

## Marvellous mistletoe: Giving forests the kiss of life

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*Forget its reputation as a parasitic tree killer, mistletoe is an unsung hero of the woods.*

OLD romantics love it. Foresters hate it. But for Australian ecologist David Watson, mistletoe is neither an excuse for a kiss nor a scourge that sucks the life from trees. He has spent more than a decade studying mistletoes across three continents in a mission to revamp the reputation of these odd parasitic plants. What he has discovered will challenge everything you thought you knew about the botanical hangers-on.

First, forget the mistletoe of Christmas cards, snatched kisses, Druids and ancient myth: Europe's *Viscum album* is just one of more than 1300 species worldwide. Mistletoes are found on every continent except Antarctica. Most grow on the branches of trees and form dense, green clumps from which a profusion of succulent stems cascade. What links these plants is not shared ancestry, for mistletoes have evolved at least five times in different groups of plants, but their lifestyle. Mistletoes are hemiparasites: they make their own carbohydrates by photosynthesis, but acquire water and minerals by plumbing themselves into their host's vascular system with a fleshy, root-like "holdfast".

Mistletoe might be a money-spinning crop for some at this time of year, but generally foresters see these aerial squatters as tree killers. "In most places, forest managers regard mistletoe as a destructive pest that should be removed," says Watson, who is based at Charles Sturt University in Albury, New South Wales. His research challenges this view and suggests the plants are overwhelmingly a force for good. Wherever they grow, they bring life, he says. "Mistletoes are the key to a rich and healthy forest. They are the engine that drives diversity from the forest floor to the canopy."

Over the past two decades, Watson and his fellow ecologists have recorded an ever-lengthening list of activities that revolve around mistletoes. Everywhere, from the cold, northern forests of Europe to the tropics of Africa, Asia and the Americas, as well as the semi-arid woodlands in Watson's part of Australia, a similar picture emerges. Always assured of water, evergreen mistletoes are a reliable year-round source of food for many forest dwellers, providing nutrient-packed leaves, sugary nectar and juicy, fat-rich berries. The dense clumps offer hideaways and cool places to roost, while the tangle of sturdy stems offers secret nooks for small birds to nest in and a solid platform for larger ones to build on. And all this activity attracts predators, too (see "Marvellous mistletoe").

All these findings suggest that mistletoes bring benefits to the wider woodland that more than compensate for the minor harm they do to individual trees, argues Watson. While studies have shown that mistletoes can slow the growth of trees, they rarely kill them, and then only when the burden of mistletoe is unnaturally high. "Even then death is usually caused by other pathogens such as bark beetles or fungal attack," he says.

Now Watson has carried out the ultimate experiment to prove his point. "The irony was that to do the research I had to rip the mistletoe out of entire woodlands. But it was for a good cause. Our experiment shows how valuable it is."

Watson and his colleague Matthew Herring, aided and abetted by teams of volunteers wielding loppers and pruning saws, stripped 5500 clumps of mistletoe from 17 large patches of eucalyptus woodland in south-east New South Wales. The predominant species was the box mistletoe, *Amyema miquelii*, which forms pendulous growths that dangle as much as 5 metres. Like other mistletoes, they are a hive of activity, with visitors ranging from nectar-drinking birds to leaf-eating marsupials and roosting possums. Three years later, Watson and Herring checked the effect of the mistletoe removal on the most conspicuous and easily monitored group of woodland animals, birds.

The results, published earlier this year, were dramatic (Proceedings of the Royal Society B, vol 279, p 3853).

"The change was bigger and faster than we envisaged," says Watson. "Where we removed mistletoe, we lost more than a third of woodland birds." What's more, the birds that vanished were not the expected ones. The researchers had assumed that the worst hit species would be the obvious mistletoe users. "But that wasn't what happened. The losses were across the board and the biggest declines were among ground-feeding insectivores."

Watson has long argued that mistletoe is a keystone resource, a plant with a disproportionate influence on the rest of the ecosystem and a key player in promoting species richness. His large-scale lopping experiment confirms just how important mistletoe is in promoting woodland diversity - but not for the reasons you might have expected.

### **Packed with goodies**

The biggest contribution mistletoe makes to the wealth of woodland life is the rain of leaves it drops to the ground, Watson argues. Mistletoe leaves are often twice as nutritious as those of their hosts and, unlike trees, mistletoes don't withdraw nutrients from their leaves before shedding them.

"Those leaves are packed with goodies," says Watson.

This makes the leaf litter below a mistletoe-laden tree both deeper and richer than elsewhere, encouraging the proliferation of soil microbes and accelerating the recycling of nutrients that fuel the growth of plants. Deeper leaf litter also harbours a greater number and diversity of invertebrates, which in turn provide food for larger animals, such as the woodland birds that vanished along with the mistletoe during Watson's experiment. If that wasn't enough, the patchy nature of the litter - rich and deep under trees hosting mistletoe, thinner and poorer elsewhere - enables many species to share the same woodland.

Sure enough, in follow-up studies at the removal sites, Watson is finding a similar picture for insects, spiders and other woodland animals. "The message that's coming through loud and clear is that wherever it is found, mistletoe has such a pervasive influence on so many woodland inhabitants that we should look after it," he says. "Rather than a scourge that needs to be controlled, mistletoes should be considered saviours of our native woodlands."

### **Marvellous mistletoe**

- Porcupines, pine martens and squirrels hibernate in it
- African monitor lizards use it for camouflage when ambushing birds
- Birds from 60 families, ranging from tiny songbirds to heavyweight hawks and owls, find it makes an ideal home
- Moths, hummingbirds and lemurs feed on the nectar
- Herbivorous mammals, from deer and rhinos to gorillas and possums, eat its nutritious leaves
- An Amazonian hatchetfish is among many animals that eat its fat-rich berries
- Some meat-eating birds line their nests daily with its fresh leaves, which are thought to have anti-bacterial properties