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NEWSLETTER OF THE LAND FOR WILDLIFE SCHEME

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JARRAH DIEBACK

Elaine Davison

Introduction

One of the most distressing things for a landholder is to watch a tree or group of trees decline in health or die. There are always questions of why this has happened, what the cause was, and whether the deaths could have been prevented. It is usually impossible to be completely confident about why the deaths occurred, but it is possible to suggest the most likely reason(s).

There are two groups of factors that can cause, or be the main cause, of tree death. The first is a combination of site characteristics and weather conditions; the second is that the deaths have been caused by pests and/or pathogens. The combination of site and weather conditions is, in my experience, by far the most common. So when asked for my opinion about recent deaths I go through my mental checklist of 'too dry, too wet, too hot, too cold'.

Site and weather conditions

There are some local examples of death or decline in health that can be attributed to a combination of site and exceptional weather. A recent example is the death of jarrah and other trees on sites with shallow soil in the northern jarrah forest that occurred in the summer and autumn of 2011. These deaths are consistent with drought deaths because they followed exceptionally low winter rainfall in 2010 and the exceptionally hot, dry summer of 2010/2011. The trees had shed a lot of leaves over summer, indicating they were under severe water stress for several months before they died. They had just run out of water.

An example of the 'too wet' explanation is the death of several species of planted eucalypts in the Lake Warden Catchment, Esperance, in 2007. These deaths started within a few weeks of the heaviest rainfall on record, in early January 2007. Although the rain was widespread, the deaths only occurred on duplex soils adjacent to saline areas. The most likely cause of death was either waterlogging, or saline waterlogging.

Dead Jarrah trees on a dieback area near Dwellingup in the 1960s. Photo: from 'Progress Report: Jarrah Dieback Research, November 1969, Forests Department Western Australia.'.

An example of heat scorch occurred in the Great Southern in February 1991 when there were several days with maximum temperatures in the mid-40s. Many wandoos, jarrahs and yates were affected. The crowns turned brown and the terminal shoots died, however most trees recovered within a few months. Similarly frost damage is not usually fatal, although it can lead to extensive dying back of affected trees.

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Jarrah dieback

Pests and pathogens

There are two examples of pests and pathogens causing widespread tree deaths, neither of these occur in Australia, and both are of quarantine concern.

The pine wilt nematode infects the sapwood of many different pines. It blocks capillaries in the sapwood so that the trees cannot conduct water efficiently, and eventually die. Similarly, the fungal pathogen that causes Dutch elm disease blocks capillaries in the sapwood of elms, resulting in wilting and death.

Local problems, where does jarrah dieback fit?

Jarrah dieback was the most significant forestry problem after the Second World War. The name was given to the death of groups of jarrahs that died suddenly, on poor quality sites that had been recently logged, and were prone to waterlogging. Banksias and sheoaks also died.

The WA Forests Department and the Forestry and Timber Bureau in Canberra were so concerned about the economic impact on timber production, that they jointly established a research station at Dwellingup to determine the cause of these deaths.

There were a number of investigations. Trees were excavated and examined to see whether pests or pathogens were involved, but this did not appear to be the case. The only abnormality was that many of the capillaries in the sapwood were blocked, but it was not known whether these blockages were the cause or the consequence of death. It is now known that waterlogging can cause these blockages, so it appears that these deaths resulted from waterlogging damage.

How does phytophthora come into the picture?

By the late 1950s the investigations into jarrah dieback had stalled, so in 1959 the Forestry and Timber Bureau appointed Frank Podger as a research officer at Dwellingup to initiate new lines of research. He started by considering whether site and weather conditions might be causing these deaths. Then in 1962 he investigated the deaths of pine shelter-belts on the Swan Coastal Plain, which directed his attention to work on pine deaths and declines in other parts of the world. These were associated with phytophthoras, pathogens that had a wide host range and were difficult to isolate. It was a breakthrough moment because Podger thought that phytophthora might be important in jarrah dieback.

He started to work with Ralph Doepel, the diagnostic plant pathologist at the Department of Agriculture, to determine whether phytophthora was involved in jarrah deaths. In 1963 they excavated dying trees, but were unable to isolate a phytophthora. So in 1964 they started pot experiments using soil from sites where jarrahs had died. Their results indicated that there might be something in the soil that was affecting the health of jarrah and banksia seedlings, but they were unable to isolate a phytophthora.

Then George Zentmyer, a phytophthora specialist from the University of California, visited them in WA, and isolated *Phytophthora cinnamomi* from soil and root samples supplied to him. Using Zentmyer's techniques, Doepel isolated *P. cinnamomi* from soil from dieback sites in the forest. Podger started a large field sampling programme and showed that *P. cinnamomi* could be isolated from many different plants, and he also showed it could infect and kill jarrah and banksia seedlings. By 1966 he was confident that *P. cinnamomi* caused jarrah dieback. Podger's explanation was accepted in good faith by the Forests Department, which started a major programme aimed at minimising spread of this soil-borne pathogen, mapping its distribution, and determining whether there were alternative timber species that could replace jarrah on infested sites.

There was a problem however with Podger's interpretation that *P. cinnamomi* caused jarrah deaths. When establishing the cause of a disease, the first step is to show that there is a constant association between infection of the host and isolation of the suspected pathogen. Podger's approach had been back to front, and in order to rectify this, he conducted a major sampling programme between 1965 and 1968 to show that phytophthora could be readily isolated from jarrah and other affected forest plants. Although he sampled 100 jarrah trees he only found five were infected, and so did not demonstrate this constant association in forest trees. Unfortunately he failed to mention this in any of his reports. What he did was argue that jarrah dieback was a single problem caused by *P. cinnamomi* that did not just kill jarrah, but other forest plants as diverse as banksias and balgas. It was an explanation that was universally accepted.

What's in a name, one problem or two?

The most likely explanation of jarrah deaths in the wet decades of the 1940s-1960s is that they died from waterlogging because deaths were on sites that had been opened up by recent logging where waterlogging occurred. The trees had symptoms of waterlogging damage in their roots and there were no consistent signs of phytophthora infection. So these deaths are an example of the site/weather conditions scenario.

Some of these sites would also have been infested with *P. cinnamomi*,

as indicated by the records of banksia deaths. These deaths would have been caused by phytophthora, because it rapidly invades the banksia sapwood, although it is not known precisely how it kills. So this is an example of death resulting from invasion by a pathogen.

Since the 1960s these banksia deaths have also been called jarrah dieback, even if they occurred on sites where jarrah does not grow. It's a recipe for confusion. More recently the name jarrah dieback has been changed to phytophthora dieback, although no attempt has been made to discriminate between jarrah deaths and banksia death. It would be better to restrict the name jarrah dieback for jarrah deaths on wet sites following exceptionally heavy rainfall, and use the name phytophthora dieback for deaths of banksias and other plants on sites infested by *P. cinnamomi*.

Looking at the jarrah forest now, jarrah deaths don't occur on the scale described in the 1940s-1960s. The climate is now much drier, with reduced rainfall over the past 30 years. The last widespread jarrah deaths occurred in 1982-84, following exceptionally heavy rainfall in January 1982. *Phytophthora cinnamomi*, however, is still with us and has caused widespread deaths of banksias, especially in the sandplains.

Does any of this matter?

These confusions arose a long time ago but it is still important to sort them out. Let's use an analogy. It you visit the doctor the most important thing you will receive is an accurate diagnosis, because this is the basis for both prognosis and treatment. It is the same for plant diseases; an accurate diagnosis is the first step for managing a problem.

Phytophthora management is well understood with strategies of quarantine and hygiene to minimise the spread of infested soil, as well as the application of phosphite fungicide to increase plant resistance.

Is it possible to manage site conditions to favour jarrah? The old forestry maxim about understanding sites, and tailoring the species used in replanting to site conditions, is still essential for survival and growth. It is worth remembering that site conditions can be changed e.g. by altering drainage or stand density, so that a tree established on a site many decades earlier may not be able to grow as well when site and weather patterns have changed.

Dr Elaine Davison was employed by the WA government in 1979 to work on jarrah dieback. She has investigated this problem from the point of view of jarrah, studying how it grows and dies on dieback sites, the suite of pathogens, including phytophthora, that affect it, and how it responds to waterlogging. She has also worked on karri, pines, tree seedlings and with horticultural crops. Between 2011 and 2013 she was President of the Australasian Plant Pathology Society. She can be contacted on:

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[For the scientific paper from which this article is drawn, contact the Editor.]

THE HIDDEN WONDERS OF LFW PROPERTIES!

Wayne Gill

Whilst reviewing a 2001 *LFW* report before a revisit to a property in the Esperance area, my attention was captured by the mention of a significant plant. It was Salt Myoporum (*Myoporum turbinatum*) a Critically Endangered Threatened Flora species only known from the Beaumont area which is 35km further to the east of the property in question. The report mentions a sample was sent to Kings Park but nothing of the resultant identification. Having been recently seconded to the flora conservation officer position I was familiar with this name, and aware there were only several hundred plants in known existence. After seeking approval from the new owners to look for the plants, I eagerly headed out to survey. What I discovered was far beyond any expectations! Yes it was the right plant, and my surveys resulted in an additional estimated 6000 plants being added to the population data, as well as a significant range extension and large amounts of new potential habitat.

This and subsequent discoveries by colleagues have resulted in the conservation status for the species being reviewed and potentially downgraded from Critically Endangered. It just goes to show, you need to know what you are looking for, as in this case, because there may be DRF everywhere under your nose!

Yellow flags indicate the location of many Salt Myoporum seedlings and juveniles surrounding a salt lake NE of Esperance.
Photos: Wayne Gill

Salt Myoporum flowers and fruit