Department for Environment and Heritage

Dieback in Native Vegetation in the South Australian Murray-Darling Basin






A guide to causes and symptoms

Government of South Australia

Natural Heritage Trust

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Purpose of this booklet

Dieback is a significant threat to the vegetation in South Australia's Murray-Darling Basin (SAMDB) 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 prominent inter-related dieback factors and their nature, severity and extent needs to be understood before more focused work to develop appropriate monitoring and control options is undertaken. 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
- 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 help identify causes of obvious **visible** damage to vegetation. Page 2 can assist identify less apparent **underlying** 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 can be found in this booklet. Page references to this booklet are provided on the chart.

Collecting information using the field record sheet and the identification of causes and distribution of dieback will assist in the development of appropriate management options and improve the understanding of severity and extent of dieback in the SAMDB.

This material was developed for the SAMDB, but may be relevant in other areas.

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Description of the Region

The region is vast, covering over 70,000 km^2 and supports a diverse range of natural environments and human activities including irrigated and dryland agriculture, tourism and recreation and various manufacturing industries.

The SAMDB can be divided into commonly accepted landscape-based areas:

South Olary Plains (SOP)

Murray Mallee / Murray Plains (MM/MP)

Eastern Mount Lofty Ranges (EMLR)

Coorong and Lower Lakes (C&LL)

River Corridor (RC)

The South Olary Plains, north of the River are predominantly low rainfall pastoral lands with generally poor soils.

The Murray Mallee / Murray Plains is a relatively flat low-lying plain, interspersed by sand ridges and sandhills with occasional large claypans.

On the western border of the basin, the relatively flat landscape rises from the Murray Plains to the higher rainfall Eastern Mount Lofty Ranges with generally deeper richer soils than the Mallee.

The Coorong and Lower Lakes is dominated by a large beach-dune barrier lagoon complex comprising the extensive Coorong lagoon and Lakes Albert and Alexandrina.

The River Corridor is unique due to the influence of riverine process in forming the landscape. Soils range from rich loams on the floodplain to alkaline mallee soils on the higher surrounding country.

What is Dieback?

"Dieback" is a common term for the gradual death or long-term decline in the health of vegetation. Some forms of dieback have probably always occurred in Australia. Our environment is marked by extremes of drought, flood, salinity 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, and riverine management, all compound these stresses.

Recovery often occurs, but plant death is inevitable if the stress factors continue long enough. Death can take weeks, months or even years. Individual plants may be affected, as well as large areas of native vegetation. 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 (NW)

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 (NW)

Stage 3 - tree death (NW)

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

Symptoms to look for -

- Thinning of crown foliage;
- Dead branches, often with bare twigs protruding from the tree crown;
- Physical damage to, or deformation of, leaves;
- Yellowing or other discolouration of leaves (not deciduous trees losing leaves in autumn); and/or
- Excessive numbers of:
  - Insects (eg. caterpillars);
  - Sticky coatings on stems, leaves or under bark;
  - Holes and tunnels in timber under bark; and/or
  - 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** Insect attack
- **B** Witches' broom
- **C** Mistletoe and Dodder-laurel infestation

UNDERLYING factors include:

- **D** Native vegetation fragmentation and isolation
- **E** Lack of available soil moisture
- **F** Waterlogging
- **G** Increase in soil salinity
- **H** Increase in soil nutrients
- **I** Loss of understorey
- **J** Soil compaction
- **K** Mundulla Yellows
- **L** Plant pathogens - organisms that cause plant disease
- **M** Other factors

Ultimately, tree death occurs when the stressed plants are no longer able to withstand the combined effects of 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 SAMDB. 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 *Insect attack (whole region)*

Insect damage is one of the more easily observed factors in dieback. Insects can affect plants in many different ways. They 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. Most insects that damage 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, sap suckers, borers or gall formers

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 leaves and mature caterpillars eat whole leaves.

The caterpillar of the Gum-leaf Skeletoniser attacks a range of eucalypts. Infestations on River Red Gums occur when the absence of flooding coincides with the larval stage. This allows insects to mature and lay eggs. Inadequate environmental flows in the rivers and creeks of the SAMDB no longer provide suitable conditions for the natural controls of the Gum-leaf Skeletoniser and their numbers will increase. Trees generally recover, but sustained attacks, or increased stresses from other factors, such as lack of available soil moisture or fire can ultimately cause tree death.

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)

Larvae of Leaf Blister Sawfly, 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 surface of the leaf.

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. However, damage usually becomes more evident as population numbers build up. If dying leaves do not appear to be chewed, then it is likely that sap-sucking insects, such as aphids, psyllids (lerp insects) or scale are present. Psyllids protect themselves by building a waxy covering (lerp) under which they feed and reproduce and are safe from predators and insecticides. Psyllids are generally most active during summer. Outbreaks of lerp insects on River Red Gum seem to occur when there is a succession of dry summers and wet winters.

***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 Mould on eucalypt (CP)

Scale look like dense colonies of white or brown globules on branches, stems and leaves, and can be found on a wide range of plants. Gum-tree Scale are a serious pest of eucalypts, particularly those with blue-green foliage, such as SA Blue Gum *(Eucalyptus leucoxylon)*. Severe infestations can cause malformation of terminal shoots, premature leaf drop, crown thinning, or even death. Scale produces sticky honeydew, upon which Sooty Mould, a black powdery fungus sometimes grows. Dense Sooty Mould can prevent adequate sunlight from reaching the leaves, effectively smothering the tree. Ants moving up the tree to feed on the honeydew can also be an indicator of scale infestation.

Borers are insects that make holes in the hard tissues in the wood, roots or bark as they feed. 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.

Borer damage affects bark growth (RP)

Bulls Eye Borer *(Phoracantha acanthocera)* larva (CP)

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

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, spherical woody balls, woody enlarged stems or large lumps on leaves.

Wasp galls on eucalypt leaf (RP)

Typical gall on eucalypt leaf (RP)

B *Witches' broom (whole region)*

Witches' broom is a symptom in woody plants where many twigs are densely clustered together, resulting in a mass of abnormal terminal 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, unless other stress factors are present. 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' broom is usually found at the growing tips on the ends of branches and does not have flowers or fruit.

Witches' broom on eucalypt branch tip (RV)

Dead mistletoe on dead eucalypt (NW)

C *Mistletoe and Dodder-laurel infestation (whole region)*

Mistletoe are a group of flowering plants that grow on other plants. They are semi-parasitic, using their host as a source of water and nutrients instead of roots. However, as with most other plants with green leaves, mistletoe produce their own food. Mistletoe reproduce from seed and are spread mainly by birds. There are 17 species of mistletoe native to South Australia and they can be found in all kinds of habitat. A healthy area of mallee or woodland will often have some mistletoe.

Many fauna species rely on mistletoe for food and for nesting. Many honeyeaters feed on mistletoe nectar, especially in late summer and autumn when little else is flowering. The Mistletoe Bird's survival is dependant on eating mistletoe fruit, and many other birds use mistletoe clumps for shelter and nesting. The leaves of mistletoe are eaten by a variety of native fauna, including butterflies and possums.

A healthy host plant can support and survive the impact of several mistletoe. However, a very heavy infestation, often resulting from other underlying stress 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.

Dodder-laurel (*Cassytha* spp.) or "snotty-gobble" are a group of native parasitic leafless plants that can, in isolated instances, become so dense that they smother the native vegetation on which they grow. They have slender twining, yellow to green threadlike stems. Seed germinates near the soil surface in spring and summer. The twining seedling coils itself around a host plant and produces small structures called haustoria that penetrate the host's vascular tissue and extract nutrients and water. Once established on a host plant, the soil root dies. Dodder-laurel can spread to surrounding hosts, creating a tangled mat of stems over affected plants. Severe infestations weaken host plants and reduce their capacity to recover from insect attack, disease and other stresses.

Box Mistletoe with flowers on SA Blue Gum (RP)

Box Mistletoe on SA Blue Gum (RP)

Dodder-laurel on Mallee (NW)

Box Mistletoe on River Box (RP)

Introduced dodder (*Cuscuta* spp.) can look similar to Dodder-laurel, and is a potentially significant agricultural issue that should be reported and controlled. For information on recognising and controlling dodder, contact an authorised Animal and Plant Control Officer through the SAMDB Natural Resource Management Board.

UNDERLYING FACTORS

D *Native vegetation fragmentation and isolation (whole region)*

Large-scale clearance for agriculture in many parts of South Australia, including the SAMDB, has resulted in fragmentation of native vegetation.

The now often-isolated remnants of native vegetation are spread amongst agricultural land that is inhospitable to most native flora and fauna. Very small remnants are often not only too small or disconnected from larger patches to provide adequate fauna habitat, but will themselves gradually die back through stresses imposed by the surrounding land use. Stress levels are highest at the edges of native vegetation and stress factors such as herbicide poisoning, changes to the soil moisture regime, weed invasions, mistletoe infestations, and exposure to more extreme weather are much more severe at edges, increasing the effect of other dieback factors.

E *Lack of available soil moisture (whole region)*

Lack of available soil moisture can seriously affect both understorey and overstorey. Symptoms include a gradual dying back from the growing tips (crown thinning), discolouration (yellow or red) of leaves and changing bark colour. Dead leaves generally remain attached to the tree or shrub.

Natural events such as prolonged, abnormally dry periods (drought) gradually starve plants of water, causing health decline and loss of vigour that may ultimately lead to death, particularly if other stress factors are present.

Vegetation on the floodplains of the River Murray is dependent upon regular flooding, and the River Red Gums in particular, owe their presence to the critical role of floods in an arid landscape dominated by drought and salt.

Decreasing the frequency, duration, depth and timing of flooding may result in a reduction in the indigenous flood-dependent understorey plants, and a proliferation of drought and salt-tolerant understorey. The reduction in available soil moisture and increase in ground water salinity levels associated with a range of management practices including river regulation and reduced flooding frequency, has killed large numbers of River Red Gum and Black Box on the floodplains of the lower River Murray.

F *Waterlogging (RC, C&LL)*

Waterlogging occurs when the roots of plants become saturated through either rising groundwater or continuous surface water inundation. Most trees can tolerate short periods of flooding during the growing season. However, if soils stay saturated for extended periods, roots cannot absorb oxygen and nutrients. Nutrients such as iron and nitrogen may become deficient. The roots decay or die and the entire plant wilts. Waterlogged trees show a wide range of symptoms including yellowing leaves, defoliation, reduced leaf size, epicormic growth and crown thinning.

River Red Gums can only tolerate 18-24 months of surface water flooding before becoming stressed. Leaves on the tree turn red then yellow before dying.

Trees and other deep-rooted plants play a crucial role in maintaining the water table. Vegetation clearance, over-grazing or gradual tree death through old age and lack of regeneration alters this balance, causing the watertable to rise. 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.

RIVER RED GUMS ON THE MURRAY RIVER FLOODPLAIN

In 2003, a Murray Darling Basin Commission report noted that, "flooding under current conditions now appears insufficient to provide the supply of water that is necessary for survival of River Red Gums in this arid area", referring to the floodplains of the lower River Murray. Large numbers of trees are exhibiting signs of severe stress and some are dying. This is of considerable concern as the health of these trees is a reflection of the ability of the floodplain to regenerate. Without either natural or artificial floods, the trees will die and the landscape will change forever. As part of an interim management response to ease stress levels in River Red Gums on the Chowilla floodplain, artificial floods have been generated through a combination of gravity supply and pumping at 14 sites on the floodplain. The response has been very positive, with River Red Gums recovering well at all sites. Prior to flooding at Werta Wert Wetland, 93% of the trees around the wetland were classified as "stressed". Since flooding, 90% of those stressed trees have developed new leaves and are now classified as "healthy". There has also been a proliferation of Red Gum seedlings at Coppermine Waterhole and Woolshed Creek sites. The long-term survival of these seedlings will depend on regular flooding and careful grazing management.

Salt scalding on the floodplain (RP)

River Red Gums and Ligum are dying and salt-tolerant saltbushes and samphires dominate the ground layer. (RP)

Increase in soil salinity (EMLR, MM/MP, C&LL, RC)

Increasing soil salinity can result from waterlogging, altered flooding regimes or from accumulation of salt in soils after irrigation water has evaporated. Waterlogging and salinity increases often occur together. Salt normally stored in the soil is dissolved and becomes available to plants, making it more difficult for them to take up water

and nutrients. Trees can withstand some salinity, but tolerance varies between and within species. River Red Gums have demonstrated moderate salt tolerance. However, it might be expected that prolonged exposure to shallow groundwater of quite low salinity could have significant impacts on growth and health, especially if coupled with long dry periods or waterlogging.

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. A large number of trees and shrubs become affected at the same time. Presence of salt-tolerant plants and salt crystals in seepage areas are good indicators of a saline environment.

H *Increase in soil nutrients (EMLR, MM/MP, C&LL, RC)*

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. 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. Symptoms such as slowed growth occur first, then leaves turn yellow.

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

I *Loss of understorey (EMLR, MM/MP, C&LL, RC)*

Understorey plants play an important role in maintaining a balanced ecosystem as they provide habitat and shelter to a wide variety of animal species. Understorey plants together with leaf litter hold soils together and reduce the impact of rain and runoff on the soil surface, reducing erosion. This 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 which controls ground water levels, causing the watertable to rise, increasing soil salinity,
- Allow stock access to grazing around tree trunks, worsening the effects of increased nutrients, soil compaction, soil erosion and potential ring-barking of trees,
- Reduce habitat for wildlife, particularly insectivores, leading to increased insect populations and potential for more insect damage.

The lack of regeneration of native vegetation further compounds these effects. As trees get older their health declines, which reduces their ability to produce seed and reproduce. If younger, stronger plants do not replace them, tree density is reduced until all mature trees are dead preventing natural regeneration.

J *Soil compaction (whole region)*

Soil compaction occurs through steady or continuous vehicle, stock or foot traffic and slows the infiltration of water into the soil, prevents aeration of the roots, interferes with nutrient cycling and affects soil microbial activity. Soils are more prone to compaction when wet. Compaction adds to other stresses such as extended dry periods, bringing about similar symptoms to low soil moisture availability.

K *Mundulla Yellows (potentially whole region)*

Mundulla Yellows (MY) is a progressive dieback syndrome and affects a wide range of eucalypts and other native species (eg. *Banksia* spp., *Acacia* spp., *Allocasuarina* spp.). Early symptoms include yellowing between the veins of leaves (interveinal chlorosis), in parts of the crown, and 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.

Little is currently known about MY. It is not clear whether it is caused by biotic (living) agents, or abiotic (environmental) factors, or a combination. Research into possible causes of MY indicates that it may be due to a complex interaction of soil properties, such as nutrient deficiency, soil compaction, water availability, increased alkalinity and salinity and the accumulation of bicarbonate in the soil.

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

Leaf yellowing can also be caused by a number of other factors including herbicide poisoning, lack of available soil moisture (see page 13), *Phytophthora* (see page 17) and nutrient deficiencies alone, such as Iron, Manganese, Magnesium, Copper, Zinc or Potassium.

Mundulla Yellows (JR)

Diseased leaf (top) and healthy leaf (bottom) (JR)

L *Plant pathogens – infectious agents that cause plant disease*

Phytophthora *(EMLR)*

Phytophthora root rot is one of the most serious diseases threatening 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 resistant plants to *Phytophthora* remain healthy. Visible symptoms may take up to a few years to develop after the initial infection. On slopes, plant deaths progress 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 fungal diseases may produce dieback symptoms and affect leaves, stems or roots. *Armillaria luteobubalina* forms a yellowish mushroom. It causes *Armillaria* root and collar rot in living native plants including *Eucalyptus*, *Allocasuarina* and *Acacia* species, often killing them. *Armillaria* also causes rotting of dead wood, such as old stumps and fallen limbs.

There are several leaf diseases caused by fungi, such as "corky leaf spot", "crinkle leaf disease", and "angular leaf spot". Generally, these leaf diseases do little long-term damage.

***Phytophthora* killing *Xanthorrhoea* (BH)**

***Phytophthora* killing *Banksia* (RV)**

Crinkle leaf disease (CP)

M *Other factors (whole region)*

There are 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 frosts, dry, hot winds, sand or dust storms and hail on native vegetation can give the impression of dieback. However, plants will usually recover from these impacts.

Herbicide poisoning

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.

Impacts can be caused by Galahs stripping bark; 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. Blackened trunks from fire can persist for many years. Most eucalypts and other natives 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. Unlike many of the mallee eucalypts, River Red Gums are easily killed by severe fires.

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 canopy thinning.

What can you do?

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

SHORT TERM remedial actions may involve:

Insect control A

Many insects are native, common and widespread. Native plants and insects have evolved together and their relationships are often beneficial rather than destructive. Rarely do insect populations build up to levels that are damaging to native plants unless they are already stressed. 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 or shrubs may be treated with insecticide or by manually removing pest insects and killing them. Spraying with soapy water can sometimes discourage insects and other browsing animals, but rain reduces the effectiveness.

Mistletoe, Witches' broom and Dodder-laurel removal B C

A healthy tree can support some Mistletoe, Witches' broom and Dodder-laurel. Severely stressed trees with heavy infestations may die back. Removal of infestations from severely affected trees allows them to recover in the short term. This should always be conducted in combination with an improvement of the management of the area. Any removal of mistletoe, witches broom or dodder laurel 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.

Improvement of hygiene practices K L

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,

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

For Mundulla Yellows, specific control measures can only be designed once the cause has been confirmed. Until then, the following general equipment hygiene practices for planting, pruning, and disposal are suggested:

- Management and hygiene as for *Phytophthora*
- Sterilise tools, such as cutting implements between plants.
- Do not remove cut material from the site.
- Do not distribute seedlings raised in one area to other sites.
- Use only local seed from trees without symptoms in new plantings.

Increasing available soil moisture E G

Whether root-zone soil water deficit is the primary cause of native vegetation health decline or whether this is coupled with salinity, there is no doubt that adequate inputs of water are required to relieve stress on affected trees on the floodplain. Complete soil wetting to sufficient depth can be achieved by:

- natural flooding on the lower River Murray, requiring flows adequate to create overbank flows in the old relict meander plains, or
- Using weir manipulation or additional structural controls on wetlands to extend the flood inundation time.

LONG TERM remedial actions may involve:

Managing Remnant Vegetation D F G H I J M

Retaining and improving the health of remnants in the SAMDB is a high priority for addressing dieback in the region. By controlling the stresses on vegetation within remnants, the overall health will improve, providing habitat for native flora and fauna which will in turn assist in alleviating some stresses. Managing total grazing pressure, controlling weed invasion and in some cases re-establishing native vegetation will all assist in improving the health of remnants. Size, shape, linkages and relationships with other remnants are very important factors affecting both the health and habitat value of remnant native vegetation. An understanding of these factors can guide re-establishment and enhancement of native vegetation adjacent to existing remnants. Improving the health of remnant vegetation through appropriate management is one of the best ways to reduce dieback in native vegetation. For more details, contact the Murraylands Bush Management Adviser.

Reducing total grazing pressure D H I J M

Grazing pressure is exerted by all herbivores, which includes domestic stock, insects, and native and introduced grazers (e.g. rabbits and kangaroos). Inappropriate grazing regimes reduce the diversity and abundance of plants, and interrupts ecosystem functioning. Fencing may be required to keep animals away from sensitive areas. Reducing total grazing pressure will, after some years, 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 will provide additional and alternative food sources, more perching and nesting sites for a range of birds, and other insect-eating predators. Replacement of an aging overstorey will provide new generations of plants better able to withstand environmental stresses than many of the very old paddock trees. If regeneration does not occur after some years following grazing removal, re-establishment of local native plants may be necessary. It is highly recommended that dead trees and shrubs, particularly those with hollows suitable for nesting are not removed, as these provide valuable habitat for native fauna.

At a regional scale, regeneration can help lower water tables and restore ecological processes.

Reducing or ceasing herbicide and fertiliser use around native vegetation H I M

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 fertiliser application or run-off from fertilised areas can also affect off-target areas and should be undertaken with care around areas of native vegetation.

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 native vegetation is likely to be most affected by activities on adjacent land.

References for further reading

: Key References

Nutrition of eucalypts edited by P.M. Attiwill & M.A. Adams (1996) CSIRO.

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Mundulla Yellows - a new tree dieback threat by D. Hanold, M. Stukely, & J. Randles (2002) Landscope, Winter 2002 pp.41-47

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Preliminary Investigations into observed River Red Gum decline along the River Murray below Euston by the Murray-Darling Basin Commission (2003) Technical Report 03/03

Tree decline in agricultural landscapes: what we stand to lose by N. Reid & J. Landsberg (2000). In *Temperate eucalypt woodlands in Australia.* (Ed R. J. Hobbs and C.J. Yates) pp. 127-166 Surrey Beatty and Sons.

The impact of tree decline on remnant woodlots on farms by R. Wylie & J. Landsberg (1987) In *Nature conservation: the role of remnants of native vegetation* (Ed. D.A. Saunders, G.W. Arnold, A.A. Burbridge & A.J. Hopkins) pp. 331-332 Surrey Beatty and Sons.

Identification aids and Field Guides

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

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

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

Field Guide to Bushland Monitoring by the Nature Conservation Society of South Australia. Due for completion in 2005.

Factsheets and pamphlets

NatureLinks

www.environment.sa.gov.au/biodiversity/ pdfs/naturelinks_strategy.pdf

ForestrySA factsheets

http://www.forestry.sa.gov.au/FM3.stm

Victorian Primary Industries Information Notes series

http://www.dpi.vic.gov.au/notes/

Mundulla Yellows information

http://www.environment.sa.gov.au/biodiversity/pdfs/mundulla_yellows.pdf

http://www.deh.gov.au/biodiversity/invasive/publications/mundulla-yellows /index.html

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

Contacts

If the contact you want is not listed here, try the Bush Management Adviser

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This booklet can be cited as:

DEH (2005). Dieback in Native Vegetation in the South Australian Murray-Darling Basin: a Guide to Symptoms and Causes. Department for Environment and Heritage, South Australia.

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