The Kwongan Foundation for the Conservation of Australian Native Biodiversity  
School of Plant Biology  
University of Western Australia, Crawley WA 6009

[Website Link]

Vision

The patrons of the Kwongan Foundation look forward to a time when Western Australians are proudly committed to the management and conservation of the State’s unique native biodiversity.

Objectives

1. provide resources for research and study at UWA;  
2. implement the gathering and sharing of knowledge;  
3. enable long-term planning;  
4. attract world-class researchers;  
5. achieve tangible improvements in the long-term conservation prospects of endangered species and associations.

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The Kwongan Foundation is a not-for-profit foundation within the University of Western Australia’s Hackett Foundation, a Deductible Gift Recipient organisation ABN:37 882 817 280)

Cover Photo: Banksia baxteri with Mt Bland in the background, taken by PhD student Graham Zemunik. Graham has a PhD scholarship from the Kwongan Foundation
Western Australians should be proud of their Global Biodiversity Hotspot, the only one in Australia and one of only 34 worldwide. In an area the size of England, 8,000 native plants species coexist. The plant diversity is greatest on WA's sandplains, which are the most nutrient-impoverished in the world. In a future Kwongan Matters, I will write about the many intriguing adaptations that some of these native plants have, to allow them to grow on these extremely poor soils. They are not only fascinating by themselves, but they can also show us some strategies for extracting phosphorus, for example, to breed into future crop plants that will grow in a world that is steadily running out of phosphorus, a vitally important nutrient for life on Earth.

As Steve Hopper explained in his contribution to our Inaugural Kwongan Matters: “Kwongan is a Noongar Aboriginal term defined as a ‘type of country ...[that is] sandy and is open without timber-sized trees but with a scrubby vegetation.” Since kwongan is where the greatest biodiversity is found in WA, we have established the Kwongan Foundation for the conservation of Australia’s biodiversity to:

- achieve tangible improvements in the long-term conservation prospects of endangered plants and ecosystems.
- provide resources for research and study at UWA
- implement the gathering and sharing of knowledge
- enable long-term planning
- attract world-class researchers

There is still so much to learn, as can be discovered in both the very first and this second newsletter, Kwongan Matters. Unlike large parts of Europe and North America, which were covered by glaciers only ten thousand years ago, South-Western Australia is one of those rare regions on Earth that has been climatically buffered for many millions of years. When landscapes elsewhere in the world were continually rejuvenated through volcanic activity, glaciations, landslides, or deposition of dust imported from hundreds of kilometres away, our soils continued to weather and lose most of the nutrients they contained when they were much younger. Evolution has continued relatively undisturbed for many millions of years. Very few places on our planet are like the kwongan in South-Western Australia. The
closest to it is the fynbos in South Africa and the campos rupestres in Brazil. We have started to explore pivotal similarities as well as subtle differences between the plants in these three regions.

There are many threats to our unique endemic flora, *Phytophthora cinnamomi* (Phytophthora dieback) being the greatest of all. Others include land clearing, invasive species (harmful microorganisms, plants and animals), salinity and climate change. Looking after our natural heritage now means looking after our own future and that of our children. This requires sound knowledge of Australia’s only global biodiversity hotspot and making sure that knowledge reaches those who care and those who make decisions. That is why we need the Kwongan Foundation, which we established in 2006.

To get the message out, we had our first Kwongan Colloquium and Kwongan Field Trip in 2006, and this has become an annual event. We also organise an annual Kwongan Workshop “On the ecology of WA’s arid zone” (since 2010). Whilst our Kwongan Colloquia target a broad audience, including practitioners, scientists, teachers or those enjoying our natural environment, our Kwongan Workshops provide much-needed information for those working in the North. Right now, we are working on a book with a focus on kwongan: “Plant Life on the Sandplains in South-West Australia, a Global Biodiversity Hotspot”.

Kwongan Matters aims to ensure that far more people will become proudly committed to what our only Global Biodiversity Hotspot in Australia has to offer and ensure that our natural heritage will be conserved.

Like the first one, this Kwongan Matters has stories, based on careful research, often involving students. Knowledge of our unique system is essential, if we are to manage our biodiversity. It is also vitally important if we wish to explore what valuable chemicals exist in our flora that might provide the cure for many diseases. We also need solid background information to make progress with mining operations without destroying our natural heritage. That is why the Kwongan Foundation sponsors research with a focus on our native biodiversity.

Hans Lambers  
Founder and Patron of the Kwongan Foundation

![Grevillea candelabroides](image)
As Steve Hopper wrote in Kwongan Matters No 1 and figured in his 2004 paper: “Kwongan is extensive, occupying about a quarter of the Southwest Australian Floristic Region, and contains 70% of the 8000+ native plant species known from this global biodiversity hotspot (Beard and Pate 1984; Hopper and Gioia 2004). Half of these species are found nowhere else on Earth. This makes Kwongan vegetation one of the most significant natural heritage assets in a temperate climatic region, deserving the increasing national and international attention it so richly merits.

Kwongan contains an array of plants, animals, micro-organisms and life histories that are both poorly studied and exceptionally diverse, affording opportunities for novel biological discovery (Pate and Beard 1984). Kwongan also offers profound insights into evolution at its most prolonged and sophisticated, on old, climatically-buffered infertile landscapes that are rare on Earth today (Hopper 2009)."


Diagram from:


So just why is there so much biodiversity in such a dry climate with such impoverished soils when it is usually expected just in rainforests? We are searching for the answers.
FOCUS

Graham Zemunik, The University of Western Australia PhD student supported by the Kwongan Foundation.

Thesis title: *The diversity and change of plant nutrient acquisition strategies and communities in infertile landscapes.*

Graham, a Western Australian, has done much field work in the Jurien and Green Head areas as well as experimental work in the glasshouses at UWA. Graham is now in Brazil doing a companion project in the Cerrado to the one on the Swan Coastal Plain. These plant communities grow in an area with white sand, which is very poor nutritionally by world standards. These plants are supposed to, and Graham now thinks indeed have, an interesting mix of nutrient obtaining strategies that typify what happens to plant communities when soils get very poor. Another piece in the puzzle!
The cover photograph, and the following are some of Graham’s photos taken in the field.

Banksia candolleana

Banksia repens

Banksia prionotes

Isopogon trilobus
Banksia leptophylla var. mellitica

Dwarf Banksia attenuata

Banksia splendidia
Banksia pulchella, teasel Banksia

Dryandra cuneata

Dryandra cirsioides flower with native bee.
Conservation of Kwongan

Greg Keighery

Department of Environment and Conservation, Western Australian Conservation Science Centre, Kensington, WA 6151

Kwongan is the iconic endemic vegetation of south-Western Australia. It is defined as shrubby vegetation (open without substantial trees) on sand-plain. Occurrences are found throughout southern Western Australia (SWWA) extending north to the edge of the desert at Shark Bay, east to around Menzies north of Kalgoorlie and south-east to the sand dunes on the margins of the Nullarbor at Toolina Cove. See map at end of article.

Beard (1984) estimated that kwongan once covered 118,260 km² (27.1% of SWWA), of which only 0.1% was hill thickets not on sand). If Banksia woodlands (which are essentially a low woodland over kwongan) are added (another 6841 km²) then sand-plain vegetation comprised 28.6% of SWWA. Beard (1984) estimated that almost half of this vegetation had been alienated by 1980.

This brief note will highlight some successes and challenges to ensure a CAR (Comprehensive, Adequate and Representative) reserve network for this quintessential Western Australian vegetation.

Current Reservation Status of Kwongan Vegetation

As mapped throughout its range by John Beard (summarised in Beard, 1984), kwongan vegetation includes Scrub Heath with Low Trees, Thicket, Mallee-Heath, Scrub Heath and Heath. Interestingly Hill Thickets, such as Wongan Hills and the Barrens, are not on sand and strictly do not fit the strict definition of kwongan, but are structurally similar and cover 0.1% of the area occupied by kwongan.

The only complete current data set of kwongan vegetation are the series of maps compiled at 1:250,000 scale by John Beard for the entire SWWA, and published as a series of maps and memoirs from 1969 to 1980.

Analysis of the adequacy of conservation of kwongan is very scale dependent. Considering the hierarchy established by John Beard, at the South West Botanical Province scale, about 51% remains so the general level of conservation is adequate. At the Biogeographic region less so. Over 90% of the Avon-Wheatbelt is cleared so conservation of any major vegetation type including kwongan here will not be adequate. Beard also combined his Vegetation Types into Vegetation Systems. Systems are based on a particular series of plant communities recurring in a catenary sequence or mosaic linked to topographic, soil and/or geological features, ie. a range of hills or a large aeolian sand sheet. Examples are given below where, even at this very broad scale, there are major deficiencies in reservation status. Finally, at the large scale (1:250,000) of mapping undertaken by Beard, the major vegetation types making up kwongan are neither uniformly distributed, nor are they uniformly reserved, as we will also see below.
1. **Scrub Heath with Low Trees**
   Composed of two types
   1.1 **Coastal Scrub Heath with Low Trees.** Between Dongara and Green Head the coastal shrublands are dominated by *Acacia* species, *Melaleuca systena*, and *Dryandra sessilis* which has emergent Illyarrie (*Eucalyptus erythrocorys*) on limestone ridges. This type is well conserved in Mount Leseuer, Beekeepers and Lake Indoon Reserves.

   1.2. **Tree Heath** is only found south of Shark Bay, where this unique vegetation type has emergent trees of *Banksia ashbyi*/*Grevillea gordoniana* over mixed tall shrubs. Containing some 28 local endemics, this type is almost entirely present on pastoral and proposed conservation reserves.

2. **Thicket vegetation** is a shrubland of 2 layers, with the upper dense and lower open. It is highly heterogeneous group of structurally similar vegetation, that comprises almost half of the mapped kwongan occurrences.

   2.1 **Previously very common,** *Melaleuca/Acacia/Allocasuarina* species, dominated in the Avon-Wheatbelt. Normally found on yellow, sand plain, this system has been cleared and is now only found in small remnants. Variation across this huge area is poorly understood but the few studies undertaken (Brown, 1989) show considerable floristic variation.

   There are major gaps apparent in the reservation of thicket vegetation. Two examples can illustrate this; the Perenjori System and the nearby Marchagee System which are both large aeolian sand sheets. They contain a range of local endemics, eg: *Adenanthos stictus* and are now over 90% cleared, being present in several small nature reserves only; Marchagee, Buntine and Matinjini. There are many other examples in the Avon-Wheatbelt.

   2.2 **Hill thickets** are better documented. It would appear even at the large scale mapping by Beard that most hill ranges...
have unique kwongan and are separated as Vegetation Systems. Detailed floristic sampling of a series of these ranges has confirmed and strengthened this impression.

However, even at the scale of Systems, many hill thickets are poorly represented in the reserve network. For example the Northampton System comprising the Morsbey Ranges and the Hutt System comprising the Yallabatharra Hills north of Geraldton. Both are covered by *Melaleuca/Hakea* or *Allocasurina campestris* thicket, but are floristically very different and both contain numerous localised endemics. The Northampton system is now present in 8 nature reserves, the Hutt in none (Keighery, 2012). Many other Hill Systems are similar, ie: ranges near Three Springs (Inering and Mullingarra) are completely unreserved. Banded Ironstone thickets of the Wheatbelt and Interzone (Koolanooka, Bungalin, Parker and Bremer Ranges) are very well documented but are subject to major land use conflicts. The Wongan Hills are, in contrast, well reserved. Along the south coast the Stirling Range, Barrens, Russell Range thicket vegetation (these perhaps fit better in Scrub Heath) and the Ravensthorpe Ranges are mostly entirely in large reserves but are devastatingly affected by *Phytophthora* dieback disease.

3. **Mallee Heath**

Almost entirely confined to the Esperance Sand-Plains (16,577 km² of 17,341), this highly variable type of kwongan is present in many large national Parks (Fitzgerald River, Stirling Ranges, Cape Arid) and nature reserves (Lake Magenta and Nuytsland). The Reservation status of this type is probably adequate and representative, but because of its inherent variability may not be comprehensive.

*Ricinocarpos psilocladus* (Euphorbiaceae), a highly localised member of the Northampton Hill Thickets, with a disjunct population on the summit of Mt Lesueur.
4. Scrub Heath

Again a two layer vegetation with the upper layer open and the lower closed. Mostly found on the northern sand-plains (22,356 km² of the total 36,937), nearly 60% has been alienated and largely cleared. There is, however, a very significant portion in the SW Interzone, east of the clearing line, that remains largely intact.

Preliminary analysis using Beard’s vegetation systems illustrates that Scrub Heath is often poorly conserved. As one example, on the northern sand-plains the Greenough System of coastal of *Acacia* species is poorly conserved but present in some large areas of Unallocated Crown Land, which could be added to the reserve network. The Yuna System, a series of heaths found on sand-dunes on Permian hilltops, *Banksia* tall shrubland on sand ridges with heath between, is found in a series of small reserves (East Yuna, Indarra Springs, Bindoo Hill), but none of these encompass the total variation of these plant communities. The Tathra system which is a heterogeneous assemblage of scrub heath on deep yellow sands (Burma Road Reserve) and low heath, with emergent *Xanthorrhoea* (Lesueur, Coomalloor Tathra National Parks), could be said to be adequately reserved. However given the known variability of these vegetation types (Griffin and
Conservation of Kwongan

Hopkins, 1990) and their considerable species richness and local endemism (Griffin et al., 1990) the reserves could hardly be classified as comprehensive or representative.

5. Heath
Mostly on the Swan Coastal Plain and Jarrah Forest (1,568 km² of 2,554), about 60% remains. It is comprised of single layer of shrubs and includes coastal heaths, limestone heaths, lateritic heaths and winter wet flats east of Esperance. Very well understood and documented and many remnants are either in actual or proposed reserves, but there remain major land use conflicts.

Research Issues with Kwongan Conservation

Obtaining an adequate reserve network for kwongan vegetation west of the clearing line for agriculture.

While numerous unique types of kwongan occur outside this area, they currently reside in an uncleared landscape. Here planning for a reasonable conservation network to conserve Kwongan Types can be established based on geology, geomorphology and the broad scale vegetation mapping established by Beard and as undertaken by Shepherd et al., (2002).
Within the south-west however, most reserves are small and contain a variety of plant communities. Using Beard’s maps (Shepherd et al., 2002) to assess conservation status of his Kwongan Types is prone to many errors due to scale, i.e., considering vegetation remnants or small reserves as one vegetation type when normally they contain several. Nearly all of Beard’s vegetation types are heterogeneous at smaller scales and numerous unique types are not covered in mapping at this scale.

For example, on the Swan Coastal Plain the Gingin and Ironstone Communities, which contain 11 highly localised endemics identified by Gibson et al., (1995) were not recorded by Beard. Similarly in the Ravensthorpe Ranges Beard (1973) mapped this 10,200 ha area as a unique system with 6 vegetation types, versus a current 1:10,000 scale map with 70, and containing 52 narrow endemics (Craig et al., 2008). This means that any analysis of reservation adequacy based on large scale maps contains serious flaws.

Understanding the variation of floristics of kwongan within the area west of the clearing line is crucial to the conservation of these vegetation types and their component species.

Management Issues with Kwongan Conservation

1. Dieback: The most serious issue facing kwongan vegetation in susceptible areas. This threat is the reason behind the nomination of kwongan vegetation of the Esperance Sand-plains as a nationally threatened community (www.environment.gov.au/biodiversity/threatened/comunities.html).

2. Maintaining Diversity: SW Western Australian vegetation in general is very species diverse, at the quadrat, vegetation and reserve scale. Large conservation reserves contain over 1,000 species (Kalbarri>1100, Mount Lesueur >1100, Stirling Ranges > 1500, Fitzgerald River >1700

Conservation of Kwongan Heath at Harrismith (SE of Narrogin). Highly floriferous, single layered shrubland. Close up is of Logania tortuosa.
and Cape Arid>1300) with numerous local endemics. Even those smaller reserves scattered through the Wheatbelt and Swan Coastal Plain which contain only portions of Vegetation Communities, contain many hundreds of species, eg: Quairading Shire Reserve > 500 species (Keighery et al., 2001). Maintaining this diversity of species with numerous life history strategies, within a fragmented landscape of often conflicting usages will be challenging.

**Discussion**

Somewhat surprisingly, despite a large effort on the conservation of individual rare species of kwongan plants and listing of highly restricted types such as the Busselton Ironstones as Threatened Ecological Communities, there has been no general overview of the conservation of kwongan vegetation since Hopper and Muir (1984). Currently a major review would be timely as our capacity to analyse vegetation on floristics and at much more detailed scales is now possible.

Apart from containing over 5,600 of mostly endemic plant species, kwongan itself is the iconic vegetation of South-Western Australia. We need to document and understand the patterns of variation, and then plan to protect the common and rare types of kwongan vegetation. Even at the scale of Beards vegetation systems, there are apparently major gaps in the reservation of kwongan, and this could be the level to commence a major review of the adequacy of conservation of the “common” types of kwongan.

**References**


Conservation of Kwongan


*Banksia Prionotes/Xylomelum angustifolium* on deep yellow sands in Quairading Shire Natural Reserve. Now a rare community with the very rare *Banksia cuneata* (being photographed).
Conservation of Kwongan


This map shows the places mentioned in Greg Keighery's paper and some key locations. My thanks to James Parker for compiling it for us. Ed.

The following paper shows how money and the will to conserve can have great results. Ed.
Barrow Island is Western Australia’s second largest offshore island. Just 50 km from the mainland, separated from the mainland for 8,000 years, uninhabited by indigenous people and un-colonised by Europeans, Barrow Island’s flora and fauna have been remarkably unaffected by human disturbances. Surveys of its bird and mammal life in the early 1900s led to the designation of the island as an A Class Nature Reserve. It is also Australia’s oldest and largest onshore oilfield which has been operating since 1967. As a result of a stringent quarantine and pest management program, the island is rodent pest free and relatively free from weed invasions.

Discovery of large gas deposits in the northwest shelf prompted Chevron Australia and its Joint Venture Participants to make an application to construct a plant to liquefy natural gas on the island. Chevron and its Joint Venture Participants implemented formal environmental impact assessments in order to better understand the flora and fauna of the island and the potential impacts of the development on the island. Pest introduction and quarantine control were raised as major issues for the environmental approval process, with invasive invertebrates (e.g. ants and spiders) being flagged as of particular concern. Such organisms, if introduced, have the potential to drastically alter the ecology of the island. However, to assess whether non-indigenous invertebrate species are already present on the island, it was first necessary to characterise the relatively undocumented terrestrial invertebrate fauna of the island.
In 2005, a pilot study of terrestrial invertebrates was commissioned by Chevron and awarded to Professor Jonathan Majer at Curtin University. The pilot study quickly revealed that an intensive baseline survey was needed, as many of the specimens collected could not be matched to known Australian species. A large number of national and international invertebrate taxonomists were then approached and willingly assisted the Curtin team. They provided identifications and information on whether any species were non-indigenous, resulting in a snapshot of Australia largely unaffected by invasive species.

As the environmental impact assessments progressed, a further study was commissioned by Chevron to find any established human-introduced species of invertebrate. Many species of invertebrate pests live in close association with human habitation (synanthropic pest species). Common, well known associates are the American cockroach, *Periplaneta americana* and the grey silverfish, *Ctenolepisma longicaudata*. These animals are cosmopolitan and are rarely found in native bush; they are usually dependent on the water and food sources we provide in our homes and offices.

By the end of 2008, the baseline studies revealed about 1850 species of terrestrial invertebrates with only a handful of species being introduced (29 species), mostly designated as synanthropic, cosmopolitan species. Statistical estimates based on species accumulation curves indicated that the total count of terrestrial invertebrates on the island is around 2,500. The intensity, length and taxonomic coverage of these surveys means that this is probably the most thorough study of terrestrial invertebrates ever carried out in Australia. However, only a small percentage of species (15%) had published scientific names and the rest were given reference numbers for future description. Specimens of each species are stored in reference collections around the country and with duplicates at Curtin University. A photographic record of each species is also available online (http://www.padil.gov.au/barrow-island/). No other area of Australia has as comprehensive a photographic record of its invertebrate species assemblages.

A friendly individual of the species *Vasilissa walkeri* Kirby. This large phasmid or stick insect is commonly found amongst the spinifex on Barrow Island and can often grow to great lengths like this female.

In 2009, ministerial approval was granted to develop the Chevron-operated Gorgon Project on Barrow Island based on a number of environmental conditions. One of the conditions of the approval was that all
activities associated with the Gorgon construction could not introduce any non-indigenous species of plant or animal to the island, including invertebrates. Chevron could not have agreed to these conditions had they not already had existing baseline knowledge of the indigenous species of the island.

With the baseline knowledge of invertebrates and an assessment of quarantine risk by an external Quarantine Expert Panel, Chevron, Curtin University and statisticians at Queensland University of Technology devised a comprehensive program to carry out a regular surveillance of the island. This is part of a two-tiered quarantine program to ensure that if a non-indigenous species is not intercepted during the supply chain, the detection program will pick it up during routine surveillance and that it can be eradicated before establishment proceeds.

The completed baseline survey and the first two years of surveillance have increased the number of indigenous species to more than 2,200 species. It is a well-established outcome that with increased sampling, further invertebrate species are usually discovered within the same survey area. This is often due to the fact that all animals do not have an equal chance of being collected with each survey. Variable conditions of the habitat such as water and food resources can increase or decrease the potential for a particular individual to be collected. There also appears to be a constant interchange of flying and wind-blown invertebrates between the island and the mainland. Hence, in any one collection period the chance of coming across a particular species is highly variable. Each new species collected is assessed by an external taxonomists or specialist and determined to be native depending on their dispersal abilities.
and the general knowledge available regarding their species group.

Results from a recent paper by the Curtin group, in the Australian Journal of Entomology, regarding the baseline surveys has shown that the highly seasonal environment of Barrow Island is a large factor in determining the assemblage of invertebrates collected at any one time. The low rainfall that occurred in the 2009 and 2010 summer seasons most likely reduced the chance of any non-indigenous species to establish. Even the most common Barrow Island natives, such as the Centralian Meat Ant *Iridomyrmex viridiaeneus*, were found in reduced numbers. The island ecosystem follows the typical boom and bust cycle of the northwest where summer cyclones and heavy convectional storms cause an explosion of life that is quickly withered away once the rains have passed. Last year’s cyclone season (December to March) provided more than 350 mm of rain for the island. This was reflected in the abundance of life that erupted on the island. As construction continues, the risk of introduction of a non-indigenous species may rise during the wet season as there are more resources available to a non-indigenous species unadapted to the island’s other extreme of dry hot weather.

Thus, each year the quarantine procedures will be tested by these variable conditions and the surveillance programs will endeavour to safeguard the precious ecosystems on the island. Chevron Australia’s activities on Barrow Island continue to demonstrate an example of how industrial custodians, armed with the correct information and processes, can be as effective as conservationists. Continued monitoring and self-assessment will provide the world with an example of how stringent quarantine and surveillance can protect a national treasure like Barrow Island.

**Further reading**


A camaeanid snail *Quistrachia barrowensis* Solem is an endemic to Barrow Island. This snail can grow to about 3cm and usually ventures out of the spinifex after rains or at dewpoint in the early morning.
UPCOMING EVENTS FOR THE KWONGAN FOUNDATION

Watch out for the upcoming Kwongan Foundation events in 2013

The Kwongan Workshop on the ecology of WA’s arid zone: 09/07/2013

The Kwongan Colloquium: 07/09/2013

The Kwongan Fieldtrip: 08/09/2013

Anyone with ideas or suggestions as to topics, please contact:
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EDITORIAL

Greetings. I hope you enjoy Kwongan Matters 2 and that it conveys some of the enthusiasm we all feel for this unique, irreplaceable and world significant flora as well as some solid information.

I have spent several weeks this year following wild flowers in Western Australia and after several years in UK and a trip to Lake Eyre, I can only say that our WA flora is fabulous and I just hope there will be thousands of flowers for the future in reserves, along all our roadsides, on properties and in every back yard, garden and patio.

Getting our special locals into cultivation is not always easy but dedicated groups are making progress year by year. It would be great if there was a great deal more financial support for research and development in this area.

Offers of articles for the April 2013 issue of Kwongan Matters are requested.

I already have 2 offers with 5 possibles in the pipeline. The following issue will be September, 2013. Please contact me at: suepr22@yahoo.com or Hans as above, if you would like to submit an article, small item or photos.

All the best, Sue Radford [editor].

Macrotristria extrema (Distant) is a large charismatic cicada that is widespread on Barrow Island and the northwest of WA.
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