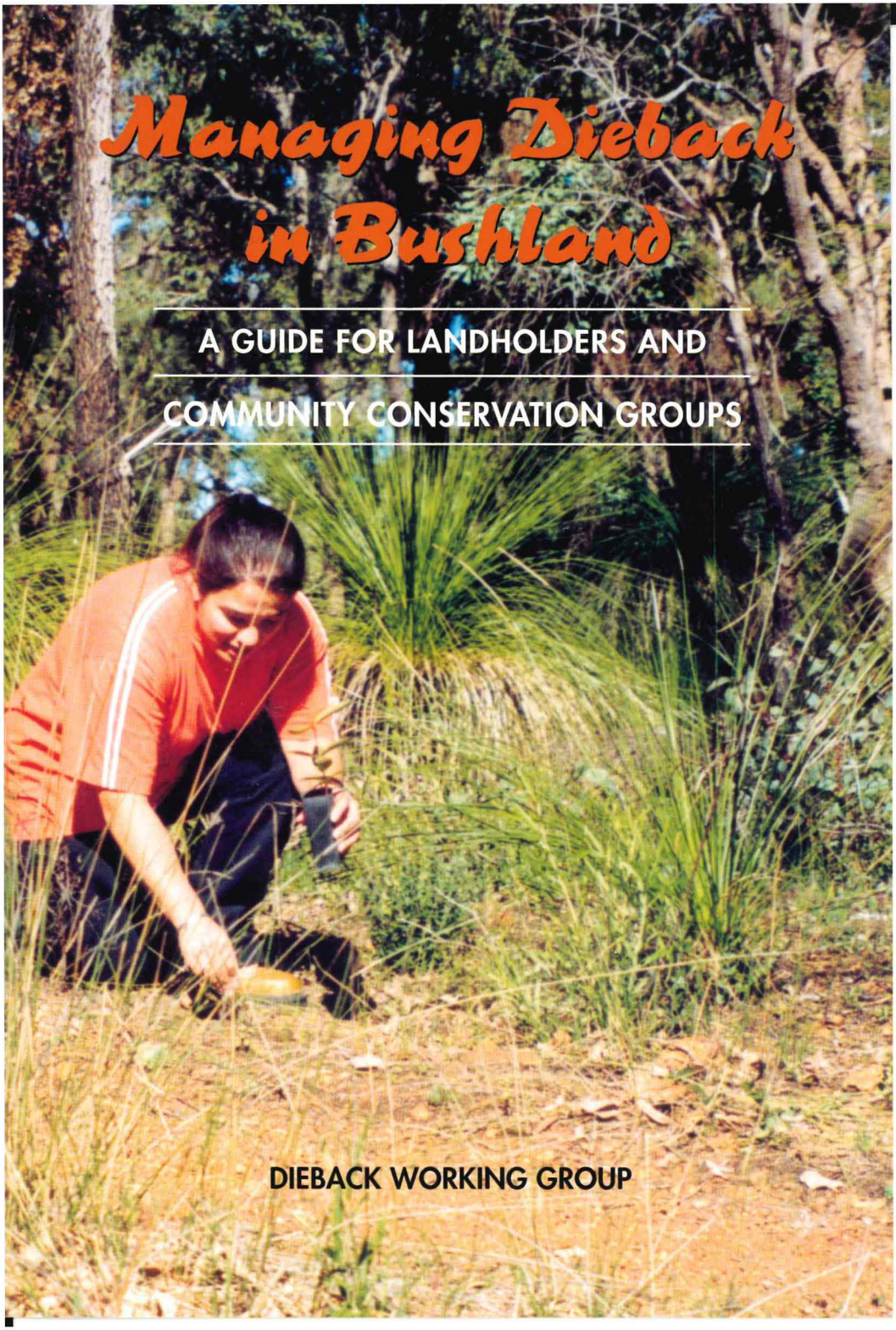
Managing Dieback in Bushland

A GUIDE FOR LANDHOLDERS AND COMMUNITY CONSERVATION GROUPS



DIEBACK WORKING GROUP

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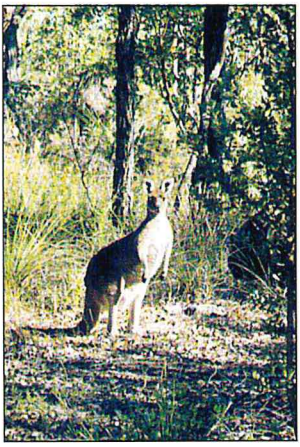

Edition 1

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

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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 'dieback' which is caused by the introduced fungus *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; and
- ▷ encourage the implementation of control measures to minimise the spread and impact of the fungus.

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
- 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

Acknowledgments

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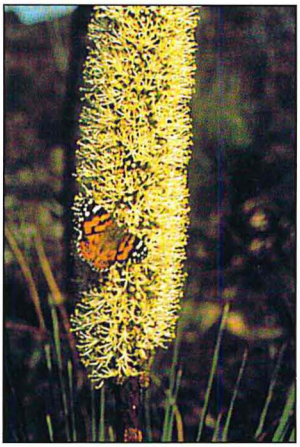
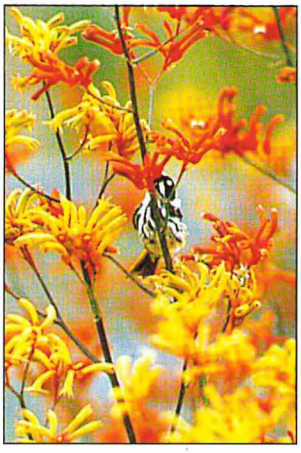


INTRODUCTION



DIEBACK is a deadly plant disease that can devastate our forests, woodlands and heathlands. The disease is caused by the introduced fungus *Phytophthora cinnamomi*. This fungus has been particularly damaging in the South West of Western Australia because it was spread widely before it was identified as the cause of permanent damage to our ecosystems. The climate and soils of south-western Western Australia also suit its survival and spread, and many south-western native plants die if attacked.

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 fungus. Many Local Governments are also in the process of adopting dieback management policies and implementing dieback control measures.

Anyone who owns, manages or uses a bushland area can also take steps to ensure that their activities do not introduce or spread the fungus. The information included in this booklet will help you identify activities that have a high risk of spreading the fungus, and ways you can significantly reduce this risk.

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

DIEBACK: A DEADLY DISEASE OF NATIVE PLANTS

What is Dieback?

In Western Australia, the name 'dieback' is used to describe the deadly plant disease caused by the fungus *Phytophthora cinnamomi.* There are many species of Phytophthora, but the species that causes the most severe and widespread damage to native plants in Western Australia is *Phytophthora cinnamomi.* (In other parts of Australia, the term 'dieback' is used to describe tree decline caused by factors such as salinity, drought, insect damage).

Where does the Fungus 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* because:

- ▷ it produces millions of spores under these conditions, and
- ▷ the spores move in the soil water to infect plant roots.

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

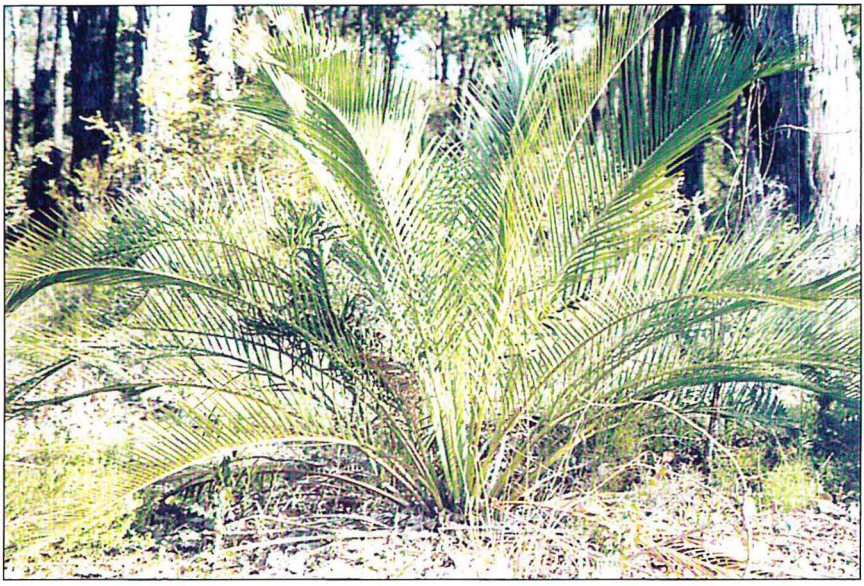
However, it is human activity that causes the most significant, rapid and widespread distribution of this fungus. Road construction, earth moving, driving dirty vehicles on bush roads and stock movement all contribute significantly to the increased rate of spread of *P. cinnamomi.* Bush restoration projects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

Which Plants does the Fungus 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.

The 'Assess Your Bushland' section (page 10 - 15) of this booklet provides an extensive list of plants which die if attacked by *P. cinnamomi* Many other plants, although not susceptible, act as a host for the fungus. This enables the fungus 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 reidlei*), Banksias and Grasstrees (*Xanthorrhoea preissii*) are just a few of the thousands of native plants killed by *P.cinnamomi* (photo by Sharon Kilgour)

Grasstrees (*Xanthorrhoea preissii*)

Bushland Values affected by the Fungus

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 dieback sites.

However, dieback-affected bushland 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 dieback.

Dead jarrah at a dieback infested site. (photo by CALM)

Dieback-infested bushland at Falls Park, Hovea (photo by Sharon Kilgour)

Dieback-free bushland at Falls Park, Hovea (photo by Sharon Kilgour)

PROTECTING YOUR BUSHLAND

To manage this disease in bushland, you need to plan ahead. The introduction or human-assisted spread of the fungus in bushland can be avoided if activities are well planned and control measures are in place. Control measures 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 Guidelines

Step 3. Treat Your Plants with Phosphite

These steps are discussed below.

Step 1. Assess Your Bushland

Managing bushland is most successful when you have determined whether the fungus is present or absent and, if present, identified the parts of the bushland that are infested. Control measures can be implemented if you are not sure if the fungus is present. However, without knowing the location of the fungus, 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 disease caused by *P. cinnamomi*, 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 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 $50 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 'Disease Indicator Species'.

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

Northern and Central Jarrah Forest	Swan Coastal Plan
Allocasuarina fraseriana – Sheoak	*Hibbertia hypercoides*
Leucopogon verticellatus – 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 reidlei* – 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

SCENARIO 1

DISEASE NOT PRESENT IN BUSHLAND

The following control measures 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. Disease impact is greatest in wet sites.

FOR ALL ACTIVITIES

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

Earthworks	▶ Avoid bringing soil, gravel or sand into bushland. If such material must be introduced ensure that it is dieback free 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 disease free. 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 practises. ▶ 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 the fungus, 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 disease 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

DISEASE 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 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-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

- Vehicles, tools, equipment and machinery must be free of all mud and soil on entry and exit from bushland, and when moving from infested to uninfested areas.
- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well drained tracks, and avoids puddles.
- 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 such material must be introduced ensure that it is dieback free or purchased from a soil supplier with Nursery Industry AssociationAccreditation (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 disease free. However, if revegetation is required:required:

	▶ Consider direct seeding rather than planting seedlings. ▶ Select plants that are resistant to *P. cinnamomi* for the infected 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 practises. ▶ 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 the fungus. ▶ Look out for activities near the bushland that could spread the fungus, 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

DISEASE 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 the fungus 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–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

- Vehicles, tools, equipment and machinery must be free of all mud and soil when exiting the bushland.
- Vehicle access 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 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 parts of the bushland. **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 practises, 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 the fungus is having, and how visitors can prevent it spreading further. ▶ Look out for activities near the bushland that could spread the fungus, 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 DISEASE IS PRESENT

The following procedures should be undertaken in bushland when you do not know if *P. cinnamomi* is present. The following control measures will minimise the risk of the fungus being introduced and prevent the fungus 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 must be free of all mud and soil when entering and exiting the bushland.
- Vehicle access 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, it should be 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 practises. ▶ 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 introduced the fungus, 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 *Phytophthora 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 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

- 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).

Tree injection
(photo by Sharon Kilgour)

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.

However, if you are entering very high value bushland, or have come from a dieback infested area, sterilising tools and footwear is an extra precaution that is worth taking. 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 disease free reserves, 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.

Dieback is not just a threat to native plants, but is a serious problem for industries such as nurseries, forestry and horticulture

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 the fungus. 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 fungus by following these guidelines.

- ▷ Contact CALM or the local Council for suitable bushwalking areas.
- ▷ 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 dieback infected areas.
- ▷ 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

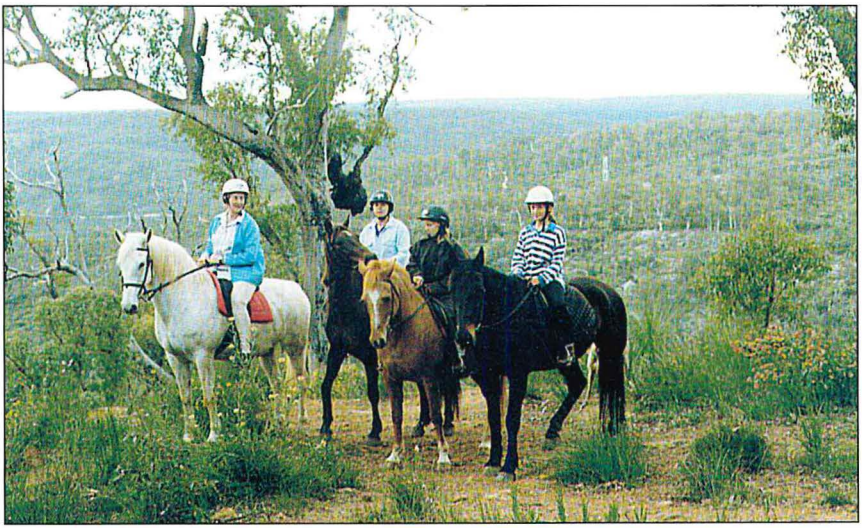
Bike tyres can pick up soil and mud, and therefore contribute to the spread of *P. cinnamomi*. To minimise this risk, cyclists should follow these guidelines.

- ▷ 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

Dieback Interpretation Services

GLEVEN Dieback Consultancy Services (Glenn Tuffnell) .	Phone (08) 9496 3336
Fungus Doctors (Matt Reynolds).	Phone (08) 9582 9215
Department of Conservation and Land Management, Swan Region (Abe van de Sande).	Phone (08) 9368 4399

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

Department of Conservation and Land Management, Vegetation Health Service. (Francis Tay)	Phone (08) 9334 0333
Curtin University (Elaine Davison).	Phone (08) 9351 3106
Agriculture Western Australia (Peter Woods).	Phone (08) 9368 3693
Hart Simpson & Associates.	Phone (08) 9388 3972

Dieback Treatment Contractors

R&J Dieback Protection Services (08 9537 8243) will complete injection and spraying on your own property.

Nurseries and Landscaping Suppliers

The Nursery Industry Association can provide an updated list of accredited wholesale nurseries and landscape suppliers.

Phone (08) 9325 8252

Peter Woods from Agriculture Western Australia will sample soil and other materials and determine if they are free of *P. cinnamomi*.

Phone (08) 9369 3693

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.

Managing your Bushland. Published by and available from CALM.

Landholders with bush blocks can consider joining the 'Land for Wildlife' Scheme to learn more about dieback and other bushland management issues. Contact CALM's Como office on (08) 9334 0333.

Web Sites of Interest

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

Environment Australia
www.biodiversity.environment.gov.au/plants/threaten/education/newsletters/brink8/4.htm

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

Nursery Industry Association
www.nia.org.au

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

COMMUNITY GROUPS 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).

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CALM (1992) *Dieback Disease – Hygiene Manual*. Department of Conservation and Land Management, Perth.

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

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

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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.

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