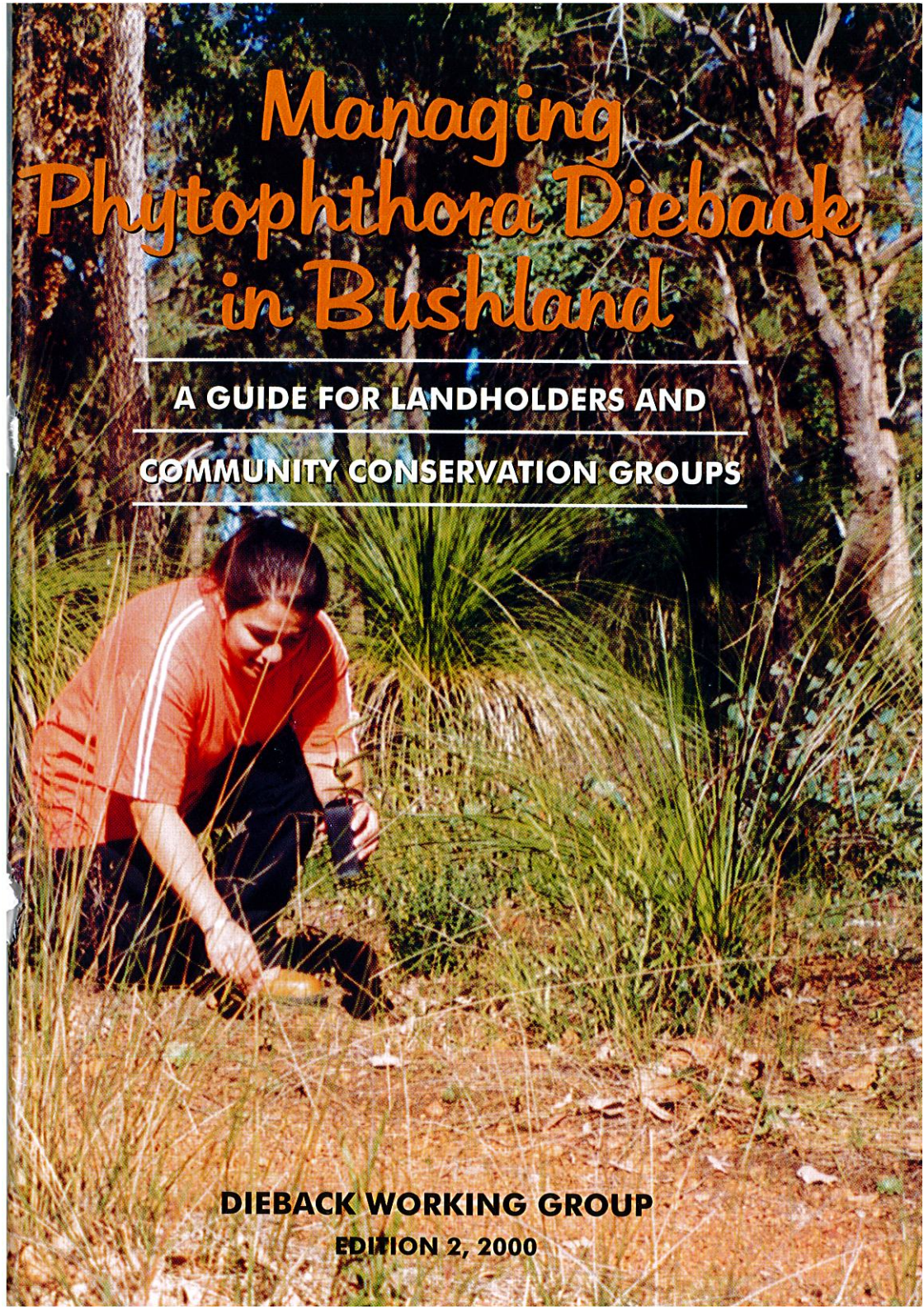
Managing Phytophthora Dieback in Bushland

A GUIDE FOR LANDHOLDERS AND COMMUNITY CONSERVATION GROUPS



DIEBACK WORKING GROUP

EDITION 2, 2000

Managing Phytophthora Dieback in Bushland

A GUIDE FOR LANDHOLDERS AND COMMUNITY CONSERVATION GROUPS

Edition 2

Dieback Working Group
Hitting Back at Dieback

Shire of Kalamunda
·A Home In The Forest·

Bushcare

Natural Heritage Trust
Helping Communities Helping Australia

Department of Conservation and Land Management

Edition 2

Written and compiled by Sharon Kilgour
Edited by Jan Knight
Design and layout by Louise Burch
Printed by Your Type Print, Art & Design
ISBN 0-646-37837-6
Published by the Dieback Working Group

PRINTED ON RECYCLED PAPER

THE DIEBACK WORKING GROUP

THE Dieback Working Group consists of representatives from Local Government, 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 'Phytophthora dieback' which is caused by the introduced pathogen *Phytophthora cinnamomi*. Since its formation in 1996, the Dieback Working Group has sought to:

- ☐ increase awareness about the plant disease caused by *P. cinnamomi;*
- ☐ encourage the adoption of disease prevention and management policies; and
- ☐ encourage the implementation of management procedures to minimise the spread and impact of the *P. cinnamomi*.

Membership

- City of Armadale
- Friends of Ellis Brook
- City of Cockburn
- Ministry for Planning
- City of Fremantle
- Shire of Kalamunda
- City of Gosnells
- Shire of Mundaring
- City of Melville
- City of Canning
- Town of Kwinana
- Shire of Serpentine-Jarrahdale
- Department of Conservation and Land Management
- Shire of Swan
- Roleystone Dieback Action Group
- Department of Environmental Protection
- Department of Land Administration
- Eastern Metropolitan Regional Council

Acknowledgments

Funding for this publication was provided by the Western Australian Minister for the Environment and the Federal Government's Natural Heritage Trust. Support was provided by the Shire of Kalamunda and the Department of Conservation and Land Management.

Thanks to Ian and Mady Colquhoun, John Nicolson, Kevin Vear (Department of Conservation and Land Management), Anne Harris, Bronwen Keighery (Department of Environmental Protection), Martin Pearce, David Lamont, John and Heather Bowler, Glenn Tuffnell, Fiona Marr, Mark Gloyn, Penny Hussey, Mike Grasby and Liz Western for their contributions and for reviewing the text.

CONTENTS

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*. *P. cinnamomi* has caused significant damage in the south west of Western Australia because:

- ☐ hundreds of south west native plants are susceptible
- ☐ the climate and soils of south west suit its survival and spread, and
- ☐ it was spread widely before it was identified as the cause of permanent damage to our ecosystems.

Organisations such as the Department of Conservation and Land Management (CALM), Alcoa and Main Roads WA follow procedures to minimise the risk of their activities spreading the pathogen. Many Local Governments are also in the process of adopting Phytophthora dieback management policies and implementing Phytophthora dieback management procedures.

Anyone who owns, manages or uses a bushland area can also take steps to ensure that their activities do not 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 ways you can significantly reduce this risk.

Honey Possum on *Banksia* coccinea flower, a plant species that is under threat from Phytophthora dieback (Photo by CALM)

PHYTOPHTHORA DIEBACK: A DEADLY DISEASE OF NATIVE PLANTS

What is Phytophthora Dieback?

Phytophthora dieback refers to the deadly introduced plant disease caused by the pathogen *Phytophthora 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 cause by salinity, drought, insect damage etc. 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?

Phytophthora 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.

Soil that is warm and moist provides the best conditions for *P. cinnamomi*. These conditions allow *P. cinnamomi* to produce millions of spores. These spores then move in the soil water to infect plant roots.

How does the Pathogen Spread?

In sloping areas *P. cinnamomi* spreads quickly when its microscopic spores move downslope in surface and subsurface water flows. It spreads more slowly upslope and on flat ground (approximately 1 m/year) because it is restricted to movement within plant roots.

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

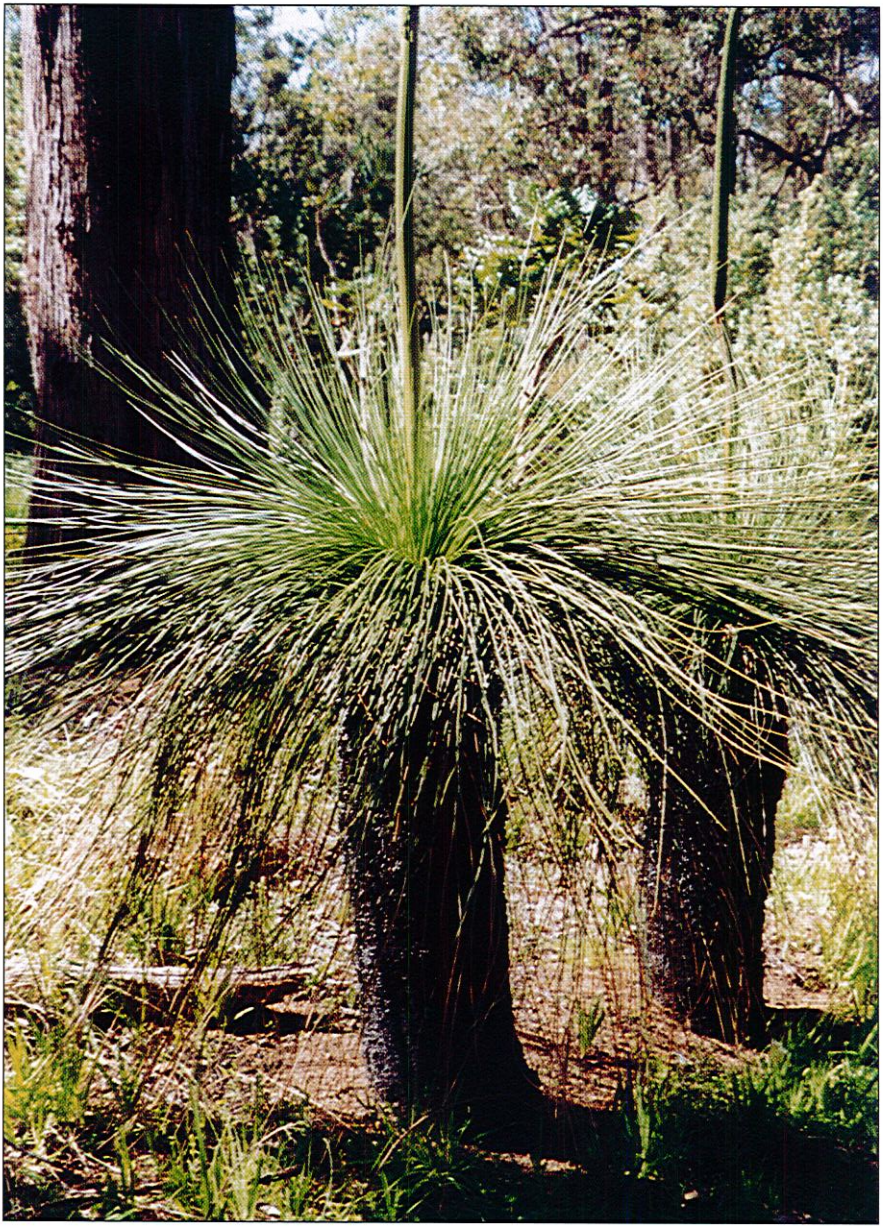
Which Plants does the Pathogen Kill?

Up to 25 per cent of native Western Australian plant species are susceptible to *P. cinnamomi* (Komorek *et al.*, 1994). Many of these plants are found only in south-western Western Australia. Some of the South West's more common plants are susceptible including Jarrah, Banksias, Grasstrees (Xanthorrhoea) and Zamia Palms.

A more extensive list of susceptible plants is included on pages 12-13. Many other plants, although not susceptible, act as a host for the *P. cinnamomi*. 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 Peach, Apricot and Avocado trees, Grapevines, Radiata Pine, Camellias, Azaleas and Rhododendrons (Cahill, 1993; Erwin & Ribeiro, 1996).

Xamia Palms (*Macrozamia riedlei*), are susceptible to *P. cinnamomi* (photo by Sharon Kilgour)



Grasstrees *(Xanthorrhoea preissii),* another susceptible species (photo by Sharon Kilgour)

Banksia grandis - another susceptible plant species
(Photo by Brian Tullis)

Avocado tree - one of the horticultural crops
attacked by Phytophthora dieback
(photo by CALM)

History

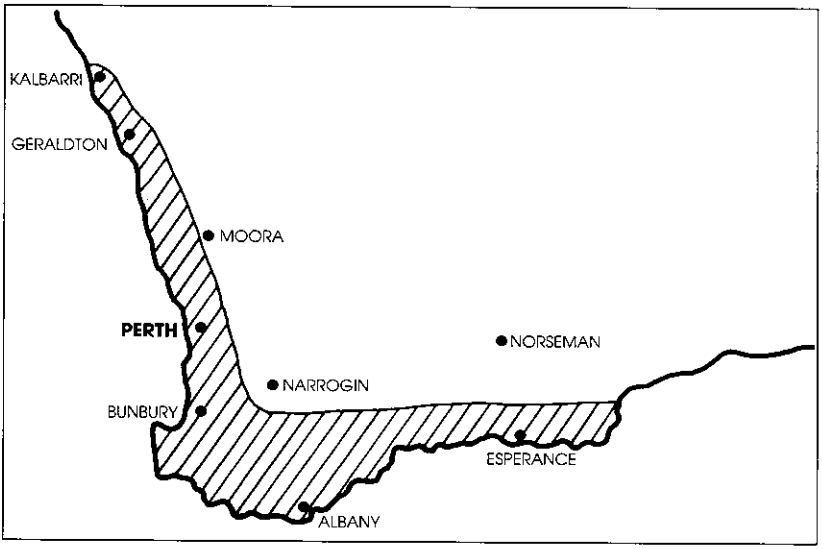
Phytophthora cinnamomi is not native to Western Australia. It is thought to have arrived in the State in soil around the roots of live plants, shortly after European settlement. Before it was realised that *P. cinnamomi* caused death in native vegetation, it had been spread extensively throughout the South West.

Geography

Phytophthora cinnamomi is now widespread throughout the South West of Western Australia. It is confined to areas with more than 400 mm annual rainfall, and extends between Eneabba and Esperance. It has infested forests, heathlands and woodlands. *P. cinnamomi* is present in many of the bushland areas in and around Perth.

APPROXIMATE DIEBACK RISK AREA IN WESTERN AUSTRALIA

(map based on information from CALM)



Bushland Values affected by Phytophthora dieback

When *P. cinnamomi* 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, often increasing the number of grasses and reducing the number of shrubs. Native fauna that rely on susceptible plants for survival are reduced in numbers, or are eliminated from sites infested with *P. cinnamomi*.

However, bushland infested with *P. cinnamomi* still retains important conservation values. It contains remnant vegetation that provides habitat for native fauna, and has other aesthetic and recreation values. Therefore, it is important to retain and maintain remnant bushland even when it is affected by Phytophthora dieback.

Dead jarrah at a site infested with *P. cinnamomi*. (photo by CALM)

Bushland infested with Phytophthora dieback, Falls Park, Hovea (photo by Sharon Kilgour)

Bushland that is free of Phytophthora dieback, Falls Park Hovea (photo by Sharon Kilgour)

PROTECTING YOUR BUSHLAND

To manage Phytophthora dieback in bushland, you need to plan ahead. The introduction or human-assisted spread of *P. cinnamomi* in bushland can be avoided if activities are well planned and management procedures are in place. Management procedures must be integrated into all bushland management activities if the impact of this disease is to be minimised.

There are three simple steps involved in managing disease caused by *P. cinnamomi* in bushland. These are:

Step 1. Assess Your Bushland

Step 2. Develop and Implement Management Procedures

Step 3. Treat Your Plants with Phosphite

These steps are discussed below.

Step 1. Assess Your Bushland

Managing Phytophthora dieback in bushland is most successful when you have determined whether *P. cinnamomi* is present or absent and, if present, identified the parts of the bushland that are infested. Management procedures can be implemented if you are not sure if *P. cinnamomi* is present. However, without knowing the location of *P. cinnamomi*, 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, and new infections may occur. It is important to re-survey for disease movement and new disease outbreaks every three to four years.

There are two options for determining whether *P. cinnamomi* is in bushland:

- ☐ engage a professional consultant; or
- ☐ do it yourself.

Professional Consultants

Professional consultants determine the presence of *P. cinnamomi* by using indicator plants and by testing soil and plant samples. Refer to page 36 for a list of Phytophthora dieback interpreters. The consultants listed have undertaken accredited training with the Department of Conservation and Land Management, and have many years' experience in completing *P. cinnamomi* surveys. This is why a consultant will give you the most reliable and accurate result.

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 $40 to $80 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.

Do It Yourself

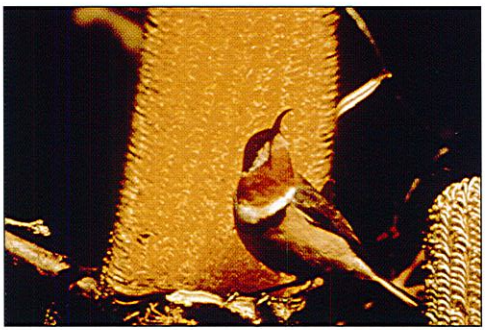
You can complete your own disease survey by studying the plants in the bushland. You will need to have a very good knowledge of native plants, various disease symptoms and other causes of plant deaths in order for the results of your assessment to be accurate and reliable.

The presence of *P. cinnamomi* is determined by observing plants which are killed by *P. cinnamomi*. These plants are called 'disease indicator species'. Dead Jarrah, Banksia, Grasstrees, Zamia Palms, Dryandra and Hakea are commonly used disease indicator species. You must be able to discount other factors that could have caused the plant death, such as fire, insects, flood, drought, watertable draw-down and other plant diseases.

Tables 1 and 2 list some common plant species and genera that are susceptible to *P. cinnamomi*, and can be used as 'Phytophthora dieback Indicator Species'.

Table 1. Common plants that are susceptible to *P. cinnamomi*

Northern and Central Jarrah Forest	Swan Coastal Plan
Allocasuarina fraseriana – Sheoak	*Hibbertia hypericoides*
Leucopogon verticillatus – Tassel Flower	*Verticordia nitens*
Eucalyptus marginata – Jarrah	*Adenanthos sericea*
Patersonia rudis – Hairy Flag	*Adenanthos cygnorum* – Woolly Bush
Adenanthos cygnorum – Woolly Bush	*Dryandra nivea* – Couch Pot Dryandra
Banksia grandis – Bull Banksia	*Dryandra sessilis* – Parrot Bush
Banksia littoralis – Swamp Banksia	*Banksia attenuata* – Slender Banksia
Dryandra sessilis – Parrot Bush	*Banksia littoralis* – Swamp Banksia
Isopogon sphaerocephalus	*Banksia menziesii*
Persoonia elliptica	*Xanthorrhoea* species
Persoonia longifolia – Snotty Gobble	*Isopogon formosus* – Cone Flower
Macrozamia reidlei – Zamia Palm	*Lomandra odora* – Tiered Mat Rush
Xanthorrhoea gracilis – Slender Grasstree	*Conospermum stoechadis*– Smoke Bush
Xanthorrhoea preissii – Grasstree	*Macrozamia riedlei* – Zamia Palm



Western spinebill on Banksia flower (photo by CALM)

Table 2. Plant genera with species known to be affected by Phytophthora species – including *P. cinnamomi* (CALM, 1999)

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*	Dasypogon
Hakea	Hypocalymma	Styphelia*	Daviesia
Isopogon*	Kunzea		Eutaxia
Lambertia*	Melaleuca		Gastrolobium
Persoonia*	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

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

- ☐ 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. Jarrah can be an exception to this. Jarrah trees may lack vigour and look sick for a number of years before suddenly succumbing ('sudden death syndrome').
- ☐ Lines or groups of plant deaths are more likely to be caused by *P. cinnamomi* than odd scattered individual plant deaths in otherwise healthy vegetation.
- ☐ Look for an edge effect – edge deaths are most obvious on sloping sites with an impeding layer in the soil, that is, clay or rock.
- ☐ Look for old deaths and recently killed plants, that is, an 'age range' in the deaths. This is because *P. cinnamomi* moves from plant to plant over time, killing each plant as it goes.
- ☐ Look for death in a range of susceptible plant species.
- ☐ Look for a vector, that is, something that could have introduced the *P. cinnamomi*, for example, a track, road, or vehicle activity.

A good quality aerial photograph may assist you to identify dead vegetation, locate the infection edge and map its spread. Aerial photographs can be obtained from the Department of Land Administration or your local Council.

Try to complete mapping when the soil is dry, or keep footwear free of soil, to avoid spreading potentially infected soil.

▮ Laboratory Testing

Like the professional consultants, you can also take plant and soil samples and have them tested in a laboratory (refer to page 36 for a list of laboratories). Sample results that are positive for *P. cinnamomi* mean that the pathogen is present at the site. Negative results do not mean that the site is free of the pathogen, as it may simply have been missed when the sample was taken.

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, and this can be a physically demanding task if you are sampling a dead Banksia or Grasstree.

Step 2. Develop and Implement Management Procedures

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 18)

SCENARIO 3. PHYTOPHTHORA DIEBACK IN ALL PARTS OF THE BUSHLAND (page 20)

SCENARIO 4. UNSURE IF PHYTOPHTHORA DIEBACK IS PRESENT (page 22)

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

SCENARIO 1

PHYTOPHTHORA DIEBACK NOT PRESENT IN BUSHLAND

The following management procedures will help to keep the bushland free of *P. cinnamomi*.

PLANNING

- Schedule activities that involve soil disturbance for low rainfall months (November–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 – mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, for example, 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 to be free of all mud and soil when entering the bushland.
- Footwear to be free of mud and soil when entering 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 Association Accreditation (refer to page 36 for information).
Bushland Restoration	**Weeding** ➢ If weeds are being manually removed they should be immediately placed in a container so plant material or soil is not dropped in 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 *P. cinnamomi*, so should be avoided in bushland that is uninfested. 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 Association wholesale accreditation, or nurseries with excellent hygiene practices. ➤ Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *P. cinnamomi*). ➤ Water should be from mains supply. If from a creek, dam or river, the water should be sterilised (refer to page 30).
Access	➤ Minimise walking in the bushland when the soil is wet and muddy. ➤ Stay on tracks. ➤ 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 the 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 *P. cinnamomi* could have, and how visitors can prevent its introduction. ➤ In public reserves, place signs next to *P. cinnamomi* susceptible plants along tracks highlighting that the plant would be killed if *P. cinnamomi* was introduced. ➤ Look out for activities near the bushland that could introduce *P. cinnamomi*, for example, road building. Find out if the activity is operating under 'hygiene 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 24-28).
Fire	➤ Mow, slash or use herbicide on fire breaks rather than plough or grade.
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.

SCENARIO 2

PHYTOPHTHORA DIEBACK IN SECTIONS OF THE BUSHLAND

Managing *P. cinnamomi* in this situation is most successful when it has been mapped. To minimise the risk of new infestations, the following management procedures should be implemented.

PLANNING

- Survey the bushland and mark the infection boundary.
- Schedule activities that involve soil disturbance for low rainfall months (November–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 do not pass from infested to uninfested parts of the bushland, or from low parts of the bushland to high parts of the bushland.
- Minimise soil disturbance – mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, for example, roads. Disease 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 to be free of all mud and soil when entering and exiting the bushland, and when moving from infested to uninfested areas.
- Footwear to 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 Association Accreditation (refer to page 36 for information on testing or suppliers). ➤ Non-certified materials can be used in the infested parts. ➤ 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 so 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 *P. cinnamomi*, so it should be avoided in bushland that is uninfested. However, if revegetation is required:

	➤ Consider direct seeding rather than planting seedlings. ➤ Select plants that are resistant to *P. cinnamomi* for the infested parts of the bushland. ➤ Complete planting when soil is moist but not wet. ➤ Purchase plants from nurseries with Nursery Industry Association wholesale accreditation, or nurseries with excellent hygiene practices. ➤ Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *P. cinnamomi*). ➤ Water used should be from mains supply. If from a creek, dam or river, the water should be sterilised (refer to page 30).
Access	➤ Minimise walking in the bushland when the soil is wet and muddy. ➤ Stay on tracks. ➤ 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.
Communication	➤ In public reserves, place signs at the 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 disease impact, the potential impact, and how visitors can prevent it spreading. ➤ On walk tracks, place signs next to susceptible plants and dead plants that have been killed by *P. cinnamomi*. ➤ Look out for activities near the bushland that could spread *P. cinnamomi*, for example, road building. If the activity is not operating under 'hygiene conditions', contact the Environment or Parks Officer at your local Council or the relevant authority. ➤ Discuss the disease 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 pages 24 - 28).
Fire	➤ Mow, slash or use herbicide on fire breaks rather than plough or grade. ➤ Construct or maintain fire breaks in the uninfested part of the bushland first, then move into the infested area.
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.

SCENARIO 3

PHYTOPHTHORA DIEBACK IN ALL PARTS OF THE BUSHLAND

If *P. cinnamomi* is present in all parts of a bushland area, it is important that any remaining susceptible vegetation is protected, and that *P. cinnamomi* is not spread to other bushland. The following management procedures should be implemented.

PLANNING

- Schedule activities that involve soil disturbance for low rainfall months (November–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 – mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, for example, 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 must be free of all mud and soil when exiting the bushland.
- Footwear must be free of mud and soil when exiting the bushland.

Earthworks	➢ Do not remove landscaping materials, soil or plant materials from the bushland.
Bushland Restoration	**Weeding** ➢ If weeds are being manually removed they should be placed immediately in a container so plant material or soil is not dropped in other bushland areas. **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 Association wholesale accreditation, or nurseries with excellent hygiene practices, to prevent other diseases being introduced.

	➤ Select plants that are resistant to *P. cinnamomi*. ➤ 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.
Fire	➤ Mow, slash or use herbicide on fire breaks rather than plough or grade.
Communication	➤ In public reserves, place signs at the 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, place signs along tracks next to dead plants that have been killed by *P. cinnamomi*, and explain the impact *P. cinnamomi* is having, and how visitors can prevent it spreading further. ➤ Look out for activities near the bushland that could spread *P. cinnamomi*, for example, road building. Inform those responsible that *P. cinnamomi* is present at the site. ➤ Discuss the disease 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 pages 24 - 28).
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 soil when exiting and keep them on hard, well drained tracks.

SCENARIO 4

UNSURE IF PHYTOPHTHORA DIEBACK IS PRESENT

The following procedures should be undertaken in bushland when you do not know if *P. cinnamomi* is present. These management procedures will minimise the risk of *P. cinnamomi* being introduced and prevent it spreading to another site.

PLANNING

- Schedule activities that involve soil disturbance for low rainfall months (November–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 - mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, for example, roads. Disease impact is greatest in wet sites.

FOR ALL ACTIVITIES

- Vehicles, tools, equipment and machinery to be free of all mud and soil when entering and exiting the bushland.
- 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.
- Footwear must be free of mud and soil when entering and exiting the bushland.

Earthworks	➤ Avoid bringing soil, gravel or sand into bushland. If such material must be introduced, ensure that it is free of Phytophthora dieback free or purchased from a soil supplier with Nursery Industry Association Accreditation (refer to page 36 for information on testing or suppliers).
Bushland Restoration	**Weeding** ➤ If weeds are being manually removed they should be placed immediately in a container so plant material or soil is not dropped in 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 *P. cinnamomi* and 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 Association wholesale accreditation, or nurseries with excellent hygiene practices. ➤ 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 *P. cinnamomi*). ➤ Water used in bushland should be from mains supply. If from a creek, dam or river, the water should be sterilised first (refer to page 30).
Access	➤ Minimise walking in the bushland when the soil is wet and muddy. ➤ Stay on tracks. ➤ Plan walks to start in high parts of the bushland and move to lower parts of the bushland.
Fire	➤ Mow, slash or use herbicide on fire breaks rather than plough or grade.
Communication	➤ In public reserves, place signs at the 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 *P. cinnamomi*, for example, road building. Find out if these activities are operating under 'hygiene conditions'. If not, contact the Environment or Parks Officer at your local Council, or the relevant authority. ➤ Discuss the disease status of the bushland with neighbouring landholders.
Protecting Vegetation	➤ Treat threatened susceptible vegetation in the bushland with Phosphite. Susceptible trees should be injected and all other vegetation sprayed (refer to pages 24 - 28).
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 soil when entering and exiting and keep them on hard, well drained tracks.

▮ Step 3. Treat Your Plants with Phosphite

Although there is no chemical that will eradicate *P. cinnamomi*, we are fortunate that a chemical is available that can protect susceptible plants. Phosphite, also known as Phosphonate, is a biodegradable fungicide that protects against disease caused by *P. cinnamomi*. Phosphite works by boosting the plant's natural defences.

Phosphite controls many species of Phytophthora, including *P. cinnamomi*. Phosphite is not toxic to people or animals (Shearer et al., 1991); its toxicity is similar 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 and rural supply stores. Treating plants with Phosphite is inexpensive. A medium sized Jarrah tree costs less than $ 0.50 to treat.

Phosphite needs to enter a plant's water transport system to be effective. This can be done by injecting Phosphite into trees, or spraying the leaves of understorey plants. 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 about three to five years of protection from *P. cinnamomi*. Spraying with Phosphite provides protection for about one to two years. Because Phosphite only provides temporary protection, treatment needs to be ongoing, and included in bushland management and 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 Australian Trust for Conservation Volunteers, or similar labour forces, to assist your group to complete the treatment.

Injecting Trees

Equipment

Tree injection (photo by Sharon Kilgour)

- ☐ Phosphite injection can be done with large syringes or with specially made stem injection equipment. If you are injecting more than one or two trees, a stem injector is recommended. It will save time and effort, and will be more effective.
- ☐ Cordless electric drill with 7/32" or 5.5 mm drill bit
- ☐ Chisel (only needed to remove bark if injecting Jarrah)
- ☐ Phosphite (Phosphite is sold in a 20 or 40 per cent solution, commonly under the labels Fosject or Agri-Fos).

Timing

The best time to inject a tree is when water is moving within the tree. Water movement is usually greatest in spring and summer. Injecting in the morning is usually more successful than in the afternoon.

1

2

3-4

Preparation

- ☐ If using 20 per cent Phosphite, dilute 1 part Phosphite with 2 parts water.
- ☐ If using 40 per cent Phosphite, dilute 1 part Phosphite with 5 parts water.

Procedure

1. Drill a hole into the tree. Injection needs to be in the sapwood, so do not drill any deeper than 3-4 cm. Drill the hole at a height that is comfortable for injecting, that is, waist height. The hole should be drilled at a slight downward angle.
2. Drill a hole every 20 cm around the tree trunk (this is 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.

Monitor plant health. If there is no decline in plant health, repeat in three to five years. If plants decline in health before three years, repeat treatment.

Spraying Plants

The solution for spraying is much weaker than for injecting, and contains a small amount of oil 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, and the solution will not harm resistant plants.

Equipment

- ☐ Backpack sprayer (ensure that it is clean and has not recently contained herbicides or other chemicals).
- ☐ Phosphite (usually sold in a 20 or 40 per cent solution, commonly under the labels Fosject or Agri-Fos)
- ☐ Synertrol oil (also called Spray Aid, available from Mirco Bros ph 08 9410 2233) or another sticking or wetting agent approved for use on native plants. Use rates recommended by the manufacturer.

Timing

Spraying is most effective in spring, summer and autumn. Spraying should occur when rain free days are forecast at least two days ahead.

Preparation

- ☐ If using 20 per cent Phosphite, mix 250 mL of Phosphite with 25 mL of Synetrol oil. Shake well.
- ☐ If using 40 per cent Phosphite, mix 125 mL of Phosphite with 25 mL of Synetrol oil. Shake well.
- ☐ Before the Synertrol oil and Phosphite begin to separate, place in the backpack and add 10 L of water. Ten litres is a comfortable weight to carry.
- ☐ Use the solution immediately and mix frequently.

Procedure

1. Place the backpack spray unit on your back and adjust the straps so it is comfortable, and the pumping lever is on the side that you prefer. Adjust the nozzle to give a coarse spray so the spray does not blow away from the plants.

Back pack spraying

2. Soak the plants so all leaf surfaces are wet. All understorey plants, including grass trees, should be sprayed. Ten litres of solution should last about 15 to 20 minutes.

Monitor plant health. If there is no sign of a decline in health, repeat in two to three years. If plants decline in health before two years, repeat treatment.

Larger spray units can be used and may be more efficient when treating large areas. The chemical concentration should be the same as for backpack spraying, and the chemicals should be kept well mixed.

Equipment Suppliers

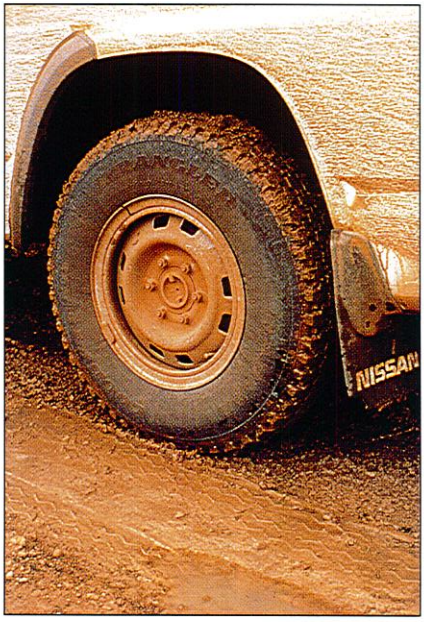
A list of equipment suppliers is included on pages 36-37

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 *P. cinnamomi*. 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 effluent to drain into bushland.
- ☐ Do not drive through wash-down effluent.
- ☐ Pay particular attention to mud flaps and tyres.



Mud on vehicles, particularly tyres, mudflaps and underbody, can spread *P. cinnamomi* (photo by CALM)

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 *P. cinnamomi*, you can take the extra precaution of sterilising tools and footwear. If you are propagating plants, sterilising tools and footwear is essential. Anything to be sterilised should first be cleaned, so all soil and mud is removed.

Sterilising Equipment, Tools and Footwear

Methylated spirits 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.

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 manufacturer's safety instructions).

Sterilising Water

To sterilise water, add 6 mL of pool chlorine to every 10 L of water (follow manufacturer's safety instructions).

Mud on footwear can spread *P. cinnamomi* (photo by Sharon Kilgour)

GUIDELINES FOR PROPAGATING PLANTS

Plants used in revegetation should be grown using hygienic methods. Nurseries with Nursery Industry Association wholesale accreditation maintain very high hygiene standards.

It is acknowledged that many community groups propagate their own plants for bushland revegetation. If community groups wish to continue this practice, and introduce the plants to areas that are free of Phytophthora dieback, they should implement the following procedures into their propagation methods.

Potting Mix

- ☐ Use a potting mix that is sterilised and is free of *P. cinnamomi.*
- ☐ Use a well draining potting mix.
- ☐ Store potting mix in sterilised, covered bins on a hard dry surface.

Water

- ☐ Water obtained from dams and streams or recycled water should be filtered and disinfected.
- ☐ Water from scheme supply, deep bores or clean roofs does not usually require treatment.

Diseased Plants

Any plants that appear unhealthy should be removed from the nursery area immediately (including the soil surrounding the plant). Dispose of the plants and the soil from the nursery area well away from the propagation and nursery 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, 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.

Phytophthora dieback is not just a threat to native plants, but is a serious problem for industries such as nurseries, forestry and horticulture (photo by CALM)

GUIDELINES FOR BUSHWALKERS

Unfortunately the enjoyable pastime of bushwalking can contribute to the spread of *P. cinnamomi*. However, responsible bushwalkers can ensure they do not contribute to the spread of Phytophthora dieback. 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.

- ☐ Contact CALM or the local Council for suitable bushwalking areas.
- ☐ Avoid bushwalking when the soil is wet and muddy (following rain).
- ☐ Keep to tracks.
- ☐ Avoid muddy areas.
- ☐ 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 value bushland or when leaving areas infested with Phytophthora dieback.
- ☐ Use footbaths 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.

Regular 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 and mud, large and small brushes and a bottle of water (from mains supply). Methylated spirits applied using a spray bottle, is an easy way to sterilise the soles of shoes.

Bushwalking can contribute to the introduction and spread of *P. cinnamomi* (photo by Wendy Fletcher)

GUIDELINES FOR CYCLISTS

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

- ☐ Contact CALM 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 declared CALM Disease Risk Areas and obey 'track closed' signs. (It is illegal for bicycles to enter Disease Risk Areas).

GUIDELINES FOR HORSE RIDERS

Horse riding is a popular activity, particularly in rural and bushland areas. Unfortunately, horse riding can contribute to the spread of *P. cinnamomi* by picking up soil in the horses hooves. To minimise the risk, horse riders should follow these guidelines.

- ☐ Contact CALM 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 CALM Disease Risk areas and obey 'track closed' signs. (It is illegal for horses to enter 'Disease Risk Areas').

Horse riding can contribute to the introduction and spread of *P. cinnamomi* (photo by Lawrie Dodd).

CONTACTS AND FURTHER INFORMATION

Phytophthora Dieback Interpretation Services (CALM Accredited)

Department of Conservation and Land Management

Como	Phone (08) 9334 0333
Bunbury	Phone (08) 9725 4300
Manjimup	Phone (08) 9771 7988
Fungus Doctors (Matt Reynolds) (Perth and South-West)	Phone (08) 9582 9215
GLEVAN Dieback Consultancy Services (Glenn Tuffnell) (Perth and South-West)	Phone (08) 9496 3336
Simon Watkins (South-West)	Phone (08) 9840 1244

Laboratories for Testing Soil and Plants for *P. cinnamomi*

Agriculture Western Australia, South Perth (Peter Woods)	Phone (08) 9368 3333
Curtin University, Bentley (Elaine Davison)	Phone (08) 9266 3106
Department of Conservation and Land Management, Vegetation Health Service, Como (Francis Tay)	Phone (08) 9334 0333
Hart Simpson & Associates, Shenton Park	Phone (08) 9388 3972

Phytophthora Dieback Treatment Contractors

R&J Dieback Protection Services will complete injection and spraying on your property (Perth and South-West)	Phone (08) 9537 8243

Nurseries and Landscaping Suppliers

Contact the Nursery Industry Association for an updated list of Accredited Wholesale Nurseries and Landscape Suppliers.	Phone (08) 9485 1144

General Phytophthora Dieback Information

The Environment Officer at your Local Government Office

Your Local Department of Conservation and Land Management

Roleystone Dieback Action Group (Ian Colquhoun) Phone (08) 9397 6813

Phosphite Injection Equipment

The Roleystone Dieback Action Group	Phone (08) 9397 6813
Roleystone Hardware	Phone (08) 9397 5643
Wildflower Society, Eastern Hills Branch, Mundaring	Phone (08) 9572 1697
Natures Reserves Preservation Group, Kalamunda	Phone (08) 9291 7480
Bassendean Preservation Group	Phone (08) 9279 9913
Friends of Talbot Road, Stratton	Phone (08) 9255 1490

At this stage, there is no contact for Phosphite injecting outside Perth. However, this is likely to change, so contact your local CALM office, the Environment Officer at your Local Government or the Roleystone Dieback Action Group for updated information.

Web Sites

Roleystone Dieback Action Group
www.quokka.murdoch.edu.au/~rdag/

Environment Australia – Threat Abatement Plan
www.environment.gov.au/bg/threaten/plans/tap/index.htm

Department of Conservation and Land Management
www.calm.wa.gov.au
(run a search on 'dieback' or 'Phytophthora cinnamomi')

AgWest Plant Laboratories
www.agric.wa.gov.au/agency/agwest/plantlabs

WORK DAY CHECKLIST

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 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.

Weeding

- ❑ Weeding is scheduled for dry soil conditions (if practical).
- ❑ Weeds will be immediately placed in a bag or container so soil does not drop out during transport.

It is important that all community conservation groups take the simple precautions listed opposite to avoid introducing or spreading *P. cinnamomi* (Photo by John Nicolson).

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, Perth.

CALM (1999) *The Wildflower Killer PHYTOPHTHORA* (Brochure). Department of Conservation and Land Management, Perth.

CALM (2000) *Phytophthora cinnamomi and disease caused by it. Volume I – Management Guidelines*. Department of Conservation and Land Management, Perth.

Erwin, D.C. & Ribeiro, O.K. (1996) *Phytophthora Diseases Worldwide*. ABS Press, St Paul, Minnesota.

Komorek, B., Shearer, B.L, Smith, B. and Fairman, R. (1994) Phosphonate offers a practical method for the control of *Phytophthora cinnamomi* in native plant communities. *Symposium on Plant Diseases in Ecosystems* (eds R.T. Wills and W.A. Cowling). Published by the Royal Society of Western Australia and the Ecological Society of Australia, Perth.

Nursery Industry Association (1997) *NIASA Best Practice Guidelines for the Nursery Industry Accreditation Scheme, Australia*. Nursery Industry Association, Sydney.

Shearer, B., Wills, R. and Stukey, M. (1991) *Wildflower Killers*. Landscope Magazine. Department of Conservation and Land Management, Perth.