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# Eucalyptus Study Group Newsletter

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## Giant eucalypts sent back to the rainforest

By Rachel Sullivan, C/- ABC

The study has implications for the conservation of old growth eucalypt forests *(Source: Greg Jordan/)*

Standing tall Giant fire-dependent eucalypts should be classified as rainforest species, a new study has found, ending decades of debate over the species' classification.

The research, published in the journal *New Phytologist* , was the first international study to examine gigantism in global tree species.

Of the world's 46 living giant tree species - those exceeding 70 metres in height - most are either conifers found along the Pacific North West Coast of North America or eucalypts from Southern and Eastern Australia.

"Australia is an epicentre of giant trees," says Professor David Bowman, a forest ecologist at the University of Tasmania. "Of these, the tallest is *Eucalyptus regnans* with temperate eastern Victoria and Tasmania being home to the six tallest recorded specimens."

"One Tasmanian tree was measured at 99.6 metres while a historical records suggest a Victorian tree reached a record 114.3 metres."

According to Bowman, most people think the conifers of North America are the largest trees on Earth, despite the flowering eucalyptus trees of Australia reaching comparable heights.

"This is surprising as Australia is the world's driest vegetated continent," he says. "Yet, this apparent paradox may explain the evolutionary advantage of gigantism in trees."

Mellowing with age

The researchers looked at the ecological and phylogenetic distributions of giant trees, the characteristics eucalypts share with other giants, their relationship with fire and the unique ecological relationship eucalypts have with rain forest.

They found that gigantism in eucalypts evolved within the last 20 million years as a recovery response following bushfire during ideal environmental conditions for explosive tree growth.

"Giant eucalypts have been a puzzle because they require fire to regenerate, yet tower over the rainforest tree canopy that regenerates without fire," says Bowman. "They are incredibly competitive when they are young, yet once established, co-exist happily with invading rainforest species.

"Their evolutionary advantages allow them to outcompete other species, however they occur on the margins of rainforests."

"Rather than seeing them in isolation they should be regarded as long-lived rainforest pioneers and a part of that ecosystem."

In fact, says Bowman, they are remarkably long-lived, with other research by his team showing that they can live for up to 500 years.

Unique type of vegetation

Giant eucalypts were originally classified as rainforest species, but were reclassified as a unique vegetation type after it was discovered by foresters in 1959 that they needed the ash bed that follows a bushfire for their seeds to germinate.

"This classification has serious scientific and conservation implications for thinking about the remaining forests of mature (old growth) giant eucalypts," says Bowman.

"Giant trees have huge value for the timber industry, yet there are strong environmental reasons for their protection.

"Classification as rainforest trees, albeit those with a unique dependence on fire, adds support to arguments in favour of old growth conservation."

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## Abstract

### Leaf traits of *Eucalyptus arenacea* (Myrtaceae) as indicators of edge effects in temperate woodlands of south-eastern Australia

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Despite recent trends in using plant functional traits to describe ecosystem responses to environmental change, few studies have examined the capacity of traits to represent environmental variation for individual species at small spatial scales, such as across forest edges. We examined the utility of 12 easy-to-measure leaf traits (fresh weight to dry weight ratio, specific leaf area (SLA), osmolality, $\delta^{13}C$, $\delta^{15}N$, and concentrations of key nutrients) to detect edge effects on the function of a dominant woodland tree, *Eucalyptus arenacea* Marginson & Ladiges. The study included replicate *E. arenacea* trees at the woodland edge (0 m) and interior (75 m from edge) of three woodlands adjoined by pasture and three woodlands adjoined by plantation established on pasture. Leaf traits proved useful in identifying potentially degrading processes at woodland edges. Notably, greater leaf P concentrations and $\delta^{15}N$ in edge than interior trees irrespective of edge type (pasture versus plantation) indicated persistent effects of nutrient enrichment from agricultural practices; and leaf osmolality and Na concentrations indicated greatest exposure of woodland trees to salinity at pasture edges. Nonetheless, leaf traits proved less useful in detecting edge effects on tree physiology, with most traits being non-responsive to a pronounced interactive effect of edge type and distance from edge on physiological measures. In addition, negative correlations between SLA and physiological measures of tree productivity were contrary to global relationships. Overall, we found that although particular leaf traits indicated potentially degrading processes of nutrient enrichment and salinisation, they were not reliable indicators of small-scale edge effects on the physiological function of *E. arenacea*.

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## Old trees in big trouble

Source: CEED

David B. Lindenmayer, William F. Laurance and Jerry F. Franklin (2012) Rapid worldwide declines of large old trees, *Science*, doi: 10.1126/science.1231070

The largest living organisms on the planet, the big, old trees that harbour and sustain countless birds and other wildlife, are dying according to a report by three of the world's leading ecologists in a recent issue of the journal *Science*.

The report warns of an alarming increase in death rates among trees 100-300 years old in many of the world's forests, woodlands, savannahs, farming areas and even in cities.

'It's a worldwide problem and appears to be happening in most types of forest,' says lead author, Professor David Lindenmayer of the ARC Centre of Excellence for Environmental Decisions (CEED) and Australian National University.

'Large old trees are critical in many natural and human-dominated environments. Studies of ecosystems around the world suggest populations of these trees are declining rapidly,' he and colleagues Professor Bill Laurance of James Cook University, Australia, and Professor Jerry Franklin of Washington University, USA, write in the *Science* report.

'Research is urgently needed to identify the causes of rapid losses of large old trees and strategies for improved management. Without... policy changes, large old trees will diminish or disappear in many ecosystems, leading to losses of their associated biota and ecosystem functions.'

Prof. Lindenmayer says they were first tipped off to the loss of big old trees while examining Swedish forestry records going back to the 1860s. More recently, a 30-year study of mountain ash (*Eucalyptus regnans*) forest in Australia confirmed not only that big old trees were dying en masse in forest fires, but also perishing at ten times the normal rate in non-fire years – apparently due to drought, high temperatures, logging and other causes.

Looking round the world, the scientists found similar trends at all latitudes – in California's Yosemite National Park, on the African savannahs, in the rainforests of Brazil, the temperate forests of Europe and the boreal forests of the far north.

Losses of large trees were also pronounced in agricultural landscapes and even cities, where people make efforts to preserve them.

'It is a very, very disturbing trend. We are talking about the loss of the biggest living organisms on the planet, of the largest flowering plants on the planet, of organisms that play a key role in regulating and enriching our world,' says Professor Bill Laurance of James Cook University.

'Large old trees play critical ecological roles. They provide nesting or sheltering cavities for up to 30 per cent of all birds and animals in some ecosystems. They store huge amounts of carbon. They recycle soil nutrients, create rich patches for other life to thrive in, and influence the flow of water within landscapes and the local climate.

The last of its kind? A large mountain ash tree being measured in the wet ash forests of Victoria.
Credit: David Blair

'Big trees supply abundant food for numerous animals in the form of fruits, flowers, foliage and nectar. Their hollows offer nests and shelter for birds and animals like Australia's endangered Leadbeater's possum (*Gymnobelideus leadbeateri*) – and their loss could mean extinction for such creatures.

'In agricultural landscapes, large old trees can be focal points for vegetation restoration; they help connect the landscape by acting as stepping stones for many animals that disperse seeds and pollen,' he says.

The alarming decline in old trees in so many types of forest appears to be driven by a combination of forces, including land clearing, agricultural practices, man-made changes in fire regimes, logging and timber gathering, insect attack and rapid climatic changes, says Prof. Jerry Franklin.

'For example, populations of large old pines in the dry forests of western North America declined dramatically over the last century because of selective logging, uncharacteristically severe wildfires, and other causes,' he adds.

The researchers liken the global loss of big trees to the tragedy that has already befallen the world's largest mammals, such as elephants, rhinos, tigers and whales, cautioning that almost nowhere do conservation programs have the time-frames lasting centuries, which are needed to assure the survival of old trees.

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## Australia's gum trees could 'tip over the edge'

Source: NERP, 23rd December 2013

**Many of Australia's iconic eucalypt ecosystems could change beyond recognition due to increased climate stress.**

Many of Australia's approximately 750 eucalypt species may be adversely affected by climate change, potentially having cascading impacts on local wildlife and other plants.
Credit: Richard Taylor

Research based at the National Environmental Research Program's (NERP) Environmental Decisions Hub and published in *Ecology and Evolution* indicates that heat waves, droughts and floods expected under climate change will alter environmental conditions so much that many eucalypts will no longer survive in their native ranges.

University of Queensland NERP Environmental Decisions Hub lead author Dr Nathalie Butt said trees are vulnerable to climate change.

'This is due to their long regeneration times and the relatively short dispersal distances of their seeds,' Dr Butt said.

'Many of Australia's approximately 750 eucalypt species may not be able to keep up with climate change sufficiently to avoid heavy losses – and these will in turn have cascading impacts on local wildlife and other plants.'

Replanting is unlikely to help woodlands and forests persist.

To find out whether Australia's various eucalypts can withstand likely climate changes, the NERP researchers tested different climate scenarios based on those used in the latest Intergovernmental Panel on Climate Change (IPCC) report.

‘Previous extreme droughts have caused widespread dieback in eucalypts in some regions,’ Dr Butt said.

‘This suggests that some, such as savannah species in northern Queensland, are already at their limits.

‘Climate change predictions of a shift to longer, drier periods in coming decades could therefore tip our eucalypts over the edge in many regions.’

In the study, the researchers applied mid-range and extreme climate scenarios to 108 eucalypt species and grouped them by climate region across Australia.

‘Large areas of central Australia will become unsustainable for eucalypts, due to extensive summer drying and more frequent droughts,’ Dr Butt said.

‘Trees may gradually shift their ranges towards the coasts where growing conditions are more favourable, or die out due to drought.

‘However, colonisation of new areas may not be possible as land is cleared for farming.

‘We can’t assume we can simply restore ecosystems by reforestation.

‘Replanting the same eucalypt species won’t help if the climate conditions are no longer suitable.

‘This research will help inform the large scale restoration activities proposed by existing and future Australian governments.

‘We need to think about how to help our local trees and plants to buffer climate stress.

‘We also need to focus on how to reduce the impacts of climate change, by cutting carbon emissions and reducing other environmental stresses on our native trees,’ Dr Butt said.

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**Abstract**

**Buds, bushfires and resprouting in the eucalypts**

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Eucalypts encounter a wide range of severe disturbances such as extensive defoliation by insects, major structural damage from cyclonic winds, as well as foliage and bark loss during drought and fire. Most healthy, mature eucalypts are not killed by these events, but regenerate vegetatively. With increasing intensity of disturbance, resprouting first occurs from the accessory buds in the small-diameter branchlets of the crown, followed by the epicormic buds in the medium- and large-diameter branches and stems, and then from the buds of the lignotuber. All these modes of regeneration are ultimately dependent on preventitious buds and, thus, the present review concentrates on axillary buds, their subsequent development into epicormic or lignotuber buds and their degree of protection from fire. The eucalypts have remarkably abundant, well protected and anatomically distinctive bud-forming structures in their leaf axils, branches, stems and lignotubers. These structures are quite consistent across this large genus, but are generally different from resprouting structures in many other plants. From an anatomical perspective, these structures seem best adapted to regeneration after fire, rather than damage from

insects, storms or drought and this also correlates with ecological observations. On a worldwide basis, the eucalypts are some of the most successful post-fire resprouters, especially epicormic resprouting after medium- and high-intensity fires. Given the apparent ecological advantages of epicormic resprouting (the rapid reestablishment of extensive leaf area while simultaneously shading basal resprouters and seedlings) this could be an important factor in the success of eucalypts in Australia. Recent phylogenetic analysis has indicated a long relationship between eucalypts, fire and bud structures that facilitate resprouting.

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## Manganese deficiency in cycads and eucalypts

BY Simon_Leake C/- SESL Australia

On a recent visit to Melbourne, Simon met up with Peter Symes, the curator of environmental horticulture at the Royal Botanic Gardens Melbourne. Peter mentioned that plants in the RBGM's rare and endangered flora beds showed chlorosis (yellowing) of varying degrees and invited Simon to come and have a look.

Frizzletop disorder of *Cycas revoluta*. The yellowing and the dead fronds indicate Mn deficiency.

*Cycas revoluta*, a Japanese native cycad, showed actual death of fronds. *Eucalypts glaucescens*, an uncommon species native to south-eastern Australia, showed chlorotic symptoms. SESL Australia analysed foliage and soil samples back in Sydney and found a clear picture of phosphorus- (P)- and pH-induced manganese (Mn) deficiency.

These plants are not considered to be P-sensitive, but this is a good example of how nutrient interactions and pH can affect nutrient availability.

Mn is involved in many enzyme reactions within the plant, including chlorophyll and protein synthesis and energy metabolism. The most obvious effect of acute deficiency is chlorosis of the youngest leaves, which appears a lot like iron deficiency.

Several things antagonise Mn uptake from soils. High pH is the most common problem, as Mn salts become increasingly insoluble at a pH above 5.5. (Remember that pH 7 is neutral; values below 7 are acidic; values above 7 are alkaline.) In addition to high pH, P also reduces Mn availability, as Mn phosphate is very insoluble. Combine these two factors and Mn can become acutely deficient. Some plants, including many Australian natives, are adapted to growing on acidic soils and have no way of taking up Mn from alkaline soils.

The symptoms of the cycad closely resembled a disorder of cycads called frizzletop, which indicates Mn deficiency, so Peter already had a strong suspicion that the problem involved high pH, high P or both. SESL's results confirmed his suspicion: soil P was excessively high, and although soil Mn was also high, the relatively high pH (nearly 7) clearly indicated that the Mn was unavailable, as confirmed by the very low tissue Mn content. In other words, although Mn was present in the soil, the plants were unable to take it up.

Both *C. revoluta* and *E. glaucescens* grow naturally in acidic soils. So their symptoms are understandable.

The usual treatment for Mn deficiency is acidification of the soil through the addition of sulphur to achieve a gradual lowering of the soil pH.

It is interesting to recognise that this deficiency (due to high pH) is the opposite to that found in *Eucalyptus haemastoma* trees intended for planting at Barangaroo, namely Mn toxicity (due to low pH).

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## Manganese toxicity in eucalypts

BY Simon_Leake C/- SESL Australia

SESL Australia is working with the Barangaroo Delivery Authority on formulating the soils for the Barangaroo Headland Park development, and selecting the indigenous species to plant.

One prominent tree species to be planted is *Eucalyptus haemastoma*, or scribbly gum. In its natural habitat, on moderately poor soils derived from nutrient-poor sandstone, the soils have a low content of manganese (Mn) of around 20–25 mg/kg. (In contrast, good agricultural soils have a Mn content of 80 to 140 mg/kg.)

Yet despite the low Mn in the soil, SESL Australia has found a leaf Mn content of around 300 mg/kg in the wild, typical of healthy crops.

SESL has been testing formulations of soils made from crushed sandstone and compost made from council-collected green waste to be used at Barangaroo. When the soils were artificially acidified to pH 4.7 (typical of sandstone-derived soils in Sydney), the concentration of Mn in the leaves rose to an alarming 1200 mg/kg (roughly 10 times the ideal), and the leaves showed reddening, indicative of Mn toxicity.

This reddening around the edges of the *Eucalyptus haemastoma* leaf indicates Mn toxicity. Contrast it with the natural reddening of the leaves below.

*Eucalyptus haemastoma* therefore appears to cope with the low Mn levels of natural soils by taking up all it can find. So when faced with high levels (which would be considered normal for most other plants) in the soil, it takes up too much.

In contrast to our findings at the Royal Botanic Gardens Melbourne, where *Eucalyptus glaucescens* was showing signs of Mn deficiency on account of a (relatively) high pH and a high soil P content, we see the opposite here, where *E. haemastoma* is showing signs of Mn toxicity on account of a low pH in the presence of (relatively) high Mn levels in the soil.

Contrast the reddening of the leaf in the photo above with normal reddening in *E. haemastoma* leaves below. The leaves on the left are young, and have a high content of anthocyanins, possibly to protect the developing leaves from sunburn. The leaf in the middle is a healthy mature leaf, with no red. The leaves on the right are senescing (ageing) leaves, again containing anthocyanins, this time as breakdown products. The distribution of the colour differs from that in the leaf showing Mn toxicity.

## Nutrient Deficiencies in Eucalyptus

By Charlma Phillips, Principal Forest Health Scientist PIRSA Forestry MOUNT GAMBIER SA

In agriculture and horticulture plant nutrition has been relatively well studied and in forestry there is a large amount of information on nutrition in conifers. However, there is a distinct lack of knowledge on nutrition and nutrient requirements of Australian native plants and in particular, eucalypts. The problem is compounded by the fact that different species (and even different provenances) of eucalypts seem to react differently to mineral deficiencies. Many deficiencies produce similar symptoms. Low levels of a particular element may also produce symptoms and these may vary depending on just how low the levels are. Multiple deficiencies may occur. Factors such as site, seasonal and climatic effects and chemicals may also be involved. It is a very complex matter and means that nutrient deficiencies are extremely difficult to diagnose. Deficiency problems may not show up for some time after planting, (possibly years), as at first there may be sufficient nutrients in the soil to meet the requirements of the trees.

The following are general descriptions of nutrient deficiencies in eucalypts based on the limited information available. Specific information is given about *Eucalyptus globulus* where possible.

<u>Boron</u>

Boron is important in actively growing areas such as shoots and root tips. It is particularly important when trees are growing in marginal areas or on shallow, rocky soils that are poorly drained or at times, waterlogged. Only small amounts are needed by the trees. Symptoms of deficiency vary depending on the species involved but the most common symptom is dieback of the young shoots. New leaves may have yellowish edges.

<u>Calcium</u>

Calcium is important for healthy root development. Deficiencies are most likely to occur in very acid soils. Deficiency symptoms show up first on new leaves and include necrosis (dead patches) and dieback. Plants may be stunted and generally have poor root development. In *E. globulus* there are few recognisable symptoms but growth is poor and there is very little branching.

<u>Copper</u>

Copper is concentrated in green leaves. Copper deficiency is commonly associated with Zinc deficiency and occurs mainly in sandy soils. In soils high in nitrogen and phosphorus, copper is often tied up so it becomes unavailable for plant to use. Deficiency symptoms include wilting and dieback of the terminal shoots and failure of the plant or grow straight - the stem or trunk may be twisted and growing almost horizontal in some cases.

Iron

Iron is important in the synthesis of chlorophyll (the green colour) in leaves. Iron deficiency is likely to occur on soils containing lime. Often there is plenty of iron in the soil but it is in a form that renders it unavailable for the plant to use. The main symptom of iron deficiency is chlorosis - a yellowing of the leaves particularly between the veins (which remain green). New growth is pale yellow.

Magnesium

Magnesium is important in photosynthesis. Magnesium deficiency is most common in very acid soils where there are high levels of potassium. Deficiency symptoms show up first on older leaves. The main symptom is chlorosis starting form the tip and edges of the leaves and progressing inwards. There may b a green "V" along the midrib. Some older leaves may be reddish in colour. In *E. globulus* there are few symptoms in the early stages but later, chlorosis develops and is particularly evident in the older leaves. There is also restricted shoot growth.

Manganese

Manganese is found in green leaves. A common cause of manganese deficiency is the liming of acid soils to reduce the pH. The main symptom of manganese deficiency is chlorosis, similar to iron deficiency. There is also likely to be cupping of the leaves and necrosis (dead patches on the leaves). Young leaves are the first to be affected.

Nitrogen

Nitrogen is very important in plant nutrition. It is essential for photosynthesis. Nitrogen deficiency is rare in eucalypts. Deficiency symptoms first appear on older leaves. These become pale yellow in colour. There may be yellow spots on the leaves and chlorosis. In some cases the veins become reddish. The colour depends on the degree of deficiency and on the species involved. There may also be premature leaf drop. In *E. globulus* yellow spots and chlorosis occur on older leaves first. Eventually all lower leaves become chlorotic and premature leaf drop occurs. Growth is poor with small leaves, thin stems and no branching. Root development is poor.

Phosphorus

Phosphorus is also a very important element. It is involved in the development of roots, stems, flowers and seeds and is vital for photosynthesis. Australian native plants are well adapted to cope with low levels of phosphorus as most Australian soils have low concentrations of this element. Consequently phosphorus deficiency is rare. Deficiencies show up first in the older leaves which take on a purple colour, often with dry tips and margins. In *E. globulus* the only symptoms are dry tips and margins of the lower leaves. Leaves are normal size but growth may be stunted with little branching, thin stems and a few brown spots at the base of the stems. Root development is poor.
Note: It is important not to confuse the purple and yellow/green colour of healthy, immature leaves with that of nitrogen or phosphorus deficiency. These deficiencies are most apparent on older, full sized leaves.

Potassium

Potassium is important in protein synthesis and in the formation of strong roots and stems. It is needed in large quantities but is often tied up in the soil and not readily available for plants to use. Deficiencies often occur in sandy soils. Deficiency symptoms appear in older leaves first. The main symptom is dead tissue on the leaf margins spreading to the leaf tip. In *E. globulus* there are few visual symptoms in the early stages but there may be brown sports on the leaves and later curling up of the tips and margins of the leaves. Initially only older leaves are affected but later all leaves become affected.

Sulphur

Sulphur is important in root formation. Sulphur deficiency is rare. Deficiency symptoms include chlorosis with pale veins and stunted growth. In *E. globulus* the only apparent symptom is likely to be slight chlorosis in older leaves.

Zinc

Zinc is important for healthy stem and leaf growth. Zinc deficiency is often associated with copper deficiency. Deficiencies appear on young leaves first. Symptoms include chlorosis and crinkly leaves with necrotic (dead) patches. There may be dieback of the tips. As stated previously, many deficiencies cause similar symptoms which makes diagnosis difficult. In most cases many factors are involved and no one factor in particular can be credited with causing the symptoms. The suitability of the site for growing trees and the soil type are important factors in healthy tree growth. If trees are not growing well, these factors need to be examined. Deficiency symptoms may occur even where there is no shortage of the element in the soil. The element may be present but unavailable for the plant to use. Climatic conditions often complicate the issue further. For example, if there is a deficiency of boron, symptoms will appear in the dry season but may disappear when it is wet.

Another factor that is often overlooked is weed competition. Eucalypts, particularly seedlings and young trees, are very sensitive to weed competition. In plantations where weeds are plentiful, the weeds compete with the trees for water and nutrients and there may be dramatic reductions in growth rates and survival of the trees. Weed control is particularly important if the site has previously been a pasture.

According to some opinions, if trees less than 4-6m high do not have healthy foliage right to ground level, the problem is likely to be either weed competition or nutrient deficiency. This view obviously assumes that insect damage, disease, moisture stress (either too much or too little) and frost have been ruled out. It is important to eliminate these factors before deciding the problem is one of deficiency. If a deficiency is suspected, leaf samples can be analysed for their chemical content but the results are often far from conclusive as so little is known about the nutrient levels in healthy eucalypts.

Perhaps the easiest way to determine whether there are sufficient levels of a particular element is to apply that element to the site or to a sample plot and monitor its effect on the tree.

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## Urgent attention members
## Vacancy required to be filled

Our membership officer, Sue Guymer is retiring from this position. Sue has provided a wonderful job in this roll over the years, initially standing in temporarily. Sue has always been relentlessly punctual in providing feedback and registration of membership, and tending to the financial records. As well as providing advice to me with the group based upon her long standing experience within the Australian Plants Society and study groups. You have been the backbone of this group, and will be certainly missed. I appreciate your assistance and your time with running the Eucalyptus Study Group, and hope to catch up with you at future APS events.

Could any members interested in filling the position of the ‘membership officer’ please contact either Warwick or Sue. This position will be required to be filled so that the group can continue functioning.

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**On another note………..**

Articles, requests and questions are ~~most welcomed (actually they are~~ wanted).
Please send all correspondence to my;
email address; tallowwood@hotmail.com
or postal; PO Box 456, WOLLONGONG 2520

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## Membership

New members wishing to subscribe to the *Eucalyptus Study Group*, please fill out the following application and forward to Sue Guymer at;
Email: aitchguy@gmail.com
Postal: No. 13 Conos Court, DONVALE, VICTORIA. 3111

Annual membership costs are;

- $A 10 per year national members, newsletter mailed (black and white).
- $A 20 per year international members, newsletter mailed (black and white).
- $A 5 per year, national and international, newsletter emailed, full colour PDF.

All subscriptions can be mailed via a cheque (made out to the *Eucalyptus Study Group*) or payment made via direct deposit into the account listed below. For payments made via direct deposit, please add your name as reference.

Post address; Eucalyptus Study Group c/- 13 Conos Court, DONVALE, VICTORIA 3111

Bank details:
BSB No: **033-044**
Account No: **289 847**
Account name: **ASAGP Euc. Study Group**

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Application for membership to the *Eucalyptus Study Group*

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