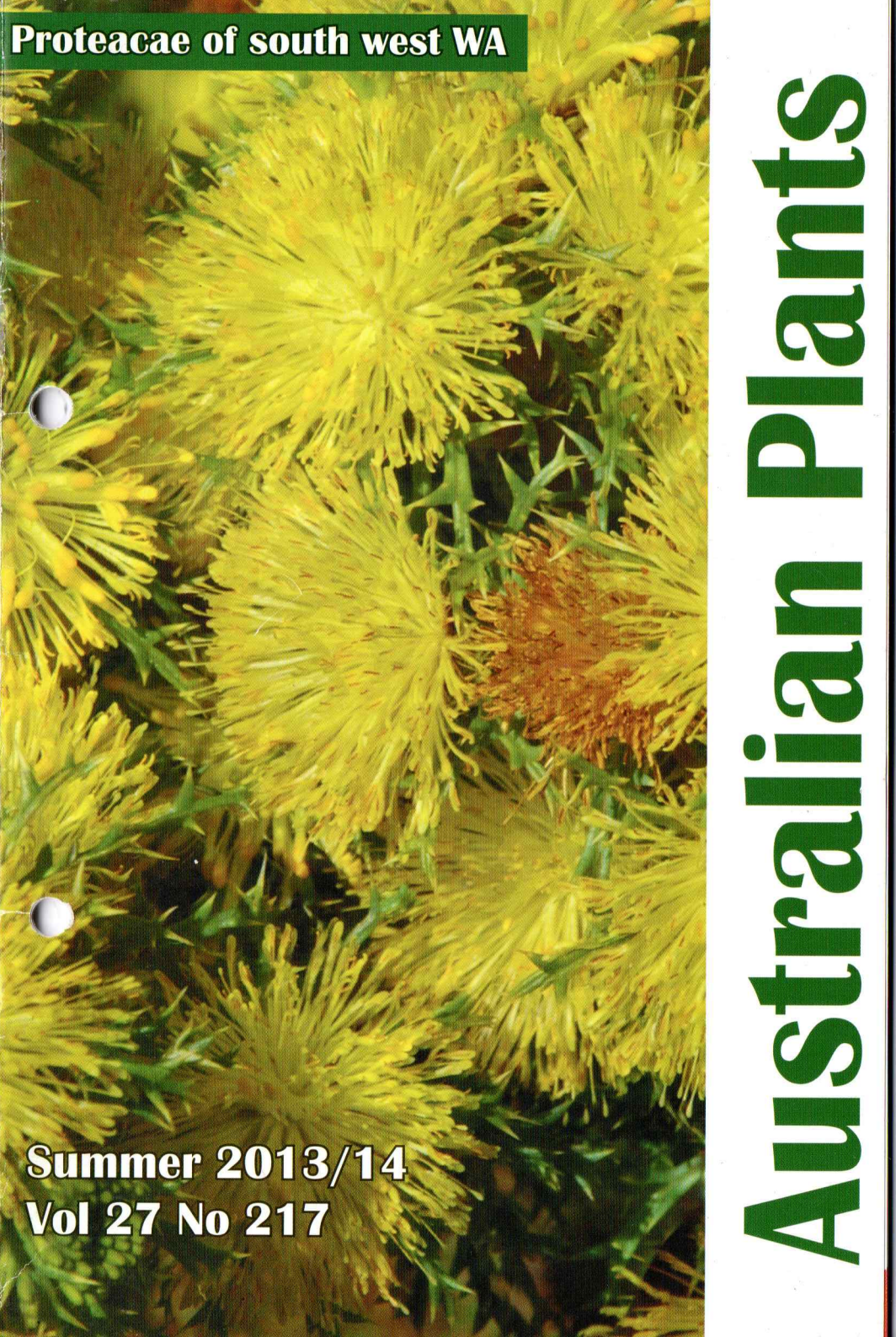




Proteaceae of south west WA

Australian Plants

Summer 2013/14
Vol 27 No 217

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All photos in this issue by Jim Barrow unless otherwise indicated.
Cover: *Dryandra polycephala*

Australian Plants is published quarterly to promote knowledge of Australian native plants. Contributions and offers to produce an issue are welcome. Please contact:

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Australian Plants No. 217 Issue of Volume 27 which comprises issues 214 - 221. Published quarterly and available nationally in 3000 copies by the Australian Plants Society NSW Ltd

© Australian Plants Society NSW Ltd 2013 ABN 87 002 680 408 ISSN 0005-0008

Printed by Elect Printing, Fyshwick, ACT Print post approved 100009857

Introduction

Jim Barrow

Jim spent nearly 40 years working for CSIRO and "retired" as a Chief Research Scientist in 1992. Post retirement he continued his scientific work but also devoted time to his wildflower interests. He is a past president of the Wildflower Society of WA.

I think it is a pity that South Africa has taken "ownership" of the *Proteas*. That is where the *Protea* genus comes from so we cannot really complain, but here, in the south-west of WA, the *Proteaceae* family is everywhere. You can hardly expect to visit a patch of bushland without encountering several members. Not only are they an important component of our flora, they have put their stamp on our landscape by secreting organic acids (mainly citric acid) from their roots, temporally dissolving iron oxides, but leading ultimately to large accumulations of gravel in many of our soils.

They are more than merely present; they are conspicuously present. The flowers are often gaudy. If they were people we would berate them for being showoffs! But they are plants so we can simply enjoy their beauty.

Fourteen genera are common here. The largest – *Banksia*, *Dryandra*, *Grevillea*, *Hakea* – are well catered for in comprehensive books, but that leaves a lot of plants for which information is not quite as readily available. The aim of this issue is to provide a summary, in which the "rest" are emphasised. Consequently, the space allocated to the individual genera bears little relationship to the number of species in the genus. Rather, space has been allocated on the basis of a subjective assessment of how well that group is already well known, how showy the flowers are, and whether further information can be easily obtained elsewhere.

Did you know that only a minority of *Conospermums* are "Smoke" Bushes, that is, that their flowers look like drifts of smoke through the bush? Did you know how to distinguish *Conospermum* from its sister genus *Synaphea*? Did you know that not all *Hakeas* protect their seeds with hard woody fruits? Some use deception with modified leaves that look rather like their fruit. And did you know that there are five sets of sister genera? Perhaps you also thought that *Dryandra* has been submerged into *Banksia*. Not necessarily. Read on.

The Proteaceae: overview

Here is a question for you: where does the name "Proteaceae" come from? If you think that the family was named by Linnaeus, I am afraid you are wrong! Linnaeus named the *Protea* genus. The name is derived from that of the Greek god "Proteus" who could change his shape at will. If you could catch him, he would foretell your future, but in an ancient version of catch 22, if you did succeed in catching him he would instantly change his shape. Consequently no one could really foretell the future – as economic forecasters regularly show us.

Ironically, Linnaeus probably never saw a live specimen. His knowledge was confined to plates by Boerhaave, who had visited South Africa. It has even been suggested that he misunderstood the plates thinking that two plants were one. He could not have known at that time just how diverse the family really is. The family name is ascribed to the French botanist Antoine Laurent de Jussieu who revamped the Linnean system to use multiple characters to define groups. This was a significant improvement over the original system of Linnaeus, who classified plants into classes and orders based on the number of stamens and pistils.

There are about 1600 species in the family. It is a Gondwanan family, occurring in Africa, Madagascar, Australia, Central and Southern America, India, New Zealand and several Pacific islands. Australia has more than 1100 species and more than 60% of these occur in Western Australia, mostly in the south-west. So ours is very much a Protean environment.

How is the family defined? Other flowering plants follow a pattern in which there is an outer whorl of flower parts called sepals which often have a protective role. Between the sepals, and inside them, there is a second whorl of flower parts called petals which often have an "advertising" role. And between the petals, there is a whorl of male flowering parts called stamens. The stamens and the sepals therefore fall in a similar position around the "clock". For monocotyledons, each whorl tends to have three parts; for dicotyledons, five parts. This basic arrangement is modified in a great many ways. For example in *Eucalyptus*, the sepals and petals are modified into a bud-cap and the number of stamens is greatly increased.

The flowers of Proteaceae do not have separate petals and sepals. Rather they have just one whorl and the individual parts are called tepals. The stamens and the tepals are in the same position around

the clock and the stamens usually adhere to the tepals. This design could have evolved from the basic design of a dicotyledon flower with the loss of the petals, perhaps with their conversion to nectaries, plus a reduction from five parts to four. This Procrustean approach has been tried several times with suggestions that the Proteaceae are derived from one of several diverse groups. However, such a highly modified flower does not fit in with the very simple female part, which consists of a single carpel. Alternatively, it has been argued that Proteaceae have always been that way. They are not a branch on the tree of life but a strong shoot from near its base. This alternative has been supported by studies using DNA and it is now accepted that Proteaceae derive from an early experiment in the evolution of flowering plants. Nature was just practising when She invented them. But it was a mighty interesting practice and gave rise to some fascinating plants.

One of the neat tricks the family has evolved is to use a "pollen presenter". The tip of the stigma is modified in such a way that, as the flower opens, it picks up pollen from the anthers. Initially the stigma does not react to that pollen but merely presents it to a passing pollinator. Subsequently, the stigma becomes sensitive to pollen. The drop-off point and the pickup point for pollen are therefore in exactly the same spot thus increasing the likelihood of pollen transfer.

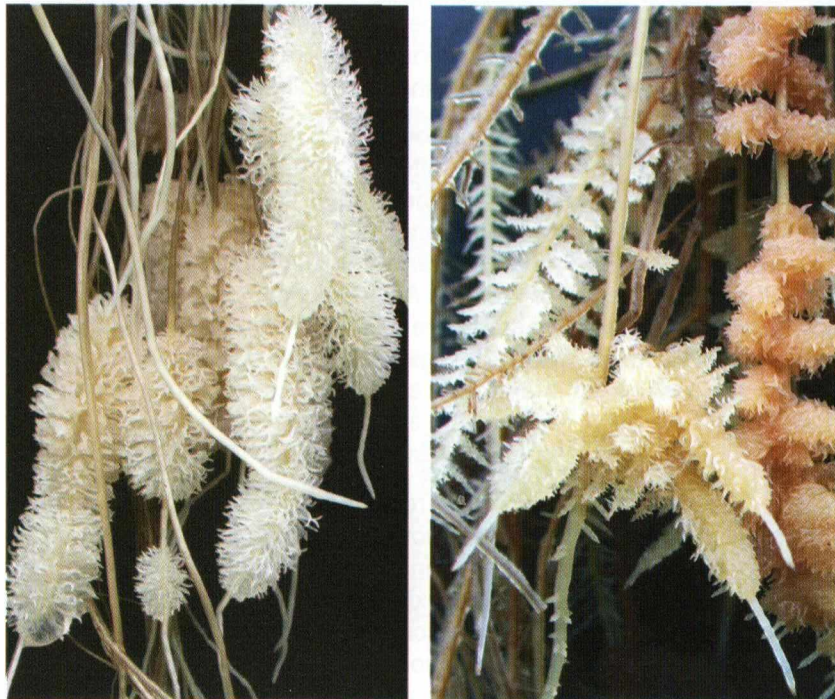
Because Proteaceae have been around for a very long time, they have been able to evolve into many different forms and to occupy many different niches. Within Australia, they range in form from tall trees to ground-hugging prostrate plants and they occur in the mountains of Tasmania (*Bellenden montana*), and the rain forests of Queensland as well as the kwongan of Western Australia. Apart from the consistent flower anatomy, there are therefore few generalisations that apply to the whole of the family. Within a region, however, rather more generalisations are possible.

Here, in the south-west, the plants have evolved to cope with a very low phosphorus environment. One of the strategies used is to grow "cluster" roots. On regions of the root, many closely spaced rootlets branch at right angles from the root and so virtually enclose a small region of the soil. The rootlets then secrete organic acids, especially citric acid, and this dissolves iron oxides and mobilises soil phosphate. Formation of cluster roots only occurs at low phosphate supply. The structures themselves are fairly short lived and, despite the secretion of inhibitors, the citric acid does not persist in soil for very long. The iron dissolved by the citric acid and phosphate released by the acid but not taken up by the plants, therefore return to the insoluble state

and aggregates of ironstone gravel therefore slowly grow. Ironically the long-term effect of this strategy is to make the soil phosphate availability ever lower, but, of course, this gives the plants that use this strategy an increasing advantage over plants that do not use it. The formation of cluster roots is so widespread within the family that they are often referred to as "proteoid" roots. However, similar structures, and strategies, have evolved many times and are present in widely diverging groups including some legumes, and it is therefore better to use the general term "cluster" roots. By the way, analogous structures have also evolved in rushes and sedges and in these groups the structures tend to be carrot shaped and are therefore referred to as "dauciform" roots.

Some members of the family, especially Banksias, have gone even further to evolve "compound clusters". That is, the primary rootlets of the cluster develop secondary rootlets thus enclosing a region of the soil even more completely. This is presumably an adaptation to super-deficiency conditions.

Cluster roots are so widespread within the family that it is commonly



Cluster roots. Simple clusters on *Hakea prostrata* (left) and compound clusters on *Banksia grandis* (right).
Photos: Michael Shane

stated that Proteaceae do not form mycorrhizas – associations with fungi that help them take up nutrients. This is not true. At least one species, *Hakea verrucosa*, has been shown to form Vesicular Arbuscular (VA) mycorrhizas. It grows in soils that are high in nickel and cluster roots may give too much access to this.

Not only are our plants good at getting phosphate from soil, they are also remarkably good at using it for growth. Many of them grow quite happily at leaf concentrations of phosphate about one tenth of that regarded as minimal for other plants. They do grow quite slowly but the limitation on growth seems to be their basic physiology rather than the shortage of phosphate. If the phosphate supply is increased many of them, but not all, are unable to cope. One reason for this is that many of them are unable to "down regulate" phosphate uptake. Most plants have a mechanism that says in effect to the roots "Hey! I am doing okay for phosphate. Ease off on the uptake a bit." Some of our plants do not have that ability. If phosphate is there, they just keep on taking it up without any consideration of whether they need it. Perhaps they have lost this mechanism because in the evolutionary history they did not ever have occasion to use it. Maybe there is also a connection with the pathway that helps plants extract phosphate from dying leaves – they are better at recovering it. In any case, a little bit of phosphate is too much.



Left. *Hakea prostrata* is poor at down regulating phosphate supply when it is in excess. It is a widespread upright plant (despite its name) and grows on a variety of soils.

Right. *Grevillea crithmifolia* is a very vigorous plant mostly growing on soils derived from coastal limestone with a relatively high (by WA standards) phosphate supply. In contrast it is good at down-regulating phosphate supply.

Plants photographed within a few metres of each other in Kings Park, Perth.

Relationships within the family

In the south-west of Western Australia, 14 genera are widespread. To be able to recognise a genus it is helpful to understand the relationships between the genera. In the following table I have set these relationships out in a simplified form. I have confined the table to the genera that occur here, leaving out the subfamilies and the tribes that do not occur. This gives perhaps a biased picture of the family but an easier one to interpret within the local context.

Sub-family*	Tribe	Sub-tribe	Genus
Persoonia	Persoonia		Persoonia
Protea	Conospermum	Stirlingia	Stirlingia
		Petrophile	Petrophile
		Isopogon	Isopogon
	Conospermum	Conospermum	Conospermum
		Synaphea	Synaphea
Grevillea	Franklandia	Franklandia	Franklandia
		Adenanthos	Adenanthos
	Helicia	Helicia	Xylomelum
	Macadamia	Lambertia	Lambertia
	Grevillea		Grevillea
			Hakea
	Banksia	Banksia	Banksia
			Dryandra

* Modified from *Flora of Australia* Volume 16 (1995). I have simplified the names of the sub-families and the tribes/sub-tribes by leaving them in the form of the genus to which they refer. The sub-familles should have the suffix "oideae", so that for example, "Persoonia becomes "Persoonioideae". The tribes/sub-tribes should have the suffix "eae" so the Persoonia becomes "Persooniaee".

Note that there are five sets of "sister" genera: Petrophile and Isopogon; Conospermum and Synaphea; Franklandia and Adenanthos; Grevillea and Hakea; and Banksia and Dryandra (more on this last pair later). I have coloured these pairs with the same scheme so they are more apparent.

The genera Persoonia

This is a fairly large genus with about 100 species, slightly less than half of which occur in WA. It was named in 1798 by Sir James Edward Smith, founding president of the Linnean Society. The name honours Christian Hendrik Persoon, a botanist and mycologist who was born in Cape Colony. Because it occurs in all states, it will be familiar to most readers. They are commonly referred to as "Geebungs" in the eastern states but in the West are known as "Snotty-gobbles". The origin of this name appears to be just what you would expect: the fruits are edible if somewhat mucilaginous. Strictly speaking, this name is supposed to only apply to one species, *P. saccata*, but common WA usage seems to apply it to all species. "Snotty-gobbles" is a delightfully evocative name but is a little unfortunate because it is used for a range of different plants elsewhere.

It is a genus of shrubs or small trees. The flowers occur in inflorescences in the axils of the leaves or can be solitary in the leaf axils of a continuing shoot. The tepals are usually yellow and are thick. They narrow towards the tip. The stamens adhere to the tepals. The fruits are characteristic. They are described as succulent drupes; that is, the same anatomy as a plum or an apricot — a stone surrounded by succulent flesh.

The genus is thought to represent the more basal elements within the family.



"Snottygobble" (as it is known in WA), Persoonia saccata flowers. Photo: Eddy Wajon



Persoonia quinquenervis unripe fruits.

Stirlingia

This is a small genus, with only seven species, confined to WA. It was named by Stephan Endlicher, an Austrian botanist, numismatist and Sinologist to honour Capt James Stirling, founder and first governor of the Swan River Colony. He had sailed up the Swan River, kicked the soil on the riverbank, and decided that Western Australia was a paradise of fertile soils. The soils of the riverbank of the upper Swan are indeed fertile, but they are about the only soils in Western Australia that are. He returned to England and sold the story that Western Australia was an ideal place for younger (and therefore landless) sons to become land-owning gentlemen.

The early days of the colony were so disastrous that the colonists eventually petitioned the British government to support them by sending convicts.

The flowers of *Stirlingia* are arranged into nearly spherical heads. They are yellow or tinged red-brown and are subtended by a small bract.



S. latifolia. Photo: S. Frawley



Flower buds of *S. latifolia*. Yellow form left and red-brown form right.

The leaves divide into two branches several times. (They are "dichotomously divided".)

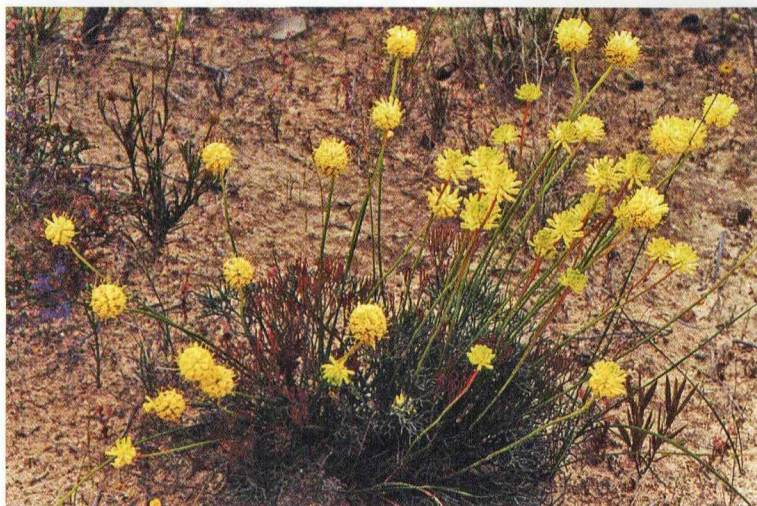
The most widespread species is *S. latifolia*, meaning "broad leaves". The leaves are not especially broad but are broader than the other species. It is a fairly robust shrub, growing up to 1.5 m tall. Its common name is "Blue boy". In the early days of settlement, colonists built huts of "wattle and daub". That is, they wove supple branches to make the basis of a wall and then plastered them with mud. When they used this plant, the mud supposedly turned blue.

Its flowers are widely used as background material in flower arrangements.



When *S. latifolia* fruit mature, they are covered with dense silky hairs and mature branches are often dyed with garish colours and used in dried flower arrangements. No thanks!

The leaves of the other six species are much narrower; indeed they are terete. They are smaller plants and the flowers are born on slender stems. For four of the species, the leaves are remarkably soft yet persist through the summer. Because of this characteristic, the plants are described as "herbs", as far as I know, the only members of the family to be so described.



One of the "herbs" is *S. simplex*. The name reflects its (mostly) undivided flowering stem.



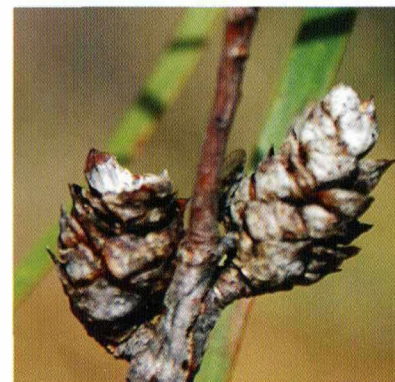
Stirlingia tenuifolia Left. The base of the plant showing the much divided, terete leaves. The flowering branchlets are also divided and this contrasts with the similar *S. simplex* for which the branchlets are not divided. Photo: Steve Pearson
Right. The inflorescence. Note that the lobes of the tepals are reflexed, the filaments for the anthers are short, and the expanded stigma. Photo: Steve Pearson



Petrophile

This genus has 53 species, 47 of which occur in Western Australia. Ten of these were first recognised in 1995 with the publication of volume 16 of the *Flora of Australia*. The name comes from the Greek "*petra*" a rock, and "*phileo*" to love: the first species collected came from rocky habitats. Pronouncing the name sometimes poses a challenge. An important clue comes from the fact that this genus was for many years spelt as *Petrophila*, and most of the species were originally given that name. However, the current spelling was instituted when it was recognised that it had priority. The rules of Latin pronunciation say that emphasis should be given to the second last syllable of each of the components of the name. According to these rules it should be pronounced: PETroFILLa, but PetROFilla is widely used,

Petrophile and *Isopogon* are sister genera. Both have numerous flowers, a true floral tube and a characteristic pollen presenter. In *Petrophile*, the cone scales become woody and persist; in *Isopogon* they do not.



Left. Cones of *Petrophile heterophylla* showing the persistent scales.
Right. Cone of *Isopogon divergens*.

Petrophile is truly protean in as much as it can take many forms. Leaves can be simple or deeply divided, flat or terete, sharply pointed or blunt. The inflorescences can be in terminal heads or in the axils of the leaves. Flowers are most often yellow(ish) but several species are pink or have pink forms and some species are recorded as white, cream and even purple.

The clue is to always look for the fruits. As shown in the pictures above they are quite characteristic.



Petrophile imbricata



Petrophile divaricata



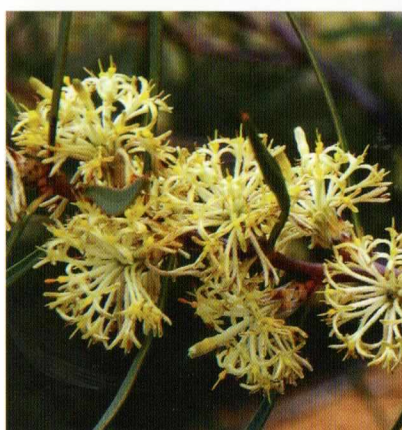
Petrophile serruriae



Petrophile linearis



Petrophile brevifolia



Petrophile heterophylla

The opposite page illustrates some of the range within the genus. They show: flower colour ranges from cream through yellow to pink; many of the inflorescences are terminal, but one is in the axils of the leaves; and the leaves include simple and multiply-divided forms, flat and terete.

Prior to the publication of the *Flora of Australia* Volume 16 in 1995, *P. imbricata* would have been classified as *P. ericifolia*. However, in that publication, eight new species and one subspecies were split off. The one illustrated, *P. imbricata*, is distinguished by the long white hairs fringing the bracts around the base of the inflorescence. If you do see a plant that appears to be a member of the *ericifolia* "group", check whether the bracts around the inflorescence are sticky. It is an important characteristic in the classification, but not one that can be readily discerned later from a photograph.

P. divaricata is a shrub to 2 m tall growing in lateritic soil from Eneabba southwards to Albany and then eastwards to Fitzgerald River. Its rather unfriendly leaves divide into equal branches and are tipped with a sharp point. These contrast with the soft red new growth. Picture taken at Dryandra Woodland, north of Narrogin.

P. serruriae is named after a South African genus: *Serruria*. It has crowded multiply-divided leaves and carries the inflorescences in terminal clusters or in the axils of the upper leaves. It extends from near Geraldton to near Albany. It is reported that pink forms of the flowers also occur.

P. linearis is probably the only member of the genus with a true common name — one that is widely used: Pixie Mops. Indeed this name has entered into everyday use and is even used for the name of a kindergarten. The plant is common on the coastal plain and the Darling Range from about Jurien to Yallingup. Its leaves are flat but narrow and usually strongly curved.

P. brevifolia is a low multi-stemmed spreading shrub. It extends from Kalbarri National Park to near Ongerup. Its leaves are simple, terete and end in a pungent point. When infused in hot water, the flowers are said to give off a brilliant yellow colour.

P. heterophylla is one of the prettiest members of the genus. Its creamy yellow flowers are born in the axils of the leaves of a spindly shrub which may be up to 2 to 3 m tall and therefore one of the few members of the genus you can walk under. It grows in gravelly soils from near Chittering (north and east of Perth), southwards to near Albany and then eastwards to about midway between Ravensthorpe and Esperance.



Isopogon formosus



Isopogon dubius



Isopogon divergens



Isopogon linearis



Isopogon sphercephalus



Isopogon teretifolius

Isopogon

This genus has 35 species, 27 of which occur in Western Australia. The meaning of the genus name is obvious: equal beard. However, just which "beard" is equal is less certain. Perhaps it refers to the tufts of hairs at the apex of the tepals of some species or maybe it refers to the hairs of more or less equal length which cover the nut on all sides.

Its leaves are just as variable as those of its sister genus (*Petrophile*). They may be simple or compound, terete or flattened. However, the inflorescence is always a dense spike. Leaf shape is therefore important in diagnosing the species. Pink is the favourite colour of the genus. About 80% of the species are pink or have pink forms. Many of them are very striking. When my mother (a roses and dahlias lady) visited us in Western Australia, she could not accept that such pretty plants could grow in the bush. Somebody must have planted them!

I. formosus (rose cone-flower) has terete leaves, grooved, rigid and sharply pointed. It grows in the Albany area and northwards including the Stirling and Porongurup ranges.

I. dubius (also called rose cone-flower) differs in that its leaf blades are flat. It also has a more northerly distribution occurring mainly on the Darling Range extending from near Cockleshell Gully south to near Narrogin. What an unfortunate name for such a pretty flower! It originated with Robert Brown who originally called it *Petrophile dubia*. Just what he was dubious about is not clear.

I. divergens (spreading cone-flower) has long terete leaves, usually divided. It is widely distributed over a range of rainfalls from as far north as the Murchison River to near Lake Grace.

I. linearis leaves are simple, flattened, with thickened margins and sharp tips. The plant grows from just south of Geraldton (Burma Road Reserve) south to near Moore River and inland to Wongan Hills.

I. sphercephalus is ostentatiously not pink. Its leaves are simple, flat, and with a prominent mid-rib underneath. It grows in sand and laterite from near Jurien southwards to near Pemberton.

I. teretifolius (nodding cone-flower) has terete leaves that divide up to three times into two or sometimes three equal sections and finish with a sharp tip. The inflorescence usually "nods". It is found from Mt Lesueur to the south coast.

Conospermum

This is a genus with 53 species of which 42 occur in WA. The name means "cone seed" and refers to the shape of the fruit. They are however commonly called "Smoke Bushes" because, for some species, the flowers look like a drift of smoke through the bush. This is a bit unfortunate because only 20 of the species have woolly flowers to give them the smoky appearance.

Conospermum and *Synaphea* are sister genera. For both of them, the flowers are zygomorphic (one side is a mirror image of the other), though this is not strongly marked in some species of *Conospermum*. Again for both of them, one anther is sterile but it is the lower anther in *Conospermum* and the upper one in *Synaphea*. However, you do not have to look at the anthers to distinguish them. For *Conospermum*, the flowers are white, blue and grey or pink but never yellow, and the leaves are always entire. Indeed, the flowers are so diverse that it can be difficult to recognise the genus, but, on the other hand, the diversity makes it easier to identify the species. For *Synaphea* the flowers are always yellow and the leaves are usually dissected. It is therefore easy to recognise the genus, but not so easy to identify the species.

Conospermum is divided into three sub-genera. For two of them, the tepals are almost equal in length. The lower parts of the tepals are joined to form a tube and for one of the sub-genera, the free part and the joined part are about equal in length. This sub-genus contains only three species, two of which are uncommon. The most common member is *C. flexuosum*. It is fairly widespread between Busselton and just east

of Albany often growing in areas subject to flooding. It is a much branched shrub with pale blue to white flowers. True leaves are often absent from mature plants with the flattened stems performing the role of the leaves.



Conospermum flexuosum

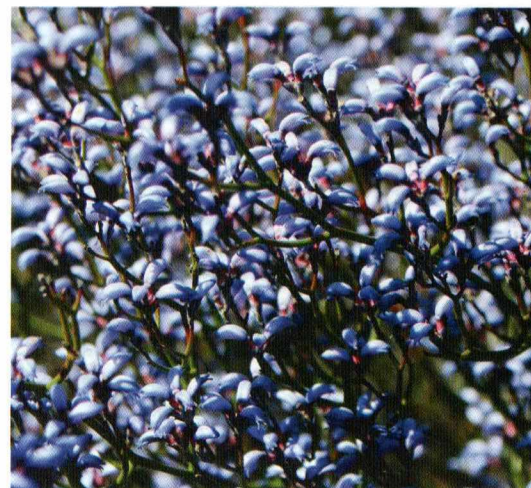
For the second sub-genus, the free part of the tepals is much longer than the joined part. Again this is a small group with only three species, none of which fit preconceptions of what a smoke bush should look like. *C. teretifolium* is a multi-stemmed shrub to about 1.5 m with (obviously) terete leaves. The creamy white flowers are about 25 mm long. It occurs from Albany to east of Esperance.



Conospermum teretifolium

The remaining 47 species fit into the third sub-genus. For these, the "top" tepal is relatively broad and the other three tepals spread to form a bottom lip. This sub-genus is then divided into five sections. In the first section, there are eight species, seven of which occur only in WA. In this section, the flowers occur in a loose, much-branched inflorescence (paniculate).

This section includes *C. eatoniae* (left), a tangled, branching shrub for which leaves are only present in young plants. The degree of branching increases as the plant ages. It is a particularly spectacular species with vivid blue flowers. It occurs in the wheat belt near Coorow and Quairading.



This section also includes the bizarre *C. glumaceum*, for which the inflorescence ends in a head-like dense spike. The cream bracteoles below the flowers are much larger than the flowers, as can be seen in the "thumbnail" below. The effect is that the shrub seems to be covered in showy cream "flowers" that usually droop. The bracteoles turn brown with age. The plant occurs from Eneabba southwards to near John Forrest National Park, east of Perth.



Conospermum glumaceum



The second section within this sub-genus has six species, five of which occur in WA. They are small shrubs with flowers in dense heads held on a non-leafy stem, above the plant and with the individual flowers facing outwards.

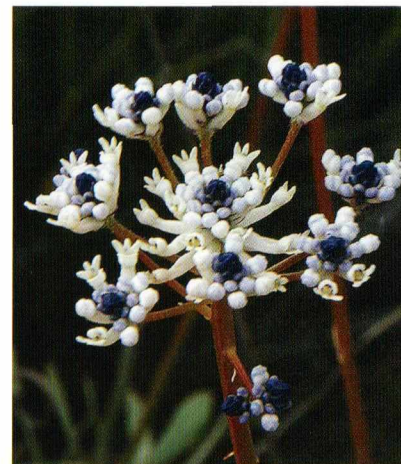


Conospermum densiflorum



C. huegelii

This group contains some very pretty members which, incidentally, show the characteristic tepals of the sub-genus very clearly. *C. densiflorum* has a limited range from Jurien southwards to just north of Perth. *C. huegelii* occurs in the Darling scarp and foothills. *C. brownii* is widespread in the eastern part of south-western WA from about Wongan Hills to Lake Grace. *C. acerosum* occurs on sandy soils from the Murchison River south to Cape Leeuwin.



Conospermum brownii



Conospermum acerosum

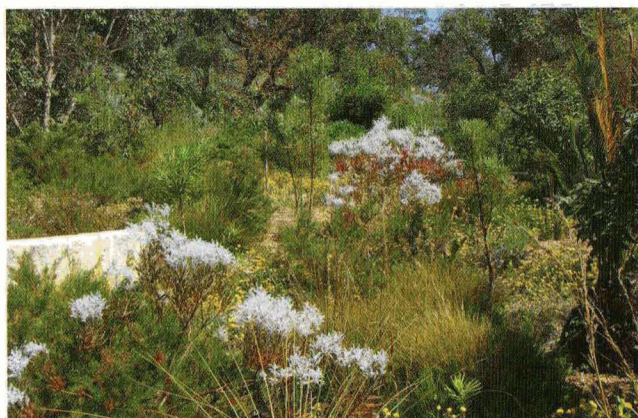
The third section has only three species all of which occur in WA. The stems are leafy and the flowers are in a simple spike in the axils of the leaves. *C. amoenum* is a spreading shrub to about 1 m tall. It is common in the Darling Range from just north of Perth southwards to Waroona.



Conospermum amoenum

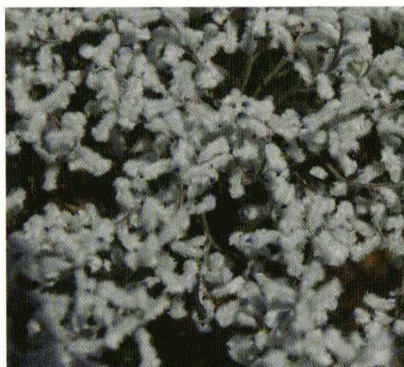
The fourth section within this sub-genus has ten species only one of which occurs in WA (*C. nervosum* is found near Eneabba). The stems are leafy and the flowers are in a (nearly) flat topped cluster. (I do not have a picture.)

The fifth and final section are the "smoky" smoke bushes; the flowers are woolly or silky. There are 20 species in this section. You can see why they are called smoke bushes in the photo below in which *C. triplinervium* is seen growing in the garden of the Ecology Centre in Bold Park near the office of the Wildflower Society. This species is a small tree to about 4 m tall and is common near Perth. It is one of the few species of the genus that has been successfully grown in gardens.



Conospermum triplinervium

Below are two typical members of this group. The appropriately named *C. floribundum* grows on sandy soils between Albany and the Stirling Range and eastwards. *C. distichum* occurs east of Ravensthorpe but also north to near Narrogin.



Conospermum floribundum



Conospermum distichum

Synaphea

In 1985 this was a small genus with only ten species, but with the revision of the genus by Alex George for the *Flora of Australia* in 1995, the number of species expanded to 50 and several more have been described since. All of them are confined to WA. Several of the new species are, however, of very restricted distribution. The best example of this is *S. quartzitica* which is known from a single locality on a quartzite hill. The genus name is from the Greek "synaphe" meaning a connection and refers to the detailed anatomy of the flower.

The genus has the honour of containing one of the first two species of Australian plants to be named after the Linnaean binomial system. The catch is that it was thought to be a fern from Java and was therefore labelled as *Polypodium spinulosum*. It may have found its way to Java as a result of the Vlaming voyage of 1697. After a somewhat complex naming history, this plant is now known as *Synaphea spinulosa*.

The flowers are always yellow. When the flower opens, the anthers and the stigma are held tightly together under tension; on being touched the stigma flicks across and the pollen is ejected. Thus the style end is not a passive pollen presenter as in many members of the family. A similar mechanism occurs in *Conospermum*.



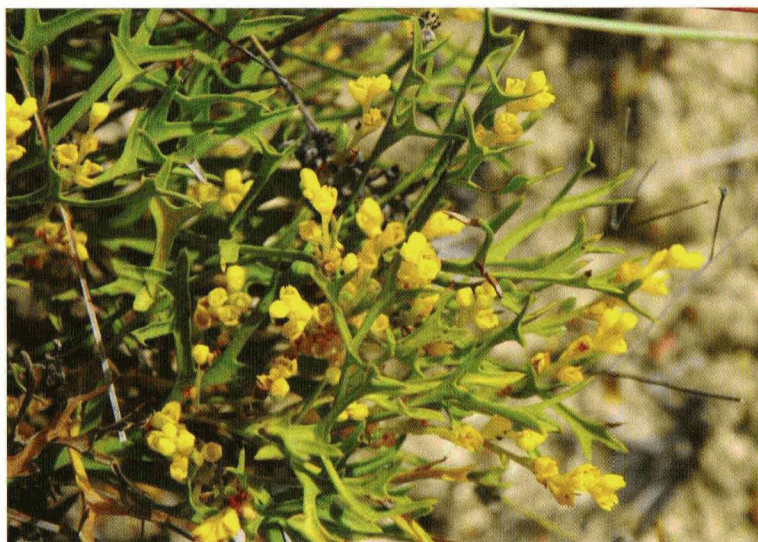
Synaphea petiolaris

Leaf shape is extraordinarily complex and varied. However, the first seedling leaf and the regrowth leaves after burning are always simple and entire. This is one reason why identification of individual species depends heavily on detailed anatomy of the flower. The picture on the left shows a plant of *S. petiolaris* re-growing in a gravel soil after a controlled burn in the Jarrah Forest approximately 12 months earlier. Note that the first regrowth leaves are simple and the characteristic leaf shape returns as the plant develops.

The following pictures illustrate some of the range within the genus. The flowers may be so bright and attractive that they almost obscure the rather prickly leaves as in *S. spinulosa*, a widespread plant occurring from Kalbarri to Bunbury and inland. In contrast, *S. polymorpha* is mostly restricted to within 30 km of Albany.



Synaphea spinulosa

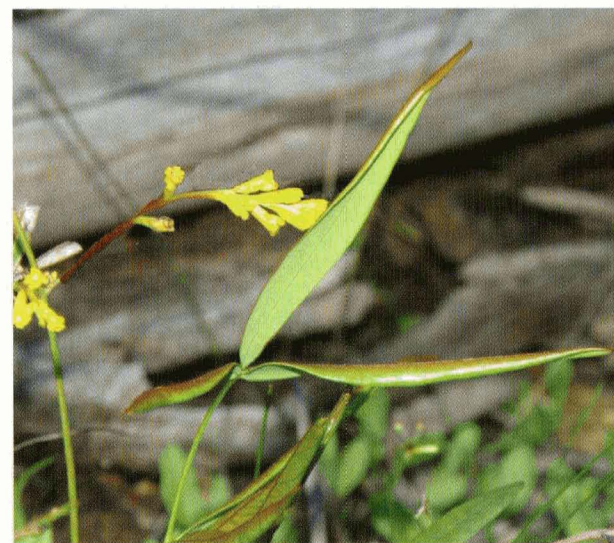


Synaphea polymorpha

These pictures illustrate some of the range of leaf shapes. The leaves of *S. flabelliformis* are fan-shaped. The bush looks rather untidy because of the accumulation of old leaves. In contrast, the deeply divided leaves of *S. pinnata* with the underside a lighter colour look rather more like a clover than a Proteaceae.



Synaphea flabelliformis



Synaphea pinnata

Franklandia

This genus has only two species, both confined to the south-west of WA. It was named after Thomas Frankland, an English botanist.

The most widespread species is *F. fucifolia*. It is a small, erect shrub with prominently-displayed, lanoline-scented flowers that are dull-gold spotted with red. It occurs on the south coast and extends as far north as Kojonup with outliers in the Whicher Range. The photograph below was taken in Fitzgerald River National Park. The less common *F. triaristata* has slightly larger creamy-white flowers with a strong vanilla/chocolate scent. The long floral tube and the flower scent suggest that the pollinators for both species are moths.

The flowers of this genus display the flower anatomy of the family very clearly. The four tepals are well shown and the four stamens are inserted at the top of the tube. This simple flower anatomy contrasts with the sister genus, *Adenanthos*, and shows again why the family name is appropriate.



Franklandia fucifolia

Adenanthos

Yet another genus with a predominantly Western Australian distribution. Of the 33 species, 31 occur in WA. One of the two non-local species occurs only on Kangaroo Island, the other in Victoria and South Australia. This genus was described in detail in *Australian Plants* Volume 23 No. 186 (March, 2006). That issue contains information on the source of the name, a description of all the species, plus notes on propagation and cultivation. The present article will therefore be confined to describing some of the biology of the genus and will include information on just a few species so that these may be compared with other members of the family.

Only a few species have lignotubers: most are killed by fire and can only reproduce by seeds. Many utilise ants for seed dispersal. They have "extra floral nectaries": glands that secrete nectar presumably to attract ants. The seeds have appendages which are rich in lipids. These are called elaiosomes. The ants carry the seeds back to their nests, consume the elaiosomes and dispose of the seed in their local garbage dump. When the seeds germinate, often as a consequence of fire, the seedlings are able to grow in a fairly nutrient-rich environment. This is an effective strategy and the species that use it are the first to re-colonise after fire.

The genus is divided into two sections. In one section, the leaves are entire, the flowers are longer than the leaves, and one of the stamens is reduced to a filament. This section includes *A. obovatus*.



Adenanthos obovatus. Note the three stamens emerging from one of the flowers.

In the other section of *Adenanthos*, the flowers are smaller, the leaves are mostly either lobed or deeply divided, and all of the stamens are fertile. *A. cuneatus*, the type species, is widespread along the south coast where it grows in deep siliceous sand. In my (Mt Claremont) garden, it grew slowly but did not persist. *A. sericeus* (Woolly bush) comes from near Albany where it also grows in deep siliceous sand. In my garden it grew fairly quickly into a tall bush but persisted for only a few years. These two species hybridise with the hybrid known as *A. x cunninghamii*. The hybrid may be seen in the field and is also available from the nursery trade. In my garden it is persistent and vigorous. Although the flowers are small, they are visited frequently by New Holland honeyeaters.



Adenanthos cuneatus



Adenanthos sericeus



Probable hybrid (*Adenanthos x cunninghamii*) observed in the field.



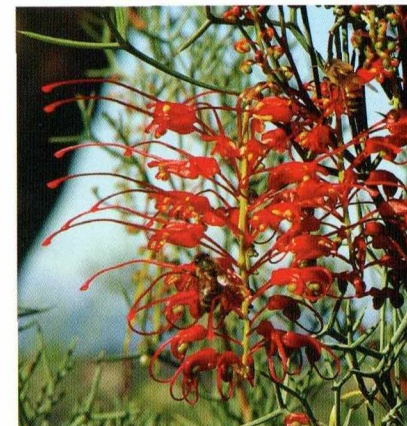
Adenanthos x cunninghamii bought from a nursery.

The Grevillea subfamily (Grevilleoidea)

In our progression through the Proteacea family we are now switching to a new subfamily. This differs from the previous in having flowers in pairs, each with a common bract. This arrangement is not always easy to see, for example in those flowers in crowded heads such as *Dryandra*. (see later). And in *Grevillea* the bract falls off early in development.



Banksia coccinea with its bright red flowers appearing well above the plant on long stems is well adapted for the cut flower trade. Its natural habitat is near the south coast. Its arching styles "marry" the flower pairs. The neighbouring pairs are offset higher and lower.



Grevillea dielsiana grows in the northern sandplain. Its pendulous lantern-like inflorescences seem to glow. It would be widely cultivated if it were not for its rather prickly leaves. Its fairly open inflorescence enables us to see the flower pairs.

Xylomelum

This genus has six species only two of which occur in Western Australia. They are small trees to tall shrubs characterised by the large, woody, pear-shaped fruit. The name comes from the Greek xylon meaning wood and melon meaning tree-fruit.

X. angustifolium, the sandplain woody pear, is common on sand plains from Murchison River south to near Corrigin. The fruit opens on drying, or after fire, to release the fairly large winged seed. *X. occidentale*, the western woody pear, occurs in sandy woodlands between Perth and Albany. Its leaves have a superficial resemblance to those of holly and it suffers the indignity of having them sprayed with silver paint and sold as Christmas decorations. Both species flower from December to February and so the attractive creamy white flowers are not seen by spring visitors.



X. angustifolium, the sandplain woody pear. The open fruit (below) shows the hollow occupied by the seeds and their wings.



X. occidentale, the western woody pear, photographed in January by Richard Clark of the Geographer Community Landcare Nursery (Busselton).

Lambertia

Lambertia is named for Aylmer Bourke Lambert, English patron of botany. There are 10 species, 9 of which occur in WA. This genus is characterised by a curious curled end to the perianth segment with the anthers in the coiled lobes. In the majority of the species, the flowers are usually arranged in groups of seven, one in the middle and the other six arranged around it. The two exceptions are named accordingly: *L. uniflora* and *L. rariflora*. The outer flowers in each inflorescence are held in by bracts which follow the "Grevilleoid" pattern. The bracts can be as long as the flowers, as in *L. ilicifolia*. The fruits are small but are ornamental and attractive. Many of them are spiny, so much so that the NSW species (*L. formosa*) is known as Mountain Devil.

In some of the species, the flowers come in two colours and the colours are often geographically separate. In *L. multiflora* (Many flowered honeysuckle), the colours are regarded as different varieties. The orange-flowered variety is common in kwongan in the Badgingarra area; the yellow-flowered variety occurs near the base of the Darling Range. Similarly *L. inermis* (Chittick), which grows near the south coast, has a yellow-flowered variety that is more common north of the Stirling Range while the orange variety is more common further south.



The two varieties of *Lambertia multiflora*.



Lambertia ilicifolia. Note the bracts around the inflorescence. The central flower lacks bracts.

Distinguishing Hakea and Grevillea

Hakea is defined by the fruit. When the fruit opens, two contrasting layers of wood are visible: an inner layer of red-brown wood and an outer layer of pale wood. The pale wood is a product of secondary thickening and occurs only in Hakea. It plays an important part in keeping the valves closed for periods of many years. The woody valves also

open in an unusual way. To understand this, put your hands together as if in prayer. Now open them from the fingertips. You are now a Hakea. For most of the rest of the family open your fingers from the little finger side.

Despite this clear and unambiguous definition, there are some groups within the genus in which the woodiness scarcely develops. In some of these, the plants have evolved a different strategy to avoid having the seeds eaten (see later).



The opened fruit of *Hakea incrassata* (marble hakea) showing the two layers of wood.

Even so, it can sometimes be difficult to distinguish a Hakea from a Grevillea, for example, if the plant is too young to have fruits or if it is from a Hakea group for which the fruits do not persist. For these cases, there is a series of rules, always accompanied by a qualification such as “usually” or “most”.

Thus, for most Hakeas, the upper and lower leaf surfaces are similar or, if they are terete, they are usually without an obvious groove or grooves for their whole length. For most Grevilleas, the two surfaces of the leaf are distinct.

With one or two exceptions, the styles and ovaries of Hakea don't have hairs, for most Grevilleas, they do. If there are hairs, it's a fair bet it's a Grevillea.

Apart from Corkwoods, the ovaries of Hakeas do not have stalks, those of Grevillea do.



Hakea buds are, however, distinct. They are covered with overlapping bracts (involucral bracts).

Hakea francisiana, an erect shrub or small tree, extends from the drier edge of the WA wheat-belt to the Eyre Peninsula in SA. The upper and lower surfaces of the leaves are similar. The photo also shows the distinctive buds.



Left. *Grevillea didymobotrya*, a large shrub from the drier edge of the wheat-belt is one of the exceptions – it has leaves for which the front and the back scarcely differ.



Right. *Grevillea olivacea*, a vigorous shrub from coastal area north of Perth, is named for its olive-like leaves with a pale underside. It is one of the parents of the Winparra hybrids.

Hakea

This is a genus with 149 species of which 93 occur in WA. The name honours Baron Christian Ludwig von Hake, a German patron of science. The name was published in Hanover, in December 1797 and was applied to three species: *H. glabra*, *H. pubescens* and *H. sericea*. The date is important because in May 1798, James Smith, unaware of the German name, applied the genus name Conchium. No species were described. Some English botanists preferred this name until 1810 when Robert Brown described 35 species as Hakea. Perhaps the priority of Hakea is a pity: Conchium, with its connotations of a shell is quite an evocative name.

For such a large group of plants, it is not possible in an article of this size to do more than briefly describe the biology and show a few of the more spectacular species. To identify WA species, see *Hakeas of Western Australia — A Field and Identification Guide* by Jennifer Young. To learn more about Hakeas of Australia and to access a Lucid key, see [www.flora.sa.gov.au/efsa/lucid/Hakea/Australian Hakea species.html](http://www.flora.sa.gov.au/efsa/lucid/Hakea/Australian%20Hakea%20species.html).

One of the strong evolutionary trends within the genus has been selection to decrease eating of seeds. One way of trying to achieve this is to evolve ever larger and thicker protective layers around the seed, culminating in the so-called cricket-ball Hakea. That is a bit of an exaggeration: the fruit is actually a little smaller than a tennis ball. It is nevertheless a pretty impressive structure. There are a couple of problems with this evolutionary strategy. One is that it is fairly costly to the plant to devote so much effort in to growing the massive structure; the other is that it is opposed by the counter evolutionary strategy that has led to the local

white-tailed cockatoo developing enormously strong jaws. Because of clearing for agriculture, they have turned to pine cones as a food source and can easily tear the cones apart.



H. platysperma, the cricket ball Hakea.

Another way of achieving the same objective is the “crown of thorns” strategy used by *Hakea corymbosa*. The flowers appear at the top of the plant, only lightly protected by the thorny leaves and are therefore open to pollinators. By the time the fruits are developing, the thorny leaves have grown to provide an almost impenetrable barrier. This strategy probably also had a second function. Not so long ago, in evolutionary terms, Australia had a population of browsing animals: animals that eat the leaves of shrubs as distinct from grazers that eat low growing herbage. The thorny demeanour of this, and several other Hakeas, would surely discourage such animals.

A different and rather sneaky, but effective strategy is adopted by twin-leaf Hakea, *H. trifurcata* and its relatives. This species has two distinct leaf types: “normal” leaves that often branch 3 times and hence the specific name, and broad, curved leaves. For some time, the function of these broad leaves was a puzzle, even though it was known that they only appear on sexually mature plants. The important clue is that they bear a strong resemblance to the seed pods. These remain green for quite some time and have very little secondary thickening. The plan seems to be that a hungry cockatoo alights on the shrub, tries several of the apparent seedpods and on finding them empty flies off in disgust. The plant is therefore saved the cost of forming all of that secondary thickening around the seed and in addition gets the benefit of the photosynthetic yield from the false fruits. It seems to be a very effective strategy and this is a widespread plant.



Hakea corymbosa.



Hakea trifurcata. The broad structures are leaves not fruits.



Left. *Hakea trifurcata* fruit from the previous year showing the shape. Note broad leaves in background. Right. *Hakea trifurcata* flowers.

Two contrasting *Hakeas* are pictured below. Outside *Conospermum*, blue flowers are rare within the Proteaceae. *H. lehmanniana* is an exception. It is a dense, prickly, low-growing shrub from the south-west especially in the Stirling Ranges. *H. orthorrhyncha* is an upright shrub from the northern agricultural areas of south-western Australia. Its bright red flowers often occur in midwinter and are particularly noticeable because many of them are on the bare stems. Its common name is "Bird-beak *Hakea*" and this appears to be a confusion in the name between "ortho" meaning straight and "ornitho" referring to birds.



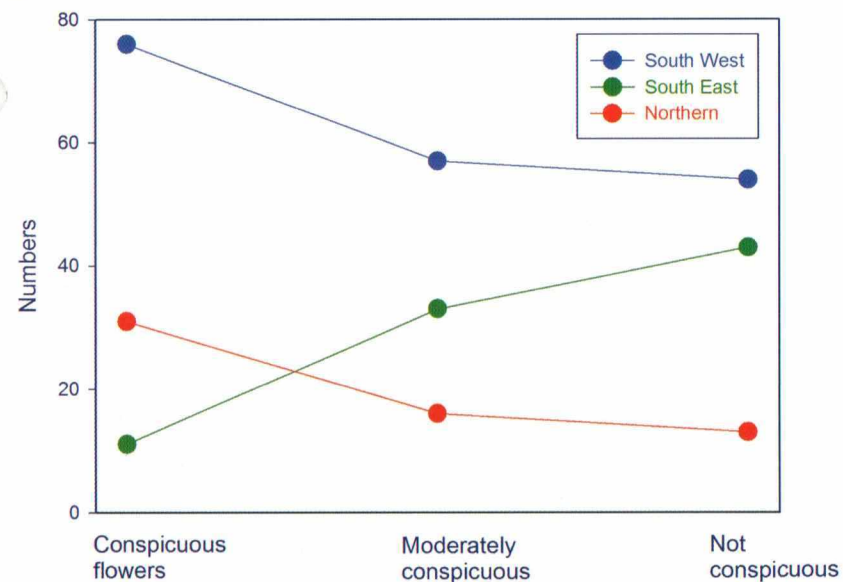
Hakea lehmanniana



Hakea orthorrhyncha

Grevillea

Named in 1804 for Charles Francis Greville, one of the founders of the (now) Royal Horticultural Society, this genus has about 360 species, the third largest genus in Australia. About half of them occur in the south-west. But what a spectacular half! The graph below shows the distribution of species with conspicuous flowers according to the (well-informed) judgment of Peter Olde and Neil Marriott in *The Grevillea Book*. The south-west has a clear majority of species with spectacular flowers.



Grevillea tenuiflora

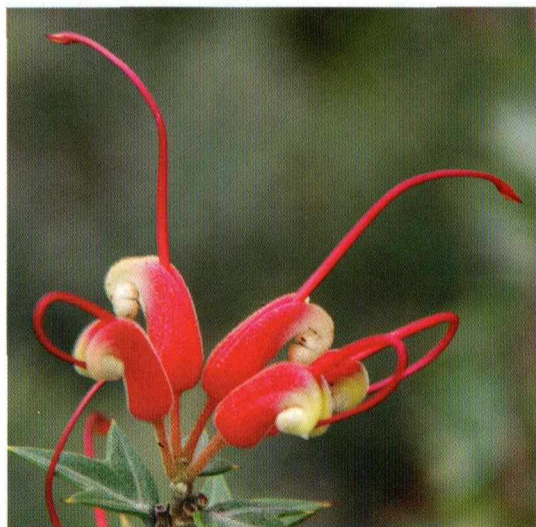
In a minority of *Grevilleas*, the flowers are "straight". That means that they are not bent over and the lobes of the tepals are more or less equal. A little-known, but rather pretty member of this group is *G. tenuiflora*. The species name means "thin flower" and refers to the slender pendulous flowers tipped with pale violet. It grows from York to Wagin.



G. paniculata is a widespread, but somewhat variable, plant. It grows from just east of Perth to Merredin and further south. In spring, when it is in flower, it is a seemingly impenetrable tangle of flowers and leaves.



In contrast, the appropriately named *G. magnifica* subspecies *magnifica* is confined to a few granite hills in the central wheat belt. It has relatively recently been introduced into cultivation and thrives in many soils.



In the majority of Grevilleas, the flower is "bent". I think of them as "knuckle bone" shaped. This is well shown here by *G. macrostylis*. It is a bushy spreading shrub, 2-3 m high and occurs along the south coast including the Fitzgerald River NP.

Four contrasting Grevilleas.

G. excelsior the Orange Flame Grevillea grows in the northern and central wheat-belt. The name refers to its tree-like growth habit. It deserves to be widely cultivated but has proved difficult to propagate.

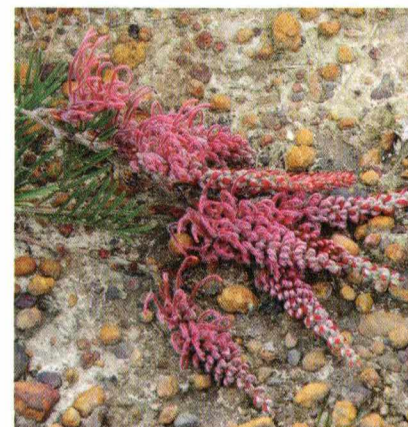
G. thyrsoidea grows in a few scattered locations near Badgingarra. Its habit of bearing flowers outside the shrub has lead to its use in horticulture especially grafted onto a *G. robusta* stem to produce a standard.

G. armigera is one of the "black toothbrushes" – a characteristic WA form. It grows in the northern wheat-belt.

G. concinna, a red toothbrush, grows in a small area near Cape Le Grand. The species name, which means "small, neat", is a bit unfortunate because of its similarity to *G. coccinea*, a similar red toothbrush.



Grevillea excelsior



Grevillea thyrsoidea



Grevillea armigera



Grevillea concinna

Dryandra and Banksia

Some people will tell you that *Dryandra* has had a name change and we *must* now refer to them as *Banksia*. That is not necessarily so. Sometimes the appropriate plant name is determined from strict rules such as the rule of priority. It is for this reason that we must speak of *Hakea* not *Conchium*, *Petrophile* not *Petrophila*. Sometimes the appropriate plant name is determined by decisions of the International Botanical Congress. Recently, the type species for *Acacia* was changed to an Australian species. That means we continue to call our Australian wattles *Acacia* not *Racosperma*. However, choosing the correct name is not always so clear cut. Changes in classification, and therefore in name, are not always accepted. For example, it has been proposed that Sturt's desert pea is so different from the other Swainsonas it should be given its own genus, but this has not been adopted. Nor is it unusual to find that some people regard a particular plant as a subspecies, others regard it as a separate species. When a name change is proposed, such as changing *Dryandra* to *Banksia* (Mast and Thiele, *Australian Systematic Botany* 20, 2007, 63-73), acceptance is not automatic. We are supposed to evaluate the proposal and decide whether or not to accept it.

It is scarcely practical for each of us to review the proposal and make our own decisions. This is particularly difficult in the present case because it is based on rather esoteric grounds. To illustrate this, here is the description of one of the "trees" developed to represent the evolution of Banksias. "Strict consensus of 40 shortest trees (130 steps; CI = 0.785, RI = 0.961) found in MP analysis using data from the rp116 intron and psbA/trnH spacer (STRATEGY II) with ti : tv = 1 : 1 and nt : indel = 1 : 1." (Mast and Givnish, *American Journal of Botany* 89, 2002, 1311-1323.)

Especially in this case, we have a more practical alternative. We can consider the expert opinion of Alex George, the world authority on both genera. The full text of an article by Alex is available at <http://anpsa.org.au/APOL2008/sep08-2.html>

Alex writes "Having studied these plants for almost 50 years I am concerned that this change is premature, probably wrong, and is having a profound effect on those using the names of these plants.... I am satisfied that there are perfectly 'good' characters that distinguished *Dryandra* from *Banksia* and I shall continue to recognise the two genera."

Let us try to summarise the arguments for and against the proposed reclassification. First the "for". The cladistic analysis shows that, early

in their development, the *Banksia* group divided into two. In one group, the stomata were not in pits and cotyledons were spoon shaped. In the other group, the stomata were in pits and the cotyledons were not spoon shaped. It was from this latter group that *Dryandra* diverged. The argument is then, for each group to have a recent common ancestor, there are several possibilities. One would be to retain *Dryandra* as a separate genus and in this case it is argued that it would be necessary to split *Banksia* into several genera each with a common ancestor. The other possibility is to lump them into one genus – the option chosen. There are curious analogies with the eucalypts here. Most botanists now divide them into three genera: *Eucalyptus*, *Corymbia* and *Angophora*. A proposal that they are so similar that it is logical to lump them into one genus (*Eucalyptus*) was treated with scornful fury.

The "against" argument is that Banksias as previously specified are a natural group with similar flowers and similar inflorescences. It is not relevant that within their evolution they diverged in their vegetative characteristics. Furthermore, any group, whether it be a new family, a new genus, or a new species, must evolve from within an old group. When the new group becomes sufficiently different, as have *Dryandras*, it is appropriate to give it a new name.

How do *Dryandras* differ? The main difference is that they have a shorter inflorescence and this is surrounded by (usually) flat bracts that persist.



Left. *Dryandra sessilis* showing the bracts around the inflorescence.

Right. *Banksia ilicifolia* is a member of a group of three Banksias that have a condensed head but without the bracts. This group is thought to not be closely related to the *Dryandras*.

Banksia flowers do have narrow bracts at the base of the spike. Usually they are not conspicuous and they often fall away before the flowers open. In some species they persist longer.



Contrasting the bracts at the base of the inflorescence of *Banksia* (left) and *Dryandra* (right).

Left. *Banksia blechnifolia* is one of six prostrate Banksias. Its flowers appear at the end of the horizontal shoots, often outside the spread of the plant which may be a couple of metres in diameter. It grows near the south coast, and also does well in gardens.

Right. *Dryandra ferruginea* subsp. *obliquiloba*, a low growing *Dryandra* from a limited area near Corrigin.

Dryandra

The name was bestowed by Robert Brown to commemorate his friend the Swedish botanist Jonas Dryander.

The book, *The Dryandras* by Tony Cavanagh and Margaret Pieroni published in 2006 included 94 species, all confined to south-western Australia. Since then, several more have been described — but as Banksias! Because the genus has been so thoroughly covered in the book mentioned above, this article can only give a broad outline.

Since their divergence from Banksias, Dryandras have radiated into many different forms. These include dwarf and prostrate species for some of which the flowers emerge from the ground several centimetres beyond the foliage. At the other extreme there are species that form large shrubs to small trees up to 7 m high. Most, however, are small

shrubs up to about 2 m tall. The leaves are also extremely diverse; many are toothed or lobed and not a few are rather prickly. The flowers are grouped in heads and these may be up to 10 cm across. The flowers are commonly yellow but range in shade from lemon to golden orange. The few exceptions to this rule are, of course, rather spectacular and therefore tended to be photographed.



Dryandra praemorsa var. *splendens* is a spectacular exception to the "yellow" rule. It grows from the Brookton Highway, south to Bannister. This photo was taken at the Banksia Farm, near Mt Barker, WA.



The flowers of *Dryandra nobilis* are closer to the "golden" rule. It is a large shrub to 4 m and thus of "noble" stature. It occurs on laterite under eucalypt woodland from Eneabba south to Katanning.



Dryandra formosa

D. formosa is the most widely cultivated *Dryandra*. Its dark-green, soft leaves and "flowers" at the end of stems make it attractive to the cut flower trade. It grows in the south between the Whicher Range and east of Albany.

D. squarrosa (Pingle) grows from Bindoon south to near Albany. Its bright yellow flowers are showy in spring.

The prominent red-brown bracts of *D. quercifolia* are characteristic. It grows near the south coast especially in Fitzgerald River NP.

D. nivea is a widespread species. It is one of the "Honey pots" – the flowers form a ring in which nectar accumulates. It belongs to a series that contains 7 similar species.



Dryandra squarrosa



Dryandra quercifolia



Dryandra nivea

Banksia

This is a genus of about 78 species; the exact number depends on whether you regard some taxa as full species or only sub-species. There are about 62 species in WA.

For a full description of the genus, see *Banksias* by Kevin and Kathy Collins, Alex George. For a full description of individual species, plus a discussion of the rather fluid position with respect to the subgroups within the genus, look in Wikipedia (http://en.wikipedia.org/wiki/Taxonomy_of_Banksia).

With such a large and diverse genus, there is only room in this article to discuss a few of the more photogenic species – and in the West this applies to a large proportion of them. For most Perth people, their local bushland will be Banksia woodland usually carrying at least two Banksia species: *B. attenuata* and *B. menziesii*.

B. attenuata is probably the most common WA Banksia. It extends from Kalbarri in the north to Cape Leeuwin in the south. At the northern end of the range it is a low shrub, further south a small tree. In Perth, it covers itself with bright yellow candles in mid summer. *B. menziesii* has a narrower distribution, from the Murchison River to Pinjarra. In Perth it is a robust tree. The timber is of no use for construction and so the early settlers used it for firewood; hence its common name: firewood Banksia. It flowers in autumn and winter and supplies a follow-on nectar source for birds and small mammals.



Left. *Banksia attenuata*. Right. *Banksia menziesii*

Four other species occur in the Perth area. *B. ilicifolia* is a tree with Holly-like leaves. It grows to about 10 m and occurs mainly in the older dunes. It is one of the three Banksia species with a condensed inflorescence (for a photo see p 185).

The spectacular *B. prionotes* is a shrub or small tree with orange woolly flowers, one of a group of four species with similar flowers. It is widespread, growing from Shark Bay south to Wagin. In Perth it is mainly seen on the younger dunes and in gardens where it grows quickly into a spectacular small tree, flowering in autumn and winter. By the way, the name is derived from the Greek "prion" meaning a saw, so there are two Banksia species whose name refers to a saw. Do you know the other?

B. littoralis is also a small tree but it occurs in low-lying, winter-damp areas. It bears bright yellow "candles" in autumn to early winter. It is one of a group of eight species with cylindrical spikes and hooked styles. The leaves are soft, dark green above, pale green beneath giving a silvery appearance in a breeze.



Left. *Banksia prionotes* with about a third of its flowers open giving an "acorn" appearance. Right. *Banksia littoralis*.

The sixth Banksia species seen near Perth is *B. grandis*. This is a robust tree, common on the coastal plain and also in the Jarrah Forest. It has easily the longest leaves of any Banksia species, up to 45 cm long and hence the specific name. Its pale yellow flowers are followed by a massive woody cone that is often used by wood turners to make "knick-knacks".

This page demonstrates four contrasting Banksias.



Top left. *Banksia ashbyi* is the only orange "non-woolly" Banksia. It grows as far north as North-West Cape yet grows well (and spectacularly) in Perth gardens.

Top right. *Banksia baueri* is officially called "Woolly Banksia" but is more commonly referred to as "Possum Banksia". Its cuddly appearance is due to long awns on the flower. It is a low shrub and occurs in the south especially in Fitzgerald River National Park where this picture was taken.

Bottom left. *Banksia occidentalis* is a small tree that grows on the south coast on peaty sand on the edges of swamps. It is another member of a group of eight species with hooked styles and cylindrical spikes.

Bottom right. *Banksia sphaerocarpa* contrasts in that its flowers are hidden within the canopy of the shrub. It is a member of a group of 13 species with hooked styles but with rounded flower heads and linear leaves with in-rolled edges.

