Department for Environment and Heritage

Dieback in Native Vegetation in the Mount Lofty Ranges






A guide to causes and symptoms

Government of South Australia

action Salinity & Water AUSTRALIA

www.environment.sa.gov.au

Acknowledgments

Funding for this booklet and associated material was provided by the National Action Plan for Salinity and Water Quality through the Mount Lofty Ranges and Greater Adelaide Interim INRM Group with support from the Department for Environment and Heritage.

Some of the information in this booklet was adapted from fact sheets produced by CSIRO, Forestry SA, Queensland Natural Resources, Mines & Energy, Forestry Tasmania, Parks & Wildlife Tasmania, SA Department for Environment & Heritage, and Department of Primary Industries, Victoria.

Valuable advice was given by Ann Prescott, Ryan Incoll, Amelia Hurren, Renate Velzeboer, Phil Barron, David Paton, Charlma Phillips and Barbara Hall. Written and produced by Roger Playfair, RMP Environmental Pty Ltd.

Photo credits

BH - Barbara Hall, SARDI
JB - J Bailey, University of Leicester
JR - John Randles, University of Adelaide
RP - Roger Playfair, RMP Environmental
SC - Stella Crossley, Monash University
CP - Charlma Phillips, Forestry SA
OR - Otto Rogge Photography
NVC - Native Vegetation Council
RV - Renate Velzeboer, DEH

Purpose of this booklet

Dieback is a significant threat to the vegetation in the Mount Lofty Ranges. The loss of remnant native vegetation and revegetation through the interaction of many environmental factors is extensive and is affecting broader environmental issues such as water quality, salinity and biodiversity conservation.

If natural regeneration processes are interrupted, then dieback can lead to the ongoing and irreversible loss of vegetation throughout the landscape. There are several inter-related dieback factors prominent in the Mount Lofty Ranges and their nature, severity and extent needs to be understood before more focussed work to develop appropriate monitoring and control options.

This booklet is part of a package of material designed to help landholders and land managers understand the factors affecting the health of their vegetation. The package includes: ***this booklet***, that provides background information on dieback, ***a diagnostic chart***, that assists in the identification of possible causes of dieback, and a ***field record sheet*** for collecting information on the type and distribution of dieback. The chart presents two approaches for identifying possible dieback causes. Page 1 can be used to identify causes of obvious visible damage to vegetation. Page 2 can assist in identifying less apparent factors that may be affecting the health of vegetation or leading to more obvious impacts. Once the potential causes of dieback have been identified from the chart, more information on the possible causes can be found in this booklet. Page references to this booklet are provided on the chart.

The identification of causes and distribution of dieback will assist in the development of appropriate management options and improve our understanding of severity and extent of dieback in the Mount Lofty Ranges.

This material was developed for the Mount Lofty Ranges, but may be relevant in other areas.

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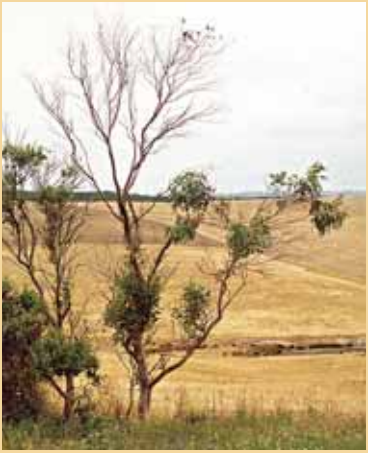
What is Dieback?

"Dieback" is a common term for the gradual death or long-term decline in the health of native vegetation. Some forms of dieback have probably always occurred in Australia. Our environment is marked by extremes of drought, flood and fire. All of these factors can place stress on plants. This can affect their health and their ability to cope with other more acute factors such as insects or pathogens. Fragmentation of vegetation through clearance for intensive agriculture or development compounds these stresses. Recovery often occurs, but plant death is inevitable if the stress factors continue long enough. Death can take months or even years. Large areas of native vegetation may be affected as well as individual plants. Most often observed in eucalypts, the classic visual symptoms of dieback occur in three stages.

1. The initial stage shows as crown or canopy thinning, beginning at the branch tips and progressively moving toward the trunk. Bare twigs often protrude from the tree crown.

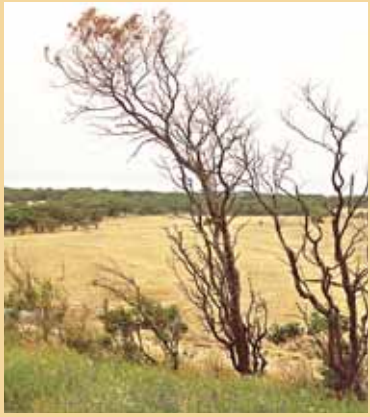
Stage 1 - crown thinning *(RP)*

2. The affected trees may partially recover through new stem and leaf growth from the trunk and branches (epicormic growth) as the tree attempts to replace the lost foliage of the crown.



Stage 2 - epicormic regrowth *(RP)*

3. Finally, all foliage, including epicormic growth dies off, leaving only dead twigs and branches.



Stage 3 - tree death *(RP)*

Symptoms to look for -

- Dead branches, often with bare twigs protruding from the tree crown
- Physical damage to, or deformation of, leaves
- Discolouration of leaves (not deciduous trees losing leaves in autumn)
- Insects (eg. caterpillars) or sticky coating on stems, leaves or under bark
- Holes and tunnels in timber under bark
- Excessive numbers of lumps or bumps on leaves and stems

What causes dieback?

Dieback is thought to be caused by any one or a combination of VISIBLE and UNDERLYING factors. Any or all of these factors can stress plants, reducing their vigour and vitality. The symptoms of the VISIBLE factors are usually more readily observed, and where these are obviously evident, some UNDERLYING factors are almost surely present.

VISIBLE factors include:

- A Yellowing leaves
- B Insect attack
- C Mistletoe infestation

UNDERLYING factors include:

- D Plant pathogens - organisms that cause plant disease
- E Lack of available soil moisture
- F Waterlogging
- G Increase in soil nutrients
- H Loss of understorey
- Soil compaction
- J Increase in soil salinity
- K Other factors

Ultimately, tree death occurs when the stressed plants are no longer able to fight off these factors.

What kind of "dieback" is affecting your vegetation?

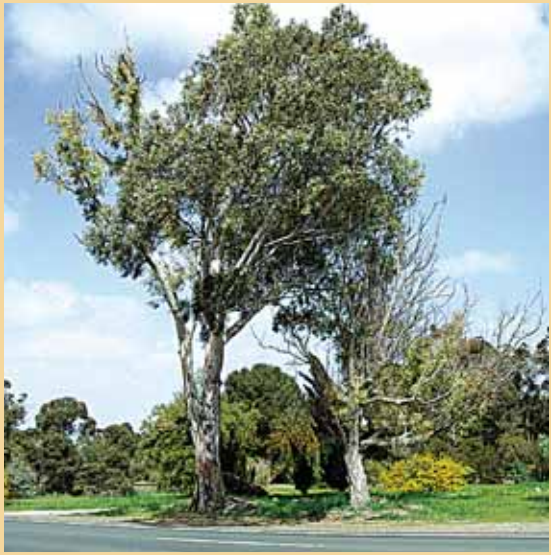
The Dieback Diagnostic Chart can be used to help identify which of these many factors may be bringing about the declining health of particular patches of our native vegetation. This chart is only intended to give an indication of possible factors causing the observable symptoms of "dieback" in native vegetation in the Mount Lofty Ranges. Once the most likely factors have been identified, further assistance and advice can be obtained from the information sources or contacts listed in the back of this booklet.

VISIBLE FACTORS

A *Yellowing leaves*

Leaf yellowing can be caused by a number of factors including herbicide drift or mineral deficiencies such as iron, manganese, magnesium, copper, zinc or potassium. Mundulla Yellows can also cause leaf yellowing. Mundulla Yellows is a plant disease affecting a wide range of eucalypts of all ages and similar symptoms have been observed on other native tree species *(eg. Melaleuca sp. Acacia sp. Banksia sp.)*. Little is currently known about the cause of Mundulla Yellows or its spread, but at present, a virus-like organism appears a possible cause. A reliable diagnostic test is not yet available.

Early symptoms include yellowing between the leaf veins in parts of the crown on the outer parts of limbs. The resulting small clump of yellowing leaves in the canopy gradually extends to affect that section of the canopy before moving to other parts of the crown. There is a progression of yellowing towards the trunk. The yellow leaves may develop red-brown spots and become distorted. Flowering and seed production declines. Later stages involve epicormic growth from below the affected area and a progressive dying back of the limb. Recovery has never been reported and affected trees eventually die.



possible Mundulla Yellows on river redgum in the South East of SA.
left: ***Early stage;*** *right:* ***Medium stage***
(JR)

A lot of confusion can be caused by false diagnosis of Mundulla Yellows. Symptoms are unsuitable for diagnosis because they may be easily confused with similar symptoms caused by environmental factors. However, the characteristic progression of Mundulla Yellows through well-defined early, medium and late stages is unlike anything reported for any other eucalypt disease or disorder.

B *Insect attack*

Insects can damage vegetation when consuming it as food or using it as shelter. Plants can normally cope with this damage, however survival may be threatened if it is excessive. Insect damage is one of the more easily observed factors in dieback. Insects can affect plants in many different ways. Most of the insects that attack native vegetation are native species themselves and are a necessary and important part of the ecosystem. They only become a problem when the natural population control factors are altered. Insects can be divided into general groups relating to the damage they cause, as leaf defoliators, leaf skeletonisers, gall formers, sap suckers or borers.

Sawfly larvae (Perga sp. - spitfires) *(SC)*

Chrysomelid (Paropsis sp.) beetles with eggs *(CP)*

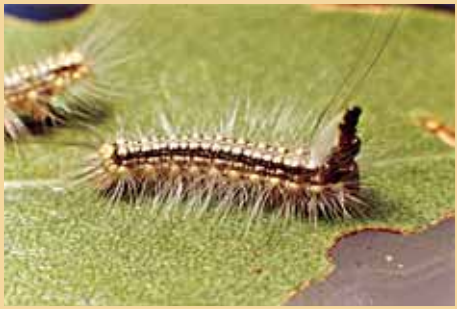
Cup moth (Doratifera sp.) larva *(RP)*

Chrysomelid beetle larvae damage *(JB)*

Leaf defoliators (or grazers) chew off pieces of leaves and eat them. Damage may appear as tiny or large holes, or as irregular shaped leaves with jagged edges. Defoliators account for a large part of the conspicuous damage to trees. Examples include caterpillars (larvae) of Cup moths, Bag moths, Emperor gum moths, Sawfly larvae and larvae and adults of Eucalypt leaf beetles (Chrysomelid beetles), Christmas and other Scarab beetles and Eucalypt weevils. Sometimes whole leaves are eaten and only the midrib remains.

Leaf skeletonisers do not chew all of the leaf, but take the surface off, leaving the veins and mid-rib exposed like a leaf "skeleton" still attached to the tree. Larval stages of the Autumn gum moth, and Gum leaf skeletoniser are examples.

Young Autumn gum moth caterpillars skeletonise and mature caterpillars eat whole leaves.



Gum leaf skeletoniser larva (Uraba sp.) *(CP)*

Leaf Skeletoniser damage *(OR)*

Mature Autumn gum moth (Mnesampela sp.) caterpillars *(CP)*

Leaf blister sawfly (Phylacteophaga sp.) damage *(RP)*

Leaf Blister Sawfly larvae, a type of leaf skeletoniser, produce distinctive transparent, brown "blisters" on leaves, caused by the larvae feeding just below the leaf surface. Leaf miners also produce similar symptoms, leaving a thin "skin" over their feeding lines as they move just below the leaf's surface.

Galls are formed in response to insects laying their eggs inside plant tissues, in response to larvae feeding or by fungi and bacteria. The plant responds by producing an enlarged growth or "gall" around it. These galls can be small pimples on the leaves or spherical woody balls, woody enlarged stems or large lumps on leaves.

Wasp galls on eucalypt leaf *(RP)*

Typical gall on eucalypt leaf *(RP)*

Witches' brooms are a symptom in woody plants where many twigs are densely clustered together, resulting in a mass of abnormal shoots that resemble a broom. Leaves are often small and deformed with yellow margins. This growth of abnormal shoots can be caused by various microorganisms or insects, including Chrysomelid beetles and by nutrient deficiencies. Witches' broom may give the tree an odd appearance, but won't kill it. Witches' broom may be confused with mistletoe. Obvious differences are that mistletoe has green leaves, fleshy fruit and flowers, and is usually part way along a branch. Witches' brooms are usually at the growing tips on the ends of branches and do not have flowers or fruit.

Witches broom on eucalypt branch tip *(RV)*

Dead mistletoe on dead eucalypt *(RP)*

Sap suckers are insects that feed by sucking the nutritious sap from leaves and stems. The damage they cause may be subtle with little initial obvious external evidence of attack. However, damage usually becomes very evident as population numbers build up. Aphids, psyllids (lerp insects) and scale are examples. Psyllids protect themselves by building a waxy covering (lerp) under which they feed and reproduce and are safe from predators and insecticides.

Cardiaspina *sp. and* Lasiopsylla *sp.*
lerps on eucalypt leaf *(OR)*

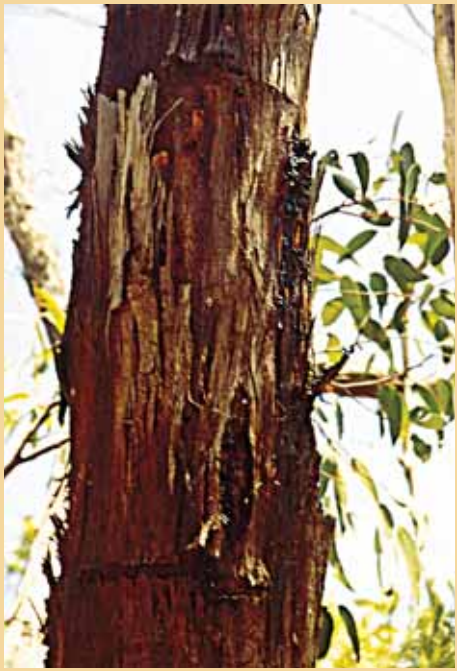
Lasiopsylla *sp. lerps and psyllid nymph*
and adult on eucalypt leaf *(CP)*

Gum tree scale and sooty mound
on eucalypt *(CP)*

Scale, a sap sucking insect, appear as dense colonies of white or brown globules on the stems and leaves. They produce sticky honeydew. A black fungus called Sooty Mould often grows on the honeydew. Often there are conspicuous colonies of ants that feed on the honeydew.

Borers are insects that make holes in the hard tissues in the wood, roots or bark as they feed. Ringbarking can occur. This damage is sometimes in dead wood, more often in live trees, and generally due to feeding by the larvae of longicorn, scarab and jewel beetles and cossid wood moths. Lifting the bark may expose the channels and tunnels of borer species that feed just below the bark. Other species feed on the inner sapwood and heartwood and their presence is usually not apparent until the adults emerge and holes are found in the tree trunks. By this time the damage has already been done.

Bulls eye borer (Phoracantha acanthocera) larva *(CP)*



Borer damage affects bark growth *(RP)*

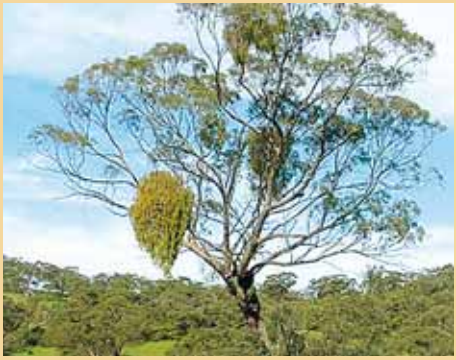
Adult longicorn beetle (Phoracantha sp.) *(RP)*

C *Mistletoe infestation*

Mistletoes are flowering plants that grow on other plants. They reproduce from seed spread mainly by birds. There are 17 species of mistletoe native to South Australia and they are found on many different trees and shrubs, but mainly on eucalypts in the higher rainfall areas. Mistletoes are partly parasitic on a range of species. They grow entirely on their host plant, have no roots in the soil, and obtain all their water and mineral requirements through their host. They also have green leaves that photosynthesise to produce organic matter. Many fauna species (birds, butterflies, ants, possums) rely on mistletoe for food (particularly when little else is flowering or fruiting) and for nesting. A healthy host plant can support and survive the impact of several mistletoe. A very heavy infestation in combination with underlying factors can cause the host plant to die. For example, severe mistletoe infestations, particularly during drought, can draw significantly on the host's water and nutrients ultimately causing the host to die.

Box mistletoe with flowers on bluegum *(RP)*

Box mistletoe on bluegum *(RP)*



Box mistletoe on redgum *(NVC)*

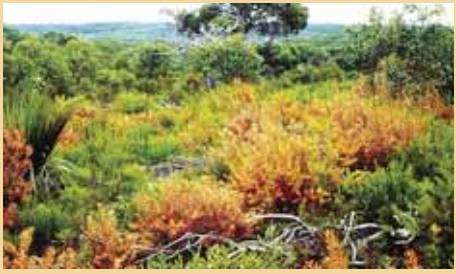
UNDERLYING FACTORS

D *Plant pathogens - organisms that cause plant disease*

Phytophthora root rot is one of the most serious pathogenic threats to native vegetation in the higher rainfall areas. It is a microscopic soil and water borne watermould (a fungus-like organism), and the only visible sign of its presence is the decline or death of the plants it attacks. Symptoms of *Phytophthora* infection are very similar to those brought on by drought. In the case of drought, the soil has been dry for some time prior to plants dying, and all plants generally die simultaneously. With *Phytophthora*, the soil has been warm and moist prior to plants dying and there is a progression of deaths over time (from a few weeks to many years). Symptoms often first appear in spring and early summer. *Phytophthora* infects roots and stems of plants. Mortality results from a restricted capacity to take up water and nutrients. Diseased plants usually show either red or yellow discolouration of foliage, while plants resistant to *Phytophthora* remain healthy. Visible symptoms may take up to a few years to develop after the initial infection. On slopes, plant death progresses down the slope more quickly than uphill and there may be a sharp boundary between diseased and healthy plants. A group of dead or dying susceptible plants is generally a good indication of *Phytophthora* infestation. Susceptible plants include *Banksia* sp., *Xanthorrhoea* sp. (yacca), *Pultenaea* sp. (bush peas) and *Acacia* sp. (wattles). Plants suffering from *Phytophthora* infection do not recover!

Other diseases that may produce dieback symptoms include the wood-rotting fungi, *Armillaria* and also fungal leaf pathogens that cause "corky leaf spot", "crinkle leaf disease", "angular leaf spot" and "sooty mould". Generally, these leaf diseases do little long-term damage.

Phytophthora killing Xanthorrhoea *(BH)*



Phytophthora killing Banksia *(RV)*

Crinkle leaf disease *(CP)*

E *Lack of available soil moisture*

Lack of available soil moisture can affect both understorey and overstorey. Symptoms show up as lowered growth rates, yellowing of young leaves and a gradual dying back from the growing tips. Natural events such as prolonged, abnormally dry periods (drought) gradually starve plants of water, causing a loss of vigour and health decline that may ultimately lead to death, particularly if other stress factors are present.

Local water tables can also be lowered through excessive extraction of water for irrigation and consumption.

F *Waterlogging*

Waterlogging occurs when there is too much water in the root zone of a plant. Roots become unable to absorb oxygen and nutrients. Leaves yellow and nutrients such as iron and nitrogen may become deficient. Wilting of the entire plant can occur as roots decay. Trees and deep-rooted plants play a crucial role in maintaining the water table. Clearance or gradual death of trees from old age alters this balance and causes the watertable to rise. Damming streams and flooding may also cause locally high watertables. Clay soils and sand over clay are most prone to waterlogging. Digging holes 40 cm deep and observing whether water flows into them provides an indication of waterlogging.

G *Increase in soil nutrients*

Fertiliser application is often used to improve growth rates in pastures and can negatively affect native vegetation by increasing nitrate and phosphate levels in the soil. Symptoms such as slowed growth occur first and yellowing leaves follow. This increase in plant nutrients favours the establishment and growth of introduced species over most native species. This gradually removes or replaces the native understorey, a key component in the ecosystem, leading to the loss of a range of animals and plants and the ecological processes they contribute to.

Nitrogen compounds can also be introduced through stock manure breaking down in the areas where stock camp. This also has a flow-on effect of making the tree leaves more palatable to some insects, leading to higher levels of insect attack.

H *Loss of understorey*

Loss of understorey does not directly cause dieback, but adds to the stresses created by other factors and affects trees in various ways. It can:

- reduce deep-rooted vegetation available to control water table levels.
- force birds that may be carrying diseases and mistletoes to roost more on overstorey plants.
- allow stock access to areas close to tree trunks, worsening the effects of increased nutrients and soil compaction.
- decrease the available habitat for insectivorous birds and other native animals. Less insect predators may increase the risk of insect attack.

Lack of regeneration and recruitment to replace old or dying plants compounds these effects. As trees get older their vigour naturally declines, making them weaker. If younger, stronger plants do not replace them, the population gradually thins out, ages and dies.

Soil compaction

Soil compaction through steady or continuous stock traffic and stock camps slows the infiltration of water into the soil, interferes with nutrient cycling and affects soil microbial activity. This adds to stresses created by extended dry periods, bringing about similar symptoms to low soil moisture availability.

J *Increase in soil salinity*

Increasing soil salinity can result from waterlogging or from accumulation of salt in soils after irrigation water has evaporated. Waterlogging and salinity increases often occur together. Salt that is normally stored in the soil is dissolved and becomes available to plants, making it more difficult for them to take up water and nutrients. Symptoms are slightly different from other forms of "dieback", in that affected plants first show a much-reduced growth rate and dead patches on leaves, particularly at the margins and tips. Leaves low on the tree are affected first, and leaf death progresses from the base of the canopy upward. Presence of salt tolerant plants and salt crystals in seepage areas are also good indicators.

K *Other factors*

There are a range of other factors that are not necessarily linked to true dieback, but can produce symptoms in native vegetation that may be similar.

Lack of essential plant nutrients

Deficiencies of some plant nutrients such as iron, manganese, and magnesium can also produce symptoms resembling dieback such as yellowing leaves, defoliation or browned-off leaf tips.

Extreme weather

Severe or unseasonal frost, sand or dust storms and hail on native vegetation can give the impression of dieback. However plants will usually recover from these impacts.

Herbicide drift

Herbicide, either leached through the soil or absorbed through leaves, can also produce symptoms of ill health and cause death in native vegetation. Different herbicides cause different symptoms, but usually include a change of leaf colour.

Damage by native animals

A range of animals can cause damage to vegetation during feeding, roosting, nesting or other behaviours. It is unusual for these activities to lead to tree death.

Koalas sometimes graze manna gums so heavily that severe defoliation and sometimes tree death occurs. Other less severe impacts can be caused by galahs stripping bark; possums defoliating trees; sulphur-crested cockatoos picking off leaves; little corellas chewing hollows out for nesting and black cockatoos removing bark and ripping open trunks whilst searching for insects.

Fire

Fire often burns off all the foliage from both understorey and overstorey plants leaving what looks like dead trunks and limbs. Some species are killed, but eucalypts are able to recover by producing new shoots from their base, trunks and limbs (epicormic growth). Over time, these trees often recover completely, but at some stages, foliage-free limbs may still protrude from the canopy. This gives the impression of dieback, but the tree is actually in a recovery phase. Blackened trunks from fire can last many years.

Old age

Many large eucalypts may be hundreds of years old and are slowly dying of old age. This shows as whole large limbs dying off, growing tips dying back and a thinning of the canopy.

What can be done?

Treatment of the UNDERLYING factors is likely to provide the only long-term solution. Treatment of VISIBLE factors may only have limited effect because reestablishment, reinfection, or reinfestation is possible if the main stress factors are not removed. It is important to identify factors correctly before taking any action.

LONG TERM remedial actions may involve:

Reduction of grazing pressure in the area G I

Reduction of grazing pressure in the area may require some fencing. Decreasing grazing pressure on the understorey will, over time, decrease the effects of compaction, reduce the importation of plant nutrients and may allow for natural regeneration of overstorey and understorey plants.

Allowing natural regeneration of both understorey H E K J and overstorey will provide additional and alternative food sources, and more perching and nesting sites for a range of birds, and for other insect-eating predators. Replacement of an aging overstorey will provide new generations of plants more able to withstand environmental stresses than many of the very old paddock trees. At a regional scale, regeneration can help lower water tables and restore ecological processes. If regeneration does not occur after some years after stock removal, re-establishment of local native vegetation may be necessary. Do not remove dead trees and shrubs, particularly those with hollows suitable for nesting, as they may still provide valuable habitat for native fauna.

Reducing or ceasing herbicide use around native vegetation K

Reduction or elimination of herbicide spray drift will ensure that native vegetation is not subjected to stresses and ill health from inadvertent poisoning. Spraying, if necessary should only be undertaken on calm days. Drift from fertilizer application can also affect off-target areas and should be undertaken with care around areas of native vegetataion. With the increasing fragmentation of remnant native vegetation, management at the boundaries between areas of vegetation and adjacent land uses is becoming increasingly important. It is at these "edges" that the vegetation is likely to be affected by activities on adjacent land.

Improvement of pathogen hygiene practices D A

For Phytophthora, the spread of contaminated soil and water must be prevented at all times. To minimise the spread of Phytophthora:

Do not enter the infested area, or if this is not possible,

- Do not work in the infested areas when it is raining or when the soil is moist. Postpone activities.
- Do not remove water, soil or plant material from infested areas.
- Work in uninfested areas before moving to infested areas.
- Stay on formed roads and tracks.
- Clean soil from, and preferably disinfect vehicles, bicycles, footwear, machinery and equipment before leaving an infested area.

For Mundulla Yellows, specific control measures can only be designed once the cause and the disease cycle are known. Until then, the following general hygiene practices are suggested :

- Clean and disinfect equipment and machinery in strong alkali or bleach solution before moving to another area.
- Do not remove cut material from the site.
- Do not distribute seedlings raised in one area to other sites.
- Use only local seed from asymptomatic trees for new plantings.

SHORT TERM remedial actions may involve:

Insect control

It must be recognised that many insects are beneficial and fill crucial roles in nature. Insect control should only be undertaken when damage reaches a level where tree survival is threatened, and then only with extreme caution so as not to harm beneficial insect populations. It is very important to identify the problem insects correctly before undertaking any control program. Whilst not necessarily providing a permanent solution, if undertaken in conjunction with other management changes, overall tree stress can be reduced, and survival rates improved. Single trees may be treated with insecticide or by manually removing pest insects and killing them. Sometimes spraying with soapy water can discourage insects and other browsing animals, but rain reduces the effectiveness. In extreme cases, removal of part or the entire affected tree can help reduce the spread.

Mistletoe

As mistletoe can be a valuable plant in its own right, any removal on a significant scale must be discussed with, and endorsed by, the Biodiversity Assessment Services Section (Dept of Water, Land & Biodiversity Conservation) or the Native Vegetation Council Secretariat except where the mistletoe is in a township or removal is from ten trees or less.

Mistletoe may be removed in accordance with the guidelines for Clearance of Box mistletoe, *Amyema miquelii* produced by the Native Vegetation Council where the trees are scattered over pasture, along roadsides, or in other situations where other native vegetation has been largely replaced by exotics, and where the trees contribute significantly to the amenity of the district or locality, and where the trees are showing signs of significant dieback clearly linked with the level of mistletoe infestation.

If in doubt, or if more information is required, use the sources or contacts listed in the back of this booklet.

Contacts

Bush Management Adviser - Mount Lofty Ranges
Dept for Environment & Heritage
115 Maryvale Rd
Athelstone SA 5076
08 8336 0954

Bush Management Adviser - Mount Lofty Ranges
Dept for Environment & Heritage
Mount Lofty Ranges Catchment Centre
corner Mann & Walker Streets
Mount Barker SA 5251
08 8391 7511

Ecologist Phytophthora Management
Dept for Environment & Heritage
PO Box 721
Victor Harbor SA 5211
08 8552 0306

Regional Ecologist
Dept for Environment & Heritage
115 Maryvale Rd
Athelstone SA 5076
08 8336 0995

Forest Health Scientist
ForestrySA
PO Box 162
Mount Gambier SA 5290
08 8724 2888

Background information

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Identification aids and Field Guides

Carnegie, Angus (2002) *Field guide to common pests and diseases in eucalypt plantations in NSW* State Forests of NSW

CSIRO Identification Leaflets – Insect pests of eucalypts on farmland and in plantations in southeastern Australia

Hanold, D. & J. Randles (1999) *A Field guide to Mundulla Yellows* (3-fold brochure) University of Adelaide

Phillips, Charlma (1996) *Insects, diseases and deficiencies associated with eucalypts in South Australia* PIRSA SA Forests

Factsheets and pamphlets

ForestrySA factsheets *http://www.forestry.sa.gov.au/FM3.htm*

Victorian Primary Industries Information Notes series *http://www.dpi.vic.gov.au/notes/*

University of Adelaide Mundulla Yellows information
http://www.agwine.adelaide.edu.au/research/plant/path/pv/MundYellow.pdf

Forestry Tasmania leaflets
http://www.forestrytas.com.au/forestrytas/pages/forest_health_leaflets.html

Phytophthora management guidelines and information brochures
http://www.environment.sa.gov.au/biodiversity/plantsand.html

June 2004 FIS 17193.04 ISBN: 1 921018 03 8