

A close-up photograph of several bright red chili peppers hanging from a branch. The peppers are elongated and have a slightly wrinkled texture. They are attached to green stems that branch out from a central point. A piece of grey, textured bark is visible, partially covered by the green stems. The background is a soft-focus landscape with green foliage and a clear blue sky.

Featuring Mistletoes

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Contents

Editorial	Merle Thompson	3
Mistletoes in folk lore	Richard J Turner	4
Introduction	David Watson	5
Mistletoes <i>are</i> Australian Plants	Richard J Turner	7
The Mistletoe environment		
Mistletoe Botany and Geography		
Mistletoe and Fauna		
The concept of “parasite”		
Mistletoes and forest		
Research into mistletoes and the health of forests		
Mistletoes mimicking host foliage		
Mistletoe species of Australia		
Mistletoe flora of Western Australia	A N (Tony) Start	33
Mistletoes of Australia’s Top End	John Rawsthorne	37
Australian mistletoes on introduced and street trees	Richard J Turner	41
Anatomy of wood of a mistletoe plant	Richard J Turner	44

Photographs unless otherwise ascribed have been provided by Richard J Turner

Front cover: An undescribed *Amyema* species from the Pilbara, Photo Bill Muir.

Back cover: Box mistletoe, *Amyema miquelii*, on host tree Blakelys red gum, *Eucalyptus blakelyi*, at Peel near Bathurst, NSW, Photo Brian Walters

Australian Plants articles

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Editorial

Merle Thompson

In *Australian Plants* the expertise of individuals, both professional and amateur, within our societies, can be drawn on to enable their special interests and knowledge to be shared with members and subscribers. Dick Turner was asked to contribute an article to a ‘miscellaneous’ issue on mistletoes but his material was too extensive to do it justice hence this issue is devoted to that topic incorporating much of his work.

Dick, or more formally, Richard J Turner, trained as a forester at Sydney University and the Australian Forestry School in Canberra. During his long career with forestry within the NSW public sector Dick’s roles included searching for forested areas that could be included in State Forest tenure using aerial photography techniques, general forestry and fire fighting in eucalypt and cypress pine forests, managing an amenity nursery, chief extension officer and research.

During this time he was able to develop extensive knowledge about Australian plants in general with the study of mistletoes being a particular interest. This interest started early in his career. A sample of *Amyema miquelii*, Box mistletoe, which he collected at Royal Camp State Forest near Casino, in 1955 is held in the National Herbarium of New South Wales in Sydney. Another specimen from the same area and time was *Amyema congener subspecies rotundifolium*.

He also became very interested in birds and is known for his almost encyclopaedic knowledge of the birds of south eastern Australia and their calls. It was when he was involved with bird surveys in Yambulla State Forest near Eden in 1992 that the interest in mistletoes was re-kindled by observing birds foraging in mistletoe plants.

We have also included the work of some of Dick’s correspondents: David Watson of Charles Sturt University has provided a technical introduction, Antony Start from Western Australia has written on the mistletoes of that state and his interest in the interaction between mistletoes and fire and John Rawsthorne on the mistletoes of the “Top End”. Photos have been provided by the authors, their contacts and those of the editor.

The term “mistletoe” as used in this issue is the name for a growth form, not a family or families of plants. Mistletoes are hemi-parasitic plants that infect their host’s stems. In contrast the genera *Atkinsonia* and *Nuytsia* as well as many genera within the Santalaceae family are root parasites. “Hemi-parasitic”, which will be explained later, means the mistletoe plant is not fully parasitic as it obtains food by photosynthesis whereas in the animal kingdom some species, such as ticks, are fully parasitic.

Mistletoes in folklore

Richard J Turner

Mistletoes have a bad reputation and have been incorrectly labelled as a weed, but there is so much to be admired in this group of plants. They are almost a whole new environment on their own, with so many interesting complex interactions.

Mistletoes occur in the Americas and Europe. One species is so common in conifer forests in North America that some consider it a problem and that, as it is hemi-parasitic, it reduces the growth of wood on the tree trunk.

In Britain, in historic times, the Druids used mistletoe foliage in their ceremonies. It is easy to determine why this foliage was considered so special, because the host trees, European oak and beeches, were deciduous so that the still live and green mistletoe would be quite obvious, especially when the ground is covered in snow, hence its use as Christmas decoration. Another plant used in Christmas decorations is the Holly, *Ilex species*, which also has evergreen, bright, shiny green leaves with red berries.

In this issue the focus will be on two botanical families, Loranthaceae and Viscaceae. There is not consensus between our authors regarding the decision of some botanists to merge Viscaceae into the Santalaceae family.

While these families are not endemic to Australia but occur on other continents, there are a significant number of species which are endemic to Australia or predominantly occur in Australia and therefore are clearly Australian native plants.



Red berries on
an Australian
mistletoe: *Lysiana
exocarp* at Uluru
Photo: Jill Dark

Introduction

David M Watson, Professor of Ecology, Charles Sturt University

Mistletoes are a group of plants that defy the usual boundaries and compartments used to subdivide the natural world. As parasitic plants, they conform to many of the same patterns as parasitic animals, exhibiting a suite of life-history strategies to fool their hosts into supplying them with nutrients and water. But, as plants, they have green leaves, photosynthesize their own carbohydrates and support their own distinctive assemblage of animal associates.

Mistletoes are defined by their growth habit – aerial shrubby hemi-parasites – and are quite distinct from root parasites like sandalwood, twining herbaceous parasites like dodder, and holoparasites lacking chlorophyll like broomrape. In this issue, Dick Turner gives a timely summary of Australian mistletoes, introducing these enigmatic plants, summarizing his research on them and providing detailed information on some of the species. Through this issue, photographs complement the descriptive text, illustrating the wide variation in growth form, foliage and flowers of these intriguing native plants.

I first met Dick at the 1994 Birds Australia Congress and camp-out. I had just completed Honours, and this was my first conference. During the camp-out at Kapalga (adjoining Kakadu National Park), I recall Dick was equally comfortable identifying plants, birds and most other animals we encountered – even pointing out that the wings covering every surface in our sleeping quarters one morning had been shed overnight after the nuptial flight of the world's largest termites! It was several years later that I became familiar with Dick's research, his work on mistletoe – bird interactions helping to guide my thinking about these plants and the animals they depend on.

In discussing my research on mistletoes with people from a variety of backgrounds, I am consistently met with misconceptions. Most people think that they're introduced, they necessarily kill trees, and they're poisonous. All of these perceptions are incorrect. None of the 91 named mistletoe species in Australia are introduced – they are as Australian as Eucalypts and Banksias, with most species found nowhere else.

In terms of host mortality, if mistletoes necessarily killed the trees they infected, they would have died out long ago. While high numbers of mistletoes can have a detrimental effect on tree growth and may occasionally contribute to premature death, a few mistletoes in the canopy has a negligible effect on water balance and nutrient status of the tree, comparable to self-shading or browsing herbivores.

Finally, although some species in the Viscaceae are known to contain toxins, mistletoes of the more diverse Loranthaceae bear abundant and highly nutritious fruit, eaten by a variety of animals and even considered a source of bush tucker by many Indigenous groups.

One of the reasons for this bad press is the “P-word” – parasite. We are repeatedly told that parasites are bad, that we should give our livestock, pets, kids medication to eradicate them. So, by extension, parasitic plants must be bad, they must have negative effects on the plants they latch on to, and the habitats they “infest”.

As we learn more about mistletoes, however, it's becoming clear that they have a surprisingly positive influence, enhancing productivity, increasing nutrient inputs and boosting biodiversity. While some of these interactions are well known – involving pollinators and seed dispersers attracted to the showy flowers and nutritious fruit – others have only recently been uncovered. Thus, in the last few years we've learned that mistletoes replace their leaves far more frequently than their host plants, shedding their nutrient-enriched old leaves and completely changing the rate of nutrient inputs beneath infected trees. As well as increasing decomposition rates and boosting understory diversity, this bottom-up process drives increased insect availability, explaining why woodlands with scattered mistletoe plants consistently support more insectivorous birds.

I commend this issue to you and encourage you to learn more about Australia's mistletoes. But be warned – once you become “infected”, there's no turning back – you'll start seeing mistletoe everywhere and eventually you'll be correcting misconceptions and inoculating trees in your backyard!



Fruit of *Lysiana
spathulata*
Diamantina
Photo: Jill Dark

Mistletoes are Australian Plants

Richard J. Turner

Dick is a long-standing member of the Australian Plants Society NSW, president of Blue Mountains Group, chair of the Glenbrook Native Plant Reserve Trust and coordinator for the Capertee Valley Regent Honeyeater revegetation scheme. See also Editorial on p3.

The mistletoe environment

Mistletoes occur across the Australian mainland in many different ecosystems. They may be found in the Australian extremities from the far north to the southern coastline and from East to West. Most ecosystems could have a mistletoe as a component, from the mangroves to rainforests, tall eucalypt forests, sclerophyll forests, woodlands and shrub lands; from the summer monsoon to the winter rainfall: from high rainfall to arid zones of central Australia.

The hemi-parasitic mistletoe attaches itself to trees and shrubs. Amazingly mistletoes may be found as a hemi-parasite on another species of mistletoe and even on a root parasite. Mistletoe *Amyema mirabilis* attaches itself to a root parasite, sandalwood, *Fusanus acuminatus*. Grasses and smaller plants might be parasitised but by other species of plants which have a different family physiology.

Some mistletoes have preferences for certain species, or genera or families of trees or shrubs.

It is difficult to write a set of rules for occurrence of mistletoe because there are so many variations that one can only apply terms such as preference and tendencies. It is possible to nominate the mistletoes that are host specific, attaching to one or few hosts. One aspect to consider is that the host bark, and its anatomy and chemistry, must be acceptable to the mistletoe seed so that it can germinate and develop further.

It is claimed that mistletoes have proliferated with the clearing of land for agriculture. On the western slopes of the Great Dividing Range box mistletoe, *Amyema miquelii*, is obvious because of the different colour of foliage and distinct, darker shape of the mistletoe clump in the crown of the tree.

Similarly, *Amyema pendula*, drooping mistletoe, can be easily noticed and creates darker shapes in eucalypts across a wide geographic area.

One reason is the increased light on the crown of a tree because the trees are left or develop after land clearing for agriculture. It follows that there are fewer trees for any species of fauna carrying seed has fewer trees to visit and spread the seed of mistletoes.

The tree pictured below is a typical situation where bystanders see an obvious display of mistletoe plants on a lone tree isolated from a healthy forest environment. The tendency is for casual observers to consider that the mistletoes are taking over the host tree, and because it is exposed to the weather and may be subject to stock sheltering under the only shade in the paddock (and in this case a mob of Eastern Grey Kangaroos also regularly feed and shelter under it) the tree's health may be adversely affected. While the single tree has mistletoe, any fauna that feeds in mistletoe is likely to continue to visit the tree and this is the situation where the number of mistletoe plants may increase to the further detriment to the lone tree.

The casual observer might not perceive the seven dead mistletoe plants that died because they have a shorter life span than the host tree, or drought, or because spread of foliage shades the mistletoe plant. At the time of the photograph the nearest mistletoe was 250 metres away to the south, although a search was not made over the hill behind the tree, because the tree was on private property. The larger well developed mistletoe plants are on the northern aspect.



Ribbon gum, *Eucalyptus viminalis*, with 18 live weeping mistletoe, *Amyema pendula*, and seven dead mistletoes, near Lithgow.

Pastoral activity has created an imbalance in that is different from the original spacing between trees. In paddocks where potential host trees have been retained or have developed, stock might shelter in the shade. This leads to compression of the soil over the roots and any manure dropped at the site creates a different chemistry in the soil. Cropping activity with cultivation may disturb the root system and any fertilisation is a change to the original chemistry of the soil close to the tree.

Another change is from the different fire regime from that of Aborigines. Their use of occasional, mild fire probably discouraged much of the spread of seed and the establishment of small mistletoe seedlings. Wildfires are becoming fiercer with a higher flame height. These hotter fires kill mistletoe while eucalypts may recover.

The main carrier of mistletoe seeds is the mistletoebird, which has obviously survived the change in the environment. This small bird can only fly a short distance before expelling the seed, which means that there may be a concentration of mistletoe plants on fewer trees remaining in a paddock or road side.



Photo: Mark Fuller

Mistletoes are more susceptible to fire and drought than the host tree or shrub. It is possible to see many dead mistletoe plants on a host tree, indicating that the host has outlived the hemi-parasite, or it has succumbed to adverse conditions. As a tree grows upwards the new foliage may shade the mistletoe until it dies due to shortage of light.

Mistletoe Botany and Geography

The mistletoe families belong to the order **Santalales**, which consists of the families Olacaceae, Opiliaceae, Santalaceae and Loranthaceae, among others.

The family Loranthaceae

The plants in this family are Gondwanaland derived plants that evolved in the great land mass in the Southern hemisphere, along with Eucalypts, Casuarinas Acacias, Banksias and Eremophilas. There are 65 genera and 900 species in the world. The family is represented in Australia with 12 genera and 70 species, according to Volume 22, *Flora of Australia* in 1984. Most of its species occur in the Southern Hemisphere in keeping with their origin, and this is the largest family of mistletoe in the world.

Many genera have flowers in groups of three or triads. Also many have bright red flowers shaped so that honeyeaters can access the nectar. After maturing, the fruits are also sought by honeyeaters and other birds.

The family Viscaceae

Note: Viscaceae is variously regarded as its own family or as a subsection of the Santalaceae. Different botanical authorities recognise one or the other. PlantNET, the reference generally used by this editor, uses Viscaceae, as do many authorities. Guest authors retain their own terminology.

Another group of mistletoe is in this family with three genera and 14 species in Australia. Plants from this family can be found on trees such as Kurrajong, Wilga, and some rainforest trees. The interesting aspect of this is that these come from the north, so most species of this group occur near the tropics. While there is a strong correlation between the two families and the hemisphere of occurrence, there are exceptions.

In contrast with the family *Loranthaceae*, mistletoe flowers in the family *Viscaceae* are mostly small and there can be different leaf shapes, with some strap shaped. Some of the species within *Viscaceae* parasitise mistletoes from the family *Loranthaceae*.

It is interesting to note that “A Census of New South Wales Plants” 1916, by Maiden and Betche included both of these families in Loranthaceae, when the former was Director of the Botanic in Gardens, Sydney. They have been separated into two different families for many years, after closer study of genetic traits. Now DNA studies may find other similarities or differences.

In spite of this geography many people consider mistletoe as an imported weed. Clumps of mistletoe are often obvious along roadsides, in paddocks and reserves. As mentioned above, mistletoes do appear to be increasing, possibly because clearing has allowed more light on to the remaining trees. Once established the small bird, the mistletoebird, carries the seed from tree to tree. The fruit contains one seed, surrounded by a sticky, juicy pulp, which also makes it an item of bush tucker.

Rather than weed, that is, “a plant out of place”, it would be more appropriate to say that many people consider mistletoes as problems or pests which will be considered later.

While discussing geography, it is interesting that there are no mistletoes in Tasmania, nor does the mistletoebird occur in that state. Yet, Tasmania has Eucalypts and Acacias as with the mainland of Australia, where every mainland state has mistletoe.

The two mistletoe families are represented below. Top left is a member of Family Viscaceae Jointed Mistletoe, *Viscum articulatum*, epi-parasitic on the Loranthaceae species, Drooping Mistletoe, *Amyema pendula* subspecies *pendula*, which, in turn, was hemi-parasitic on Tallowwood, *Eucalyptus microcorys*.



Mistletoe and fauna

It is most likely that birds and mistletoes evolved together. In one specific study in 1984 in Australia 54 species of birds were recorded feeding in mistletoe plants. Of these species 23 were honeyeaters, such as the Eastern Spinebill. Olive-backed oriole and spiny-cheeked honeyeater, being larger birds, also consume mistletoe fruit. The painted honeyeater depends on mistletoe fruits.

The Mistletoebird has to be considered the first mistletoe specialist. In Eden, and in other study areas, when mistletoebirds were recorded there were mistletoe plants in sight. A paper on mistletoe in Yambulla State Forest has recorded an increase in the number of mistletoe plants – followed by an increase in the number of mistletoebirds sighted. The mistletoebird consumes the fruit which is so sticky that the small bird has trouble expelling the spent fruit and does so by perching sideways on the branch of a tree to wipe the fruit on the branch. And this has to be expelled within about 14 minutes. Thus, when one observes mistletoe, there may be other species of mistletoe, but all will be confined to a small area.



Female mistletoe bird with chick. Photo: Mark Fuller

Possums and gliders eat mistletoe foliage, because the hemi-parasites contain more nutrients than the host plant. With settlement and pastoral activities there are fewer mammals left in the reduced number of trees which may allow the mistletoe to spread at a greater rate than normal.

Insects in mistletoe

Because the mistletoe has higher plant nutrients and higher sap content the flowers are attractive to insects that pollinate the flowers. Amongst the insects visiting mistletoe flowers are butterflies, moths, flies, beetles and wasps.

Many moth and butterfly larvae feed on the foliage. Some of these have irritating hairs as a defence and are a serious threat to human skin, so it is wise not to disturb any caterpillar seen feeding on the leaves. Certain species of butterfly favour one species of mistletoe, for example, larvae of the Common Jezebel feed on mistletoe foliage attached to She-oaks.

Box mistletoe attaches to boxes and ironbarks and they have different species of moth or butterfly. Altogether, 25 species of butterfly depend on mistletoe plants.



Left: The Mistletoe Moth, *Comocrus behri*, curled into a defensive position,

Far left: Common Jezebel, *Delias nigrina*, the larvae feed on various species of mistletoe. This butterfly was photographed at Mount Wilson, NSW.

Birds find that this group of butterflies are distasteful and know not to feed on them.

Birds feed on the soft fruit and nectar from the flowers. There are insects in the bark of the mistletoe and host plant that are also attractive to foraging birds.

Weevils also are known to be associated with mistletoes. A larva of a species of weevil creates small holes in the haustoria, and when they leave as an adult there are a series of holes that may be used by butterfly larvae and their companion ants. See photo in next section.

The concept of “parasite”

Mistletoes are hemi-parasites because the new plant fixes itself to the xylem of the host tree to capture water and nutrients. Mistletoe plants obtain water and mineral nutrients from the host plant through this junction. Then the mistletoe is capable of photosynthesis, flowering and fruiting as a semi-independent plant. The host plant does not continue growth along the branch beyond the mistletoe, making it one of the reasons for dieback in trees (but a minor reason). Mistletoes are usually many branched, and mostly have opposite leaves.

The site where the mistletoe fixes itself to the host tree is called a haustoria, and, in the case of the box mistletoe, can develop into a large growth even to 25 cms across. The photograph below shows a piece of wood large enough to be attacked by borers (and be turned into bowls.)



A piece of *Amyema miquelii* haustoria, partly turned, showing borer holes. Grain of wood seen at top middle of image. A species of jewel beetle also bore into the wood of the haustoria.

Mistletoe foliage has a higher moisture content and higher content of plant nutrients than its host tree so it is attractive to leaf eating animals. Possums and other mammals graze on the leaves and the Greater Glider has been observed feeding on mistletoe foliage at Mount Wilson in the Blue Mountains of NSW. Plants within the family Loranthaceae are more commonly known to be used by insects.

In the case of a mistletoe attached to another mistletoe the plant is called an epi-parasite or a hyper-parasite. As part of this amazing world the second parasite has even more minerals and nutrients than the host mistletoe or host tree or shrub!

Mistletoes are dicotyledons so attach to other dicotyledons, not to monocotyledons such as grasses.

Health of host trees

Some diagnoses of death of trees is simple and straightforward – too much water, or drought or herbicide. When trees and shrubs are under stress there may be cracks in the bark or other failures that allow insect attack. Often gardeners state that borers killed their shrub, especially a wattle, but it is more likely to be the case that the shrub was ageing or suffering some stress and insect attack follows.

The presence of mistletoe is more complicated. The same principle may be involved but there are many examples discussed below which indicate large numbers of mistletoes on the one shrub or tree which can be detrimental.

The claim is often made that an attack of mistletoe “infection” has killed the host tree. A tree observer will have noticed a dead tree with numbers of dead mistletoe and assume that the mistletoe killed the tree.

Tree surgeons should look for reasons for an unhealthy tree. One of the first symptoms to investigate is any change in drainage. Relic stands of trees left in road reserves and stock routes mostly have items of interference such as roadworks. The aim is to create table drains to run water off the road, which means into the surviving trees. There may be a chemical change along with the excess water and road materials. Eucalypts are sensitive to changes to the water table which means addition of soil over their root zone can downgrade their health.

The next important consideration is the application of herbicides which may have been intended for a roadside weed. Examples of dead and dying trees can be sighted by the road and adjoining paddocks. Even if the tree or shrub has not been killed outright, it might still be suffering from the herbicide. Sometimes this can be recognised by discoloured or distorted foliage but obviously can be difficult to diagnose if the treatment was applied some months ago. However indiscriminate use of herbicide is very common and widespread.

If insect attack involves a leaf eating or sap sucking insect the outward symptoms can be detected. Wood borers may be present and leave no external signs even though they are active under the bark. It is agreed

that a tree suffering consistent insect attack is an unhealthy tree, but the presence of mistletoe on a tree is not as clear.

Grey Box (*E. moluccana*) in the western suburbs of Sydney suffered attack from sap-sucking lerp insects after the millennium drought. Some trees died but the most interesting part was that the mistletoe remained untouched on the trees.

Mistletoes have a shorter life span than most of their hosts, for example, the mistletoes on eucalypts may live for 10 to 20 years while the host may survive for hundreds of years. If the host tree grows over the mistletoe, then the parasite suffers from shortage of light.

In the forests near Eden where the numbers of mistletoes were counted by tree species, there were always some dead mistletoes in the crown of the tree and dead mistletoes on the floor of the forest. Some trees had as many as 14 mistletoe plants in the canopy. There is no doubt that energy and growth is being diverted to the hemi-parasite rather than the host eucalypt.

The question remains – at what stage does the number of hemi-parasites on a host plant seriously affect the health of the host tree or shrub?



A kurrajong, *Brachychiton populneus* that appeared to have died during the millennium drought in 2007 in the Capertee Valley in NSW had lost all its foliage, and so the mistletoe died. After a shower of rain the host kurrajong recovered and re-sprouted as can be seen by the sprouts on the upper trunk.

Mistletoes and forests

The research on forests near Eden described below showed an increase in mistletoes but no mention is made of any deleterious effect in the health of the forest. Indeed it is considered that mistletoe is part of the forest and the biodiversity it supports.

Photosynthesis is an efficient process when water from the leaf and carbon dioxide from the atmosphere absorbs energy from the sun to form carbohydrates. These molecules are used to increase growth of the tree or shrub and form cellulose to strengthen the stem of the plant. It follows that if another plant is diverting some of these ingredients for its own use rather than used by the host, then growth of the host will be reduced.

Over 260 hectares of mixed species plantations have been planted on various properties in the Capertee Valley over twenty years. Prescriptions for the plantings were to match any existing habitat and this was so successful that box mistletoe appeared in small trees within 6-7 years. Mistletoebird nests were found in the growing saplings. By 2015 a planting of 2010, surrounded by natural bush, produced an earlier result with mistletoe attaching in five years and finches nesting under the clump.

In 1955 in the ACT some red box, *E. polyanthemos*, were measured and were found to have suffered loss of diameter growth due to presence of mistletoe.

Forests NSW have established 26,000 ha of eucalypt plantation since 1994. Mistletoe had never been a problem in eucalypt plantations, but the regular health inspections revealed two species of mistletoe in plantations north of Grafton. Six species of eucalypt were involved but the mistletoes were mostly on the smooth barked spotted gums that were 3-10 years old. Previously 20,000 ha of plantation on the north coast had not been affected by mistletoe, still in areas of predominantly summer rainfall. When growth of the young trees is reduced by the presence of mistletoe one wonders whether climate change is having an influence with higher temperatures and increased summer rainfall. Another point to consider that these plantations are a monoculture on sites that were previously agricultural land.

Sandalwood has been planted in northern Western Australia which is of double interest, because the small tree is a root parasite. Growers are concerned about large numbers of the mistletoe *Amyema mirabilis*.

Research into mistletoes and the health of forests

Eden

A series of experiments were planned within Yambulla State Forest south and west of Eden, New South Wales. The trials of different treatments involved logging and burning, and it was soon discovered that the mammals returned readily so surveys of birds continued for longer. After the logging a third of the trees were retained. These trials were conducted over an extended period from 1989 to 2006. The initial report was prepared in 1990.

This research involved studies within an area of 1,500 hectares in 180 sample plots. In this study there were 12 species of eucalypt, two species of mistletoe and 89 species of birds. Observation aroused awareness that birds frequently inhabited mistletoe plants.

There were 41 birds in flowering mistletoe compared with eleven birds seen in flowering Silvertop Ash, which means that more birds were seen in mistletoe than in eucalypts. This also indicates that mistletoes are an important part of the biodiversity in forests.

A follow-up survey in 2004/06 showed an increase in numbers of mistletoe plants to nearly triple the first count and the trees with mistletoe increased by one third. The tree with the most mistletoes and the highest increase was yertchuk, *Eucalyptus consideriana*. In nine



Bass Road in Yambulla State Forest, near Eden South Coast, NSW, with logged forest on the left and unlogged forest on the right.

of the plots being surveyed mistletoebirds were observed, and in every plot where these birds were recorded there were mistletoe in the trees.

There were more mistletoes developed on the seed trees and growing trees in the logged blocks, no doubt because more light was available to the tree left to develop and produce the next forest.

Just as important was the observation that there was a change in trees carrying mistletoe, with some losing the hemi-parasite while other trees gained more plants. One tree was found to have 14 plants of weeping mistletoe, *Amyema pendula*, two dead mistletoe of the same species, one *Muellerina eucalyptoides*, and two dead mistletoes of this species, possibly showing an upper limit, because the tree was not healthy. Other dead mistletoe plants were found on the ground under trees showing that trees can overcome the presence of mistletoe, while excess numbers may kill the host tree.



Amyema pendula,
Drooping Mistletoe
Photo: Jill Dark
Woodford NSW

Barrington Tops-Gloucester-Dungog

In 1992 bird surveys were conducted in 150,000 hectares of State Forests, National Forest and National Park, from Stewarts Brook across Barrington Tops to Dungog as part of an Environmental Impact study. This area was more diverse than the forests at Eden with 18 species of eucalypt, other myrtles and some rain forest trees and six species of mistletoe and 128 species of birds. Also, the area of this study was ten times greater than the Eden study. In spite of this diversity, there were fewer mistletoes per tree and fewer trees per hectare with mistletoe than in the Eden study. Some of the forest had never been logged, while much of the forest had been logged for 150 years. Mistletoe and

its relationship with birds was studied in 155 out of the total of 280 plots of the whole study.

With regeneration of mistletoe there were more mistletoe on the seed trees and growing trees in the logged areas – and some of the areas had been logged many times over the last 100 years. This can be explained by the greater availability of light in the logged areas. There was a statistically significant difference as with the results obtained in Yambulla State Forest near Eden.

Spotted Gum, *Corymbia maculata*, and Rough-barked Apple, *Angophora floribunda*, were in flower during the survey during January 1992. In one Spotted Gum there were eight Noisy Friarbirds and one Scarlet Honeyeater, making a total of nine birds in flowering myrtles. Mistletoe *Amylotheca dictophleba*, or Rainforest Mistletoe, was in flower with its spectacular red flowers. There were 16 individual birds of six different species in mistletoe, again, outnumbering those in flowering eucalypts (and Angophoras).

A count was made of the plots where mistletoebird was recorded and in 65 plots this small bird was observed. In one instance a bird was observed gathering cobweb for a nest.

This was the sightings of six observers over the whole project. The point of recording mistletoebird was that only two of the plots had no mistletoe, strongly indicating that the small bird is able to locate trees carrying mistletoe.

Other interesting features in this study were that some species of common trees did not carry any mistletoe plants such as, Black She-oak, *Allocasuarina littoralis*, Messmate, *Eucalyptus obliqua*, and Red Bloodwood, *Corymbia gummifera*. There were 0.4 host trees and one mistletoe plant per hectare. This is an average over all of the plots involved, but, in fact, the occurrence of mistletoe was in clumps or groups leaving substantial areas of forest with no mistletoe.

Morisset, Watagans and Pokolbin forest areas

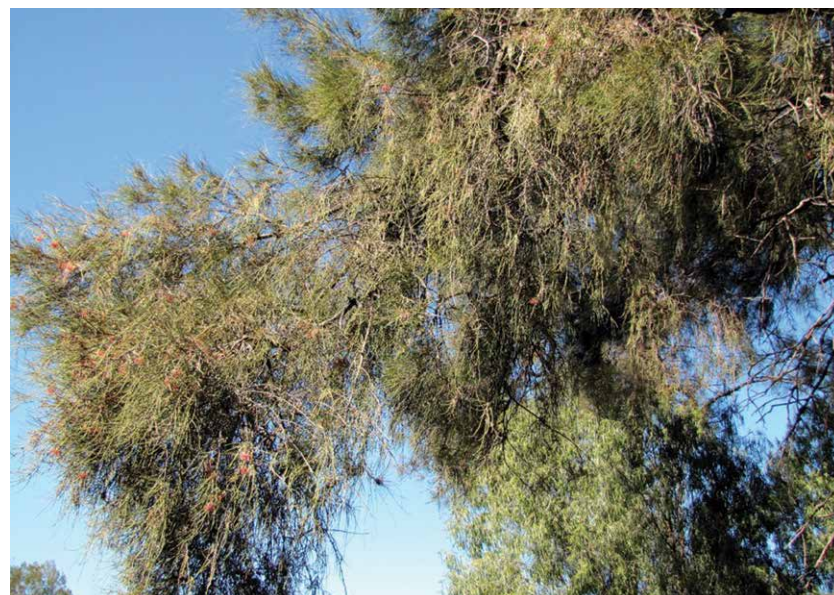
In 1994 an environmental impact study was conducted in State Forests of the Morisset, Watagan Mountains and Pokolbin areas of the Hunter River valley. 220 plots were located in seven different forest types. There were 22 species of eucalypt, two angophoras, Turpentine and Forest She-oak, and seven species of mistletoe.

Across all the forest there were 0.5 trees per hectare with mistletoe and 1.08 mistletoes per hectare, also fewer than the forests at Eden. Seven species of bird were recorded in mistletoe with 11 host trees out of the 22.

Mistletoes mimicking host foliage

Some mistletoes mimic the foliage of their host plant. This phenomenon is not just a simple copy of the majority foliage. The most probable explanation is that if the foliage of the mistletoe can imitate the foliage of the host plant it reduces the possibility of grazing by possums and other mammals that prefer mistletoe foliage to the host eucalypt or other species of host. Over millennia the parasite evolves the most successful foliage and complies with the host.

Like all other situations, this is a tendency and not a rule. The image below shows a mass of foliage of belah, *Casuarina cristata*, between Moree and Narrabri in NSW, but it is actually three species of plant. Attached to the belah are two species of mistletoe, *Amyema cambagei* and *A. linophylla* mimicking the foliage of the host tree. Some mistletoe flowers can be seen on the left hand side.



In a completely different environment, such as the mangroves growing in salt water, mistletoes have rounded and fleshy leaves that are similar to the host plant.

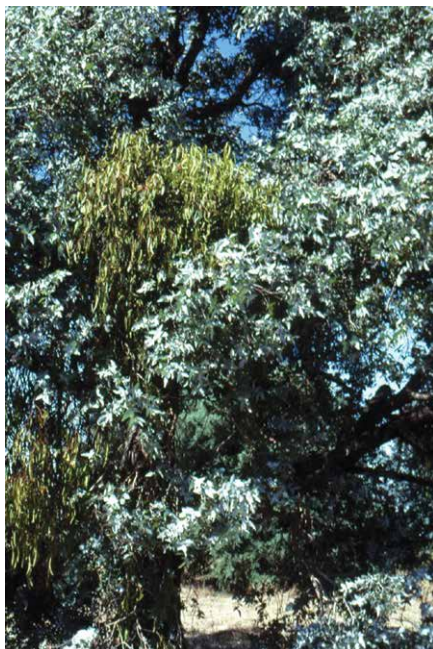
Grey mistletoe, *Amyema quandang*, has grey lance shaped leaves that are similar to many of the wattles where they are found.

Two different species have leaves that are long and slightly lanceolate and falcate quite similar to their host tree – one of the eucalypts.

The image below is drooping mistletoe, *Amyema pendula*, with eucalypt like foliage, so is selected for that reason, but is actually attached to a green wattle, *Acacia decurrens*, beside the road near Mittagong, NSW.



This image is an argyle apple, *Eucalyptus cineria*, planted near the dog on the tucker box, Gundagai, NSW. The host eucalypt in this case has opposite glaucous leaves which is a complete contrast to the olive-green foliage of the two plants of drooping mistletoe, *Amyema pendula*.



Mistletoe species of Australia

Family Loranthaceae

This family group has the most genera and species.

Amyema

The derivation of the word is from Greek, a, “not”, myeo, “I point out anew”, or “initiate”, referring to the fact that earlier classifications had fewer generic names. In other words – a genus previously not known. Species within this genus may be found in a restricted area or over huge tracts of the continent, and may be found at the extremities of Australia.

Another marvel is the occurrence of a specific species maybe on a single host species or on over 900 different host species.

Across the Pacific Ocean there are 100 species but of 36 in Australia, 32 are endemic. Colours of flowers are mostly red or red-brown, but there are also green, yellow, orange, pink or golden. The aerial shrubs may be pendulous or upright. Fruits are edible and are mostly red. This mistletoe might be most commonly observed by casual onlookers. If closer to the eastern coast on peppermints and some stringybarks and silvertop ash the mistletoe would be *A. pendula*, with the leaf being similar in shape to the host eucalypt, but a slightly different colour in a darker clump. On the western slopes with boxes and ironbarks the mistletoe is likely to be *A. miquelii*, the box mistletoe.

Many plants from this genus were used in Aboriginal culture.

Amylothea also comes from the Greek, *amos*, “starch” and *theka*, “seed box”, referring to the seeds. There are two species in Australia with these and others extending to New Guinea and New Caledonia.

Amylothea dictyophleba, Brush Mistletoe, occurs along the coast from the tip of Cape York in Queensland and as far south as Nowra in New South Wales. The flowers are mostly red, growing on many species of rainforest trees. In the Watagan Mountains and near Glenbrook, Blue Mountains NSW this species has been seen on Turpentine, *Syncarpia laurifolia*.

Amylothea subumellata, occurs in northern Queensland in open forest and growing on she-oaks, a few myrtles and grevilleas.

Benthamina alyxifolia, Shiny leaf mistletoe. occurs from Newcastle in NSW to Gympie in Queensland on rainforest trees. It is one of the three genera that are monotypic, which means that there is only one species in the genus. This species has bright, red flowers and has runners along the branch.

Ceccaria obtusifolia, occurs in the Cape York Peninsula in Queensland but also in the Philippines, New Guinea and the Solomon Islands. The generic name displays the ingenuity of botanical names because the plant was called after Cecil Errol Carr, a botanist from New Guinea. Host trees are from the family *Myrtaceae* in rainforest.

Dactylophora novaeguineae, occurs in far north Queensland and on to New Guinea. The plant has large, shiny green leaves and masses of flowers on dry rainforest trees.

Decaisnina. This group has 30 species from the Philippines to Tahiti, but seven species in Australia. All are restricted to the northern most parts of the continent. The generic name is derived from a French botanist.

Dendrophthoe also comes from the Greek for “tree” *Dendron*, and *pthoe*, “corruption”, so named because of the hemi-parasitic nature of the plant. Most species of this genus are in India and the rest of Asia, with some in tropical Africa and in Australia, seven are in the northern extremes. The flowers have five petals and the plants have runners along the branch of the host.

Diplatia, also comes from the Greek, *diplosios*, “double” or Greek *di* for “two” *plateia*, referring to the two bracts surrounding the flower. The species have petals free to the base of the flower.

Lysiana, from the Greek, *lysios*, or *lyo*, “set free”, another reference to the separation from the Genus *Loranthus*.

Muellerina was named after the botanist Baron Sir Frederick von Mueller who was Government botanist for Victoria and was involved in botanical expeditions. *Muellerina* species have external runners along the branch between the plant and the host tree, so, if one wishes to remove the mistletoe, the runners must be removed also.



Muellerina eucalyptoides,
Capertee Valley NSW
Photo: Dick Turner

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Conference Theme: *Grass Roots to Mountain Tops* is depicted in our logo with *Themeda*, the grass roots, and the recognisable mountain tops shaping the map of Tasmania.

Dates: 15–19 January 2018

Venue: Wrest Point in Hobart, with wonderful conference facilities and stunning views of the Derwent River but most importantly a flat and navigable site with our own space for lectures, displays, meeting places, happy hour and dinners.

Program: The program is being developed and will contain all the traditional sections, lectures and social events.

Pre- and post-conference Tours: A selection of tours is being planned to King Island and to alpine and rainforest areas of Tasmania.

Pre-conference tour – Hobart and surrounds. If you choose to go on this tour, one of your day trips will be to Mount Field National Park, one of Tasmania's most loved national parks. The visit will include stops for subalpine and alpine flora and an easy walk around Lake Dobson to visit the Pandani Grove.

More detail is available at www.apstas.org.au/conference and this site should update as planning proceeds.

Some species of Loranthaceae mistletoe

***Amyema linophylla*, Buloke or Bulloak or Lone Leaf Mistletoe** has white tomentose foliage with terete leaves to 12 mm long and clumps of red flowers. The main occurrence is from South Australia across New South Wales to South East Queensland. There are two outlier occurrences with the one in Western Australia on a species of casuarina and the other in coastal Queensland.



Amyema linophylla,
Capertee Valley NSW.
Photos: Carol Proberts

Amyema maidenii, Maiden's Mistletoe or Pale Leaf Mistletoe occurs across a huge area of all mainland states except Victoria with its white or brownish foliage and yellow or green flowers. It grows on arid or semi-arid acacias such as Brigalow, *Acacia harpophylla*, Mulga *A. aneura*, *A. victoriae*, and Gidgee, *A. cambagei*.



Photo: Jill Dark,
Alice Springs NT

Amyema miquelii, Box Mistletoe, occurs across most of Australia except for the Cape York Peninsula. With the widespread occurrence, it grows on numerous eucalypts, some wattles She-oaks with 125 host species recorded. It appears to have the largest haustoria, often a large, black hump between the mistletoe and its host tree.



Photographed
on Rosewood,
*Heterodendron
oleifolia*.

Photo: Brian Walters

Amyema nestor: A Western Australian species with the indumentum dense and often golden to russet on young parts and showy, orange to red flowers arranged in 2 parallel rows of 3.



Photo: Jill Dark, Meekathurra.

Amyema quandang, Grey Mistletoe, was reported by Major Mitchell in 1848 during his explorations in western New South Wales. It has white tomentose lanceolate leaves and red flowers, occurring in all mainland states, but with strong presence in arid and semi-arid eastern Australia. Host trees include Mulga, Gidgee, Brigalow, Western Myall and other wattles.



Photo: Jill Dark,
Diamantina.

***Dendrothoe glabrescens*, Orange Mistletoe**, occurs across a wide area from the Kimberleys in W A, Northern Territory to Cape York then extending southward to Tumbarumba in New South Wales. It grows on many trees in open woodland or on the edges of rainforest.



Photo: Jill Dark, Riversleigh.

***Dendrothoe vitellina*, Long-flowered Mistletoe**, is mostly found along the east coast. It has erect yellow flowers. While it grows in open forest, mainly on the family Myrtaceae, it has also been recorded from twelve species of introduced trees. This was one of the species painted at the arrival of the First Fleet in Sydney.



On *Hakea francisiana*
at Castlereagh NSW
Photo: Brian Walters

***Lysiana exocarp*, Harlequin Mistletoe**, occurs across all eastern states. It can be found in arid and semi-arid lands on many species of trees such as legumes, casuarinas, eremophilas and also on other mistletoes.



Photo: Jill Dark, Riversleigh



Lysiana murrayi, called Mulga Mistletoe, because that shrub is its main host, occurs across the arid areas of mid Australia. Other acacias are recorded as host shrubs along with eremophilas.

Photo: Jill Dark, Uluru.

Lysiana spathulata is another northern Australian extending as far South as central Australia, but its strongest presence is the Northern Territory. There are two subspecies growing on wide variety of hosts in woodlands, mainly acacias but some legumes, cypress and eucalypts.



Photo: Jill Dark, Diamantina.

Lysiana subfalcata occurs in northern NSW, Queensland, NT and northern WA in sclerophyll forest on a variety of hosts.



Photo: Jill Dark, Diamantina NP.

The family Viscaceae

This family is mainly one of the Northern Hemisphere with *Viscum album* being the mistletoe worshipped at Christmas time because it is evergreen on a deciduous tree in winter. *Arceuthobium species* can cause damage in coniferous forest in Northern America.

There are three genera in Australia within the characteristics of mistletoes. The fruits of some species are poisonous to humans, while others are being investigated for chemical properties.

Korthalsella is named after a Dutch explorer/botanist from the East Indies. This genus occurs from Hawaii, Australia New Zealand, Indonesia, Asia and East Africa. There are eight species in Australia. The genus only has scale-like foliage.

Nothothixos, named from the Greek, *notos*, “the back” and *thixos*, “touching”, because this genus is parasitic on other hemi-parasites. Half of the species in this genus occur in Australia, with these four species mostly in eastern Australia.

Viscum is the Latin word for mistletoe. This genus is widespread with about 100 species occurring from Europe and Asia, Africa and Australia. Again, there are four species in Australia.

***Nothothixos cornifolius*, Kurrajong Mistletoe**, occurs in eastern Australian, in New South Wales and Queensland and New Guinea. Hosts are mostly Kurrajong and other family Sterculiaceae.

***Nothothixos subaureus*, Golden Mistletoe**, is also endemic to Australia, with a golden tomentum as recognised in the common name. It occurs from

Kurrajong, *Brachychiton populneum*, with about 12 mistletoe, *Nothothixos cornifolius*, in Capertee Valley, August 2015



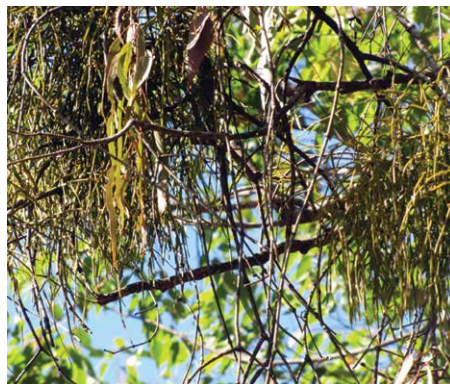


Centre of image *Notothixos subaurea*, golden mistletoe, host tree, *Casuarina equisetifolia*, horse-tail she-oak, on Nambucca River estuary.

Mallacoota in Victoria through to Cape York Peninsula in north Queensland. It may attach to rainforest trees or she-oaks, but is a spectacular example of a Santalaceae mistletoe attaching to a family Loranaceae mistletoe with records from 16 different mistletoes.

***Viscum articulatum*, Jointed Mistletoe**, is common from the Kimberley Ranges in Western Australia, with some in the Northern Territory and the coasts of Queensland and New South Wales, as well as New Guinea and southern India and China. As the common name indicates, the plant is leafless, appearing quadrangular. It also attaches to other mistletoes and some myrtles but especially interesting is the host trees of *Exocarpus* spp, the native cherry, a root parasite.

Shown right are two species of mistletoe on a tallowwood, *Eucalyptus microcorys*, on Congarinni Road between Macksville and Bowraville NSW in August, 2015. Drooping mistletoe, *Amyema pendula*, was the first mistletoe and the epi-mistletoe was jointed mistletoe, *Viscum articulatum*.



Mistletoe flora of Western Australia

A. N. (Tony) Start. Research Associate, Western Australian Herbarium

Western Australia (WA) occupies almost a third of the landmass of Australia with habitats as varied as Tropical savannas, mangrove forests and rainforest patches, through arid spinifex deserts and mulga woodlands to wet and dry sclerophyll forests, woodlands and heaths in the south. Not surprisingly, it has a rich and varied mistletoe flora, but, surprisingly, in the south west, in the family Santalaceae, there are only two mistletoe taxa in one genus (*Korthalsella*) while in the Loranaceae there are only 12 taxa in two genera (*Amyema* and *Lysiana*), most of which are a subset of the much richer mistletoe flora of adjacent more arid areas. This relative paucity of mistletoes in the southwest is particularly pronounced in the forests where, only one species infects forest trees in the dry sclerophyll Jarrah forest and none infect trees in the tall, wet sclerophyll Karri forest and none at all occur in the Warren bioregion which is the wettest and heavily forested part of the southwest, lying adjacent to the western south coast. In contrast the wettest bioregion in the Kimberley, the Northern Kimberley, has the highest mistletoe diversity as well as the highest number of rare and endemic species of any bioregion in the State.

While the south west has the least diverse mistletoe flora, the richest is in the Kimberley, where in the Loranaceae there are 22 taxa in five genera and in the Santalaceae three species in one genus (*Viscum*). (*Viscum* and *Korthalsella* were formerly in the Viscaceae but that family has now been incorporated in the Santalaceae). Another feature of the Kimberley is the presence of two genera that are absent from the rest of WA. They are *Decaishnina* and *Dendrophthoe*; both of which occur across northern Australia and are more diverse in PNG than Australia and, in the case of *Dendrophthoe*, throughout South East Asia. Their ancestors were probably fairly recent arrivals in Australia.

The southwest and the Kimberley are separated by a vast arid zone, a large part of which is desert where the vegetation is dominated by spinifex (*Triodia* spp.) grasslands although there are also large areas of Mulga (*Acacia aneura*) woodland and other vegetation types associated with, for example, extensive salt lakes and the massive limestone sheets of the Nullarbor plain. Perhaps surprisingly, these arid regions harbour a mistletoe flora that is almost as diverse as that of the Kimberley although many of the species are different. For instance, in the Pilbara and adjacent deserts there are 16 mistletoes and the arid, eastern part of southern WA contains 20 mistletoes including eight on the Nullarbor!

However, the richest arid zone mistletoe flora occurs in association with mulga woodlands although not necessarily infecting Mulga itself.

Just as WA's flora is diverse, so are the forms. The smallest species, *Korthalsella arthroclada* is seldom more than 4 inches (about 10 cm) long and often half that. It has minute green flowers that are probably pollinated by small insects. The fruits are not much more than 1 mm long and the single sticky seed appears, like its New Zealand counterparts, to be ejected by hydrostatic pressure. Being so small the seeds don't travel far and often fail to infect adjacent canopies. Not only is this the smallest, it is also one of the rarest species, being known only from *Melaleuca* hosts around a small collection of lakes at one location in a farmland setting.



Photo: Kevin Thiele

While that is a small and unspectacular plant, many of WA's mistletoes are large and showy. Elsewhere in this Volume, Dick Turner has described how many have red flowers that attract bird pollinators. That holds true in WA where it is also true that many have red fruits that attract birds.

Among the most spectacular are some of the Kimberley species like *Decaisnina angustata*, with brightly coloured inflorescences that look like tooth brushes.



Decaisnina angustata, Mitchell River National Park, Photo Bill Muir

Another spectacular one is *Amyema sanguinea* with masses of crimson flowers, each off-set by a velvety black stigma. This colourful northern species comes with two varieties, each with spectacular flowers; but they have another interesting property. The haustorium sends out root like structures that creep along the host's branches. They are called epicortical roots (epi = outside or above and cortical = skin or bark). From place to place these epicortical roots send 'sinkers' into the host's branch. Once they have established a connection to the hosts xylem, the sinkers can send out new leafy shoots and, if intervening section of the epicortical root dies, as it usually does in time, the mistletoe will have given rise, vegetatively, to a new plant. As mistletoe seeds are usually distributed by birds, this can lead to the astonishing presence of *A. sanguinea* growing from the undersides of huge branches, where no bird could possibly deposit a seed.



Amyema sanguinea var. *sanguinea* in *Eucalyptus victrix*, Millstream National Park, Note the epicortical root that gave rise to this plant on the underside of the host branch.
Photo Antony Start

No account of WA's mistletoes could be complete without mentioning fire. Almost all mistletoes are killed if scorched and most of WA is prone to bush fires. What's more, mistletoes have no means of surviving within a burnt area. They seem to be unique in Australia's flora in this regard. All other plants that live within fire-prone areas can regenerate from soil-stored seed banks (like most Acacias) or by re-sprouting, either from lignotubers or dormant buds under protective bark. Even orchids store tubers safely underground but mistletoes can do none of these things. They can only regenerate from fresh seed deposited on a suitable host twig but fire destroys the fruit as well as the rest of the plant.

So, mistletoes can be eradicated by fire and can only re-colonize a burnt area if birds import fresh seed from nearby un-burnt places and mistletoe birds usually hang about where there is food – i.e. fresh mistletoe berries. They are not philanthropists and don't travel far into sterile burnt areas to 'plant' mistletoe seeds. Sadly, today's fires often burn thousands of hectares and WA is losing its mistletoe flora from vast tracts and with them go the butterflies and many other insects whose larvae depend on mistletoes for food. Even the faithful mistletoe bird is doomed locally when that happens.



Amyema sanguinea
var. *pulchra*, Mitchell
River National Park,
Photo Alan Lowrie

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Notes on the mistletoes of Australia's Top End

Text and images by John Rawsthorne

John has studied mistletoe-frugivore interactions across a range of temperate, arid and tropical systems. John currently lives in Darwin, Northern Territory.

Introduction

Mistletoes, with their aerial parasitic habit, have long intrigued biologists. Indeed, the first plant mentioned in Charles Darwin's *Origin of Species* is mistletoe. Our fascination with these plants continues in this volume. Dick Turner has provided a wonderful account of the mistletoes of south-east Australia elsewhere in this issue. These notes provide some comparison and contrast between the mistletoes of the south east and those of the western Top End of Australia.

Mistletoe diversity in the Top End

Of around ninety species of mistletoe recognised in Australia, about one quarter have been recorded in the region north of Katherine, including Kakadu National Park and parts west thereof and the Tiwi Islands. As with other parts of Australia, in the western Top End the Loranthaceae (at least 20 species of 4 genera, of which at least 4 species are common in suitable habitat) are more diverse and common than the Viscaceae (2 species of the genus *Viscum*, neither common).

The mistletoes of the Top End are present in four main habitats, discussed below.

Monsoon Vine Forest

Monsoon vine forests are rain-forests that occur in the wet/ dry tropics. They are typically highly patchy, often related to low-lying areas that retain standing water in the dry season, and comprise a small proportion of total vegetation. Monsoon forests have much greater diversity and structural complexity than nearby savanna woodlands and grasslands.



The diminutive Mistletoebird processing *Dicaeina signata* fruit—the bird has swallowed the seed and is mandibulating the skin in order to squeeze further pulp from it before it is discarded.

Decaisnina (discussed in more detail below) is the most common mistletoe genus of monsoon vine forests, but *Amyema villiflora* and the less common *A. haematodes* are also largely restricted to monsoon vine thickets, both coastally and inland. These monsoon forest mistletoes exhibit wide host ranges, including *Alstonia*, *Melaleuca*, *Ficus*, *Barringtonia*, *Mallotus*, *Terminalia* and *Pouteria* spp.

One viscaceous mistletoe, *Viscum articulatum*, is also mostly found in monsoon forest in the region. This mistletoe is commonly found as a nearly leafless epiparasite on other mistletoes.

Mangroves

There are two mistletoe species – *Amyema mackayensis* and *A. thalassia* – in the Top End that are restricted solely to mangroves. *A. mackayensis* exists on a range of mangroves, primarily *Rhizophora* and *Avicennia*, while *A. thalassia* (at right) is limited to *Avicennia* mangroves in the NT. Both mistletoes are locally common in the Top End. Limited data indicate that these mangrove mistletoes blossom at most times of year, but have ripe fruit during the late wet and early dry season.



The subtly coloured blossoms of a mangrove mistletoe, *Amyema thalassia*, Ludmilla Creek, Darwin NT.

Sandstone Escarpments

There are several species of mistletoe found in dissected sandstone escarpments in the south and east of the region, two of which are found only in this habitat within the region. *Dendrophthoe acacioides* is typically found on the crowns of these escarpments on *Acacia* spp., while *Amyema tridactyla* parasitises a range of host trees and shrubs, especially *Calytrix* spp. Neither mistletoe is common, although both may be found on sandstone isolates as well as larger sandstone escarpment areas. Fruit is present in the early dry season.

Savanna Woodland

Savanna woodland is typically open with a grassy understory, with *Eucalyptus* spp. the most common trees. Such woodland is often burnt, and mistletoes are more susceptible to fire than their hosts. Regular

understory fire keeps mistletoe levels lower than otherwise, and the lowest-hanging mistletoes do not survive grass fires. More intense fires associated with invasive gamba grass may kill mistletoes in savanna woodlands as the gamba grass spreads, although the woodlands themselves are also under threat from gamba-related intense fires.

Common mistletoes of savanna in the region include *Amyema sanguinea* and *Dendrophthoe odontocalyx*, with several other Lorantheaceous mistletoes also found less commonly. Hosts include predominantly eucalypts along with a range of other trees.

Viscum whitei is an uncommon mistletoe of the savanna that is most often found as an epiparasite on other mistletoes.

In the savanna most mistletoes have ripe fruits available in the early dry season, although *D. odontocalyx* may provide fruits and flowers right through the late dry season.

Decaisnina (Loranthaceae) – the Top End's common mistletoe

Decaisnina signata is perhaps the best known and most commonly seen mistletoe in the Top End, occurring regularly on parkland trees in suburban Darwin including *Alstonia*, *Melaleuca* and *Ficus*, as well as monsoon vine forests across the Top End.



The showy flower of *Decaisnina signata*, providing a year-round nectar supply.

While many Lorantheaceous mistletoes are host foliage mimics, *Decaisnina* foliage does not closely resemble that of any of its major hosts, and it parasitises a wide variety of hosts with different foliage and bark characters. The strikingly coloured red and green flowers provide year-round nectar for birds including Brown (Lichmera indistincta) and Dusky Honeyeater (Myzomela obscura), while the foliage is the larval food plant for butterflies including Scarlet Jezebel Delias argenthona and Northern Purple Azure Ogyris zosine.

Decaisnina provides a year-round supply of fruit, and the main fruit consumer appears to be the Mistletoebird (Dicaeum hirundinaceum). The infection pattern of *Decaisnina* on host trees appears to be more highly aggregated than typical infection patterns of mistletoes in

Decaisnina signata germinated seed with holdfast attached to *Ficus* branch. The fruit skin is still attached to the seed, indicating that this seed was discarded rather than swallowed and gut-passed.



southeast Australia, with single host trees bearing heavy mistletoe loads while nearby potential host trees remain mistletoe-free. The Mistletoebird typically discards the relatively large seeds of *Decaisnina* fruits in or under the host tree attached to the skin of the fruit. This may lead to a more contagious seed rain by the Mistletoebird than that for smaller-seeded mistletoes, where seeds are typically swallowed with the fruit pulp then defecated, often away from the host tree. This different dispersal syndrome for *Decaisnina* stresses the importance of generalist frugivores in dispersing seeds to establish new infection centres (Rawsthorne *et al.* 2011, 2012; Watson & Rawsthorne 2013). Further study is required to properly understand the relative contribution of generalist frugivores to mistletoe seed dispersal and distribution.

Acknowledgements

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Australian mistletoes on introduced trees

Interesting observations can be made of Australian local mistletoe species growing on introduced trees, especially when the host tree is deciduous, which makes the evergreen mistletoe more obvious during winter. A paper has been published giving lists of all the mistletoes kept in herbariums and their host plants, and many of the hosts are introduced and/ or horticultural trees.

Near Penrith in NSW apostle mistletoe, *Dendrothoe vitellina* has been seen, on, for example, Chinese elm, *Ulmus parvifolia*, and tulip tree, *Liriodendron tulipiferum*. Because they were so apparent in the winter they were easy to recall each year, so, it became equally obvious when they died and the deciduous tree replaced mistletoe foliage with the host tree's foliage.

Some years ago apostle mistletoe was found in poplar plantations on the fertile river flats in the Macleay Valley, near Kempsey, NSW.

Another mistletoe seen near Dungog in June 2016 appeared to be variable mistletoe, *Amyema congener* in deciduous poplars along a stream some distance away. While it was at too great a distance to accurately identify, the dark profile was obvious from the main road. Herbarium collections have records of this species on ten different introduced hosts including peach and pear trees. In contrast, box mistletoe, *Amyema miquelii*, has been recorded from 125 different hosts, but the hosts for this species are all Australian native trees.

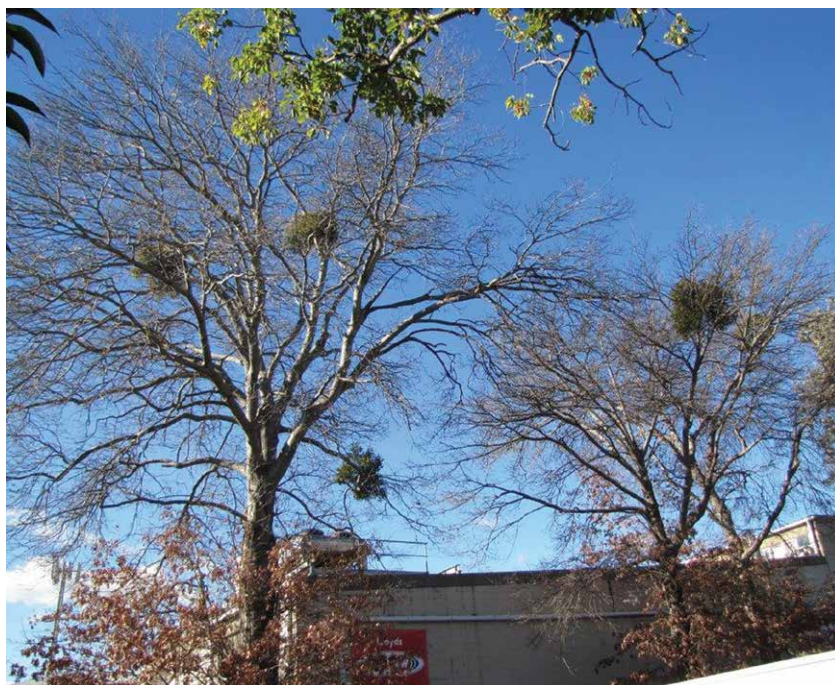
This photo right shows Apostle Mistletoe, *Dendrothoe vitellina*, hemi-parasitic on honey locust, *Gleditsia triacanthos*, in a municipal park in Dungog NSW in June 2016. The mistletoe is obvious on the deciduous tree which can be identified by the dark bark and the large seed pods. Herbariums hold specimens of Apostle Mistletoe which have been collected from 12 different introduced hosts.

In the municipal park in Dungog, there were two species of mistletoes on two different



species of shrub and tree. But, it is always interesting to note other species in the vicinity that do not accept /receive/ carry mistletoe, and in this situation there were pecan nut, camphor laurel, liquidamber and slash pine with no mistletoe.

Apostle Mistletoe, *Dendrothoe vitellina* (below) is very obvious in the shopping centre in Springwood, Blue Mountains, NSW. There were five variable mistletoes on three Pin-oak, *Quercus palustris* trees. The autumn leaves are a brilliant scarlet, but with no leaves in June the clumps of mistletoe are in stark contrast. The photo at right is the same species in a London Plane Tree along the same road.



Mistletoes in street trees

Mistletoes can be found on native species street trees and shrubs which is an indication that the carrier, most likely the mistletoebird, had visited the street.

At Richardson Street, Wingham there were variable mistletoe plants on weeping bottlebrush planted along the street. Two weeping bottlebrush, *Callistemon viminalis*, both had over 20 clumps of variable mistletoe, *Amyema congener*. This is an example of the number of mistletoe influencing the health of the host plant. The nearest cross street had four shrubs with a few mistletoes. However, there were other species of bottlebrush with no mistletoe, and other street plantings had no mistletoe.



The haustoria where the variable mistletoe, *Amyema congener*, joins with the host shrub, weeping mistletoe, *Callistemon viminalis*.

Anatomy of wood of a mistletoe plant

Richard J Turner

Some mistletoe plants have a large haustoria, that is, the formation at the junction of the mistletoe hemi-parasite and the host tree or shrub. Some haustoria are large enough to be installed on a woodworking lathe, although any results are not the usual formal shape.

Mistletoe wood is categorised as a hardwood because of the pores in the structure, although it is probably not durable, but this has never been tested in the way other commercial timbers are tested. The wood may have been attacked by borers, but seems to season well.



Large haustoria turned into a sphere by Ernie Newman of Blaxland NSW.



Two haustoria with yellow box, *E.melliodora* and box mistletoe on the left and all box mistletoe, *Amyema miquelii* on the right with a 50mm indentation.

Some haustoria wood was examined under the microscope in the late 1991. The species selected were Drooping Mistletoe, *Amyema pendula*, attached to a Sydney Peppermint, *E.piperita*, from near Winmalee, in the Blue Mountains NSW. Specialised equipment was employed to slice a very neat and very thin slice of the wood. The sample was treated with dyes so that cellulose is stained blue while lignin is stained a deep red. Cellulose is 40 to 45% of the wood and lignin about 30% of the wood.

The following images have been displayed as slides in talks about mistletoe, but certainly never published and are too small in reproduction in this context to being fully explanatory.

In Image 1 is a cross section, note the dark to black bark on the top right corner, with most of the top half of the image mistletoe wood. Notice that some mistletoe wood is “intruding” into the peppermint wood about the centre of the image, and most of the lower half is eucalypt wood.

Image 2 is another cross section showing the medullary rays. These cells are parenchyma or soft tissue that can store plant nutrients. The other function of these cells is to convey liquids to other parts of the wood.

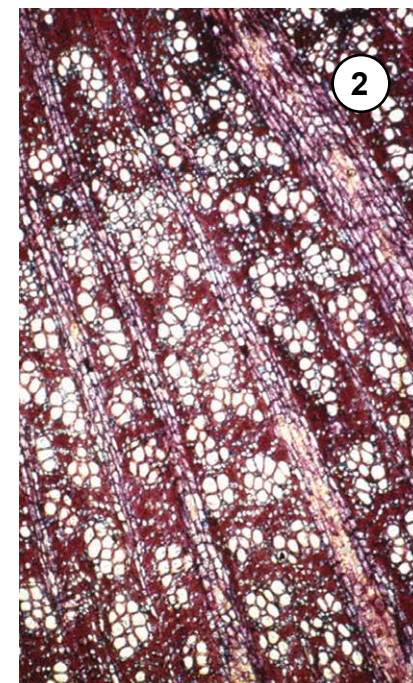
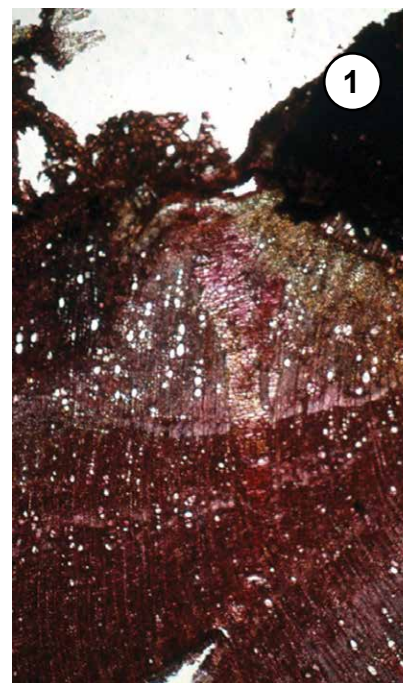
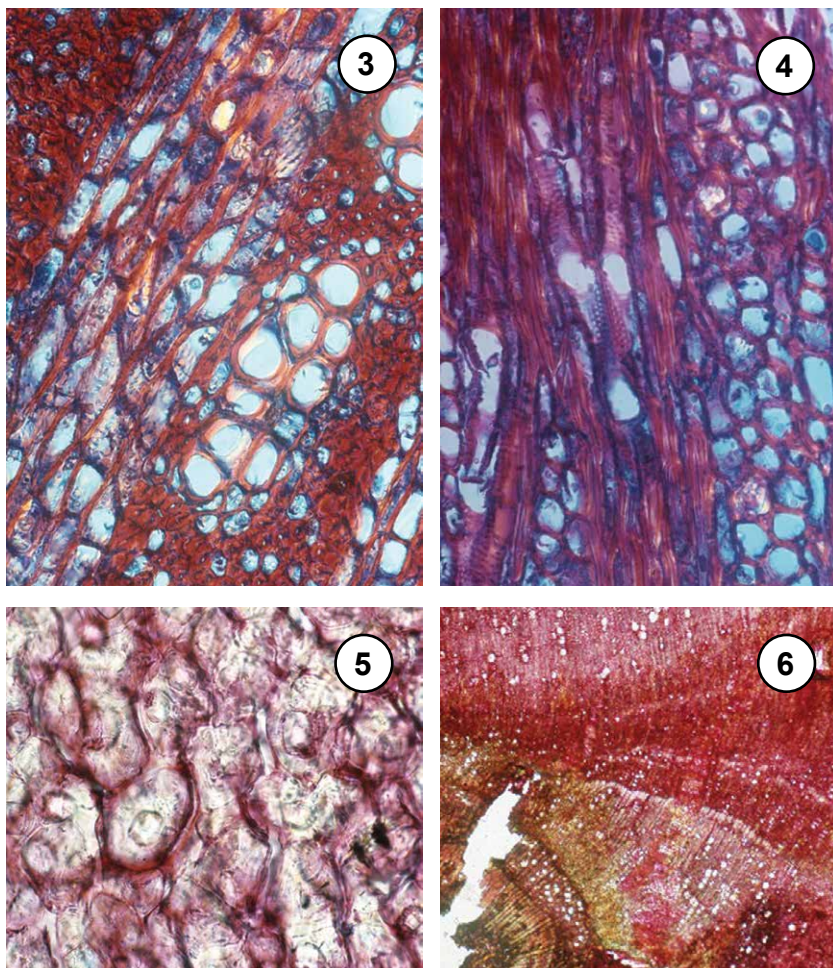


Image 3 is a cross section of Box mistletoe, *Amyema miquelii*, hemi parasitic on coastal grey box, *E.moluccana*, from Prospect in western Sydney, showing pores, medullary ray tissue, also some crystals and starch.

Image 4 is a tangential section of the same species of mistletoe as above showing grains of starch, crystals and multiseriate rays.

Image 5 is 128 times magnification of a cross section of bark of Drooping Mistletoe showing contents of cavities in bark.

Image 6 is 6 times magnification of host wood, Sydney peppermint, *Eucalyptus piperita*, top left, dark red drooping mistletoe, *Amyema pendula*, with bark of mistletoe lower left.



How to grow your own mistletoe

Native plant lovers have expressed a wish to grow their own mistletoe. Indeed some enthusiasts have attempted to establish mistletoes in gardens.

The problem is to find a mistletoe that is compatible with the potential host plant in the garden. Bear in mind that the box mistletoe is a large plant that attaches to large trees, in the series *Adnataria*, or the box and ironbark group. By reading through the brief descriptions of mistletoe species, the grower might be able to match the mistletoe plant with the *Callistemon*, or *Melaleuca* or *Grevillea* species. Then the grower has to locate the seed of the required mistletoe and plant that along the branch of the selected host shrub or tree.

One successful grower was forester in the ACT. He established a small plantation of red box, *Eucalyptus polyanthemos*, collected seed of Box mistletoe then planted that along the branches. It is interesting to note that when the trees started to shade the mistletoe plants they faded.

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