

= Banksia aemula =

Banksia aemula, commonly known as the wallum banksia, is a shrub of the family Proteaceae. Found from Bundaberg south to Sydney on the Australian east coast, it is encountered as a shrub or a tree to 8 m (26 ft) in coastal heath on deep sandy soil, known as Wallum. It has wrinkled orange bark and shiny green serrated leaves, with green @-@ yellow flower spikes, known as inflorescences, appearing in autumn. The flower spikes turn grey as they age and large grey follicles appear. *Banksia aemula* resprouts from its woody base, known as a lignotuber, after bushfires.

First described by the botanist Robert Brown in the early 19th century, it derives its specific name "similar" from its resemblance to the closely related *Banksia serrata*. No varieties are recognised. It was known for many years in New South Wales as *Banksia serratifolia*, contrasting with the use of *B. aemula* elsewhere. However, the former name, originally coined by Richard Anthony Salisbury, proved invalid, and *Banksia aemula* has been universally adopted as the correct scientific name since 1981. A wide array of mammals, birds, and invertebrates visit the inflorescences and are instrumental in pollination; honeyeaters are particularly prominent visitors. Grown as a garden plant, it is less commonly seen in horticulture than its close relative *B. serrata*.

= = Description = =

Banksia aemula is generally a gnarled shrub or small tree to 8 m (26 ft), although usually smaller. Conversely, individual wallum banksias have been measured at 8 @. @ 3 ? 12 @. @ 1 m (27 ? 40 ft) high, with a maximum diameter at breast height of 44 cm (17 in) in forest on North Stradbroke Island. The trunk has thick orange @-@ brown wrinkled and warty bark, and the new growth is hairy but becomes smooth as it ages. New shoot growth is in spring and summer. The shiny green leaves are obovate to oblong in shape and measure 3 ? 22 cm (1 1 ? 4 ? 8 3 ? 4 in) in length, and 1 ? 2 cm (1 ? 2 ? 3 ? 4 in) in width. The leaf ends are truncate and the margins flat and serrated. Flowering is in autumn, from March to June; the green @-@ yellow flower spikes, known as inflorescences, are terminal, found on the ends of branches and emerging from the foliage. Measuring 4 to 20 cm (1 1 ? 2 to 8 in) in height and 8 to 9 cm (3 1 ? 4 to 3 1 ? 2 in) in width, they are various shades of pale and greenish yellow. Anywhere from 800 to 1700 individual small flowers arise from a central woody spike (or rachis). Initially tipped with white conical pollen presenters, the flowers open sequentially from the bottom to the top of the flower spike over one to two weeks, in a process known as sequential anthesis. Each flower produces nectar for around seven days after opening. The flower spikes turn grey as they age and up to 25 finely furred grey follicles appear, which can be very large, measuring 3 ? 4 @. @ 5 cm (1 1 ? 4 ? 1 3 ? 4 in) long, 2 ? 3 @. @ 5 cm (3 ? 4 ? 1 1 ? 2 in) high, and 2 ? 3 @. @ 5 cm (3 ? 4 ? 1 1 ? 2 in) wide. They split open either after bushfire or spontaneously, and release oval seeds 4 ? 4 @. @ 7 cm (1 1 ? 2 ? 1 3 ? 4 in) in length, composed of a wedge @-@ shaped body 1 ? 1 @. @ 5 cm (3 ? 8 ? 5 ? 8 in) long and 1 @. @ 1 ? 1 @. @ 6 cm (3 ? 8 ? 5 ? 8 in) wide, and curved wing 2 ? 3 @. @ 2 cm (3 ? 4 ? 1 1 ? 4 in) wide. *Banksia aemula* resprouts from its woody lignotuber after fire.

B. aemula closely resembles *Banksia serrata*, but the latter can be distinguished by a greyer, not orange @-@ brown, trunk, and adult leaves wider than 2 cm (3 ? 4 in) in diameter. Inflorescences of *serrata* are generally a duller grey @-@ yellow in colour, and have longer (2 ? 3 mm), more fusiform (spindle @-@ shaped) or cylindrical pollen presenters tipping unopened flowers. Finally, the follicles are smaller.

= = Taxonomy = =

Banksia aemula was called wallum by the Kabi people of the Sunshine Coast, giving rise not only to its common name of wallum banksia but also to the name of the ecological community it grows in. Frederick Manson Bailey reported in 1913 that the indigenous people of Stradbroke Island knew it as mintie. Banyalla is another aboriginal name for the species.

Banksia aemula was collected by Scottish botanist Robert Brown in June 1801 in the vicinity of Port Jackson , and published by him in his 1810 work *Prodromus Florae Novae Hollandiae et Insulae Van Diemen* . The specific name , Latin for " similar " , refers to its similarity to *B. serrata* . Brown also collected a taller tree @-@ like specimen from Sandy Cape which he called *Banksia elatior* ; the specific name is the comparative form of the Latin adjective *altus* " elevated " .

For many years in New South Wales , the wallum banksia had gone by the scientific name of *Banksia serratifolia* . Richard Anthony Salisbury had published this binomial name in 1796 , which was followed by Otto Kuntze , and then Karel Domin in 1921 . Botanist and banksia authority Alex George conclusively established *aemula* as the correct name to be used in his 1981 revision of the genus . He pointed out that Salisbury 's original described the leaves only , was insufficient to diagnose the species and is hence a *nomen dubium* ? the description could have fit juvenile leaves of *B. paludosa* as well . In fact , Brown himself had been unsure whether *serratifolia* applied to what he called *Banksia aemula* . Salisbury 's taxon appeared as *Banksia serraefolia* in Knight 's 1809 work *On the cultivation of the plants belonging to the natural order of Proteaceae* , but that entry might also refer to *serrata* . Where Salisbury got his material is unclear , but John White had sent material to James Edward Smith now held in the Linnean Society marked as *B. serratifolia* Salisb. as well as *B. aemula* R.Br.

Under Brown 's taxonomic arrangement , *B. aemula* and *B. elatior* were placed in subgenus *Banksia verae* , the " True Banksias " , because the inflorescence is a typical *Banksia* flower spike . *Banksia verae* was renamed *Eubanksia* by Stephan Endlicher in 1847 , and demoted to sectional rank by Carl Meissner in his 1856 classification . Meissner further divided *Eubanksia* into four series , with *B. aemula* placed in series *Quercinae* on the basis of its toothed leaves . When George Bentham published his 1870 arrangement in *Flora Australiensis* , he discarded Meissner 's series , replacing them with four sections . *B. aemula* was placed in *Orthostylis* , a somewhat heterogeneous section containing 18 species . This arrangement would stand for over a century .

In 1891 , German botanist Otto Kuntze challenged the generic name *Banksia* L.f. , on the grounds that the name *Banksia* had previously been published in 1775 as *Banksia* J.R.Forst & G.Forst , referring to the genus now known as *Pimelea* . Kuntze proposed *Sirmuelleria* as an alternative , republishing *B. aemula* as *Sirmuelleria serratifolia* . The challenge failed , and *Banksia* L.f. was formally conserved .

= = = Current placement = = =

Alex George published a new taxonomic arrangement of *Banksia* in his classic 1981 monograph *The genus Banksia* L.f. (*Proteaceae*) . Endlicher 's *Eubanksia* became *B. subg. Banksia* , and was divided into three sections . *B. aemula* was placed in *B. sect. Banksia* , and this was further divided into nine series , with *B. aemula* placed in *B. ser. Banksia* . He thought its closest relative was clearly *Banksia serrata* and then *B. ornata* , and that the three formed a link with western species . Since Brown 's original publication had treated all of Fraser 's specimens as syntypes (shared type specimens) for the species , George also chose a lectotype (a single specimen to serve as the type specimen) .

In 1996 , Kevin Thiele and Pauline Ladiges published a new arrangement for the genus , after cladistic analyses yielded a cladogram significantly different from George 's arrangement . Thiele and Ladiges ' arrangement retained *B. aemula* in series *Banksia* , placing it in *B. subser. Banksia* along with *serrata* as its sister taxon (united by their unusual seedling leaves) and *ornata* as next closest relative . This arrangement stood until 1999 , when George effectively reverted to his 1981 arrangement in his monograph for the *Flora of Australia* series .

Under George 's taxonomic arrangement of *Banksia* , *B. aemula* 's taxonomic placement may be summarised as follows :

Genus *Banksia*
Subgenus *Banksia*
Section *Banksia*
Series *Banksia*

B. serrata
B. aemula
B. ornata
B. baxteri
B. speciosa
B. menziesii
B. candolleana
B. sceptrum

In 2002 , a molecular study by Austin Mast again showed the three eastern species to form a group , but they were only distantly related to other members of the series *Banksia* . Instead , they formed a sister group to a large group comprising the series *Prostratae* , *Ochraceae* , *Tetragonae* (including *Banksia elderiana*) , *Banksia lullfitzii* and *Banksia baueri* .

In 2005 , Mast , Eric Jones and Shawn Havery published the results of their cladistic analyses of DNA sequence data for *Banksia* . They inferred a phylogeny greatly different from the accepted taxonomic arrangement , including finding *Banksia* to be paraphyletic with respect to *Dryandra* . A new taxonomic arrangement was not published at the time , but early in 2007 Mast and Thiele initiated a rearrangement by transferring *Dryandra* to *Banksia* , and publishing *B. subg . Spathulatae* for the species having spoon @-@ shaped cotyledons ; in this way they also redefined the autonym *B. subg . Banksia* . They foreshadowed publishing a full arrangement once DNA sampling of *Dryandra* was complete . In the meantime , if Mast and Thiele 's nomenclatural changes are taken as an interim arrangement , then *B. aemula* is placed in *B. subg . Banksia* .

= = Distribution and habitat = =

Banksia aemula is found along the east coast of Australia from around 70 km (43 mi) north of Bundaberg in central Queensland down to Sydney . Specifically , its southernmost occurrence is at La Perouse on the northern side of Botany Bay . It is also found on Fraser , Moreton and North Stradbroke Islands . Almost all populations are within a few kilometres of the coast , except for one at Agnes Banks in western Sydney , and two just north and south of Grafton at Coaldale and Glenreagh , and a last around 30 km (19 mi) southwest of Bundaberg .

B. aemula is most commonly found in deep sandy soils , either on dunes or flattish areas which may be seasonally wet . On coastal dunes in southern Queensland , it replaces *Banksia serrata* , which occupies the same niche to the south . The latter areas , with open woodland or heathland , are known as wallum . In Queensland it is found with *Banksia robur* , with the latter species found in flatter wetter areas and *B. aemula* found on rises . It is also found with *Banksia oblongifolia* in Queensland . In some areas of wallum , it may grow as a small tree , along with mallee forms of the red bloodwood (*Corymbia gummifera*) . In Cooloola National Park , it is an occasional emergent plant (along with *Melaleuca quinquenervia* and *Eucalyptus umbra*) in closed graminoid heathland , a community of shrubs 0 @. @ 5 ? 2 m (1 3 ? 4 ? 6 1 ? 2 ft) high containing *Xanthorrhoea fulva* , *Empodisma minus* , *Petrophile shirleyae* , and *Hakea* and *Leptospermum* species . On the New South Wales Central Coast , it generally grows as a 1 ? 2 m (3 1 ? 4 ? 6 1 ? 2 ft) high shrub and is a canopy component of *Banksia aemula* open heathland , located on coastal headlands on highly leached Pleistocene white sands overlying Triassic and Permian strata . Areas include Wybung Head in Munmorah State Conservation Area , and near Myall Lakes . Other plants it grows in association with include *Ricinocarpos pinifolius* , *Brachyloma daphnoides* , *Dillwynia glaberrima* , *D. retorta* , *Allocasuarina distyla* , *Bossiaea ensata* , *Aotus ericoides* , *Phyllota phyllicoides* , and *Empodisma minus* . Sandmining has eradicated much of the community around Redhead . In less leached yellower sands , the community (and *B. aemula*) is replaced by a taller heath containing *B. serrata* and *B. oblongifolia* .

At the southern end of its range , *B. aemula* is a component of the Eastern Suburbs *Banksia* Scrub (ESBS) , designated an endangered ecological community . This community is found on younger , windblown sands than the heathlands to the north .

The Agnes Banks Woodland in western Sydney has been recognised by the New South Wales

Government as an Endangered Ecological Community . Here *Banksia aemula* is an understory plant in low open woodland , with scribbly gum (*Eucalyptus sclerophylla*) , narrow @-@ leaved apple (*Angophora bakeri*) and *B. serrata* as canopy trees , and *B. oblongifolia* , *Conospermum taxifolium* , *Ricinocarpus pinifolius* , *Dillwynia sericea* and nodding geebung (*Persoonia nutans*) as other understory species .

On North Stradbroke Island , *B. aemula* is one of three canopy tree species of *Eucalyptus signata* @-@ dominated forest 12 ? 15 m (39 1 ? 4 ? 49 1 ? 4 ft) high , the third species being *E. umbra* . This forest is found on a ridge 100 m (330 ft) above sea level formed from an ancient sand dune . Here bracken (*Pteridium esculentum*) dominates the understory . Other tall shrubs associated include *Persoonia cornifolia* and *Acacia concurrens* .

= = Ecology = =

Most Proteaceae and all *Banksia* species , including *B. aemula* , have proteoid roots , roots with dense clusters of short lateral rootlets that form a mat in the soil just below the leaf litter . These roots are particularly efficient at absorbing nutrients from nutrient @-@ poor soils , such as the phosphorus @-@ deficient native soils of Australia . A study of six wallum species , including *B. aemula* , found they have adapted to very low levels of phosphorus and are highly sensitive to increased levels of the element , leading to phosphorus toxicity . Some evidence suggests they are efficient at using potassium , and sensitive to calcium toxicity as well . A field study on North Stradbroke Island noted increased root growth in autumn (around April) , but that overall root growth was more constant than other species looked at , possibly because its deeper roots had more regular access to groundwater .

A 1998 study in Bundjalung National Park in northern New South Wales found that *B. aemula* inflorescences are foraged by a variety of small mammals , including marsupials such as yellow @-@ footed antechinus (*Antechinus flavipes*) , and rodents such as pale field rat (*Rattus tunneyi*) , Australian swamp rat (*R. lutreolus*) and grassland melomys (*Melomys burtoni*) and even the house mouse (*Mus musculus*) . These animals carry pollen loads comparable to those of nectarivorous birds , making them effective pollinators . Grey @-@ headed flying foxes (*Pteropus poliocephalus*) were also observed visiting *B. aemula* and their heads and bellies were noted to contact stigmas while feeding . Bird species that have been observed feeding at the flowers of *B. aemula* include rainbow lorikeet and scarlet and Lewin 's honeyeaters . Several other honeyeaters were recorded on *B. aemula* inflorescences for The *Banksia Atlas* , including the New Holland , brown , white @-@ cheeked , and tawny @-@ crowned honeyeaters , noisy miner , little wattlebird and noisy friarbird . The Bundjalung field study found the brown honeyeater carried much higher loads of *B. aemula* pollen than other species measured , which included white @-@ cheeked and yellow @-@ faced honeyeaters and silvereyes . Insects such as ants and bees (including the introduced honeybee) have also been recorded .

Banksia aemula resprouts from a lignotuber or shoots from epicormic buds after fire . Fire management of *Banksia aemula* heath in Southeast Queensland recommends 7- to 20 @-@ year fire intervals . Intervals of 10 ? 15 years are recommended for the Eastern Suburbs *Banksia* Scrub , as longer leads to overgrowth by *Leptospermum laevigatum* . Experimenting with seed germination and early growth of *B. aemula* showed that phosphorus was toxic to seedlings , inhibiting growth at double normal soil concentrations and causing seedling death at quadruple normal soil concentrations . The addition of potassium or magnesium ameliorated these effects a little although potassium in high concentrations impacted on growth as well . Overall , seedlings grow slowly over the first 21 weeks of life compared with other plant species , the reasons for which are unclear , although it may be that it offers an increased chance of survival in a nutrient- or water @-@ poor environment . Seed was killed by exposure to 150 ° C , but survived seven @-@ minute exposure to 100 ° C .

A study of coastal heaths on Pleistocene sand dunes around the Myall Lakes found *B. aemula* grew on ridges (dry heath) and *B. oblongifolia* on slopes (wet heath) , and the two species did not overlap . Manipulation of seedlings in the same study area showed that *B. aemula* grows longer

roots seeking water and that seedlings do grow in wet heath , but it is as yet unclear why the species does not grow in wet heath as well as dry heath . Unlike similar situations with banksia species in Western Australia , the two species did not appear to impact negatively on each other . A field study on seedling recruitment conducted at Broadwater National Park and Dirrawong Reserve on the New South Wales North Coast showed that generally *Banksia aemula* produced seedlings in low numbers but the attrition rate was low , and that seedlings had a greater survival rate on dry rather than wet heaths . Field work including the experimental planting out of seedlings at Crowdy Bay National Park showed that *Banksia aemula* seedling roots reach the water table within six months of germination , and that they can germinate in the presence or absence of recent bushfire . The reasons for bradyspory (that is fewer seeds with greater percentage of survival) is unclear , but may be a defence against seed @-@ eating animals . Similarly in field work on North Stradbroke Island , *B. aemula* was noted to shed its winged seeds over time between (as well as after) fire , and germinate and grow readily with little predation by herbivores .

= = Cultivation = =

In 1788 , *Banksia aemula* was one of the first banksias to be cultivated in England , where it was illustrated in Curtis 's Botanical Magazine and its rival , The Botanical Register . Its shiny green leaves , showy flower spikes , huge follicles , and wrinkled bark are attractive horticultural features . It is also a bird- and insect @-@ attracting plant .

Trials in Western Australia and Hawaii have shown *B. aemula* to be resistant to *Phytophthora cinnamomi* dieback . It requires a well drained slightly acid (pH 5 @. @ 5 ? 6 @. @ 5) soil , preferably fairly sandy and a sunny aspect . Summer watering is also prudent , as it does not suffer water stress well . Slow @-@ growing , the plant takes four to six years to flower from seed . It is less commonly grown than *Banksia serrata* . An investigation into optimum temperatures for germination found a nighttime temperature of 20 ? 28 ° C , and a daytime of 24 ? 33 ° C gave best results , and recommended summer planting times .

It has also been used as a rootstock for grafting *Banksia speciosa* , and has potential in bonsai . The red textured timber has been used in cabinet @-@ making .

= = Cultural references = =

Although *Banksia attenuata* was the common banksia in Australian children 's author May Gibbs ' own childhood in Western Australia , the old flower spikes of *Banksia aemula* with their large follicles are thought to have been the inspiration for the villains of her Snugglypot and Cuddlepup books , the " Big Bad Banksia Men " .