

There's a photo

that 16-year-old Ivy McGufficke likes to look at every time she returns to her family farm near Cooma after a term at boarding school. It's 2005 and two-year-old Ivy is standing in a sheep pen wearing a blue jacket, holding a half-eaten sandwich in one hand and in the other an old sheep pellet tub, repurposed as a peg bucket. Her destiny is already sealed; the youngest of three daughters born to Monaro graziers Alan and Michelle McGufficke, she will grow up as connected to this land as the merinos that poke their woolly heads over the sheep race alongside her.

But it's what's in the background of the photo that keeps drawing her eye. It's the trees. They rear up behind her, dwarfing the wide-eyed farm girl – mighty *Eucalyptus viminalis*, commonly known as manna or ribbon gums. Their canopies are full and

green and along the length of their trunks thin strips of bark peel away like streamers at a birthday party. Her first memories are of playing under those trees, digging up pieces of crockery and tiny animal bones in the soil, climbing the strong branches.

But as Ivy grew stronger the trees grew weaker until each one of them shed its leaves and died. Her games evolved to hiding in the rotting hollows, collecting fallen birds' nests that the canopy could no longer cradle, filling wheelbarrows to cart away dead wood for bonfires. The bushland of her childhood went from an enchanted forest to next year's firewood. Today, her mother Michelle describes their farm as looking like Hiroshima. "It's like a nuclear blast has come through. People come here and say, 'What have you done with your trees?' They must think we poisoned them."

But it wasn't just their place. Next door, farmer David Whiting lost all his ribbon gums. So did Jim Litchfield down the road. In fact,



Dying

By Ricky French

DEAD EUCALYPTS LITTER THE MONARO LANDSCAPE AND NOW THE SNOW

ribbon gums have died on a huge scale through a sort of Bermuda Triangle of death in the Snowy Mountains region between Cooma, Nimmitabel and Jindabyne. Across 2000 square kilometres – an area about the size of the ACT – every last ribbon gum is dead or dying, leaving a desolate landscape littered with skeletal remains and bony branches jutting against the sky like fork lightning. The dieback has taken an emotional toll on the people of Monaro and on those who visit this unique Australian landscape, or pass through on their way to the snow. Want to see a ghostly vision of the future? Take a drive from Cooma to Jindabyne.

The wave of destruction was quick and brutal, first observed around 2005 and escalating over the next five years. Dieback is not uncommon but this recent event is now recognised as one of the most significant and mysterious ever to hit

Australia. And worse could be yet to come. Up in nearby Kosciuszko National Park, the iconic snow gums are showing signs of going the same way, as are others in the ACT and Victoria. Scientists don't know where it will end because they don't know where it started, or why.

"It's the size and scale of this dieback that makes it stand out," says associate professor Cris Brack from the Australian National University. "It spread to 2000 square kilometres before anyone really noticed. That's the scary thing. It was also species-specific. It hit ribbon gums and nothing else." Not that there was much else for it to hit. The ribbon gums largely ruled alone in rocky, inhospitable outposts. Like castles, they occupied hilltop strongholds atop weatherbeaten granite knolls and ridgelines, commanding a stable presence over the naturally treeless basalt plains to the west.

Brack says he spent years trying to rouse interest from government with no success – no



shame

MOUNTAINS GUMS ARE IN TROUBLE. WHAT'S KILLING THESE MIGHTY TREES?

Photography Rohan Thomson

department thought it was their responsibility. In 2015 he and an honours student, Catherine Ross, conducted what is still the only study of the dieback. They swiftly found a suspect: a eucalyptus weevil was devouring the leaves. Trees have a way of dealing with insect attack: if a eucalypt loses its crown it will shoot out fast, new growth known as epicormic foliage. These new leaves provide the tree with a kind of sugar hit – enough energy to start repopulating its depleted mature leaves. But if the insects keep attacking, eventually the tree gets stuck in a lethal loop. It runs out of the energy stores needed to flush out new growth, and will eventually succumb and starve to death.

So, a weevil was implicated in the dieback. Case closed? If only it were that easy. This is a native insect, meaning the trees have evolved over millions of years to cope with it. Why, then, were they suddenly powerless to defend themselves? Why didn't they have the energy to fight back?

"There's always been a war," says Brack. "The trees are always trying to stop their leaves getting eaten and the weevils are always trying to work out how to eat them. It's been in balance forever. But something has thrown that balance out." Something else was going on.

Brack and Ross set up a batch of experiments – eight study stands of trees in a diverse array of environments within the dieback area. They compared stands in grazed areas and ungrazed areas; stands that had been fertilised with ones that hadn't; stands where the water was good with stands where the water was bad; stands that had been burnt to a crisp with ones that had dodged bushfire. "The expectation was that one of the stands would be worse than the others if there was a culprit," says Brack. But what they found was dead trees everywhere, uniformly across all the stands. It yielded no clues.

Brack can't rule out the root-rot pathogen *phytophthora*, responsible for killing New Zealand's famous kauri trees and the jarrah forests of Western Australia, but he says the Monaro doesn't fit the pattern of *phytophthora* dieback. The study's conclusion, if there was one, was that the millennium drought led to such high levels of water stress that the trees, already at the limit of their range in terms of water and temperature tolerance, didn't have the strength to fight off the weevils. Seems plausible. But then the drought broke and the trees kept dying. And now it appears the weevils have gone; none has been spotted since autumn. Brack's summation is difficult to refute: "It's all very strange."

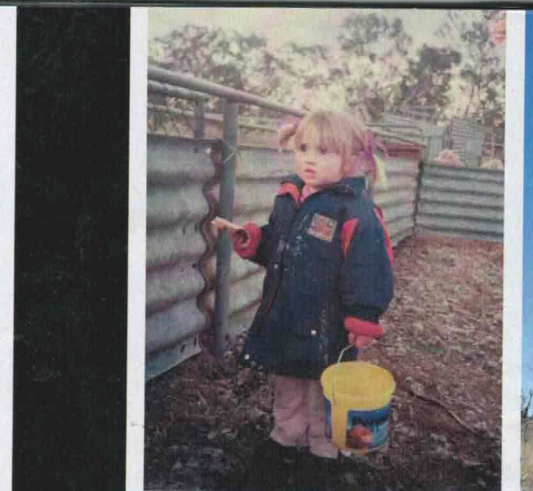
Spring snow has painted the Main Range white. Up at Dainers Gap, not far from Perisher ski resort, Matthew Brookhouse, senior lecturer from the Australian National University, is trudging through the drifts. His footsteps in the snow trace a path from tree to tree, camera and notebook in hand. Here, it's our highest altitude trees, *Eucalyptus niphophila*, that are in trouble. This time the government's listening, for these are the trees featured in a thousand landscape photos, the trees strewn throughout our country's largest alpine resort, visited by three million tourists every year. They are our iconic snow gums.

A different type of insect is applying the fatal blow here. A species of *Phoracantha*, a native wood-borer, is ringbarking the trees. In Perisher you see their handiwork everywhere: cracked and dead bark, bore holes and the distinctive, deep horizontal channels in the trunk. It's not just the *niphophila* dying, either – every sub-species of snow gum is showing signs of dieback over a huge area, from Long Plain in the northern region of the park to the top of the Brindabella Range in ACT and south into the Victorian Alps. "We know it's widespread, it's consistent and it's the same insect damage," says Brookhouse. "We just don't know what's driving it."

Picking it up early gives Brookhouse some hope. "The situation we don't want to be in is the one we're left with down the road: a landscape littered with dead trees, and us still asking questions why," he says. "These trees are part of the living culture of the Snowy Mountains, and we're watching them die. We're talking about a species that has nowhere left to go."

Starting in summer, Brookhouse will lead a comprehensive survey to map the full extent of the declines and establish long-term monitoring plots. The public can help too, via an online mechanism to report tree damage, uploading photos to the online Atlas of Living Australia. Brookhouse is worried these aren't isolated instances of dieback, but something much greater in scale. "Some people think there is a distinction between decline and dieback. I tend to see dieback as part of a continuum of decline. It's the extreme end of a general decline in health of the ecosystem. I don't think anyone would have forecast that almost every *viminialis* on the Monaro high plains was going to die. You'd have been called alarmist if you had predicted that."

No closer to getting answers, I spend the night with friends – farmers from Jindabyne. Hanging on the wall in their kitchen is an old aerial photo of a typical chunk of Monaro countryside. The



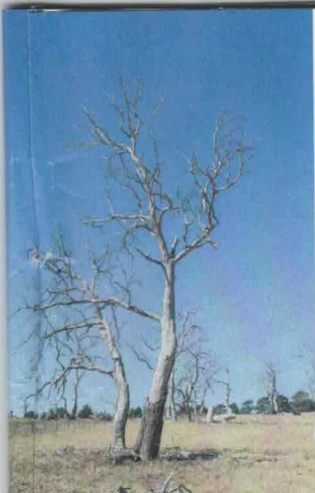
Memories: Ivy McGufficke, aged two; Matthew Brookhouse



land is cleared of trees apart from a few pockets here and there – stands clustered on rocky hill-tops or deep gullies, which, by virtue of their awkward position, escaped land-clearing. In the photo the trees stand isolated, huddled together without the protection or companionship of the former forest. These are the doomed *viminialis*.

Companionship? The word might sound odd, but it's accurate. We know now that trees are linked below ground by a sophisticated network. They feed each other, pumping sugar into struggling neighbours, and communicating dangers (such as insect attack) via chemical and hormonal messages so that other trees can rally their defences. When those social networks are cut off, trees lose their ability to communicate. So trees need other trees around them – the more the merrier – for an efficient ecosystem. Together their canopies can protect each other from extreme wind, stop the heat of summer scorching the forest floor and help the whole community store more water and generate humidity. In other words, a forest creates its own ideal habitat.

After surviving the massive clearing, the remaining *viminialis* here would have had to cope with the sort of conditions that no tree could be



"These trees are part of the living culture of the Snowies, and we're watching them die"

expected to endure. Grazing brought with it massive erosion, stripping the topsoil, compacting the ground and squeezing out moisture like a weight being lowered onto a sponge, turning soft soil to ceramic. Surface water formed into rivulets, which in time became deep gullies, instead of soaking into the ground. Rising water tables sent salinity levels soaring. The application of superphosphate brought artificially high levels of nutrients to the soil, interfering with the trees' natural nutrient and sugar distribution systems. Native grasses were replaced with pasture grasses, resulting in lost biodiversity. That's before we even start talking about climate change and drought.

I stand back from the aerial photo and let a few things sink in. Viewed through the prism of history, the Monaro dieback suddenly starts to make some sense. Once you realise the dead ribbon gums weren't always straggly, lone soldiers but part of a huge, interwoven bushland, their eventual demise seems plausible, even inevitable. It also makes the wider prognosis far more ominous. If disrupting just one element of an ecosystem can start a snowball effect, what happens when virtually every part of it is upended? Maybe we're beginning to find out.

The underground is often overlooked. Peter Marshall is a forest mycologist – a fungi specialist – who rehabilitates degraded land. A graduate of ANU's forestry school, he has a special interest in the symbiotic relationship between tree roots and a type of subterranean fungi called mycorrhizae. Marshall says foresters have underestimated the importance of this relationship. "Without it," he says, "our forests would be dead."

A mycorrhizal relationship is a beautiful thing. The fungi wrap masses of tiny filaments called mycelia around a tree's roots; ideally, every rootlet will be completely encased in the fungus, so that the roots themselves won't even touch the soil. The mycelia spread out like a web through the soil, connecting with other trees' roots and forging a sophisticated underground network. The benefits for the tree are enormous. The mycelia can get into places roots can't, increasing the area of absorption for the tree hundreds or thousands of times. The fungus will seek out nutrients and water to give to the tree, or to exchange with other trees, protecting the roots from pathogens, filtering out heavy metals and allowing for information to be shared between trees. Working together, the fungi and the tree can tap into the richest sources of underground nutrients and water. In exchange for these