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Eucalyptus Study Group Newsletter

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The Eucalypt Invasion of Portugal

By Michaela McGuire

Source: https://www.themonthly.com.au/issue/2013/june/1370181600/michaela-mcguire/eucalypt-invasion-portugal

Just a short drive from the Portuguese university town of Coimbra, in Vale de Canas, a sea of eucalypts extends to the horizon in all directions. The tallest tree in Europe sprouted here 120 years ago, in a deep, foggy gorge. “Karri Knight”, as the tree is known, is a lone *Eucalyptus diversicolor* piercing the sky at 72 metres. The brown and white–trunked giant was measured using a laser hypsometer by a team of self-professed “gum nuts” in 2010. Native to Western Australia, Karri Knight is nearly as far from home as I am.

Popular for ornamental and medicinal reasons, eucalypts were introduced to Europe in the late 18th century by British and French botanists, including Sir Joseph Banks. By the 19th century there was almost no native woodland left in Portugal and, in 1866, some 35,000 eucalypts were planted around Coimbra in an effort to control devastating erosion. The thinking also went that the trees would help to drain swamplands and reduce the incidence of malaria.

Almost a century later, Scandinavian timber companies began buying up vast parcels of Portuguese land to grow *Eucalyptus globulus*, or blue gums, to pulp for paper. The vast plantations crippled village economies, many of which still relied on communal farming, by usurping land and lowering the water table.

“Portugal was not in a position to guard against those projects,” says Pedro Bingre, the regional director of Portugal’s major environmental group, Quercus, named after the native cork oak tree that, thanks in part to the proliferation of eucalypts, is in steady decline. “By the early ’70s Portugal was fighting wars in three African countries, so we needed the money. Special laws were created for the expansion of the eucalyptus.”

Now the exotic blue gum is the most abundant tree in Portugal, covering about 7% of the land. Walking through Vale de Canas beneath the towering gums feels bizarrely familiar, but Portuguese gum forests are deathly quiet. “Our fauna can’t feed on it; they can’t find refuge in it. Our insects can’t eat eucalyptus, so there are no birds,” says Bingre. “We should introduce koalas. At least there would be something cute to look at.”

Plantation eucalypts are grown in rotation periods of 12 years, during which time the undergrowth is cleared at least twice. “In a native oak forest you’d find, in one hectare of woodland, at least 70 or 80 species of plant,” says Bingre. “In a eucalyptus forest, you would hardly find more than 15.”

But it was the drying up of village water supplies that sparked a groundswell of opposition to the “eucalyptisation” of Portugal. “Ever since the mid ’70s people have been protesting,” explains Bingre.

In many parts of Portugal, eucalypts already grow wild. “As does the Australian wattle tree,” Bingre tells me. “The two trees are very aggressive species.”

Paulo Bernardo de Andrade, one of Quercus’ co-founders, was among the original plantation opponents. “One of the most effective protests was to pull out the baby trees,” he tells me, sitting in his dining room in Coimbra. “We used to chain ourselves to the machinery used to excavate the earth, too.” He smiles ruefully. “That was the ’70s. Things have changed.”

Today, Quercus sees education as its best strategy, helped by evolving technology. Currently Brazil produces twice as much pulp per hectare as its former colonial master, and Portugal only remains competitive because of the high cost of transporting pulp from Brazil to Europe. Meanwhile, demand for paper is declining. “People are buying less newspapers, less magazines,” says Bingre. “Some

studies say that in 20 or 30 years' time there won't be enough demand to justify these huge plantations of eucalyptus, which will be a new problem for us. It's very unlikely that the landowners and pulp-producing companies will be willing to convert their plantation forest back into native cork forest. It would be very expensive." Screw-top wine caps have nobbled demand for cork, at least abroad, and it doesn't help that eucalypts are particularly hardy, capable of regrowing up to three times after harvesting. In many parts of Portugal, eucalypts already grow wild. "As does the Australian wattle tree," Bingre tells me. "The two trees are very aggressive species."

To local environmentalists, the gum tree is to Portugal what the rabbit is to Australia. But de Andrade can find one redeeming feature. "Eucalyptus, it's good for some things," he says, pulling a long, slender object wrapped in bright fabric from the corner of the room. The didgeridoo is covered in a pattern of curls that he has marked into the wood using a small blowtorch. He gives me a quick demonstration and is surprisingly proficient. "It's easier to make these out of bamboo or balsawood," he says, testing its weight in one hand. "But eucalyptus is more special, I think."

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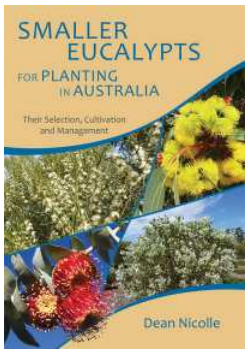
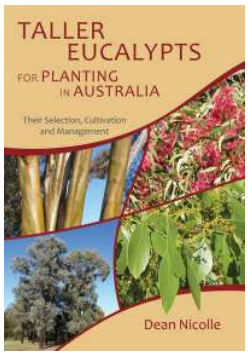
BOOK REVIEW

By Elspeth Jacobs



1. SMALLER EUCALYPTS FOR PLANTING IN AUSTRALIA
Their Selection, Cultivation, & Management Dean Nicolle 2016



2. TALLER EUCALYPTS FOR PLANTING IN AUSTRALIA
Their Selection, Cultivation, & Management Dean Nicolle 2016

Available from APS Vic Book Sales

These two stand-alone volumes fill a gaping hole in our knowledge of eucalypts for horticulture. There is very good information available now for botanical descriptions, natural distribution, and field guides for eucalypts but little to assist the home gardener or public gardens horticulturist.

Many gardening books list very few species and often the images are of up-close flowers rather than the general appearance. There is also much 'fear' about eucalypts…'they will get too big and drop limbs on your house'!
So, at last, two very comprehensive, authoritative volumes to correct this. The aim is not to introduce us to rare, interesting new species, but species that are most likely to be successful in particular situations.

No-one could be better qualified for such an undertaking than Dean Nicolle. He himself IS a rare species. Born in 1974, from a very early age he devoted himself to seeing, collecting seed of, growing, keeping research records of, and photographing over 800 species from all over Australia at his Currency Creek Arboretum in southern SA.

At the same time he gained his BSc (Hons, Botany) from Adelaide University and then a PhD in "Eucalyptus Systematics" from Flinders University. So his knowledge is both academic and practical.
In 1998 (aged 24) Dean was the keynote speaker at the Fred Rogers Seminar in Hamilton. This resulted in a big leap forward for many enthusiasts.

He has over this time been very generous with information and sharing with others interested in this genus. Dean continues to be a consultant arborist, botanist and ecologist.

In 2015 Dean was awarded the inaugural "Bjarne K Dahl Trust" medal for his "outstanding contribution to eucalyptus conservation and education".

The two volumes cover 165 species (84 smaller, 81 taller). The design and layout by Annett Boerner are excellent, beautifully clear and very user-friendly. A glossary is included, but where possible non-botanical terms are used.

The first sections in each book describe eucalypts in general, for example, habit, bark, leaves, buds and flowers, fruit and seeds. Sections on Management, Uses and Commonly planted species for each capital city conclude this introduction.

The bulk of the books are the descriptions of individual species in alphabetical order.
Each species has a two-page spread with the left page having written information. This covers Features, Natural Distribution, Habitat, Cultivation, Management, Requirements for water, soil, temperature, and light and finally a "Why Plant Me" box. A map of Australia in included for quick reference.

One of the most useful sections on this page are "Closely related species" where differences can be quickly identified rather than having to flick from one page to another. Many confusions for the eucalypt enthusiast are sorted out here. For example, the *Eucalyptus orbifolia/websteriana/ewartiana/crucis* group.

The right-hand page consists of up to 7 images of each species in a planted situation showing, for example, habit, different management (pruning), buds and fruits.

I really cannot recommend these volumes more highly and would love to see at least one of them in every APS members' library! Thank you Dean!

Abstract: Eucalypt forests as indicators of the gradients within the central Queensland serpentine landscape of Australia

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The eucalypt forests of the central Queensland serpentine landscape on the eastern coast of Australia are dominated by two overstorey species. These are *Eucalyptus fibrosa* F.Muell. subsp. *fibrosa*, the most dominant tree occurring throughout the landscape, and *Corymbia xanthope* A.R.Bean & Brooker, a serpentine endemic species which has a more restricted distribution. We hypothesised that the structure and foliage elements of the eucalypt forests could be used as biological indicators of the severity of the serpentine soils. This was tested by surveying 30 plots (50 × 20 m) within the upland landform patterns of the central Queensland serpentine landscape. The structure of the forests and abundance of the species were recorded and foliage samples from the dominant tree *E. fibrosa* subp. *fibrosa* were collected and analysed for metal and nutrient content. Soil samples from each site were collected and analysed for major cations, bio-available metals and fertility. Analysis of the data showed that there are significant correlations between the structure of the eucalypt forests and the landform patterns and soil chemistry. The relative basal area of *C. xanthope* is a useful measure of the severity of the serpentine soils and correlates to the soil Mg : Ca quotients. The tree *E. fibrosa* subsp. *fibrosa* was found to regulate its uptake of soil elements and cannot be used as an indicator of soil elements.

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Australia’s tallest trees

By Alyce Taylor

Only trees in North America and Borneo rival the size of our native eucalypts, some almost 100m tall.

EVERYONE SEEMS TO KNOW about the soaring redwoods of California and their record height, the tallest measuring 115.6m. Australia's iconic eucalypt giants, however, receive far less attention, although they are close rivals for California's botany crown.

In total there are only 22 tree species worldwide known to reach over 80m tall. These trees are native to only three areas of the world; the west coast of North America, Borneo and Australia. All the Australian species are from the *Eucalyptus* family.

Australia's mountain ash (*Eucalyptus regnans*) is the second tallest growing tree species in the world. The tallest specimen – nicknamed 'Centurion' – stands at 99.6m in Tasmania's Arve Valley. It is the world's tallest flowering plant and known hardwood tree.

The species grows extraordinarily quickly, reaching its maximum height in 200 years, a rate five times faster than the redwoods.

"The eucalypts do not live long enough to rival the redwoods in size. However, there may have been genetic 'freaks' that may have – and could in the future – reach over 100m tall," says Brett Mifsud, a specialist in finding and measuring tall trees.

Historic records show that in 1880 a felled mountain ash was recorded at 114.5m in Thorpdale, 137km south-east of Melbourne, making it the tallest tree in the world at the time.

Are Australia's tall trees endangered?

Although scientists are unsure how successful tall tree species were in Australia thousands of years ago, the high rate of land clearing and the unregulated nature of the early timber industry suggests that the number of tall trees has declined significantly since European settlement.

Federal government data states that since settlement, Australia has lost 22 per cent of its forest and woodlands.

"There are most definitely less over the last 200 years, and that's because most of the tallest ones have been cleared," says Dr Dean Nicolle, director of Currency Creek Arboretum in South Australia. "Areas of tall trees are now much smaller, which makes them more prone to being wind-thrown and burnt."

How to measure a tall tree

The most accurate way to measure a tree is still to climb it and drop a measuring tape, which can record height to within a 10cm range.

"Generally surveyors can narrow which are the tallest trees or species using broader scale methods like remote sensing or geometry," says Dean. "But to pin down the exact height of a tall tree, it needs to be climbed."

Laser rangefinders, similar to those used by golfers to track the distance of their swing, are a far easier and safer way of measuring height, within the nearest metre or two.

Light detection and ranging (LiDAR) systems mounted on planes or satellites are a more advanced version of this technology. LiDAR instruments send pulses of light to both the ground and the tree's crown. By measuring the difference in time it takes for these two pulses to bounce back, an accurate measurement of height can be calculated.

Traditionally, a tree's height was calculated by using a clinometer and working with the angle made between a trees's crown and the ground.

"You would have to assume that the tree's top was directly below the base and that never was the case," says Brett. "It is the case for an electricity pole, it is the case for an MCG light tower, but it not the case with Eucalypts."

Dean and Brett say many of the older, inaccurate records that were calculated with this method are still being officially used today.

Finding Australia's biggest trees

"People are so interested in trees and big trees just add an extra dimension to it," says Derek McIntosh, director of Australia's national register of big trees.

Since its establishment in 2009 the public archive has recorded 580 large tree specimens spread over nearly 300 species. The size of a tree is gauged using a more holistic measurement than just height. Everyone from backpackers to university academics have contributed to the registry's list.

"It's not meant to be a clinical thing, or give too much detail about trees; you don't want to frighten people away with too much jargon," explains Derek, a tree enthusiast since his teenage years.

"It has brought me so much fun and enjoyment but what is so exciting is that it brings everyone else so much enjoyment, as more and more people start looking and then adding to it."

This list was complied with the assistance of eucalypt expert Dean Nicolle

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Abstract: Genetic diversity and the insular population structure of the rare granite rock species, *Eucalyptus caesia* Benth

GF Moran and SD Hopper

Australian Journal of Botany 31(2) 161 - 172
Published: 1983

There are 15 populations of *E. caesia* Benth. on granite rocks in south-westem Australia which include a total of about 2120 plants. The level of genetic variation at 18 allozyme loci in 13 populations was estimated. Seven loci were monomorphic for all plants assayed. At a majority of the 11 polymorphic loci the level of polymorphism was very low in most populations. Within populations the mean number of alleles per locus was 1.31 and the genetic diversity 6.8%. However, populations differed markedly in allelic frequencies at a number of loci. The genetic diversity within populations was remarkably low for a tree species but the level of population differentiation was the highest reported for any tree species. The data suggest that genetic drift may in part have been responsible for the low overall genetic diversity and the extensive population differentiation. The optimal strategies for conservation of the genetic resources of this valuable ornamental are considered in the light of the results of this study.

Winter Flowering Gums

Source: ABC Science; 5 May, 2005; http://www.abc.net.au/science/articles/2005/05/05/3299439.htm

By Heather Catchpole

Come winter, a special group of eucalypts opens up its flowers to a host of species that rely on these winter flowering gums for their survival.

Source: Margaret Moir

At a conservative estimate, there are over 900 species and subspecies of eucalypts in Australia. They make up the very essence of 'the bush'. Generally the mass of olive foliage overpowers the distinct, star-like flowers of eucalypts.

But at certain times of the year, gum trees burst into vivid pink, red, yellow, orange, purple or white flowers. Many of them spread their colours in spring and summer, counting on attracting the fresh influx of insects brought by the warmer weather.

Insects also pollinate some late autumn and winter flowering species.

But come winter, there are fewer insects to transfer the pollen of eucalypts, and the winter flowerers turn instead to the birds, and the mammals.

When: Late autumn through winter
Where: Across Australia
Other info: There are probably more winter flowering gums in the southwest of the country where winter rainfall makes it the season of plenty, but winter flowerers occur all around Australia, in a myriad of colours.

Bees needs

Bees and eucalypts have a rapacious relationship at times. (Source: iStockphoto)

You could walk all around Australia and keep busy year round observing the sporadic inflorescence of eucalypts. Which is just what our native (and European) bees do to keep the hive happy during the cold winters down south.

Eucalypts are mostly insect-pollinated and in winter in the southern parts of Australia, there aren't many insects because it's too cold. But even in late autumn, there are bees enough for a number of eucalypt species, including the important honey tree, the Yellow Gum.

The relationship between bees and eucalypts isn't always sweet. European honey bees particularly use the trees in a fashion detrimental to other wildlife, hogging the good nest spots in hollows that they fill with their swarms.

But it's not just bees that rely on winter-flowering eucalypts. Birds do, too.

A parrot's lunch

Birds pollinate gum trees incidental to collecting nectar, the pollen from the flowers sticking to the tiny feathers of the birds' beards.

Honeyeaters of all shapes and sizes pollinate winter flowering eucalypts. Most of Western Australia experiences a veritable orgy of flowering in the winter after the relatively barren, long, dry spell in the summer. Birds see red very brightly, and vividly coloured eucalypts put on their display of brightly coloured flowers to attract them.

In Victoria and Tasmania, one threatened species in particular relies on the winter flowering eucalypts for its survival.

Pressure on winter flowering species threatens the few remaining Swift Parrots (Source: Geoffrey Dabb/)

The swift parrot counts on Victorian winter flowering gums as part of its winter diet as it wheels between Tasmania and Victoria each year. With favourites such as red ironbark, yellow gum, and inland grey box, the swift parrot's picky tastes leave it vulnerable as Victoria's ironbark-box forests, typified by ironbark and box eucalypt species, face land clearance.

On the other side of their range, the spring-flowering Tasmanian blue gum, the birds' breeding grounds, are similarly disappearing.

The continuing fragmentation and land pressure on the mainland winter flowering species further threaten the estimated fewer than 1000 swift parrots left.

Furry feeders

A number of mammals both use and are used by winter flowering eucalypts. In Western Australia, the tiny honey possum, weighing only nine grams as an adult but eating its own equivalent weight in nectar each day, feasts on both the winter-flowering eucalypts and banksias. It provides a valuable service when insects are scarce by pollinating the flowers.

In the east, sugar gliders, fruit bats and flying foxes provide this service. The animals both pollinate eucalypts and spread their seed in convenient packages complete with their own fertilisers.

Humans also make use of the leaves of winter-flowerers to make essential oils. For instance, the Lemon-scented gum (*Eucalyptus citriodora*) from north Queensland (June to November) is important to the essential-oils industry. The omnipotent oil is used in everything from washing clothes, warding off colds and rubbing aching muscles.

Winter flowerers by region

The different winter flowering species are too numerous to do justice to, and some species appear only in restricted areas. But there are a few trees in particular that you can look out for in the different regions of Australia.

Southwest

(Source: Margaret Moir/)

Down in the southwest, the magnificent karri (*E. diversicolor*) are currently displaying. One of the tallest trees in Australia, and the tallest in Western Australia, the karri's lovely creamy white flowers may be best seen from the forest floor where they have fallen from the up to 75 metre tree tops.

Look out also for the pink-flowering of caesia (*E. caesia*), the cream flowers of the Badgingarra box (*E. absita*) and later in winter, the pale yellow flowers of ironbarks (*E. indurata*) and redwoods (*E. transcontinentalis*).

Northern Australia

Northern Australian species are more similar across east to west than southern species and don't experience seasonal change in the way southern species do.

Up north the creamy white-flowered desert bloodwood (*E. terminalis*) is in bloom. The small, white flowers of the long-fruited bloodwood (*E. polycarpa*) and the smooth-stemmed bloodwood (*E. bleeseri*) are present until June.

The orange pom pom like flowers of the Scarlet gum ('E. phoenicea') (Source: Dean Nicolle/)

North Queensland Clarkson's bloodwood (*E. clarksoniana*) and the tall flooded gum (*E. grandis*), which grows more than 80 metres tall, are also bursting into white blooms as is the heart-leaved mallee (*E. minniritchi*) in the inland ranges in central Australia.

More colourful is the splendid scarlet gum (*E. phoenicea*) with its brilliant orange flowers.

Southern Queensland and northern New South Wales can look out for the white flowers of the narrow-leaved grey box (*E. pilligaensis*), inland grey box (*E. microcarpa*) and the majestic spotted gum (*E. maculata*).

Eastern Australia

Winter-flowering eucalypts in eastern Australia tend to have white flowers, relying on insects and mammals for pollination. The Blue-leaved stringy bark (*E. agglomerata*), narrow-leaved red ironbark (*E. crebra*) and the misshapen Tumbledown gum (*E. dealbata*) are all showing white flowers.

A more colourful counterpart includes the mugga, or red ironbark (*E. sideroxylon*), with dark, furrowed bark and lovely bright red, pink or white flowers (inland and coastal NSW; northern Victoria; also Queensland).

Southern Australia

The South Australian cup gum ('E. cosmophylla') (Source: Dean Nicolle/)

Further south, the iconic species is probably the South Australian blue gum (*E. leucoxylon*), with white, pink or red flowers. The summer to autumn-flowering Pink gum (*E. fasciculosa*) is still showing its white flowers, as is the South Australian mallee box (*E. porosa*) and the narrow-leaved red mallee (*E. leptophylla*). Native to South Australia, the cup gum (*E. cosmophylla*), is also in bloom.

With such a plethora of foliage to brighten up the coldest winter walk, there's little excuse for not visiting the winter flowering eucalypts this season. After all, the birds and the bees do it, so why can't we.

Credits

Thanks to Ian Brooker, Margaret Moir, Dean Nicolle and Geoffrey Dabb.

Abstract- Did early logging or changes in disturbance regimes promote high tree densities in river red gum forests?

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Submitted: 15 February 2016 Accepted: 12 August 2016 Published: 27 September 2016

Density of woody plants is thought to have increased in many ecosystems in Australia since European colonisation. Globally, there has been much debate as to whether this phenomenon is driven by the process of post-disturbance recovery – whereby historical logging resulted in the replacement of large, mature trees with smaller, younger trees – or by the process of encroachment – whereby cessation of disturbance events reduced the mortality of seedlings and saplings. We examined the extent to which historical changes in forest structure are compatible with each of these models. The study was conducted in river red gum *Eucalyptus camaldulensis* Dehnh. floodplain forest on the River Murray at Millewa Forest, southern New South Wales. We compared 'historical' (~1860s) stand structure to 'current' structure in 45 one-hectare quadrants randomly stratified between three forest productivity classes. Historical trees were determined by stumps or stags likely to have been cut during the late 1800s. Size and position of each historical and current tree was recorded, and used to calculate stem density, basal area, canopy cover and the area of the 'zone of influence' (the peripheral extent of the root zone). Current stand structure was vastly different from historical structure. Stem density has increased 9-fold, from a mean of 17 (historical) to 147 (current) trees ha^{-1}. However, basal area increased only slightly, from 13.0 to 15.3 m^2 ha^{-1}. Canopy cover increased substantially from 22.1 to 33.5% cover, as did zone of influence, from 55 to 81% cover. Evidence for both the post-disturbance recovery and encroachment hypotheses was found. The 9-fold increase in stem density between historical and current stands was attributable largely to the replacement of large trees with small trees, because basal area had increased only slightly (by 18%). However, the increase in basal area was associated with a substantial increase in canopy cover and area of the zone of influence, supporting the encroachment hypothesis. Regardless, the post-disturbance recovery hypothesis accounts for the bulk of changes in this river red gum forest.

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Cultivar profile: *Eucalyptus 'Golden Crown'*

***Eucalyptus scoparia* 'Golden Crown'**

Source**:** Australian Cultivar Registration Authority; https://www.anbg.gov.au/acra/descriptions/acc321.html

ORIGIN: *Eucalyptus* 'Golden Crown' arose as a seedling from a batch of seed of *E. scoparia* grown at the Goldup Nursery at Mt Evelyn, Victoria in 1981. The seed was collected from a tree growing at Mt Evelyn. The cultivar was first received by the authority in January 1984. Registration applied for by Mr and Mrs P Goldup, Goldup Nursery, Mt Evelyn, Victoria.

DESCRIPTION: At the time of application this cultivar had not yet reached its mature size. The new foliage of this plant is a bronze colour, gradually turning gold. As the foliage matures, the gold changes to a lime green colour. The foliage contrasts well with the red branchlets.

DIAGNOSIS: This cultivar can easily be distinguished from the typical *E. scoparia* by the pale coloured mature foliage.

CULTIVATION NOTES: Because this cultivar is still young, all cultivation details have not yet been fully tested. It is unlikely that the tree will not be as vigorous nor reach the ultimate size of *Eucalyptus scoparia*. The plant is being tissue cultured for a release in the near future. Grafting is another possible method that could be used. These types of vegetative propagation must be used to ensure retention of the cultivar features.

COLOUR CODE: RHS Colour Chart 1966

leaves: yellow group 7A-7B

stems: red group 46A though lighter on the younger branchlets

ACRA REFERENCES: ACC321, ACRA041, CBG8400213

ACCEPTED FOR REGISTRATION ON: 30 October 1987

Source: *http://www.cloudforest.com/northwest/forum/6517.html*

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Unravelling the mystery of eucalypt scribbles

Source: https://theconversation.com/unravelling-the-mystery-of-eucalypt-scribbles-11023

Some natural phenomena are so familiar to us that they feature in our lives and culture, yet we know precious little about them. Sometimes we don't even know how little we know.

Take the subject of our most recent research: scribbly gum moths. The "scribbles" on the scribbly gums are not just a well known feature of smooth-barked eucalypt trees in southeastern Australia, they are considered an Australian icon.

The author of the Snugglepot and Cuddlepie books, May Gibbs, made them a feature of the gumnut babies' world, and the great Australian poet Judith Wright cemented their place in literary culture with her 1955 poem Scribbly-Gum. Max Whitten has detailed the contribution of eucalypt scribbles to Australian culture in his article in the journal Meanjin.

But for all the inspiration they have provided, we had no idea of the biology behind the complex scribbles.

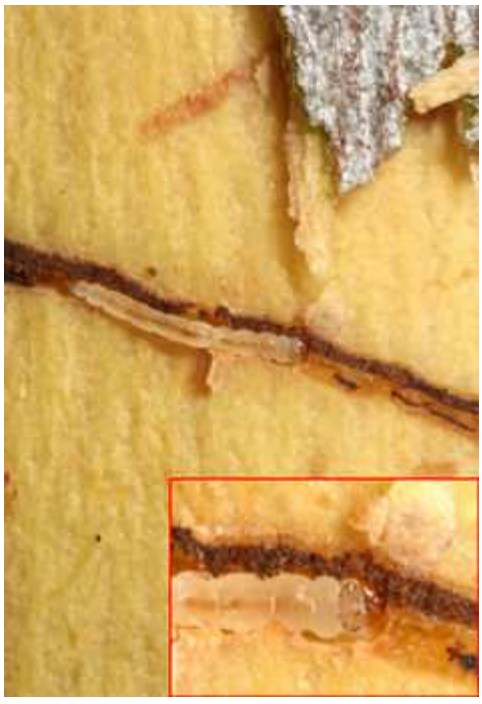
Originally thought to be the work of beetle larvae, it was recognized in 1934 that a moth larva was responsible when the scribbly gum moth from a snow gum, *Ogmograptis scribula*, was described.

The distinctive scribbly gum scribbles are an Australian icon. Marianne Horak, CSIRO

Ogmograptis did not seem to fit into any Lepidoptera family and its position remained so enigmatic that it was left out of the authoritative 1990 book Moths of Australia.

Our study, published in Invertebrate Systematics, was intended to resolve the life history behind the scribbles, but it revealed much more. It showed that Ogmograptis comprises many species in three groups, with the biology known only for those making scribbles on smooth-barked eucalypts. We described 11 new species.

Second, we discovered a hitherto unknown insect/plant interaction. Third, the larva of Ogmograptis provided unique characters to assign it to the *Bucculatricidae* and to expand and redefine this enigmatic family. Fourth, we demonstrated that Ogmograptis is part of a southern group of Bucculatricidae once living on the supercontinent Gondwana and feeding on southern plant families.



So how are the scribbles made? Moth larvae bore a meandering tunnel through the eucalypt tree's bark at the level of the future cork cambium, a growth layer within the bark. First it burrows in long irregular loops and later in a more regular zigzag which is doubled up after a narrow turning loop.

Caught in the act: a scribbly gum caterpillar goes to work on a 'scribble'. You Ning Su, CSIRO

When the cork cambium starts to produce cork to shed the outer bark it produces scar tissue in response to the feeding of the caterpillar, filling the doubled part of the larval tunnel with highly nutritious, thin-walled cells. These replacement cells are ideal food for the caterpillar which moults into the final larval stage with legs, turns around and eats its way back along the way it has come.

It now grows rapidly to maturity, leaving the tree to spin a cocoon at its base where it pupates. Not long after, the bark cracks off, exposing the iconic scribbles beneath.

DNA analysis, as well as two unique larval structures revealed by scanning electron microscopy, clearly assign Ogmograptis to the family Bucculatricidae. Also in the family are the Australian genus Tritymba, which produces the "ghost scribbles" on eucalypts, and a genus from South Africa. These three southern genera are the sister group of the world-wide genus Bucculatrix.

These are very exciting discoveries. Gerry Cassis' recent explainer should give you a sense of the difficulties involved in classifying insects.

At this point I should point out that I, like the other main contributors to this research, am retired. Under the guidance of 96-year-old entomology legend Max Day AO, Ted Edwards AM and I undertook this work at the Australian National Insect Collection (ANIC) in CSIRO — all of us as Honorary Fellows. The botanical nous came from another retired but active Honorary Fellow, Celia Barlow, who devoted both her time and access to the trees on her property for the investigation.

The nutritious tree cells consumed by the scribbly gum caterpillars in the final stage of their scribbling' allow them to grow rapidly to maturity and eventually turn into a moth. Adult *Ogmograptis racemosa* seen here. Natalie Barnett, CSIRO

None of us expected to make big discoveries while trying to understand the biology of a common insect. The results are a stunning example of how little we still know about the insects in this country, even the ones we can see signs of everyday. For example, only about half the species of Australian moths have been described and named and we understand the biology of only a small fraction of them. This is a tantalising prospect for budding young scientists.

To the next generation of entomologists, a treasure trove of wonder and discovery awaits you.

Footnote

By Warwick Varley

Twenty five out of the 784 species of Eucalypt listed in Euclid[1] have been described to contain bark scribbles consistent with the Scribbly Gum Caterpillars. The list of these species (botanical and common name) have been listed below along with the place of natural occurrence. The *Eucalyptus* subgenus *Eucalyptus* appears to be more partial to attack. Some of these trees like *E. piluaris* (Blackbutt) will often be void of scribbles, however other species like the *E. haemastoma* (Scribbly Gum) will commonly have the scribbles. The incidence for scribbles also appears dependent on the location of the tree, where bush and remnant plantings of *E. haemastoma* (Scribbly Gum) will near

[1] Slee A.V., Brooker M.I.H., Duffy S.M., West J.G., 2006, Euclid; Eucalypts of Australia, 3rd edit. Centre for Plant Biodiversity Research, CSIRO Pub. Australia

always have scribbles. However when grown outside of the natural environment or as a sole planted specimen the incidence for scribbles is greatly reduced. The species that contain scribbles appear to be almost isolated to the east coast, with twenty of the twenty five species occurring in NSW. Only one species (*E. virginea*) occurs outside of this area, being WA.

E. burgessiana (Falconbridge Mallee Ash); NSW
E. croajingolensis (Gippsland Peppermint); NSW, Vic
E. cunninghamii (Cliff Mallee Ash); NSW
E. delegatensis subsp. delegatensis (Alpine Ash); NSW, Vic, Tas.
E. dendromorpha (Budwang Ash); NSW
E. fastigata (Brown Barrel); NSW, Vic
E. fraxinoides (White Ash); NSW, Vic
E. haemastoma (Scibbly Gum); NSW
E. kybeanensis (Kybean Mallee Ash); NSW, Vic
E. multicaulis (Whipstick Mallee Ash); NSW
E. nitida (Smithton Peppermint); Vic
E. olsenii (Woila Gum); NSW
E. pauciflora subsp. debeuzevillei (Jounama Snow Gum); ACT, NSW
E. pauciflora subsp. niphophila (Snow Gum); ACT, NSW, Vic.
E. pauciflora subsp. pauciflora (Snow Gum); Qld, NSW, Vic, ACT, SA, Tas.
E. pilularis (Blackbutt); NSW, Qld
E. racemose subsp. racemose (Scribbly Gum); NSW, Qld
E. racemose subsp. rossii (Scribbly Gum); NSW, Qld
E. stenostoma (Jillaga Ash); NSW
E. stricta (Blue Mountains Mallee Ash); NSW
E. triflora (Pigeon House Ash); NSW
E. virginea; WA
E. willisii subsp. falciformis (Grampians Peppermint); Vic, SA
E. willisii subsp. willisii (Peppermint); Vic., Tas
E. delegatensis subsp. tasmaniensis (Blue leaf); NSW, Vic, Tas.

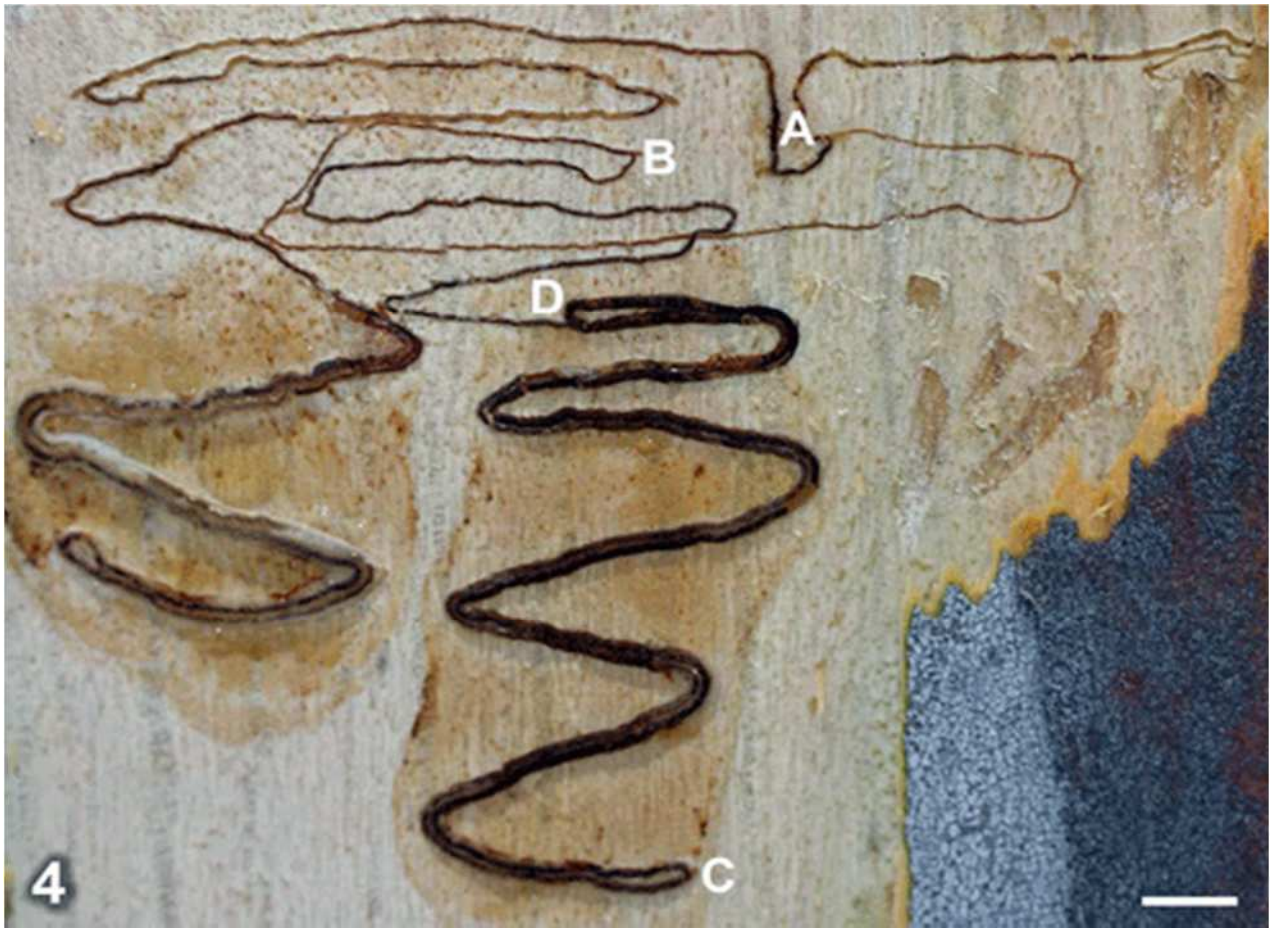
Photos: Adult moth; *Ogmograptis scribula* and example of the scribbles

Photos source: Australian National Botanic Gardens
https://www.anbg.gov.au/gardens/visiting/exploring/fauna/insects/ogmograptis.html

Extract from the article: **Retirees find link between 'bush graffiti' and Gondwana**

By Chris McKay

"…… the mechanism by which the moth larvae make the distinctive scribbles and in the process have uncovered a unique ecological interaction that occurs between tree and moth (see the image and caption below)."



The life cycle of scribbly gum moths can be seen in their tracks. **Point A**: Larva chews through underside of egg and through outer bark to reach the bark layer where the future cork cambium will form. There it turns to bore along this layer, possibly moulting to its 2nd life stage. **Track A–B**: Track is narrow, irregular, often meandering and occasionally crossing itself. Larva feeds on bark tissue, apparently moulting to its next stage part-way between A and B. **Point B:** Beginning of series of regular track zig-zags; larva moults near point B. **Track B–C**: First pass of doubled zig-zags which don't cross each other; larva feeds on bark tissue. **Point C**: First turning loop of doubled track. **Track C–D**: Return track of doubled zig-zags, either closely parallel in separate track (*O. scribula*) or joining and enlarging initial track (*O. racemosa*); larva feeds on bark tissue. **Point D**: Second turning loop; larva (after turning) moults at point D to its final stage and now has legs. **Track D–E**: Larva returns along the way it came towards point C along the doubled track. It now feeds on the highly nutritious callus tissue that has filled the track, as well as the incorporated frass from the earlier passage(s). **Point E**: Emergence hole where mature larva bores to the surface somewhere between points D and C (not visible after outer bark has abscised). The caterpillar spins a cocoon at the base of the tree and turns into a moth. (Adapted from Horak *et al.* 2012)[2]

[2] Horak M, Day MF, Barlow C, Edwards ED, Su YN and Cameron SL (2012) Systematics and biology of the iconic Australian scribbly gum moths *Ogmograptis Meyrick* (Lepidoptera : Bucculatricidae) and their unique insect–plant interaction. *Inverterbrate Systematics*, Volume 26 (4)

Abstract- The Breeding System, Genetic Diversity and Pollen Sterility in *Eucalyptus pulverulenta*, a Rare Species With Small Disjunct Populations

GB Peters, JS Lonie and GF Moran

Australian Journal of Botany 38(6) 559 - 570
Published: 1990

There are eight known populations of *E. pulverulenta*, which has a disjunct distribution in south-eastern Australia. Levels of genetic variation were studied in four populations of about 5000 plants in all. Of a total of 16 allozyme loci examined eight were polymorphic, but the level of polymorphism was generally low. Within populations there was a mean 1.42 alleles per locus. Both the total species and mean population genetic diversities were low for a tree species (0.10 and 0.07 respectively), while the between-population genetic diversity was high at 30%. These data are consistent with the effects expected of genetic drift. Population structure may thus have been critical in determining levels of genetic diversity throughout the species' range.

Analysis of half-sib arrays in three populations showed that the mean outcrossing rate (t) was 70%, comparable to values from other *Eucalyptus* species. The mean level of inbreeding (Wright's F) was 0.19, although both F and t varied considerably between populations. Significant levels of pollen sterility have been reported in this species, and data presented here show that this trait extends through much of the species' range. Overall, these data suggest that neither its disjunct population structure nor its tendency to male sterility caused the species' detectable level of outcrossing to differ markedly from levels reported in other eucalypt species. However, it remains possible that pollen sterility may have had some effect in at least one population. Strategies for conservation of this rare species are also considered.

E. pulverulenta; Leaf and capsule
Source: https://selectree.calpoly.edu/tree-detail/eucalyptus-pulverulenta

Articles, requests and questions are needed
Please send all correspondence to my;
email address; tallowwood@hotmail.com
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