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Editorial

Joanne Caldwell, Publishing Committee

This edition has a 'Butterflies and Bees' theme. The Sankowsky's initial aim was to breed butterflies, with plantings heavily biased towards butterfly host plants but now they have a proper scientific botanical garden on their Queensland property. The Warrior Bush is also a butterfly host plant.

Ian Fraser's article on maintaining the links between plant and animal communities is thought provoking to say the least, and if it leaves you feeling a little depressed then Beng Tan & Jonathan Lester's research into the pollination of Pink Everlasting Daisies in WA has a surprising conclusion.

The advantages of small Eucalypts are immediately obvious. Helen Moody brings news of two genuine dwarf forms of *Eucalyptus ficifolia*. Daniel Kearney writes of *Eucalyptus pimpiniana*, the small attractive Pimpin Mallee.

Dick Burns reports on the flora of the Tasman Peninsula that has developed in isolation from the rest of Tasmania and the Rath's tell us about the garden they have developed since forsaking Sydney in 2000.

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Front cover: *Idiospermum australiense* - photo G. Sankowsky - see pp 219

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Our Garden No 42:

'Sankowsky Botanical Garden'

Garry & Nada Sankowsky, Tolga, North Queensland

In the summer of 1982 we moved from Mt Tamborine to North Queensland to set up a butterfly farm. The land boom was well and truly on and we had difficulty finding a suitable block of land. We finally settled for a rural residential block of 5 acres (2.5 ha) with town water. It has deep basalt soil and is just outside the 'Golden Triangle' agricultural region of the Atherton Tableland. The main reason our area was not used for cultivation is that it contains a huge number of rocks. This is certainly not a disadvantage when planting trees.

Because our initial aim was to breed butterflies, the types of plants that we planted in the first couple of years were heavily biased towards butterfly host plants. We brought two thousand plants with us from Mt Tamborine, which gave us a good start. These were not exclusively plants from the south of Queensland; we had made many trips to North Queensland in previous years and collected numerous northern species.

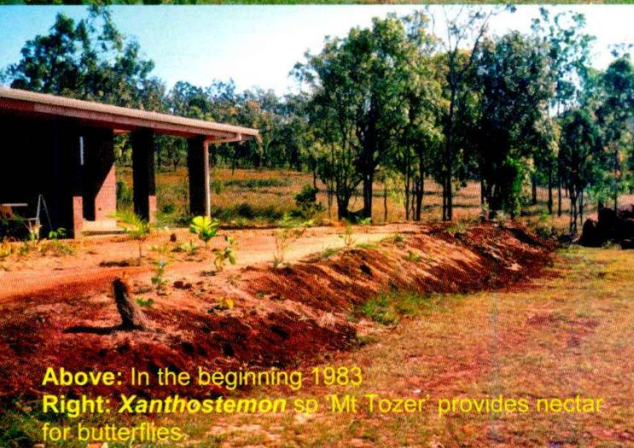
Our first priority was to set up nursery facilities and a butterfly breeding cage. As well as bush-houses we built a mist house for the propagation of cuttings as this is the way we grow many of our plants. We have found that cutting-grown plants establish and develop much more rapidly than seedlings and of course seeds are only available at one time of the year for each species whereas cuttings can be taken at any time (in North Queensland).

We wanted a block that was mostly cleared so that we could plant a very wide range of species. We thought (and rightly so as has been proven) that the dry climate just outside the rainforest belt would enable us to grow plants from many types of habitats and climates. Average rainfall is 1,048 mm.

Just at the time we were starting our garden there was a lot of local interest developing in the collecting and planting of North Queensland rainforest species. This encouraged us to expand our range of plants far beyond butterfly host plants.

I feel that I must point out that it would not be possible for someone to do today what we have done. Up until the early 1990s it was extremely easy to collect propagating material from State Forests. The Forestry Department had a simple permit called a Minor Products License that cost about \$100 per year and covered all State Forests in a particular region. Under the latest regulations it is so complicated that most people do not bother. As well as this, many of the State Forests have been changed to National Parks, where no collecting is permitted. What was once Swipers Logging Area is now part of the high-altitude Wooroonooran National Park, but by the end of this year there will be no high-altitude rainforest outside of a National Park where collecting can be carried out. This may force a change in the regulations. I certainly hope so or there will be nothing but inbred stock in the nursery trade. Alas! The 'good old days' are gone.

Below: The House in 2004

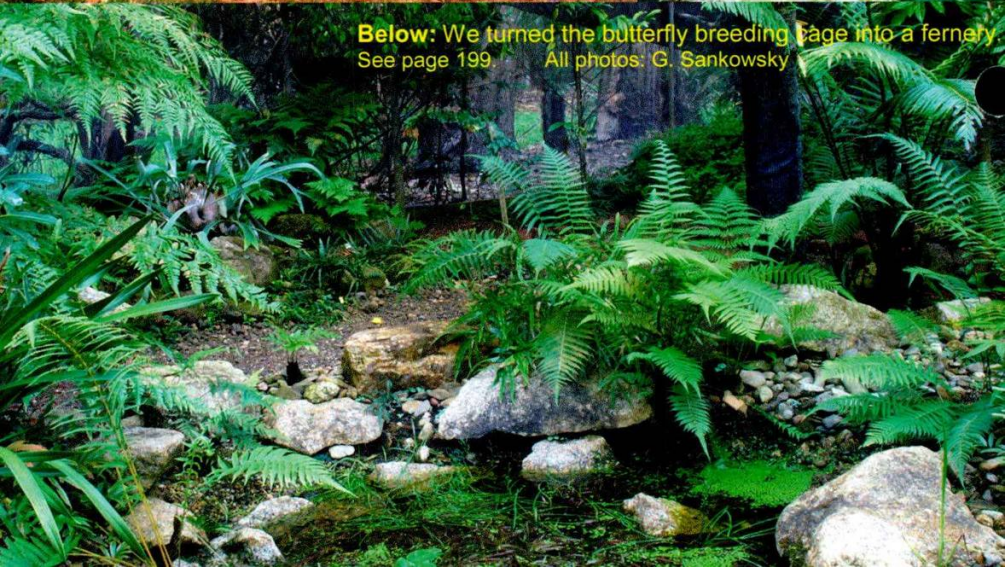


Above: In the beginning 1983

Right: *Xanthostemon* sp. 'Mt Tozer' provides nectar for butterflies.



Below: We turned the butterfly breeding page into a fernery.
See page 199. All photos: G. Sankowsky





Top Left:

Syzygium buettnerianum

See page 218

Above:

Archidendron hirsutum

See page 218

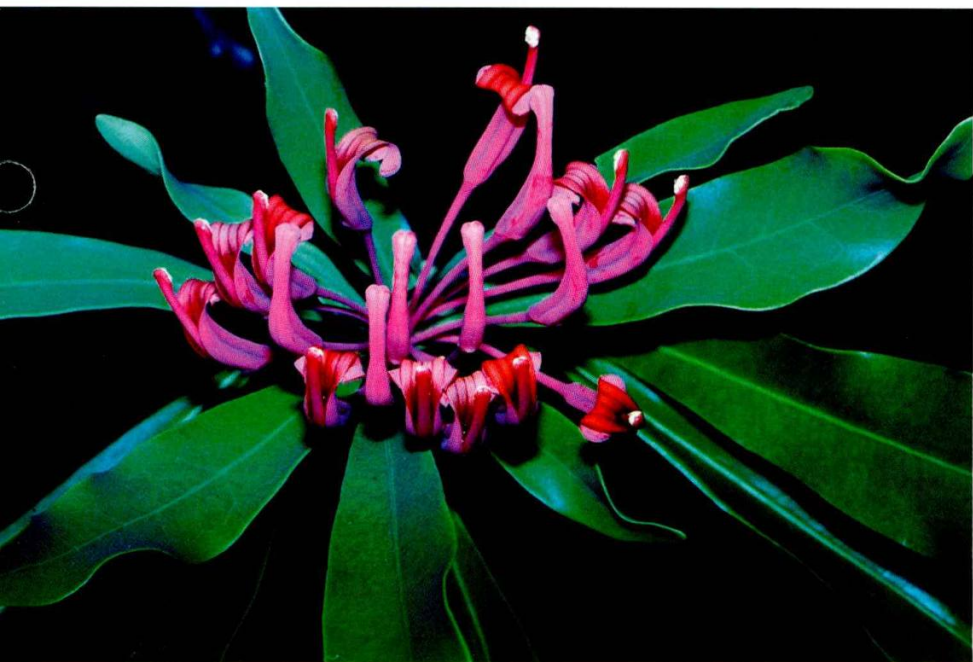
Left: *Callicarpa brevistyla*

See page 218

Below: *Alloxylon wickhamii*

See page 202

Photos: G. Sankowsky



The first section we planted was the perimeter, as locals referred to this area as Siberia. One corner of the block faces the south-east, which is the source of our prevailing winds, where we have grown a very effective windbreak. The one big mistake that we made was planting some *Acacia melanoxylon* in the windbreak. These suckers are so aggressive that they choke out other species. The suckers are now marching into the property next door and present an ongoing problem. Only last week a huge one came crashing down destroying the fence, and putting us to considerable expense to have the top half removed from the neighbouring property.

Because we only had town water we usually restricted our plantings to the wet season. As soon as the monsoon trough activated in January we started planting and continued till about mid-March. We generally planted a thousand or more plants each year.

In the beginning we could not find someone with suitable equipment to cultivate the areas we wanted to plant. We were lucky with the front half of the block because the rocks were not so plentiful and we were able to use a rotary hoe. We tried using a disc plough in the rocks, but this was not very successful. We finally found a local bulldozer owner who had a small D4 and this proved to be the ideal solution. Each year in about May or June we would get an area ripped for the following wet season's planting. We then purchased sufficient peanut shell to mulch it. At that time peanut shell was only \$70 for a 30 metre truck load. One of our plots took seven loads of shell. The peanut shell was then spread over the cultivated ground with a bobcat and left till the wet season. By January the fines in the shell had broken down and the soil underneath was a seething mass of worms and incredibly soft and friable. This enabled us to establish the plants well and eliminated the need for watering them later in the year.

That is, until the rot set in during the early 90s when we had very poor wet seasons and extremely long and hot dry seasons. It was during this period that disaster struck. In November 1992, when we were experiencing extremely hot dry, northerly winds, a fire got out of control on a nearby farm and burnt out a large section of our garden. It was made worse by the fact that there was still a good depth of peanut shell mulch on the ground. Because of our dry climate the peanut shell lasts for about five or six years, making it by far the cheapest and most effective mulch available. By the time it has completely rotted down the ground has long since been covered by the plants and natural leaf drop is providing the rainforest plants with mulch. The smoke was so thick from the burning shell that it was not possible to get close to it to put it out and it burnt for more than twelve hours. We lost about 2,000 plants in the fire. Except for two species, most of these could be replaced fairly easily. One was a rather rare Euphorbiaceae plant, *Suregada glomerulata* that we have not been able to find again and the other one was as rare as a plant can get. It was collected north of Weipa and was a new genus for Australia, in the Flacourtiaceae family, *Hydnocarpus* sp. (Possum Scrub G & N Sankowsky 1349). It was a tiny seedling (instantly recognised as something new) germinating in a pile of dirt pushed up by a bulldozer; no more plants can be found, juvenile or adult. It is assumed that the seed would be spread by birds so the adult plants must be within a kilometre or two of

where the seedling was found. Luckily it flowered in cultivation and a specimen was lodged with the Queensland Herbarium.

In 1993 we decided to put down a bore to supplement our water supply and were lucky enough to obtain a reasonable flow. Drillers had previously been unsuccessful in locating water in our area and were very reluctant to drill as there are numerous collapsed lava tubes beneath us. These trap the drill and the diamond bits are very expensive to lose. With the bore water we have been able to keep most of our plants alive during the very dry periods that we have had since then.

To eliminate the need to continually water plants all over the garden, we have concentrated the plants that require lots of water into 'wet zones' where they can all be watered at once. This has proved very successful and saves a lot of time and water. In these wet zones we grow plants from misty mountain-tops, and ferns.

Gardener's Tip:
Group plants that
require lots of
water into 'wet
zones'.

To contain flood waters we dug a gully across our property. This was a dry gully until we put down the bore. We then set up sprinklers in the gully to water two or three times a week. We now have a ferny gully complete with those giants of the fern world - King Ferns. The gully has become one of the wet zones, and delicate and shade-loving plants are planted along it.

Another major problem that we had was wallabies. At first we only had Agile Wallabies. They were bad enough as they flattened many plants, especially ferns, as they hopped around. A few years ago the Mareeba Rock Wallabies showed up and they were a disaster. They feed mostly on plants other than grass, and they ate huge numbers of ferns, orchids and other small plants. Last year we decided to fence them out and built a wallaby proof fence around the block. We are now replanting all the devastated areas.

After we stopped breeding butterflies we turned the butterfly breeding cage into a fernery where we now grow a large number of native ferns and other delicate plants under 70% and 80% shade cloth. A photo of the fernery can be seen on page 196.

Gardener's Tip:
Protect ferns and
other delicate
plants under 70%
and 80% shade
cloth.

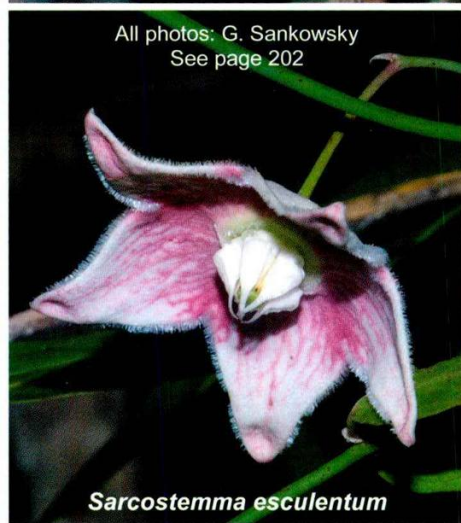
As we wanted to make our garden a proper scientific botanical garden we divided the plantings into grids of about 10 m x 10 m squares so the plants could be accurately located and recorded. Almost all the plants are from wild collections (not grown from seed or cuttings taken from cultivated plants) and this gives them scientific integrity. Each plant receives a number and is recorded in a database along with the locality where it was collected, which plot number it is in, when it was planted, along with other information such as when it first flowered. There are at present 9,379 plants in the database, with probably about 1,000 more to be recorded. If you take off 2,000 that died in the fire that leaves about 8,000 plants in the garden. These are almost all rainforest plants from tropical Australia.



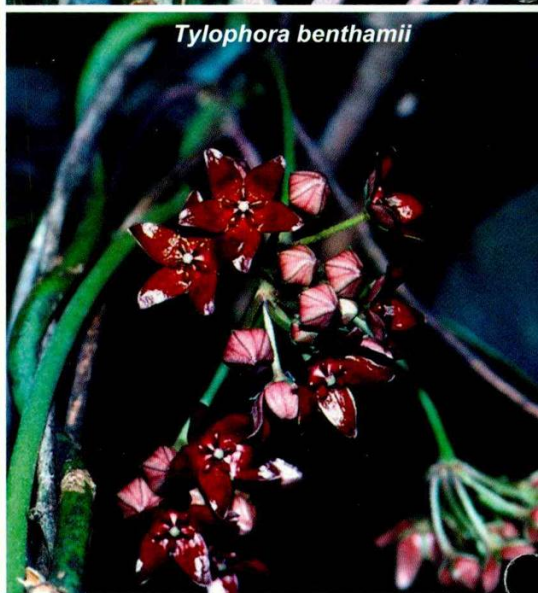
Pararistolochia australopithecus



Marsdenia hemiptera



Sarcostemma esculentum



Tylophora benthamii



Left: *Parsonsia sankowskyana*
Below: *Uvaria concava*



Because of the scientific nature of the plant collection the garden is often used by scientists studying various aspects of botany and plant biology. A few years ago a couple of botanists from Austria spent a several weeks here studying the pollinators of Annonaceae plants. We have all but one of the Australian plants in the Annonaceae family. A couple of these we actually discovered. Luckily most of them flower in November and December. Another use is to supply material for DNA work, as we have almost complete collections of many families.

Many people are reluctant to plant vines. As we wanted as complete a collection as possible (and many vines are butterfly host plants) we collected numerous vines. The main problem with them is if they are planted near small trees they will soon swamp them. If we had a lot more room we could grow them on trellises but as we had a limited space we had to think of another way. We had a number of eucalypt trees growing on the property (*Eucalyptus crebra*, *E. clarksoniana* and *Corymbia tessellaris*) so we decided to grow the vines up these plants. Each 'vine tree' had about 30–50 vines planted at its base. From pegs driven into the ground bailing twine was tied to galvanised roofing nails placed about 6–8 m up the tree, allowing the vines to go straight up and not twine around the base of the trees. This proved very successful (perhaps a bit too successful as two eucalypts have been killed by the vines) and enabled us to have a large collection of vines. Pages 197 and 200 show a selection of our vines.

We found that some vines do not survive well with competition. They do well for the first couple of years while the cultivated soil is still loose and the roots of nearby plants have not yet invaded. However, after a few years they fade away. Growing them in pots was not very successful until we tried the 'bog method'. This consists of standing the pot in a tray that has holes drilled in it about 30–50 mm from the bottom and filled with sand. The sand soaks up the water and maintains a reservoir to supply the plant. Watering need only occur two or three times a week and the vines can be placed where they will have the required amount of light. Many difficult species are now doing very well. Some pots are illustrated on the right.



The pot on the left in the 'bog method' picture is on a piece of plastic as it is a species that has to be left un-watered during the dry season. It is *Sarcostemma viminale*.

A few vines are completely deciduous and these pose special problems. The basalt soil has proven to be completely unsuitable for some of these so they are also grown in pots. Instead of standing them in a tray, they sit on a piece of black mulching plastic, or are grown in a hanging basket. The black plastic prevents the roots of trees going up into the pots when the vines have died back. They are then not watered until the first storms of early summer. This is the only way we can grow *Cynanchum leptolepis* and *Ceropegia cumingiana*.

The vines illustrated on page 200 are:

Pararistolochia australopithecurus, a small to medium vine that occurs in the very wet lowland and upland rainforest from about Topaz, on the Atherton Tableland, through to the coast near Garadunga. It is certainly the most spectacular flowering *Aristolochia* in Australia, but is, unfortunately, very difficult to grow. The large flowers occur near the base of the plant so they are easily seen. In the limited area where it occurs it is the host plant for the Cairns Birdwing butterfly.

Marsdenia hemiptera is a small vine that occurs from Cape York to south east Queensland. In spite of the fact it is found over such a wide range, it is rarely cultivated. The flowers are quite large and showy.

Sarcostemma esculentum is a vine from Western Australia that grows in the mud along the edge of streams, especially the Ord River. The bog method is the only way we have been able to grow this vine and it is now flowering for the first time. The flower is probably the largest of any Australian Asclepiadaceae plant. It is the host plant for the Orange Tiger butterfly.

Tylophora benthamii is a medium sized vine with large fleshy leaves and a yellow caustic sap. It occurs along the entire east coast of Queensland, but like many vines is rarely cultivated. The deep red flowers resemble a Hoya.

Parsonsia sankowskyana is a large vine that was grown from cuttings collected at Hervey Bay. It is possible that it is now extinct in the wild as recent attempts to find a wild population have failed. Most of the coastal areas near Maryborough are now a sea of houses. There may still be some in the wild and further attempts will be made to find them.

Uvaria concava is a large vine in the Annonaceae family. It occurs along the east-coast of Queensland as far south as Cairns. The large red or orange-red flowers can be found from November to January. Like many vines in this family it starts off as a weeping shrub. As it matures it will climb over a tree if one is within reach. It can be kept permanently as a weeping shrub if pruned each year.

Continued on page 218

Maintaining Links

Between Landscape, Plant and Animal Communities Ian Fraser

Time scales

To understand something of the intrinsic nature of the relationships between landscapes and the plant and animal communities which inhabit them, it is probably necessary to try to grasp in some way the vast time involved, over which the relationships have evolved. One way is to imagine that one human pace = 100 years. Europeans have been here for just two paces. The past 2000 years, the whole of Christian AD time just one cricket pitch. People have been in Australia for about 30 cricket pitches. But Australian landscapes and their biota have been evolving in isolation for some 600 km, i.e. the distance from Canberra to Coffs Harbour or Bourke or the Grampians.

This perspective is necessary if we are to grasp the immensity of 'Australian' time, and the minutely insignificant part of that we have occupied. Because if we forget **that**, then we have no chance of managing the place properly, because we have no hope of understanding it and being us, we'll be sure that we do, and get it wrong. For instance, a short-term view leads to assertions about managing forest fire regimes when we haven't been around long enough to see even a single natural cycle of the fire regime of a wet forest like the Alpine Ash of the Brindabellas.

Not only is there great satisfaction in seeing the world as it really is, but great dangers in the arrogance of using 'our time' as the norm. That is a bit like a bacterium on our body, living/dying in a few hours and seeing no change in its environment, and concluding that there is therefore no change. It is like the ant seeing 'the world' as defined by its 200 m radius.

It leads to assertions that starlings, mynas, rabbits, pines, willows, brumbies are "part of evolution" i.e. a "natural part" of the landscape because "they've always been there" (i.e. as long as I can remember!).

Short-term thinking can also lead to focusing on individual threads of the tapestry, rather than the whole picture. What I think I've been invited to do today is to look at some selected pieces of the tapestry picture to illustrate the point.

This paper was given at the 2001 ASGAP Conference in Canberra.

Ian Fraser is a well known Canberra naturalist and Conservationist, particularly through his regular ABC radio work and adult education courses. With partner Margaret McJanette he has co-authored six books on local natural history, the most recent being *Wildflowers of the Snow Country*. They have run the educational bush-based **Environment Tours** for the local environment movement since 1984. He is deputy chair of the ACT Environment Advisory Committee and a member of the ACT Flora and Fauna Committee. He specialises in being a generalist, knowing just a little bit about lots of things. He is particularly interested in the origins and evolution of Australian landscapes and biota, and is especially passionate about birds and orchids.

A classic story

I'll start with a classic story on the theme, not from Australia, but from Mauritius where the extraordinary giant flightless pigeon, the dodo, evolved in isolation 800 km east of Madagascar and became one of the many island animals to be exterminated in modern times, by about 1700. In the 1970s an ecologist Stanley Temple published an extraordinary paper, purportedly demonstrating that the few living endemic Tambalacoque trees on Mauritius all dated from the last days of the dodo. He proposed (with supporting evidence) that the tree had relied on the dodo to abrade the tough pit in its gizzard to enable germination. So, a very neat piece of tapestry; a plant relying on an animal so entirely that its inevitable extinction follow that of the animal, even after a time lag of centuries. The only problem with this elegant explanation of the plight of the tree is that the problem it seeks to explain seems not to be true; in fact the tree, though rare, is not nearly as rare as Temple thought, and there are many Tambalacoques a lot less than 300 years old. The problem apparently was that Temple, an ornithologist, wasn't a good enough botanist to distinguish Tambalacoque saplings from those of others of the family Sapotaceae. Dodos probably did eat Tambalacoque seeds, but the tree didn't rely on them and its rarity is not due to the tragic demise of the dodo.

The proposition was plausible though, and many equally remarkable and apparently obligatory plant-animal relationships do exist in Australia.

Pollination

An obvious set of obligate plant-animal relations relates to plant pollination by animals. The great partnership of angiosperms and insects began at least 120 million years ago, perhaps in western Gondwana. (The one way relationship of insects eating plants began long before that, at least 300 million years ago, on the evidence of munched and sucked tree fern fronds from Illinois.)

More recently, many plants, especially in Australia, enlisted birds as pollen-bearers. Over 100 Australian species are known to visit perhaps 1,000 plant species in Australia; more than 600 plant species in 70 genera are pollinated by birds in south-west WA alone. The full significance of birds as pollinators in Australia is still being realised; only thirty years ago the leading Australian authorities on the topic were only suggesting 250 bird-pollinated plant species for the whole of Australia. Even this would be extraordinarily high compared with equivalent latitudes in Europe-North Africa (0); Asia (2); North America (8). The great forests of south-western WA apparently rely on the vast swarms of Purple-crowned Lorikeets that fill towns during flowering for their pollination. On the other hand, in Australia there are no close bird/flower species to species associations (cf tropical hummingbirds, where one hummingbird species is often adapted to just one flower species).

Where we might get closer to that is in another group of animals, whose importance is only just being recognised. Twenty-five marsupial species are now known to visit flowers. Six or seven members of at least three disparate possum groups, as well as some supposedly carnivorous dasyurids and even rodents are regular visitors and important pollinators of Myrtaceae and Proteaceae, in both eastern and western Australia. Several WA banksia flowers for instance appear to have evolved specifically to attract mammals rather than birds or insects. Closer to home, the rigid hooked styles of *Banksia spinulosa* certainly strike me as mammal fur combs, a proposal supported by research at Barren Grounds Bird Observatory near here. So, who is to say what the long-term impact on such plant species might be if these mammalian pollinators were to disappear? Some, such as the Dibbler in WA are already desperately rare. Fragmentation of heathlands might leave nice flowery areas, but will it leave the furry pollinators essential for long-term survival plants which need them?

And of course any talk that I give will inevitably touch on orchids at some stage, and it is here that we find the most elegant and most fragile partnerships, those where a plant species is reliant on just one species of pollinator - and of course vice versa.

Due to David Attenborough among other sources, most of us are aware of the extraordinary relationships between some orchids and male insects, whereby the flower mimics the female insect with such virtuosity that the male is fooled into attempting to mate with her. In the ensuing struggle pollen is transferred. Amazingly, there are abundant examples among the orchids of pseudocopulation as a pollination strategy, including among many local orchids the familiar big green spider orchids.

I'm going to illustrate the point with *Chiloglottis*, bird orchids; strange squat little green and purple orchids with a wide flower close to the ground between a pair of distinctive broad fleshy leaves. The key is large triangular nodding labellum (a modified petal) with scattered black stalked growths called calli. Recent work has indicated that the various species of *Chiloglottis* each have a unique relationship with one species of small thynnid wasp.

It seems that these thynnines are crucial to the development of several Australian orchid groups. While our knowledge is incomplete, it is growing. We now know of 500 species of thynnids in 38 genera. For a long time it was claimed that the same wasp species pollinated different orchid species, but it now seems that this was our ignorance. It always seemed illogical, given the need for the wasp to recognise only his own species' females, and for the flower to have a faithful carrier who would not waste the precious pollen on flower from another orchid species. Only a one-to-one relationship would work.

Bird orchids take advantage of an extraordinary behavioural characteristic of the wasps. The female wasp is flightless and spends most of her time underground. When she is ready to mate she emerges and climbs to the top of a low shrub or grass stem and poses with erect antennae, emitting the species-unique pheromone. Pheromones are remarkable chemicals by which many advanced insects communicate in a strange language of smells. The various bird orchids mimic this posture. The male wasp zig-zags quickly upwind to the scent source, racing other males to it. He grabs the female, and flies off with her to higher vegetation. To save time, they feed on nectar while mating. Later, being a Sensitive New Age wasp, he gives her a lift back home, where she burrows again, and lays eggs in scarab beetle larvae, as one does in such a situation.

The orchid takes advantage of the male wasp's enthusiasm with a nodding labellum; he mistakes it for the object of his desire, and when he grasps the labellum he is catapulted, still hanging on, into the pollen structure. It is suggested that the orchids are at their peak just before the female thynnids have emerged, when the males are ready to go but not distracted by real female wasps. And there are at least scores of different orchids each exploiting a single male wasp species in similar ways alongside each other. And indeed it seems very likely that any orchids using artificial pheromones (such as spider orchids) will need to have a one-to-one relationship with the insect. So, the loss of an apparently insignificant - and possibly nameless wasp means the inevitable loss of an orchid.

Seed dispersal

Other examples of essential ties are rife in the next stage of the process - the distribution of seed. Habitat destruction and deliberate harassment by fruit growers (and even botanic gardens!) has led to pressure on at least some fruit bat species. Most Australian rainforest trees produce fleshy fruits for vertebrate frugivores, among which fruit bats are pre-eminent. Seeds must not be allowed to fall under parent trees. Few if any grow, and seed predation decreases with the distance from the parent tree. Individual bats visit different trees several kilometres apart, often in different rainforest patches, carrying seed in the mouth or gut. Additionally, a recent study in northern NSW showed that Fruit Bats feeding on paperbark or eucalypt blossoms moved between stands of trees several kilometres apart, carrying lots of pollen in their fur. It may be that isolated rainforest patches in particular are reliant on fruit bats for survival of at least some of their component species.

The role of cassowaries in distributing seed of quite a number of plants of the wet tropics seems to be very significant indeed, and that species is in serious decline.

A totally different type of bait is offered by over 1,500 species of Australian plants to a very different group of animals. Australia has one of the richest ant faunas in the world, so it should be no surprise that they have been employed by so many plants. In fact at the time of the major study done in 1975 and partly in the Brindabellas, there were only 300 other such plant species known for the rest of the world! Ants are not encouraged to eat the seeds, which are generally too hard for them, because doing so would defeat the end point of the plants exercise. Instead they are offered another incentive to take the

seed. A fleshy fruit coating would presumably make the whole package too bulky (although some heaths for instance do offer that). Rather they are usually offered a nutritious dry attachment known as an elaiosome, smaller than the seed, which encourages them to carry the whole seed away. It has recently been recognised that elaiosomes contain chemicals which resemble some found in insect blood. These chemicals trigger a biting and holding response in carnivorous ants. Having carried the parcel to the relative safety of the nest surrounds, the ant removes the elaiosome from the seed, discarding the unwanted seed outside on a garbage heap, or in an underground dump. Since they may carry the seeds up to 75 metres this suits the plant very well indeed. In fact groups such as *Hibbertia*, family Euphorbiaceae, peas, *Goodenia*, sedges, lilies, wattles, family Rhamnaceae, *Boronia*, family Sterculiaceae and *Tetratheca* rely heavily on ants for their seed dispersal. In general I suspect that we simply don't know which ant species are the relevant ones, so could not predict the impact on the loss of ant species through habitat loss, widespread chemical or biological attack on localised species, or competition from introduced ant species.

Termites

On that track I'm not sure either that we really understand the role of termites in fire regimes, by removing vast amounts of flammable litter from forest and woodland understoreys. We have also only recently become aware of the role of termites in pollinating *Rhyzanthella*. So I have concerns about the potential implications of the sort of work done by CSIRO in biological control of pest termite species.

Small mammals

It is only very recently that we have started to understand the role of potoroos, bettongs and bandicoots, the very size class of mammals which has suffered the most dramatic extinction and declines in Australia, in distributing spores of hypogeal fungi. In low-nutrient Australian soils these subterranean fungi form essential symbiotic relationships with the roots of many shrubs and trees, including many forest eucalypts. Without them the tree cannot receive sufficient food and nutrients to survive. North American work has demonstrated the essential role in dispersal of such fungal spores of mammal truffle-eaters such as ground squirrels and voles, and an equivalent picture is starting to emerge here. Loss of truffles will mean further loss of the mammals which rely on them, they form 80 to 95 percent of the diet of the rare Long-footed Potoroo and conversely, it is probably not too dramatic to suggest that loss of the mammals could mean long-term loss of the forest itself.

Don't throw it away

Aldo Leopold described the first precaution of intelligent tinkering as not throwing anything away just because we don't understand its purpose. And there's a very great deal about the nature of Australia and its connections that we don't understand yet.

Eucalyptus ficifolia grows smaller

To only 3 metres tall

Helen Moody

The beautiful red flowering gum, *Eucalyptus ficifolia**, is the eucalyptus people swoon over, especially when it actually has red flowers. The problem is that seedling variation results in flowers that vary between crimson, scarlet, orange, pink and even white. Furthermore, seed-raised plants can take 7–10 years to flower for the first time. Then there is the size issue as trees can grow over 10 metres tall and while they make wonderful roadside and park plantings, they aren't exactly perfect for the average backyard.

Hence professional nurserymen and native plant enthusiasts around the country have long tried to 'shrink' this species to make it more suited to garden cultivation. It has been established for some time that grafted plants can provide guaranteed colours and flowers at an early age. Now Tarrawood Native Nursery, located near Bega on the far south coast of NSW, are producing two genuine dwarf forms, Dwarf Crimson and Dwarf Orange, grafted *Eucalyptus ficifolia* that grow to a mere 3 metres tall by 3 metres wide. Tarrawood is owned by a father and son team, David and Michael Wood, who specialise in grafted Australian natives.

Sales in recent years of grafted and hybrid smaller flowering gums show demand is high. The Wood's are convinced that their plants, which are grafted but are not hybrids, will remain even smaller than those on the market now, making them great candidates for container planting as well as for specimen garden plants.

Grafted onto hardy rootstock, plants are suitable for temperate and sub-tropical east coast conditions, provided they are planted where they get good drainage. Even juvenile plants in pots flower spectacularly, with massed trusses of deep vermilion orange or vivid crimson flowers. Plants start to flower in spring, with peak flowering from late November, through December until the end of January, depending on location.

RRP approximately \$34. For detail of stockists contact Tarrawood Native Nursery: Phone: 02-6492 4828; Fax: 02-6492 0704; Email: tarrawood@ozemail.com.au PO Box 683 BEGA NSW 2550, 12 Cabarita Lane TARRAGANDA NSW 2550.

*For those of you who like to keep up current name changes, the Australian Plant Name Index (APNI) web-site has our old favourite, *Eucalyptus ficifolia* F.Muell. currently listed as *Corymbia ficifolia* (F.Muell.) K.D.Hill & L.A.S.Johnson.

The reference attributed to this change is:

Hill, K.D. & Johnson, L.A.S. (1995) Systematic studies in the eucalypts. 7. A revision of the bloodwoods, genus *Corymbia* (Myrtaceae). *Telopea* 6(2-3)



Above:
Eucalyptus pimpiniana
one of the smallest, most
attractive Eucalypts.
See page 210

Photo: D. Kearney

Right:
Dwarf grafted ***Eucalyptus***
ficifolia that grows to a
mere 3 metres tall.
See page 208
Photo: Tallowood Nursery



Eucalyptus pimpiniana

Daniel Kearney

Description

The Pimpin Mallee, *Eucalyptus pimpiniana* (Maiden), has an isolated home; it is found naturally along the Ooldea range in the Southern Great Victoria Desert in South Australia and extends West to Lake Minigwal in Western Australia, where it grows on red sand plains or dunes.

It has a multi-stemmed, shrub-like growth habit, usually reaching 1–2 m high with a similar spread. The bark is smooth and white to pink in colour. The thick, oil gland rich blue green leaves and large pendulous cylindrical buds and fruits are attractive in their own right, but it is the clusters of bright yellow flowers, present in umbels of seven to fifteen, that make this shrub stand out.

Flowering is often profuse, and may be almost continuous in cultivation, with more intense bursts of flowering in winter and spring. The flowers are keenly attended by small honeyeaters.

Cultivation & Propagation

Experience with *Eucalyptus pimpiniana* appears limited, but not surprisingly, it appears to be very hardy. The natural habitat of this plant would suggest an open, sunny position in well-drained soil, but it appears to cope well in heavier soils if drainage is improved. Success has been achieved in Adelaide in neutral clay loam with annual rainfall of a little under 600 mm.

It forms a compact, slow growing shrub that flowers profusely and for an extended period. Another advantage is that plants flower when quite young (2–3 years). Pruning may be required to improve the shape of ageing plants - severe pruning should be tolerated well.

Pot culture may be an option in cool, wet or summer humid climates, particularly if placed in a protected sunny position such as against a north facing wall. Reliability in the Eastern Coastal regions appears uncertain - feedback from those with experience cultivating this Eucalypt would be welcome.

Propagation is easy from seed, but care must be taken to prevent seedlings from damping off.

Reference

1. Eucalypts of South Australia, Dean Nicolle 1997.

A Flora of Isolation

Plants of the Tasman Peninsula _____ Dick Burns*, Tasmania

The Landforms and Climate

The spectacle and beauty of the coastline of the Tasman Peninsula has a grandeur that rivals the best of the mainland.

Horizontal layers of sandstone have been intruded by the igneous rock dolerite on a massive scale. Beds of up to 300 m thick were formed. The sheer cliffs of the Peninsula are unique, due to the vertical columns formed as the dolerite magma cooled and solidified. The sandstone and dolerite have been reworked by large and extensive earth movements and by coastal erosion, including the effects of sea-level changes. Fast-running streams have cut deep gullies.

Past events have kept the Peninsula plants isolated from the rest of Tasmania.

Tasman Peninsula was probably an island until a narrow isthmus of sand formed Eaglehawk Neck. This joined it to the Forestier Peninsula, which in turn is joined to the bulk of Tasmania by a narrow neck at Dunnalloy.

During the last ice age, Tasmania was joined to the mainland by a land bridge extending from the north-eastern corner. However, extremely dry conditions down the East Coast insulated Tasman Peninsula from migration of mainland plants.

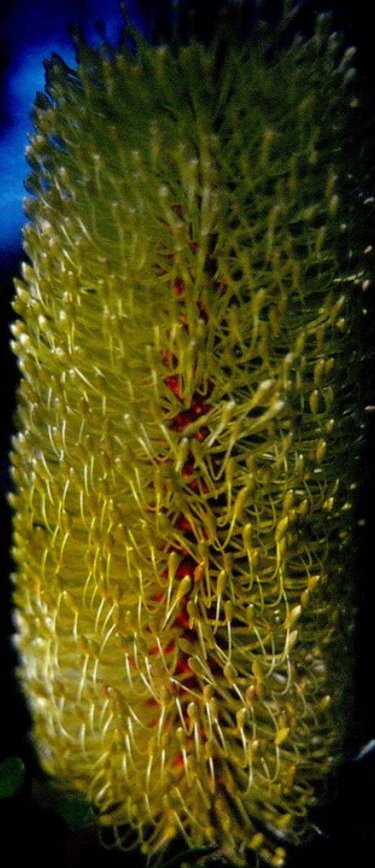
The rugged topography rises to over 300 m around the south-east corner. This fronts onto the Tasman Sea. The altitude generally drops away to the more sheltered north-western side. This affects the climate. It varies from humid and warm near sea level to moist sub-humid and cool in areas exposed to the southerly winds, and humid and cool at high altitudes. The Tasman Sea often sends in strong salt-laden winds.

More rain falls in winter although there is generally rain each month. The annual average is higher than the rest of south-east Tasmania, up to 1,200 mm rainfall along the higher eastern side to 700 mm in more sheltered areas. The summers of 2002/3 and 2003/4 have been unusually dry, resulting in widespread plant stress.

A Fragment of History

There have been Tasmanian Aborigines on the Peninsula for more than 6,000 years.

Among the first Europeans to remark on the spectacular coast were Matthew Flinders in 1798 and those on the French scientific expedition of Nicholas Baudin in 1802. Subsequent settlers cleared land for prisons, grazing and agriculture that included orchards. By 1989, only 11% of the native vegetation had been cleared. The extensive stands of prime forests were selectively logged for all the time of settlement, until economics became more important than forests.



Banksia marginata

See page 214

Photo: D. Burns



Bedfordia linearis

See page 227

Photo: D. Burns



***Spyridium gunnii* on
the Tasman Peninsula**

See page 229

Photo: D. Burns



***Olearia archeri* at Murounna**

See page 227

Photo: D. Burns



male flowers of
Eucasuarina crassa
See pages 214 & 228 Photo: D. Burns



Boronia pilosa ssp.
tasmanensis

See page 230

Photo: D. Burns



Cyathodes platystoma

See page 214

Photo: D. Burns



Ozothamnus purpurascens

See page 227

Photo: D. Burns

Forestry is still a major industry with Forestry Tasmania controlling large sections. An 'Easter Island' attitude seems to prevail with decision-makers who allow the destructive clear-felling of the magnificent forests.

Tourism has developed as the other major industry.

The Tasman National Park was declared in 1999, protecting about one fifth of the Peninsula, along with a wide range of vegetation types. A management plan for the Park was prepared in 2001 (see references).

A series of bushwalking tracks lead to the more interesting sites. These are well described in the book *Peninsula Tracks* (see references).

Plant Communities

The varied topography and geology allows a wide range of communities to develop. Wildfire has been an influence on the vegetation since at least before the last advance and retreat of glaciers (>26,000 years ago).

Communities on Tasman Peninsula include dune vegetation, coastal heathland, salt-marsh, wetland, button grass moorland, woodland, dry and wet sclerophyll forests with small areas of sub-alpine scrub and cool temperate rainforest. Tall open forest and coastal heathland dominate the eastern parts of the national park.

Some communities have developed in such a distinctive way as to add to the uniqueness of Tasman Peninsula. Here are some examples:

Cape Pillar Scrub

At exposed sites that have evaded fires, (e.g. on the way to Cape Pillar and Cape Raoul) a thick, near-impenetrable mass of vegetation up to 3 m high has developed. Rigid branches of *Banksia marginata*, *Melaleuca* spp., *Leptospermum* spp., etc., interlock and are woven together by long canes of *Bauera rubioides*.

The Hobart Walking Club's mighty effort in cutting the Cape Pillar Track through this scrub is chronicled in *The Tasmanian Tramp* (see references). Nowadays we stroll along a walled corridor studded with the flowers of coastal heathland and single or double flowers of *Bauera* coloured white pink and magenta.

Closed forest with dominant trees *Bedfordia salicina* and *Olearia argophylla*

The Cape Pillar Track encounters this community at Tornado Hill and near The Blade. The understorey may be of ferns, but mostly it contains shrubs such as *Richea dracophylla*, *Telopea truncata*, *Cyathodes platystoma* (photo on page 213) or *Anopterus glandulosus*.

Hurricane Heath

At one of the narrower parts of Cape Pillar, sea winds are funnelled up the 300 m cliffs and focussed on one small area. Tree species such as *Allocasuarina crassa* (photo page 213) and *Banksia marginata* (photo page 212) grow prostrate or in wind-pruned 'bowsprits' in the lee of boulders. Intermingled are shrubs of *Pimelea nivea*, *Correa* spp. and *Calytrix tetragona*, with a pygmy form of *Stylidium graminifolium* in crevices.

Continued on page 227

Warrior Bush

Eric Whiting & Colin Sell, Murrumbidgee Field Naturalists*

A farmer once described a small tree as an upside down porcupine on a stalk. I showed him a photo of a Warrior Bush and was immediately greeted with "that's it!".

Also known variously as Broombush, Mustard Bush or Currant Bush, Warrior Bush (*Apophyllum anomalum*) is a very distinctive gnarled small tree to 4 metres (occasionally taller) or, as it is so slow growing, more often only bush sized. The long, often drooping, leafless branches are smooth and dark green - clearly separating it from the jointed branches of the Casuarinas with their rings of scale leaves. Actually leafless is not quite correct as young branches and plants can have some small linear leaves, but these are readily dropped. Photos of the Warrior Bush can be seen on pages 216 and 217.

Apophyllum means 'free of leaves'; if it were 'without leaves' the name would be *Aphyllum*. To add to the distinctive character, the trunk and older branches are very gnarled and twisted, and the bark is almost black.

The leafless condition is a move to being drought resistant. Warrior Bush can thereby grow on very dry soils in semi-arid areas. It looks as if it would be quite at home in the arid interior but does not extend very far westwards from here in Griffith. Its distribution is a rough line from Ardlethan, Griffith, to Gunbar northwards up into Queensland. It is found on open plains to woodlands, on both sands and clay soils.

One of its nearest relatives, the Wild Orange (*Capparis mitchelli*) can be found nearer the Darling River towards Bourke and again northwards and also westwards into Central Australia. Apart from that one, other members of the family Capparidaceae (alternatively known as Capparaceae) occur in sub-tropical or tropical areas and all are truly leafy. Hence the specific name of *anomalum* for the Warrior Bush. (By the way, Wild Orange is not related to the fruits oranges and lemons - they are in the family Rutaceae.)

When in flower in late spring Warrior Bush can literally come alive. It is one of the host plants of the Caper White Butterfly, *Anaphaeis java teutonia*, one of Australia's most common butterflies that migrates in large swarms. If the butterfly is the pollinator it comes at a high price as the butterfly lays its eggs on the Warrior Bush (and other Capparidaceae) and the caterpillars feed on the young succulent growth. Strangely the butterfly can migrate as far south as Victoria and a few stragglers are recorded in Tasmania, yet the Warrior Bush is its furthest south host plant.

The flowers are fragrant and numerous either singly on the branches or in globular clusters. The four petals are creamy and only 2-5 mm long. Male and female flowers are on separate plants, although female flowers can have a few stamens (no reference to them being functional). The male flowers have 8-16 stamens as long as the petals. The ovary of the female flower is on a short stalk. This elongates as the fruit ripens into a round purple edible berry of 5-8 mm diameter.





Seed of Warrior Bush has shown variable germination rates, however Colin Sell of Griffith has had some success; fresh seed sown in early March 2002 germinated well in about 3 weeks. He found plants to be reasonably slow growing. Colin also adds the berries are very sweet.

* The Murrumbidgee Field Naturalists are an active group with members centred around Leeton & Griffith; of which Eric Whiting and Colin Sell are members.

Sankowsky Botanical Garden

continued from page 202

Just a tiny sample of some of our beautiful trees are illustrated on the front and back covers and page 197.

Idiospermum australiense is a rare tree from the Wet Tropics region of North Queensland. It is found in the Cape Tribulation and Harvey Creek areas where it grows in very wet, lowland rainforest. In spite of this it grows very well at Tolga. Illustrated on the **front cover**.

Archidendron hirsutum is a small tree from the rainforests of Cape York Peninsula and is found as far south as the Rocky River, east of Coen. It is a very hardy tree. The delicate pink flowers are followed by bright orange pods. Illustrated on page 197.

Callicarpa brevistylia is a small tree, again from Cape York Peninsula, that occurs as far south as Cooktown. It is very hardy and fast growing. Unlike the other *Callicarpa* species it produces black berries that are eaten by birds. Illustrated on page 197.

***Arytera* sp. Chester River** shows some of the spectacular foliage that can be found on tropical rainforest plants.

Alloxylon wickhamii is a beautiful tree from the upland and mountain rainforests of the Wet Tropics. It is a little difficult to grow at Tolga but several plants have done well with extra watering during the dry season. The new growth is tipped with pink to purple. Illustrated on page 197.

Brachychiton muellerianus is a small to medium tree from Cape York Peninsula. It is found from about Heathlands to Coen, in the open forest. The one illustrated is a selected form from the Pascoe River. The flowers are usually red. Illustrated on the **back cover**.

Syzygium buettnerianum is a spectacular small tree from Cape York Peninsula. It is small enough to grow in any garden and is quite hardy. The beautiful flowers vary from pink to purple and attract numerous birds and butterflies. Illustrated on page 197.

Some pictures of our garden, both before and after, can be seen on page 196.

Our Garden No 43:

Love in a Dry, Cold Climate

(In Love with Natives) _____ Donna & Terry Rath, Mt Rankin, Bathurst

The Bathurstians tell us that it will rain one day and the floods will come. They have memories of this flood & that flood so we can but wait and trust them. We are one of the many families who have forsaken the city to live 'country'. In 2000 we were some of early birds in the gold-rush to the West. Our property overlooks Bathurst. We have 25 acres on the hilly rim that surrounds the city.

Decomposed granite, grazing country does not compare favourably with the Hawkesbury sandstone and farming country at Galston where we once grew so many and such varied Aussies. To eke out scarce bore water and search the sky for rain is a far cry from coastal conditions. And yet we wouldn't even think of looking back or going back.

Our new property has great windbreaking pines and significant mature deciduous plantings that allow us to share Autumnal colours with the city of Bathurst but the crowning glories of the three acre house paddock are some huge *Eucalyptus melliodora* & *Eucalyptus blakelyi*.

Together with assorted Eucalypts, particularly *Eucalyptus leucoxylon* there was an invitation for understorey plantings. Casuarinas grow happily down the driveway. There has been a resurgence of the native grasses in this area over the last year as a balance has been established between keeping an eye out for snakes, mowing and encouraging the seeds to set. There are views East across the plains towards the Blue Mountains and from the front gate Westward we can see Mt Canobolas. Glorious sunrises & sunsets begin and close our days.

Plant close and prune often has been our practice with the understorey. Donna has been the garden designer and her planning is now taking shape as each native begins to sculpture the garden areas. Mulch has been provided from the judicious culling of exotic and some native trees that were originally planted too closely and the resultant vistas have opened scenic gems.

In deciding what to plant, we have been bold in the house area but in the six acre 'dam' paddock where water is less available we have stayed close to the local indigenous plants. Painful lessons have been learned, but there is always the hope that we can find a spot that will suit a particular plant. The Central West Group has published lists of the most likely plants to survive here and we have followed the guidelines but why not stretch the boundaries. Three years ago we invited the Group members to give us their suggestions on our property. This year they are coming back to see our progress. Having gone through the big dry and the big frosts there remains the big wet. Let it come.

Gardener's Tip:
Use local
indigenous plants
where water is less
available.



Above: Driveway with Casuarinas (left) & *Acacia vestita* (right).
Left: *Eucalyptus melliodora* (Yellow Box) *Acacia mearnsii* (Black Wattle) & *Eremophila nivea*.
Below: foreground: *Grevillea* 'Poorinda Constance' (left) & *Grevillea victoriae tenuinervis* (right). Background: *Acacia fimbriata* (left) & *Casuarina cunninghamiana*.

Photos: D. Rath





Top left:

Parahebe arenaria (prev.
Derwentia arenaria)

Above:

Eremophila calorhabdos

Below Left:

***Grevillea* 'Sunrise'**

(*G. bipinnatifida* X
'Clearview Robin').

Below Right:

***Wahlenbergia stricta*,**
(Austral Bluebell).

Photos: D. Rath

One of the special joys of wide range plantings is to go into a corner of the garden with precious water to find that many of the 'Little Aussies' are growing and blooming through it all, grateful for the help but doing just fine thank you very much.

All our plantings have been listed on computer files. We have them listed according to where they are on the property as if one were walking around. Those that have died are in an obituary file. An email to raths@lisp.com.au will obtain a copy with our compliments. Each plant has been labelled using cutting edge technology. We buy plastic knives, roughen the blade with steel wool and use a 3B pencil. The handle is placed in the ground and the writing on the serrated end. After three years they are still surviving the UV rays quite well.

Gardener's Tip:
Plastic knives
make good plant
labels. Write on
the blade with
a 3B pencil.

When we are planting, part of the ritual is to see that each plant has a name. Memory for names never was good. As a plant grows the label, sticking out of the soil is moved so it is not lost.

In the house paddock we built a raised garden with a low rock wall where *Brachyscome multifida* and *Chrysocephalum apiculatum* can be found beside various *Correa* varieties. There are some great grasses as features, *Poa labillardierei*, *Pennisetum alopecuroides* and *Agrostis parviflora*. The most asked about plants in this garden are two grafted *Eremophila nivea* that have grown so well and are so different in colour from the hundred odd others. As the various *Callistemons* & *Grevilleas* grow, this garden will require pruning and maybe culling. The *Xanthorrhoea glauca* and *Xanthorrhoea johnsonii* (legal of course) have plenty of growing ahead of them. There is a *Grevillea robusta* that has survived the frosts and reminds us of Galston. Both Donna and I have a special interest in a delightful little *Grevillea oleoides* that presents its delicate flowers on long delicate curved branches. This 'rock' garden is the first seen driving down to the house from the front gate.

We have recently had two huge *Eucalyptus scoparia* removed. They were planted, unwisely, too close to the house. Beautiful though they were, they were sucking water from the nearby gardens, and breaking sewer pipes. They are mulched and helping the plants they once hindered.

Since coming to the Central West, we have discovered the *Correa*. Every garden area has these great plants flowering and adding a different texture and colour. We have *Correa pulchella*, *C. decumbens*, *C. alba*, *C. reflexa*, (various forms) *C. reflexa* var. *nummulariifolia*, *C. baeuerlenii*, *C. glabra* var. *turnbullii* (prev. *C. schlechtendalii*), 'Fire Bird', 'Candy Pink', and 'Federation Belle'. Likewise we have found the *Eremophila*. Their flowers have featured stunningly in Donna's macro photography. As well as the stunning grafted *Eremophila nivea* we have *E. microtheca*, *E. racemosa*, *E. maculata*, the grafted *E. hygrophana* (Silky Bells) and grafted *Eremophila* 'Yanna Road'.

Recently, the gardens around the house have been planted with some of the many *Anigozanthos* varieties to be found these days. *Anigozanthos flavidus* survived a winter so the bullet has been bitten and "Bush Ranger, Bush Sunrise, Green Dragon, Bush Tango, Yellow Gem, Red Dragon, Gold Fever, Royal Cheer" have all come to take their chances.

Wait for further reports. The above Kangaroo Paws have been planted in a new area for *Hakeas* and *Callistemons*, all beneath the Yellow Boxes and relatively frost free. This garden area is adjacent to the *Banksia* area where *Hardenbergia violacea* both the blue and white thrive with the *Banksia integrifolia* and *B. ericifolia*. These are the only *Banksias* we have been able to grow successfully.

The garden areas we first planted were the terraces at the front of the house. They are the most advanced. It was there that we first discovered the *Grevillea rosmarinifolia* in various forms. These have proved sturdy supporters of our plans to shape the garden beds and encourage birdlife as have the *Correas* of course. This year, the newly planted *Callistemons* began to present us with their flowers but we need to wait for some more growth before they become significant. Among them are *Callistemon rigidus*, *C. brachyandrus*, *C. pachyphylus*, *C. viminalis*, 'Burgundy Jack', 'Taree Pink', 'Pink Alma', 'Candy Pink', and 'Perth Pink'.

Acacias have been a great joy to us because we have been able to plant about thirty different types. *Acacia vestita*, *A. cardiophylla*, *A. dealbata* and *A. rubida* are leaping out of the ground and are already giving shelter to other plants. There is a spectacular *A. fimbriata* making a dense ball of flower. In the house paddock one cannot help gazing at the *A. covenyi* even if it has yet to flower. *A. howittii* is small but like *A. fimbriata* says 'look at me!' In the list of the dearly departed there is scarcely an acacia to be seen.

As yet I have not mentioned the six acre paddock that contains our two empty dams. We have planted eucalypts, acacias, forests of casuarinas and native grasses and they were going well till the intense heat of this summer when we were unable to give them any water. When it does rain, those that were meant to survive will still be there. It's a harsh world down there with little shade. We dug a new dam three years ago and are still waiting for it to fill. We have limited bore water and natives, of course, are not fond of it. It's bore water or nothing but watch them recover when it rains.

There is a small wet area that we call the "bog garden" near the septic outlet. Very little water reaches it because we use our grey water with non phosphorus soap wherever gravity will take it. However, a *Eucalyptus kitsoniana* (Bog Gum) is making headway when bugs & beetles permit. Speaking of such things, the Christmas beetles visited this year and denuded some of our favourite eucalypts. It's a jungle out there! To top it off, the white cockatoos are in the orchard and the walnut and the almond trees.

In the garden areas we have planted Kangaroo Grass, Wallaby grasses Poa grasses, Weeping Lovegrass, Native Sorghum, Swamp Foxtail, and many others in the hope of gaining seed for the property.

Our plant lists contain nothing that can be called rare or endangered. We are planting for another generation as well as our own pleasure. We have plans for new areas and projects galore. There is never enough time. We plan to keep at it till we drop off the twig or can't remember where the twig is. Best Wishes. Good Native Gardening.

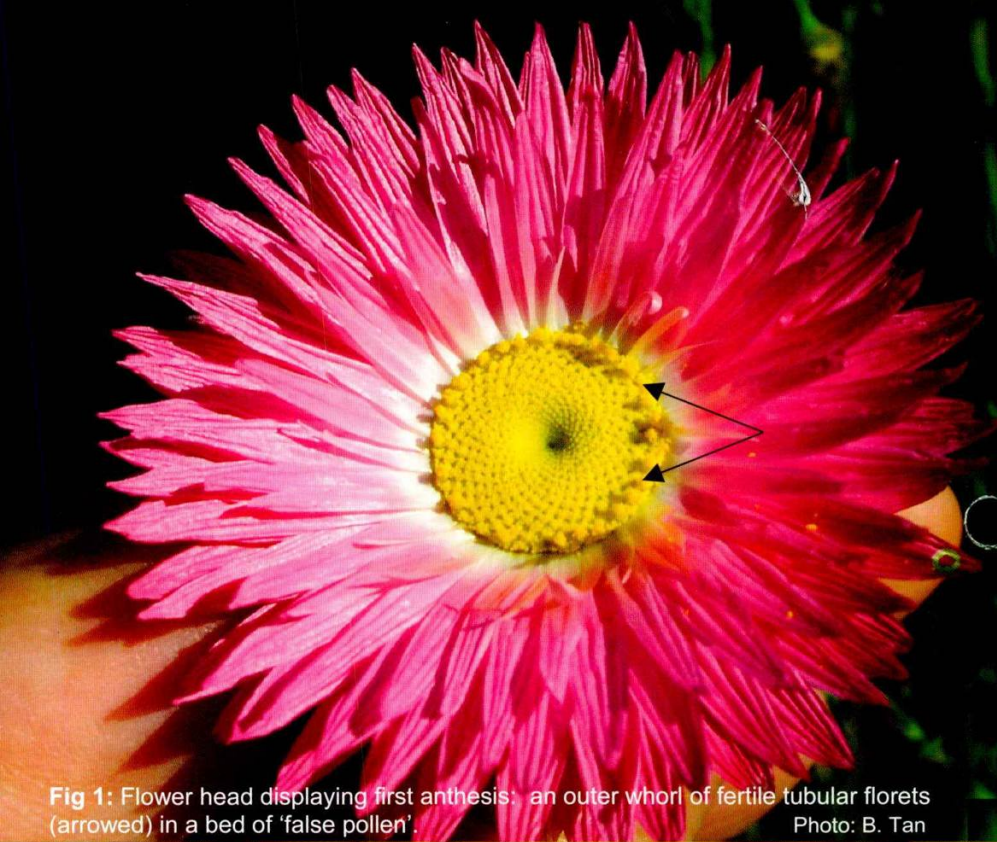


Fig 1: Flower head displaying first anthesis: an outer whorl of fertile tubular florets (arrowed) in a bed of 'false pollen'.

Photo: B. Tan



Fig 2: Non-, and germinating but inhibited self pollens (arrowed) on stigma.

Photo: B. Tan

Pink Everlasting Daisy: *Is pollination wind-assisted?*

Beng Tan and Jonathan Lester
Department of Environmental Biology
Curtin University of Technology

Wind-pollination is the dominant form of pollination in the monocot families Poaceae (grasses and cereals), Cyperaceae (sedges) and Juncaceae (rushes). It is also operative in a small number of dicot families (e.g. Betulaceae, Casuaranaceae, Urticaceae).

Wind-pollinated flowers are characteristically odourless, nectar-less, unspectacular and dull. Copious quantities of pollen are produced and 'cast to the wind' to secure pollination with a fair probability that a small proportion will reach their stigmatic targets. The distance that pollen can travel is determined by wind (dispersal agent) velocity and the terminal velocity of the pollen grain. For pollen to disperse efficiently by wind, it will have to be slight and small, generally in the range of 20–60 microns, which is at the lower end of the broader range of 5–250 microns for all known pollens.

By contrast, flowers that are insect or bird-pollinated are relatively large, coloured and conspicuous. Distinctive flower markings or colours, as well as nectar rewards, have evolved to bribe specific insect, bird or animal pollinators. Bees, for example, are attracted to yellow and blue flowers with markings, while beetles and flies are drawn to flowers which produce a strong odour or stench. Sweet-smelling tubular flowers attract butterflies or moths if they open at night. Honey-eaters and small native marsupials are differential to red nectar-producing flowers.

What about the Pink Everlasting Daisy (*Rhodanthe chlorocephala* subsp. *rosea*), arguably the popular native daisy in Western Australia? It is a self-sown annual producing a mixed stand of deep pink ('red'), pink, and white flowers. The pollination biology of native daisies, including common ones like *Rhodanthe*, *Xerochrysum* (formerly *Bracteantha* and *Helichrysum*) and *Schoenia*, is not well researched but is generally assumed to be insect pollinated because of their showy and brightly coloured flowers. A much-studied crop relative like sunflower (*Helianthus annuus*), for example, is self-incompatible and relies preponderantly on honey bees for cross pollination, to the extent that seed set is closely correlated with bee foraging activity. By contrast, cockle burr (*Xanthium strumarium*), an asteraceous North American weed, is wind-pollinated; relying on wind for pollination, the flower head is not surprisingly small, dull and unattractive.

Heresy?

To suggest that Pink Everlasting, with its brightly coloured flower heads, is wind-pollinated is to go against the grain of textbook wisdom in pollination biology. But, personal observations made of the breeding behaviour of stands and individual plants would not completely write off such a proposition.

Consider the following:

- Populations are heterogeneous for flower colour, shape and disc markings, reflecting plant heterozygosity, which is maintained presumably by cross-pollination. Heterozygosity is corroborated by observation of genetic segregation for flower colour within the seed progenies of individual plants.
- White-flowered plants may not breed true, as evidenced by progeny plants with pink flowers. As white flower is a recessive trait, these observations point to an out-crossing mating system.

Perhaps the more meaningful questions to ask are: the extent of out-crossing and the vector(s) or agency(-ies) involved. Although unequivocal answers to these questions require experimentation, clues abound if one is observant and inferential.

- Visitation by bees and other potential insect pollinators are too infrequent to account for the copious seed sets in open plantings. Tiny, solitary thrips have been observed to forage the flower heads for pollen but their significance as an important albeit inconspicuous pollinator of Pink Everlasting flowers cannot be fully appraised.
- Plants that are isolated - spatially and/or temporary by extreme early flowering - are barren or produce very few seeds, indicating that cross-pollination is preferential or is a requisite for successful seeding. Selfing may be a last resort in the absence of cross-pollination, as has been noted in some native myrtles including *Eucalyptus*. Genetic self-incompatibility has also evolved in some out-crossers to avoid or minimise the risk of inbreeding.

In the context of pollination mechanism, the structural and anatomical details of florets and parts on the flower head can shed light on their predisposition to self- or cross-pollination, or both.

Organisation of flower head (capitulum) and floret structure

Flowers in Asteraceae are clustered in a complex flower head, comprised of several whorls of petalous ray florets on the periphery and cylindrical tubular florets (3–4 mm x 1 mm), compacted into a circular matted disc. The outer petalous whorls, in the case of Pink Everlasting, are actually sterile coloured bracts, while the tightly-bunched innermost tubular florets on the disc (approx. 25% by area, see Fig. 2) are sterile by virtue of their rudimentary ovary. Although hermaphroditic, not all tubular florets are sexually functional: one group has a shorter corolla tube, a membranous sheath of five fused petals, enclosing a crown of five fused anthers (corona) overhanging a relatively short style of about three-quarters of tubular length. Neither is pollen release copious nor stigma protrusion prominent in these smaller tubular florets. Interspersed are longer tubular florets which exhibit protandry (early pollen shed) and stigma protrusion. Organised in one or several 'fertile rings' (Fig. 1), these larger florets are sexually functional and potentially seed-forming (Fig. 3) and, by bold extrapolation, are predisposed to some form of cross-pollination.

Continued on page 231

The Oasis

Further along the same track, old yellow sand dunes are stranded above the sea cliffs. *Hakea lissosperma*, *Allocasuarina crassa*, *Leucopogon australis* and *Leptospermum* sp. grow lush.

Wet sclerophyll forest with *Gahnia grandis* understorey

The author foolishly wandered off the track into this, once. Next morning he emerged, needing new trousers and new skin on his knees, while leaving a trail of happy leeches behind.

Various woodlands and open forests

In spring the understorey is a delight of pinks, whites and yellows. *Hibbertia riparia*, *Tetratheca pilosa* and *Epacris impressa* are some of the species that abound, with *Euryomyrtus ramosissima* trailing everywhere.

Tall Eucalypt forest

The road to Fortescue Bay is a corridor through majestic tall forests dominated by *Eucalyptus obliqua*. Side roads run off everywhere to clear-felled coups, seen regularly through the road tree screen.

Some Notable Plants

The 2001 management plan lists over 610 species of vascular plants, with more to be added. About half of Tasmania's ferns and fern allies occur on the Peninsula. Dicotyledons have a typical proportional representation, e.g. 72 species of Asteraceae, 32 of Epacridaceae and 25 of Myrtaceae. The most frequently found monocotyledons are Orchidaceae (>60 species), Poaceae (58 species) and Cyperaceae (34 species).

Many individual species are worthy of attention by home gardeners, or are simply a delight to find and see.

NOTE: e indicates plants endemic to Tasmania
ep indicates those endemic to the Tasman and Forestier Peninsulas
r indicates rare or vulnerable plants

FAMILY ASTERACEAE

Bedfordia salicina e generally prefers wet forests, where it can form a small tree. The irregular growth may deter some gardeners but the sprays of bright yellow flowers emitting their distinctive perfume are real assets. The same pleasant smell is obtained by crushing the long green to dull leaves. Propagation can be difficult. The shrubby *Bedfordia linearis* e displays its flowers better, has the same perfume. Careful pruning can control its shape. Photo page 212.

Ozothamnus X purpurascens e (photo p 213) and *Ozothamnus reticulatus* e are bushes that cope with exposed dry coastal sites. Both are medium upright shrubs. *O. X purpurascens* has greyish foliage, often dense. The second species has white stems with crowded linear leaves that are dark green above, white below. Both species strike from cuttings, *O. reticulatus* being easier.

Olearia archeri e is a stunning daisy. It forms a rounded mound growing from spreading then erect stems. Large linear leaves stand away from the stems. Terminal clusters of white daisies, each one about 2 cm across, form in spring. It can be grown from cuttings. Photo on page 212.

FAMILY CASUARINACEAE

Allocasuarina crassa **ep r** grows initially as a spreading shrub but eventually forms a stout tree over 10 m tall. The green stems are thicker than other Tasmanian species, with large yellowish sprays of male flowers and startlingly large red female flowers. It is easily grown from seed.

FAMILY EPACRIDACEAE

Ron Crowden and Yvonne Menadue have recently given a full coverage of this family (*Australian Plants* Vol 21). Of all the epacrids growing on Tasman Peninsula, I especially recommend the following for gardens.

Cyathodes platystoma **ep** likes wet sites, but grew for 20 years in my dry garden at Penguin. Its most striking features are the large spreading leaves (photo AP Vol 21, p41) and the large purple berries.

Epacris marginata **e** has distinctive leaves and masses of flowers in the crowded leaf axils (photo AP Vol 21, p109).

Epacris myrtifolia **e** is a variable shrub, but good forms turn white in spring with the dense terminal heads of flowers (photo AP Vol 21, p116).

Pentachondra involucrata **e** is a distinctive plant with crowded light green leaves that have hairs around the rim, and 1 cm white flowers with dense hairy lobes. This plant is happy in dry clayey situations.

Richea dracophylla **e** has the same strange foliage as *Dracophyllum* sp. its large white inflorescences (photo AP Vol 21, p212) are laden with nectar. It prefers damp sheltered sites, although healthy plants can be found in sunny gullies along the cliffs.

FAMILY ESCALLONIACEAE

Anopterus glandulosus **e** is widespread through Tasmania high-rainfall forests. But its large glossy green leaves and clusters of delicate white bells in spring & summer make it an essential feature of any article recommending Tasmanian plants. In dark forests this plant grows with long weak stems, but forms a neat upright shrub elsewhere. It makes an excellent pot plant. Grow from cuttings or seed.

FAMILY MYRTACEAE

Euryomyrtus ramosissima (syn. *Baeckea ramosissima*) also occurs elsewhere. On Tasman Peninsula, it is mostly prostrate with its fine stems trailing across rocks and through other plants. In spring the white or pink flowers line the edges of tracks through drained sunny sites. Grow the selected form from cuttings.

Leptospermum scoparium var. *eximium* **e** is an interesting variety of the species. Frequent in coastal heathland, its leaves are broader than subsp. *scoparium*, with shorter distances between nodes. This produces a more compact floral display. Forms can be found from upright to spreading or prostrate. Flowers are sometimes pure white, often with pink buds and white petals. Selected forms strike readily.

FAMILY ORCHIDACEAE

Some revisions have been suggested recently, but I will use the names as given in *The Orchids of Tasmania*.

The management plan lists 4 orchid species regarded as rare or threatened.

Caladenia filamentosa **r** is a red-flowered spider orchid with pronounced long thin extensions to the 'petals', found in heathy and sedgy open-wooded areas on sandy soil.

Orthoceras strictum **r** is the only one of its genus in Tasmania. One to several flowers form down a thick scape. One sepal forms a large hood and 2 are held erect, horn-like. Colour is variable but there is a yellow patch on the labellum. It prefers wet open sites.

Prasophyllum apoxychilum **e r** is a leek orchid that has a long narrow labellum with a pointed tip. It is found in open grassy or shrubby sites on sand, clay or among rocks.

Thelymitra azurea **r** has distinctively inflated buds. The azure colour is most pronounced on the outer surface and rim of petals. It has been found at Eaglehawk Neck in wet heathy sites.

FAMILY PLANTAGINACEAE

Plantago triantha **e** is a coastal flat-growing plant that forms colonies in exposed sites near the salt-spray zone. Sometimes it fills vertical clefts in escarpments; sometimes it forms mats at the back of rock platforms.

FAMILY PROTEACEAE

Hakea epiglottis subsp. *epiglottis* **e** is a varied plant. In the wet soaks of button grass moorland, it is a small irregular shrub, but reaches 3 m in sheltered spots. In spring small flowers form, mostly bright yellow on the Peninsula. The are often pleasantly perfumed. Male plants make the better display. Cuttings strike occasionally.

Hakea megadenia **e** is a recently described species. It is larger in all parts than the previous species, prefers drained sites and flowers in late summer/autumn.

The population of *Lomatia tinctoria* **e** on Tasman Peninsula is remarkable for its leaf variation. Leaves are lobed. The width and shape of lobes changes between adjacent plants. All are attractive and strike readily.

FAMILY RESTIONACEAE

Eurychorda complanata has reddish flower heads that provide a noticeable contrast to the rest of the bush. It forms colonies along the track in wetter sheltered places.

FAMILY RHAMNACEAE

Spyridium gunnii **e** and *Spyridium obovatum* **e** have been described in an earlier issue, (AP Vol 19, see references), although both photos (p368) are upside down. *S. gunnii* grows in a cleft on top of the sea cliffs on the Mt Fortescue Track. It has greener more glaucous leaves than the west coast form. The flower colour of *S. obovatum* at Tasman Peninsula is normally paler than in that photo, but both upright and prostrate forms occur. Photo on page 212.

FAMILY RUTACEAE

Boronia pilosa subsp. *tasmanensis* **ep r** is a recently described taxon. It is a small delicate shrub in open wet heathland, woodland. Flowers are pink in terminal and axillary clusters. Photo on page 213.

FAMILY SCROPHULARIACEAE

Euphrasias are ephemeral, but a delight to find. *Euphrasia semipicta* **ep r** has small mauve flowers and grows on slopes away from the cliff edge. 3 species growing right on the cliff edge are *Euphrasia amphisepala* **ep r**, *Euphrasia phragmostoma* **ep r**, and *E. sp. 'fabula'* **ep r**. I have not seen *E. amphisepala* flowering, but the other 2 are worth 'getting down and dirty' to look into the flowers.

FAMILY STYLIDIACEAE

The miniature form of *Stylidium graminifolium* found at Hurricane Heath has already been mentioned. It also occurs at the nearby Perdition Ponds.

Mixed with the pygmy trigger plant at Perdition Ponds is the giant *Stylidium armeria*. This species is really a plant of the foreshore, growing on slopes or at the bottom of sand dunes just above the beach. It occurs all around the south of Tasmania, with limited distribution on the mainland. Some plants can be found on the track down to Remarkable Cave, but colonies with tall dense flowering spikes can easily be found at the nearby foreshore.

Both plants maintain their form in the garden, but are perennials.

References

1. Buchanan, AM (ed.) (1999) *A Census of the Vascular Plants of Tasmania*, The Tasmanian Herbarium, ISBN 0 7246 4811 9. A 2002 update is available on the Herbarium web site
2. Storey, P & S (1996) *Peninsula Tracks*, Tasmanian Conservation Trust, ISBN 0 947291 05 9
3. Parks and Wildlife Service DPIWE (2001) *Tasman National Park Management Plan*, ISBN 0 7246 6253 7
4. Smith, SJ (ed.) (1989) *Tasman Peninsula, Is History Enough?*, Royal Society of Tasmania, ISBN 0 9598679 5 3
5. Jones *et al.* (1999) *The Orchids of Tasmania*, Miengunyah Press
6. Burns, R (1998) A Tasmanian Garden, Tasmanian Rhamnaceae at Penguin. In *Australian Plants* 19(156)
7. Christie, T (1970) Cape Pillar. In *The Tasmanian Tramp* No.19, Hobart Walking Club
8. Crowden, RK & Menadue, Y (2001) Tasmanian Epacridaceae. In *Australian Plants* 21(166-169)

*Dick started visiting Tasman Peninsula soon after arriving in Tasmania in 1970. Trivia buffs will know that it is the first part of the main bulk of Australia to receive dawn light every New Year's Day. As well, this south-eastern corner of Tasmania has one of the State's richest and most diverse floras. More than a third of Tasmania's plant species are found on the Peninsula, nearly 15% of them being endemic to Tasmania and 20 species are listed as being rare or under some degree of threat.

Each floret is ringed by about 10–12 branching stalked hairs (paraphyses) (Fig. 3) terminated with pigmented clubbed cells. Compaction of these yellow- or purple-pigmented hair cells produces, respectively, a bright yellow or black tufted floral dais, which functions, respectively, as pollen lure or (UV-reflecting) visual guide; but, oddly, bee visitation of Pink Everlasting flowers is infrequent if not rare. Is there a plausible explanation to reconcile this obvious paradox?

Pollen size

Any suggestion that pollination in Pink Everlasting is wind-assisted ought to be supported not only by evidence of small pollen size but also by some experimental demonstration of its wind dispersal capability.

Microscopic examination reveals Pink Everlasting pollen as a small spiky spherical grain of about 30 microns (Fig. 8), not dissimilar in size to most grass and cereal pollens (20–30 microns); the latter however possess a smooth pollen coat (exine). The difference in exine texture may be related to surface texture of their complementary stigmas, which are villi-like in Pink Everlasting but feathery in grasses. Pollens of bird-pollinated flowers are by contrast heavier (3–4 times larger) and sticky (Fig. 8). Fresh Everlasting pollens tend to be form small aggregates of 50–100 grains but these can still be launched when rustled by wind or draught.

Experimental Pollination

As mentioned above, it has been noted that isolated plants set few seeds whereas plants in open clustered plantings yield prolific seed quantities. A preference for out-crossing and its correlation with fecundity was surmised, and this was verified by experimental pollination in the glasshouse. Experimental plants were individually raised in pots from seedlings and selected for synchronous flowering. They were assigned with replications to the following situations:

- No hand-pollination of primary flower head isolated in bakery sleeve (Fig. 11);
- Sleeve isolation and hand self-pollination of primary flower head by gentle rubbing of disc with finger; process is repeated every second day for about two weeks;
- Hand cross-pollination of flower heads on different plants, placed in small groups in the glasshouse (Fig. 12).

Comparison of their seed sets (Table 1) confirmed that that isolation and selfing resulted in nil or very few seeds, whereas cross-pollination by hand gave a 20-fold increase in seed yield. 'Natural' pollination by agent(s) unknown in open plantings, gave the highest average seed set, or about twice that obtained with inter-crossing by hand in the glasshouse. The low seed sets in isolated and selfed flower heads cannot be ascribed to any adverse microclimatic environment created by sleeve sheathing as there was no moisture build-up within the 'breathable' sleeve. Besides, these poor seed-set outcomes merely corroborated what already has been noted in non-glasshouse potted plants that have been isolated either in space or flowering time. The higher seed-set in naturally-pollinated plants probably reflects

accrual from additional rounds of pollination encompassing the later-flowering younger (inner) florets.

Table 1 Comparison of seed sets following different experimental treatments

Treatment of flower heads:	Isolated in sleeve, in glasshouse	Sleeved & hand self-pollinated, in glasshouse	Sleeved & hand cross-pollinated, in glasshouse	None, potted plants grouped in open plots
No. heads examined ⁽¹⁾ :	7	9	20	20 randomly from >200
Av. seed set per head ⁽²⁾ :	2.28 ± 1.67 (a)	2.22 ± 0.94 (a)	47.82 ± 4.56 (b)	93.90 ± 14.12 (c)
Av. seed density (no. seed cm ⁻²) ⁽²⁾ :	1.71 ± 1.26 (a)	1.56 ± 0.77 (a)	23.80 ± 2.36 (b)	38 ± 4.55 (c)
Range:	0 – 12 (3 with no seed)	0 – 8 (3 with no seed)	9 – 80	20 – 289 ⁽³⁾

⁽¹⁾ A single primary flower head sampled per plant;

⁽²⁾ Within rows, seed values with the same alphabet denotes no significant difference in statistical terms;

⁽³⁾ Typical range was 50–150; the exceptionally high seed set (289) was recorded for a single exceptionally large flower head (2.5 cm disc diameter).

Microscopic study of pollen germination

If self-pollination results in zero or dismal seed set, could this be due to inhibition of its own (self) pollen on its own stigmatic tissue? The stigma itself cannot avoid pollen from the same floret, although it may not be receptive when pollen is shed (Fig. 5).

Stigma receptivity is recognised after protrusion from the corolla tube and unfolding of the forked stigma to form an inverted anchor (Figs 4 & 6). This is when the stigma becomes visible to the naked eye as a miniature 'clothes-hoist' above a yellow carpet of 'false pollen' (Fig. 1 & 3).

The pollen grains seen microscopically on the receptive stigma of an unprotected floret/flower are effectively a mixture of self and non-self pollens if cross-pollination has taken place. This admixture will confound any microscopic study of pollen germination in 'cross-pollinated' flower heads, but in protected and hand-pollinated flowers, all adhering pollen grains are assumed to be exclusively self pollens (in the absence of thrips or similar potential pollinators).

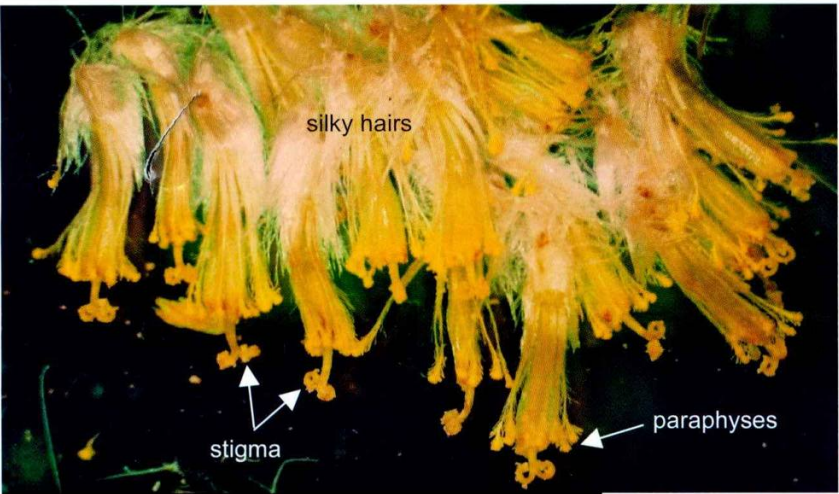
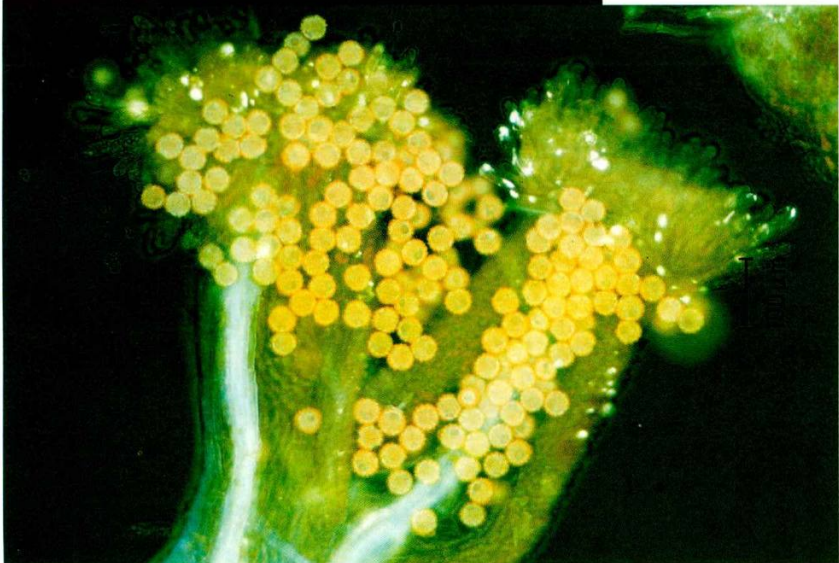


Fig. 3 (Above): Group of fertile tubular florets with a protruding stigma; white silky hairs develop on ovary after fertilisation.

Fig. 4 (Left): Dissected fertilised tubular floret revealing flower parts and young fruit.

Fig. 5 (Below): Unavoidable: young stigma is challenged by crown of dehiscing anthers and splattered with self pollen when emerging from corolla tube.

Photos: B Tan



Pollen germination on the stigma and pollen tube growth in the style can be studied with appropriate tissue pre-treatment and viewing of squash preparations by UV Microscopy. In self-pollinated florets, very few self pollen grains were observed to germinate on the style and their short pollen tubes suggests growth inhibition emanating from recognition of self pollen (Fig. 6). Pollen germination and tube growth in the style were observable in hand cross-pollinated florets, and progress of pollen tube(s) to the ovary, to effect fertilisation, could also be traced (Fig. 7). Considering that there is sporadic seeding among a few isolated and hand self-pollinated flower heads (Table 1), inhibition of pollen germination and tube growth, a manifestation of genetic self-incompatibility, is not absolute in Pink Everlasting; further, it may be possible to select for or against this genetic trait in a variable population.

Demonstration of wind dispersal

That Pink Everlasting is largely self-incompatible and preferentially out-crossing appears unequivocal, but in the absence of the usual and obvious suspect (such as a bee or similar insect), wind is alluded as the more likely agent of cross-pollination. A replicated pollen trapping experiment was set up to test such a proposition. Pollen traps in the form of vaseline-coated microscope glass slides tied on stakes at flower height, and placed at varying distances in four orientations (N,S,E,W), with each facing a small population of flower heads (Figs. 9 & 10). The traps were replaced daily and scores were made of Pink Everlasting pollen aggregates trapped on each collected slide (notes: pollens of other plant species, e.g. *Acacia* could be distinguished by shape and size; single grains were ignored as they were too small for accurate scoring under a stereo-microscope). Wind directions and other meteorological data were also collected over the trapping period.

Table 2 Flight distances and amount of Pink Everlasting pollen trapped over ten days during flowering

Distance travelled (cm)	Av. no. pollen aggregates trapped per day
10	18.8 $\pm$ 2.76 (a) ⁽¹⁾
20	16.5 $\pm$ 2.22 (a) ⁽¹⁾
40	9.8 $\pm$ 1.10 (b) ⁽¹⁾

⁽¹⁾ Same alphabet denotes no significant difference in value, statistically.

The results (Table 2) clearly demonstrated that Pink Everlasting pollen, even as small aggregates, can be dispersed by wind over short distances of half a meter or more. The effective distance of dispersal is likely to be farther as single pollen grains were not included in the counts. In densely-planted populations, this relative short distance may be ample to achieve cross-pollination. It was further established that pollen load was related to ambient conditions: for example, more pollen was trapped on a warm sunny day than when it was cool and cloudy, and no pollen was trapped at all on wet days due to closing of whole flower heads. Direction of dispersal was also directly related to wind direction: for example, a trap placed west of the plot trapped most pollen when wind is mostly easterly for that day.

The flight dynamics of the Pink Everlasting pollen was also studied in the laboratory. Flower heads were tapped over a filter funnel, clamped 1 m above the floor, to release loose pollens through the funnel tube. A black cardboard with a drawn series of concentric circles was placed directly below the funnel to determine the radial dispersion of pollen in (a) a still atmosphere, and (b) in a light breeze situation (fan-generated, unidirectional wind speed of 0.3 m/sec). Fifteen flower heads were used in each situation and scores again were for pollen aggregates that were visible on the black cardboard. Pollen aggregate counts, summarised in Table 3, indicated that Pink Everlasting pollen is capable of dispersal over short distances and this is accentuated with breeze; single pollens and smaller aggregates should be able to disperse over a greater distance after shedding.

Table 3 Count of pollen aggregates falling in still air and light breeze

Radial distance from plumbed centre (cm)	Still air	Breeze (0.3 msec ⁻¹)
0–5	44	9
5–10	67	15
10–15	160	12
15–20	140	21
>20	148	numerous (no score)

Summary and speculation

This investigation was prompted by observation of population heterogeneity (see *Australian Plants* June 2001, pp. 110–114) and paltry seeding of isolated plants, both of which point to Pink Everlasting as naturally out-crossing. Although the flower has all the trappings for bee or insect pollination, visitations are too infrequent to account for prolific seeding in open plantings. The natural pollinator in the original population (near Port Gregory in WA) may well be a native bee or a native insect. The absence of a natural pollinator(s) outside the centre of origin may have brought about an adaptive change where wind is supplanting insect as an equally effective agent of cross-pollination, especially in improved populations which are now widely cultivated beyond the original epicentre. The shift in disposition to an abiotic agent for cross pollination may be reinforced with further selection for horticultural qualities with improved seed set under conditions of cultivation, which are dissimilar, ecologically, to the species' natural habitat.

Acknowledgement

We would like to thank Ms Lydia Kupsky for assistance with UV microscopy.

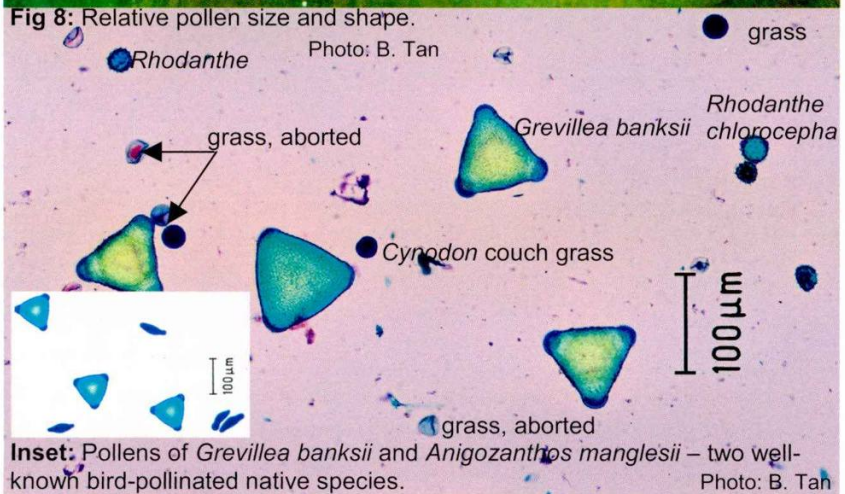
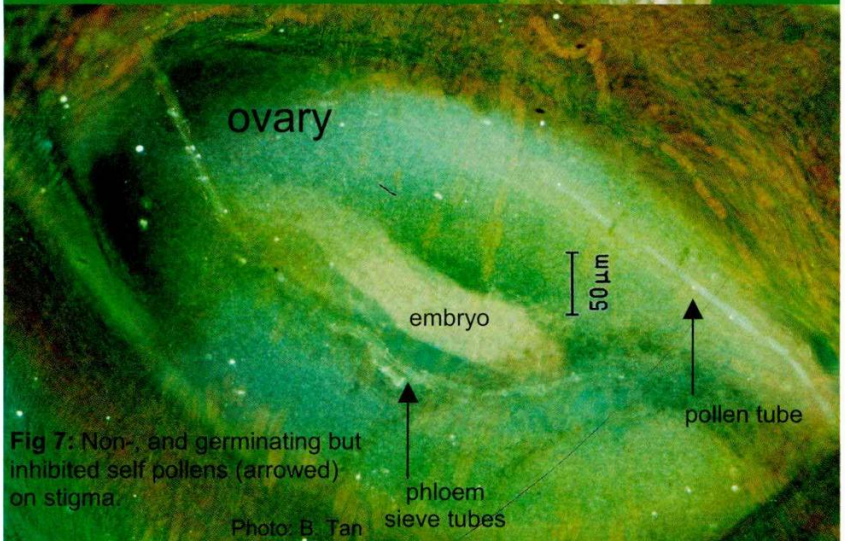


Fig. 9 (Right):

A replicate plot in pollen trapping experiment: flowering plants are surrounded by staked vaselined glass slides.

Photo: J. Lester



Fig. 10 (Left): Close-up of plot showing staked glass slides facing flower heads.

Fig. 11 (Below left):

Glasshouse-maintained plant with primary flower head isolated in pin-holed bakery sleeve.

Fig. 12 (Below right):

Replicate cohort of plants used for controlled hand cross-pollination.

Photos: J. Lester



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<http://www.trump.net.au/~joroco/sgaptas-index.htm>

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Online: <http://farrell.riv.csu.edu.au/ASGAP> is the national internet page for all the above Societies, receiving thousands of 'hits' from all over the world. The wealth of information is augmented by a newsletter, Australian Plants Online, all free. Refer to it and enjoy.

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Brachychiton muellerianus is one of the beautiful trees in the Sankowsky Botanical Garden. The flowers are usually red.

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Photo: G. Sankowsky

