neophoca cinerea*) lying on the beach (just in the shade).

## 24) The Darling Ranges

A ridge of hills, visible from space, marks where the Indian subcontinent once joined Australia. Geologically the hills have resulted in having a red lateritic, clay soil (derived from dolomitic rock) on the top adjacent to yellowish granite gritty soil (derived from granodiorite rock) on the side, allowing opportunity for different plant communities. Jarrah and marri grow above on the laterite, whereas wandoo woodland (*Eucalyptus wandoo*) grows below on the granite, with heath being dominant on the steep, thin soiled side of the escarpment.

Easily accessible from Perth city are a number of walking trails through the hills including trails in Lesmurdie Falls National Park. The falls sit on the leading edge of the escarpment, after the prolonged wet winter the 100m tall falls were dramatic in full flow, attracting many visitors. The area is well promoted and popularly known as 'The Perth Hills' and the surrounding hillsides were rich in flowering plants. In particular large drifts of showy pink isopogon (*Isopogon* sp.) and the exotic large blooms of grevillea (*Grevillea bipinnatifida*) catch the eye but the area also included plants not seen elsewhere. Strongly scented freesia (*Freesia alba x leichtlii*) a persistent and widespread weed from South Africa, was rampant. It cloaked damp streamside areas and stony hillsides but a community group is working at reducing its numbers.

Appendix 9 lists plants identified from photographs and/or observations at Lesmurdie Falls



Left: Lesmurdie Falls with hillside of *Isopogon* sp.

Top row plants: *Tremandra* sp.; *Grevillea bipinnatifida*

Middle row plants: *Darwinia citriodora*; *Orthrosanthus laxus*

Bottom row plants: *Stypandra glauca*; *Melaleuca* sp.

## John Forrest National Park

Within the Darling Range above the escarpment sits the John Forrest National Park, the first area in WA designated with National Park status. It is a truly lovely place with pristine dappled jarrah and marri woodland, waterfalls and spring flowers. Time spent here was unexpectedly limited to only a brief morning and couple short walks, simply not enough to be fully immersed, but understandable considering the botanical promise of Coalseam National Park (see below).



John Forrest National Park

## 25) Western Australia Botanic Garden (WABG) at Kings Park (KP), Perth

Once a typical European styled city park, sitting on a hill above Perth, WABG has embraced its state flora with gusto, becoming the leading global horticultural institution for the propagation, cultivation, conservation, scientific research and development of WA plants. The seventeen hectare garden contains the world's most comprehensive collection of WA plants, allowing visitors to view and compare in one location approximately 3000 species from diverse habitats across the entire state.

The WABG takes a prime riverside location within KP. Understandably popular with Perth city folk, KP provides a number of opportunities for rest and relaxation including native bushland, planted transitional beds (which grade between bushland and botanic garden), expansive areas of parkland, a number of distinct separate gardens and parks appealing to different age groups and a range of restaurants, barbeque areas, memorials and pavilions as well as the WABG.



WA state flower *Anigozanthus manglesii* displayed in the WABG within KP



Kings Park sits on a hilltop close to Perth city

## 26) Coalseam National Park, Depot Hill and surrounding area

Everlasting annual wildflowers, annuals with dry petals that if harvested make long-lasting displays, were outside of the original aims and objectives tour. However, from listening to the compelling discussions between horticulturalists at Kings Park it became apparent that September 2016 was considered the best year for everlastings (and annual wild flowers in general) for over twenty years. Making the most of this opportunity, a small group of horticulturalists and I made last minute plans and undertook a trip north to see this botanical wonder. Without doubt, this was the right decision.

The phenomenon of mass drifts of wildflowers after winter rains occur at the arid edges of Mediterranean climate areas (such as the California deserts and Namaqualand in South Africa). If conditions are right a mind-blowing display of annual flowers will be on show for just a short few weeks. It was a delight and immense privilege to see this wonder of nature.

Coalseam Conservation Park is the location of the first coal mining in WA. Glowing wildflowers, including far reaching virtual mono-cultures of *Waitzia acuminata*, *Schoenia filifolia*, *Cephalopterum drumondii* and *Goodenia* sp., bloomed throughout the fertile gorge valley and on the hillsides high above the limestone cliffs.

Close by, Depot Hill Reserve is a small stream-side valley with rugged rocky hillsides. The valley floor was awash with wild flowers whilst many others emerged between rocks on the hillsides. Further up into the valley the annuals ebbed away giving way to a flora of scrubby shrubs growing in drier sandy soil.

The dazzling displays of annual and everlasting wildflowers weren't restricted to WA's conserved areas. En-route from Morewa to Perenjori as-far-as-the-eye-could-see the flat roadsides erupted into colour amongst sparse woodland.

With encouragement from King's Park senior curator, the wildflower road-trip then turned further north, along Highway 95 to the Ningham junction. Here the reward was a delightful collection of many species of mulla-mulla (*Ptilotus*) in full flower.

Throughout the areas visited it was clearly noticeable that each patch had its own composition of flowers. Rarely were there more than four different dominant species, but the composition frequently changed and all were simultaneously in full flower. Everlastings typically grow in loamy soils and it was observed that they rapidly petered out as soil became drier and sandier. They were flowering in early September after winter rains which begin in earnest in May and begin to ease off at the end of August. Daytime temperatures during these winter months barely rise above 20°C until September, whilst night time temperatures remain below 10°C until October. Considering these factors it should be possible to cultivate and display a good range of everlastings at Eden (and under glass elsewhere in the UK). In Eden's sharp soil regular foliar feeding will most likely be required and /or incorporating additional organic matter. Germination and establishment would be expected in the spring months when temperatures in the Mediterranean Biome are similar to those described, with flowering anticipated in late spring and early summer.

Appendix 10 lists plants identified from photographs and/or observations on the wild flower road trip in everlasting country



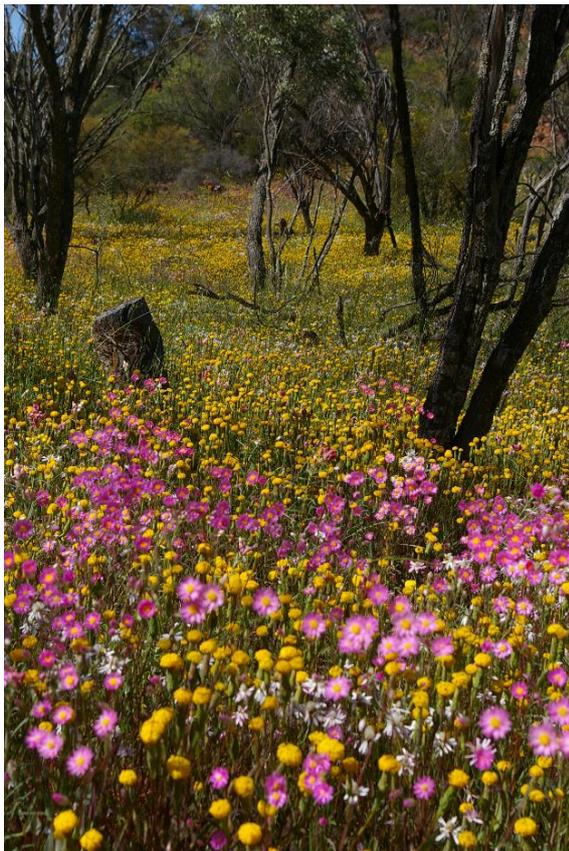
Mono-culture of *Schoenia filifolia* at Coalseam Conservation Park



Coalseam Conservation Park  
Pink: *Bellida graminae*  
Purple: *Brachycome* sp.  
Orangey yellow: *Waitzia acuminata*  
Yellow: *Schoenia filifolia*



Depot Hill Reserve



Depot Hill Reserve  
Left: yellow: *Podolepsis* sp; pink: *Rhodanthe manglesii*  
Right: *Caladrinia* sp.



En-route from Morewa to Perenjori



En-route from Morewa to Perenjori  
 Blue: *Brunonia australis*  
 Pink: *Velleia rosea*  
 Yellow: *Podolepis aristata*



En-route from Morewa to Perenjori  
 Creamy white: *Rhodanthe chlorocephala*  
 Pink: *Velleia rosea*



Highway 95 Ningham junction wildflowers



Mulla-mulla at Highway 95 Ningham junction

Left to right: *Ptilotus* sp. *Ptilotus rotundifolius*; *Ptilotus exaltus*

During the road-trip a stop was also made to see perennial flowering plants close to the salt flats between Perenjori and the Mount Gibson Mining operation on Highway 95. Here were a collection of the infamous wreath flowers (*Lechenaultia macrantha*). These unusual plants are ‘hunted down’ in flowering season by besotted photographers and botanists. Seemingly, local tourist offices compete to give the most cryptic directions to plants in their Shire. The plants are uncommon disturbance opportunists, and were only seen growing in the narrow roadside gully, not in the adjacent dry shrub-lands where a range of more arid climate perennial plants thrived. Wreath flowers have proved extremely challenging to grow in cultivation, even for the team from WABG who are still trying to successfully cultivate them for public display.



Roadside *Lechenaultia macrantha*



Dry habitat *Stylidium* sp.



Dry habitat plants alongside road Perenjori to Highway 95

Top row: *Dasymalla terminalis*; *Dampiera* sp., *Keraudrenia* sp.

Bottom row: *Cyanostegia angustifolia*; *Lachnostachys verbascifolia*; *Eremophila* sp.

## 27) Bold Park

A short drive from Perth city on the coastal plain is the other area managed by the WABG. Apart from a central historic pine plantation (which seemed entirely incongruous), Bold Park is wild bushland. It includes a range of habitats from coastal dunes to marri woodland but is dominated by banksia woodland, with some mature heavy-weight specimens. The park is actively conserved and the bushland ecology restored. Priority areas undergo a two year programme to clear perennial alien invasive plants, notably rose pelargonium (*Pelargonium capitatum*) veld grass (*Ehrharta* spp.) spurge (*Euphorbia* spp.) and bridal creeper (*Asparagus asparagoides*). Areas are then replanted with natives in the cool moist conditions of early winter to promote establishment. Whenever possible plants grown for Bold Park (at the WABG nursery site) are of Bold Park provenance. No further assistance is provided but plants are monitored for three years. Reabold Hilltop afforded great views out to sea to the east whilst the Balga walk afforded equally great views south to WABG and Perth city.



Left: *Macrozamia fraseri*

Centre: *Daviesia divaricate*

Right: Balga Walk (balga is the local Aboriginal name for the *Xanthorrhoea preisii*)

## Overview of work placement at Kings Park

From being completely enthralled by WA natives in the bush, the opportunity to learn skills to cultivate these plants from the experts at KP was a horticulturalist's dream. Time spent at KP fell into different areas of learning:

- 1) Introduction to KP and WABG
- 2) Nursery production of WA natives
- 3) Garden cultivation of WA natives
- 4) KP science, conservation and research activities
- 5) WA commercial plant development
- 6) Public interpretation and education
- 7) How best to interpret and present WA habitats in the UK

### 1) Introduction to KP and WABG

The park attracts 6 million visitors annually, is open at all times and is funded by the state. The majority of KP is native bushland with a minimal maintenance regime. However it also contains numerous gardens, including the WABG. One of the most popular gardens within the park is Rio Tinto Naturescape, a natural playground with pebbly billabong (stream), sunken walkways and native plants, attracting up to 10,000 individuals a week (predominantly children). Synergy Parkland garden, focuses on the evolution of plants and showcases WA natives in a home garden setting, informing and promoting their use in domestic gardens. Many of the newer gardens and memorials within KP have been exceptionally well designed and integrated into the wider landscape, the work of landscape architect David Smith. Recently a small marsupial, the bandicoot, has returned to KP indicating the good health of the bush.

As to be expected in a Mediterranean climate location, and particularly near a large urban centre, water is a valuable resource at KP. The supply is limited and application carefully managed. Subterranean (50mm below) irrigation pipes are laid in the garden beds and the application controlled by a flow manager system which takes into account soil water, daily evapotranspiration rates (calculated via the park's weather station), rainfall and area priorities in order to utilise the water in the most efficient way. In midsummer, priority areas such as lawns may receive water twice a week and most garden beds receive it once a week. Regular maintenance of the system is critical and wilting kangaroo paws (*Anigozanthos* spp.) are the first indicators if beds are too dry. New plantings in the KP bushland are watered, but by bowser and are rationed; 8lt per plant per week for the first summer, 4lt for their second summer.

In addition to the regular staff there are over 1000 volunteers, and 40 students working in the park. The strong volunteer group grow WA plants to sell in quarterly sales, man telephone advice lines, maintain the memorial signage and assist with the horticulture.

The WABG in KP is only 50 years old. It showcases WA flora by genus (eg the banksia garden and hakea beds) and habitat (eg Pilbara and Wheatbelt). There are also conservation beds displaying approximately 400 of WA's endangered and

critically endangered plants. Showcasing plants from such diverse habitats and climates is a challenge. One particular plant receives unusual horticultural treatment, an enormous boab tree (*Adansonia gregorii*). This 750 year old tree was brought to WABG from the north of the state instead of being destroyed during land development. In order to prevent the tree from getting too wet in the winter it is dressed with a plastic skirt which directs rain away from the root zone. In the summer the skirt is removed and the tree given measured doses of water. The WABG sits on sand, many feet deep, so some plants, eg trees, have a thick garden compost mulch applied annually to help ameliorate the soil. Detailed plant records are kept on bg base (botanical garden database) and the accession labels hidden underground.



Water reservoir slow sand filters



Dam building fun in the billabong



Relocated boab tree



KP volunteer's plants prepared for fundraising sale

## 2) Nursery production of WA natives

A crucial part of the work placement were days within the nursery, learning how best to propagate and establish WA plants. The WABG nursery grows about 90,000 WA native plants annually, for the WABG, Bold Park, the state conservation department and Perth arboriculture team. The majority of plants are planted out in autumn/ winter. About 8000 annuals are also grown for planting out in winter/ spring.

Where possible plants are sown from seed, however many species need to be propagated vegetatively by cuttings or, for species difficult to propagate by cuttings or seed and those intolerant of the soil conditions at KP, by grafting. In general the cooler winter months favour sowing WA natives from the south of the state whereas plants from the hotter northern parts of the state need summer sowing. Sowing more often than not involves pre-treatments of smoke water and /or scarification using nicking, gibberellic acid, hot water and / or soaking. (Detail of these treatments for specific desirable species to grow in the UK was discussed at length). WABG propagate large numbers of plants from cuttings and through experimentation have devised best practise protocols for individual species, even so some species eg *Banksia brownii* have persistently low success rates. Most often cuttings are nodal, and typically taken in early summer. Rhizotonic and aspirin are used as a pre-soak and hormone is used at striking. Grafting, usually a wedge graft, is done in spring and summer using rootstock material propagated the previous year. It is particularly useful for *Pimelea* spp., *Eremophila* spp. and *Verticordia* spp.

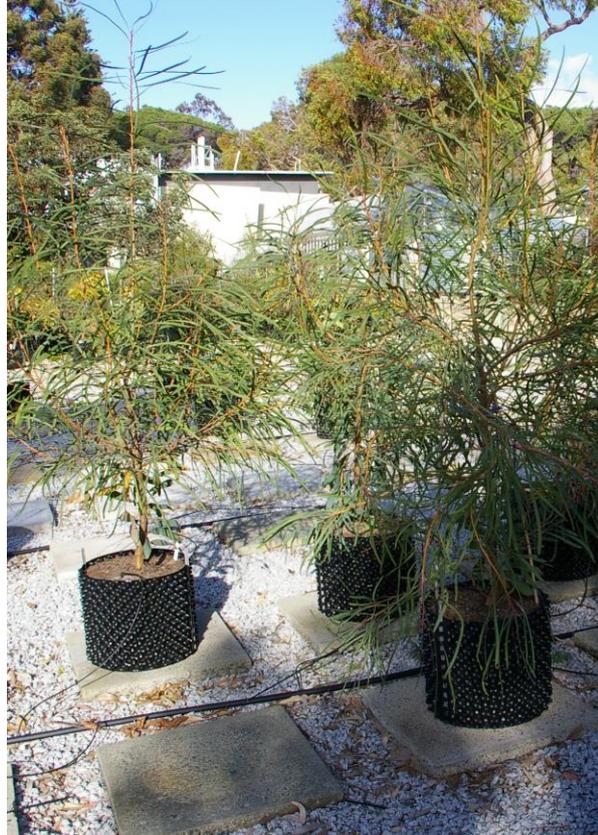
The various nursery propagation composts used are all very free draining (ensuring no collar or root rot), low in nutrients (particularly phosphorous as many WA plants have such superb abilities to take up phosphorous at very low concentrations that higher levels can be toxic) and impeccably clean through steam sterilisation (reducing the risk of die-back transfer). Coarse river sand, fine pine bark, perlite and peat are the main ingredients. Potting on mixes have some fertiliser added.



Nursery *Boronia* spp. collection



My attempt at a wedge graft (before taping) *Eremophila calorhabdos* scion and *Myoporum insulare* rootstock



*Eucalyptus* sp. plants, only one year old, from direct sowing in spring rings

### 3) Garden cultivation of WA natives

A typical year sees direct sowing of annuals in late autumn, followed by the bulk of the planting through into the winter months. The main annuals begin to fade in early summer and are replaced by annuals from the hotter, northern areas (eg mulla-mulla *Ptilotus* spp. and Stewart desert pea *Swainsona formosa*). At this time many of the spring flowering shrubs (eg *Hakea* and *Grevillea* spp.) also require post-flowering pruning. Many *Pimelea* are pruned back by half eg *P.ferruginea* and *P.spectabilis*. The kangaroo paws flower for long periods and can either have individual spent flowering stems cut out or the entire plant may be cut to the ground. During midsummer the waxes (*Chamelaucium* ssp.) are cut back by half. Plants from the hottest region, the Kimberley, are also planted out once temperatures rise in mid-summer. A number of plants including kangaroo paws and *Pimelea* are propagated and replaced on a regular basis every two to three years. This cultivation ensures a floristic show for a long duration from late winter into summer.

Even in WABG grasstrees are carefully cultivated. Large specimens are acquired from nurseries specialising in lifting plants where sites are being developed. The trees are established in pots before being replanted. Planted specimens have their soil water levels checked regularly in their first three years, and are watered at ground level by hand, if required, when more than 200mm depth of soil is dry. However they can be tricky, and even here not all plants survive the transition from pot back into the ground.

Unexpectedly, the garden plants are well fed. At planting they receive low phosphorous slow-release feed and for their first two to three years they are also likely to be fed with this in the winter. Additionally many plants receive seaweed liquid feed throughout the year.

In order to reduce the susceptibility to die-back banksias are sprayed in the autumn and spring with potassium phosphite. Common pest problems include scale insect on grasstrees and gums but spraying is limited to cooler months to avoid scorching foliage. *Anigozanthos* spp. (particularly *A.gabrielilae*) are prone to black ink-spots but this is reduced by ensuring they have subterranean irrigation and no over head watering.



Early spring flowering *Hakea bucculenta* (left), *Grevillea dielsiana* (centre) and

*Chamelaucium* cultivar (right)



Direct sown display of everlasting *Rhodanthe chlorocephala* ssp. *rosea*



WABG tools of the trade

#### 4) KP science, conservation and research activities

KP has a statutory obligation to protect WA flora and undertakes this role in many ways including seed collection and storage, garden collections and propagation.

Through active seed collection, the park aims to collect and preserve seed from the entire WA flora. Expeditions are made across many locations (some remote), collecting at least 5000 seeds from around 40 new plants each year. Priority is given to threatened plants, and requests from WABG's senior curator, the Millennium Seed Bank at Wakehurst Place (MSB), KP science and research team, KP development team and the field council. Each species collected also has three herbarium samples made, one each for Kew, KP and the WA state herbarium. These samples allow botanists (at WABG and elsewhere) to verify each plant collected. The WA government's on-line database 'Florabase' is used as a key tool in the planning of these expeditions and bg base is used to record every detail of information about each plant from which seed is collected. The expeditions often discover new species or sub-species.

Collected seed is dried and processed at KP. This can be very time consuming eg all seed takes eight weeks of drying out, to extract *Banksia* seed from pods they may need individual gas torching, then soaking and oven drying. Winnowing and polymer coating machines assist. Seed is stored at KP in state-of-the-art facilities at -21°C, having been stabilised at 15°C and 15% relative humidity, here it should remain viable for 400 years. Seed is also dispatched to the WA State Department of Parks and to the MSB. WABG is the largest single contributor of seed to the MSB, having deposited around 1300 lines to date.

KP is the only place in WA with all the facilities for micro-propagation, cryogenic storage and lab work such as embryo rescue. The small science and research team rely on securing competitive funding for their salaries. Ironically the funding often comes from the very same mining corporations causing the habitat loss. These corporations are required to rehabilitate areas after operations, and so need to have conserved and have knowledge in place to be able to regrow the plants.

The priorities are the critically endangered plants (currently 164 species) and the endangered plants (425 plants listed). In addition there are 3500 species of priority concern which are monitored in the wild. The team work on cracking the techniques required for successful tissue culture propagation of each plant and then protocols for establishing and successfully growing the plant. Living material is retained in the science nursery and in WABG nursery (from where it may be introduced into the garden). As wide a range as possible of geotypes of each threatened plant species is conserved, preserving a good gene pool. Although a really straightforward species may be successfully assessed in six months, woody trees and shrubs are notoriously problematic. The aim is also to get some material of each species into cryogenic storage (ultra-long term cold storage of shoot tips) and to work out how to revive it. Once all these protocols are established the team move onto the next species.



*Eucalyptus brandeana*, new species discovered on collecting expedition, named after WABG senior curator Grady Brand



Seed collector Luke Sweedman with purpose built expedition truck



Undetermined *Darwinia*, labelled with seed collection site 'Chipparcoping'



Growth room at KP science

## 5) WA plant development

KP is involved in some incredibly interesting plant breeding work using native WA plants to develop ornamental garden worthy plants. This brings revenue into KP and also introduces the spectacular native flora to a wider number of people, locally, nationally and internationally. Importantly, the plant releases have lower irrigation and fertiliser requirements than traditional European favourites (such as lawn grass, roses and bedding plants) regularly seen in WA suburbia, and they provide better habitats for native fauna, assisting towards KP's conservation activities. Introduced plants are infertile or have low fertility, ensuring they don't become a future weed.

WA plants are often well suited to breeding work; there are numerous sub-species, massive variation between communities in isolated populations across the state and, as the populations are so ancient, the traits remain stable even when the plant is grown elsewhere e.g. the Geraldton wax (*Chamelaucium uncinatum*) has about sixty separate communities varying in foliage, flowering time and colour, habit and size.

Working with commercial partners in the last stages of the plant selection, KP has released a number of cultivars including *Scaveola* 'Blue Print' (2010), *Grevillea* 'Spirit of Anzac' (2015) and *Boronia* 'Plum Bells' (2016) and many more are on their way. The average time to develop a new cultivar is seven years, but this varies immensely. Occasionally a particularly good plant form is discovered in the wild (eg *Alogyne* 'Blue Heeler') and introduced as a named form. More often traditional controlled pollination is used to develop specific plant traits. Most recently the team have started using cell fusion (fusing cells of two different plants together in the laboratory with an electromagnetic field) in the quest to develop winning plants.

Working out protocols for germinating seed, propagating plants and cultivating the selections are essential for plant breeding, but also contribute to KP's conservation efforts. Difficult to germinate plants often require laboratory techniques and growth cabinets. Embryo rescue is particularly helpful for difficult seeds eg *Boronia* spp. Organogenesis of petioles may prove a viable propagation method for *Corymbia*, allowing commercial production of selected clones. Such laboratory techniques aren't determined by time of year, thus enabling researchers to develop protocols year round. Successful weaning from growth cabinet to nursery setting has also been a focus for research, also contributing to the successful conservation of endangered species.

Current breeding aims include developing a scarlet and white bicour wax flower (*Chamelaucium* spp.), black flowering soft-leafed *Grevillea*, red flowering gums (*Corymbia* sp.) that flower when young in the pot, drought tolerant *Boronia*, scented pink *Boronia* and a kangaroo paw that is as healthy and as showy as the fantastic 'Federation Flame' but is much easier to propagate. Successful new cultivars generally need to be compact, adaptable to garden conditions and commercially viable i.e. easy to propagate, easy to grow and well presented in pots. However fashion and the likely destination of the cultivar also dictate what is desirable e.g. spiny plants are good for the landscape industry, pink flowers are popular with female purchasers (70% of the purchasers) and whilst bright clear colours are most popular in hot places (eg California) softer shades appeal more in cooler temperate areas (eg the UK).



*Chamelaucium* breeding



*Grevillea* trial bed

## 6) Public interpretation and education

Many strategies are employed at WABG to educate and inspire visitors, exploring these gave many useful pointers for the interpretation of a WA exhibit in the UK. Each area has colourful, easily understood signboards with key points about WA's flora; such as these plants being living fossils and as valuable as jewels, the incredible number of plants found here that grow nowhere else on earth (endemics) and the needs of the plants, insects and fungi to be grown alongside one another (symbiotic relationships and adaptations).

Through the busy spring period the horticultural staff give tours of the gardens informing visitors about WABG, about WA's plants and giving cultivation advice. Weekly talks by the horticulturists in Synergy Parkland promote the use of WA natives for waterwise gardening.

Beautiful artistic installations approach education with subtlety. Images of banksia flowers and wattle leaves have been skilfully created from inlaid stone on terraces in the banksia and wattle gardens. Carvings in tree trunks of massively enlarged native fauna attract interest in younger visitors in the Variety Club garden, whilst the brand new WABG entrance statement artwork, named Symbiotica, elegantly echoes the weeping habit of the endangered *Eucalyptus caesia* planted alongside, and looks at the relationship between plants and insects, depicting seeds of endemic WA flora.

Aboriginal plant use is introduced to visitors through an Aboriginal trail, highlighting key plants, their uses and the traditional culture (plant uses are outlined in appendix 2). During the work placement the annual Kalunga Katitjun festival occurred. This inspiring, lively, one day event educates and inspires 1000's of children primarily in conservation and Aboriginal culture with workshops, talks, animal petting, music, dance and a whole host of activities.

The behind-the-scenes seed and science work of KP was revealed in a temporary exhibition of electron microscope images of seeds, this visually appealing and interesting format directly highlighted the science conservation work to plants flourishing in the garden. Year round, visitors may climb a double helix DNA tower to enjoy far reaching views, and incidentally learn about the discovery and role of DNA.



Typical WABG style signboards



Banksia garden terrace



Aboriginal tool making and artwork activities at Kalunga Katitjun festival



Horticulturist led tour starting at the new WABG entrance artwork

## 7) How best to interpret and present WA habitats at the Eden Project

Valuable time was spent discussing and viewing how KP portray natural habitats; notably banksia-jarrah woodland and kwongan, and their WA decorative flowering beds. Plant lists have already been generated for each area at Eden with guidance from WABG but this trip gave opportunity for detailed discussion of how plants should be arranged, allowing each area to flow from one to the other, e.g. the grasstrees, although a priority species in banksia-jarrah, should drift into kwongan (confirming what had been seen in the national parks). Time was also spent studying plants that do well in lower light levels yet still represent WA flora, as the lower light levels at the Eden Project are of concern.

Although WABG's banksia-jarrah exhibit features the correct plant composition, showy species such as *Anigozanthos manglesii* and *Boronia heterophylla* are used in greater concentrations than in the wild, a technique to be replicated at Eden. *Boronia heterophylla* does well in shade, as do *Grevillea* 'Superb' (whose parentage is from jarrah woodlands) and, somewhat surprisingly, the grey leafed *Adenanthos sericeus*; so these are expected to be good performers in the UK. The banksia-jarrah habitat is low maintenance, with structural trees and an open feel which represents fire ecology, with post fire opportunists including *Chorizema* spp. providing the most colour. Although jarrah grows on laterite, a coarse, lumpy, yellow to reddish substrate, there is surface leaf mulch providing a foil to the plants.

The WABG interpretation of kwongan has showy plants, namely annuals, trickling through in much higher concentrations than seen in the wild. WABG grow a wide range of annuals. Viewing and discussion about them finalised choices to trial at Eden, considering the heat and light levels available. These will be grown in mixes of three or four species to trial their suitability. The coarse sand mulch used in WABG's kwongan is an important addition, representing the deep sand that kwongan grows on, and setting the scene. This will need replicating in at Eden.

Many of the cultivation practises used WABG's decorative beds will be useful for ensuring a floristic show at the Eden Project. Approximately twelve plants are planned per m<sup>2</sup> and cultivars of many genus (eg *Scaveola* and *Chrysocephalum*) are used for providing reliable interest. It was agreed that regularly replacing perennial material in these flowering beds will be a useful approach, possibly importing tissue cultured material on an annual basis if propagation in the UK proves difficult. Hard pruning will be essential to retain vigour.





WABG interpretation of jarrah forest with white *Pimelea ciliata* in full flower



WABG interpretation of kwongan

Page 66 WABG decorative bed using WA natives



WABG annual display of *Schoenia filifolia* subsp. *filifolia* and *Brachycombe iberidifolia*



WABG display of *Grevillea* 'Superb' growing well in shade and recommended for UK

## Conclusion

Prior to the visit, contact with WA flora had been limited to UK botanic garden collections and through websites/ books. By travelling, visiting and exploring such a wide range of locations an amazing overview of WA habitats has been gained along with a thorough introduction to the wonderful, diverse and bizarre flora, with numerous genus seen in-the-flesh for the first time. The study allowed for observation of many adaptations of plants to their impoverished, harsh existence.

Visiting a number of National Parks, and the areas between, enabled first hand study of the soils, landscapes, ecosystems and plant communities, as well as a really wide range of plants. These observations will inform how the plant communities are recreated at Eden, eg the densities of planting, the soil and surface mulches, the needs for patches of open forest floor within banksia-jarrah and limitation of each species to a small area within kwongan. Knowledge gained from working alongside the WABG horticulturalists and learning about how they recreate these areas will influence the density and distribution of species for an appealing public exhibit. All of these experiences will prove invaluable when recreating the naturalistic ecologies within the Mediterranean Biome at Eden.

Time spent at KP and WABG furthered understanding and massively assisted in the naming of the incredible flora of WA. The work placement taught pertinent horticultural techniques, such as the unexpected reliance on foliar feed, the requirement of hard pruning, and also highlighted how good horticultural practises are pleasantly consistent in botanic gardens on opposite sides of the globe. Working alongside the nursery team and studying the propagation of WA flora highlighted the different approaches required for species from different areas across the state, with sowing times and propagation facilities needing to be suitable. All this gives confidence for the continued propagation, establishment, management and maintenance of the new collection at Eden.

Time was well spent, and enjoyed, with the wider WABG team, who it would appear, feel somewhat isolated horticulturally and appreciated the interest shown in their work. Connections were established and plans made for continuing conversations with KP team, including writing for their garden magazine. Similarly articles are already planned at Eden. Presentations have been given in the UK, and more are planned, inspiring others about WA flora and sharing the learnings of the study trip.

The visit revealed the Noongar people's reliance on plants for their every need, their huge respect for and sustainable relationship with the land and their cultural practises. Further research and study of this will continue as individual plants are explored in more detail and storylines developed to share with the public prior to the Eden exhibit being installed.

In conclusion, this study visit was brilliantly successful in fulfilling its aim of developing familiarity with WA flora and achieved all the objectives first set out. In addition the rare opportunity to be immersed in plants without the demands of normal life, and to have such a concentrated learning experience has been highly inspirational.

## Future plans

This study visit has enabled far deeper understanding on flora, soils, habitats and aboriginal plant use which is proving invaluable as the team at Eden pull together the exhibit for 2017. Continued communication with WABG is providing insight into the monthly developments of the garden, continuing the work on developing up a year-round successful representative display in the UK. One particularly interested horticulturalist from WABG has now secured funding to come to the UK for 2017 exhibit installation (and to spend time at the Royal Botanic Gardens Edinburgh on base training), and The Banksia Farm owner also hopes to visit in 2017. Input from these individuals will benefit a large group of horticulturalists in the UK. Plans have already been made for a number of further presentations and to write articles for KP and Eden Project magazines about this trip, the collaboration, exhibit installation and establishment.

Although the study visit was a full month, the reality is that it only touched the tip of the floristic iceberg. There are aspirations to return to WA, to explore other biodiversity hotspot regions further north into the arid zone, and to experience the Mediterranean south-west region later in the spring and early summer. The areas visited on this trip gave an excellent overview (particularly those recommended by Grady Brand) but if possible a second trip would also include the Stirling ranges.

## Personal reflections

I found the flora of WA entirely mind-blowing. The diversity of plants, particularly within the hotspots, the significant numbers of sub-species and endemics and the absolute possibility of knowledgeable individuals discovering new species was virtually unbelievable. Of all the areas of the globe I have visited WA has really caught my heart and I know I will soon be hankering to return. It would appear that compared to other popular bio-diverse areas, such as South Africa's Western Cape and the Amazon, WA's diversity is little known or appreciated. I would recommend other horticulturists interested in non-hardy flora to visit, and be intoxicated by WA.

Practically wise, WA is an easy area to explore. Initially I toured with a horticultural colleague from Eden, choosing in the end to hire a small campervan. This proved an excellent solution, enabling us to make full use of the available time, often camping overnight on or close to the areas of interest and sharing large driving distances. However, checking in advance what times to expect dawn and dusk would have been sensible. Travelling with another horticulturalist was really beneficial as habitats could be discussed and plants identified together. However, with the limited duration, we were reluctant to 'waste' a moment of our time 'resting', maybe a side effect of the flora being so enticing.

The dominant wet weather for the first part of the trip was frustrating, and not expected for the time of year. Neither the team at WABG or The Banksia Farm were aware of the closure of Fitzgerald River so it was no surprise that we were unaware, and this came as a disappointment. Being weather flexible was important, and the cave visiting ideal; worth noting for future trips.

Upon returning to the UK I was felt swamped with the information gleaned and it took weeks before my mind coalesced everything into a sensible structure. In addition I have been amazed at how long it has taken, at weekends and free evenings, to work through the 1000's of photographs taken, identifying and labelling them, although I should mention what a great learning process this has been. Should anyone plan a similar trip they should be in no doubt about the amount of time required for post trip synthesis.



Colourful ornamental gum trees at The Banksia farm

# Budget

signed.....

Expenditure item	Actual	Anticipated
<b>Travel</b>		
Air fare UK to Perth	£770.85	
UK travel Cornwall to/from airport	£186.60	
Buses in/out of Perth to car-hire & airport	£5.40	
Taxi into Perth from car-hire	£27.30	
Vehicle hire	£778.18	
Fuel	377.74	
<b>Total:</b>	<b>£2146.07</b>	£1953
<b>Administration</b>		
Travel Insurance	£106.19	
<b>Total:</b>	<b>£106.19</b>	£146
<b>Subsistence</b> (accommodation:		
Perth Comfort Inn	£108.87	
Mandurah caravan/campsite	£19.47	
Bunbury caravan/campsite	£20.32	
Yallingup caravan/campsite	£22.58	
Contos x 2 caravan/campsite	£26.52	
Augusta caravan/campsite	£18.00	
Peaceful Bay caravan/campsite	£12.00	
Quallup Homestead caravan/campsite	£18.00	
Hyden caravan/campsite	£21.34	
Badgingarra caravan/campsite	£15.00	
Jurien Bay caravan/campsite	£18.41	
Sandy Cape caravan/campsite	£9.00	
Perth caravan/campsite	£16.91	
Perth Hay Travellers Inn Hostel	£152.93	
Perth Betty Lodge Hostel	£212.52	
Mingenew cabin	£79.67	
Food	£355.53	
<b>Total:</b>	<b>£1127.07</b>	£1499
<b>Other costs</b>		
Araluen entry	£6.00	
Wardan Aboriginal Centre bushwalk	£21.00	
Banksia Farm	£14.90	
Caves entry	£33.00	
Walpole Tree top walkway	£11.40	
National Parks Pass	£26.40	
<b>Total:</b>	<b>£112.70</b>	£69
<b>Miscellaneous costs</b> (i.e cash withdrawal) Such as additional camping blanket and pillow plasters, small food items, additional memory card and batteries, glue/screws to fix van.	<b>£124.68</b>	
<b>Expenditure grand total:</b>	<b>£3616.71</b>	£3667

## Funding received grand total: £3436.60

£1750 RHS Coke Trust Bursary Fund  
 £1000 RHS Jimmy Smart Memorial Bursary Fund  
 £500 David Miller Travel Bursary  
 £186.60 Eden

## References/Bibliography

Barrett Russell, Eng Pin Tay, (2005) Perth plants: a field guide to the bushland and coastal flora of Kings Park and Bold Park, Perth, Western Australia. Botanic Gardens and Parks Authority.

Beard J.S. (1990) Plant Life of Western Australia. George A.S. and Gibson N. (eds). Rosenberg Publishing Pty Ltd.

Brand Grady, Thomas Jeremy, Shade Amanda, Webb Mark, Sweedman Luke, Merritt David et al. (2013) Australian Native Plants The Kings Park Experience. Webb Mark (ed). Botanic Gardens and Parks Authority, Csiro Publishing.

Craig G. F. (2010) Fitzgerald River National Park Improvement Project Culham Inlet to Hamersley Inlet Vegetation and Flora.

Nevill Simon, McQuoid Nathan, Smith Peter G., Knowles David, Greeve Margaret, Start Joff (2008) Guide to the Wildflowers of Western Australia. Simon Neville Publications.

Olney Chris (2016) 'Inspired by nature', For People and Plants (Friends of Kings Park quarterly magazine) (95, 3-4)

Pieroni Margaret. Discovering Wildflowers of Western Australia. Quality Publishing Australia.

Scott Jane, Negus Patricia (2013) Wildflowers of Southwest Australia Augusta-Margaret River region. Cape to Cape publishing [2012].

Plant identification:

Western Australia state flora database <https://florabase.dpaw.wa.gov.au/>  
accessed frequently between 26/11/16 and 3/12/16

Boranup Drive Information:

<http://www.roamingdownunder.com/boranup-drive.php>

accessed 16/11/16

Karri forest information:

The Western Australia Department of Conservation and Land Management

<http://www.australiannationalparks.com/westernaustralia/Brockman/default.htm>

<http://www.westernaustralia-travellersguide.com/karri-tree.html>

accessed 17/11/16

Blackwood river information:

<http://www.swnmstrategy.org.au/sub-regions/blackwood-basin/lower-blackwood/landscapes-lower-blackwood/> accessed 18/11/16

Walpole tingle forest and tree top walkway information:

[https://parks.dpaw.wa.gov.au/sites/default/files/downloads/parks/votg\\_factsheet.pdf](https://parks.dpaw.wa.gov.au/sites/default/files/downloads/parks/votg_factsheet.pdf)

<http://www.gondwanalink.org/natwonders/tingle.aspx>

accessed 18/11/16

Native plants in UK information (2013)

<http://drmgoeswild.com/how-many-plant-species-are-there-in-britain/>

accessed 19/11/16

Fitzgerald National Park information brochure download from

<https://fitzgeraldcoast.com.au/fitzgerald-river-national-park/>

accessed 19/11/16

Badgingarra information:

<http://www.visitpinnaclescountry.com.au/pages/badgingarra-nature-trail-now-iain-wilson-nature-trail/>

accessed 22/11/16

Mt.Leseur national Park information brochure download from

[https://parks.dpaw.wa.gov.au/sites/default/files/downloads/parks/2006035\\_lesueur\\_np\\_brochure.pdf](https://parks.dpaw.wa.gov.au/sites/default/files/downloads/parks/2006035_lesueur_np_brochure.pdf)

accessed 24/11/16

Pinnacles information:

<http://www.visitpinnaclescountry.com.au/pages/the-pinnacles/> accessed 25/11/16

Lake Thetis strombolite information:

<http://www.visitpinnaclescountry.com.au/pages/lake-thetis-and-stromatolites/>

accessed 26/11/16

Lesmurdie Falls plant information:

<https://perthwildflowers.wordpress.com/category/lesmurdie-falls/page/2/>

accessed 26/11/16

## Appendices

### Appendix 1: Itinerary

Day 1	Wed 17 <sup>th</sup> August	Depart Cornwall & travel to London Depart for Singapore (overnight on plane)
Day 2	Thurs 18 <sup>th</sup> August	Arrive Singapore Depart Singapore
Day 3	Fri 19 <sup>th</sup> August	Arrive Perth in the early hours, stay in Perth Pick up campervan and groceries Visit Araluen Botanical Park en-route south to Mandurah
Day 4	Sat 20 <sup>th</sup> August	Visit Lake Clifton thrombolites View recently burned habitat at Preston Beach Road Explore Ambergate Nature Reserve at Busselton
Day 5	Sun 21 <sup>st</sup> August	Imposed 'rest day' (torrential rain, therefore visit Nigili Cave, viewing Tuart forest en-route ) Stay Yallingup
Day 6	Mon 22 <sup>nd</sup> August	Visit Wardan Aboriginal Centre Visit Protea cut-flower farm Stay Contos
Day 7	Tues 23 <sup>rd</sup> August	Walk Contos Banksia-Jarrah trail to Lake Cave Drive Borranup drive Stay Contos
Day 8	Wed 24 <sup>th</sup> August	Walk Karri forest trail Explore Cape Leeuwin Afternoon off to go whale watching Stay Augusta
Day 9	Thurs 25 <sup>th</sup> August	Explore Blackwood river inlet Drive east to Walpole Visit Walpole Treetop walkway Stay Peaceful Bay
Day 10	Fri 26 <sup>th</sup> August	Visit The Banksia Farm at Mount Barker Visit Nindethana WA native seed supplier at Albany Stay Betty's Beach
Day 11	Sat 27 <sup>th</sup> August	Explore Southern Kwongan habitat at Betty's Beach Drive east to Fitzgerald River National Park, view Southern Kwongan flora Stay Quallup Homestead
Day 12	Sun 28 <sup>th</sup> August	Walk Quallup Homestead trails Start the drive north, stopping at Hyden
Day 13	Mon 29 <sup>th</sup> August	Visit and explore Wave Rock Drive north and west to Badgingarra
Day 14	Tues 30 <sup>th</sup> August	Walk trail at Badgingarra National Park Visit Lake Thetis Strombolites Visit Pinnacles National Park Stay Jurien Bay
Day 15	Wed 31 <sup>st</sup> August	Drive and walk trails at Mt.Leseur National Park View Jurien Bay marine park Stay Sandy Cape
Day 16	Thursday 1 <sup>st</sup> Sept	Rest day (relax at Sandy Cape)

		Drive south to Perth
Day 17	Friday 2 <sup>nd</sup> Sept	Walk Lesmurdie Falls trail in Perth Hills Return Campervan Stay Perth
Day 18	Sat 3 <sup>rd</sup> Sept	Rest day (explore Perth city)
Day 19	Sun 4 <sup>th</sup> Sept	Rest day (visit Freemantle)
Day 20	Mon 5 <sup>th</sup> Sept	Kings Park work placement: Tour of WA botanical garden by garden staff and Senior Curator Tour of WA Botanical Garden Nursery by Nursery Curator
Day 21	Tues 6 <sup>th</sup> Sept	Kings Park work placement: Tour of Kings Park by Gardens Manager
Day 22	Wed 7 <sup>th</sup> Sept	Kings Park work placement: WA flora propagation workshop with nursery staff Seed germination and dormancy breaking techniques discussion with nursery staff
Day 23	Thurs 8 <sup>th</sup> Sept	Kings Park work placement: Decorative garden beds discussion with garden staff Join gardener led tour for public of WABG
Day 24	Fri 9 <sup>th</sup> Sept	Kings Park work placement: Working alongside gardens team
Day 25	Sat 10 <sup>th</sup> Sept	Visit John Forrest National Park Drive north to Minganew
Day 26	Sun 11 <sup>th</sup> Sept	Visit Coalseam National Park Visit Depot Hill Explore and view annual wild flowers and wreath flowers Return to Perth
Day 27	Mon 12 <sup>th</sup> Sept	Kings Park work placement: Tour of plant development department Overview of seed collection work
Day 28	Tues 13 <sup>th</sup> Sept	Kings Park work placement: Discussing Eden Project WA exhibit: general planting plans, plant diversity and numbers, viewing and discussing how WABG presents Banksia-Jarraah woodland and Kwongan habitats with Senior Curator
Day 29	Wed 14 <sup>th</sup> Sept	Kings Park work placement: Enjoy Kalunga Katitjun festival day Overview of Kings Park irrigation by Garden Curator
Day 30	Thurs 15 <sup>th</sup> Sept	Kings Park work placement: Discuss and look at products used in WA nursery trade Visit Bold Park
Day 31	Fri 16 <sup>th</sup> Sept	Deliver presentation about Eden Project to Kings Park staff Discussion on difficult to germinate WA flora with nursery staff Depart Perth for Singapore Arrive Singapore, depart for London
Day 32	Sat 17 <sup>th</sup> Sept	Arrive London Travel to Cornwall

## Appendix 2

Plants identified from photographs and/or observations at Ambergate Reserve

Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>	Grasstree
Dasygogonaceae	<i>Kingia australis</i>	Drumstick grasstree
Haemodoraceae	<i>Conostylis setigera</i>	Conostylis setigera
Proteaceae	<i>Adenanthos obovatus</i> <i>Conospermum flexuosum</i> <i>Stirlingia latifolia</i>	Basket flower Tangled smokebush Blueboy
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Acacia</i> sp. <i>Hardenbergia comptoniana</i> <i>Kennedia prostrata</i>	Wattle Native wisteria Scarlet runner
Rutaceae	<i>Boronia dichotoma</i>	none
Goodeniaceae	<i>Dampiera linearis</i>	Common dampiera

## Appendix 3

Range of Aboriginal plant uses identified whilst in WA

<i>Acacia</i> spp.	<ul style="list-style-type: none"> <li>• Young roots were eaten</li> <li>• Wood was useful for spears, digging sticks and boomerangs</li> </ul>
<i>Acacia acuminata</i>	<ul style="list-style-type: none"> <li>• Seeds are eaten raw or ground for flour</li> </ul>
<i>Acacia saligna</i>	<ul style="list-style-type: none"> <li>• Seeds are eaten raw or ground for flour</li> <li>• The bark was used as a fish poison (stupefy fish)</li> </ul>
<i>Agonis flexuosa</i>	<ul style="list-style-type: none"> <li>• Oral antiseptic</li> <li>• Vapour from leaves relieves congestion</li> </ul>
<i>Allocasuarina fraseriana</i>	<ul style="list-style-type: none"> <li>• The 'women's medicine tree'.</li> <li>• Boiled root for incontinence.</li> <li>• The wood is used for making boomerangs and bowls</li> <li>• Infusion of the bark used to treat diarrhoea</li> <li>• The roots provided a water supply</li> <li>• The gum and chewed branchlets quenched thirst drink</li> <li>• The leaf needles were used as bedding</li> </ul>
<i>Banksia grandis</i>	<ul style="list-style-type: none"> <li>• By carrying embers inside nut/pod fire could be transported and the pods kept people warm</li> <li>• Nectar in flowers can be sucked directly from the flower (one flower yielding up to one tablespoon of nectar)</li> <li>• Flowers can be soaked and fermented to make sweet, a light brew</li> </ul>
<i>Corymbia calophylla</i>	<ul style="list-style-type: none"> <li>• The medicine tree, a powder made from the antiseptic resin treated diabetes and stomach complaints</li> <li>• The liquid resin was used as a plaster</li> <li>• Cure for cycad poisoning</li> <li>• Flowers soaked and fermented to make wine</li> </ul>
<i>Dasypogon hookeri</i>	<ul style="list-style-type: none"> <li>• To treat arthritis</li> </ul>

<i>Eucalyptus gomphocephala</i>	<ul style="list-style-type: none"> <li>• Slices of the bark and timber were removed to make containers, shields or build shelters</li> </ul>
<i>Eucalyptus occidentalis</i>	<ul style="list-style-type: none"> <li>• Gum mixed with wattle flour to make cake</li> </ul>
<i>Haemodorum spicatum</i>	<ul style="list-style-type: none"> <li>• For treating blood issues and cancer</li> </ul>
<i>Macrozamia riedli</i>	<ul style="list-style-type: none"> <li>• Flour can be extracted from nuts, but it is laborious and time consuming (many weeks) to extract toxins so not used as first choice</li> <li>• Leaves were used to cover shelters</li> </ul>
<i>Melaleuca</i> spp.	<ul style="list-style-type: none"> <li>• Fresh pink bark, soaked in water, to wrap food for cooking in a fire</li> <li>• Brown bark twisted to form rope</li> <li>• Bark used to make watertight containers</li> </ul>
<i>Melaleuca raphiophylla</i>	<ul style="list-style-type: none"> <li>• Leaves and oil extract for treating colds</li> <li>• Bark used as bandage and for wrapping bodies in preparation for funeral</li> <li>• Bark used as a waterproof covering for shelters</li> <li>• Fish are wrapped with the bark and cooked under coals, when the bark is removed the fish scales peel off too</li> </ul>
<i>Nuytsia floribunda</i>	<ul style="list-style-type: none"> <li>• The tree yields a sweet gum and the hard centre of the roots is sweet to eat</li> </ul>
<i>Prasophyllum brownii</i>	<ul style="list-style-type: none"> <li>• Bush potato, the small tubers are reputedly delicious (but protected)</li> </ul>
<i>Santalum acuminatum</i>	<ul style="list-style-type: none"> <li>• Fruit (native peach) are eaten</li> <li>• Seeds eaten or crushed into flour</li> </ul>
<i>Trymalium floribundum</i>	<ul style="list-style-type: none"> <li>• Leaves are moistened and rubbed vigorously to make a soapy lather</li> </ul>
<i>Xanthorrhoea</i> spp.	<ul style="list-style-type: none"> <li>• Leaves for thatch</li> <li>• Smother a fire with leaves to make a warm bed with comfortable mattress</li> </ul>
<i>Xanthorrhoea gracilis</i>	<ul style="list-style-type: none"> <li>• Hard centre of this non-trunk forming species use as a spindle for lighting fire</li> </ul>
<i>Xanthorrhoea preissii</i>	<ul style="list-style-type: none"> <li>• Resin exudate, mixed with kangaroo dung and charcoal is used as glue for making tools (eg axes) and decorative pieces (eg hair slides)</li> <li>• Trunks used as firewood</li> <li>• Leaf bases, gum from flower stalk and centre of trunk are edible</li> <li>• Fibres from trunk for fire lighting</li> <li>• Kapok like material in centre</li> </ul>

#### Appendix 4

Prevalent weed species in WA, highlighting those originating from South Africa

Trees	Shrubs and climbers	Herbaceous
<i>Acacia longifolia</i>	<i>Coprosma repens</i>	<i>Allium triquetum</i>
<i>Acacia pycnantha</i>	<i>Polygala myrtifolia</i>	<i>Oxalis</i> spp.
<i>Acacia iteaphylla</i>	<i>Asparagus</i> spp.	<i>Agapanthus praecox</i>
<i>Eucalyptus grandis</i>	<i>Westringia fruticosa</i>	<i>Zantedeschia aethiopica</i>
<i>Eucalyptus robusta</i>	<i>Hibbertia scandens</i>	<i>Correa</i> spp.
<i>Eucalyptus saligna</i>	<i>Hedera helix</i>	<i>Gazania</i> spp.
<i>Leptospermum laevigatum</i>	<i>Argyranthemum frutescens</i> ssp.foeniculaceum	<i>Erigeron karvinskianus</i>
<i>Homalanthus novoguineensis</i>	<i>Dipogon lignosus</i>	<i>Dietes</i> spp.
<i>Pittosporum undulatum</i>	<i>Solanum linnaeanum</i>	<i>Pennisetum</i>
<i>Psoralea pinnata</i>	<i>Fumaria</i> spp.	<i>Freesia</i> spp.
	<i>Pelargonium capitatum</i>	<i>Ixia</i> spp.
	<i>Euphorbia</i> spp.	<i>Watsonia</i> spp.
		<i>Gladiolus</i> spp.
		<i>Sparaxis bulbifera</i>
		<i>Bartsia trixago</i>
		<i>Petrorhagia dubia</i>
		<i>Arctotheca</i> spp.
		<i>Senecio elegans</i>
		<i>Echium plantagineum</i>
		<i>Ferraria crispa</i>
		<i>Ehrharta</i> spp.

#### Appendix 5

Plants identified from photographs and/or observations at Betty's Beach

Dasygogonaceae	<i>Dasygogon bromeliifolius</i> <i>Kingia australis</i>	Pineapple bush Drumstick grasstree
Asparagaceae	<i>Chamaescilla corymbosa</i>	Blue squill
Haemodoraceae	<i>Conostylis</i> sp.	Cottonhead
Proteaceae	<i>Adenanthos cuneatus</i> <i>Banksia coccinea</i> <i>Banksia</i> sp. ( <i>meisneri</i> or <i>violaceae</i> ) <i>Banksia formosa</i> <i>Conospermum caeruleum</i> <i>Hakea culcullata</i> <i>Hakea elliptica</i>	Coastal jugflower Scarlet banksia Banksia Showy Dryandra Blue brother Hood leafed hakea Oval-leaf hakea
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Acacia</i> sp.	Wattle
Myrtaceae	<i>Calothamnus</i> sp. <i>Melaleuca</i> sp. <i>Taxandria marginata</i>	One-sided bottlebrush Paperbark none
Ericaceae	<i>Andersonia caerulea</i> <i>Leucopogon apiculatus</i>	Foxtails none
Apiaceae	<i>Xanthosia rotundifolia</i>	Southern cross

Solanaceae	<i>Anthocercis viscosa</i> subsp. <i>viscosa</i>	Sticky tailflower
Goodeniaceae	<i>Lechenaultia formosa</i>	Red leschenaultia

Plants identified from photographs and/or observations of roadside leaving Betty's Beach

Iridaceae	<i>Patersonia occidentalis</i>	Purple flag
Proteaceae	<i>Lambertia inermis</i>	Chittick
Loranthaceae	<i>Nuytsia floribunda</i>	Christmas tree
Rutaceae	<i>Boronia spathulata</i>	Boronia
Myrtaceae	<i>Eucalyptus</i> sp. <i>Thryptomene</i> sp.	Gum or Mallee none
Goodeniaceae	<i>Lechenaultia biloba</i>	Blue leschenaultia

#### Appendix 6

Plants identified from photographs and/or observations at Quaalup

Haemodoraceae	<i>Anigozanthos humilis</i>	Catpaw
Orchidaceae	<i>Caladenia</i> sp.	Spider orchid
Proteaceae	<i>Adenanthos cuneatus</i> <i>Banksia attenuata</i> <i>Banksia baueri</i> <i>Banksia baxteri</i> <i>Banksia coccinea</i> <i>Conospermum distichum</i> <i>Hakea corymbosa</i> <i>Hakea denticulata</i> <i>Hakea nitida</i> <i>Lambertia inermis</i> <i>Petrophile longifolia</i> <i>Petrophile ericifolia</i>	Coastal jugflower Slender banksia Woolly banksia Baxter's banksia Scarlet banksia None Cauliflower hakea None Frog hakea Chittick Long leaved cone bush None
Dilleniaceae	<i>Hibbertia mucronata</i>	Prickly hibbertia
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Davisia incrassata</i> <i>Hovea pungens</i> <i>Templetonia retusa</i>	None Devil's pins Cockies tongues
Rutaceae	<i>Boronia</i> sp. <i>Philothea nodiflora</i>	Boronia Blue waxflower
Ericaceae	<i>Leucopogon apiculatus</i>	none
Myrtaceae	<i>Actinodium cunninghamii</i> <i>Calothamnus gracilis</i> <i>Chamelaucium</i> sp. <i>Eucalyptus preissiana</i> subsp. <i>preissiana</i> <i>Melaleuca thymoides</i> <i>Regelia inops</i>	Albany daisy none Wax flower Bell fruited mallee  none none
Malvaceae	<i>Lasiopetalum</i> sp.	none
Thymelaeaceae	<i>Pimelea physodes</i>	Qualup bell

Appendix 7

Plants identified from photographs and/or observations at Badgingarra

Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>	Grasstree
Dasygogonaceae	<i>Calectasia hispida</i>	none
Hemerocallidaceae	<i>Johnsonia pubescens</i>	Pipe lily
Haemodoraceae	<i>Anigozanthos humilis</i> <i>Blancoa canescens</i> <i>Macropidia fuliginosa</i> <i>Conostylis</i> sp.	Catspaw Winter bell Black kangaroo paw Cottonhead
Orchidaceae	<i>Caladenia flava</i>	Cowslip orchid
Proteaceae	<i>Banksia candolleana</i> <i>Banksia carlinoides</i> <i>Banksia sessilis</i> <i>Conospermum boreale</i> <i>Hakea flabellifolia</i> <i>Hakea obliqua</i> <i>Petrophile shuttleworthiana</i> <i>Stirlingia latifolia</i>	Propeller banksia Pink dryandra Parrot bush none Fan leafed hakea Needles and corks none Blueboy
Gyrostemonaceae	<i>Tersonia cyathiflora</i>	Button creeper
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Hovea pungens</i>	Devil's pins
Eleocarpaceae	<i>Tetralochea</i> sp.	none
Celastraceae	<i>Tripterococcus brunonis</i>	Winged stackhousia
Myrtaceae	<i>Calothamnus torulosus</i> <i>Chamelaucium uncinatum</i> <i>Darwinia speciosa</i> <i>Melaleuca</i> sp. <i>Verticordia grandis</i>	none Geraldton wax none paperbark Scarlet featherflower
Malvaceae	<i>Guichenotia</i>	None
Ericaceae	<i>Conostephium pendulum</i>	Pearl flower
Lamiaceae	<i>Hemiphora</i> sp.	none
Goodeniaceae	<i>Lechenaultia biloba</i>	Blue Leschenaultia
Stylidiaceae	<i>Stylidium</i> sp.	Trigger plant

Appendix 8

Plants identified from photographs and/or observations at Mt. Lesueur National Park

Zamiaceae	<i>Macrozamia fraseri</i>	Cycad
Asparagaceae	<i>Sowerbaea laxiflora</i> <i>Thysanotus manglesianus</i>	Purple tassels Fringed lily
Hemerocallidaceae	<i>Johnsonia pubescens</i>	Pipe lily
Colchicaceae	<i>Burchardia congesta</i>	none
Haemodoraceae	<i>Anigozanthos manglesii</i>	Mangle's kangaroo paw
Orchidaceae	<i>Caladenia flava</i> <i>Caladenia</i> sp.	Cowslip orchid Spider orchid
Proteaceae	<i>Banksia menziesii</i> <i>Conospermum</i> sp. <i>Grevillea eriostachya</i> <i>Grevillea leucopteris</i> <i>Hakea conchifolia</i> <i>Hakea undulata</i>	Firewood banksia Smokebush Flame grevillea White plume grevillea Shell-leafed hakea Wavy-leafed hakea

	<i>Hakea neurophylla</i> <i>Isopogon</i> sp. <i>Petrophile brevifolia</i>	none none none
Dilleniaceae	<i>Hibbertia</i> sp.	none
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Gastrolobium</i> sp.	none
Rutaceae	<i>Boronia ramosa</i> <i>Diplolaena</i> sp. <i>Philotheca spicata</i>	Boronia none Pepper and salt
Celastraceae	<i>Stackhousia monogyna</i> <i>Tripterococcus brunonis</i>	None Winged stackhousia
Myrtaceae	<i>Calothamnus</i> sp. <i>Calytrix</i> sp. <i>Darwinia</i> sp. <i>Darwinia sanguinea</i> <i>Melaleuca</i> sp.	One sided bottlebrush none none none Paperbark
Malvaceae	<i>Guichenotia</i> <i>Lasiopetalum drummondii</i>	none none
Thymelaeaceae	<i>Pimelea suaveolens</i>	Scented banjine
Ericaceae	<i>Astroloma glaucescens</i> <i>Astroloma xerophyllum</i>	none none
Violaceae	<i>Hybanthus calycinus</i>	Wild violet
Goodeniaceae	<i>Lechenaultia biloba</i>	Blue lechenaultia
Stylidiaceae	<i>Stylidium</i> spp.	Trigger plant

#### Appendix 9

Plants identified from photographs and/or observations at Lesmurdie Falls

Asparagaceae	<i>Chamaescilla corymbosa</i>	Blue squill
Hemerocallidaceae	<i>Styandra glauca</i>	Blind grass
Iridaceae	<i>Orthrosanthus laxus</i>	Morning iris
Proteaceae	<i>Banksia dallanneyi</i> <i>Grevillea bipinnatifida</i> <i>Hakea trifurcata</i> <i>Petrophile biloba</i>	Couch honeypot Fuchsia grevillea Two-leafed hakea Granite petrophile
Dilleniaceae	<i>Hibbertia</i> sp.	none
Droseraceae	<i>Drosera</i> sp.	Sundew
Fabaceae	<i>Acacia</i> sp. <i>Daviesia horrida</i> <i>Hovea pungens</i> <i>Kennedia prostrata</i>	Wattle Prickly bitter-pea Devil's pins Scarlet runner
Phyllanthaceae	<i>Phyllanthus calycinus</i>	False boronia
Sapindaceae	<i>Diplopeltis huegelii</i>	none
Myrtaceae	<i>Calothamnus</i> sp <i>Calytrix glutinosa</i> <i>Darwinia citriodora</i> <i>Hypocalymma angustifolium</i>	One sided bottlebrush none Lemon-scented darwinia White myrtle
Malvaceae	<i>Lasiopetalum glutinosum</i>	none
Ericaceae	<i>Astroloma foliosum</i>	Candle cranberry

## Appendix 10

## Plants identified from photographs and/or observations in Coalseam Park

Asparagaceae	<i>Dichopogon</i> sp.	Chocolate lily
Dioscoreaceae	<i>Dioscorea hastifolia</i>	Warrine
Loranthaceae	<i>Amyema</i> sp.	Mistletoe
Chenopodiaceae	<i>Chenopodium</i> sp.	none
Fabaceae	<i>Acacia tetragonophylla</i> <i>Acacia</i> sp. <i>Bossiaea</i> sp. <i>Senna</i> sp.	Kurara Wattle None none
Myrtaceae	<i>Eucalyptus camaldulensis</i> <i>Melaleuca</i> sp.	River gum Paperback
Malvaceae	<i>Seringia</i> sp.	Fire bush
Boraginaceae	<i>Halgania</i> sp.	none
Solanaceae	<i>Solanum</i> sp.	none
Scrophulariaceae	<i>Eremophila</i> sp.	none
Goodeniaceae	<i>Goodenia</i> sp.	none
Asteraceae	<i>Bellida graminea</i> <i>Brachyscome</i> sp. <i>Cephalopterum drummondii</i> <i>Chthonocephalus</i> sp. <i>Lawrencella davenportii</i> <i>Podolepis</i> sp. <i>Podotheca gnapalioides</i> <i>Schoenia filifolia</i> <i>Waitzia acuminata</i>	Rosy bellida None Pompom head None Sticky everlasting None Golden long-heads Schoenia Orange immortelle

## Plants identified from photographs and/or observations at Depot Hill

Asparagaceae	<i>Thysanotus</i> sp.	none
Iridaceae	<i>Orthrosanthus</i> sp.	Iris
Haemodoraceae	<i>Anigozanthos humilis</i>	Catspaw
Orchidaceae	<i>Caladenia flava</i>	Cowslip
Proteaceae	<i>Grevillea eriostachya</i>	Flame grevillea
Portulacaceae	<i>Calandrinia</i> sp.	Purslane
Fabaceae	<i>Isotropis</i> sp.	none
Myrtaceae	<i>Scholtzia</i> sp.	none
Asteraceae	<i>Brachyscome</i> sp. <i>Podotheca gnapalioides</i> <i>Rhodanthe manglesii</i> <i>Waitzia acuminata</i> <i>Waitzia suaveolens</i>	none Golden long-heads None Orange immortelle Fragrant waitzia

Annual wild flowers identified from photographs and/or observations en-route  
Morewa to Perenjori

Goodeniaceae	<i>Brunonia australis</i> <i>Goodenia</i> sp. <i>Velleia rosea</i>	Native cornflower none Pink velleia
Asteraceae	<i>Brachyscome</i> <i>Cephalopterum drummondii</i> <i>Lawrencella</i> sp. <i>Myriocephalus</i> sp. <i>Podolepis aristata</i> <i>Rhodanthe chlorocephala</i>	None Pompom head none none none eveerlasting

Plants identified from photographs and/or observations on dry roadside from  
Perenjori to Mount Gibson

Haloragaceae	<i>Glischrocaryon</i> sp.	none
Fabaceae	<i>Acacia</i> sp.	Wattle
Malvaceae	<i>Androcalva</i> sp.	none
Lamiaceae	<i>Cyanostegia angustifolia</i> <i>Dasymalla terminalis</i> <i>Lachnostachys verbascifolia</i>	Tinsel-flower Native foxglove Lamb's tails
Scrophulariaceae	<i>Eremophila</i> sp. (blue flowering) <i>Eremophila</i> sp. (pink flowering)	None none
Goodeniaceae	<i>Dampiera</i> sp. <i>Lechenaultia macrantha</i>	None Wreath flower
Stylidiaceae	<i>Stylidium</i> sp.	Trigger plant



Sunset at Bold Park; the park attracts over eighty species of bird