



Isopogon & Petrophile *Study Group*

Newsletter No. 18

March 2016

ISSN 1445-9493

Website <http://anpsa.org.au/iso-pet.html>

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Isopogon dubius. Tootbardi Road near Badgingarra, Western Australia, September 2015. Note the pure gravel it is growing in on the side of the road. See page 6 for our profile of this species.

Back issues of the Isopogon and Petrophile Study Group Newsletter are available at
<http://anpsa.org.au/iso-pet.html>.

From the editor

Hi fellow Isophiles,

We trust you have had a nice relaxing Christmas/ New Year break and that you are getting stuck into one of the serious parts of life – propagating and growing isopogons and petrophiles. And of course telling all your friends what great plants they are!

We have a fantastic issue for you, thanks to the great contributions from you, our members. The theme for this issue is the propagation of isopogons and petrophiles. We examine three methods – seed raising, cuttings and grafting. Members from the winter-rainfall States Victoria, South Australia and Western Australia may be able to grow many species on their own roots with some success, however grafting is essential on the East Coast for most of the WA species. Here at Milton NSW the WA isopogons and petrophiles are our worst performing genera on their roots, well behind banksias and eremophilas!

John Knight reports on some interesting investigative work he has carried out on the pollination efficiency of *Isopogon anethifolius* and implications for germination. This report ties in nicely with our propagation theme and sheds light on why growing isopogons and petrophiles from seed is often difficult.

We also have a fascinating story by Tony Cavanagh on the origin of one of the few isopogon hybrids, *I. 'Stuckey's Hybrid'*. This is a great plant which we all should be growing. We have grown this for many years and currently have four plants grafted on *I. anethifolius* and all are growing vigorously. The largest is around 0.5 m and is around three years old. We prune our plants heavily after flowering which results in plants with a huge number of flowers each spring.

We also report on the latest botany news covering the reinstatement of *I. buxifolius* var. *spathulatus* to its original name, *I. spathulatus*, and Mark and Carolyn Noake share their I&P addiction with us in Mark's article about their garden at Glendeuart. Our feature plants this issue after last issues eastern choices are *I. dubius* and *P. teretifolia*, two stunning species from WA.

Thanks very much for your positive feedback and encouragement on our first newsletter. In general we have had a very good reaction. Since we released Newsletter 17 last September, we have been very busy on native plant matters. In November we conducted a pre-conference trip to the NSW South Coast, with considerable help from John & Sue Knight and Peter & Margaret Olde. Apart from bogging the bus and regular showery weather, all participants seemed to have a great time, and we were able to show them a number of isopogons and petrophiles. The star isopogon/petrophile on the trip was the very under-appreciated *P. pedunculata* which was at peak flowering, with masses of golden yellow terminal flowers. Participants also saw the two other South Coast petrophiles, *P. pulchella* and *P. sessilis*, and the two common isopogons, *I. anethifolius* and *I. anemonifolius*. All of these species were past peak flowering, but occasional flowers could be found on each.

We then attended the ANPSA conference in Canberra where we provided a presentation on our study group, highlighting the spectacular nature of many isopogons and petrophiles, and outlining the study group's aim to change the dearth of knowledge about these genera, through propagating, growing and promoting these plants. There was plenty of comment and interest from delegates afterwards, an encouraging sign. At the conference we also had a study group display using a combination of new material and some previously used by David Lightfoot. On the Tuesday evening there were study group meetings held in the hall which worked well as people could move between groups they were interested in or belonged to, with some new people joining our group at the I&P table. It was nice to meet people face to face.

We have also been doing our best to turn many of the field trips of the APS groups from Canberra, Nowra and SE NSW into Isopogon & Petrophile Study Group excursions! We never miss the opportunity to do some field work and education. On a trip in February we found some late-flowering *I. anemonifolius* and also many *P.*

sessilis in flower at Booderee National Park, Jervis Bay.

After bemoaning the neglect and invisibility of I&Ps in the last newsletter and at the conference, we have happily been shown otherwise recently. Having occasion to send some letters in January, we had to visit the post office and shell out for the new \$1 stamp – imagine our surprise to see a beautiful image of *I. formosus* *ssp. dasylepis*! For more on the new stamp, see the article below. Since the last newsletter a petrophile has even featured on the TV program *Gardening Australia*. In a story on 26 September 2015, John Patrick discussed the way we can use microclimates to grow things we otherwise can't grow and extend the range of plants we grow, and featured a tall plant of *Petrophile biloba* growing against a huge rock in the Weird and Wonderful Garden at the Royal Botanic Gardens Cranbourne. Some lovely filmwork showcased the stunning flowers. We hope you caught it.

The APS is also coming to the party – first there was the front cover of the Queensland journal (as foreshadowed last newsletter), now the cover of the March Canberra *Journal* features *I. anemonifolius*, complete with bug (*Coccinella transversalis*, courtesy of our entomologist and native plant expert Roger Farrow, see right). In addition, Wendy Grimm (NSW Study Group Liaison Officer) featured our photo of a bunch of isopogon flowers from our garden in her study group roundup in the January 2016 issue of *Native Plants*. We have also received donations from some APS groups.



The isopogons and petrophiles in our garden have had a wet introduction to the year, with 252 mm falling on them in January. The resulting gaps from the odd drowning (happily no I&Ps died) have allowed us to plant out a couple of recently grafted isopogons – *I. ceratophyllus* and a dwarf form of *I. cuneatus*. All our isopogons and petrophiles (all western species are grafted apart from *P. serruriae*) are thriving in the damp conditions, with most budded up for great winter/spring flowering.

Regards
Catriona and Phil

NEXT ISSUE

In the next issue we will focus on cultivation, which can often be more difficult than propagation. Stay tuned for another questionnaire on your experiences trying to successfully grow isopogons and petrophiles.

We hope to have an expanded list of members who can provide cutting or seed material to other members.

We are also looking for articles on your gardens, or any other topics of interest. As always, keep sending your comments and queries, photos or reports.

About our members

We have a number of new members, many as a result of the ANPSA conference. We love to find out about our members, so feel free to send a few sentences about yourself or your activities by way of introduction.

Karlo Taliano, Georges Hall, Sydney

As a new member to the I & P Study Group, my knowledge and experience with growing species within these genera is limited. I've been a member of APS East Hills Group since 2005 and also joined the Banksia Study Group in 2008. My fascination with Western flora has me growing many such species (mainly *Verticordia*, *Eremophila*, *Banksia*, *Grevillea*, *Hakea* and other *Proteaceae*) in my raised beds in western Sydney. I have grown a grafted *Isopogon latifolius* for several years – the shrub is now 1.5mH x 2mW but if I were to let it grow, it could easily reach another metre each way. Its vigorous growth has me pruning it back to half its size each year so it doesn't block out the sunlight to adjacent plants. The shrub seems to only get around 12-15 flower-heads each year. Colder winters (down to 2^oC) in some years see it flower more prolifically. I am also growing grafted specimens of *Isopogon asper*, *Isopogon prostratus* and *Petrophile teretifolia*. After visiting WA again last year, I'm keen to learn more about the diversity within Isopogon/Petrophile.

Graeme O'Neill, Mildura

We were very sad to hear of the sudden passing of Graeme, an enthusiastic and supportive I&P man. We spent a few days with him in WA last August enjoying long discussions about what exactly was the difference between isopogons and petrophiles and spotting and trying to identify them in the bush. He was particularly taken with the beauty of *I. gardneri* and we had a lot of fun trying to outdo each other in finding the best specimen. Graeme was the first to congratulate us on our first issue of the newsletter and particularly commented on some of the photos. Graeme also alerted us to the latest botany news from *Nuytsia* (see article below). Neil Marriott has written a tribute in *Growing Australian* March 2016 (VIC).

Graeme & Denise Krake, Brogo

Denise sent photos by way of introduction. Graeme and Denise grow eastern species (guarded with netting against swamp wallabies) and some WA species in pots. The photos from their garden below show, left to right, what looks like *I. anemonifolius* 'Sunshine', a stunning *I. fletcheri* (best flowers we have ever seen) and *P. ericifolia*.



Margaret Pieroni, Denmark, WA

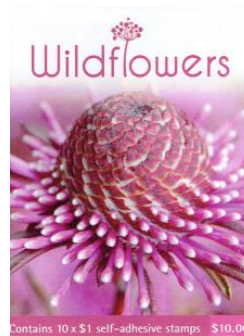
I have grown several isopogons and petrophiles with varying success. I used to have three very good plants of *P. helicophylla* in my garden here in Denmark but they didn't live long although they flowered well. The beautiful plant of *P. longifolia* pictured in newsletter no. 16 from 2012 died not long afterwards. It produced a lot of seed and I have grown several plants. A plant of *I. formosus* which also flowered and died, has self-seeded in the garden. I am struggling to keep the small plants alive by hand watering them. I have a nice plant of a tall form of *P. squamata* doing well and I have replaced the beautiful *I. cuneatus* several times but each time the plants struggle to grow.

I have done paintings of several of the plants when they were growing well. Unfortunately, climate change has hit us hard here in Denmark and we no longer have rain year-round. This summer, we have had two dry periods of over a month. I have been hand-watering regularly to no avail – even plants growing naturally in my bush are dying. I will probably give up trying to grow plants from other areas and just concentrate on trying to keep the local flora from dying out. I have had some brilliant banksias, dryandras and other Proteaceae growing and flowering for years but their replacements do not survive. One plant, the only petrophile growing naturally on my block, *P. diversifolia*, on the other hand, is thriving.

Wildflowers stamp issue

Nature's wonderful bounty on display

The Wildflowers stamp issue featuring WA wildflowers was released in mid-December and is the first release under Australia Post's new price structure. The first of three \$1 stamps features *I. formosus ssp. dasylepis* (the others are *Mirbelia spinosa* and *Eryngium pinnatifidum*). There is also a \$2 stamp featuring *Drosera microphylla*.



These beautiful stamps were designed by Simone Safinofsky. Australia Post's *Stamp Bulletin* (Issue No. 338 January-February 2016) notes that 'the tightly cropped blooms highlight the distinctive form and beauty of each species'. Acknowledging WA as the country's hotspot for wildflowers, the Rose Coneflower (*Isopogon formosus*) is described as follows:

'...a low, bushy or slender, upright shrub that grows between 20 centimetres and two metres high. Its compact, divided foliage has pointed tips, and its blooms, which begin as tight globular cones, open to around six centimetres in diameter. The stamp design shows the subspecies *dasylepis*.'

Enjoy the isopogon every time you send or receive a letter! Almost makes it worth using snail mail! We were too late to pick up any products such as a first day cover for the study group, but if anyone spots one, please do so on our behalf.

Mystery growth



Last newsletter we published this photo by Lyn Alcock from Narrogin WA of a strange growth on what looks like *Petrophile glauca* and asked if anyone had any idea what it is. Dave Handscombe said: 'The photo looks to me like fasciation. I don't think anyone knows for sure what triggers this to happen but it should only affect a small section of the plant and shouldn't spread to other plants.'

Fasciation is a condition of abnormal growth in which the growing tip, which normally is concentrated around a single point and produces approximately cylindrical tissue, instead becomes elongated perpendicularly to the direction of growth, producing flattened, ribbon-like, crested, or elaborately contorted tissue.

Lyn recently added: 'After lots of debating and to and froing I have come to the conclusion what I photographed was fasciation. Alex Chapman seems to disagree, but I went to the Facebook site Fasciation Fascination and the many photos on there certainly seemed to confirm my conclusion. The comments on the page seemed to confirm my thoughts. Most other people agree with me generally.'

Plant Profile – *Isopogon dubius* (R. Br.) Druce

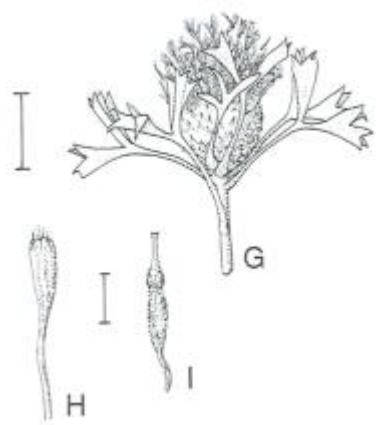


Photo: Lyn Alcock

Robert Brown first collected *Isopogon dubius* in 1830 and named it *Petrophile dubia*. Its current name was given by Druce in the *Botanical Exchange Club and Society of the British Isles Report* for 1916, Supplement 2 (1917). 'Dubius' is Latin for doubtful, referring to Brown's uncertainty about the genus of the species when he

first collected it. It is also known as the Pincushion Coneflower or Rose Coneflower.

Description – *Isopogon dubius* is consistent in stature, growing to a compact, bushy shrub to around 1.2 m. The branchlets are reddish-brown and the branchlets and young leaves hairy, glabrescent. The leaves are often deeply three-lobed or pinnate, with a canaliculate (longitudinally grooved) lamina, and spiky point. The involucre bracts are numerous and densely hairy at the base. It produces pink to red-pink flowers between July and September, often in clusters of four, and mostly terminal. The cones are ovoid, and beaked to around 3.5 mm length, with linear and densely hairy scales. The flowers and cones are sessile. *I. crithmifolius* is a very similar WA species, distinguished from *I. dubius* because of its flat lamina in contrast to the canaliculate lamina of *I. dubius*.



G – flowering branchlet, H – flower bud, I – pollen presenter

Scale bar: G = 2 cm, H = 3 mm, I = 2 mm. Drawn by P. Cooper (*Flora of Australia* Vol. 16)

Distribution – *Isopogon dubius* is widespread in south-western WA, extending from Jurien Bay and Wongan Hills in the north to near Narrogin in the south. It occurs mainly on the Darling Range.



SG members Don Williams and Kevin Collins with Catriona, recording *I. dubius* in its natural habitat at Badgingarra WA

Cultivation – This spectacular species is one of the better-performing western species in gardens, but does best in a low summer rainfall climate in well-drained soils. In the summer-wet east coast, plants can die quickly after wet periods, and should therefore be grafted to ensure longevity and reliability. We used to successfully grow *I. dubius* on its own roots in Canberra so frost does not appear to be a problem. The easiest way to propagate this species is through cuttings, which readily strike at most times of the year, using Clonex purple, and exposing of the cambium layer to promote root development. This species requires little attention once established and retains a dense, bushy habit with minimal if any pruning. It grafts readily on *I. anethifolius* and appears to be long-term compatible with this rootstock.

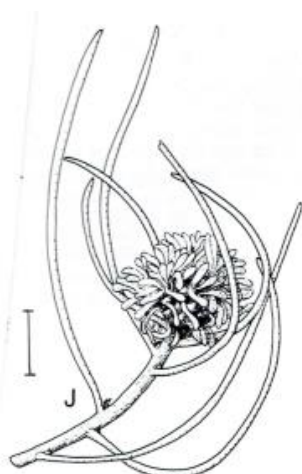
I. dubius is now rarely seen in nurseries, despite its lovely, bright green foliage and showy pink flowers in spring. The production of reliable grafted plants is needed to convince nurseries to regularly stock the species. Its positive attributes make this a very good species for Study Group members to promote.

Plant Profile – *Petrophile teretifolia* R. Br., *Trans. Linn. Soc. London 10: 68 (1810)*



Robert Brown initially named this *Protea teretifolia* when he collected it at Lucky Bay east of Esperance in Western Australia in 1802. He subsequently gave it its current name in 1810, in reference to its terete (round in cross-section) leaves.

Description – *Petrophile teretifolia* varies considerably in stature, from a low, spreading shrub less than 0.5 m in height, to an upright, bushy shrub up to 2 m in height. The leaves are terete and undivided, varying in length from 4-20 cm and generally ending in a sharply acute tip. It produces grey-pink to mauve flowers between September and January, mostly terminal. The cones vary in both size and shape, from globose (ball-shaped) to ovoid (egg-shaped, broadest below middle) to elliptic (oval, widest in middle), and between 15 and 25 mm in length. The flowers and cones are generally sessile or with a very short peduncle.



J – flowering branchlet, K – pollen presenter

Scale bar: J = 2 cm, K = 2 mm. Drawn by P. Cooper (*Flora of Australia* Vol. 16)

Distribution – *Petrophile teretifolia* is widespread along the southern coast of WA, extending from the Stirling Range east to Israelite Bay.

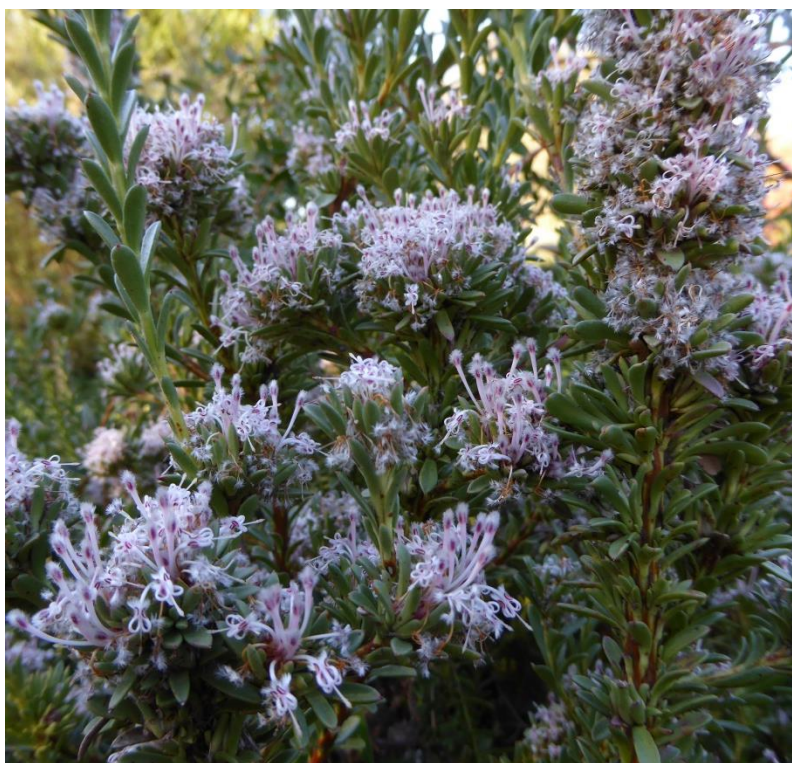


Cultivation – This is stunningly beautiful in flower, but is extremely rare in cultivation. Like most WA petrophiles it requires very good drainage, and should

be grafted for introduction to east coast gardens. A few Study Group members are trialling this species in their east coast gardens, so we should aim to build our knowledge of its requirements in cultivation, and the best ways to propagate it. It is currently available from Kuranga Native Nursery and Vaughan's Native Plants, so if you are in Melbourne grab a plant and let us know how it goes in the garden. Don't forget to take some cuttings of the plant as backup before you plant it!

Reinstatement of *Isopogon spathulatus*

Isopogon buxifolius var. *spathulatus* has been reinstated to the name given to it by Robert Brown in 1830, *Isopogon spathulatus*. Barbara Rye and Michael Hislop from the WA Herbarium report this change in Volume 25 of the Herbarium's journal *Nuytsia*, released on 9 October 2015.



Brown originally recognised two varieties of *Isopogon spathulatus*, var. *linearis* and var. *obovatus*. Both of these varieties were transferred to *Isopogon buxifolius* by Bentham in 1870, where he recognised four varieties based primarily on leaf shape – var. *buxifolius*, var. *spathulatus*, var. *obovatus*, var. *linearis*.

Rye and Hislop have decided on this reinstatement because of differences between *Isopogon spathulatus* and other members of *Isopogon buxifolius*, in respect of leaf, bract, tepal and anther morphology. They also foreshadow further changes to this group, including the naming of *I. sp.* Canning River and a possible renaming of *I. buxifolius* var. *obovatus*.

The full report in *Nuytsia* can be found at <https://florabase.dpaw.wa.gov.au/science/nuytsia/761.pdf>

Following the reinstatement of *I. spathulatus* the revised key for the *buxifolius*/ *spathulatus* group is as follows:

Key and descriptions

1. Largest leaves mostly ± ovate, 8–14 × 6–9 mm. Involucral bracts 1–1.5 mm wide, about 1.5–2.5 × as wide as the floral bracts. (Denmark–West Cape Howe) **I. buxifolius** var. **buxifolius**
- 1: Largest leaves linear to obovate, 10–52 × 1.5–16 mm, usually either longer than or narrower than the above choice. Involucral bracts 1–4 mm wide, 2–6 × as wide as the floral bracts, if as narrow as above choice then at least 3 × as wide as the floral bracts **2**
2. Stems directly below each inflorescence moderately to very densely hairy with spreading hairs as well as appressed ones. Largest leaves 1.5–7 mm wide. (Ruabon–Collie–Stirling Ra. area)..... **I. spathulatus**
- 2: Stems directly below each inflorescence glabrous or with a matted, appressed indumentum, without spreading hairs. Largest leaves 8–16 mm wide..... **3**
3. Largest leaves 20–52 mm long, greatly narrowed to a petiole-like base. Involucral bracts 3–4 mm wide. Floral bracts 1.3–1.5 mm wide. Longest hairs at the apex of the tepals 0.5–0.8 mm long. (Canning River–Boddington) **I. sp. Canning River**
- 3: Largest leaves 12–33 mm long, broad-based. Involucral bracts 1.4–2 mm wide. Floral bracts c. 0.4 mm wide. Longest hairs at the apex of the tepals 1.3–2 mm long. (Manypeaks area–Cape Riche area)..... **I. buxifolius** var. **obovatus**

Mark & Carolyn's Glendeuart Garden

By Mark Noake

There are advantages to being a bit of a nuisance. For me it meant an assignment to a quiet corner of the Eurobodalla Regional Botanic Gardens nursery to work on the family Proteaceae. After a few years of working on the gardens' Grevillea collection I was approached by then manager and avid plantsman, John Knight, to "have a go at growing some of these". "These" were a particularly nice dwarf form of *Isopogon anemonifolius* from a nearby headland (left, growing in Mark and Carolyn's garden).



Isopogons and Petrophiles are naturally addictive, providing a wealth of interest to plant growers. We were hooked and are now fortunate enough to grow most of our local I&Ps here in Glendeuart some 8 kilometres inland and just north of Moruya on the Far South Coast of NSW.

Local species include *I. anemonifolius* (dwarf and taller forms), *I. anethifolius* (dwarf and taller forms), *I. prostratus*, *P. pulchella*, and *P. sessilis*. *P. pedunculata* also grows locally and we were having a great deal of trouble picking the difference between it and our *P. pulchella* until Phil T very politely pointed out that all of our specimens were *P. pulchella*! The quest is on to add *P. pedunculata* to our collection.



Left, *I. prostratus*, Right, *P. sessilis*

Carolyn has been on a bit of a mission and has so far added *I. cuneatus*, *I. "Stuckey's Hybrid"*, *P. teretifolia*, and *I. formosus* to the mix. A very good friend and keen exponent of the graft (no corruption) has added some grafted specimens to our garden. The upshot is that we are having a lot of fun with our I&Ps. The local stuff grows very happily with no additional care once established. They all flower profusely and for an extended period.

I. formosus grows like the national deficit for a few months then, usually after a huge downpour, cashes in its chips. Our latest attempt to grow it on its own roots has led to plantings adjacent to one of our dry stone walls on a healthy slope. So far they have done very well. *I. cuneatus* has not survived in its natural state but the adjacent grafted plant is thriving. One grafted and one non-grafted *I. "Stuckey's Hybrid"* are so far thriving side by side. *I. "Candy Cones"* has survived its first few months in our garden and we are about to add a grafted *I. latifolius* once the heat dies down a bit. New plantings are soaked in a weak seaweed solution before removal from their pot. Carolyn fills a generous hole with water and allows it to seep away, then pours the bucket of seaweed solution over the fresh planting. Plants are watered for a few months at a frequency determined by rain and days of extreme heat.



Isophile beds and new dry stone terraces

Our soil is decomposed granite with a thin layer of topsoil over a gritty clay subsoil. A particularly sandy spot at the bottom of our block (believed to have at one time been a river course) provides good drainage and a very open forest environment with lots of direct sun for our small collection. Our PH is about 5.5.

So far I have only propagated I&Ps from cuttings but I have been inspired by Phil and Catriona's splendid garden to get into some grafting. Phil is very generous in sharing his knowledge of grafting. We love the ancient feel of these plants. Their forms are often complex and the flowers are prolific and attractive. They are a welcome addition to our garden.

Isopogon “Stuckey’s Hybrid” – a plant to remember a great pioneer grower

By Tony Cavanagh, Ocean Grove

Many people have probably not heard of Ken Stuckey, grower of Australian plants extraordinaire. Yet in the 1930s, when growing Australian plants was not fashionable, this South Australian farmer was fired with enthusiasm and began setting aside part of his property at Furner, near Millicent, to grow Australian plants.

With a special interest in Proteaceae, especially *Banksia*, he made numerous trips to WA to collect seed and corresponded and had close contact with other pioneers, Alby Lindner, Dave Gordon, the Althofer brothers, Alf Grey to name just a few. In the 1970s and 1980s, the garden was known as “Stuckey’s Folly” with many acres of bush garden. I was fortunate to visit it twice and found him a generous host, generous with his time and especially his knowledge. Even with many thousands of plants in the “Folly”, it was uncanny how he could put names to the most obscure plants. And I could not believe my eyes when as an enthusiastic amateur in the mid 1970s, I saw part of his *Banksia* plantation with a row of perhaps 30 plants of *Banksia goodii*, a plant then considered so rare with seed impossible to obtain and every *Banksia* enthusiast’s “holy grail”. In the 1980s, with the help of his daughter, Ken developed a thriving business with cut flowers and pioneered the export of foliage to the Japanese market where leaves of Australian plants such as *Banksia grandis* and *Dryandra drummondii* were highly sought after. And because this is the *Isopogon* Study Group, I should mention my shock at seeing a whole paddock of many hundreds of plants of *Isopogon latifolius* in full flower (see right).



On February 16, 1983, nature intervened in the cruellest possible way with what became known as the Ash Wednesday Fires which devastated both south-east South Australia and Victoria. In South Australia alone, 28 people died and over 200,000 hectares burned, with hundreds of houses and buildings destroyed. One of these was the Stuckey property which was completely burnt out, and Ken and his wife only saved themselves by jumping into their swimming pool. Yet within a few months, Ken was busy planting again and keenly observing the regeneration of a whole new crop of plants where once the plantations had stood. Some regrew from lignotubers but the majority of the Proteaceae sprang up in abundance from seed scattered after the fire. And there were a few suspected hybrids, at least one *Dryandra* and I believe (but have no evidence for this but would welcome comment) the plant that we know today as *Isopogon* “Stuckey’s Hybrid”. Ken Stuckey, however did not live to see his plant in other gardens as he was found dead in his “*Banksia* patch” on 21 April 1991. He had been in ill health for many months previously and had been unable to attend an SGAP meeting in February where he was awarded Associate Life Membership of the Society in South Australia.

It was surprisingly difficult to find out much about this plant. I don’t know who introduced it into cultivation or whether it is readily available from nurseries today. David told me it was relatively easy to strike from cuttings but was not long-lived on its own roots. I had guessed, and he confirmed, that its likely parents were *I. cuneatus* and *I. buxifolius* (but see below). A friend in Ocean Grove is growing a grafted plant, probably grafted onto the eastern *I. anethifolius* or *anemonifolius*, which is around 10 years old. The very wet late summer and autumn rains meant that the plant is flowering this year in July as well as I have seen it. It is about 2 m high with similar spread and covered with hundreds of flower heads. It is growing in part shade in an elevated garden and the flower heads are smaller somewhat paler and sparser than either of their parents. I don’t know how it would perform in a full sun situation or whether the flower colour would be different.

I have attached several pictures of this plant including close ups of a flower head. Close examination of the floral and leaf details (isn't it wonderful what you can do with digital pictures) leads me to ask whether one parent could have been *I. latifolius* rather than *I. cuneatus*. The generally accepted differences between these two (as I understand it), is that *I. latifolius* has (much) larger flower heads and broadly elliptical leaves with a blunt apex ending in a short point. It may be folk law but I also thought that the tip was red. *I. cuneatus* leaves are quite variable but tending to obovate and with a blunt apex. Several of the leaf tips visible in my close up of *I. "Stuckey's Hybrid"* show all the hallmarks of *I. latifolius*, with a short, red point. I would welcome comment on this point and of course would love to know more about the history of the plant. Perhaps one other feature is worth mentioning. *I. "Stuckey's Hybrid"* flower heads are closer to a small scale version of *I. latifolius/cuneatus* but all three show the same yellow style ends on the opened flowers. However, the hybrid also shows some red style ends, particularly on the lower left side of the head. This is what Wrigley and Fagg say in their book *Banksias, Waratahs & Grevilleas* about *I. latifolius* (p. 433) "The style end is yellow with a white conical stigma and it ages to red shortly after opening". So perhaps *I. latifolius* is a parent.



Isopogon buxifolius

plus



?*Isopogon cuneatus*

gives



Isopogon 'Stuckey's Hybrid'

Propagation

The rest of this issue is devoted to propagation. It incorporates the collective experience of our members relating to the three main methods of propagation. We start with the two most popular methods of propagating isopogons and petrophiles, by cuttings and seed, before bursting the 'too hard' image most people have of grafting, by outlining a simple method to solve the problem of growing the spectacular but drop-dead WA species. Don't miss John Knight's article on isopogon pollination and the implications for seed propagation, and note our proposals for exchanging cuttings and seed to further the study group's work.

Propagation by cuttings

This is unquestionably the easiest way to propagate isopogons and petrophiles. Some species, such as *Isopogon formosus*, are among the easiest of all native plants to strike, and a 100% success rate is not uncommon. Of course keeping plants alive subsequently is a totally different matter!

What are the best cutting mixes?

There are varying views on the best cutting mixes to use, but the essential factor in all mixes is that the mix be sterile, so that cuttings are protected from any possible disease while roots are forming. Mixes should not include commercial potting mix for this reason. Here are three of the most popular mixes used to propagate native plants:

- 20 mm peat plugs (available from Garden City Plastics). These are available in polystyrene trays of 240 plugs. Cuttings are simply inserted into a hole in each plug, which can be lifted out to check for roots. Once roots are well established in the plug, the plug is then planted in potting mix, with no disturbance of the roots which can occur when potting on from cutting mixes.
- A mix of perlite and coco-peat, generally 3-5 parts perlite to 1 part coco-peat.
- A mix of coarse sand, coco-peat and perlite. One of our members, John Knight, with vast experience in the horticulture industry, swears by a mix with 3 parts coarse sand and 1 part peat.

Recommended method

Cuttings can be taken at any time of the year from any material other than soft new growth which tends to wilt quickly. Cuttings are generally 5-10 cm long. All but the top few leaves should be removed. Be careful not to strip the bark when removing leaves! Cutting leaves off with flower snips is the best way to avoid stripping bark. A shallow scrape of the bark on both sides of the bottom of the cutting (around 5 mm long) should be made to expose the cambium layer. This exposed cambium layer should then be dipped into a hormone gel such as Clonex purple or Ezi-root (this promotes root development) and then the cutting placed into the cutting mix. Cuttings can be expected to take at least 6 weeks to strike, but may take a number of months depending on weather conditions and the time of the year.

Our members have a wealth of information on growing isopogons and petrophiles by cuttings. Here are some of their secrets!

Keith Alcock from Kalamunda WA reports great recent success with cuttings including *I. latifolius*, *I. baxteri* and *P. ericifolia*, after unsuccessful attempts with seed. He uses 20mm peat plugs as the cutting medium.

Neil Marriott from the Grampians recommends either 1 part coco-peat to 3 parts medium perlite or peat plugs and uses Clonex purple: 'I have struck many species including *I. anemonifolius*, *I. anethifolius*, *I. asper*, *I. axillaris*, *I. baxteri*, *I. buxifolius*, *I. cuneatus*, *I. dawsonii*, *I. divergens*, *I. dubius*, *I. formosus*, *I. prostratus*, *I. teretifolius*, and *I. trilobus*. Most Petrophiles are just as easy including *P. aspera*, *P. biloba*, *P. brevifolia*, *P. carduacea*, *P. conifera*, *P. divaricata*, *P. ericifolia*, *P. glauca*, *P. linearis*, *P. longifolia*, *P. macrostachya*, *P.*

scabriuscula, *P. serruriae*, *P. sessilis*, *P. shuttleworthiana*, *P. squamata*, and *P. teretifolia*.

Cuttings are far easier to strike than seedlings, however seed grown plants are a LOT hardier, developing a good deep root system compared to cuttings which tend to be far more surface rooted, and never develop a deep taproot. However seedlings are a pain in the neck, damping off readily and taking months to establish after potting up. Worth the effort though!!'

David Lightfoot from Melbourne has successfully grown a huge number of species from cuttings: 'I use Clonex purple rooting gel and a propagating mix of commercial native potting mix with added coarse sand and sometimes perlite. I also add some osmocote or other slow release native plant fertiliser. I don't have a strict recipe so each batch is different. I use mineral water bottles cut in half and with the lids off as a mini green house for the cuttings until they've rooted. I don't have underbench heating. Some species are easy (e.g. *Isopogon formosus*) and most are moderately easy. I have had success with *Isopogon dawsonii*, *formosus*, *dubius*, *anethifolius*, *anemonifolius*, *baxteri*, *linearis*, *teretifolius*, *divergens*, *polycephalus*, Stuckey's hybrid, *mnoraifolius*, *inconspicuus*, *asper*, *attenuatus*, *buxifolius*, *scabriusculus*, *sphaerocephalus*, and *trilobus*, also *Petrophile fastigiata*, *prostrata*, *multisecta*, *longifolia*, *latericola*, *teretifolia*, *linearis*, *seminuda*, *nivea* (although it took nearly 5 years to grow roots!). Getting all those to stay alive has been quite a different story!'

Liesbeth Uijtewaal from The Netherlands has been attempting lots of cuttings lately: 'Propagation is carried out indoors under tube light in a simple propagator with bottom heat. I usually apply Clonex Purple or Root Strike and don't hesitate to keep cuttings in the fridge for 1 or 2 weeks before propagation, tightly wrapped in moist newspaper. I use commercial propagation mix which consists of finely sieved peatmoss with sand and perlite added. I add some more sand and fine volcanic grit to obtain an open free draining mix.'

Note: The months mentioned below are the Australian months (e.g. August for me is February for you so if I did anything in August this report says February)

- *Isopogon anemonifolius*: no success in February
- *Isopogons anemonifolius*, *anethifolius*, *cuneatus* and *dubius* taken in April: 70-100% strike rate in 2-5 weeks. Kept at 4C for a week before propagation.
- *Isopogon formosus* gives good strike rates throughout the year. However, the two clones I am growing differ greatly.
- *Isopogon petiolaris* (from 9 months old seedlings) in March: failed

Cuttings taken early December 2015:

- *Isopogon formosus*: 4 out of 12 struck after 4 weeks
- *I. 'Stuckey's Hybrid'*: 6 out of 13 struck after 4-8 weeks
- *I. mnoraifolius*: 2 out of 10 struck after 6 weeks

No roots after 12 weeks for *Isopogons anemonifolius*, *trilobus*, *dawsonii*, *divergens*, *dubius* and *anethifolius*. All *Petrophile serruriae* cuttings failed.

Cuttings taken in July:

- *Isopogon latifolius*: struck after more than 12 months
- *Isopogon cuneatus*: failed
- *Isopogon formosus*: failed (this turned out to be a less successful *formosus* clone, see above)

Graeme Downe from Melbourne has used a mix of 1/3 each peat/sand/perlite to strike *I. Stuckey's Hybrid*, *I. anethifolius*, *I. trilobus*, *I. dawsonii*, *I. cuneatus*, *I. formosus* and *I. anemonifolius*.

Bob O'Neill from Narre Warren South, Victoria uses Bio Gro Professional Growing Medium and Clonex purple: 'The most recent batch of cuttings was a batch of 4 *Isopogon cuneatus* cuttings prepared on 31-12-15. We had

3 cuttings strike in 6 weeks. *Isopogon formosus* and *I. anemonifolius* have also struck readily for us in the past.'

Mark Noake from Moruya NSW: 'Cuttings are taken from semi-hard wood and dipped in a 2½% solution of Esi-Root for at least 25 seconds then set in a mix of sand, peat and perlite. They strike quicker with bottom heat but will eventually make roots when just kept in green house conditions.'

Where to house your cuttings

It is relatively easy to provide conditions good enough to successfully strike cuttings of isopogons and petrophiles. These two genera are not overly demanding in their humidity requirements, so here are a few rules to follow:

- Shaded conditions are essential in the warmer months, but the high humidity provided by glasshouses is generally not needed.
- The shaded conditions should protect plants from strong winds. These conditions can be provided by a shadehouse, or a simple Yates Propagation House available at hardware stores for around \$25.
- The cutting mix or peat plugs should be moist but not too wet. A mix that becomes too wet can kill cuttings. Particularly close attention is required for peat plugs which can easily become too wet or too dry.

Potting on cuttings

Producing roots on cuttings is only half way to successfully propagating from cuttings. It can be very difficult to grow on cuttings that have produced roots, particularly with species from WA, which demand a better drained potting mix than provided by most commercial potting mixes. Some of our members have provided great information on ways of loosening up potting mixes to minimise losses.

Neil Marriott in the Grampians suggests adding perlite to commercial potting mix – "I suggest you open up your mix with medium grade perlite =2 parts potting mix: 1 part perlite. Puts lots of air into the mix very effectively!! I do this for really touchy Grevilleas and it works a treat!!"

Keith Alcock from Kalamunda WA pots on WA species using a mix of two parts Osmocote Seed and Cutting Mix and one part coarse sand.

Propagation by seed

Propagating isopogons and petrophiles by seed seems to have been very much trial and error in the history of our study group. While there have been notable successes, most reports are of failure of seeds to germinate, with old seed being blamed. Hopefully over the next few years the study group can develop successful methods of raising seed for both genera. Catriona and I have not attempted to grow any species by seed so over to our members for their advice.

The role of fire or smoke in germination is a particularly interesting question, and as you can see below there are different views on its importance.

Margaret Pieroni from Denmark WA reported one of the success stories back in 2012 in Newsletter 16: 'In April this year, I returned to the location of the plant we think is *Isopogon divergens*, about 20 km east of Frankland. I collected about 8-10 seed heads and proceeded to clean them, scraping off the fluffy bracts and scales and separating the tiny, hairy seeds. Thinking that I might have missed a few seeds, I spread the left-over, fluffy material on the top of three pots of seed-raising mix. To my surprise, in about three weeks, seedlings began to appear. In August, with help from a friend, I potted up 60 seedlings. I also got excellent germination from seeds that I'd sown which I still have to pot up.' Margaret adds: 'Back then, I used to burn

dry eucalyptus leaves on top of the sown seeds, in the pots or trays.'

However, there have also been challenges, although Margaret is lucky to have some species self-seed at her place: 'Years ago, I grew *P. helicophylla* from seed collected years earlier. Since then, I have not been able to germinate any more seeds though I've tried with fresher seed. A beautiful plant of *P. longifolia* which died produced a lot of seed and I have grown several plants. A plant of *I. formosus* which also flowered and died, has self-seeded in the garden. One plant, the only petrophile growing naturally on my block, *P. diversifolia* grows fast but is short-lived. Hundreds of new seedlings appear every season.' (Photo, right)



Neil Marriott from the Grampians VIC also reports some success:

'mostly from fresh seed, some a bit older. Seed is soaked in dilute smoked water for 12-24 hrs before sowing onto peat and perlite mix (1 part coco-peat to 3 parts medium perlite). Seed is very lightly buried to about its own depth in the same mix before watering in and placing in an open sunny site where it is kept watered daily. Seedling germination is highly erratic, with most germinating in c 24-30 days. Much never germinates!! Without the smoked water I get almost zero germination. One exception is the local *Isopogon ceratophyllus* which grows naturally in our heathland. For this species I break off the old dead branches full of opening cones and simply shake them out all through the heathland. I started off with 3 plants and now have about 30!!'

Maria Hitchcock from Armidale NSW also reports success lightly burying the seed: 'I use a mix of 1:1:1 Coir peat, fine perlite, fine vermiculite. Sow seed shallowly in a punnet. I used to use capillary watering but now I put the punnets in my igloo which gets a fine mist for 10 minutes each day. Not sure about the freshness of seed - don't think it matters all that much. I have grown *I. anemonifolius*, *anethifolius*, *dawsonii*, *petiolaris* and *P. canescens*.'

Marina Tyndale-Biscoe from near Braidwood NSW has successfully used coarse river sand as her seed-raising mix with *I. anemonifolius*, *anethifolius*, *formosus*, and *fletcheri*. She has also tried other isopogon species without success.

David Lightfoot from Melbourne, has extensive experience as you would expect of our former Study Group Leader: 'I have grown a number of species from seed. These include *Isopogons dubius*, *anethifolius*, *anemonifolius*, *alcicornis*, *divergens*, *drummondii*, *latifolius*, *cuneatus*, *buxifolius*, *trilobus*. *Petrophiles carduacea*, *diversifolia*, *divaricata*, *longifolia*, *pulchella*, *shirleyae*, *serruriae*. I tend to just put the seed on the top of growing medium then cover in sand or vermiculite. I don't pre-soak or smoke-water them. Anecdotally I think fresh seed is best, but I haven't experimented formally. That said I did get *Isopogon alcicornis* to germinate about 8 years after collecting the seed.'

Liesbeth Uijtewaal from The Netherlands uses a pre-germination method similar to that used by Hakea Study Group Leader Paul Kennedy for his hakeas: 'All seed obtained from Nindethana. I usually pre-germinate seed on moist kitchen towelling at room temperature, germinated seed is then transferred to seed raising mix. It takes another 1 or 2 weeks for seedlings to emerge from the mix; germination mentioned below is the actual moment a rootlet emerges from the seed. I've treated the seed with Kirstenbosch Smoked Paper Discs.

Isopogon divergens: 4 of 20 seeds, 22-25 days from sowing

Isopogon petiolaris: 9 of 23 seeds, 22-25 days from sowing

Petrophile linearis: 11 of 36 seeds : 11-17 days from sowing (2 y.o. seed, collected near Cataby WA)

Germinating other batches of seed in the past failed, those were probably too old. I'm currently repeating the

procedure with the *Isopogons* to see whether the one-year storage of the seed has affected germination.'

John Nevin from Armidale NSW has also had success with fresh seed: 'I have grown *Isopogon dawsonii*, *isopogon anemonifolius* and *Petrophile canescens* from fresh seed. All successful, albeit very slow growing. Seed fresh (less than 2 months old) in each case. I used Bunnings seed raising mix and kept the seeds moist.'

Mike Beamish from Boolarra VIC also reports low germination rates from fresh seed: 'I've sown seeds from *I. ceratophyllus*, *I. dawsonii*, *I. dubius*, *I. formosus* and *I. prostratus*. Only 1 seedling from 8 for *I. formosus* and 2 seedlings from dozens of seeds for *I. prostratus*, the rest all failed. The seeds that germinated would have been relatively freshly collected from plants in my garden, but all the other species were from the seed bank.'

John Knight from Batemans Bay NSW recalls his experience growing isopogon from seed while head of the Eurobodalla Regional Botanic Gardens: 'Various suggestions have been made as to how to germinate seed of this genus. Often suggested is the removal of the hairs, as this might enable moisture to enter the nut. It was thought that the hairs, which are most likely to aid in dispersing the seed away from the parent plant, are hydrophobic, and also may hold the nut away from soil contact, so preventing the fruit from germinating. I don't believe that removing the hairs is necessary, or even preferable, as once they are thoroughly wetted, viable fruits seem to germinate at will. I have used water alone, and the seed seem to sit upon the surface, held by the tension applied by the water, but with a little detergent added the seeds soon became wetted sufficiently to enable the process of germination to begin.'



Mention has been made of placing the seed between sheets of damp kitchen towelling, and placing these between saucers, enclosed in a green plastic bag, keeping in a warm place until the fruits began to germinate. This of course would save the need to isolate the viable and non-viable fruit. It has been said that germination using this method is relatively quick, often only a couple of weeks. I spoke to member Paul Kennedy, who has been using this method for quite some years with great success with his hakea seed, and he still enthuses over results. There is an article on this very subject in *Australian Plants*, vol. 9. No. 73 by Pam Watson, which is quite descriptive of the process.

I have observed many instances of mass germination following fire over the last 20 years, and have noted also that a similar event occurs when areas have been logged, or even along roadsides which have been recently graded. Always keen to take on board recommendations by others more experienced than myself, and noting that fire did have a positive effect on germination, I followed for some years the advice to pass the seeds over a fire, to remove the hairs and also to allow the mysterious effects of fire/smoke to work some magic. Unfortunately the results were always poor, and mostly nil. Similarly, when the fruit were allowed to soak in smoke water, using Regen 2000 liquid, no better germination occurred than with seeds simply sown without any treatment. I might add that these results were only with local eastern state species when I worked at the Eurobodalla Regional Botanic Garden. The results might well be different with some of the spectacular Western Australian species, which I will hopefully put to the test in time.

With regard to mass germination following fire, has anyone considered whether it is the current crop of fruit, fallen since the fire, which has germinated, or that stored from previous falls. I ask this as the germination noted after tree clearing can be almost as generous, despite many cones still being attached, unopened.'

Propagation by grafting

Grafting addresses the problem with growing fussy WA species which love to throw in the towel when they are subjected to conditions away from their homeland. Most grafting to-date has concentrated on the two spectacular pink WA isopogons, *I. cuneatus* and *I. latifolius*. Very little, if any work has been carried out on petrophiles, despite so many being potentially desirable garden plants. So we have lots of work to do, as grafted plants are really the only viable option to introduce the western species into cultivation on the summer-wet east coast. In my experience isopogons are one of the easiest native plants to graft and I use them when teaching others to graft.

There are two main methods of grafting isopogons and petrophiles (or any native plant):

1. Grow the stock into a rooted seedling and then graft the scion (the plant being grafted onto the rootstock) onto this seedling.
2. Graft the scion onto a cutting of the rootstock and treat the resulting graft as a cutting. We will call this a cutting graft.

Method 2 has a number of advantages for the home gardener wanting to try grafting:

- The time and effort growing stock seedlings needed for Method 1 is unnecessary, allowing for cheap and easy experimentation which is likely to encourage greater participation by members in grafting.
- Growers can choose a rootstock from their own garden, from a plant which is proven to be vigorous and hardy in their conditions.
- Given practise, cutting grafts are easier and quicker than Method 1.

The main advantage of Method 1 is that the grafted plant becomes ready to plant out faster than cutting grafts, whereas cutting grafts require more time to grow on.

We will only discuss the cutting graft technique here because of the advantages outlined above.

Steps for successful cutting grafts

1. Assemble tools: Stanley knife, Stanley knife blade, flower snips (Figure 1).
2. Scion (plant being grafted): Take a cutting of your chosen scion. Select firm, semi-hard scion material and trim to around 5-8 cm in length. New tip growth should be avoided as this will tend to wilt quickly resulting in the graft failing.
3. Stock: Take a cutting of your chosen stock plant. This cutting should be chosen to match the diameter of the scion material, and should be around 8-10 cm in length. Remove all leaves from the stock cutting, apart from one leaf at the very tip of the cutting (Figure 2). All other leaves can be removed – be careful not to strip the bark when removing leaves. Keeping the top leaf is vital to prevent any 'dieback' around the graft union.
4. Soak stock and scion cuttings in a bleach solution (1 part bleach to 8 parts water) for a few seconds then rinse in water and pat dry with paper towel. This prevents any fungal growth while the graft takes.
5. Use the blade of a Stanley knife to make a 1 cm slit down the middle of the stock cutting (Figure 3). NOTE: correct technique is vital to avoid cutting yourself – hold the blade in your left hand and the stock cutting in your right hand, then move the cutting to the blade, wiggle the cutting slowly onto the blade until the 1 cm cut through the middle of the cutting has been completed. The left hand holding the blade does not move. You will only cut yourself if you push the blade into the cutting and it slips!
6. Use a Stanley knife (only the blade is used in step 5, whereas this step uses the knife itself) to cut a wedge in the bottom of the scion stem of around 1 cm so that this can be inserted into the stock cutting.

7. Insert the wedge-cut scion into the cut at the top of the stock cutting (Figure 4). Then tape the graft union using Nescofilm or Parafilm (the piece of tape should be about 5 cm long and 1 cm wide – cut tape into pieces of this size) so that the graft union is totally covered and is waterproof (Figure 5). The tape should be stretched as it is wrapped so that the taping is tight and the tape adheres to itself.
8. Treat the resulting cutting graft as you do a cutting, i.e. knick the bottom of the stock, insert into Clonex Purple Gel for 5 seconds then place into cutting mix.
9. Roots should appear on the stock within 2 months in the warmer months (may take longer in the cooler months).
10. Once the cutting graft is potted up the graft should have taken and the plant can be grown as for a normal cutting.



Figure 1: Stanley knife, blade, flower snips



Figure 2: Leave one leaf at the tip of the stock cutting



Figure 3: Make a 1 cm slit down the middle of the stock cutting. The hand holding the blade does not move.



Figure 4: Insert the wedge-cut scion into the cut at the top of the stock cutting



Figure 5: Tape the graft union so that it is totally covered and waterproof

Choosing your stock plant species

Which isopogons and petrophiles should be used as stock plants? The identification of both hardy and long-term compatible stock plants should be an important aim of this study group. The main stock used so far has been *I. anethifolius*, a hardy, vigorous eastern species which strikes relatively easily. However, there appear to be a number of other potential stocks which could be used. These include *I. mnoraifolius*, which comes from the NSW north coast near Yamba and is reported from one Study Group member as being ‘as tough as old boots’ and immune to the savage frosts up to -10C in places like Armidale. *I. dawsonii* from the western ranges of NSW is also worth trying, though its hardiness in high rainfall areas needs to be tested. These three plants are all non-lignotuberous, which means they have the advantage of being less likely to re-sprout below the graft.

Successful isopogon grafts on *I. anethifolius* (long-term compatibility indicated for plants older than 2 years)

- *I. cuneatus* (long-term compatible)
- *I. spathulatus* (long-term compatible)
- *I. 'Stuckey's Hybrid'* (long-term compatible)
- *I. latifolius* (some unexpected deaths after 12 months, raising doubts on long-term compatibility)
- *I. pruinosus/panduratus* (many succumb after 3-4 years – is it long-term compatible?)
- *I. adenanthoides* (one plant died after growing vigorously for 18 months – need more trials to ascertain long-term compatibility)
- *I. ceratophyllus*
- *I. baxteri*
- *I. tridens I. fletcheri*
- *I. trilobus*
- *I. divergens*
- *I. scabriusculus ssp. scabriusculus*
- *I. dubius*
- *I. sphaerocephalus*

The obvious missing species from this list which needs to be grafted is *I. formosus*. I am currently trialling this on *I. mnoraifolius* after many failed attempts on *I. anethifolius*. I have one young plant successfully grafted onto *P. pulchella*! Graeme Downe from Melbourne has successfully grafted one plant of *I. formosus* onto *I. anethifolius* so it might just be a difficult combination.

Members' experience in grafting has been limited to date. Hopefully, we can inspire members to try the cutting graft method to expand the range of isopogons and petrophiles they can grow.

Graeme Downe from Melbourne has successfully grafted *I. latifolius*, *I. cuneatus*, *I. dubius*, *I. formosus*, *I. sphaerocephalus* and *I. baxteri* using *I. anethifolius* and *I. dawsonii* as rootstocks.

Liesbeth Uljtewaal from The Netherlands has tried some unusual combinations, but it should be noted that she is growing all her plants to thrive in pots, not in an Australian garden: '*Isopogons cuneatus* (2x) and *formosus* (1x) taken in July, were grafted (top wedge) onto *Isopogon formosus* after having spent 6 weeks in the propagator. After 2 months all three had taken. They're still doing well after 2 years. BTW, one might think it's a bit odd to graft *formosus* onto *formosus*. Indeed, it is, but at the time I thought my stock plants were *Isopogon dubius* whereas the scions I got were labelled *Isopogon anethifolius*. They both turned out to be *formosus* instead! Pieces of 9 months old *I. divergens* and *petiolaris* were grafted onto *I. formosus* but like the cuttings, these grafts failed. The material may have been too soft.

Isopogons dubius (1x), *anethifolius* (2x) and *dawsonii* (2x) of the material taken early December 2015 were grafted onto *I. formosus* plants after having spent 8 weeks in the propagator. At the moment, three weeks later, they all look very promising and are putting on some growth. The grafts are top wedge grafts, the scions + some leaves of the stock plant were covered by a zip-lock bag partly zipped up. The leaves of the stock plant make sure the humidity inside the bag is high. The plants are kept indoors under tube lights (12 h/day).'

Grafting petrophiles

In our previous location in Canberra I successfully grafted *P. media* onto *I. anethifolius*. This was still growing well when we sold up and moved to the coast. I have trialled a number of petrophiles onto *P. pulchella*, so far without success. *P. pulchella* can be slow to strike, but the main problem has been a lack of vigour in the rootstock, with stocks dying within a couple of months of striking roots. Technique rather than compatibility could be the main issue here, so I will continue further trials. I am also conducting grafting trials of petrophiles onto *I. anethifolius* and *I. mnoraifolius*. Hopefully there will be some results to report in the future.

Exchanging cuttings and seed

Many isopogons and petrophiles are difficult to obtain from nurseries, so we need to facilitate a means for members to gain access to seed and cuttings to further our research. Initially we need a list of members who can provide material and the species they can provide. We will start the ball rolling with our list of species.

All States apart from Western Australia allow cuttings to be mailed freely from NSW. Unfortunately Western Australia requires a permit and inspection at a cost of \$104 per shipment. This may not be a big issue for WA members given that most of the isopogons and petrophiles come from WA!

If you would like us to send cuttings or seed to you, here are the steps (may vary for seed-only requests):

1. Email us to check that material is currently available catrionaandphil@gmail.com.
2. Once availability is confirmed, purchase a 500g Express Post satchel from Australia Post (costs \$10.55), self-address it, put in an envelope and send to:
Isopogon and Petrophile Study Group
PO Box 291
ULLADULLA NSW 2539
3. We will then package up your cuttings/seed and send it back to you Express Post.
4. An email will be sent to you on the day the package is mailed so that you can be ready to propagate as soon as the parcel arrives!

Here are the species that we can provide cuttings or seed at this stage. We plan to expand this range rapidly:

Isopogon – anethifolius, anemonifolius (1.5m shrub, 0.3m shrub), buxifolius var. spathulatus (now *I. spathulatus*), cuneatus, dawsonii, divergens, dubius, formosus, latifolius, mnoraifolius, petiolaris, sphaerocephalus, tridens, trilobus

Petrophile – canescens, ericifolia, pedunculata, pulchella, serruriae, sessilis, shirleyae

Could any members able to provide cuttings/seed using the above arrangement please send us your species list so that we can include these details in the next newsletter.

Investigating Isopogon pollination and the implications for seed propagation

By John Knight

Isopogons and Petrophiles fit within the scheme of Proteaceae subfamily Proteoideae, then tribe Conospermeae, finally arriving in the well-defined subtribe Petrophilinae, members of which have flowers in dense cone-like spikes or heads, with imbricate (overlapping) scale-like floral bracts. The subtribe has just 2 Genera, *Petrophile* and *Isopogon*. The clearly evolutionary modification of the style, which is thickened below the stigma, therefore forming a pollen presenter, is evidence of the strong relationship of the members of this subtribe. The stigma often has a brush of hairs apparent, readily visible under a 10x lens. The fruit is dry and indehiscent, being usually a small nut or achene, and the floral bracts become firm and woody, protecting the developing fruits.

Petrophile flowering inflorescences are longer than wide. The perianth tube, consisting of 4 parts, is split to the base. Cone scales (floral bracts) remain attached to the floral rachis similar to a pinecone, opening just

sufficiently to release flattened nuts when the plant suffers some stress, such as occurs in bushfires.

Isopogon flowering inflorescences are generally rounded in outline, and the perianth tube does not split to its base. Cones disintegrate, the woody floral bracts falling with the nuts, often when the nuts mature, usually within 6-12 months of flowering, but in many cases remaining firmly closed for some time, until released by fire or other event which causes the cones to dry and collapse. I have noted that *I. anemonifolius* and *I. anethifolius* often have cones which appear to be 3 years old, still firmly closed but on removal from the bush, will soon fall apart to reveal their seeds. *I. prostratus* holds its cones in cultivation, although in the tougher environment where it grows naturally, the cones, if fertile may disintegrate before the next flowering.



Isopogon anemonifolius

It is noted by many that *Petrophile* produces a majority of fertile mature fruit, whereas *Isopogon* fruit is often infertile. This situation appears to matter little whether the plants are growing in their wild state, or in gardens. This obviously has a lot to do with the pollinators of each.

A paper titled 'Pollen grains, why so many?' R.W. Cruden (1997) shows that *Isopogon* is atypical in the production of pollen in relation to the surface of the stigma. The paper discusses the expectation that stigmas with a large area contact more of the pollen bearing area compared to stigmas with a smaller area, and that fewer pollen grains should be required for equivalent pollination success.

Pollen number should be positively related to the pollen bearing area. If the pollen bearing area decreases the pollen grains are closer together, thus increasing the likelihood of a pollen grain contacting a stigma, and pollen number should decrease. Conversely if the pollen bearing area is large, the pollen grains are further apart and it takes more pollen grains to achieve a density that is equivalent to species with smaller pollen bearing area.

A decrease in pollen grain number should be associated with an increase in pollen grain size and an increase in stigma area and/or a decrease in pollen bearing area. Stigma area relative to the pollen bearing area directly influences the likelihood of a pollen grain reaching a stigma, hence pollen grain number and pollen:ovule ratio. At one extreme are species with a quite low pollen:ovule ratio, and stigma areas that are large relative to the pollen bearing area.

In contrast, the stigma of *I. anethifolius* (eg) were situated within a tiny cavity at the tip of the style, which were small relative to the pollen bearing area, and the pollen:ovule ratio were high. *Isopogon* has a small stigma area, tiny pollen grains and high pollen:ovule ratios of >25000:1. With all this pollen you might expect that every flower would produce a fertile nut, but we know that this is rarely the case. This leads us to wonder then whether the pollination efficiency is naturally poor, or that the necessary pollinators are few in number, and therefore rare visitors.

As noted earlier, my experience is that the success of fertile production is similarly poor in the wild as it is in cultivation. The latest experiment, using *I. anethifolius*, wild collected from Jerrawangala in Morton National Park showed that from three large cones, containing 396 floral bracts, and we can then assume 396 flowers, each holding 25,000 grains of pollen, produced 214 fruit, of which 63 appeared fertile. The result of these 3 inflorescences producing almost 10 million pollen grains, resulting in just 63 potential progeny, seems very inefficient, representing one fertile nut for around 160,000 pollen grains.



396 woody bracts!

However the process is obviously successful, as Isopogon is an ancient member of the flowering plants.



Plump viable fruit, outnumbered 3 to 1 by apparently non-viable ones

The fertility test involved rolling the nuts between thumb and forefinger, feeling for plumpness. There appears to be some science here, albeit primitive. To test the theory, hairs were removed from 6 fruit, 3 each of those I thought fertile, and 3 I had dismissed as infertile. The fruit were dropped to a table from a height of 20 cm. Those fertile fell quickly, suggesting they were more weighty than the infertile, which whilst not floating down, certainly hit the table slower, and without any noise (I use this test always for Banksia seed, as many are infertile). The seed have not yet been sown, as I am waiting for the weather to cool a little. The results will be reported next newsletter.

There is a need for members of the study group to observe, when their plants are in flower, just what vector appears to do the work of pollination. I have seen native bees or hover flies around the plants in my garden, but never birds. The flowers would appear not to attract birds due to their unusual design, but maybe in the wild some other animal might be at work. As an ancient plant group, their evolution might have occurred when insects dominated. That is a task for someone better placed than me to determine.

Financial Report

We now have a new Bendigo Club Account set up for the Study Group. For reference, the details for any money transfers or donations are: BSB: 633-000, Account No: 156858730.

Last year we received donations from Queensland and NSW APS groups in lieu of membership fees, and now expect to receive a generous donation from ANPS Canberra Region. The Study Group funds assist with expenses associated with producing the newsletter and promotional material, but there is potential to use them for Study Group activities such as propagation. As we are not charging for membership we do not expect to grow the funds significantly, so funding major activities will require donations and planning (please send us your suggestions if you have any).

Balance 31/9/2015	\$964.62
Final transfer from previous account	\$101.00
Expenses	\$83.31
Balance 22/3/2016	\$982.31