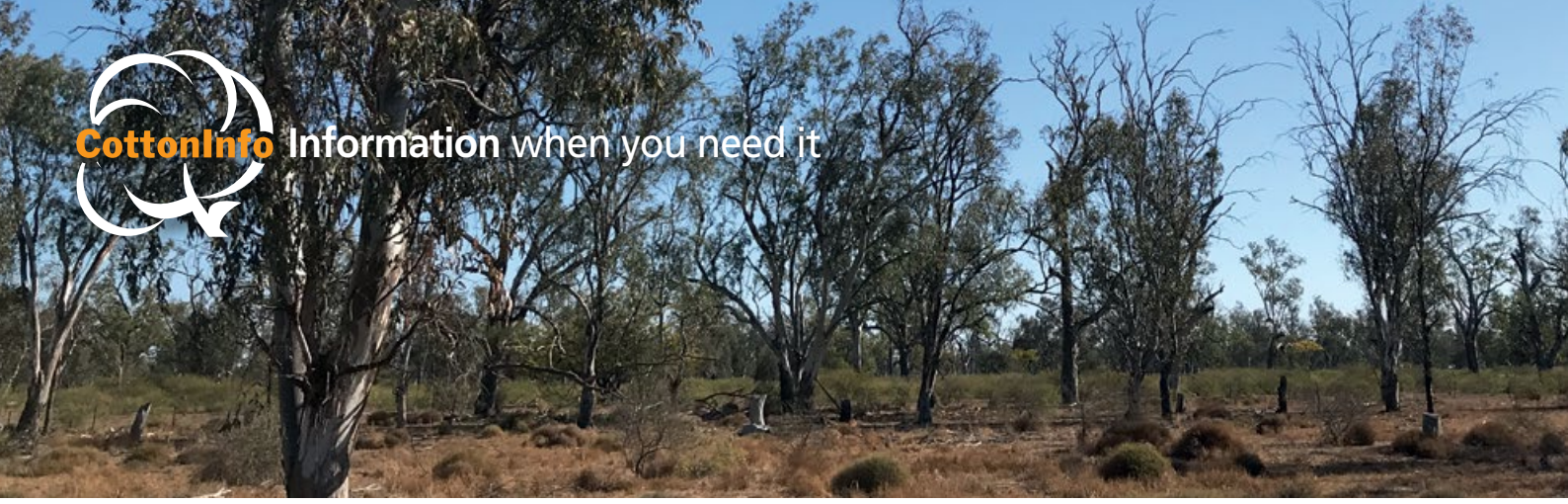

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September 2018

Tree dieback identification and management guide

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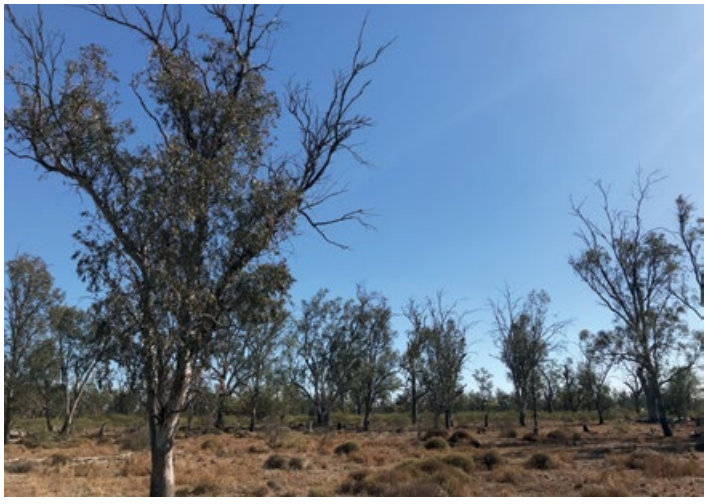


Introduction

Dieback is a tree's response to negative stress occurring within its environment. All trees are susceptible to dieback, a condition where trees die or decline in crown health prematurely and often rapidly. A noticeable decline in tree health in agricultural regions, including cotton landscapes across Australia has occurred recently. Many factors contribute to tree dieback – these can be natural, related to land management, or a combination of both. In most cases where widespread dieback is occurring it is not one stress but a combination of stresses that is causing the decline and or death of trees.

With increasing value being placed on biodiversity as a vital part of sustainable agriculture, it is important that land managers have tools available to assist them identify threats and risks to biodiversity on their farm, as well as best management recommendations to mitigate them.

This guide outlines several causes of dieback within Australian cotton landscapes as well as tips for identification and best practice recommendations for the management and prevention of dieback.

une University of New England

NSW GOVERNMENT Local Land Services North West

Best Practice

CAUSES: Drought/water deficit

Description: Trees suffer water stress at different times and many Australian species have evolved to tolerate these conditions. But river regulation, floodplain development, falling water tables, as well as increasing frequency and duration of droughts and heatwaves have resulted in less water and increased tree water stress. During periods of prolonged water stress, water conducting vessels become damaged as the tree works harder to obtain water from increasingly dry soils. Eucalypts moderate water loss by reducing their canopy area, and when conditions are favourable, restore their canopy through epicormic growth, i.e. growth from under the bark of the trunk and larger branches as opposed to new leaves produced on the outer edges of the canopy. Epicormic growth uses the trees' carbohydrate energy stores and is highly palatable to insects that may take advantage of the conditions and grow their populations. As cycles of dry conditions and insect attack increase in frequency and duration, trees are forced to mine their carbohydrate resources until they run out and the tree dies.

Identification: Eucalypts follow a predictable sequence of stages as water stress progresses. First, the canopy contracts, i.e. young leaves are shed, followed by general loss of leaves and canopy thinning, and finally >

Dieback of river red gums.

Restoring areas using drought tolerant species and good ground preparation techniques can improve survival rates.

branch death. Large, apparently healthy branches may be shed on hot days in an attempt by the tree to reduce its canopy area and therefore reduce photosynthetic area and water loss. River red gums are particularly notorious for dropping large branches on hot days, hence their nickname 'widow-makers'. Trees that exist in marginal environments on the edge of their ideal range are at greatest risk of water stress. For example, river red gums that occur away from the river or major creek channel, or poplar box occurring on heavy cracking clay soils will suffer during dry times.

What can I do?

- Maintain natural cycles of flooding to prevent dieback occurring
- If possible, irrigate affected areas
- Maintain good groundcover (including grasses and herbs, litter and mulch) as this helps reduce soil temperatures and improve soil organic matter, in-turn improving soil moisture-holding capacity
- When undertaking revegetation programs choose species that are suitable to the area and are drought tolerant
- Plant tree lines of drought tolerant species to slow wind speeds and conserve soil moisture

For more information:

Cotton *my*BMP Sustainable Landscapes (natural assets) module – Maintain groundcover: www.mybmp.com.au

Contact your regional Natural Resource Management organisation, Landcare group or Local Land Services for more information on suitable local native vegetation species for revegetation works.

CAUSES: Salinity

Description: Salinity is an accumulation of salts (usually sodium chloride) in soils and water sources at concentrations that impact humans and natural assets (e.g. plants, animals, water sources, irrigation infrastructure, etc.). Salt is naturally present in Australian landscapes and primary salinity is a natural phenomenon, e.g. salt marshes, salt lakes or natural salt scalds. However, secondary salinity is the result of human activity and occurs when (1) water tables rise as a result of land clearing (and the loss of perennial vegetation that would otherwise regulate groundwater levels); (2) salts are no longer flushed from the soil due to reduced flood frequency, or (3) deep drainage or irrigation with saline water increases salt concentrations in the soil and raises groundwater levels (or a combination of all of the above). Secondary salinity can be detrimental to trees as water tables rise, soils become waterlogged (and hypoxic) and salts become concentrated in the plants' root zone. Waterlogging and high salt concentrations impact plant root growth, uptake of water (the osmotic effects of salinity) and may lead to nutrient imbalances.

Identification: Plants subjected to saline conditions experience similar symptoms to plants suffering drought stress. As such, the initial indication of salinity may be premature leaf shedding. In severe cases, trees may fall over as root growth is compromised. Salt may be present on the soil surface and the composition of understorey species may change, favouring salt-tolerant species such as couch grass (*Cynodon dactylon*), salt bushes (e.g. *Atriplex* spp.) and other chenopod species, or no groundcover at all. Salinity generally affects areas that are low in the landscape as the groundwater level rises and discharge areas appear.

Dieback of trees caused by rising groundwater (photo George Truman).

What can I do?

- Plant perennial deep rooting plants such as trees to reduce deep drainage either at the site or upslope as interception lines. Plantings in groundwater recharge zones (i.e. higher in the landscape) may slow recharge rates and therefore lower water tables elsewhere in the landscape.
- Increase surface groundcover on scalded sites and minimise evaporation from soil surface.
- In areas impacted by salinity, plant salt-tolerant species such as river red gums, she-oak (*Casuarina* spp.) or bulloak (*Allocasuarina* spp.), salt bushes and salt tolerant grasses to lower water tables and protect the soil surface from erosion.
- In extreme cases, engineering works may be required to sufficiently drain excess water to allow establishment of perennial vegetation.

For more information:

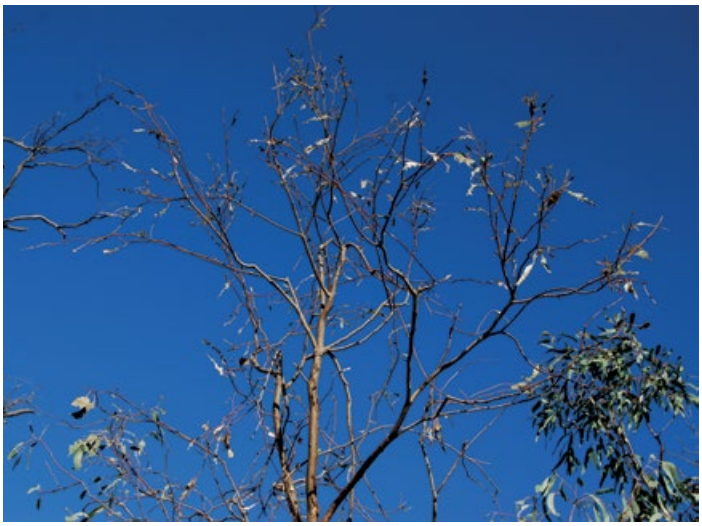
Queensland Government Salinity Management Handbook: https://publications.qld.gov.au/en/dataset/salinity-management-handbook

CAUSES: Insect attack

Description: Outbreaks of insects such as psyllids are becoming more frequent and severe in response to increasingly favourable conditions including climate change and reduced natural enemy numbers. Natural enemies of herbivorous insects include parasitic wasps and small insectivorous birds. These natural enemies have declined in numbers in the landscape following land clearing and habitat fragmentation, and increased use of non-selective insecticides. Increasing abundance of noisy miners in response to habitat changes have led to lower numbers of small insectivorous birds, and the use of broad spectrum insecticides may lead to reduced populations of parasitic wasps and other beneficial invertebrates. Trees in the red gum group of eucalypts (e.g. river red gums, Blakely's red gum and forest red gum) are particularly vulnerable to insect attack as they occur in the most productive and nutrient-rich parts of the landscape and have large, soft leaves compared to other eucalypts.

Identification: Psyllids can be identified by their waxy protective coating referred to as a lerp. Different species create different lerps and some species are specific to certain tree species. Sap-sucking insects remove nutrients and moisture from leaves, leaving a dead or damaged leaf behind. Chewing insects remove the leaf material on either side of the central vein of the leaf, leaving this behind. Insect damage is often patchy amongst the canopy in the initial stages, for instance as a larval pest becomes established and slowly moves out through the canopy. Some pests confine themselves to young leaves, while others are less selective, taking new and old leaves without discrimination. Unusually warm, wet weather may facilitate insect outbreaks, particularly when overwintering conditions are conducive to maintenance of large pest populations. Stressed trees, e.g. trees that have been attacked by insects previously or are water stressed are generally hit hardest and can take considerable time to recover, if they recover at all.

Lerps of a sap-sucking psyllid (*Cardiaspina* spp.) on river red gums (photo Nick Reid).



Damage caused by chewing insects (caterpillars).

What can I do?

- Plant trees and understorey shrub species to improve connectivity. Shrubby vegetation encourages small insectivorous birds into the area that provide a natural pest control service. Incorporating flowering shrubs such as bottlebrush, tea tree and wattle spp. will increase the presence of parasitic wasps and minimise noisy miner populations as they prefer open eucalypt woodland habitats
- Control weeds and minimise grazing to allow native groundcovers and shrubs to regenerate

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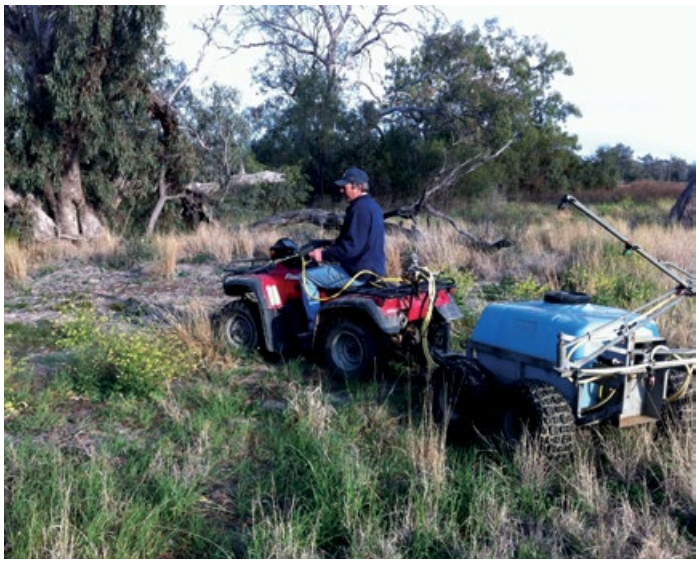
- When using insecticides, consider 'soft' chemicals and observe thresholds for spraying to minimise impacts on beneficial invertebrates, birds and microbats that predate on insect pests.

For more information:

Field guide to common pests, diseases and nutritional disorders of eucalypts: http://era.daf.qld.gov.au/id/eprint/2039/

Cotton pest management guide: www.cottoninfo.com.au/publications/cotton-pest-management-guide

Pests and Beneficials in Australian Cotton landscapes: https://www.cottoninfo.com.au/publications/pests-and-beneficials-australian-cotton-landscapes



Control weeds to reduce competition with native species.

Severe psyllid-mediated dieback of river red gums.

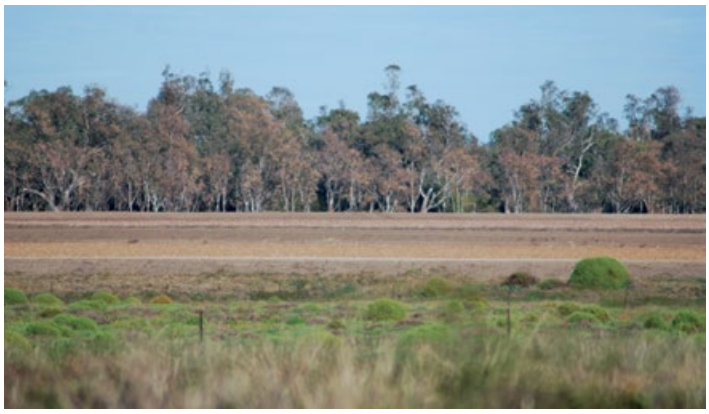
CAUSES: Spray drift

Description: Use of Roundup Ready crop varieties has seen an increase in the amount of glyphosate herbicide being used in agricultural landscapes, and a simultaneous increase in herbicide spray drift damage to trees. Repeated herbicide drift along crop margins can be detrimental to tree health by killing the leaves and growing tips. In addition, insecticide drift may harm predatory and parasitoid insects that would normally provide a pest control service and keep herbivorous insects in check.

Identification: Spray drift generally affects one side of the tree, i.e. the side closest the crop. A major drift event may result in total loss of canopy on one side of the tree, whereas a minor drift event may appear as 'burn' marks on tree leaves where individual droplets of herbicide have come into contact with the leaf. Herbicide drift damage to trees can also occur kilometres from the site of application as a result of application during an inversion layer. Trees such as she-oaks and belah are most susceptible due to the way air 'swirls' around the leaves. Dead leaves may remain on the tree for several weeks or months.

What can I do?

- Prevent drift by implementing best practices for spray application
- Install natural or artificial barriers to intercept spray drift
- Adhere to product label NO SPRAY ZONE instructions
- Select target-specific herbicides as opposed to broad-spectrum herbicides
- Select non-soil active herbicides when remnant vegetation is nearby
- Use an Integrated Weed Management approach when managing weeds
- In affected areas, minimise likelihood of repeat damage and implement BMP for native vegetation condition (weed and pest control, maintain good groundcover, etc.) to help tree recovery



Severe herbicide spray drift.

Mild chemical drift on coolibah trees.

For more information:

Cotton Pest Management Guide: spray application chapter: www.cottoninfo.com.au/publications/cotton-pest-management-guide

Vegetative barriers for spray drift management: www.cottoninfo.com.au/publications/nrmpesticide-input-efficiency-using-vegetative-barriers-minimise-spray-drift-cotton

Cotton *my*BMP pesticide management module: www.mybmp.com.au

Australian Pesticide and Veterinary Medicine Authority resource: https://apvma.gov.au/node/10796

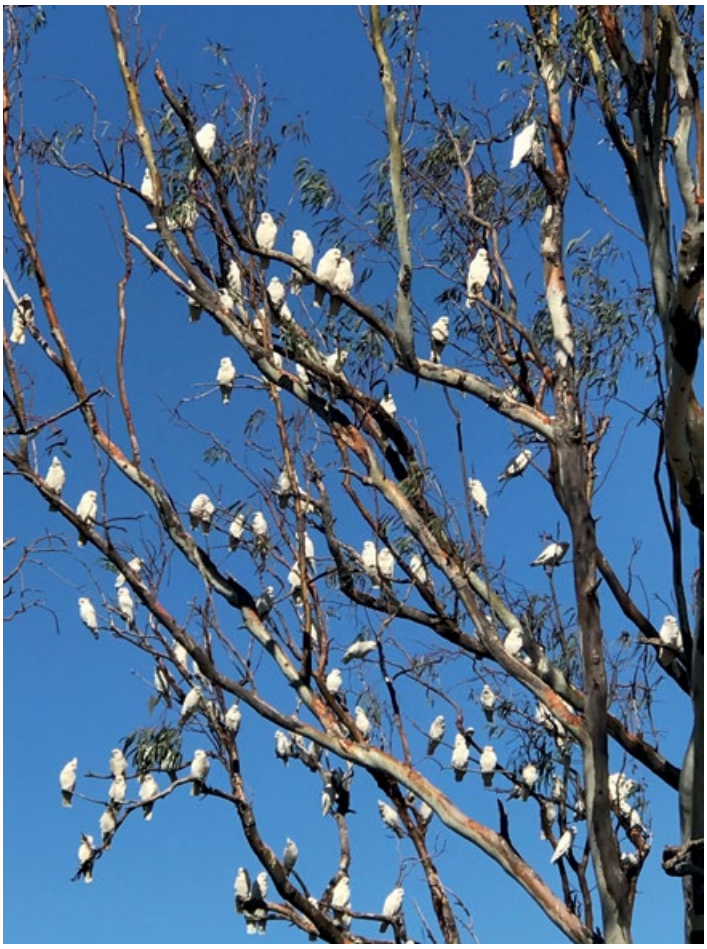
CAUSES: Cockatoos

Description: As trees age, they develop large hollows capable of accommodating large parrots such as cockatoos and corellas. As dieback sets in, these birds facilitate the dieback process by excavating hollows and removing small branchlets to create perches that allow them to see predators. Therefore they are a symptom not a cause of dieback. In addition, large parrots chew on non-food items to maintain their beaks. Large parrots have increased in numbers due to abundant food supplies (i.e. wheat and other grains) and are typically very social, forming large flocks that can result in extensive areas of tree damage.

Identification: The deafening alarm call of a cockatoo or corella can be heard before you see them. The birds remove branchlets up to 5 mm in diameter, creating a carpet of branchlets on the ground under trees. They also deposit faecal material under the tree as they spend time in one spot. Cockatoos and corellas nest in large hollows such as those developed in river red gums. They also require access to water, so riparian zones provide ideal habitat. Woodlands and open-woodlands, particularly those already impacted by dieback are their preferred habitat as trees provide perches and the vegetation is sparse enough to allow birds to survey their surrounds.

What can I do?

- Cover grain and clean up grain spills to minimise food supplies for large parrots.
- Invest in a scare gun to frighten birds away from vulnerable sites affected by dieback.
- Identify the actual cause/s of dieback and implement recommended BMP
- Maintain and improve native vegetation extent and condition on farm to provide a range of large parrot habitats



Corellas removing foliage from river red gums.

For more information:

NSW DPI, National Guidelines for the management of pest birds: www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/193739/managing_bird_damage-full-version.pdf

CAUSES: Grazing & groundcover

Description: Grazing significantly influences vegetation structure and patterns of vegetation regeneration. Good groundcover, particularly leaf litter, increases native species diversity and abundance and is an important seed source for woody species such as eucalypts. Leaf litter also inhibits seedling emergence from riparian soil seed banks, which according to research in the northern Murray Darling Basin, are dominated by weed species. Livestock chew or rub on juvenile trees or trample seedlings, reducing seedling establishment rates. Livestock grazing can result in altered soil nutrient status, with high nitrogen levels increasing the palatability of eucalypt leaves to insect pests and increasing weed burdens. In addition, livestock grazing can result in low groundcover and reduced competition, facilitating the spread of weeds such as lippia (*Phyla canescens*). Lippia invasion

Lippia (*Phyla canescens*).

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Lippia infestation impacting on tree regeneration.

across the northern Murray Darling Basin has resulted in fewer regeneration events and thinning of trees as dead trees are not replaced. Lippia has recently been found in the Lachlan and Murrumbidgee catchments. Once established, lippia is a vigorous competitor, robbing soil moisture and restricting access to the soil surface, thus preventing seed germination and establishment of other species.

Identification: Lippia is a perennial, mat-forming, broadleaf herb (see image). It has a central taproot of approximately 80 cm long and branched stems up to 1 m long, often rooting at nodes along the stems. It reproduces from seed and vegetative fragments carried by flood waters. Lippia is unpalatable to livestock and heavy grazing pressure facilitates its invasion where removal of native groundcover reduces competition.

River Red gum recovering after the removal of lippia via cultivation.

Fence off sensitive areas to allow long periods of rest from grazing (photo Millie Hobson).

What can I do?

- Fence off areas to allow long periods of rest from grazing to improve groundcover and let grasses and other species that can compete with lippia, regenerate.
- If the area is grazed, at least 70per cent ground cover should be maintained to reduce erosion and ensure the soil structural integrity.
- In instances of extreme lippia infestation, use of selective herbicides or cultivation may be required to thin lippia plants and allow native grasses to increase in size, and ultimately compete with lippia.

For more information:

Managing Riparian Lands in the Cotton Industry: www.cottoninfo.com.au/publications/managing-riparian-lands-cotton-industry

http://weeds.dpi.nsw.gov.au/Weeds/Details/79

Cotton *my*BMP Sustainable Landscapes (natural assets) module: Maintain groundcover & Stock Management: www.mybmp.com.au

CAUSES: Other causes of dieback

The broad causes of dieback described above are the most common causes in the New South Wales and Queensland cotton growing regions, but dieback can be caused by many interacting factors. The following specific causes have been documented:

- **WATER STRESS**
  - Drought
  - Falling water tables
  - River water extraction
  - Reduced flooding – extent and duration
  - Cavitation
  - Livestock-induced soil compaction
- **RISING WATER TABLES (WATER LOGGING) AND DRYLAND SALINITY**
- **INVERTEBRATE HERBIVORY**
  - Natural insect outbreaks
  - Woodland fragmentation
    - Ecosystem dysfunction
    - Noisy miners
  - Insect pests favoured by nutrient enriched foliage
    - Epicormic growth in stressed trees
    - Livestock redistribution of nutrients
    - Shallow aquifer recharge from N-enriched river water
    - N-leakage into aquifers from soil
    - Fertilizer drift
    - N-pollution of river water
    - New England dieback
- **AGRICULTURAL CHEMICALS**
  - Herbicide drift
  - Defoliant drift
  - Herbicide and pesticide pollution in water sources
- **VERTEBRATE HERBIVORY**
  - Bird damage
  - Marsupial browsing

Other causes of dieback (continued)

- **PHYSICAL DAMAGE**
  - Storm damage
  - Stubble burning
- **PARASITES, PATHOGENS AND SOIL MICROBIAL CONDITIONS**
  - Mistletoe infestation
  - *Phytophthora cinnamomi*
  - Mundulla Yellows
  - Changes to soil microbe communities
- **OLD AGE, CUMULATIVE IMPACTS AND LACK OF RECRUITMENT**
  - Old age and senescence
  - Carbohydrate depletion
  - Reduced seed viability and barriers to germination
  - Reduced seedling establishment
- **WEED INVASION**
- **CLIMATE CHANGE**

** Table modified from Reid et al 2007.*

Acknowledgements

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