



Threatened
Species
Network



Australian Government



WWF

The Threatened Species Network is a community-based program of the Australian Government and WWF-Australia.

The Threatened Species Network

The Threatened Species Network (TSN) advises, collaborates and networks to increase the public's involvement with the protection and recovery of threatened species and their habitats. Since its formation in 1990, the TSN has empowered the community to participate in research, monitoring, management and education projects across the country for the conservation of threatened species. The TSN achieves this through working cooperatively with government agencies, scientists, educators, landholders, Indigenous Australians and community groups.

Managing Phytophthora Dieback in Bushland

A Guide for Landholders and Community Conservation Groups



australia's aluminium



Government of
Western
Australia



swan catchment
council

For more information
about Phytophthora Dieback
please contact your local
government authority or
the Dieback Working Group
Phone: 0438 044 488
Web: www.dwg.org.au



Dieback
WORKING GROUP



Dieback
WORKING GROUP

This publication is a joint initiative of
the Dieback Working Group and the
Threatened Species Network.

The Dieback Working Group

The Dieback Working Group consists of representatives from local governments, community conservation groups and State Government agencies. The group was formed in response to the lack of knowledge and management assistance about the plant disease in native vegetation known as 'dieback' which is caused by the introduced water mould *Phytophthora cinnamomi*. Since its formation in 1996, the Dieback Working Group has sought to:

- Increase awareness about the plant disease caused by *Phytophthora cinnamomi*.
- Encourage the adoption of disease prevention and management policies.
- Encourage the implementation of control measures to minimise the spread and impact of the disease.

Acknowledgements

Funding for this publication was provided by the TSN. The Dieback Working Group is grateful for the support of the Natural Heritage Trust, Alcoa World Alumina Australia, the Department of Conservation and Land Management, and the Swan Catchment Council.

The following have made contributions and assisted in the reviewing of this document: Anne Harris, Bronwen Keighery, David LaMont, Charles Stevens, Emer O'Gara, Fiona Marr, Giles Hardy, Glenn Tuffnell, Ian Colquhoun, John Nicolson, John and Heather Bowler, Katherine Miller, Kevin Vear, Lesley Thomas, Liz Western, Mady Colquhoun, Mark Gloyn, Martin Pearce, Mike Grasby, Chris Dunne and Penny Hussey.

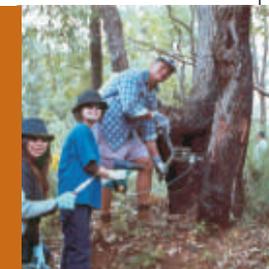
Edition 4

Edited and Compiled by Steve McCabe
First Edition written by Sharon Kilgour
Design and Layout by Micromedia
Printed by Scott Print
ISBN 0-646-37837-6
Published by the Dieback Working Group
© Dieback Working Group 1999, 2000, 2005, 2008

Please Note:

Every effort has been made to ensure the accuracy and completeness of the information in this Guide. However, to the extent permitted by law, neither the Threatened Species Network nor the Dieback Working Group accept any legal liability for errors or misconceptions in the Guide, or any responsibility for any information or advice given in relation to, or as a consequence of, anything contained in the Guide. This is a general information Guide. It is not a substitute for independent professional advice and may not suit your particular circumstances.

CONTENTS



Introduction	1
Phytophthora Dieback: A Deadly Disease of Native Plants	3
What is Dieback?	3
Where Does the Pathogen Live?	4
How Does the Pathogen Spread?	4
Which Plants Does the Pathogen Kill?	5
History	7
Geography	7
Bushland Values Affected by Phytophthora Dieback	8
Protecting Your Bushland	9
Step 1. Assess Your Bushland	9
Step 2. Develop & Implement Management Guidelines	15
Scenario 1	
Phytophthora Dieback Not Present in Bushland	16
Scenario 2	
Phytophthora Dieback in Sections of the Bushland	19
Scenario 3	
Phytophthora Dieback in All Parts of the Bushland	23
Scenario 4	
Not sure if Phytophthora Dieback is Present	26
Case Studies	29
Sampling Procedures	31
Treating Your Plants with Phosphite	33
1. Injecting Trees	34
2. Spraying Plants	36
Guidelines for Cleaning and Sterilising	38
Guidelines for Propagating Plants	40
Guidelines for Bushwalking	42
Guidelines for Cyclists	43
Guidelines for Horse Riders	44
Contacts and Further Information	45
Community Group Work Day Checklist	46
References	48



© Jiri Lochman - DEC

Introduction

Phytophthora Dieback is a deadly plant disease that can devastate our forests, woodlands and heathlands. The disease is caused by the introduced pathogen *Phytophthora cinnamomi*. Phytophthora Dieback is causing significant damage in the South-west Australia Ecoregion of Western Australia (WA) because:

- Over 40% (2284) of native plant species in the region are susceptible (Shearer et al., 2004)
- the climate and soils of the South-west Australia Ecoregion suit the pathogen's survival and spread, and
- the pathogen was spread widely before it was identified as the cause of permanent damage to our ecosystems.

Organisations such as the Department of Environment and Conservation (DEC), Alcoa and Main Roads WA follow procedures to minimise the risk of their activities spreading the pathogen. Many local governments are also adopting Phytophthora Dieback management policies and implementing management procedures.

Banksia woodland site in the Perth metropolitan area devastated by Phytophthora Dieback.



© Dieback Working Group

Anyone who owns, manages or uses a bushland area can also take steps to ensure that their activities don't introduce or spread the pathogen. The information included in this booklet will help you identify activities that have a high risk of spreading Phytophthora Dieback and how you can significantly reduce this risk.

Southwest Australia Ecoregion

The Southwest Australia Ecoregion is one the world's top 34 'biodiversity hotspots'. It is characterised by an exceptional concentration of species that are found nowhere else (endemic species). More than 4,000 species of endemic plants and 100 endemic vertebrates have been recorded in the region, and new plant species continue to be discovered. Many of these endemic species are rare and endangered, giving the Southwest Australia Ecoregion the highest concentration of rare and endangered species on the continent.

Unfortunately, Phytophthora Dieback is having a devastating impact on the biodiversity of this region.



Southwest Australia Ecoregion of Western Australia. Produced by WWF-Australia using information adapted from Olson & Dinerstein.



© Chris Dunne

Phytophthora Dieback: A Deadly Disease of Native Plants

What is Phytophthora Dieback?

Phytophthora Dieback refers to the deadly introduced plant disease caused by *Phytophthora cinnamomi* (pronounced Fy-tof-thora - meaning 'plant destroyer' in Greek). There are over 50 species of *Phytophthora*, but the species that causes the most severe and widespread damage to native plants in WA is *P. cinnamomi*.

In the past, Phytophthora Dieback has been known as 'dieback' and 'Jarrah dieback'. Unfortunately, these names have contributed to confusion about the pathogen. For example, in other parts of Australia, the term 'dieback' is used to describe tree decline caused by such factors as salinity, drought or insect damage. Furthermore, the disease affects a huge number of introduced and native plant species other than Jarrah. Therefore, to overcome this confusion, the term 'Phytophthora Dieback' is now used.

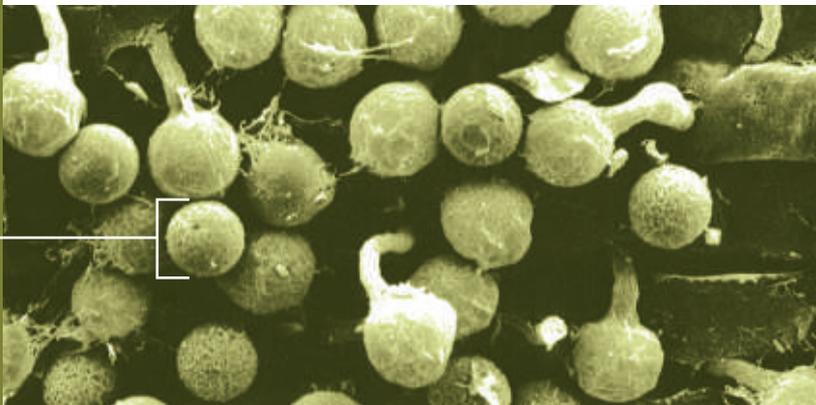
Originally *P. cinnamomi* was classified as a fungus, however it is now classified as an Oomycete or water mould.

Where Does the Pathogen Live?

P. cinnamomi spends its entire life in the soil and in plant tissue. It attacks the roots of plants and causes them to rot. This kills the plant by limiting or stopping the uptake of water and nutrients. The pathogen is able to survive within plant roots during the dry soil conditions commonly experienced during the summer months.

An electron microscope image of zoospores encysting on a host plant's roots.

Zoospores measure approximately 8µm (micrometres) in diameter



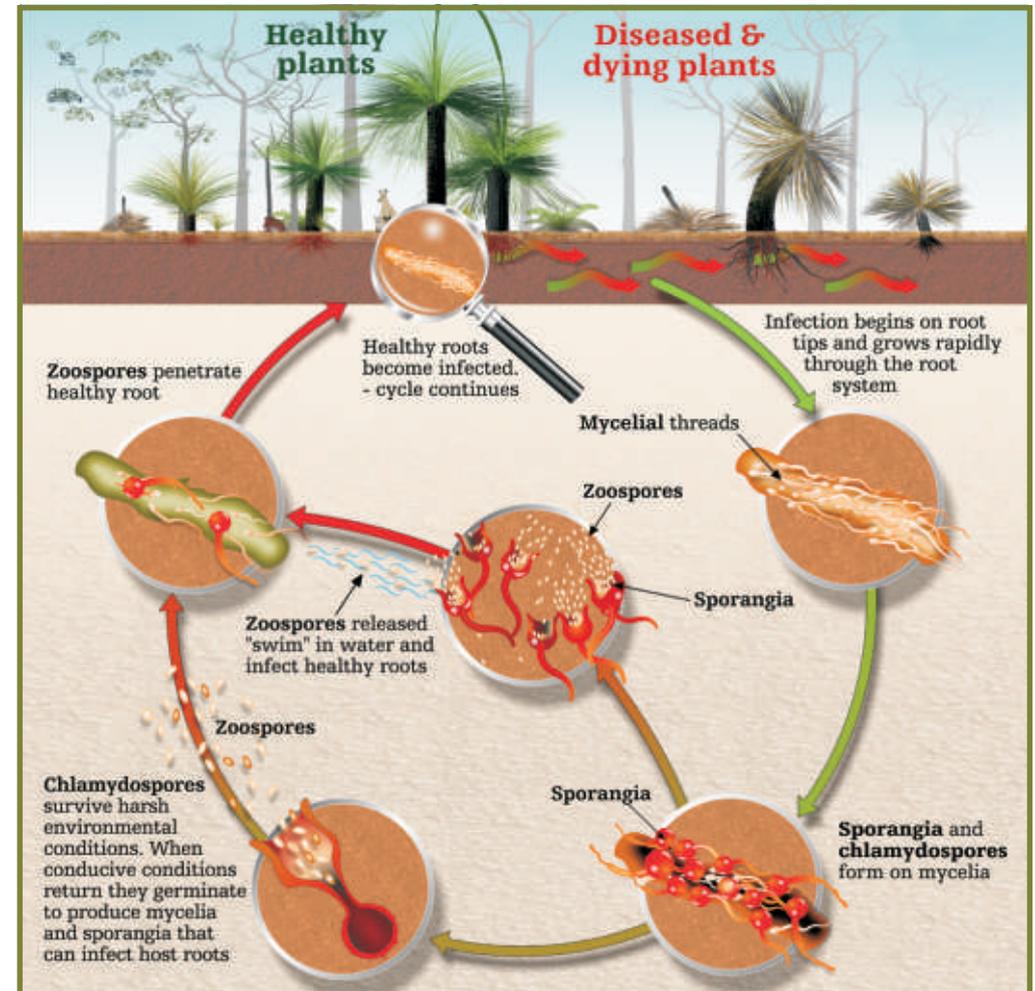
© Giles Hardy

How Does the Pathogen Spread?

In sloping areas Phytophthora Dieback spreads quickly when the microscopic spores move downwards in surface and sub-surface water flows. It spreads slower up-slope and on flat ground (approximately one metre per year) because it is restricted to movement by root-to-root contact.

However, it is human activity that causes the most significant, rapid and widespread distribution of this pathogen. Road construction, earth moving, driving vehicles on bush roads and stock movement can all contribute significantly to the spread of Phytophthora Dieback. Bush restoration projects may also inadvertently spread the pathogen.

Soil that is warm and moist provides the best conditions for Phytophthora Dieback. These conditions allow the pathogen to produce millions of spores. These spores are attracted to the plant roots by swimming through the soil water.



The Phytophthora Dieback Lifecycle

Phytophthora Dieback:

A Deadly Disease of Native Plants

Which Plants Does the Pathogen Kill?

Over 40% of native WA plant species are susceptible to *Phytophthora cinnamomi* (Shearer et al., 2004). Over 50% of the WA's rare or endangered flora species are susceptible. Many of these susceptible plants are only found in South-west Australia Ecoregion. Some of the regions more common plants are susceptible, including jarrah, banksias, grasstrees (Xanthorrhoea) and zamia palms.

A more extensive list of susceptible plants is available on the Dieback Working Group website www.dwg.org.au/. Many other plants, although not susceptible, can act as a host for the pathogen. This enables it to persist indefinitely in an area once it has been introduced.

A range of horticultural crops and garden plants are also susceptible to *P. cinnamomi* including apple, peach, apricot and avocado trees, grapevines, radiata pine, camellias, azaleas, roses, proteas and rhododendrons (Cahill, 1993; Erwin & Ribeiro, 1996).

Banksia woodland heavily impacted by Phytophthora Dieback.

© Chris Dunne



Gull Rock near Albany is extensively infested with Phytophthora Dieback.

© Dieback Working Group



Bushland free of Phytophthora Dieback, Falls Park, Hovea.

© Sharon Kilgour



Bushland infested with Phytophthora Dieback, Falls Park, Hovea.

© Chris Dunne

This area of Jarrah forest is heavily infested with Phytophthora Dieback. The site was once a gravel extraction area.

© Chris Dunne



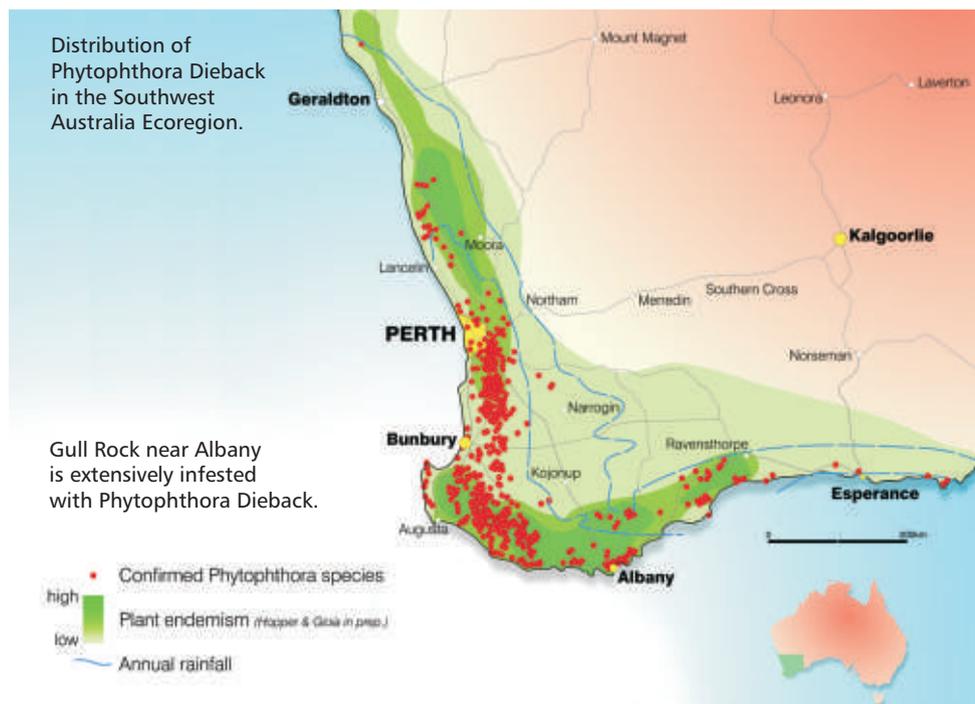
Phytophthora Dieback: A Deadly Disease of Native Plants

History

Phytophthora cinnamomi is not native to WA. It is thought to have arrived in the State shortly after European settlement in soil around the roots of live plants. Before it was realised that *P. cinnamomi* caused death in native vegetation, it had been spread extensively throughout the south-west. The disease was first recognised killing jarrah (*Eucalyptus marginata*) in the jarrah forest near Karragullen in 1921. It wasn't until the mid 1960s that *P. cinnamomi* was identified as the cause of the disease.

Geography

Phytophthora Dieback is now widespread throughout the South-west Australia Ecoregion. It is confined to areas with more than 400 mm annual rainfall, and extends between Eneabba in the north and Cape Arid near Esperance in the east. The pathogen causes the highest impact in areas that receive more than 600 mm of annual rainfall. It has infested forests, heathlands and woodlands. Phytophthora Dieback is also widespread in the bushland in and around Perth, but there are still large uninfested areas that require protection.



Bushland Values Affected by Phytophthora Dieback

When Phytophthora Dieback spreads to bushland, it kills many susceptible plants, resulting in a permanent decline in the diversity of the bushland. It can also change the composition of the bushland by increasing the number of grasses and reducing the number of shrubs. Native animals that rely on susceptible plants for survival are reduced in numbers or are eliminated from sites infested by Phytophthora Dieback.

However, it is important to realise that bushland infested with Phytophthora Dieback still retains important conservation values. It contains remnant vegetation that provides habitat for many native animal species and provides environmental services, such as protecting the landscape from the affects of salinity and erosion. Therefore, it is important to retain and maintain remnant bushland even when it is affected by Phytophthora Dieback.



Honey possums are one of the native animals reliant on susceptible plants for survival.
© Babs & Bert Wells - DEC



Many birds rely on plants affected by Phytophthora Dieback.
© Babs & Bert Wells - DEC



© Dieback Working Group

Protecting Bushland

To manage Phytophthora Dieback in bushland, you need to plan ahead. The introduction or human assisted spread of the pathogen in bushland can be avoided if activities are well planned and management procedures are in place. Phytophthora Dieback management procedures must be integrated into all bushland management activities if the spread and impacts of this disease are to be minimised.

There are three simple steps involved in managing Phytophthora Dieback in bushland.

These are:

1. Assess your bushland
2. Develop and implement management procedures
3. Treat your plants with phosphite

The steps are discussed in detail below.:

Step 1. Assess Your Bushland

Managing Phytophthora Dieback in bushland is most successful when you have determined whether the pathogen is present or absent, and if present, identified what parts of the bushland are infested. Management procedures can still be implemented if you are unsure if the pathogen is present. However, without knowing the location of the Phytophthora Dieback, management will not be as effective, it will be difficult to monitor the success of your work, and you may be taking some precautions that are not necessary.

Remember that when you have had bushland surveyed for Phytophthora Dieback, the result will only be accurate at that point in time. The disease will spread will spread autonomously and new infections can occur. When planning management procedures for controlling Phytophthora Dieback it is important to re-survey for disease movement and new disease outbreaks every one to two years.

There are two options for determining whether Phytophthora Dieback is present in bushland:

1. Engage a professional consultant; or
2. Do it yourself.

Professional consultants

Professional consultants determine the presence of *Phytophthora cinnamomi* by using indicator (susceptible) plants and by testing soil and plant samples. Refer to page 31 for a list of Phytophthora Dieback interpreters. The consultants listed have undertaken accredited training with DEC and have many years of experience in completing Phytophthora Dieback surveys.

The cost of a consultant survey will vary, depending on the size and location of the bushland, and the degree of difficulty experienced in interpreting disease symptoms. Consultant fees usually do not include the cost of processing the soil and plant samples (sample processing usually costs between \$70 to \$120 per sample). Discuss costs with the consultant prior to the work being undertaken.

Community groups can consider applying for funding from various sources to cover the cost of disease surveys. For more information on these potential funding sources contact the Environmental Officer at your local council or the Dieback Working Group.

Do it yourself

You can complete your own disease survey by studying the plants in the bushland. You will need to have a very good knowledge of native plants, various disease symptoms and other causes of plant deaths for the results of your assessment to be accurate and reliable.

The presence of Phytophthora Dieback is determined by observing susceptible plants that are killed by *P. cinnamomi*. These susceptible plants are called "indicator species". Dead jarrah, banksia, grasstrees, zamia palms, dryandra and hakea are commonly used indicator species. You must be able to discount other factors that could have caused the plant death, such as fire, insects, flood, drought, nutrient deficiencies or toxicities, and other plant disease, for example, Armillaria root rot. If non-susceptible trees, for example red gums, tuarts, flooded gums or wandoo are dying then its likely that the cause of poor plant health is not Phytophthora Dieback.

Tables 1 and 2 list some common plant species and genera from the Jarrah forest and swan coastal plain ain that are susceptible to *P. cinnamomi*, and can be used as Phytophthora Dieback indicator species. For a more detailed list on resistant and susceptible plant species please see consult the Centre for Phytophthora Science and Management website

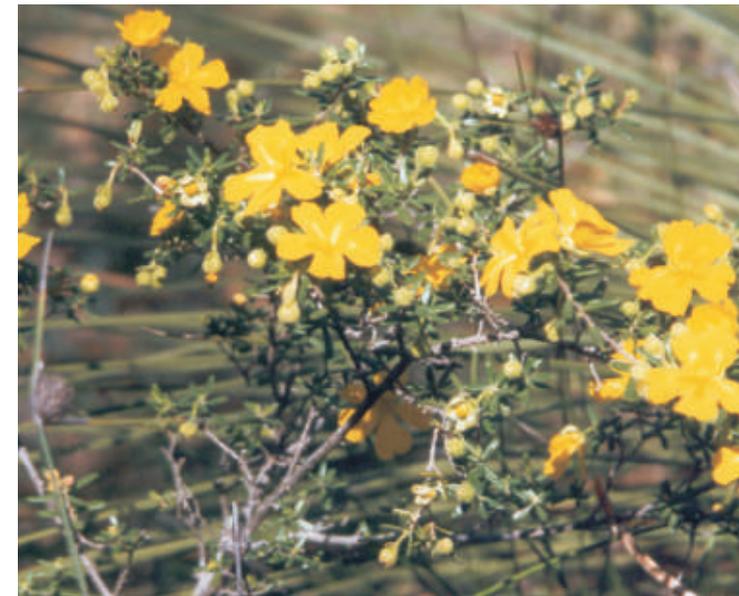
(www.cpsm.murdoch.edu.au).

Protecting Bushland

Table 1. Plant genera with species known to be affected by Phytophthora species - including *P. cinnamomi* (CALM, 1999b).

Proteaceae	Myrtaceae	Epacridaceae	Other
Adenanthos	Agonis	Andersonia*	Allocasuarina
Banksia*	Beaufortia	Astroloma*	Anarthia
Conospermum	Calothamnus	Leucopogon*	Boronia
Dryandra	Calytrix	Lysinema*	Conostylis
Franklandia	Eremaea	Monotoca*	Dampiera
Grevillea	Eucalyptus	Sphenotoma*	Dasyogon
Hakea	Hypocalymma	Styphelia*	Daviesia
Isopogon*	Kunzea		Eutaxia
Lambertia*	Melaleuca		Gastrolobium
Personia*	Regelia		Hibbertia*
Petrophile*	Scholtzia		Hovea
Stirlingia*	Thryptomene*		Jacksonia
Synaphea	Verticordia*		Lasiopetalum*
Xylomelum			Latrobea
			Macrozamia
			Oxylobium
			Patersonia
			Phlebocarya
			Xanthorrhoea
			Xanthosia

* many species in the genus are severely affected



Hibbertia species are highly susceptible to Phytophthora Dieback.

© Dieback Working Group

Iconic species like the Albany woolly bush *Adenanthos sericeus* are susceptible to Phytophthora Dieback.



© Chris Dunne

Zamia palms *Macrozamia riedlei* are susceptible to Phytophthora Dieback.



© Sharan Kilgour

Protecting Bushland

As well as observing indicator species, the following vegetation features can be used to indicate the presence of Phytophthora Dieback.

- Total deaths. *P. cinnamomi* kills most plants completely and quickly. Most plants do not die one branch at a time, and there is usually no chance of recovery. For example, an infected banksia often suffers from a sudden death. Occasionally Jarrah trees may look sick for a number of years before suddenly succumbing.
- Lines, groups or localised areas of plant deaths are more likely to be caused by Phytophthora Dieback than odd scattered individual plant deaths in otherwise healthy vegetation.
- Look for an edge effect. Edge effects are most obvious when there is a clear distinction between healthy and diseased vegetation.
- Look for old deaths and recently killed plants, that is, an 'age range' in the deaths. This is because Phytophthora Dieback moves from plant to plant over time, killing each plant as it goes.
- Look for signs of the disease in a range susceptible plant species.
- Look for something that could have introduced the disease, for example, a track, road or vehicle activity.

Laboratory testing

Like the professional consultants, you can also take plant and soil samples and have them tested in a laboratory (refer to page 46 for a list of diagnostic laboratories). Sample results that are positive for *P. cinnamomi* mean that the disease is present at the site. Negative results don't mean that the site is free of the pathogen, as it may simply have been missed when the sample was taken. The chance of a positive sample being recorded can be significantly increased if the tissue sample is collected from a plant that has a lesion (decaying tissue) present underneath the bark at the base of the main trunk.

You will need to get instructions from the laboratory on how to take a sample, the best time to take the sample and how to store and transport it. Sampling usually involves digging up a dead plant to get to the roots. This can be quite a physically demanding task if you are sampling a banksia or grasstree.



Mount Lesueur National Park a biodiversity hotspot is under threat from Phytophthora Dieback.

© Chris Dunne



Waychinicup Nature Reserve near Albany is under threat from Phytophthora Dieback.

© Sharan Kilgour

Protecting Bushland

Scenario 1

Phytophthora Dieback Not Present in Bushland

Step 2. Develop & Implement Management Guidelines

The way Phytophthora Dieback is managed in bushland depends on your knowledge of its presence. Select the most appropriate scenario for your situation from the four listed below and refer to the appropriate page.

- Scenario 1 Phytophthora Dieback not present in bushland (Page 16)
- Scenario 2 Phytophthora Dieback in sections of the bushland (Page 19)
- Scenario 3 Phytophthora Dieback in all parts of the bushland (Page 23)
- Scenario 4 Unsure if Phytophthora Dieback is present (Page 26)

Each of these situations will require slightly different management to ensure that the pathogen is not introduced, or does not spread further. However, all management guidelines are based on minimising movement of soil, plant material and water, and protecting plants by treating them with phosphite.



Road construction with Phytophthora Dieback infected soil or gravel can lead to the introduction of the disease to adjacent bushland.

© Dieback Working Group

The following control measures will help to keep the bushland free of Phytophthora Dieback.

Planning

- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks through the bushland and ensure that all tracks are well drained. Avoid constructing tracks on the upper slopes of the bushland.
- Minimise soil disturbance during fire break maintenance. Mow, slash or use herbicide rather than grade or plough.
- Ensure that water doesn't drain into the bushland from other areas, e.g. roads. Phytophthora Dieback impact is greatest in wet sites.

For all Activities

- Vehicle access to bushland should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when entering bushland.
- Footwear should be free of mud and soil when entering bushland.

Earthworks

- Avoid bringing soil, gravel or sand into the bushland. If this material must be introduced, ensure that it is free of Phytophthora Dieback or purchased from a soil supplier with Nursery Industry accreditation (refer page 46 for information about soil testing and suppliers).

Bushland Restoration

Weeding

- If weeds are being manually removed they should be immediately placed in a container to ensure that plant material or soil is not dropped in other parts of the bushland.

Scenario 1 (continued)

Revegetation

If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing Phytophthora Dieback, so should be avoided in bushland that has not been infested. However, if revegetation is required:

- Consider direct seeding rather than planting seedlings.
- Complete planting when soil is moist but not wet.
- Purchase plants from nurseries with Nursery Industry accreditation.
- Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *Phytophthora cinnamomi*).
- Water should be from the mains supply. If from a creek, dam or river, the water should be sterilised (refer to page 39).

Access

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider up-grading tracks to a hard well-drained surface that does not allow for the easy movement of soil around the bushland.
- Plan walks to start in high parts of the bushland and move to low parts of the bushland.

Communication

- In public reserves, place signs at reserve entrances to highlight the disease situation in the bushland and recommend avoiding access when the soil is wet and sticking to footwear.
- In public reserves, hold a 'wildflower walk' in spring. Highlight the potential impact of Phytophthora Dieback and how visitors can prevent its introduction.
- Look out for activities occurring near the bushland that could introduce the pathogen, for example, road building.

Scenario 1 (continued)

Find out if the activity is operating under hygienic conditions. If not, contact the Environment or Parks Officer at your local council or the relevant authority.

- Discuss the Phytophthora Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

- Observe susceptible plants and note any deaths. Implement phosphite treatment if plant death occurs (refer to page 33-37).
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

- Keep horses and other stock out of bushland.
- If horses or other stock must enter bushland, ensure that their hooves are free of mud and they stay on hard, well drained tracks.

Fire

- Mow, slash or use herbicide on fire breaks rather than plough or grade.
- Have contractors clean the equipment before entering bushland.



Preventing vehicle access into healthy bushland can prevent the accidental introduction of Phytophthora Dieback.

Scenario 2

Phytophthora Dieback in Sections of the Bushland

Managing Phytophthora Dieback in this situation is most successful when the presence of the pathogen in the bushland has been clearly identified and mapped. To minimise the risk of new infestations occurring, the following control measures should be implemented:

Planning

- Survey the bushland and mark the infection boundary.
- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks through bushland and ensure that all tracks are well drained.
- Plan or realign tracks so they don't pass from infested to uninfested areas of bushland, or from low areas to higher areas.
- Minimise soil disturbance during firebreak maintenance. Mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, e.g. roads. Disease impact is greatest in wet sites.

For all Activities

- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks, and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil on entry and exit from bushland, and when moving from infested to uninfested areas.
- Footwear should be free of mud and soil when entering and exiting the bushland and when moving from infested to uninfested areas.

Earthworks

- Avoid bringing soil, gravel or sand into bushland. If this material must be introduced, ensure that it is free of Phytophthora Dieback or purchased from a soil supplier with Nursery Industry accreditation (refer page 46 for information about soil testing and suppliers).
- Non certified materials can be used in the infested parts.

Scenario 2

(continued)

- Do not move soil or plants from infested to uninfested parts of the bushland.

Bushland Restoration

Weeding

- If weeds are being manually removed, they should be immediately placed in a container to ensure that plant material or soil is not dropped into other parts of the bushland.

Revegetation

- If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing Phytophthora Dieback, so should be avoided in bushland that is disease free. However, if revegetation is required:
 - Consider direct seeding rather than planting seedlings.
 - Select plants that are resistant to Phytophthora Dieback for the infested parts of the bushland (for a list please refer to the publications section of the Dieback Working Group website: www.dwg.org.au)
 - Complete planting when soil is moist but not wet.
 - Purchase plants from nurseries with Nursery Industry accreditation.
 - Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *Phytophthora cinnamomi*).
 - Water used should be from the mains supply. If from a creek, dam or river, the water should be sterilised (refer to page 39).

Access

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider up-grading tracks to a hard well-drained surface that does not allow for the easy movement of soil around the bushland.
- Avoid walking between infested and uninfested parts of bushland when soil is wet, and plan walks to start high in the bushland and move to lower parts.

Scenario 2 (continued)

Communication

- In public reserves, place signs at reserve entrances highlighting the disease situation at the reserve and recommend avoiding access when the soil is wet and sticking to footwear.
- In public reserves, hold a 'wildflower walk' in spring. Highlight the potential impact of Phytophthora dieback and how visitors can prevent it spreading.
- On walking tracks, place signs next to susceptible plants and dead plants that have been killed by the pathogen.
- Look out for activities occurring near the bushland that could spread the disease, for example road building. If the activity is not operating under hygienic conditions, contact the Environment or Parks Officer at your local council or the relevant authority.
- Discuss the Phytophthora Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

- Treat susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected, and all other vegetation sprayed (refer to page 33 - 37). Consider strategic buffer treatment to protect vegetation at the greatest risk if total area is too large to treat in a cost-effective manner.
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, hooves should be free of mud and soil when entering and exiting and animals should be kept to hard, well drained tracks.

Scenario 2 (continued)

Fire

- Mow, slash or use herbicide on fire breaks rather than plough or grade.
- Have contractors clean the equipment before entering bushland.
- Construct or maintain fire breaks in the uninfested part of the bushland first, then move into the infested area.



© Dieback Working Group

Diverting runoff or drainage into bushland can provide ideal conditions for the establishment of Phytophthora Dieback.

Scenario 3

Phytophthora Dieback in all Parts of the Bushland

If Phytophthora Dieback is present in all parts of a bushland area, it is important that any remaining susceptible vegetation is protected, and that the pathogen is not spread to other bushland. The following control measures should be implemented:

Planning

- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks through the bushland and ensure that all tracks are well drained.
- Minimise soil disturbance during fire break maintenance. Mow, slash or herbicide rather than grade or plough.
- Ensure that water does not drain into the bushland from other areas, e.g. roads. Disease impact is greatest in wet sites.
- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks, and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when exiting the bushland.
- Footwear should be free of mud and soil when exiting the bushland.

For all Activities

Earthworks

- Do not remove landscaping materials, soil or plant material from the bushland.

Bushland Restoration

Revegetation

- If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. However, if revegetation is required:
- Purchase plants from nurseries with Nursery Industry accreditation to prevent other diseases being introduced.
- Select plants that are resistant to Phytophthora Dieback.

Scenario 3

(continued)

- Complete planting when the soil is moist but not wet.

Access

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider up-grading tracks to a hard well drained surface that does not allow for the easy movement of soil out of the bushland.

Communication

- In public reserves, place signs at reserve entrances highlighting the disease status of the reserve and recommend avoiding access when the soil is wet and sticking to footwear.
- In public reserves, place signs along tracks next to dead plants that have been killed by Phytophthora Dieback, and explain the impact the disease is having, and how visitors can prevent it spreading further.
- Look out for activities occurring near the bushland that could spread the pathogen, e.g. road building. Inform those responsible that Phytophthora Dieback is present at the site.
- Discuss the Phytophthora Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

- Treat any remaining susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected, and all other vegetation sprayed (refer to page 33-34). Consider strategic buffer treatment to protect vegetation at the greatest risk if total area is too large to treat cost effectively.
- Do not remove plants from the bushland.

Horses and Livestock

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, ensure that the hooves are free of mud and soil when exiting and animals should be kept to hard, well drained tracks.

Scenario 3 (continued)

Fire

- Mow, slash or use herbicide on fire breaks rather than plough or grade.
- Have contractors clean the equipment before leaving the bushland.



© Dieback Working Group

Particular care needs to be taken when revegetating dieback free bushland so that the disease is not introduced by way of contaminated plants, soil or mulch.

Scenario 4 Unsure if Phytophthora Dieback is Present

The following procedures should be undertaken in bushland when you don't know if the pathogen is present in order to minimise the risk of the Phytophthora Dieback being introduced and prevent the disease spreading to another site:

Planning

- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks in the bushland and ensure that all tracks are well drained. Avoid constructing tracks on the upper slopes of the bushland.
- Minimise soil disturbance during fire break maintenance. Mow, slash or herbicide rather than grade or plough.
- Ensure that water does not drain into the bushland from other areas, e.g., roads. Disease impact is greatest in wet sites.

For all Activities

- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks, and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when entering and exiting the bushland.
- Footwear should be free of mud and soil when entering and exiting the bushland.

Earthworks

- Avoid bringing soil, gravel or sand into bushland. If this material must be introduced, ensure that it is free of Phytophthora Dieback or purchased from a soil supplier with Nursery Industry accreditation (refer page 46 for information on testing or suppliers).

Bushland Restoration

Weeding

- If weeds are being manually removed they should be placed immediately in a container to ensure that plant material or soil is not dropped in other parts of the bushland.

Scenario 4 (continued)

Revegetation

- If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing Phytophthora Dieback, so should be avoided in bushland that is disease free. However, if revegetation is required:
 - Consider direct seeding rather than planting seedlings.
 - Purchase plants from nurseries with Nursery Industry accreditation.
 - Complete planting when soil is moist, but not wet.
- If moving from one area of the bushland to another, ensure that all equipment and shoes are free of mud and soil.
- Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *Phytophthora cinnamomi*).
- Water used in bushland should be from the mains supply. If from a creek, dam or river, the water should be sterilised first (refer to page 39).

Access

- Minimise walking in the bushland when the soil is wet and muddy. Stay on tracks. Consider up-grading tracks to a hard well drained surface that does not allow for the easy movement of soil out of the bushland.
- Plan walks to start in high parts of the bushland and move to lower parts of the bushland.

Communication

- In public reserves, place signs at reserve entrances to recommend avoiding access when the soil is wet and sticking to footwear.
- Look out for people undertaking activities near the bushland that could introduce the pathogen, for example road building. Find out if these activities are operating under hygienic conditions. If not, contact the Environment or Parks Officer at your local council, or the relevant authority.

Scenario 4 (continued)

- Discuss the Phytophthora Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

- Treat susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected and all other vegetation sprayed (refer to page 33 - 37).
- Do not remove plants from bushland.
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, ensure that the hooves are free of mud and soil when entering and exiting and keep animals to hard, well drained tracks.

Fire Management

- Mow, slash or herbicide fire breaks rather than plough or grade.
- Contractors should have equipment cleaned prior to entry and before leaving the bushland.

Case Studies

Management Scenarios for Small Properties

Scenario 1

Joan and John own a ¼ acre urban block and have noticed that their rose bushes are slowly dying one by one and that they have also lost a much loved grass-tree.

Management suggestion

Sample the most recent death for *Phytophthora* and if positive treat all host plants with phosphite including rose plants.

Scenario 2

Mike and Sarah own a semi rural ½ acre bush block and have lost a number of Banksia, grass-trees and mature Jarrah trees. Most of the plants die suddenly and totally with the exception of some of the Jarrah trees that seem to be dying slowly. Mike has noticed that most of the deaths occur in the lowest section of the property but that they are slowly spreading upslope and that the plants tend to die in Spring and Autumn although there have been deaths all throughout the year. Sarah has also noticed that she has trouble keeping her Azaleas and Rhododendrons alive.

Management suggestion

Total treatment of all host plants every 3 years with phosphite as patterns of death indicate *Phytophthora* Dieback.

Case Studies

Management Scenarios for Small Properties

Scenario 3

Kate and Matthew own a hobby farm of 10 acres in a semi rural location and have noticed that their small grove of avocados have wilting branches even though they are getting plenty of water and nutrients. They have also noticed that their surrounding bush experiences on going scattered deaths in Jarrah, grass-tree and Sheoak and that locals recall a time when Banksia species were dominant in the midstory but now there are hardly any to be seen. Kate and Matthew aren't overly concerned as their bush gardens look in good condition

Management suggestion

Symptoms indicate that the property has an old established infestation around it and that the property itself may be infested. It would be advisable to treat vegetation adjacent to any vector that could introduce the *Phytophthora* spores onto the property to a distance of 10 to 15 metres depending on slope (the steeper the downslope angle the greater the treatment buffer) with phosphite. These vectors could be driveways, drainage lines, firebreaks, pathways or areas adjacent to introduced soil or mulch.

Avocados are very susceptible to *Phytophthora* and these symptoms are indications of infection in avocados (quite different to most native expression). Ideally they would be treated twice yearly with 20% phosphite concentration via stem injection. Native vegetation on the other hand would be treated every three years to provide maximum levels of protection.

Sampling Procedures for a domestic situation



1. Select an appropriate dead plant

Ideally your dead plant will be:

- freshly dead or as fresh as possible.
- totally dead (if it is not totally dead it may not be *Phytophthora* Dieback)
- possibly one of many that have died over a period of time indicating that the cause of death is an on going process (like *Phytophthora* Dieback) rather than something that has come and gone (like fire, drought or frost), and;
- be a plant that is susceptible to *Phytophthora* dieback, see www.dwg.org.au/



2. Sterilise your sample tool

In order to have confidence in the result of your sample you need to be sure you aren't infecting the sample through a dirty sample tool. Undiluted methylated spirits is an ideal sterilising medium. Remove any loose soil and plant material from the tool and spray on the methylated spirits until the digging part of the tool is saturated and allow to dry. If your sample tool has areas that may harbour soil (for example gaps between the head and the handle), you may need to soak it in a bucket of methylated spirits for an hour or so.



3. Dig around the base of your sample plant

You now need to dig down the collar (the main stem of the plant that goes underground), of the plant into the roots preferably into moist soil. The depth will vary depending on the plant but be sure to take chips of root and enough soil to half fill a standard chinese food container from two or three sides of the plant to increase your chances of recovering a positive sample.

Sampling Procedures for a domestic situation



4. Place your soil and roots into a suitable bag

Your bag needs to be strong enough to ensure that it will not split open during transport to the laboratory (geologists bags are ideal for this purpose) and be sealed with a cable tie or any other means that will prevent accidental opening. Make sure you have your details written on the bag in clear printing, include the date and the sample number if you are taking more than one sample.

If your sample is dry it is a good idea to moisten it with some distilled water, be sure not to drown it but rather add enough so as to create a moist environment for the *Phytophthora* (remember it is a water mould!). Make sure your sample does not get hot during transit, ideally keep your sample in an esky, in an insulated house or an air-conditioned car out of direct sunlight until you can get it to the lab.



5. Sterilise your sample tool

It is a good idea to get in the habit of re-sterilising your sample tool to avoid cross contamination or introduction of *Phytophthora* into another site. You may also wish to record your sample site with a Global Positioning System (some labs insist on a GPS reference prior to accepting your sample; you can use a metro UBD to find a GPS reference in the metro area), and physically mark your sample site with a piece of flagging tape with your details on it for easier relocation.

Protecting Bushland

Step 3. Treating Your Plants with Phosphite

Phosphite (Phosphonate), is a biodegradable fungicide that protect plants' against Phytophthora Dieback. Phosphite works by boosting the plant's own natural defences and thereby allowing susceptible plants to survive within Phytophthora Dieback infested bushland.

It is important to note that there is no chemical that will eradicate Phytophthora Dieback, including Phosphite. However, an integrated approach can successfully control the spread and impact of the disease. Within bushland an integrated approach may combine the use of strategic phosphite treatment, controlling access, correcting drainage problems and implementing excellent hygiene protocols.

Phosphite controls many species of Phytophthora, including *Phytophthora cinnamomi*. Phosphite is not toxic to people or animals (Shearer et al., 1991) and its toxicity has been compared to table salt. There is a very low pollution risk associated with phosphite. When phosphite is sprayed on to the foliage of plants, it is applied at a very low rate, so any phosphite that reaches the soil is bound to the soil and does not reach the water table.

Phosphite is available from most large nurseries, rural supply stores and treating plants with phosphite is inexpensive. A medium sized jarrah tree costs less than 50 cents in chemical to treat.

Phosphite needs to enter a plant's water transport system in order for it to be effective. This can be done by injecting phosphite into trees, or spraying the leaves of understorey plants. In bushland the most common tree species injected include jarrah, snootygobblers, banksia species, sheoak and woody pears. Only inject trees with a diameter at chest height of 10-14 cm or greater. Phosphite not only protects a plant from *P. cinnamomi* infection, it can also help a plant to recover if it is already infected. If a jarrah tree is showing signs of infection, treatment with phosphite can help to save it.

Injecting a tree with phosphite provides three to five years protection from Phytophthora Dieback. In contrast, spraying with phosphite provides protection for only one to two years. Because it only provides temporary protection, treatment needs to be ongoing and included in bushland management and future action plans.

Injecting and spraying a large reserve can be a large task for a small community group, so consider applying for funding to employ a private contractor (refer to page 31), Conservation Volunteers Australia, Greencorp or similar labour forces, to assist your group to complete the treatment.

Protecting Bushland

Precautionary Note

This section outlines current best practice of managing Phytophthora Dieback as developed through research by the Department of Conservation and Land Management [now the Department of Environment and Conservation] (CALM 1999a). For information about more research please contact the Science Division at the Department of Environment and Conservation.

In some cases stressed plants that are treated with phosphite will show signs of leaf burning. In most cases this is a short-term effect and the plant will recover with the change of the seasons. In a small number of cases the plants that are already infected may be killed by the added stress of the phosphite treatment. To reduce the likelihood of any potential leaf burning the phosphite rates described are chosen from the lower end of the prescribed range. For injecting that is five per cent and one third of one per cent for spraying.

Prior to undertaking any phosphite treatment of bushland for commercial gain, a contractor must contact the Australian Pesticides and Veterinary Medicine Authority for further information.

1. Injecting Trees

Equipment

- Phosphite injection is not usually done with large syringes or with a number of different types of stem injection equipment, for example the Sidewinder tree injector, Rawlins tree injector or the F1-11 trunk injector.
- Cordless electric drill an appropriate drill bit with syringes (the correct drill bit size is 4 - 4.5 mm or 11/64" or 6/16"). Follow safety instructions associated with the use of the drill.



© Nicole Moore

Protecting Bushland

- Phosphite (Phosphite is sold in a 20, 40 or 60 per cent solution, and is commonly sold under the label Fos-ject® or Agri-Fos®). For a list of common phosphite products please refer to the phosphite treatment section of the Dieback Working Group website; www.dwg.org.au.
- Personal protective equipment including safety glasses, gloves, well covered shoes and protective clothes.

Timing

The best time to inject a tree is when water is moving within the tree. Water movement is usually greatest in spring and early summer. Injecting in the morning is usually more successful than in the afternoon. For further information on storage, disposal of containers and first aid consult the material safety data sheet for your phosphite product.

Preparation

- If using 20 per cent phosphite, dilute one part phosphite with three parts water.
- If using 40 percent phosphite, dilute one part phosphite with seven parts water.
- If using 60 per cent phosphite, dilute one part phosphite with eleven parts water.
- Use a good quality water source, preferably scheme water or rain water.

Procedure

1. Drill a hole into the tree. Injection needs to be in the sapwood, so do not drill any deeper than 2-3 cm. Usually the wood colour will change from the brown bark to cream at the correct depth. Drill the hole at waist height so that injecting will be comfortable for you. The hole should be drilled at a slight downward angle.
2. Drill a hole every 20 cm around the tree trunk (approximately one hand span). Multi-stemmed trees need holes in all stems.
3. Follow the instructions that come with the tree injector regarding its set up and use.
4. Insert the nozzle of the syringe or injector into the drilled hole and twist slightly to get a good seal. Slowly push/pump the solution into the tree. Make sure the solution is taken up by the tree and does not run out. Inject 20 mL of the solution into each hole.
5. Monitor plant health. If there is no sign of a decline in plant health, repeat in three to five years' time. If plants show a decline in health prior to three years, repeat treatment.

Protecting Bushland

2. Spraying Plants

The solution for spraying is much weaker than for injecting and contains a small amount of wetting or sticking agent to hold the droplets on the leaf surface until they are absorbed. Not all understorey plants are at risk but it is easier to spray all plants. Phosphite spraying should not be conducted along creek lines and streams as it can cause adverse effects on some amphibious animals.

Equipment

- Backpack sprayer - ensure that it is clean and has not recently contained herbicides or other chemicals.
- Phosphite - sold in a 20, 40 or 60 per cent solution, commonly sold under the label Fos-ject or Agri-Fos.
- Synertrol or BS1000 (available from Mirco Bros 08 9410 2233) or another wetting agent or penetrant approved for use on native plants. Use rates recommended by the manufacturer.

Denmark Dieback Working Group applying phosphite with a fogger in a high conservation value bushland.



© Chris Dunne

Timing

Spraying is most effective from winter to spring in spring and summer. Spraying should not occur one day after rain or one day before rain.

Preparation

Dilute phosphite to approximately 0.5 per cent phosphite for spraying.

- For a 20 per cent phosphite solution this is one part phosphite to 40 parts water. Therefore, to make 10 litres of solution, add 250 mL phosphite to 10 litres of water.
- For a 40 per cent phosphite solution this is one part phosphite to 80 parts water. Therefore, to make 10 litres of solution add 175 mL phosphite to 10 litres of water.

Protecting Bushland

- For a 60 per cent phosphite solution this is one part phosphite to 120 parts water. Therefore, to make 10 litres of solution, add 85 mL phosphite to 10 litres of water.
- Shake well.
- Be sure to add penetrant or wetting agent before use as per the manufacturer's instructions.
- Use the solution immediately and mix frequently.

Procedure for backpack spray unit

1. Place the backpack spray unit on your back and adjust the straps so it is comfortable and the pumping lever is on your preferred side. Adjust the nozzle so it gives a coarse spray to ensure the spray doesn't blow away from the plants.
2. Soak the plants so all leaf surfaces are wet and the solution is seen to be running off. All understorey plants, including grass trees, should be sprayed. 10 litres of solution should last about 15-20 minutes.
3. Monitor plant health. If there is no sign of a decline in health, repeat in one to two years' time.

Larger spray units, for example a spray trailer, can be used and may be more efficient when treating large areas. The chemical concentration should be the same as the concentrations listed above, and the chemicals should be kept well mixed.

Phosphite being applied with a back spray unit.
© Dieback Working Group



Guidelines for Cleaning and Sterilising

In most cases, removing all mud and soil from vehicles, machinery, tools and equipment is sufficient to minimise the risk of spreading *Phytophthora Dieback*. Where possible, operators should minimise the movement of soil on vehicles and equipment to reduce the level of cleaning required. The following guidelines provide information on the most effective ways to 'clean down'.

Cleaning vehicles and machinery

- It is best to clean down at a wash down facility rather than doing it in the bush.
- Try to remove soil and mud when it is dry.
- Remove as much mud and soil as possible with a brush, and minimise the amount of water used.
- Use a brush or stick to remove compacted soil.
- Wash down on a hard, well drained surface, for example a road, and on ramps if possible.
- Do not allow mud and 'wash down' water to drain into bushland.
- Don't drive through 'wash down' water.
- Pay particular attention to mud flaps and tyres.

A simple wash down unit consists of a high pressure water system, concrete pad, and a drainage system to collect the potentially contaminated water.

© Chris Dunne



Guidelines for Cleaning and Sterilising

Cleaning footwear

- Try to remove mud and soil when it is dry.
- Remove as much mud and soil as possible with a brush, and minimise the amount of water used.
- Collect all mud and soil removed in a bag or bucket, and do not allow it to enter bushland.



However, if you are entering very high value bushland or have come from an area that is infested with Phytophthora Dieback you should take the extra precaution of sterilising tools and footwear. If you are propagating plants then sterilising tools and footwear is essential. Anything to be sterilised should first be cleaned so that all soil and mud is removed.

Cleaning boots and spraying with methylated spirits or bleach can reduce the spread of Phytophthora Dieback.

© Chris Dunne

Sterilising equipment

- Methylated spirits (undiluted) is suitable for sterilising small hand tools and footwear in the field. Place the methylated spirits in a spray bottle, spray to cover all surfaces and allow a few minutes to dry (follow manufacturers safety instructions).
- Other equipment can be sterilised by soaking in a disinfectant such as bleach (containing the active ingredient sodium hypochlorite). Dilute the bleach (1 part bleach to 10 parts water), soak the tools for a few minutes, then rinse (follow manufacturers safety instructions).

Sterilising water

To sterilise water, add 6 ml of pool chlorine to every 10 litres of water and allow 5 minutes before use (follow manufacturers safety instructions). If the water is turbid a higher rate of chlorine maybe required for successful sterilisation.



Guidelines for Propagating Plants

Plants used in revegetation should be grown using hygienic methods. Nurseries that are accredited under the Nursery Industry Accreditation Scheme Australia (NIASA) maintain very high hygiene standards. Not all nurseries are accredited as the scheme can require very high standards.

Therefore, if your local nursery is not accredited, ask the nurseryman what procedures are in place to ensure that their plants remain free of Phytophthora Dieback. Further information on the requirements for NIASA accreditation can be obtained from the Nursery & Garden Industry (see contact on page 47).

Guidelines



© Chris Dunne

For confidence that plants are dieback-free, only purchase plants from nurseries accredited under the Nursery Industry Accreditation Scheme Australia (NIASA).

Guidelines for Propagating Plants

Many community groups propagate their own plants for bushland revegetation. If community groups wish to continue this practice and introduce the plants to disease-free reserves, they should implement the following procedures into their propagation methods.

Potting Mix

- Use a quality potting mix. Ensure that it is sterilised and is free of Phytophthora species. In WA there are only a limited number of accredited media suppliers, including Bailey's, Biowise and Richgro.
- Use a well draining potting mix.
- Store potting mix in sterilised, covered bins on a hard dry surface.

Water

- Water obtained from dams & streams or recycled water should be filtered (5µm) and/or sterilised.
- Water from scheme supply, deep bores or rain water does not usually require treatment.

Diseased Plants

- Any plants that appear unhealthy should be removed immediately (including the soil surrounding the plant). Unhealthy plants and the soil with them should be disposed of well away from the propagation area, preferably low in the landscape, into a bin or deep hole.

Equipment and Hygiene

- Wash equipment, tools and pots well away from the propagation and nursery area.
- Disinfect the workbench daily.
- Clean and sterilise propagation tools daily, or if possible, between batches of seedlings.
- Sterilise any tools used to dispose of unhealthy plants.
- To reuse pots, wash them first, soak them in a bleach solution for an hour, and then rinse in clean water.

Storage

- Do not store plants on bare ground. Plants should be stored so that water cannot flow between the bottom of pots. An elevated, mesh covered table is ideal.

Watering Plants

- Avoid over watering.



Guidelines for Bushwalking

Unfortunately the enjoyable pastime of bushwalking can contribute to the spread of Phytophthora Dieback. However, responsible bushwalkers can take steps to ensure they do not contribute to the spread of the pathogen. If you are planning to bushwalk in your local bushland reserve, in state forest, or in a national park, you can minimise the risk of spreading the pathogen by following these guidelines:

Guidelines

- Contact DEC or the local council for information about suitable bushwalking areas.
- Avoid bushwalking when the soil is wet and muddy (following rain).
- Keep to tracks.
- Avoid muddy areas and puddles.
- Make sure your footwear is free of all mud and soil when arriving at a bushwalking site, and try to keep your footwear as clean as possible during the walk.
- Sterilise footwear when entering high conservation value bushland or when leaving areas infested with Phytophthora Dieback.
- Use footpaths or shoe cleaning facilities when provided.
- Obey 'track closed' signs.
- Make sure your vehicle is clean when arriving at bushwalking sites.
- Park your car in designated car parks.

Frequent bushwalkers may find it useful to carry equipment in their packs and/or vehicle to help keep their footwear clean. A 'bushwalking hygiene kit' should contain a bag to collect scraped off soil/mud, large and small brushes and a bottle of water (from mains supply). Methylated spirits can be applied using a spray bottle to sterilise the soles of shoes.



© Dieback Working Group

Guidelines for Cyclists

Bike tyres can pick up soil and mud and therefore contribute to the spread of Phytophthora Dieback. To minimise this risk, cyclists should follow these guidelines:

- Contact DEC or the local council to find out areas suitable for cycling.
- Stay on tracks.
- Avoid riding your bike following rain and when the soil is wet.
- Avoid muddy areas and puddles.
- Ensure that your bike is free of mud and soil (on the frame and tyres) when you begin your bike ride.
- Do not enter areas that have been closed off to bike riders.
- Do not enter DEC Declared Disease Risk Areas and obey 'track closed' signs. It is illegal for bicycles to enter Disease Risk Areas.



© Lawrie Dodd

Guidelines for Horse Riding

Horse riding is a popular activity, particularly in rural and bushland areas. Unfortunately, horse riding can contribute to the spread of Phytophthora Dieback through the spread of soil via the horse's hooves. To minimise the risk, horse riders should follow these guidelines:

- Contact DEC or the local council to find out areas where horse riding is appropriate.
- Avoid riding in bushland areas, particularly following rain or when the soil is wet.
- Avoid muddy areas and puddles.
- Obey signs that specify no horse riding.
- Stay on tracks
- Ensure that your horse's hooves are clean before entering bushland.
- Do not enter declared DEC Disease Risk Areas and obey 'track closed' signs. It is illegal for horses to enter Disease Risk Areas.



Checklist for a Community Group Work Day



Contacts and Further Information

General

- No soil will be moved between areas within the bushland.
- Activities are scheduled for days when the soil is too dry to stick to footwear and tools.
- Equipment, tools and footwear are free of soil and mud.
- Footwear will be free of mud and soil when entering the bushland, and when moving between areas within the bushland.
- No vehicles will be taken into the bushland. If vehicles are necessary, they will be clean on entry and confined to hard, well drained surfaces.
- Techniques that minimise soil disturbance will be used.

Planting

- Direct seeding has been considered.
- Tree planting will be conducted in moist, not wet, soil conditions.
- Plants have been grown using hygienic methods.
- If using mulch, it has been well composted.
- Mains or sterilised water is being used to water plants.

Planting

- If practical weeding is scheduled for dry soil conditions.
- Weeds will be immediately placed in a bag or container so soil doesn't drop out during transport.

Dieback Working Group

- Dieback Working Group - Project Coordinator. Phone 0438 044 488.
- Dieback Working Group - Chair (Ian Colquhoun). Phone (08) 9397 6813

Dieback interpretation services

- Glevan Consultancy (Evan Brown). Phone (08) 9582 7772.
- Department of Environment and Conservation . Phone (08) 9368 4399.
- Coffey Environemnts – Albany (Jeremy Spencer) Phone (08) 9892 6400

Dieback treatment contractors

- Dieback Treatment Services (Glenn Tuffnell). Phone 1300 785 311

Laboratories for testing soil and plants for Phytophthora Dieback

- Department of Environment and Conservation, Vegetation Health Service. Phone (08) 9334 0317.
- Murdoch University, Centre for Phytophthora Science and Management. Dr Giles Hardy. Phone (08) 9360 6272.
- Curtin University. Dr Elaine Davison. Phone (08) 9266 3106.
- Agwest Laboratories. Department of Agriculture. Phone (08) 9368 3693.



Contacts and Further Information

Nursery accreditation scheme

- Contact the Nursery Industry Association for an updated list of Accredited Wholesale Nurseries and Landscape suppliers. Phone (08) 9358 4811. Internet <http://www.ngia.com.au/accreditation/niasa.asp>.

For further information

- The Environment Officer or Parks Officer at your local council.
- Roleystone Dieback Action Group, Ian Colquhoun. Phone (08) 9397 6813.
- Your local community conservation group.

Web sites of interest

- AgWest Plant Laboratories
<http://www.agric.wa.gov.au> (search for 'Agwest laboratories')
- Centre for Phytophthora Science & Management, Murdoch University
<http://www.cpsm.murdoch.edu.au/>
- Department of the Environment & Heritage
<http://www.deh.gov.au/> (search for 'dieback')
- Department of Conservation & Land Management
www.calm.wa.gov.au
(run a search on 'dieback' or 'Phytophthora cinnamomi')
- Nursery & Garden Industry of Western Australia
http://www.ngia.com.au/your_industry/your_industry_wa.asp
- The Threatened Species Network
<http://www.wwf.org.au/tsn>



References

- Cahill, D.** (1993) Review of Phytophthora diseases in Australia. Rural Industries Resource and Development Corporation. Report Series No. 93/94. DPIE Canberra.
- CALM** (1992) Dieback Disease - Hygiene Manual. Department of Conservation and Land Management.
- CALM** (1999a) Phytophthora cinnamomi and disease caused by it. Volume III - Phosphite Operations Guidelines. Draft. Department of Conservation and Land Management.
- CALM** (1999b) The Wildflower Killer PHYTOPHTHORA (Brochure). Department of Conservation and Land Management.
- Erwin, D.C. & Ribeiro, O.K.** (1996) Phytophthora Diseases Worldwide. ABS Press, St Paul, Minnesota.
- Nursery Industry Association** (1997) NIASA Best Practice Guidelines for the Nursery Industry Accreditation Scheme, Australia. Sydney.
- Shearer, B.L., Crane, C.E. and Cochrane, A.** (2004) Quantification of the susceptibility of the native flora of the south-west botanical province, Western Australia, to Phytophthora cinnamomi. Australian Journal of Botany. 52: 435-443.
- Shearer, B., Wills, R., and Stuke, M.** (1991) Wildflower Killers. Landscape Magazine. Department of Conservation and Land Management.