



Essays from WA

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Introduction

Jim Barrow

For those who came in the late, as they used to say in the serials, I used to be a Chief Research Scientist in the CSIRO, but that was 27 years ago. I still do science stuff, writing scientific papers and reviewing manuscripts for journals now as an Honorary Research Fellow at the University of Western Australia. And in my spare time, I write articles for Australian Plants.

There is very little in common about the articles in this issue – except that they are all the products of my active, grasshopper mind that needs to keep busy, and has a deep fascination for our plants.

The first article is about our eucalypt flowers. We make such a fuss about all the other brilliant flowers that we forget that the south-west is blessed with some very attractive flowering gums. Mind you, some of them are pretty rare and indeed some of them look a bit scruffy in the bush but in cultivation they flower magnificently.

More famous are our daisies and indeed the so-called everlastings make fantastic displays especially in the “good” years. Although the tourist bureaus tend to emphasise them, it is a bit difficult to utilise them as a tourist product. They are indeed ephemerals with each species in full bloom for only a limited period and not every year is a good year. However many of them can be easily grown and make good garden plants – but we do need to solve some of their germination problems.

The next article explains how I finally worked out why plants in our garden seldom lasted for long and what I did about it.

Should *Hakea* and *Grevillea* be combined into one genus? Names that would then be appropriate have been published. But don’t panic, it doesn’t look as if it’s going to happen.

On the other hand, our comfortable and familiar arrangement of three sub-families within the peas looks like it’s going to be changed and expanded to six sub-families. And acacias will no longer have a sub-family with other mimosas, but in a sub-family combined with the cassias and their relatives.

When you prepare issues such as this one, you sometimes have an awkward bit of space left over so you need a “filler”. This is just a paragraph about how the Germans name flower parts.

Finally, there is a puzzle about buzz pollination. Some flowers need to be buzzed by bees to release pollen. Standard signalling colour for such plants requires bluish petals and/or sepals and bright yellow anthers. But some plants have bright yellow petals, so how do they signal to the appropriate bees? They are “bee purple”.

Flowering gums

When I was growing up in country Victoria, my parents spoke about the flowering gum. I think they thought it was the only gumtree that actually had flowers. Our farm was just north of Melbourne; it is a suburb now. It had been an important source of transport fuel for the city: hay. For that purpose, it had been very thoroughly cleared. Originally it would have been a fairly open woodland, well populated with river gums (*Eucalyptus camaldulensis*). There were only two of these left; somewhat scrawny, though picturesque specimens overhanging a pool in the creek. For some reason, when eucalypts were planted in those days they planted sugar gums (*Eucalyptus cladocalyx*). There were three or four planted near the farmyard, but again for no reason I understood, they were regularly pollarded. I don't think they ever got a chance to flower.

How different Western Australia is with its spectacular selection of brightly flowering eucalypts. Of these, which is the most spectacular? One candidate, and arguably the best known, is surely the Western Australian Flowering Gum (*Corymbia ficifolia*). (Also known as *Eucalyptus ficifolia*)



This small tree is fairly widely planted both as a garden tree and an amenity tree in Perth and elsewhere. There are many subtle variations in colour. Some of these are inherent in the species, but others come from hybridisation with the closely-related marri *Corymbia calophylla*. (Also known as *Eucalyptus calophylla*).



Colour variations. The bottom right-hand picture is from a rather large tree that was certainly a hybrid.



E. calophylla nuts on left; *E. ficifolia* on right.

The two species differ in several ways; marri is a much taller tree, usually with cream flowers. Its seeds do not have wings; flowering gum seeds are winged. That difference is not always convenient for diagnosis. There are other differences. Flowering gum leaves are stiffer with a bigger contrast between the front and the back, and are usually without glands. Their fruits are usually barrel-shaped whereas marri fruits are usually urn-shaped. If you collect seed from an attractively-coloured *ficifolia* growing in a Perth suburb, you never know what you will get. It might be directly hybridised with Marri – they are very common in Perth parklands, or it might have picked up genes from a nearby hybrid. Consequently, grafted forms, of certain colour, are available.



Base of the trunk of a grafted tree whose flowers are shown in the top left-hand of the previous page. There is some graft incompatibility, and probably as a consequence, some dwarfing.

Canker on a limb of a *E. ficifolia* tree. The tree died soon after the picture was taken.

The close relationship with marri is important for another reason. Both species are susceptible to a fungus called *Quambalaria coryecup*, which causes a canker. It used to be thought that marri simply carried the disease but was not susceptible to it. That is no longer the case and extensive deaths of marri are occurring. On the other hand, flowering gum has always been known to be very susceptible and many plantings don't last long. There are however, long-term surviving plants in some of the older suburbs and these appear to be resistant.

It is somewhat ironic that the tree therefore grows much better outside its native state.

Another candidate for most spectacular is surely the red-capped mallee *Eucalyptus erythrocorys*. I well remember seeing a bright flash of chrome-yellow in our first February (1962) in Western Australia. I knew that wattles had yellow flowers but I did not think one would be flowering in February. Of course it was *Eucalyptus erythrocorys*, now much more widely planted than it was then. It is a small tree providing the double benefit of large and spectacular flowers preceded by a brilliant red bud cap. The helmet-shaped fruits are somewhat of a mixed benefit. They are an interesting shape, but the tree tends to be excessively fruitful and the weight of the fruit can distort the branches. A bit of pruning after flowering seems like a good idea.

The form widely grown in Perth comes from the Dongara area just south of Geraldton.



Buds and flowers



The helmet shaped nuts are an interesting shape, but they are very heavy and weigh the branches down.



The buds themselves are very attractive,

My vote for most spectacular goes to the Rose of the West or Mottlecah (*Eucalyptus macrocarpa*). With the largest of all eucalypt blossoms, it is way out in front. It is a sprawling shrub which does not develop typical adult eucalypt leaves but rather has broad, stalk-less leaves. In its native, rather harsh environment it tends to be rather scrawny with almost every leaf chewed by some insect and only summoning up enough energy to flower occasionally. It adapts very well to gardens. Its silvery leaves are themselves attractive and it seems to always have flowers.



Rose of the West or Mottlecah (*Eucalyptus macrocarpa*). It is a good plant for demonstrating eucalypt bud caps.

And then there are all the “also rans”.



E. rhodantha is closely related to *E. macrocarpa* differing mainly in having long, down-turned flower stalks. It is a rare and endangered plant restricted to a few areas north of Perth

E. youngiana (right) and *E. pyriformis* (below) are both desert plants and both thrive under cultivation in Perth (photographed in Kings Park). *E. youngiana* is most closely related to *E. kingmillii*.



E. pyriformis (Dowerin Rose) is easily distinguished by its large down-turned buds in umbels of three.





E. kingsmillii with its distinctive fluted bud-caps, has cream flowers and isn't quite as showy.



E. macrandra (River Yate) is a mallee or small tree. It illustrates another way of achieving a large "flower" – by aggregating several flowers into a tight inflorescence. If you are going to have long stamens, you have a problem packing them in the bud. Several Western Australian species solve this problem by having long thin bud caps.



Eucalyptus caesia -
:Silver Princess".



I could hardly leave out *E. caesia* with its red-pink flowers in midwinter and silver bells all the year. It occurs in about a score of granite domes mostly growing in cracks in the rock. There seems to be some question about whether the large-leaf form is still recognised as subspecies *magna* but Florabase regards it as "current" so we will go with that. Its distribution is more easterly than that of the other subspecies. It adapts well to cultivation, growing into a substantial multi-stemmed tree.



E. preissiana ((Bell Fruited Mallee) grows in the Stirling Range to Fitzgerald River area where it usually grows between 1 and 2 m high. In cultivation however it will readily grow to 4 to 5 m.



E. pleurocarpa (Tallerack) used to be widely planted in native gardens. It is a sprawling shrub, not particularly spectacular, but suitable as a background plant. It is included here more because it is interesting: the small teeth at the apex of the bud are parts of the calyx. You may know it as *E. tetragona* but that name was given to a type specimen that was not typical, so a new type specimen was used and an old name resurrected.



E. kruseana (Bookleaf mallee) is a small shrub. It is restricted to just three rocks or hills, two of them east of Kalgoorlie, the other southeast. It is a popular ornamental in drier parts of southern Australia and in central Australia because of its mallee habit, flower colour and unusual leaves. There should be room for it in even the smallest of modern gardens. It is named after John Kruse (1822–1895) who was a pharmacist of German birth who was active in the establishment of the College of Pharmacy.



It is a pity that *E. woodwardii* is not more-widely known. It is a mallee up to 10 m high with the tips of the pendulous branches brushing the ground. The bark is smooth and sheds in long ribbons that often remain partly attached and are conspicuous blowing in the wind. Mallees are trees with slender trunks with branches steeply angled to them. They do not have lignotubers or epicormic buds. *E. woodwardii* grows in the southern part of the Great Victoria Desert on sandy rises. It is grown as an excellent amenity tree in Kalgoorlie and in some wheatbelt towns.



E. synandra is a lovely weeping lignotuberos tree. It occurs on the northern wheatbelt and is fairly rare. It, and three closely-related species, are the only eucalypts with the stamens united in a tube. The flowers start off cream, then turn red – a fairly common scheme for many unrelated plants.

Some daisies of the South West

Our so-called “everlastings” feature in much of the tourist literature — and fair enough, they are very pretty indeed especially in a “good” year.

The common name is derived from its old name meaning “days eye”. This is because the “petals” (of *Bellis perennis* the daisy of English lawns) open at dawn and close at dusk.

The scientific name is a bit more complicated. These days the names of families are constructed by taking the name of the type genus and tacking on “aceae”. So the daisy family is known as Asteraceae from the type genus *Aster*, which is a Greek term that means “star”. The old name was “Compositae”. This had the advantage of reminding us that the “flower” was not really a flower at all but an inflorescence of several small flowers, or florets. (Actually, it is a validly published name and we are entitled to use it if we wish. It is just that it is not “current”.)

That flower arrangement is very effective with the family being recognised as the largest in the plant world with something like 24,000 species (depending on who is counting). And it has been around for a long time: about 87 million years. Why so successful? Presumably this construction can send a very clear message to pollinators — here is my centre where you can get your reward and at the same time transfer pollen. Many members of the family have fluffy seed that can be transported long distance by wind. We have all played “clocks” with dandelion flowers. Especially in areas subject to advance and retreat of ice, such as much of northern Europe and north America, the ability to invade new areas must have been a big advantage. This probably also applies to Tasmania where daisy bushes are a prominent component of the flora. The ability of members of the family to store energy as fructans (mainly inulin) is an advantage in relatively dry zones. Fructans are long chain polymers of fructose molecules.

“Daisy Bell (Bicycle Built for Two)” is a popular song, written in 1892 by Harry Dacre, with the well-known chorus “Daisy, Daisy/ Give me your answer, do./ I’m half crazy/ all for the love of you”, ending with the words “a bicycle built for two”. The song was inspired by Daisy Greville, one of the many mistresses of King Edward VII. The reference in the last line to “a bicycle built for two” is a subtle reference to the infamous “sex chair” that the monarch had constructed in his Paris apartment whilst he was Prince of Wales.

There are two kinds of florets: disk florets and ray florets. Disk florets, as the name implies, occur on the disk of the daisy flower. They are tiny versions of “normal” flowers with the five tiny petals distributed around the outside of the florets. Ray florets on the other hand occur around the outside of the disk. The petals are moved around to one side to form a strap or ray. You can often see the individual petals as marks on the strap or as “teeth” at the tip.

Daisy flowers may have both disk and ray florets, ray florets alone without disk florets, and disk florets alone without ray florets.

Both disk and ray florets

This is the standard arrangement within the family yet it by no means dominates in the south-west. There are some species that are grown, or could be grown, in gardens.



Brachyscome iberidifolia seems like a delicate flower yet it grows naturally in quite dry conditions. It often grows in mixtures with other daisies (top right), but sometimes as the main flower (lower).

Brachyscome and Roebuckiella

The annual, *Brachyscome iberidifolia*, is the best known of these horticulturally. Many colour selections are now available and brilliant highlights of blue, purple, mauve, pink and white can create mass displays.

Botanically the *B. iberidifolia* group and the *B. ciliaris* group are still open to more study while a new genus *Roebuckiella* was recently split away. This includes a mauve daisy with petals that turn back and is now *R. ciliocarpa*. The name *Roebuckiella* was chosen after William Dampier's ship (the Roebuck) in which he visited the Shark Bay region in 1699 and was the first Englishman to collect Australian plants including a daisy now allocated to this genus. Initially the name "*Roebuckia*" was proposed, but Alex George pointed out that name was already assigned to a fossil fern and so the name was changed.

"Brachyscome" means "short hair" in reference to the short pappus — and just like Le(s)chenaultia there is a troublesome "s". To cut a long story short, the original spelling was with the "s", but the author subsequently removed the "s". This created a dilemma and one that was never really solved with a firm decision from the nomenclature committee. The "plus s" spelling is now most used.

Olearia.

Olearia is a fairly large genus with about 130 species native to Australia and New Zealand. The name does not commemorate some Irishman but is derived from a supposed resemblance of the leaves of the type species to the leaves of the olive (*Olea*) and therefore should be pronounced "Olee-AR-ee-a". *O. axillaris* has attractive silvery foliage and it is becoming increasingly planted. *Olearia rudis* (Azure Daisy Bush) occurs in all mainland states. It is an attractive, small, white-flowered daisy bush. It deserves wider cultivation. Seeds of *O. axillaris* can be readily germinated using smoke and it is likely that *O. rudis* would respond also.

It occurs in a wide range of environments, usually as an isolated plant, and because of its broad similarity to daisies commonly grown in gardens can be mistaken for a garden escape.



Olearia rudis flowers. You can see why it might be mistaken for a garden escape.

Podolepis.

This is a genus recently revised to nine species plus several sub-species. A clue to recognising it is that the ray florets usually have "nicks" at the edges corresponding to the petals. Several species would be worth growing. *P. aristata* (below) is very attractive and grows in fairly harsh conditions.





Podolepis gracilis is usually white as shown above but attractive blue or pink forms occur (left, Picture Hazel Dempster)

Ray florets only

In the south-west of the WA there are quite a few plants in this category, and most of them are weeds; plants such as dandelion, flat weed, and sow thistle. Consequently, the few that are native can easily be mistaken for weeds. This applies especially to *Sonchus hydrophilus*, which apparently has been here for a very long time but was initially mistaken for a weed. More palatable is the “Yam Daisy”.



Microseris scapigera

According to Flora-base, the correct name is *Microseris scapigera*, but most articles on the Internet refer to it as *Microseris lanceolata*. The plant does look like a large dandelion. It even has a seed head like a dandelion “clock”. The root tubers were a major food item for aboriginal people in the south-east of Australia where it is referred to as Murnong. It was also eaten by the Noongar people of the south-west. Unfortunately it was also eaten (avidly) by sheep and it soon became quite rare. In the south-west it is now confined to the margins of salt lakes, granite rock areas and samphire flats. I remember tasting it as a boy in central Victoria; as I recall it tasted crisp and sweet.

Growing instructions are as follows. “Plant *Microseris lanceolata* seeds by pushing them straight down in the soil, just leaving the fluffy ‘wing’ exposed, in a well-drained mix in full sun or part shade. This is best done in autumn/winter in subtropical zones to avoid the hot wet summers where damping off becomes a problem. Keep moist until germination in 1-2 weeks. Separate seedlings when large enough and plant in a deep pot.” The plants are reported to respond to fire and were surely fire-stick farmed by aboriginal people. It is a fair bet that germination would be improved with smoke.

Disc florets only

Most of our attractive daisies are in this category. The pretty petal-like structures that surround the disk are not ray florets but modified bracts. If the flower is dried, these bracts retain their colour (at least for a little while) and become paper-like. Hence names such as “paper daisies”, “straw flowers” or, more commonly, “everlastings”.

Most of these plants come from the semi-arid zone. They are adapted to a fairly tough environment. They must only germinate when soils are moist enough for them to have a fair chance of completing their life cycle. Many of them will only germinate when exposed to light. This is counter-intuitive; any good gardening book will tell you to plant seeds at a depth of 2 to 3 times the size of the seed. Following such sensible guidelines is one of the major reasons why people fail to grow everlastings. How does such a curious requirement work? If you get summer rain, the surface soil will only stay moist for a day or so. Not a good time to germinate. But if the surface soil stays moist for 4 to 5 days, it is a fair bet that the soil is well moistened and there is a fair chance of completing the life cycle. How do you know if you are a seed on the surface? Because you have access to light, of course.

They must then be able to grow quickly, flower, and seed during the short window of opportunity. Live fast, die young is all very well but if a plant is to do this it must have a reasonable supply of nutrients.



Sights like this one used to be very common in the agricultural areas of Western Australia – fields of everlastings amongst “jam” trees (*Acacia acuminata*). The soils in this ecosystem had higher fertility than those of the kwongan and they were quite easily cleared. Farmers soon recognised this and nowadays there are few such areas left. The pink flowers are mostly *Schoenia cassiniana* with some *Lawrencella rosea* and the yellows are mostly *Podothea gnaphalioides*

This poses a dilemma for the gardener: you must supply enough nitrogen and phosphorus for the plants to grow reasonably well, but too much and you get soft floppy plants — and of course weeds like a high-nutrient environment also. So apply a little bit of fertiliser a couple of times while they are growing.

At the end of the growing season, the seeds are shed, and in the natural environment, must be able to withstand several months when temperatures at the soil surface can get as high as 60°C followed by quite cool nights. Seeds that are so well protected that they can withstand these extremes can sometimes be hard to germinate. In some cases at least, it is just a matter of time. Seed from the previous year, which is say about six months old, can be very difficult to germinate, but seed that is a year older is much easier.

Here are some species, arranged in sequence from most commonly (and easily) grown down to seldom grown.

Rhodanthe chlorocephala subspecies *rosea*. What a mouthful of a name! The type species was collected by James Drummond who was notoriously reticent about disclosing the sites of his collections. In this case it is thought to have been somewhere in the Moore River area. *Rhodanthe* means “Rose-coloured flower” and “*chlorocephala*” means “green head”, but according to Flora-base, flower colour is yellow. Problem is that no one can be sure because no one has seen the type species again; all we have is the dried specimen. So the name means the pink subspecies of the green headed species of the rose coloured flower — and that is a bit dicey also because the flower colour ranges from deep pink through to white.



One of the many mass displays in Kings Park photographed in September.

This is easily the most widely cultivated species in Perth and is seen not only as mass displays in Kings Park but also on street verges in many suburbs. The seed is readily obtainable, germinates readily, and rewards the grower with a spectacular display.

The main problem is that the seedlings are like chocolate ice cream to snails; they will travel many metres for the treat. A promising patch of everlastings can disappear in a couple of nights. The only practical solution seems to be generous use of snail bait. Baits based on EDTA rather than on metaldehyde are safer.

Woolly bear caterpillars can be a problem. They race around a garden and can gobble your delicate seedlings. They are the larvae of a tiger moth, so called because of stripes on their abdomen, not because they are little aeroplanes.



Some typical flowers of *Rhodanthe chlorocephala subspecies rosea*

Rhodanthe manglesii (pink sunray) is a somewhat more delicate species with a slender stem. It therefore tends to be “floppy” if grown with too much nitrogen. The disk is somewhat smaller than for the above species and the bracts that surround the flowering head have an attractive silvery appearance. Mostly the flowers are a uniform deep pink, but white forms also occur. Seeds saved from last year are difficult to germinate but seeds that are one year older germinate readily.

Schoenia filifolia. The name of the genus comes from the name of a Hamburg eye specialist. He would have spelt his name “Schön” (which, by the way, means “beautiful” in German). It is difficult to explain how to pronounce “ö”, but it is a bit like the first vowel in “murder”. Certainly the name of the genus should not be pronounced “Show-ee-ia”.

It is an attractive annual with narrow, thread-like leaves (*filifolia*). The yellow flowers are of reasonable size and held above the plant to make a good display. They do not fade – in contrast to *R. chlorocephala* for which the pink forms fairly quickly fade to white. Again seeds that are some 18 months old germinate readily.



Rhodanthe manglesii.



Buds of *Rhodanthe manglesii* showing the shiny bracts.



Schoenia filifolia.



Schoenia filifolia (yellow) and *Rhodanthe manglesii* (pink) growing together in a pot.

Schoenia cassiniana. An attractive pink-flower everlasting easily recognised by the branching structure of the plant. I grew it for several years but eventually lost it as a result of planting the seeds too deeply. It seemed to be fairly sensitive to phosphate supply.



Schoenia cassiniana.

Rhodanthe humboldtiana. Another everlasting with heads of yellow flowers. Its normal habitat is fairly dry country but it does well in Perth. Kings Park grow a few in their gardens. It deserves wider cultivation.



Rhodanthe humboldtiana

With *Waitzia acuminata*, the bracts that enclose the flower are attractive before the flower opens. They are often infused with a touch of red. *W. aurea* is a “standard” golden everlasting. They seem to germinate readily so it is surprising that they are seldom seen in gardens.



Waitzia acuminata buds (left) and *W. aurea* opened flowers above..

Waitzia suaveolens is a somewhat neglected little cousin. It grows in woodland near Perth. It never makes a bold display; it just quietly goes about its business.



Lawrencella rosea and *L. davenportii* are both pink everlastings. They hold strongly to the “live fast die young” motto; the plant makes sure that seeds are formed soon after flowering and the rather long pappus soon replaces the flowers. The pink bracts are shiny, giving them a mettalic appearance.

L. davenportii is larger — although that won’t show in the pictures here. It has prominent flowers and remarkably large seeds. You would think it would be easy to germinate, but not so.



Only the top right picture is *L. davenportii*. The others are *L. rosea*.

Bellida graminea is a rather strange little plant. Because of its prominent pappus, it is thought to be related to *Lawrencella*, but it differs in that the flowers are not surrounded by brightly-coloured bracts: they are just little yellow buttons. Ironically it is the bright red pappus that draws our attention yet this is probably camouflage because insects are unable to detect red.



Craspedia variabilis (Billy Buttons) occurs across southern Australia. It was previously divided into several species, but in 1992 it was concluded it was one, albeit variable, species – and hence the specific name.



Before 1992, tthis would have been called *C. glauca*. It is now *C. variabilis*.

Myriocephalus guerinae. Another showy golden everlasting but one seldom seen in the bush and never in cultivation. Seeds are not available from any of the seed suppliers.



Myriocephalus guerinae.



These pictures were taken beside a road east of Mullewa. The plants seemed to be benefitting from run-off from the road. Next time I was there, there was no sign of them. Presumably a grader had "tidied it up".

Cephalopterum drummondii. This curious plant comes in two colour forms; white and golden. In the wild, they seldom mix so you get pure stands of gold in one place and pure stands of white in another. The gold form is particularly obvious in the Coal-seam Conservation Park.



The florets are surrounded by coloured bracts that are very petal-like. Heads of the golden form are shown above; a head of the white form is shown right; and a vista of the golden form at the Coal-seam Conservation Park shown below.



Podothea gnaphalioides (Golden Long-heads) seems to be almost always present, at least to a minor extent, in most patches of everlastings. Occasionally you see thick patches of it.



Where to get the seed.

Seeds of most of the plants mentioned above can be obtained on-line from Nindethana Seed Company. *Microseris scapigera* can be obtained from "Natural Regeneration". *Rhodanthe rosea* can also be obtained from "Australian Wildflower Seeds" I could not find a source for *Myriocephalus guerinae*. Seed starter vermiculite that has been exposed to smoke can be obtained from the Australian Wildflower Seeds.



A mass display of *Podolepis lessonii* photographed near Hamelin Pool by Hazel Demster,

On death — and resurrection

We came to Perth in 1961, when the population was about a quarter of the present one. We bought a block in Wembley Downs, which was then considered an outer suburb. Perth suburbs are mostly built on a series of sand dunes. In contrast to the biblical injunction, sand is a very good substrate on which to build a house. Wembley Downs is sited on the Spearwood dunes. These are thought to date from before the onset of the last ice age. The subsoil contains just enough clay and iron oxide to provide some water retention and they are good soils for establishing a garden.

Our block was well populated with banksias, sheoaks, grasstrees, acacia saplings and even a fairly large tuart – not that we knew what they were at that time. We kept as many of them as we could. This greatly puzzled our new neighbours all of whom cleared their blocks completely; why would you keep those ugly things when you could grow roses? As you did in those days, we also planted extensive lawns.

Then, in 1978, we had severe water restrictions. We ripped out the front lawn and planted several native shrubs including verticordias. These thrived without any summer watering, as you might expect on Spearwood sands with their moisture-holding subsoil. About the only problem was cutting them back occasionally. But after 29 years, we decided that the house in which our children grew up was no longer appropriate. (That house was subsequently demolished, and the block divided. The native plants were removed and roses planted!)

We bought a block of land in Mt Claremont. This time, there was no opportunity to retain existing trees; the block was bare. I thought at the time this was because the land had been cleared to form a buffer zone around what was called in those non-PC times, the lunatic asylum, but I now suspect there was a different reason.

We planted native plants in the front garden and fruit trees and grapevines and a small patch of lawn in the back garden. At first, everything grew well even though we were sited on the back slope of the relatively young dune on which the soil comprised coarse grey sand overlying coarse white sand. The first to go was a woolly bush. I didn't worry too much about that; they tend to have a merry life but a short one. But that was the first of a long list of plants that made short guest appearances in our front garden. Sometimes they died slowly, one branch after another, but more often it was sudden death; the plant looked okay one day but was dead the next. Even Geraldton wax plants lasted but a few years. The problem wasn't confined to the native plants; a loquat

tree did a “Cheshire cat” slowly disappearing limb by limb. After about 15 years of healthy growth, even the grapevines slowly began losing vigour and dying back. What was going on?

In December 2011, I noticed that the leaves of some of the grapevines were showing symptoms I hadn’t seen before. They were quite different from powdery mildew, which is a very common in disease of grapes. They were due to downy mildew, a disease that had caused millions of dollars of loss to the viticultural industry over the centuries but had only fairly recently arrived in Western Australia. It is caused by an organism called *Plasmopara viticola* – and that needs a bit of explanation.

Linnaeus, who wanted to classify everything, said that there are three kingdoms one of which was minerals! There were two kingdoms of life; plants and animals. If you were not an animal you were a plant. It wasn’t until the 1980s that this was queried. Fungi are not plants; they didn’t evolve from plants and they didn’t evolve into plants. They are a separate kingdom. The same argument goes for bacteria. That left a whole grab-bag of very odd organisms many of which probably represent nature’s less-successful experiments. It includes the water moulds most of which mind their own business but three of which comprise the “terrible Ps”: *Plasmopara*, *Pythium*, and *Phytophthora*. *Pythium* causes damping-off of seedlings and *Phytophthora* kills plants.

Until the 1980s, downy mildew was treated as if it were caused by a fungus; copper sprays were used but they were quite ineffective. Extensive research then showed that a simple chemical which, for the moment, I will call sodium phosphite was extraordinarily effective. Imagine the chagrin that must have caused the chemical company. How can you patent a simple well-known chemical and thus recover the considerable research costs. They got around it by patenting the aluminium salt but it turns out that it is no more effective than the simple sodium salt.

I therefore sprayed the infected grapevine, but, to be sure, also sprayed the uninfected ones. To my surprise, they immediately showed an increase in vigour. So that was a problem! Sodium phosphite is also effective against *Phytophthora*. That must be why things kept dying and also why the block was bare. In Western Australia, we tend to think of *Phytophthora* in terms of the introduced *P. cinnamomii* which kills plants quickly, but there are also several “native” species that also kill plants but less quickly. One of these has the frightening name of *P. multivora* which means it eats lots of things. It was first identified in 2009 and is also pathogenic to bark and cambium of tuart (*E. gomphocephala*) and jarrah (*E. marginata*). When it girdles the stem, the result is sudden

death. It was first discovered in tuart forest (*Eucalyptus gomphocephala*) so we may assume it is common in near-coastal areas.

Obviously, I needed to treat the garden. When plants are badly affected, spraying doesn’t convey sufficient of the active ingredient: you need to inject it. For this, you drill a 6 mm (quarter inch) hole in the trunk of the plant and screw the nozzle of the tree injector into the hole (see picture). The plant has to be big enough to permit such a hole to be drilled so for small plants apply frequent sprays and cross your fingers. Our garden tends to have selected itself down to a few fairly-large plants.



My injector is about 19 cm long and delivers 30 ml. Injectors with a smaller volume can be bought on the internet. If that is too much, I dilute the liquid. Injection is achieved using a powerful spring. You load the injector by pulling back the plunger (against the force of that spring), twist the plunger a little to hold it in position while you screw the nozzle into the hole, then release the plunger. The spring forces the liquid into the tree. This can take several hours. The chemical is fully systemic; it is transferred upward to the leaves via the xylem and downward to the roots in the phloem.

So the message is: if you are having trouble keeping plants alive, consider the possibility that the problem is *Phytophthora*. The simplest diagnosis is treatment – if treatment cures the problem, then deduce that it was caused by *Phytophthora*.



Alyogyne huegelii flower. Without injection, this plant never lasts more than a year. The plant is now more than 5 years old and thriving.



The four plants in this picture have all been injected. In the foreground, *Calothamnus graniticus* ssp *graniticus*. Behind that is *Alyogyne huegelii*, surviving well beyond its expected lifespan in our garden. Next is Grevillea "Honey Gem" which was half dead before injection. In the background is *Eucalyptus erythrocorys* (see next page).



Calothamnus rupestris is a multi-stemmed plant. Unfortunately I only injected one stem. It is thriving but the other stems have died.



Eucalyptus erythrocorys. In the left picture, taken in 2014 before injection, the bark is lifting from the affected area, the right picture is recent. The tree is healthy but the affected area hasn't quite healed.

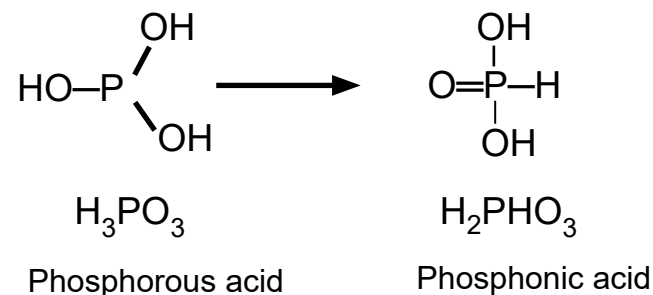


Calothamnus graniticus leptophylla. The left picture was taken in 2014 when it was almost dead and just before injection, the right picture is recent.



A tuart tree (*Eucalyptus gomphocephala*) at the bottom of our street. Sudden death in spring 2019, almost surely another casualty of die-back

Finally, a word about terminology. The acids formed from fully-oxidised forms of sulfur and of phosphorus end with “ic”. Thus sulfuric and phosphoric acids. The salts from these acids are called sulfates and phosphates. For the less-oxidised forms, the ending is “ous” and thus sulfurous and phosphorous acids. The salts are called sulfites and phosphites. That sounds very logical but the problem is that phosphorous acid does not exist in solution. The atoms jump around like this.



(This is called “tautomerization”, a lovely word. Try it on your friends one day. Bit long for Scrabble.)

The product on the right now has five bonds instead of three and so “phosphorous acid” is not an appropriate name. The correct name is phosphonic acid and its salts are called phosphonates. You can see that this causes some confusion. It probably should be used as the standard name more commonly. More than once I have heard garden gurus confused between phosphoric and phosphorous acids. By the way, the compound on the right should not be all that unfamiliar; replace the hydrogen atom with the simple amino acid called glycine and you have glyphosate, the active ingredient in Roundup. Join two phosphonates together and you have a compound used to treat osteoporosis.

Further reading

Scott P.M. et al. 2009, *Phytophthora multivora* sp. nov., a new species recovered from declining *Eucalyptus*, *Banksia*, *Agonis* and other plant species in Western Australia. *Persoonia* 22: 1–13.

Hakillea?

Jim Barrow

Many of the Proteaceae of Australia are classified as groups of genera. For example, *Hakea* and *Grevillea* are regarded as sister genera. (I can't help wondering whether in these politically correct days that is the appropriate term. Perhaps they should be called sibling genera!) The two genera are indeed pretty similar; often you have to look quite closely to know which one you have. But the boundaries between them are sharply defined. *Hakea* fruits are woody and have secondary thickening; *Grevillea* fruits do not. Further, put your hands together as in an Asian greeting. Open them at their fingertips keeping the wrists together; now you are a *Hakea*. Close them and open them at the little fingers: now you are a *Grevillea*.

People have often wondered whether someday botanists will decide the two genera should be combined. As *Hakea* was the first named of the two (1797 versus 1809), if they were combined that is the name that would be preserved. Some of you may have heard that this has already happened. Not quite! Thereto hangs a tale.

It begins with a study by Austin Mast and others published in 2015. It was a large, complicated study involving “reading” the DNA of many *Hakea* and of *Grevillea* species and also of *Finschia*. This is a genus of trees growing in New Guinea. Currently three species are recognised. There are probably more in remote places unknown to western biology. It includes a tree with edible nuts that is commonly planted around villages and has been transported to nearby islands.

The large amount of data collected was then fed into a computer program to generate evolutionary trees. More than one evolutionary tree is possible depending on which parts of the DNA are used. In one tree, some of the hakeas form a group in the middle of some of the grevilleas but that was not strongly supported, and overall, hakeas form a distinct group with the slightly “odd” species like the corkwoods and the twin-leaf species occurring nicely in the middle of the branches. But of course hakeas and grevilleas have a common ancestor; botanists sometimes think of hakeas as grevilleas that developed a different kind of fruit. The other important result is that *Finschia* falls in the middle of the grevilleas. That is not surprising; plants exposed to the different selection pressures of a New Guinea rainforest are going to evolve into something different. If the difference is large enough, the resulting daughter (oops child) group may qualify to be classified as a different genus.

This causes a problem for modern classification which is entirely rooted

in evolution. The first rule is that all the members of one group must have a common ancestor – here “group” means family, sub-family, genus, species or what you will. I don't think anyone has any problems with this rule. The second rule is more contentious. It is that all descendants of a common ancestor must be in the same group. Strict application of this rule would mean that all three genera have to be combined into a common genus. However, this is normally applied with some circumspection. If it were strictly applied, hierarchical classification would be impossible as everything evolved from something else; there could only be one group – called “life”. Here are some further (somewhat silly) examples. We mammals evolved from reptiles. Strict application of the second rule means that the classification “mammals” is not permitted. We are just hairy, warm-blooded reptiles. Similarly reptiles certainly evolved from bony fishes, so we are air-breathing, hairy, warm-blooded fish. In practice, the rule is not applied if it is considered that the evolutionary jump is large enough.

The paper did not recommend any specific taxonomic changes. Indeed, the opposite because they wrote that such changes needed careful consideration and further discussion.

The story now jumps to early 2018 when a group calling themselves “Plant Gateway” published a document on-line called “The Global Flora, a practical flora to vascular plants of the world”. It involves several different families and includes two new genera, four new species, 415 new names and 3286 new combinations none of which have been subject to peer review. They quote the Mast paper and note that names have not yet been changed but say: “we think it necessary to at least make the names available for use”. Mostly they just take the *Grevillea* (and the *Finschia*) species names and change them to *Hakea*, but there are occasions on which the *Grevillea* name is already used for a *Hakea* and so they make up a new name. For example *Grevillea canescens* becomes *Hakea novae-austrocambriae* (that is rather clever; it means New South Wales). They also raise several subspecies to full species status without any justification or discussion.

This rapid publication online, took advantage of change in the rules introduced in 2012. The article fulfils the rules that were set up, so it can be considered to be validly published. Usually scientist's work is submitted to established journals and subjected to peer review.

Taxonomists were not amused by what they consider premature publication. So much so that the leadership of the American Society of Plant Taxonomists published a letter to their members. One of their concerns is that publication on-line by-passes the usual peer review

system. Here is what they wrote. “Though the ICN does not require nomenclatural innovations to be made in a peer-reviewed journal, ideally the science that underlies these changes should be peer-reviewed. In addition, nomenclatural changes are made in collaboration with, if not directly by, researchers doing the peer-reviewed science, especially with increased accessibility to specimens and literature through digitization. This is important to ensure a link between nomenclatural changes and rigorous scientific research. “

And later: “Massive renaming following a ‘mechanical approach’ (as opposed to one based on new data and new results with a scholarly integration of all available evidence) breeds skepticism. By ‘mechanical approach’ we mean skimming the recent phylogenetic literature for suggestive results and translating them en masse into new names or combinations. This approach can result in chaos, especially when the data do not strongly support the revised taxonomy, and it can result in credit and recognition being appropriated from those who have generated the data and performed and interpreted the underlying analyses.”

The Plant Gateway people were not repentant.”The combinations in our paper were the result of many months of careful research, and the suggestion that this constitutes a “mechanical approach” is nothing short of insulting.”

So where does this leave us? Even though these new names have been validly published, no Australian herbarium has accepted them. *Grevillea* remains. The solution to this problem will not be reached tomorrow. Systematic botanists are careful people; they realise there is often more than one solution to a problem and they like to be pretty sure they have chosen the best solution before they commit themselves. Although the sample of plants that was used by Mast was large, it was still only about 1/3 of all the species. Australian botanists want to study a much larger sample. At the moment they think that *Grevillea* and *Hakea* can both be retained by separating some species from *Grevillea* giving rise to a few small genera. But it is not going to happen tomorrow; we also need to be patient.

Further reading.

Paraphyly changes understanding of timing and tempo of diversification in subtribe Hakeinae (Proteaceae), a giant Australian plant radiation 1 Austin R. Mast American Journal of Botany 2018 1534-1646

The trouble with grevilleas. Kevin Thiele. <https://www.taxonomyaustralia.org.au/post/the-trouble-with-grevilleas>

Letter re GLOVAP from ASPPT leadership to Society, <https://www.aspt.net/news-blog/2018/letter-re-glovap-from-aspt-leadership-to-society#.XsY4scCPKUK>

Response to: Letter ...<http://www.plantgateway.com/aspt-response/>

The peas – revisited.

In the spring 2018 issue of Australian Plants, I included an article about the peas of the south-west. I pointed out that the legume group had now been brought into line with other families in that the family name was derived from the type genus – just as we have seen earlier, the family name for the daisies is derived from the type genus “Aster”. So the family name for the legumes is now accepted to be Fabaceae and thus the type genus is “Faba”. I thought it would be interesting to see what the type genus looked like. Only problem is, it doesn’t exist. The genus *Faba* was “sunk” into *Vicia*, the vetch genus, by Linnaeus in 1753. It is now called *Vicia faba* L., the broad bean, a vegetable more horrible than Brussels sprouts. As far as I can make out, the two names are regarded as synonyms because *Faba* was already a Latin name, the Roman name for beans.

I also pointed out that the three groups formerly recognised as three separate families by, for example, Blackall and Grieve, were now recognised as three subfamilies. The peas became Faboideae, the Acacias and relatives became Mimosoideae, and the Cassias and relatives became Caesalpinioideae. That seemed to be very neat. But, these days, in systematic botany, changes do occur. It seems that the *Cassia* group (Caesalpinioideae) had been used as a sort of a dumping ground for plants that didn’t fit elsewhere. This has been re-examined by “The Legume Phylogeny Working Group”. This group has 97 members belonging to 53 different organisations. In their report published on-line in February 2017, they propose that there are six subfamilies not three. They base their proposal largely on DNA evidence but provide a table summarising anatomical differences between the six subfamilies. The names of the subfamilies are as follows.

Cercidoideae (12 genera, ca. 335 species)

Detarioideae (84 genera, ca. 760 species)

Duparquetioideae (1 genus, 1 species)

Dialioideae (17 genera, ca. 85 species)

Caesalpinioideae (148 genera, ca. 4400 species) ; includes genera of the mimosoid clade.

Papilionoideae (503 genera, ca. 14,000 species)

The first four are tropical trees and vines and belong to genera few of us will ever see. Notice that one subfamily is as small as you can get: one genus and one species. Apparently it is a very strange liana from tropical West Africa.

There are a couple of aspects of their proposal that are a bit contro-

versal. A minor one is that they have chosen “Papilionoideae” as the name for their pea group. That is, of course, a well-known name, but in contrast to the other five groups, the name does not refer to a genus. Rather more controversial is that the Mimosa group (Aciacis and relatives) is not recognised as a separate subfamily. Instead, those plants are included in the Caesalpinioideae. They proposed that it should be recognised at a lower level as a separate tribe.

Will their proposal be accepted? Who knows! It is a pretty powerful and widely representative group so their proposal has to be taken seriously. But many people are rather fond of their Acacias so won't take kindly to their demotion.

If you would like to read about it for yourselves, you can find the report easily – just enter LPWG into your search engine. You will be surprised to see some of the flowers that are classified as Papilionoideae, presumably on DNA evidence. Some of them look more like Cassias than what we come to regard as the standard pea flowers. Makes you realise that the categories do grade into each other.

Blumenteile

German is a very parsimonious, self-sufficient language. Unlike English, it resists importing words from French or Latin or Greek to deal with new concepts. Why think up a new word for glove when “Handschuh” will do the trick? Similarly you can probably guess without any German the meaning of “Krankenhaus” and “Krankenwagen”, just from the sound of them. Comical, clumsy perhaps, but effective. (You can easily translate between languages these days using Google Translate in which these words have been checked.)

It is when we come to describe the flower parts (Blumenteile) that it becomes interesting. German botany students should have no trouble with the theory that the flower parts are derived from modified leaves.

Starting from the outside, the calyx is called der Kelch. Here the Germans use an old word for cup or chalice whereas we use the Latin word. Note also that all German nouns have a gender, here masculine. So again avoiding new words, the sepal becomes das Kelchblatt where “Blatt” means leaf. Similarly the petal becomes das Blütenblatt, and the stamen becomes das Staubblatt where “Staub” means dust. Obviously the anther itself would therefore be called der Staubbeutel – the dust bag. With similar inevitability, the carpel becomes das Fruchtblatt – the fruit leaf. Somewhat ironically, the ovary becomes the masculine der Eierstock – the egg-store.

Buzz pollination and “Bee-purple”

Fans of David Attenborough (just about every wildflower enthusiast) will remember him talking about buzz pollination. To demonstrate it, he brings a tuning fork, tuned to the correct frequency, up to the flower in order to induce it to eject its pollen.

The tuning fork mimics the action of several species of bee that also vibrate their wing muscles at the appropriate frequency and this causes the anthers to shed their pollen. These flowers don't provide nectar; the pollen is the reward. About 400 species of plants on the south west are buzz pollinated. Several species of native bee, such as the blue-banded bees, can do it. Honeybees cannot, but bumblebees can. The anthers of buzz pollinated flowers are typically long and thin and have a pore at the top end. This flower structure is common in Solanaceae species including tomato – and this is why growers of glasshouse tomatoes would rather like to import bumble bees into mainland Australia.

If you are to rely on buzz pollination, you need to attract the appropriate bees to your flower. It is therefore a good idea to adopt a common colour scheme and a similar structure. Many buzz pollinated flowers mimic the solanum colour scheme, that is, blueish-mauve petals (and sepals for monocots) and bright yellow anthers.



Solanum symonii showing typical *Solanum* colour scheme.



Cheiranthra filifolia is an attractive member of the Pittosporum family. For obvious reasons, its common name is Finger Flower or Five Finger Flower. Not, as I read in one brochure “Singer flower”.



Calectasia narragara, Star of Bethlehem (left) is a member of the Dasypogon family. *Conostephium pendulum*, Pearl Flower, (right) is a member of the Erica family. Its flowers hang downwards in common with several other winter-flowering plants – an adaptation to keep the pollen dry in our wet winter.

(Football fans will have noticed that these are the colours of the West Coast Eagles.) Buzz pollination also occurs in *Conostephium* (Pearl Flowers) and there the colour scheme is white and purple. (These colours are also used by that other WA football team. That must have some significance!)

However buzz pollination also occurs in yellow flowers such as *Hibbertia*, *Senna* and *Labichea*. And that poses a problem. Why are blue petalled flowers used by many species but yellow petalled flowers used by others? Before trying to answer this question, I had better tell you a little more about these three genera.



Left *Hibbertia huegelii* and right *Labichea punctata*. These plants often grow near each other and probably use the same pollinators.



Senna artemisioides ssp. *filifolia*

Hibbertia will be familiar to you. It is a genus with about 120 species in Australia and about 85 in Western Australia. The genus takes its name from George Hibbert (1757-1837) an eminent merchant and amateur botanist. Here, in the south-west, there would be few patches of bushland without at least one species of *Hibbertia* present. For all but three species of *Hibbertia*, the flowers are yellow. For the three exceptions, they are shades of orange.

Senna and *Labichea* are both legumes. *Senna* has had a complex taxonomic history. For a long time, it was included in *Cassia*, and Australian species were thought to belong to that genus. That is why the common name of many of the species is as a cassia. For example, *Senna artemisioides* is known as silver cassia.

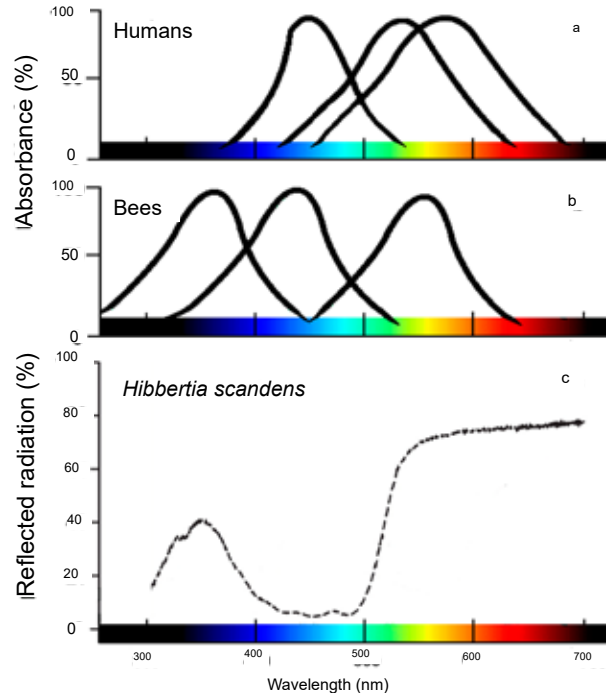
As currently recognised, *Senna* has about 350 species with about 80% of them occurring in America. WA has about 40 species, mostly occurring outside the better-watered areas of the south-west. The “standard” number of stamens is 10. However, in many species, three of them are infertile and the remaining seven may be modified so that two deposit their pollen on the back of the bee and the others provide her with the reward.

Labichea is a much smaller genus with about 14 species, nine of which occur in Western Australia with the remainder in Queensland and the Northern Territory. It is named for Jean Jacques Labiche, second lieutenant of Uranie on Freycenet’s voyage. It differs from *Senna* in that there are only two stamens. Of our nine species, only two are common in the south-west. These are *L. punctata* (with anthers of similar size) and *L. lanceolata* (with one anther bigger).

It is easy to walk past them thinking the flowers are “just” another *Hibbertia*. And that is worth thinking about. Why the similarity? To have produced such similarity, there must have been a very strong selection pressure and considerable advantage to the plant. This selection

pressure was exerted by bees who also recognise the *Solanum* colour pattern. The answer to this question may be in the way that bees and humans perceive colour.

Bees and humans both have three-colour vision. However, we see different parts of the spectrum. Bee vision is shifted to shorter wavelengths; they do not see red and for them the longest visible wavelength is yellow, but they see well into the ultraviolet down to wavelengths that are invisible to us. When we see a mixture of the long wavelength red, and the short wavelength blue, we interpret the resulting colour as purple. When bees see a mixture of their long wavelength, which is yellow, and their short wavelength ultraviolet, they also interpret it as a different colour which is sometimes referred to as “bee-purple”.



Comparison of human vision with bee vision and with the colour spectrum of *Hibbertia scandens*. (Parts a and b redrawn from: <http://www.cals.ncsu.edu/course/ent425/tutorial/colorvision.html>. Part c redrawn from: Parallel evolution of angiosperm colour signals: common evolutionary pressures linked to hymenopteran vision. Dyer et al. (2012).



We see the flower on the right but bees see something like the flower on the left (*Hibbertia scandens*).

How many of these “yellow” flowers are really bee-purple? We don’t know. We do know that the few that have been tested all qualify. Dyer (1996) included 6 species of *Hibbertia* and one *Cassia* (Now referred to as a *Senna*). All reflected UV light from their petals but not from their anthers and would therefore appear to bees something like the picture above. For them, the colour scheme is “super-solanum”.

And what about David Attenborough’s tuning fork? It was tuned to middle C (261 Hz). Does the buzzing have to be at that particular frequency? Certainly not. Vicky Powys, who is well known for her work on recording bird songs, has recorded the buzzing frequency of seven different native bees, ranging in size from a tiny 5 mm-long reed bee, to a carpenter bee quite a bit bigger than a honeybee. They were working on *Hibbertia obtusifolia* flowers at Capertee Valley NSW. Within one species there was often a considerable range: in one case from 157 to 260 Hz. Over the whole seven species, the range from minimum for one species to maximum for another was from 157 to 331 Hz. That is just over one octave, in musical terms from E3 to E4, with middle C roughly in the middle! Bee size was not related to buzz pitch; the smallest and the largest bees were both high pitched. All of the pitches used appeared to be effective: all of the bees were covered in pollen.

Dyer, AG, Boyd-Gerny S, McLoughlin, S, Rosa, MGP, Simonov, V, Wong BBM (2012) Parallel evolution of angiosperm colour signals: Common evolutionary pressures linked to hymenopteran vision, *Proceedings of the Royal Society B: Biological Sciences* 279(1742):3606-3615

Powys, V (2016) Buzz-pollination of *Hibbertia obtusifolia* by Australian native bees - a comparative study of bee buzzing behaviour in Capertee Valley, New South Wales. caperteebirder.com/web_documents/powys_australian_bees_090117.pdf

