Dieback lessons: learning how to manage sustainably

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Background

Dieback is a term used to describe the death of vegetation - vegetation that is 'dying back'. All plants have a life-span and, eventually, individuals will die. This is quite natural. However, it is less common for large patches of plants to die at once. It is therefore with great alarm that, in recent decades, extensive landscape-wide death of native vegetation has been observed, particularly in heavily cleared rural environments.

Dieback can occur in two ways - as a natural event caused by natural processes or as an unnatural event caused by ecosystem dysfunction. This Note concentrates on the latter of these two processes as this is the major cause of dieback affecting natural vegetation across private land in Victoria.

Why be concerned? Rural dieback is a symptom of a wider illness affecting our land systems. Things aren't as healthy as they should be. We're not just losing a few trees, though this is significant in itself, but underlying this are changes in hydrology, salinity, the build up of pest insect populations and other factors. Our loss includes the shade for livestock, the wildlife and the panoramic Australian eucalypt-dominated landscapes. We can make decisions now that will shape what the future outcomes will be like but this will only occur if plans are turned into action. The history of concern about dieback goes back to last century. On-ground management changes are needed to address the problems associated with dieback.

How urgent is the situation? By comparing trees visible in aerial photographs in 1971 and 1993, covering 3300 ha of pastoral land in north-east Victoria, it has been calculated that in just 22 years 28% of the living trees have died[1]. If this rate continues, it will take just 77 years for all remaining trees to die.

There is still a great deal to learn about dieback. This Note is based on studies conducted into dieback. However, the exact causes of dieback in any particular instance may be quite complex, may vary from site to site, are likely to be inter-related and can be very difficult to determine. It has been necessary to make informed judgements, or best guesses, about many of the issues due to the lack of sufficient research. Please take this into account when using the material. Landholders are encouraged to use the information in this Note to undertake their own trials and explore approaches to dealing with dieback locally. An exciting challenge for this generation of landholders!

The aim of the Note is to develop practical ways for landholders to think about solving dieback problems, and tackling land management issues in general, and to encourage action.

The key messages are that we must manage our environment in an integrated way if we want to achieve the most benefits from it and that it is an option for us to shape what the future environment in each region will be like - these are processes that humans can determine, at least to some degree. Complacency toward dieback may occur when vegetation appears to recover, presumably due to improved conditions (e.g. a drought may kill beetle scarabs and reduce defoliation in subsequent years)[3]. Dieback must be treated as a complex problem requiring long-term solutions.

Symptoms

The following symptoms typify dieback-affected vegetation.

Loss of vigour

Typically, the first sign of dieback is loss of vigour. Plants become more and more unhealthy and reproduction may be affected. For example, all seed produced may be sterile. Rapid death may follow, such as in healthy vegetation affected by Cinnamon Fungus (*Phytophthora cinnamomi*), but often there are episodes of recovery, presumably as conditions improve for a time.

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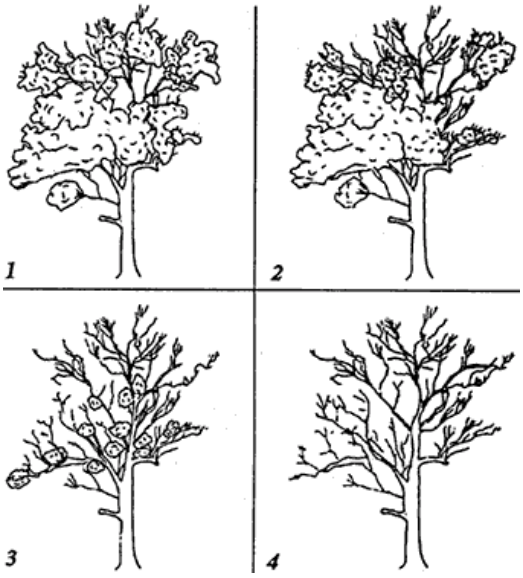


Stages of eucalypt dieback. 1. branch tips die, 2. extensive defoliation, 3. epicormic regrowth 4. tree death. Note that dieback in other plants may have different symptoms. Drawings by Stephen Platt.

Crown death

The uppermost small branches of trees and shrubs may die. Gradually this may extend to most of the crown. Intermittently, in good seasons, there may be recovery of vegetation, often from epicormic buds concealed beneath the bark of eucalypts, leading to clumps of healthy foliage amidst dead limbs.

Mistletoe infestation

Trees may become infested with parasites and diseases as they lose health. For example, tens of mistletoe plants may infest a single eucalypt or wattle. This is not a typical event in healthy native vegetation[2] and is probably a symptom of dieback.

Insect infestation and defoliation

The other commonly observed phenomenon is massive attacks by defoliating insects. For example, the entire foliage of trees may be consumed by species of beetles. Also, Swamp Paperbark *(Melaleuca ericifolia)* dieback in Rhyll Swamp, Phillip Island, coincided with defoliation by native Paperbark Sawfly caterpillars (*Pterygophorus* sp.) but the cause was not determined[8].

Large psyllid infestations, often attended by a colonial native species of bird, either Noisy or Bell Miner, are another indicator of unhealthy eucalypts. Psyllids are small insects (about 1-2mm long) that live on eucalypt leaves. The insect shelters beneath a covering, called a lerp, that is usually white and may be fan shaped or variously adorned with hairs or other protuberances.

Psyllid, under its lerp shelter, on a eucalypt leaf. Large numbers of psyllids may be an indicator of declining tree health. Photo:P. Atkinson

Causes of dieback

There may be one or more causes of dieback in any particular situation. The following processes are all potential candidates for causing dieback. Not all have been confirmed as causes due to insufficient research, but are regarded as probable causes by persons qualified to make such judgements[3]. They have been split into primary and secondary causes by the author because, whilst many causes are now operating, they may not have been the original cause of dieback. Several factors influencing dieback may act together, complicating management solutions.

Primary causes

Landscape clearance, and consequent ecosystem dysfunction, is believed to be the primary cause of rural dieback. Plants that were once fully integrated into a continuous forest or woodland, that are now standing isolated in a sea of introduced plants subject to completely different conditions, could be expected to be under extreme stress.

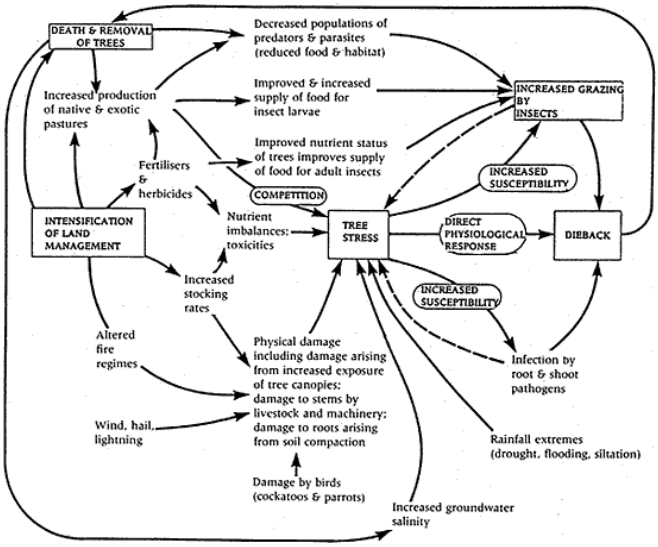
The obvious solution, though by no means an easy task, is to restore ecosystem function or at least those parts of the ecosystem that are necessary to ensure that as many benefits as possible can be maintained. This subject is considered later in this Note.

Simple monitoring techniques allow a deeper understanding of what is causing dieback. In this example, a tree branch has been bagged to exclude defoliating insects but allow light and air to enter. The result indicates that the tree is healthy and renders unlikely as explanations some potential causes of dieback such as old age, salting or nutrient deficiency. Photo: J. Landsberg

Secondary causes

Once the natural ecosystem is placed out-of-balance by massive clearance, other factors come into play. They relate to both human land management and to unusual fluctuations in otherwise natural phenomena.

In each of the following descriptions, it is the aim to indicate methods of monitoring or testing what is going on locally and also to suggest some of the potential remedial actions that might be taken. Please note that the actions must be used as an integrated package.



Possible relationships between factors contributing to dieback. From: Wylie, F.R. and Landsberg, J. (1990).

The diagram (above) indicates some of the probable linkages between the factors contributing to dieback

Insect attack

Beetles (especially Christmas Beetles), psyllids and phasmids are often involved. Some insect infestation of vegetation is normal and necessary for maintenance of insect-eating birds and other animals. In healthy vegetation, insect numbers are usually controlled by birds and other natural predators, or climate. Healthy plants are able to defend against a degree of insect attack but large numbers of insects can overcome these mechanisms. Insects may have benefited from increased pasture (beetle larval habitat), use of fertilizers (enriched food) and loss of natural predators. Monitor by exclusion bags over branches, leaf counts of insect numbers or defoliation, mapping the distribution of Noisy or Bell Miner colonies (psyllid harvesters - the feeding activity of these Miners is actually an advantage to psyllids), other small birds (psyllid feeders which are excluded by Miners), bats and Sugar Gliders (beetle feeders). Actions 1-6, 9-12.

Salinization, waterlogging, Cinnamon Fungus.

Sites, particularly those that are low in the landscape, may be affected by rising salinity, waterlogging or a fungal pathogen that attacks plant roots. Monitoring includes test wells to determine salinity levels and water depth and soil and plant tissue analysis to look for pathogens. Actions 7-9.

Nutrient enrichment

Particularly where stock camp under the shelter of trees and in areas where fertilizers and other chemicals are used. Also, from improper disposal of nutrient rich sources such as dairy and household effluent. Monitoring may include soil and water tests for nutrients and tracking nutrient disposal from source to outlet. Actions 2,6.

Pathogens

Some fungi, which are normally not a problem in healthy eucalypts, may spread in defoliated trees and can play a role in dieback. Observe stem sections for cankers (dead wood surrounded by live wood). Action 7. The role of Cinnamon Fungus is referred to above.

Senescence

An ageing population of plants will obviously include a greater proportion of unhealthy and dying individuals. Monitoring could include looking at the response when exclusion bags are placed over defoliated branches (to look for healthy regrowth in absence of insects, no regrowth might indicate a plant has no capacity to recuperate), counting the number of saplings (to indicate recruitment of future generations) and percent of seed germination. Actions 5, 9, 11.

Grazing of bark

This affects stringybark eucalypts in particular. Obvious signs of bark loss at or below breast height indicate this as a likely problem if livestock are present. Action 5.

Livestock can certainly play a role in dieback. These trees have been girdled by livestock. They are likely to die.

Drought

Severe droughts may be a contributing cause of dieback. They may also be involved in recovery from dieback where pest insect populations are affected.

Soil acidification

Occurs as a result of fertilizer use. A problem for pasture as well as native vegetation. Simple soil test kits are available to monitor acidity. Compare unhealthy sites with healthy ones. Action 3.

Airborne salt

Can affect vegetation within range of coastal winds (approx. 15 km). Monitoring may take the form of sampling vegetation to check for salts or comparing salt pruning of shoots on more and less exposed areas (leeward side of larger blocks of vegetation). Actions 3, 9.

Nutritional disorders

Practices associated with agriculture may have affected the availability of some essential plant nutrients. Soil tests can detect nutrient deficiencies. Actions 2, 6.

Deterioration of soil structure

Compaction by livestock and loss of soil conditioning organisms through application of chemicals, fertilizers and ploughing, may be a factor in dieback. Monitoring might involve testing soil penetration at healthy and unhealthy sites using a steel rod or taking equal quantity of soil samples from a number of sites and laying them on paper to count the number and diversity of soil organisms that emerge. Actions 2, 5, 8, 12.

Mistletoe

Mistletoe infestation at levels experienced by isolated trees in paddocks may cause the death of the tree but mistletoe infestation is probably not an initial cause of dieback. Parasites, such as mistletoe are likely to become prolific when the natural defences of a plant are reduced due to ill health[2]. Actions 1-12.

Loss of natural predators

Loss of birds, reptiles, mammals and predatory insects may be an important factor in dieback, permitting defoliating insect populations to spiral out of control. This may be helped along by Miner colonies which harvest psyllids and exclude other small birds which feed on them[5] . Compare small bird populations in healthy and unhealthy areas, map the distribution and score the diversity of understorey species. Actions 1, 3-5, 10-12.

Altered fire regimes

Has been associated with dieback. Comparing sites which have been burnt with those unburnt may help determine if this is a likely factor. Alternatively, investigating the response of an area after burning may indicate its use as a management technique. Action 11.

Damage by livestock, machinery, herbicides and other agricultural chemicals

All these factors can be detrimental to plant health and may be responsible for localised occurrences of dieback. Monitoring may involve comparing the areas potentially damaged with areas that could not have been. Actions 2, 5.

Flooding, hail, wind, frost, lightning

May cause local incidence of dieback.

Actions

How can such a complex issue be solved?

The first point to note is that whilst some dieback issues are very local (e.g. ringbarking) most occur at a landscape scale and so working with neighbours is necessary to find solutions. There are many options for facilitating this, including *Landcare* and *Land for Wildlife* groups. You may be able to obtain advice and co-ordination from the local Catchment and Land Protection Board or CNR office.

The second point is that tackling dieback is as fundamental as addressing water quality, salinity and other catchment issues that affect the local human population and its environment. Many of the actions necessary are possible

to achieve, particularly if every person contributes. Of course, there are barriers such as financial costs involved and physical capacity to carry out the work. Assistance on both of these issues is available through various incentive scheme, grant programs and philanthropic trusts and via government employment programs. Ask your local *Land for Wildlife* extension officer to identify sources of assistance. Many of the resources are available locally and this is another reason to work with neighbours, as much of the equipment and ideas can potentially come from local sources.

Thirdly, a great deal can be learnt by setting up a monitoring program. Test actions and follow the response of the vegetation. For example, photograph areas at regular intervals following treatment.

Reinstate natural processes to the maximum extent possible.

This may involve:

1. restoring understorey vegetation (e.g. Black Wattle provides essential winter food for Sugar Gliders which eat Christmas Beetles, Tree Violet provides for predatory wasps). Include a diverse array of local native species in your revegetation efforts to build in as many natural links as possible (LFW Note 32 'The value of understorey vegetation').
2. minimizing fertilizer and chemical use. Where used, they should be kept away from native vegetation and water bodies. Safer storage and disposal of chemicals.
3. creating blocks of vegetation, rather than narrow strips, and linking areas of vegetation with corridors. Blocks are less affected by edge effects[6].
4. retaining live and dead trees with hollows as wildlife habitat (LFW Note 6 'Wildlife needs natural tree hollows').
5. fencing to exclude livestock (LFW Note 29 'Fencing wildlife habitat').
6. managing nutrient disposal (contact the Department of Agriculture, Energy and Minerals).
7. quarantining areas infected by Cinnamon Fungus[7].
8. controlling salinity and erosion through revegetation.
9. revegetating areas of land.
10. controlling predators of wildlife (cat, fox). Artificial manipulation of predator populations using nest boxes or feeding supplements may be a short-term response. (LFW Notes 24 - fox, 25 - cats, 31- rabbits, 14 - nest boxes).
11. reinstating natural fire regimes (discuss the options with CNR staff).
12. leaving leaves, twigs and branches where they fall in selected areas managed for dieback control and wildlife habitat.
13. and other measures that address the primary cause or potential for secondary causes to start up or continue operating. Taking greater care to avoid direct damage to vegetation (e.g. as caused by vehicle movements) is also important.

As a general rule, begin with protecting what is still healthy first.

While it may not be possible to save an individual tree or other plant affected by dieback, due to the poor state of its health, it may be possible to preserve the benefits by allowing it to regenerate by fencing the area and other means (refer *Land for Wildlife* Notes 13 'Natural regeneration - principles and practice' and 16 'Natural regeneration - case studies on the farm').

It is probable, in many situations, that going back to the original forces operating in an ecosystem is not an option due to the extraordinary extent of changes that have occurred. Even so, some rebuilding will be possible.

Alternatively, you can choose species selected to withstand the new regimes, which may include exotic species but should not include species which have the potential to invade native vegetation (environmental weeds). A list of environmental weeds is available from *Land for Wildlife* extension officers. If this choice is selected then many values associated with local species will be lost.

What will happen if nothing is done?

We can guess that a new balance in the ecosystem will be achieved. However, this new balance may not include as many benefits for humans as the previous one. Saline unproductive land, increased management inputs, reduced water quality, less wildlife and so on are likely.

Tackling dieback is part of an overall need to manage land more sustainably. Your contribution today will benefit many future generations of people who live on, and rely on, the land.

References and further reading:

One way or another, most of the Notes in the *Land for Wildlife* series relate to this issue.

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