Kwongan Matters

Inaugural Newsletter of the Kwongan Foundation
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

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

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Cover Photo: Royal Hakea (Hakea victoria) in kwongan near West Mt Barren, Fitzgerald River National Park, taken by PhD student Graham Zemunik. Graham has a PhD scholarship from the Kwongan Foundation.
Conservation of Australian Native Biodiversity

Anyone with a keen interest in Australia’s biodiversity, whether practitioner, scientist or someone enjoying our natural environment, will be proudly committed to what Australia’s only Global Biodiversity Hotspot has to offer. There is still so much to learn, as can be discovered in this very first newsletter, Kwongan Matters. There are so many threats, Phytophthora cinnamomi (Phytophthora dieback) being the greatest of all. Other threats include land clearing, invasive species and climate change. There is so much we can gain from our biodiversity hotspot, including chemicals as a cure for serious diseases, fresh water for use in our households, and germplasm for a more sustainable agricultural industry, to name just a few. Looking after our natural heritage now means looking after our own future and that of our children.

After having established the Kwongan Foundation in 2006, when we also had our very first Kwongan Colloquium and Kwongan Field Trip, it was decided to lift our game. We will continue to organise these annual events and we also started our annual Kwongan Workshop “On the ecology of WA’s arid zone” (since 2010). This newsletter aims to ensure that far more people will become proudly committed to what our only Global Biodiversity Hotspots has to offer and ensure that our natural heritage will be conserved.

This first Kwongan Matters is full of stories, based on careful research, often involving students. That research is essential, if we are to manage our biodiversity. It is also vitally important if we wish to make progress with mining operations whilst safeguarding 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
Kwongan and why it matters

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Kwongan is a Bibbelmun (Noongar) Aboriginal term of wide geographical use defined by Beard (1976) as a ‘type of country ...[that is] sandy and is open without timber-sized trees but with a scrubby vegetation. It consists of plains in an Australian sense of open country rather than in a strict sense of flat country. ... there are two principal plant formations in the kwongan, scrub heath and broombush thicket ... both ... are sclerophyll shrublands and possess a certain unity when contrasted with woodland and forest or steppe and succulent steppe communities.’ Kwongan today has replaced other terms applied by European botanists such as sand-heide (Diels 1906) or sand heath (Gardner 1942), rightly in my view giving priority to the language of people who have lived continuously in the southwest for more than 50,000 years.

Thus, kwongan has come again into common usage for the Southwest Australian Floristic Region’s shrubland vegetation and associated countryside, equivalent to South Africa’s fynbos, California’s chaparral, France’s maquis and Chile’s matorral as seen in these other regions of the world experiencing a Mediterranean climate.

To reflect contemporary orthographies, linguists strictly spell kwongan as ‘kwongkan’ (Douglas 1976, Dench 1994), or ‘quarngq-qaan’ (von Brandenstein 1988). As with so many other aspects of the southwest flora, colonial botanist James Drummond was the first to record Bibbelmun usage of the term in an 1839 letter to Kew’s Director Sir William Hooker, where ‘guangan’ was described as the Noongar name for ‘sand, but I mean by it the open sandy desert which commences 80 miles E.N.E. of Fremantle and is known to continue in the same direction for 200 miles ... Fresh water is scarce ... even in our rainy season. It is undulating country, the hills generally small and low, the soil on them is strong clay ... the valleys between these hills are generally extensive and sandy, covered thinly with small shrubs.’ (Drummond 1839). An 1839 map of Toodyay Valley Land Grants and Locations has on it the term ‘Guangan’ two miles east of Bejoording townsite, south of Bolgart (reprinted in Erickson 1969: 32). Another collector Ludwig Preiss spelt the term as ‘quangen’ (Beard 1976). Moore (1842) gave the spelling ‘gongan’ for ‘a sandy downs, covered with low shrubs or bushes’, and Brooke (1896) spelt as the local Aboriginal
The town of Wongan Hills derives its name from *kwongan*. Drummond (3rd October 1842, republished in Erickson (1969: 165) and in Hercock et al. 2011:313) reported the native name of *Guangan Catta*, which means hills above the *kwongan*, when he first saw the hills in the distance accompanied by Cabbinger and an unnamed Bibbelmun guide. An article in the Perth Gazette (1st June 1847) by ‘Ketoun’ reported on ‘A trip to the Wong-an Hills’, where on 27th April 1844 his party ‘...crossed an immense “gwongan”, these gwongan are open undulating patches of scrubby country, ... of a quartz formation.’ (reprinted in Hercock et al. 2011: 337).

The same term with a different spelling was recorded by pastoralist J.P. Brooks (1896) for the Israelite Bay-Cape Arid district some 900 km SE of Wongan Hills. He described and defined *quowken* as the Aboriginal word for sand plain or ‘open plain without timber’, occasionally interspersed with small swamps dominated by trees of ‘yate’ (*mauw* (von Brandenstein 1988), *Eucalyptus occidentalis*) and ‘yauwl’ (*yauwarl* (ibid.), *Melaleuca cuticularis*). Approaching from the northeast after traversing the head of the Great Australian Bight, explorer E.J. Eyre in 1840 noted these same ‘sandy downs, covered with low shrubs or bushes’ (Eyre 1845), but was unaware of the local Aboriginal name applied to them.

Jeramungup settler A.A. Hassell recorded the name used by Woiwinnen people for sand plain as *qwonken*, and journalist-ethnologist Daisy Bates in 1913 was the first to record the spelling as *kwongan* (Bindon and Chadwick 1992). Bibbelmun people clearly used the term widely, across many dialects and substantial distances in semi-arid country northeast and southeast of Perth.

The first book devoted to *kwongan* (Pate and Beard 1984) attempted to divorce the application of the term to both sandy countryside and vegetation, as Noongars had used it. Beard and Pate (1984) preferred to apply *kwongan* strictly to vegetation, defining it technically as: ‘...any community of sclerophyll shrubland in southwestern Australia which has a stratum + 1 m tall or less of leptophyllous and nanophyllous shrubs. It may also contain either taller shrubs, which may be dominant – so long as the dominants are of genera other than *Eucalyptus* – or scattered trees of any kind which are not dominant.’ Thus, they intended to extend use of the term *kwongan* to shrublands beyond those on sandy soils, such as coastal heaths on limestone and granite, and hill thickets on various rock types. Conforming to Brooks’ (1896) definition,
scattered trees were also included as a component of kwongan provided they did not dominate the heaths and thickets. The countryside on which kwongan vegetation most commonly occurred was termed ‘sandplain’ by Beard and Pate (1984). This clarification, while helpful for strict vegetation science, removed the use of kwongan well beyond its original Noongar meaning of sand or sandy country, easily traversed because of low scrubby vegetation, occasionally with scattered trees. Such scientific nomenclatural appropriation is controversial today in cross-cultural dialogue. However, a focus on both vegetation and on sandy soils and sand plain will undoubtedly remain important components of kwongan studies, whichever nuance of definition and meaning is favoured.

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).

Bibbelmun people developed and have profound understanding of aspects of kwongan useful to human lifeways (e.g. von Brandenstein 1988) that will become increasingly important in a rapidly changing world. For example, developing new forms of agriculture in phosphorus-limited landscapes has much to learn from the study of kwongan plants, and inclusion of Bibbelmun staples such as youck (Platysace tubers) in future agriculture is now under active experimentation (Moule 2009).

We would all be diminished if we let kwongan slip away through our fingers, losing one of the world’s biological treasure houses, containing many useful but largely unused plants. Kwongan and its repair and restoration are vital responsibilities deserving increasing focus. The cultural, economic and biological value of kwongan is likely to increase as more is discovered about this globally important vegetation and associated landscapes.

References


Pate, J.S., Beard, J.S., eds. 1984. *Kwongan—Plant Life of the Sandplain*. University of Western Australia Press, Nedlands.

A tale of plant survival - old landscapes, new tricks

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From when I was growing up in the kwongan north of Perth I was amazed, even startled by the remarkable ability of the plants of the kwongan with their colours, forms, strategies and resilience to drought, poor soils and summer heat.

From a career working on kwongan plants, I keep being amazed by the extraordinary mechanisms and devices that have evolved in these plants that keep them one step (sometimes many steps) ahead of what is one of the toughest environments on Earth for a plant to survive. Here I share just a few of these vignettes.

Though we are only just starting to unlock some of the secrets of how kwongan plants survive, what is clear is that the stories that are emerging are rewriting the textbooks on plant adaptations and survival mechanisms—from underground orchids to the world’s largest mistletoe. The only rule that has emerged is that we assume functional capability in kwongan plants at our peril. Only solid research and robust science can truly unlock the secrets of plant survival on the world’s oldest and most infertile landscapes. Here I will share with you some of the stories of survival – essentially a plant version of ‘Survivor’.

The first thing that strikes the eye of the initiated on walking through the kwongan is what appears to be monotonous, unchanging species. But scratch below the surface and every square cm is bursting with diversity and bewildering survival mechanisms embodied in species that are among some of the oldest evolutionary lineages on Earth.

As an example I would like to take a piece of kwongan, say Mt Lesueur and unpack nature’s suitcase of species. The first plant that is striking is what appears to be species of grasstrees. Dig deeper and you will find that there are at least three species, one being *Kingia*, a species totally unrelated to the familiar *Xanthorrhoea*. *Kingia* shares the blackened ‘trunks’ and rounded head of leaves typical of grasstrees in general, but that is where the similarity ends. *Kingia*

[Image of a plant]

The red-ink sundew, *Drosera erythrorhiza* forms large, sticky mats of leaves in winter and spring with flowering in autumn if the area has been burnt in the previous summer.
belongs to Australia’s only endemic order, the Dasypogonales, and the kwongan is one of the only biomes to have its very own endemic order dated at about 120 million years old, just 15 million years after evolution of the first flowering plants.

But look more closely at the Kingia and more stories begin to emerge. Beneath the trunk, Kingia is anything but usual as each season a new crop of roots is produced from the leaf crown with roots facing the arduous task of growing up to 2-3 meters between the leaf bases and stem core before reaching the ground. Many roots will not complete the journey and Kingia cleverly maintains beneath the soil a bunch of large, fattened roots packed full of water storage that act as the emergency root system should the new season’s root crop fail to reach the soil. But Kingia’s story does not end there. Even the flowering of this plant is keenly pitched to match the environment with flowers produced only after fire (presumed to be a pulse of ethylene produced when the flames of a bushfire lapped at the crown of leaves) ensuring that the subsequent seed crop falls onto soil free of competition and with space for the young seedling to grow and develop. And just in case Kingia gets into ecological trouble and over-extends its trunk, or insect damage kills the single growing apex in the leaf crown, Kingia pulls another trick out of evolution’s box of wonders and produces up to 20 or more small vegetative off-sets that remain under-developed and quiescent, being called into action when the parent trunk dies. So the next time you see a Kingia, chances are you are most likely looking at a remarkably old plant in both an age and evolutionary sense.
Surrounding our *Kingia* is a host of smaller plants that on closer inspection might be playing that usual kwongan trick of appearing uninteresting. But looks can be deceiving. If it is autumn or early winter there will be a variety of plants that will be in flower often in bone-dry soil. Using clever growth devices and underground tubers packed full of water and nutrients from the previous year enable bunny and hare orchids (*Eriochilus* and *Leporella*) to red-ink sundews (*Drosera* species) to pop the flowers through the parched sands. It is thought that flowering at this odd time of the year enables these species to capitalise on the availability of pollinators that would otherwise be difficult to entice in the mayhem of spring flowering. And producing seed in concert with the winter rains means germinating immediately without waiting a year in the soil seed bank.

The red-ink sundews comprise a number of species and use the same trick as *Kingia* relying on a pulse of ethylene gas from a summer bushfire to trigger flowering. Just as *Kingia*’s reliance on fire can be a risky strategy, red-ink sundews also have a few more tricks to risk-manage their lives – producing annual crops of daughter plants on the end of long underground stems as well as attaining a great age – some plants can be over 50 years old producing a dinner-plate size rosette of leaves that capture all manner of insect prey to supplement the meagre nutrients in the soil. These features help red-ink sundews form carpets of glistening rosettes in the winter sunshine.

Entwined with the stems and branches of kwongan plants are small plants growing like chicken-wire. This is the intriguing wire-netting trigger plant (*Stylidium repens*). What is surprising about these diminutive plants is the habit of stiltin’ – where the tiny branching rosettes are launched on long runners (like miniature strawberry runners) with each rosette producing a single prop-root that holds the rosette 10-12 cm from the soil. Why, at first sight has such a risky habit evolved? Intuitively in such a hot, dry environment protecting your...
roots would seem to be obvious; however, the wire-netting trigger plant seems to have worked out an even more cunning strategy where the rosette is held at precisely the right point above the soil to avoid the piercing reflected heat and scorching surface of the soil. Equally, stiltling enables this species to wander at will between the kwongan shrubbery, taking advantage of open soil and nutrient-enriched hotspots.

But other plants, quite independently have taken on board the stilt root strategy as an effective device for coping with the stringencies of life in the kwongan. Sundews, sedges, cottontails and lilies have species that have taken stilt roots to an extraordinary degree of refinement where quite large plants will be perched atop a mangrove-like cluster of roots. What unifies the roots of these species is their anatomy that has been shown to be keenly adapted to surviving high temperatures at the soil surface. Specialised toughened cells line the outer walls of the roots and the all important phloem vessels (these are delicate cells that bring sugars from the shoots) are buried deep inside the root to ensure these vital conducting cells are well protected. Few other plants on Earth have come up with such an ingenious solution to protecting their roots.

Here I have touched upon a few of the many stories of life in the kwongan – there are many more to be told, from why so many species pack such small patches of bushland to how such an impoverished environment is able to support such an astonishing variety of species. I believe the kwongan holds many world-class episodes on surviving and thriving under drought in poor soils and summer heat. But time is slipping by and the kwongan needs urgent scientific work to unlock these secrets before we lose species to extinction. This same science will be the foundation to protecting kwongan plants so that future generations can have the joy and privilege I enjoyed living and working with nature’s great garden – the kwongan.
Is the Kwongan a Food Heaven or Hell for Cockatoos?

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Visitors to the kwongan-dominated areas of SW Australia often feel that they have arrived in a botanical wonderland, which has something missing. The landscapes, which boast a rich diversity of plants, appear to be lifeless since there are few large animals or significant numbers of birds and insects to be seen or heard. Densities of herbivorous animals are particularly low and this is not unexpected in such low-nutrient landscapes where the plants are mostly tough-leaved sclerophylls rich in anti-herbivore compounds. Despite this apparent lack of animal life, the kwongan is home to often unnoticed animals critical for providing ecosystem services such as pollination (insects, birds and small marsupials) and seed dispersal (ants). These animals are rewarded for their efforts through copious nectar production and the availability of lipid bodies (eliaosomes) on the seeds of many of the dominant plants. The lack of palatable plants means that kangaroos and other medium-sized herbivores are sparse; however, the kwongan is a critical habitat for the seasonal foraging activity of one of WA’s most iconic birds, the endangered Carnaby’s Black Cockatoo.

Carnaby’s are found across the SW of Western Australia and their distribution coincides with the geographic spread of the species-rich Banksia (260 spp) and Hakea (158 spp) genera of the family Proteaceae. Species in this family which are common in kwongan have seeds, rich in proteins and lipids, which provide a high-energy and nutritional resource in an otherwise nutrient-constrained environment. Since most Banksia and Hakea shrubs are serotinous and keep their seeds in the canopy until released by fire, chances are high that a significant proportion of the aerial seed bank could be lost to pre-dispersal seed predators. To reduce the predation risk we see a rich array of mechanical defences in banksias and hakeas. Their fruiting bodies or infructescences can be large cone-like structures or single follicles, which provide mechanical defence and act to increase food handling times, so slowing the bird’s feeding rate. When we compare the carbon cost of producing such large mechanical defences we find that banksias and hakeas allocate about 150 times more biomass to defensive structures than they do to seeds. In members of the Proteaceae growing in the fynbos of southern Africa which has no large seed predators, the defence to seed ratio allocation is only 15, some 10 times less than it is the case in WA.

At ECU we are currently investigating the foraging habitat of Carnaby’s Black Cockatoo because land-use change, such as urbanisation on the Swan coastal...
Plain, is reducing foraging habitat. The loss of native foods is being exacerbated by the removal of the pine plantations, which have been used as a supplementary food source over the past 40 years. How will Carnaby’s cope with these changes? One possibility is that they will spend more time in kwongan vegetation such as on the northern sandplain, since these areas, unlike the wheatbelt, still contain extensive tracts of native vegetation containing desirable foods. We are unsure whether kongan can be used for prolonged foraging periods, because, when compiling a list of known food species, we found that we have very little information about what Carnaby’s actually feed on in the kwongan. We also have little information about food handling times for all the different species they may consume. Without more information about the food resources available in the kwongan, we are unable to say whether these areas will be a heaven of readily available high-quality food or a hell of well defended unobtainable food. To understand the role that kwongan might play in the persistence of this iconic West Australian bird we are interested in hearing about any interesting Carnaby’s feeding experiences that you may have observed or photographed. We are particularly interested in new records of desirable food plants and observations on how long Carnaby’s Black Banksia and Hakea mechanical seed protection structures. The follicles on the Banksia cone have been opened by cockatoos and the seeds removed with their large beaks and dexterous tongues.

Cockatoo take to feed on different species.

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Photos: Will and Jennie Stock
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