



What's killing the trees? Investigating *Eucalyptus viminalis* (Ribbon Gum) dieback in the Monaro region of NSW^{*+}

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Abstract: Over the last decade, huge stands of *Eucalyptus viminalis* across the Monaro plains in south-east NSW have been declining in health. The affected area is estimated to cover around 2000 km², with almost all *E. viminalis* within that area now either dead or severely affected. An initial investigation suggests that 'traditional' causes of rural and forest dieback such as agricultural practices or altered fire regimes have no effect on the severity of the dieback, but points to climate change and extreme weather events as the underlying cause. The harsh climate of the Monaro is at the edge of the climatic range of *E. viminalis*, and the recent drought and changes in climate may have pushed the species beyond a critical threshold. With no apparent recovery and little regeneration occurring, *E. viminalis* may be lost entirely from the Monaro region. The management and rehabilitation of this devastated landscape will be a huge challenge over the coming decades.

I am going to talk about trees at a grasslands forum! The trees are in the Monaro region of southern NSW, which is well known to many of you here today. The story I am going to tell is a summary of my Honours' research through the Australian National University and sponsored by Greening Australia. The work finished in mid-2013, and there have been few changes in the treescape since.

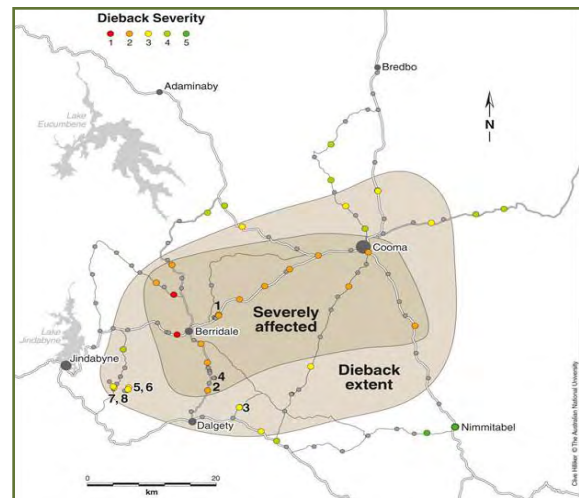
Tree dieback is very visible from the road when driving towards the Snowy Mountains between Cooma and Jindabyne. Over the last 10 years or so, the Ribbon Gums (*Eucalyptus viminalis*) have been gradually declining in health and most of them are now either dead or very close to it.

The Monaro region is a high plain that extends between Bredbo, Numeralla, Nimmitabel and Jindabyne, south of Canberra. The map (right), drawn from a road survey I did, gives an idea of the extent of the problem. The dieback in this area, which is dominated by *E. viminalis*, covered just under 2000 km² at that time – almost the size of the ACT. The central area of the map is more severely affected than the entire region.

The dieback seems to gradually lessen towards the edges of the mapped area, and the edges are defined by a change in species composition to either Snow Gum *E. pauciflora* or Box-Gum *E. melliodora* – *E. blakelyi*.

Dieback refers to a general decline in the health of a stand of trees, which can lead to premature death, and the declining health can be caused directly by things such as salinity, pollution or disease. Usually, however, the term dieback refers to a more complicated situation which is often a result of a range of interacting factors. It can be associated with insect attack, and that can either be the main cause or the result of an underlying problem. When trees are defoliated by insects they attempt to replace their crown by generating epicormic growth. However, that is growth very palatable to insects, and there is a feedback effect with repeated defoliation and regrowth until the trees eventually exhaust their resources and die.

In the situation on the Monaro, the dieback is associated with the Eucalyptus Weevil *Gonipterus* sp. (photo, right) and we know that this is the





ultimate cause of death because the remaining foliage shows characteristic damage from both the larvae and the adults. Only Ribbon Gums are affected and they are the preferred food of this weevil. There have been trials using a stem-injected pesticide to protect some trees, and those trees showed a significant improvement in health. I had the weevil identified and it is native to the area. It is not known to have serious outbreaks in Australia. When introduced to eucalypt plantations overseas it has caused problems, probably because of the absence of a parasite that normally controls it here. To have an effect like this in the Monaro, when it is not a species that has outbreaks cyclically like the Christmas Beetle *Anoplognathus* spp., there must be some underlying cause.

A range of factors have been implicated in other episodes of dieback related to insect attack and they are interrelated and quite complicated. One example is agricultural practices such as clearing, grazing and fertilising, which can cause stress to trees, making them more vulnerable to attack. Sometimes an insect species' predator is missing from the environment. Dieback in New England in the 1980s was attributed to this cause. It was associated with Christmas Beetles whose larvae feed on the roots of pasture grasses and therefore benefit when trees are isolated in paddocks, which often happens in agricultural landscapes. Fire exclusion can also lead to dieback, by causing nutrient imbalances and competition with understorey species. Another possible factor is climate, either putting stress on the trees through extreme events such as droughts or flood or affecting an insect pest by increasing its reproduction or survival rates or by affecting its predators and parasites.

The Monaro dieback

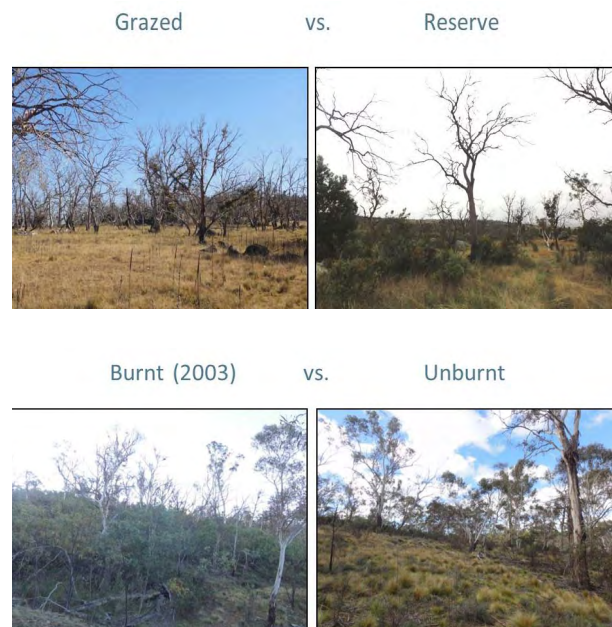
My research showed that agricultural practices and fire exclusion are not likely to be main causes in this case. Across the whole affected area I found very little difference in the severity of dieback at small scales. There were differences at the large scale, but not in response to differences in management or fire history.

For example, in the photos at right, the lefthand image is of a fairly typical paddock under regular grazing in that area. It has a combination of exotic and native pasture species, and it has been highly simplified structurally: logs have been removed, and there is little diversity among the plant species. The righthand image is of land just across the road at a Travelling Stock Reserve, which is relatively undisturbed. It has quite a healthy and diverse native understorey, but the severity of the dieback is the same across those two sites. These two are just a few hundred metres apart on a single property.

Compare the two photos (right) of areas burnt and unburnt, also just a few hundred metres apart on the same property. The area on the left was burnt in the 2003 bushfires, and the area on the right was not burnt. The fire stimulated a thick regrowth of *Acacia* and *Eucalyptus*, but again, there was no difference in the severity of dieback.

While a single fire does not equal a fire regime over a long period, this comparison suggests that using fire as a management tool for the dieback would be unlikely to succeed in the short term. We would need to impose several fires before we could assess whether fire would have an effect over the long term.

Current management strategies for dieback usually aim to limit disturbance and increase vegetation diversity. Typical practices include excluding stock to limit nutrient input and





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soil compaction, and reintroducing native understorey species to attract insect predators, or using burning. These strategies might be very important in solving other issues, but they seem unlikely to solve the dieback problem.

The only factor remaining from the list above is climate. The lack of small-scale differences in dieback suggests that the cause is acting on a much larger scale, and therefore I suggest the most likely explanation of this dieback is that it is related to climate. The Monaro is in the rain shadow of the Snowy Mountains and is very dry in comparison to the surrounding areas. The most severely affected area of dieback, in the centre, also has the lowest annual rainfall. The timing of this dieback also coincides with one of the worst droughts on record, as well as, over the longer period, a changing climate. There has also been a change in the distribution of rainfall in this area. The net result is that although there has been a small drop in annual rainfall overall, there is a large difference in its distribution, with more in summer and very much less rainfall in autumn.

During the Millennium Drought, annual rainfall dropped from about 550 mm to 450 mm. Ribbon Gums normally grow in relative wet areas. At 550 mm the tree is already at the edge of its natural range, and the reduction of rainfall to 450 mm could have had a major effect on that species. I conclude that the most likely cause of the Monaro dieback is climate, possibly related to a number of other factors. However, much of the evidence is circumstantial and it is unclear how the climate and the insect attack interact to cause the dieback.

There has been no evidence of recovery of the trees, despite the drought ending, and there is little regeneration happening. Therefore it seems that Ribbon Gums may disappear entirely from this area where they have been dominant in the past, and this could be one of the first examples of significant vegetation change due to climate change in eastern Australia. The challenge for managers now is to decide not just how to restore this landscape, but also what to aim for, given that we cannot go back to what was there before and we know that there are likely to be further changes in the future.

The team at Greening Australia want to know what species to plant there, and that raises two questions. What will survive in the future climate? What will provide the ecosystem values that have been lost or that we want to have there?

One suggestion is to translocate species into this Monaro area from a region that resembles our expectation of the Monaro climate in the future. That is quite controversial. Translocation has been widely talked about in the context of species that are threatened by climate change and are likely to be lost altogether. We are talking about moving these to a new location, but we have not really talked about translocations into a new gap left by the loss of a widespread species. I think that is an important discussion that we need to have and I hope the audience here will consider it and make suggestions.

Catherine recently completed her degree at the Australian National University, and received first class for her honours thesis. She now works as a project officer at Greening Australia Capital Region. This presentation is based on research for her honours project investigating the causes of eucalypt dieback in the Monaro region of NSW, at the Fenner School of Environment and Society, ANU.

+ This record of the talk given at the forum has been checked by the presenter, but not peer-reviewed. To find out more, contact the presenter, via their institution or by email to: info@fog.org.au.

* The work reported here is now published as:

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<http://www.tandfonline.com/doi/pdf/10.1080/00049158.2015.1076754>

