1 Introduction

Strictly speaking, 'mistletoe' is the name the English apply to the parasitic plant *Viscum album*, which grows not only in England but across much of Europe, parts of North Africa and through Asia all the way to Japan. Throughout its vast range, that mistletoe has been the subject of many cultural myths and legends. It is still an important festive symbol; for example, along with holly and ivy, it is a common component of English (and Australian!) Christmas trappings, as it has been since time immemorial. Anyone lingering under the mistletoe at that time of year might expect (or hope) to be kissed! Sadly, this is not the place to delve into the rich tapestry of mistletoe myths and legends from around the globe. Interested readers can find many stories by Googling the phrase 'mistletoe legends' or similar words.

Nowadays, the term 'mistletoe' is applied throughout the English-speaking world to plants that have the same broad growth habit as *V. album*. That is, mistletoes are parasitic shrubs that grow on and obtain mineral nutrients and water from a host's branch. Mistletoes are not completely parasitic: there is chlorophyll in their leaves and sometimes in their stems, and they photosynthesise their own products such as sugars and their derivatives (discussed further in Chapter 2).

Interest in mistletoes is growing. On the one hand, some people consider them to be pests: the thinking is that, like ticks and tapeworms, parasites must be bad. On the other hand, there is a growing appreciation that many species are beautiful, and a growing awareness that they are natural components of our indigenous flora. Many native animals are dependent on them. The larvae of some of our most beautiful butterflies feed on nothing but mistletoe leaves (Figs 1.1 and 1.2). Mistletoebirds and some honeyeaters depend on mistletoe berries (the importance of this relationship between plants and birds is even reflected in the mistletoebird's common name). Many mistletoes, including Perth's commonest mistletoes *Amyema preissii* and *A. miquelii*, flower at the height of summer

Photo: AN Start; reproduced with permission from Australia Post.

Fig. 1.1. Australian postage stamps showcasing the Spotted Jezebel (*Delias aginaippe*). Its larvae, like those of many Jezebels, feed on mistletoes. Photo: AN Start; reproduced with permission from Australia Post.

Photo: AN Start; reproduced with permission from Australia Post.

Fig. 1.2. Australian postage stamps showcasing the Amaryllis Azure butterfly (*Ogyris amaryllis*). Michael Braby (2004) recorded its larvae feeding on 12 species of mistletoe that occur in Western Australia. Other Azures also use mistletoes as larval food plants.

when many nectar-feeding birds have few other nectar sources.

The natural history of mistletoes is considered in the introductory chapters of this book. The book is also an aid to identification. Brian Barlow's revision of the families Loranthaceae and Viscaceae in *Flora of Australia* (Vol. 22, 1984) covered all Australian species known at that time, but it is technical, not readily accessible, and not very suitable for use in the field. Moreover, since 1984, our knowledge of the taxonomy, distribution and ecology of Western Australian species has improved greatly. David Watson's more recent *Mistletoes of Southern Australia* (2019) includes species from southern WA, but not the rich mistletoe flora of the state's north.

Identification keys and up-to-date accounts of all mistletoe species known from WA are the core of this book. Keys are provided to the families, genera and species of all recognised WA mistletoe taxa and are based, wherever possible, on vegetative features rather than on flowers and fruits, which are not always available. The descriptive species accounts are accompanied by photographs and distribution maps. They include diagnostic features to help distinguish similar and related species, as well as information on hosts, distribution, conservation status and threats. Where possible, technical jargon has been avoided; at the end of the book there is a glossary of terms that have been used.

We make no apology for avoiding common names. Recently, many common names have been coined, but many are not appropriate for WA species. For example, 'Wire-leaved Mistletoe' could apply to several species of *Amyema* and a *Lysiana*, so the name is confusing and tells us nothing about the relationship of one species to another in the way that scientific names can. Moreover, if we used common names in this book, we would have had to invent some for tropical species that lack them. This book is designed for use by people with a reasonable botanical knowledge, who are generally comfortable with scientific names and appreciate the information on relationships that names provide. After all, everyone is comfortable with *Banksia* and *Eucalyptus*, so why should *Amyema* and *Lysiana* not become familiar to people interested in mistletoes?

4 Do mistletoes have roots?

Most plants have two distinct sections, a root and a stem. The root supplies a plant's water and mineral nutrients from the soil while the stem supports leaves, flowers and fruits. Fuelled by light, chloroplasts in the leaves (and sometimes stems) combine carbon dioxide with water to produce sugars and their derivatives, providing the energy the plant needs to grow.

Most mistletoes also have green leaves, but a few replace or augment functional leaves with green stems (Figs 4.1 and 4.2) or even huge, persistent floral bracts (e.g. *Diplatia* spp.) (Fig. 4.3). Either way, mistletoes synthesise their own carbohydrates. However, as they grow on the stem of their host, mistletoes don't have conventional roots with which to acquire water and mineral nutrients from the soil. So, what takes the place of roots?

Photo: AN Start.

Fig. 4.1. *Korthalsella leucothrix* (Santalaceae), a hemiparasitic stem parasite that has no 'ordinary' leaves but does have chlorophyll in the stems.

Photo: JD and MJ Start.

Fig. 4.2. *Viscum articulatum* (Santalaceae), a hemiparasitic stem parasite that has no 'ordinary' leaves but does have chlorophyll in the stems.

Like other seeds, a germinating mistletoe seed produces a radicle, the progenitor of a root system (Fig. 4.4). However, to obtain minerals and water, the mistletoe radicle must penetrate a suitable host's stem and tap into its water and mineral 'supply line', the xylem. It does this by developing a

Photo: AN Start.

Fig. 4.3. The large green floral bracts of *Diplatia grandibractea* will persist and continue photosynthesising long after the flowers and fruits have gone.

Photo: JD and MJ Start.

Fig. 4.4. A germinating seed of *Decaisnina angustata* (Loranthaceae). The 'head' is the radicle or embryonic root. The small green objects are seeds of *Viscum articulatum*.

Photo: AN Start.

Fig. 4.5. The base of *Viscum whitei* (Santalaceae). There is little indication of swelling in the host plant's stem, despite the haustorium in it.

highly modified structure called a haustorium. Most WA mistletoes depend on their initial (primary) haustorium throughout their lives (but see below).

As we saw in Chapter 2, mistletoes occur in two WA plant families, the Santalaceae and the Loranthaceae. In santalaceous mistletoes, the primary haustorium develops inside the host's branch. The host continues growing beyond the point of infection and there is little external evidence of the intercepting structure apart from a modest swelling of the host's stem (Fig. 4.5). However, in loranthaceous mistletoes the haustorium is generally large and complex and the mistletoe component is usually externally visible.

Loranthaceous haustoria come in several designs. Their anatomy has been studied and the types have been classified, but little attention has been given to the functions behind variation in form. Nevertheless, studies in WA show that some types of haustoria have important functional attributes besides tapping the host's xylem. Not surprisingly, given the state's fire-prone environment, one function of some types is to improve the mistletoe's ability to survive fire (discussed further in Chapter 7). The next sections of this chapter describe the basic types of haustoria found in WA's loranthaceous mistletoes.

Ball haustoria

The commonest design is called a ball haustorium. In ball haustoria, tissues of

7 Fire and other threats

Most Western Australian plant communities are affected by fire, and the plants that occur in them have evolved various survival strategies. Some, like grasstrees and palms, protect their apical buds deep within their crown. Many eucalypts and shrubs can resprout from their rootstock or from dormant buds protected under thick insulating bark. Banksias and hakeas store long-lived seed in thick woody capsules that open after fire, allowing the seed to fall on a nutrient-rich ash-bed, while many acacias build up long-lived seed-banks in the soil.

Mistletoes are perhaps unique among WA flowering plants living in fire-prone habitats in that they can do none of these things. Mistletoe plants (and any fruits they may be carrying) are killed if scorched by a bushfire (Fig. 7.1). And as only fresh fruits are eaten by dispersing birds and the seeds must germinate almost as soon as they're deposited, most mistletoes have no means of survival after severe scorching by a bushfire.

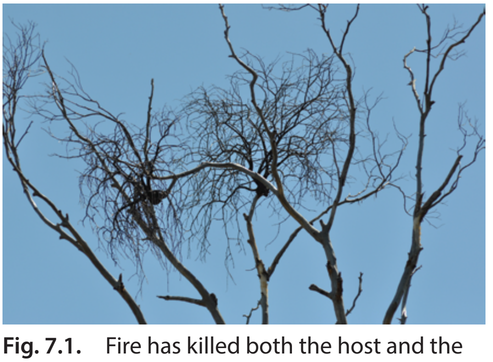


Photo: AN Start.

Fig. 7.1. Fire has killed both the host and the mistletoes it supported. Wood-roses show where *Amyema miquelii* was growing on a marri tree (*Corymbia calophylla*).

Recolonisation of burnt areas requires the dispersal of fresh seeds from unburnt areas. As we saw in Chapter 5, many mistletoes are host-specific, at least to some extent. If an acceptable host can live through a bushfire and regenerate its canopy, as eucalypts do, recolonisation by mistletoes can begin almost straight away. However, if fire kills the hosts (as in many acacias) or even just the above-ground stems (like mallees), recolonisation can't begin until a new generation of host stems has matured, usually several years after the fire.

Birds that distribute mistletoe seeds (Chapters 3 and 9) tend to stay close to their food resources. However, fires can be very extensive, particularly in the Pilbara, Kimberley and deserts, where they often burn for weeks and cover many thousands of hectares (Figs 7.2 and 7.3). This means that the distance between a potential host and a source of seeds may be very large. For this reason, mistletoe recolonisation of burnt areas tends to be very slow. This is a serious challenge when fires become either more frequent or more extensive, which has happened over much of WA. Mistletoes have been incrementally almost eliminated by wildfires over huge areas, particularly in the spinifex-dominated Pilbara and deserts and the tropical savannas of the Kimberley.

The continuing decline of mistletoes has cascading consequences for biodiversity

Photo: S van Leeuwen.

Fig. 7.2. Hot spinifex- (*Triodia*-) fuelled fires in the Pilbara and other hummock grass-dominated landscapes completely scorch the canopies of most shrubs and trees, thereby killing most mistletoes.

Photo: S van Leeuwen.

Fig. 7.3. Few canopies, or mistletoes, survive hot fires that sweep across vast areas like this in the Fortescue Valley, with the Hamersley Range in the distance.

(see Chapter 9). The good news is that no known species (except, perhaps some rare species in the Northern Kimberley bioregion) are at risk of becoming extinct, because all the others have at least some means of persisting somewhere.

The most common survival strategy is to include potential hosts that grow in relatively fire-safe refugia such as riparian areas, rocky gorges, scree slopes or rainforest patches. Mulga woodlands (which seldom burn unless there is a lot of spinifex in the understorey) safely support good populations of several mistletoe species, either because the mulga itself is a suitable host or because preferred hosts also find shelter in those woodlands. A second (and safer) way for a mistletoe species to ensure fire is not a risk is to be highly host-specific to hosts that only grow in fire-safe places. A prime example is *Amyema thalassia*, which only infects mangroves – and mangrove stands very rarely carry fire.

A third, less common, strategy adopted by a few species is to have a very wide host range, so that almost any shrubby plant or tree is likely to be an acceptable host. The situation described in Chapter 5, where *Lysiana casuarinae* was recorded growing on 11 host species in five families in one small area, is a good example. Sadly, this strategy is far from secure – a wildfire has eliminated that population from all its hosts. The strategy may have worked better historically, when Indigenous peoples created mosaics of small burns of different intensities, but it is no longer effective against today's often severe fires that scorch entire canopies over vast areas.

Some species, such as *A. benthamii*, employ all three strategies in different parts of their ranges. In the fire-prone Kimberley this species has a remarkably wide range of hosts, some of which grow in relatively fire-safe places. In southern WA it has only one host, the relatively fire-safe kurrajong (*Brachychiton gregorii*). In the Pilbara it has three recorded hosts, one of which, *Terminalia circumalata*, grows in fire-safe, gravelly riverbeds.

There are a few cases of mistletoes that can sometimes survive a fire. As we saw in Chapter 4, *A. sanguinea* can extend ramifying haustorial tissue within the stems of the eucalypt host's branches. After canopy

9 The relevance of mistletoes

All Australian mistletoes are native and are natural components of our rich floral heritage. In reviewing the contributions that mistletoes make to global biodiversity, David Watson (2001) credited them with the status of 'keystone' species. In architecture, a keystone is the special stone placed at the apex of an archway that locks all the other stones in place and prevents the arch from collapsing. In ecological terms, keystone species serve an analogous function. If they are removed from an ecosystem, there is danger of a cascading collapse of interdependent members of the community in which they lived.

Watson and Herring (2012) demonstrated experimentally that the removal of mistletoes resulted in a decline of Australian woodland bird species, including, surprisingly, species that did not feed on mistletoes. Their explanation was that, in eucalypt woodlands where there are mistletoes, the mistletoe leaves are shed sooner and decompose faster than the hard sclerophyllous leaves of the eucalypts. A flow-on effect of faster recycling of nutrients was healthier eucalypts, leading to better quantity and quality of food resources for insects and hence the birds that preyed on them.

The larvae of many butterflies and moths feed on mistletoes (Figs 1.1, 1.2 and 9.1).

Photo: Jean and Fred Hort.

Fig. 9.1. A moth larva on *Amyema preissii*.

Some feed on nothing else; some are so iconic that they have featured on Australian postage stamps illustrating the nation's wildlife heritage. Watson (2001) tallied insects from six orders that are known to feed on Australian mistletoes. These in turn are food for other animals, including other insects and birds, both of which may be important to the ecology of components of the communities in which they live. So important are mistletoes to native insects that the Brisbane-based Butterfly and Other Invertebrates Club published a book on the mistletoes of subtropical Queensland, New South Wales and Victoria (Moss and Kendall 2016). An entomological club publishing a book on mistletoes shows the value of mistletoes as larval food plants for some of the insects in which the club is interested.

When a natural community loses its mistletoes, it loses an important food resource on which many animals depend, at least at certain times of year. The two commonest mistletoes in south-western Australia, *Amyema miquelii* and *A. preissii*, flower and fruit from summer through autumn into early winter (Figs 9.2 and 9.3), a time when food resources for honeyeaters, silvereyes and mistletoebirds are scarce (Napier *et al*. 2014).

Besides supporting birds with food in the form of insects, fruit and nectar, the branches of many mistletoes form dense clumps and are ideal places for birds to nest. Cooney *et al*. (2006) recorded 217 Australian bird species nesting in mistletoe clumps and it has recently been shown that, in the Strzelecki Desert, red kangaroos seek out shady spots under mistletoe

Photo: AN Start.

Fig. 9.2. The masses of flowers of *Amyema miquelii* provide an important food resource for many nectar-feeding birds at times when other food is scarce.

Amyema Tiegh

Taxonomic notes. The largest genus of mistletoes in Australia, named by the French scientist Philippe van Tieghem (1839–1914).

Derivation of name. From the Greek for 'not yet initiated', in reference to the fact that this large genus had not yet been fully segregated from the previous genus *Loranthus* at the time the name was published.

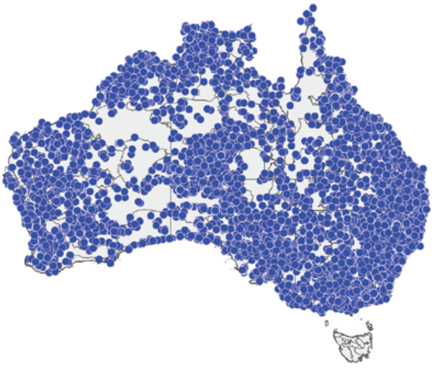
Type species. The type species is *Amyema congener* (Sieber ex Schult. & Schult.f.) Tiegh.

Description. Hemiparasitic shrubs infecting their host's stems, without epicortical roots (except in a few species including the Western Australian *A. sanguinea*), often with pendulous branches. Leaves mostly have curved, more or less parallel nerves from near the base. Inflorescences are axillary umbels (sometimes very condensed and thus head-like) with two or more rays each of which carries a single flower, a diad or (most commonly) a triad, each flower usually subtended by a single small bract (which may be larger on the central flower of triads). Flowers have four to six petals that (in Australian species) are free to the base rather than united into a tube, and are usually red but may be bicoloured, green with red staminal filaments, or entirely green or yellow.

Related and similar genera. *Diplatia*, with its long leaves and pendulous branches, is similar to some *Amyema* species but the inflorescence comprises a pair of sessile triads enclosed by a pair of very large foliose bracts.

Numbers of species and distribution. World: About 100 species ranging from Peninsular Malaysia through Indonesia, the Philippines and New Guinea to Australia and parts of the western Pacific. **Australia**: 37 species (32 are endemic). **Western Australia**: 23 species. Five species and two subspecies are endemic and three species are represented by two subspecies or varieties.

Conservation. The most significant threat is fire (see Chapter 7), which is eroding the distributions of many species. No species are currently listed as Threatened but one species, *A. pyriformis*, is listed as Priority 1 on the Western Australian Priority list.



Amyema benthamii (Blakely) Danser

Subspecies and varieties. None.

Derivation of name. Named in honour of George Bentham (1800–1884), English botanist and author of *Flora Australiensis.*

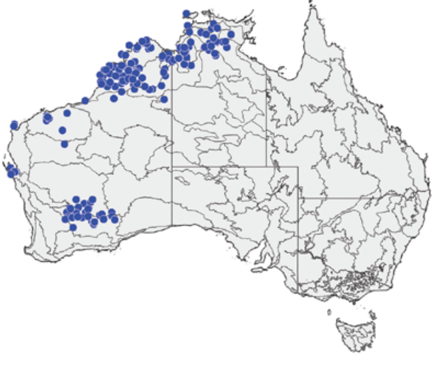
Type locality. Comet Vale, Western Australia.

Description. A medium-sized round to semi-pendulous mistletoe mostly found in the Kimberley and Goldfields, with sessile, opposite, triangular or ovate to almost orbicular leaves with rounded to cordate bases. The inflorescence is a (usually) two-rayed umbel with each umbel bearing a triad with the central flower sessile and the lateral ones pedicellate (rarely, the triad seemingly a three-flowered head). The rays and pedicels are usually relatively stout and short but are sometimes longer and slender. The flowers are usually bicoloured, maroon below and green above but may be all green. The ovary and fruit have short white to grey hairs. In the south of the species range these may be restricted to the base with the remainder of the fruit glabrous and yellow, while in the north the hairs usually cover the whole fruit including the persistent calyx, making the fruit appear greyish, often with a pink undertone.


Photo: WP Muir.


Photo: AN Start.

Fruit from a southern population.



Related species. Western Australian relatives are *A. conspicua*, *A. dolichopoda*, *A. mackayensis* and *A. villiflora*. These all occur in the Kimberley, where they occasionally hybridise. This group of species may need taxonomic revision.

Similar species. South of the Kimberley, this is the only mistletoe with broad, sessile, often cordate (stem-clasping) leaves. Within the Kimberley there are several other species with similar leaves; however, all these have yellow to orange flowers except