



Arresting *Phytophthora* Dieback

The Biological Bulldozer





Dabbler

“It may be in 2029, regret will be expressed that so little effort was made as far back as 1929 to ensure the preservation of the rare and beautiful flora. To deny future generations the right to enjoy its wonders is to deserve the censure of the unborn.”

*A Story of a Hundred Years Western Australia
1829-1929, Sir Hal Colebatch C.M.G.*



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ISBN: 1 875941 77 0

Special thanks

Dieback Working Group, Dept. of Conservation
and Land Management, Murdoch University
Centre for Phytophthora Science and
Management for extensive contributions to this
document

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Honey Possum

Foreword

For nearly 150 years an introduced microscopic organism called *Phytophthora cinnamomi* has been quietly devastating the natural heritage of Southwest Australia. The scale of this destruction is now becoming clear. With over 40% of our native plant species under threat from this “Biological Bulldozer”, many of our unique animal habitats are threatened too.

This publication clearly articulates the scale of this threat to both native plants and animals. The State government has developed a Dieback Response Framework consisting of strategies and actions to combat this threat. A Dieback Response Group has been formed that will ensure the Framework is implemented with the support of state and local government, landowners, industry and community groups such as the Dieback Working Group. This document supports the Dieback Response Framework and identifies what urgent action must be taken.

I commend this publication to you and would like to thank all of the contributors and sponsors. I also seek your support in increasing the awareness of everyone to the serious threat that Phytophthora dieback poses to our natural environment. This is an important summary of the issues and actions required to protect our natural heritage for future generations to enjoy.

Mr. Peter Elliott

Chairman for Dieback Consultative Council

September 2004



Executive Summary

As you read this document, a rogue bulldozer is at work destroying bushlands, heathlands, woodlands and jarrah forest, much of which is habitat for rare and endangered species. Native Western Australian flora and fauna species are disappearing, and wildflowers that draw thousands of visitors to the State each year are facing devastation. Horticulture-based industries and domestic Perth gardens are not immune either. Although this destruction is widespread throughout Southwest Australia, it is often barely visible.

The bulldozer is biological – a microscopic fungus-like organism called *Phytophthora cinnamomi* (pronounced Fy-tof-thora - meaning plant killer in Greek). Originally called jarrah dieback, it is now referred to as Phytophthora dieback. However, what is not commonly known is that jarrah is only one of thousands of species that the pathogen attacks and destroys.

Southwest Australia is one of WWF's Global 200 Priority Ecoregions and one of the world's 25 Biodiversity Hotspots. About 5700 described plant species occur in the Southwest Botanical Province and over 2300 of these species can be killed by Phytophthora dieback. This means that over 40% of our native plant species are under direct threat. Research is showing that there is also a direct threat to fauna. Animals that were once abundant in bushlands are disappearing along with their habitat.

This document outlines the effects of Phytophthora dieback on our native plants and animals. It provides information on the biology of the disease, its impact on the landscape, and how it spreads. It also presents case studies of the impact on our native fauna and what we, as a community, must do to "Arrest the Threat." The impact on the community will be widespread – from increasingly limited or prohibited recreational access to bushland, to the e unknown.

The need to increase awareness of this disease, and for investment in its control and management, is urgent. Extinction of species goes beyond the boundaries of the bush and affects us all. Though this disease was recognised 150 years ago, it is still destroying Australian natural ecosystems and landscapes. The legacy we leave for future generations is dependant on our proactive action today.

In addition, this report aims not only to increase awareness of Phytophthora dieback but to challenge governments, industries, conservation organisations and the community to work together to invest in the research and management necessary to put a stop to the devastation of the Biological Bulldozer – Phytophthora dieback.

WWF Australia and the the Dieback Consultative Council (DCC) recommends that a strategic and coordinated approach is taken by all stakeholders ranging from community groups to government agencies, industry and business, to research organisations and non-government conservation groups.

WWF Australia advocates the need for large scale investment in management and research of the disease which is essential if the long-term conservation of Southwest Australia's global biodiversity values are to be safeguarded from this Biological Bulldozer.



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Spiny-cheeked Honeyeater

The Biological Bulldozer

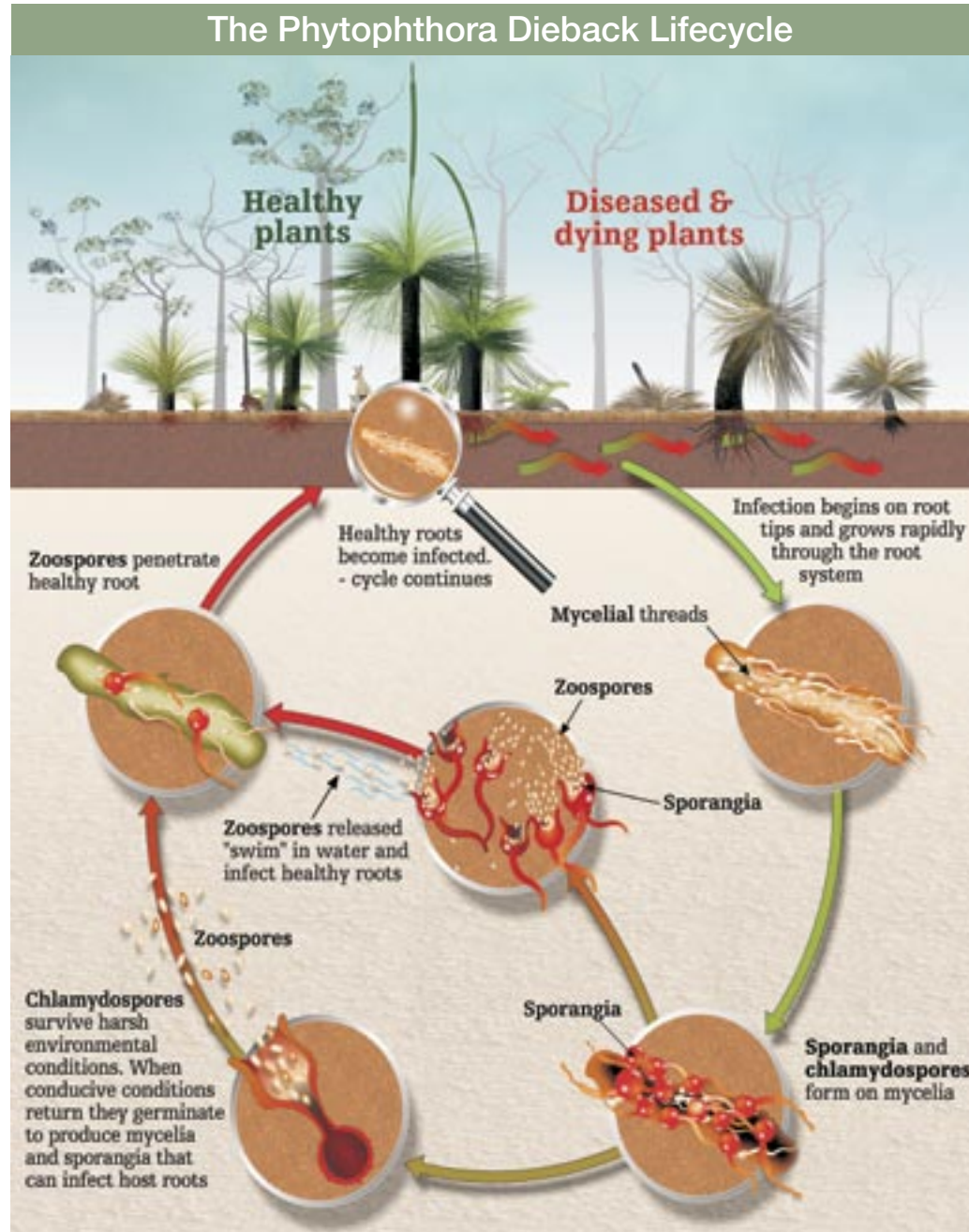
What is Phytophthora dieback?

Phytophthora dieback is affecting millions of hectares across Australia. It is a recognised key threatening process under federal legislation (along with the predation by the European red fox, land clearance, and loss of habitat from climate change) and has the potential to be more devastating to the environment than salinity. Phytophthora dieback has the potential to cause economic costs of around \$1.6 billion on a nationwide scale over the next 10 years.

Phytophthora dieback is a disease caused by a microscopic soil-borne water mould, *Phytophthora cinnamomi*, that kills many plants in the forests, woodlands and heathlands of Southwest Australia. The organism is invisible to the human eye but its impact on ecosystems is enormous.

Probably originating in Asia, it is likely to have been brought to Australia soon after European settlement. As the early settlers needed a horticulture industry for self-sufficiency, live plants were imported from overseas, which most probably included some soil infested with the Phytophthora pathogen.

The Phytophthora pathogen invades a plant's roots and stems to obtain nutrients for growth and reproduction. This process kills plant cells and reduces the plant's ability to transport water and nutrients. The disease is not restricted to native flora or natural bushland but is also prevalent in domestic gardens.



Honey Possum on *Banksia coccinea*

There are no known eradication methods. Limiting the spread to prevent further damage is the most cost effective measure.

Phytophthora dieback has the potential to be more devastating to the environment than salinity.

Throughout urban areas there is increasing evidence of infestation. It threatens the region's biodiversity and has serious economic impacts. *Phytophthora dieback* is a Biological Bulldozer. Field detection of the disease is difficult until the plant is dead (eg. banksias) or it displays severe symptoms of decline (eg. jarrah). Dead and dying plants are easily visible in infested areas such as roadside verges, national park walking tracks and private gardens.



Lambertia echinata occidentalis

Phytophthora cinnamomi moves through ecosystems by two mechanisms. The most destructive is when infested soil or plant material is relocated around the landscape. This leads to new site infections from which *Phytophthora dieback* will spread independently. It can also move in free water or by root-to-root contact between plants. Upslope it moves slowly, about one metre a year - this is known as autonomous spread.

How can infested soil and plants move? The answer is simple – transported by humans and some animals. It is easily carried on boots, muddy tyres, in flowerpots and by animals such as horses and wild pigs.

Any process that transports soil in the landscape can potentially move the pathogen to a disease-free site where a whole new cycle of infection is established.

Downslope it can move rapidly and cover long distances if infested water is allowed to move freely. Spreading *Phytophthora dieback* to a new area of the landscape is disastrous. It results in the death of susceptible plant species and ecosystem breakdown.



Destruction of native forests by Phytophthora dieback is widespread, however, there are areas where there is no visible sign of infestation.



Western Spinebill

Without applying the urgent action necessary to remove this key threatening process, it is likely that many more species will be driven closer to extinction.

Where is *Phytophthora dieback* in Southwest Australia?

As a general rule, all high rainfall plant communities and low elevation temperate vegetation communities are susceptible to *Phytophthora dieback*. Hundreds of thousands of square kilometres are at risk in Southwest Australia alone.

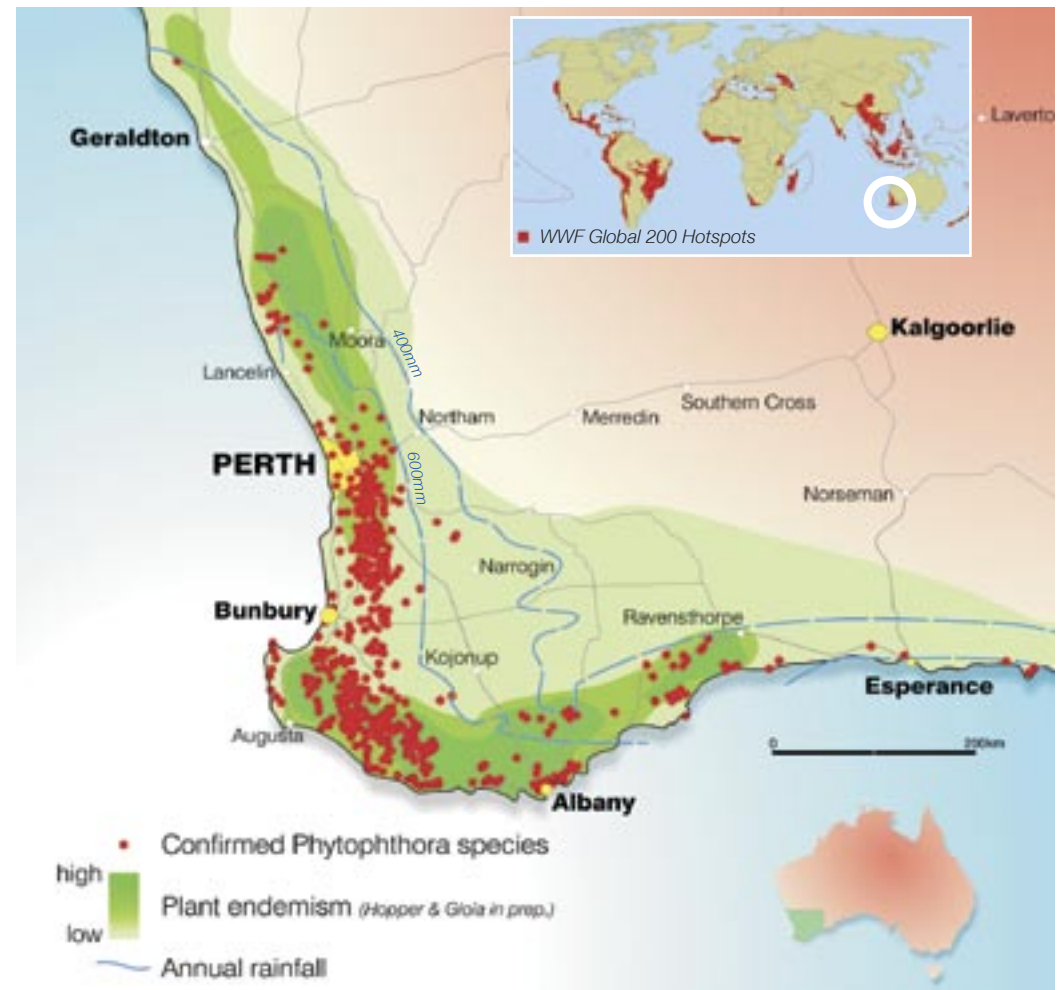
In Western Australia, *Phytophthora dieback* is killing and destroying stretches of forests, woodlands, heathlands, home gardens and horticulture properties from Eneabba in the north to Esperance in the Southeast. It can be found on the coast in areas such as Two Peoples Bay Nature Reserve and bushland areas within the Perth Metropolitan Region such as Lightning Swamp Bushland and in places including the Stirling Range National Park, Bagingara National Park and Fitzgerald River National Park. It is also having a serious impact in parts of Victoria, NSW, South Australia and Tasmania. The ability of *Phytophthora dieback* to kill plants in a wide range of environments demonstrates its adaptability and is an alarming signal that we need to take seriously.

What is the impact on biodiversity?

Southwest Australia is one of the world's 25 Biodiversity Hotspots and Australia's only Global Hotspot, reflecting its high level of species richness. Biodiversity hotspots were defined in a study undertaken by Conservation International which was published in February 2000. In this study, a biodiversity hotspot is defined by five key factors including species per area ratios and habitat loss. Southwest Australia is also included in the WWF Global 200 Ecoregion list, which identifies the richest, rarest and most distinct examples of Earth's diverse natural habitats under the highest threat.

More than 5700 described plant species occur in the Southwest Botanical Province and more than 2300 of these can be killed by *Phytophthora dieback*. This means that at least 40% of our native plant species are under threat.

The capability of *Phytophthora dieback* to destroy so many thousands of hectares of different plant communities is alarming. These plant communities can not be restored and could be lost forever. *Phytophthora dieback* warrants more serious action across Australia.



Distribution of *Phytophthora dieback* in Southwest Australia

The Threat to Native Flora

The pathogen has a wide host range, affecting mainly woody shrubs and trees, and nearly 50% of Declared Rare Flora and Priority Flora. This includes some of the State's most endangered species such as *Banksia brownii*, *Dryandra montana*, *Lambertia echinata* sub species *echinata* and the Eastern Stirling Montane Heath Thicket - a nationally threatened ecological community.

The loss of biodiversity in Southwest Australia is causing a significant change in the make-up of the region. It is estimated that between 15-20% of the jarrah forest has been infested and more than 60% of the Stirling Range banksia woodlands have also been affected. In the Stirling Range, 48% of woody plant species are susceptible to *Phytophthora dieback*.

The capability for *Phytophthora dieback* to destroy millions of hectares of diverse plant communities is alarming. These plant communities cannot be rehabilitated and could be lost forever. *Phytophthora dieback* warrants more serious action across Australia.

The banksia, pea and hibbertia families are extremely vulnerable to *Phytophthora dieback* infestation – members of the banksia family dominate many communities in the region. Hence, *Phytophthora dieback* causes localised extinctions of many plant species and, by this, changes the composition and species diversity of plant communities in Southwest Australia.

Death of these plants can lead to the loss of more than 50% vegetation cover and large changes in vegetation structure. The threats to native vegetation from *Phytophthora dieback* are serious and research is revealing that the impact of the pathogen is not confined to flora.

Flora on the brink!



Lambertia echinata sub species *echinata* Stirling Range National Park

The Eastern Stirling Range Montane Thicket and Heath Community is one of the most threatened ecological communities in Australia. It is highly susceptible to *Phytophthora dieback* and supports over 44 known species of mature plants.

Lambertia echinata

One of Australia's most endangered plant species is *Lambertia echinata* sub species *echinata* which is found in the Cape Le Grande National Park heathlands. This species is highly susceptible to *Phytophthora dieback* with only three populations known making up only 76 plants in total.

Unfortunately, phosphite treatment for this species is ineffective and translocation efforts to re-establish it in the wild have also failed.

Banksia brownii

Banksia brownii is another flora species on the brink of extinction. It is highly susceptible to *Phytophthora dieback*. Only 12 populations exist in the wild and all of these are declining and infested with *Phytophthora dieback*.

Like *Lambertia echinata* sub species *echinata*, *Banksia brownii* will become extinct in the wild in the near future if long term and sustainable control measures are not found soon.



Lambertia echinata sub species *echinata*



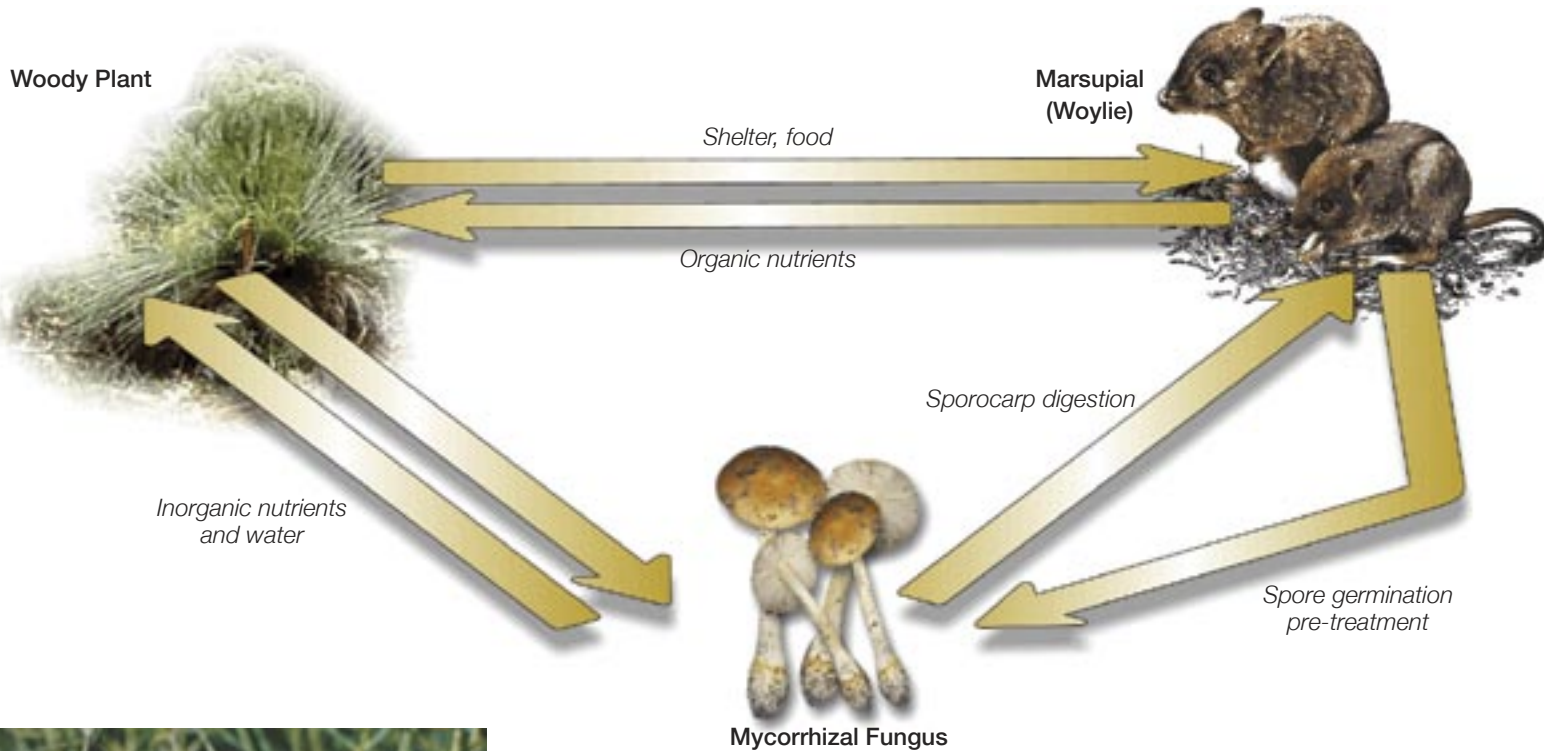
Changing vegetation structure alters habitats that provide food and shelter for marsupials, birds, reptiles and insects. Thus, like weeds and feral animals such as foxes and cats, the spread of *Phytophthora dieback* is impacting on native fauna populations.

Native fauna species have already severely suffered from the devastating effects of feral animals, and native vegetation clearance. *Phytophthora dieback* adds another layer of devastation impacting upon native fauna in Southwest Australia. Without applying the urgent action necessary to control this key threatening process, it is likely that many more species will be driven closer to extinction.



Advanced destruction of vegetation structure

Dryandra montana is a critically endangered species in the Montane Thicket and Heath Community of the Eastern Stirling Range



Mycorrhizal Fungus

**Figure 1.
Keystone Species**

The co-dependence between woylies, fungi and plants.

A keystone species is one that interacts with a number of other species in a community. The removal of this species can cause widespread changes to community structure.



Key Threatening Processes to Australian biodiversity

A process is defined as a Key Threatening Process if it threatens, or potentially threatens, the survival, abundance or evolutionary development of a native species or ecological community. A damaging environmental process can be listed as a Key Threatening Process if it could:

- Cause a native species or ecological community to become eligible for addition to a threatened list (other than conservation dependent)
- Cause an already listed threatened species or threatened ecological community to become more endangered
- Adversely affect two or more listed threatened species or threatened ecological communities.

In Southwest Australia alone, Phytophthora dieback is affecting woodlands, heathlands and forests that are the habitat of threatened fauna and flora. The spread of the disease leads to the collapse of ecosystems and the destruction of homes for many native fauna species.

This damaging environmental process increases the threat to endangered species such as the dibbler (*Parantechinus apicalis*) and potentially to Australia's most threatened mammal, Gilbert's potoroo (*Potorous gilbertii*). Both of these threatened species occur in Southwest ecosystems that are at high risk of degradation caused by Phytophthora dieback.

Species such as the dibbler and the Gilbert's potoroo need your help!

The Threat to Native Fauna

So far this document has provided an overview of the impacts of Phytophthora dieback on biodiversity in Southwest Australia. Until recently, the impacts on fauna were poorly understood. However, recent research by conservation biologists has revealed some interesting relationships between Phytophthora dieback and the decline in fauna, primarily mammal species, across southern Australia.

The loss of certain plant species from an ecosystem has the potential to cause the collapse of entire ecosystem processes. These species are known as “keystone” species. A keystone species is a species that interacts with a large number of other species in a community. Because of these interactions, the removal of this species can cause widespread changes to community structure.

In Australia, many threatened fauna species exist in habitats affected by, and susceptible to, Phytophthora dieback. This includes 9 vulnerable, 10 endangered and 6 critically endangered bird species, and approximately 32 species of mammals that are either threatened or conservation dependant.

The following examples provide a “focus on fauna” and the consequences of Phytophthora dieback for some threatened and conservation dependant species in Southwest Australia. They suggest that by investing now in Phytophthora dieback management and research, it is possible to protect habitats for threatened fauna and the ecosystem services they provide.

It is necessary for government, industry and community to view the loss of fauna from Phytophthora dieback seriously, as the case studies also highlight that it is impacting on ecosystems at a landscape level. Urgent investment is required for long-term protection of threatened and ecologically significant species and communities.

The Woylie

The woylie (*Bettongia penicillata*) is a keystone species that was almost extinct in the mid-1980s but has recovered recently due to extensive predator control programs. However, its future survival depends on continuing control of threatening processes, including Phytophthora dieback.

Woylie biology shows a link between ecosystem function and health. Woylies dig profusely, searching for fungi and other foods, and each woylie can turn over nearly 5 tonnes of soil per year, creating soil mosaics. Fungal spores are dispersed in the scats and can germinate to form beneficial associations with many woody plants. Woylies also collect and bury sandalwood seeds and this habit is thought to be important in sandalwood regeneration. Woylies illustrate a functional three-way link between animals, fungi and plants, and demonstrate how a single species can be vital for maintaining a healthy ecosystem (Figure 1).



The Dibbler

The dibbler (*Parantechinus apicalis*) is an endangered small nocturnal insectivorous marsupial. Although the dibbler is cryptic and rarely seen, if found it can be characterised by a soft grey drizzling through its fur and a distinct white ring that surrounds its bulbous eyes.

Dibblers were considered to be extinct until 1976 when one was photographed on banksia flowers in Torndirrup National Park near Albany.

A combination of wildfire and Phytophthora dieback has modified their habitat and the species is under threat.

The Mardo

Another small marsupial that is affected by Phytophthora dieback is the mardo or yellow footed antechinus (*Antechinus flavipes*). In the Jarrah forest, this species occurs in much lower numbers in diseased areas than in healthy forest.

The most likely cause of the reduction in mardo numbers is the loss of vegetation structure and floristic diversity, which has resulted from the death of those plant species susceptible to Phytophthora dieback. Furthermore, many of the plant species killed by Phytophthora dieback, including the grass trees (*Xanthorrhoea* species), banksias and jarrah, provide nesting sites, refuge, foraging and nutrient resources for small mammal communities.

In the jarrah forests, Phytophthora dieback has



an independent, or autonomous, uphill spread of about 1 metre a year. Each year, the suitable habitat for mardos is decreasing by this amount.

Gilbert's Potoroo

The Gilbert's potoroo (*Potorous gilbertii*) is Australia's most endangered marsupial. It was discovered by John Gilbert near Albany in 1840. At that time, it was recorded as very common around King George Sound.

It's now only known to exist in the wild at Two Peoples Bay Nature Reserve east of Albany. This small marsupial, thought to be extinct since the late 1870s, was rediscovered in 1994 at Two Peoples Bay during scientific studies on mainland quokka populations.

Predation, particularly by foxes, reduced numbers to around 50 animals inhabiting a restricted public access and controlled study location near Mt Gardner in an area where the bush has not been extensively burnt for more than 100 years.

Gilbert's potoroo feeds almost exclusively on small underground, truffle-like fungal fruiting bodies. Gilbert's potoroo habitat is infested by *Phytophthora cinnamomi*, however, the impact of Phytophthora dieback on this species is poorly understood.

Phytophthora dieback could be a factor that is adding further pressure to Australia's most



endangered mammal possibly through degrading the dense understorey layer that shelters Gilbert's potoroo populations from predators or from causing a decline in truffles through the interruption of the symbiotic relationship between underground fungi and plants.

These statements are speculative and further investigation into the impacts of the disease on Gilbert's potoroo habitat must be undertaken.

Honey Possum

The honey possum (*Tarsipes rostratus*) is one of the few mammals that depend on nectar and pollen as their main source of food. Weighing less than 10 grams, it is tiny but has a tremendous capacity to roam heathland vegetation for plants flowering in the greatest abundance.

Its favoured food plants are banksias, which are extremely vulnerable to *Phytophthora* dieback. Death of banksias removes shelter as well as food. The decline in banksia dominated communities is compromising some honey



Honey Possum

possum communities. Honey possums require suites of different banksia species to survive at different times of the year, and even brief shortages of food can drive a population to extinction.

As the honey possum visits flower blossoms and inserts its pointy snout past the stamens, it collects pollen on its fur which it then transports to other flowers. Thus, the honey possum plays an important role as a pollinator.

The honey possum represents a strong link between *Phytophthora* dieback and fauna:

***Phytophthora* infestation of banksia = decline of honey possums.**

Western Spinebill

Like the honey possum, many nectarivorous birds are affected by *Phytophthora* dieback. One of the most beautiful of these is the western spinebill (*Acanthorhynchus superciliosus*) which has a long, fine curved bill – perfect for probing nectar from long-fluted flowers. Many of the nectar-producing plants on which the birds feed are understory components of our forests and woodlands that are killed by *Phytophthora* dieback. This loss severely restricts the productivity of ecosystems for nectar-feeders such as the spinebill and the honeyeaters.



Western Spinebill



*Stirling Range National Park - an important eco-tourist site is more than 60% infested with *Phytophthora* dieback*

What is the Economic and Social Impact ?

Residents of Southwest Australia communities value the natural environment with its abundant bird life, bushland and nature-based recreational activities. *Phytophthora* dieback is destroying wildflowers through the Southwest, devastating local bushland areas and destroying native gardens. *Phytophthora* dieback is responsible for the closure of many parts of National Parks, thereby restricting public access and enjoyment of natural areas.

Backyards, gardens and local bushland areas are being impacted, reducing community amenity and aesthetics. This hidden cost is borne by the community.

Unless the spread of the disease in this global hotspot is urgently addressed, it will continue to bulldoze biodiversity, compromising community values.

Bushland recreation and the bushland experience is threatened as access becomes restricted.

The cost to the community is substantial. Western Australia is a rich source of some of the world's most beautiful wildflowers and fauna which support a substantial tourist economy. Many of our world-renown flowering plants, such as the banksias, hakeas, grasstrees, eucalypts and peas, are killed if their habitats become infested with the pathogen.

Horticultural crops such as macadamias, chestnuts, azaleas, avocados, and floristic species such as proteas are killed by *Phytophthora dieback*.



Chuditch

Important timber species such as jarrah are also severely affected. Direct economic costs are predicted for the Western Australian forestry industry with the loss of royalties to the State estimated at \$742,000 p.a. through a yearly reduction of 19,000 cubic metres of jarrah sawlogs as a result of the predicted spread of *Phytophthora dieback*.

On a national scale, the economic costs of not investing in the management and abatement of *Phytophthora dieback* has been estimated at up to \$160 million per year, including losses to agriculture, forestry and tourism.

Loss of wildflower diversity in our coastal heathlands will detrimentally affect the associated tourist industries and the image of Southwest Australia.

In total, the costs to the Australian economy as a result of uncontrolled and unmanaged *Phytophthora dieback* is around \$1.6 billion over the next ten years! This does not include the economic costs from the loss of ecosystem services such as the production of oxygen and the sequestration of carbon dioxide emissions.



The cost to the economy

The economic cost to Australia, per year, is \$160 million, however, the cost to our economies through the loss of ecosystem services and ecosystem breakdown is unknown.



Banksias destroyed by Phytophthora dieback



Severe Phytophthora dieback infestation

The economic costs highlight the urgency to halt the Biological Bulldozer and protect industries from the devastation of *Phytophthora dieback*.

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© Marie Lochman/CALM

Slowing the Bulldozer

Currently, there are no eradication methods for *Phytophthora cinnamomi*. Limiting the spread to prevent future destruction is the most effective way to manage the disease caused by it. This will require cooperation, partnerships and investment from government, industry, landholders, non-government organisations and the community.

Below are some actions that have been taken thus far that have slowed the spread of *Phytophthora* dieback, but unfortunately have not been able to stop its path towards ecological devastation.

Threat Abatement Plan

The Australian Government has listed *Phytophthora* dieback as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act* 1999. This resulted in the preparation of a national "Threat Abatement Plan" with two broad goals:

- To protect threatened species and communities from the disease; and
- To prevent further species and communities from becoming endangered through exposure to the pathogen.

The plan encourages implementation of management programs, improved understanding, education and coordination. This plan is the overarching plan for the management of *Phytophthora* dieback in Australia.

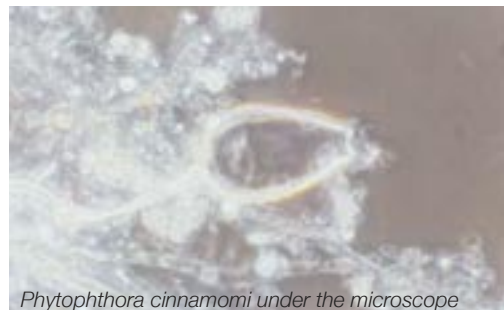
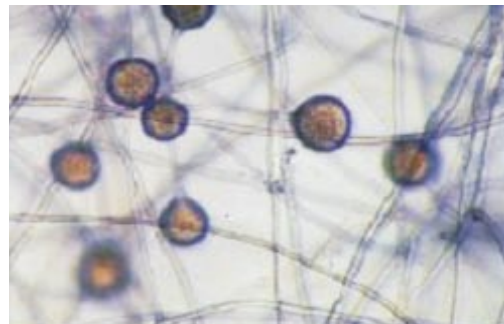
The threat abatement plan has identified priorities on a broad scale, but more state, regional and site specific investment and implementation is required for the effective management of *Phytophthora* dieback.

Western Australian Dieback Response Framework

In March 2004 the Western Australian Government established an action orientated Dieback Response Group to implement a statewide Dieback Response Framework.

The framework includes:

- Development of a dieback atlas for Western Australia
- The preparation of management guidelines for land tenure (particularly on private and local government land)
- The development of a generic *Phytophthora* dieback risk assessment methodology
- Action plans to tackle *Phytophthora* dieback in priority areas such as the Fitzgerald River National Park
- A whole-of-government policy.



Phytophthora cinnamomi under the microscope

© Jiri Lochman/CALM



The Dieback Response Framework is aimed at taking a more cohesive and coordinated approach to effectively manage *Phytophthora* dieback across government agencies. It is a State government initiative to undertake state-based priorities for the management of *Phytophthora* dieback in Western Australia. To ensure that the Dieback Response Framework is effective, it is important that financial and human resources investment occurs in all aspects of the framework.

Dieback Consultative Council

The Dieback Consultative Council was formed by the WA Minister for Environment in 1997. Membership encompasses a broad range of research and management expertise, as well as industry and other stakeholders. The primary function of the Dieback Consultative Council is to provide high quality advice to the Minister for Environment in relation to *Phytophthora* dieback in Western Australia. The Dieback Consultative Council has been instrumental in establishing the Dieback Response Framework.

Dieback Working Group

The Dieback Working Group was formed in 1996 by Perth Metropolitan Area local government authorities, community groups and state government land management agencies concerned with the management of *Phytophthora* dieback. Since its formation, the Dieback Working Group has sought to:

- Increase awareness and understanding about *Phytophthora* dieback in the Perth Metropolitan Area and Southwest Australia
- Encourage the adoption of *Phytophthora* dieback prevention and management policies
- Encourage the implementation of management procedures to minimise the spread and impact of the pathogen.

To achieve these aims, the Dieback Working Group has mapped the occurrence of the pathogen within significant bushland around Perth and Southwest WA; developed best practice guidelines using appropriate hygiene procedures; and promoted the use of phosphite. Furthermore, the Dieback Working Group has produced a number of publications on the management of the pathogen within local governments, community-managed bushland and the extractive industries. These management documents have focused on minimising the spread and impact of the pathogen.



Hand spraying of Phosphite solution.



Phosphite injection of trees prone to *Phytophthora dieback*

It is essential that the Dieback Working Group remains adequately resourced to enable the continued provision of community and industry dieback management services.

Murdoch University Centre for Phytophthora Science and Management

The Murdoch University Centre for Phytophthora Science and Management aims to work in partnership with industry, government, and community to provide science and management training to mitigate the threats posed by *Phytophthora cinnamomi*.

The Centre for Phytophthora Science and Management is conducting a number of research programs, which include the biology of the pathogen in ecosystems, managing the disease, conservation, biodiversity and ecosystem restoration, as well as detection, diagnosis and mapping of the disease.



Wood White Butterfly

Quarantine and Hygiene

Industry, government and community are responsible for preventing the spread of *Phytophthora dieback* from infested to non-infested sites. The aim of quarantine and hygiene measures is to eliminate the transfer of soils between sites by people.

The objective of protecting non-infested areas is to be “clean-on-entry”. Some strategies employed to avoid the cross-contamination between infested to non-infested areas include temporary seasonal closure of roads and walk trails, signage, permanent closures, and the establishment of hygienic entry and clean-down points.

It is important that everyone follows these hygiene guidelines to prevent the further spread of *Phytophthora dieback*, regardless of whether they are industry employees, nature-based tourists or gardeners.



Shoe cleaning station

For more information on quarantine and hygiene measures, see: http://www.naturebase.net/projects/dieback_documents.html - also see more information on page 21

The Use of Phosphite

Phosphite is a chemical used to fight Phytophthora dieback. In the last 10-15 years, phosphite has been successfully used to reduce the spread and impact of Phytophthora dieback in small infested areas. Phosphite can be applied to trees through injections in the trunk or aerial spraying of whole plant communities. Research has shown that it increases the resistance of susceptible or infected species to Phytophthora attack.

Broadscale spraying techniques can prolong the survival of plants for up to two years. Trunk injections are more effective, with up to five years of containment, but are more labour intensive.

Phosphite treatment does not eradicate Phytophthora dieback. It requires ongoing repeated application to prolong the onset of the disease making it expensive and an unsustainable long term solution.



Advanced Phytophthora dieback destruction of Xanthorrhoea pressii.



Community involvement is vital.

Regional Natural Resource Management

Natural resource management is about managing resources in an integrated and ecologically sustainable manner. This means finding the balance between social, economic and environmental values, whilst ensuring the integrity of ecosystems are not compromised.

Natural Resource Management groups are responsible for the development and implementation of Regional Natural Resource Management Strategies.

It is important that Regional Natural Resource Management Strategies adequately recognise Phytophthora dieback as a key threat and invest in a suite of management actions to address the disease throughout each relevant region in Australia.

Community Action

Community groups are invaluable for the protection of bushland areas. They provide leadership, a watchful eye and on-ground rehabilitation services. Many community groups have been working with Phytophthora dieback experts, the Dieback Working Group and others to protect areas from infestation and working with local authorities in developing management plans and control measures such as phosphite treatment. Two examples of community groups that have been pro-active in Phytophthora dieback management are the Friends of Lightning Swamp Bushland and Roleystone Dieback Action Group.

Friends of Lightning Swamp Bushland

Lightning Swamp Bushland, a 70-hectare bushland in the City of Bayswater, Perth, WA presents an excellent example of an urban bushland area that has been protected through the work of the local community. The Friends of Lightning Swamp Bushland has approximately 50 members who have pulled together to protect the banksia woodlands, seasonal wetlands and other values of the reserve.

A priority for the Friends Group is protecting the bushland from Phytophthora dieback as more than two-thirds of the bushland, mainly the wetland areas are affected.

Below are some of the key measures that the Friends of Lightning Swamp have taken:

- Produced a map showing the extent of Phytophthora dieback affected areas
- Established a buffer zone to prevent the spread to unaffected areas
- Injected phosphite in high-risk plants that border the Phytophthora dieback areas
- Established fencing to prevent unlawful entry by four-wheel drives and trail bikes, and to reduce the risks of spreading the disease

- Installed pedestrian access gates and limestone paths to avoid further spread of the disease by the public
- Erected wooden barriers on trails to prevent access to non-infested areas by the general community
- Ongoing phosphite injection and spraying of native vegetation.

The group is currently working on an education and awareness-raising campaign through the design and implementation of interpretative signage to raise community awareness of the impact of Phytophthora dieback.

Roleystone Dieback Action Group (RDAG)

The Roleystone Dieback Action Group is another example of community driven action in fighting the threat of Phytophthora dieback. The Roleystone Dieback Action Group has been working for 10 years to treat bushland reserves around Roleystone, a hills suburb in the city of Perth WA. The Group aims to prevent the spread of Phytophthora dieback and minimise the impacts on the biodiversity of the reserves.

The Group also takes an active role in community education and fostering community stewardship to control the disease on private land and with other community bushland groups.

These case studies highlight the value of community groups working with land managers to protect biodiversity from threats such as Phytophthora dieback.



Mardo

Stopping the Bulldozer

National collaboration and state-wide coordination is required to bring together existing knowledge, take a coordinated and strategic approach to management and research into *Phytophthora* dieback, and to ensure that the limited funds available are used cost-effectively. This will require a united approach and long-term commitments from government agencies, academia and industry to allocate serious investment into understanding the disease and developing new tools to control it.

It will require a whole-of-government, whole-of-industry and whole-of-community commitment and must happen now if the region's unique and world-class mega-diversity is to be conserved.

The risks and effects of this disease have reached a critical stage. It requires immediate attention before it lays waste to the environment and productivity at levels more extreme than salinity.

Whose responsibility is it?

It is everyone's responsibility, especially that of industry and organisations with the potential to manage the disease, to invest in research and management and educate others. Coordination and collaboration will result in a more channelled approach, and a more strategic use of limited funds to contribute to better communication and more effective and efficient implementation methods. Figure 3 illustrates the need for coordination, collaboration and responsibility.



Figure 3:

Arresting the Biological Bulldozer

This diagram illustrates the necessity of partnerships and coordination in the management of *Phytophthora* dieback in Southwest Australia. Should one partner not play their role, the wheel will not turn on the road to biodiversity conservation.





Plants under immediate threat of advancing Phytophthora dieback

Dead and dying plants showing impact of Phytophthora dieback

The destruction of habitat in progress as a result of Phytophthora dieback

Less susceptible plants remaining

Greatly reduced diversity and impoverished animal habitat

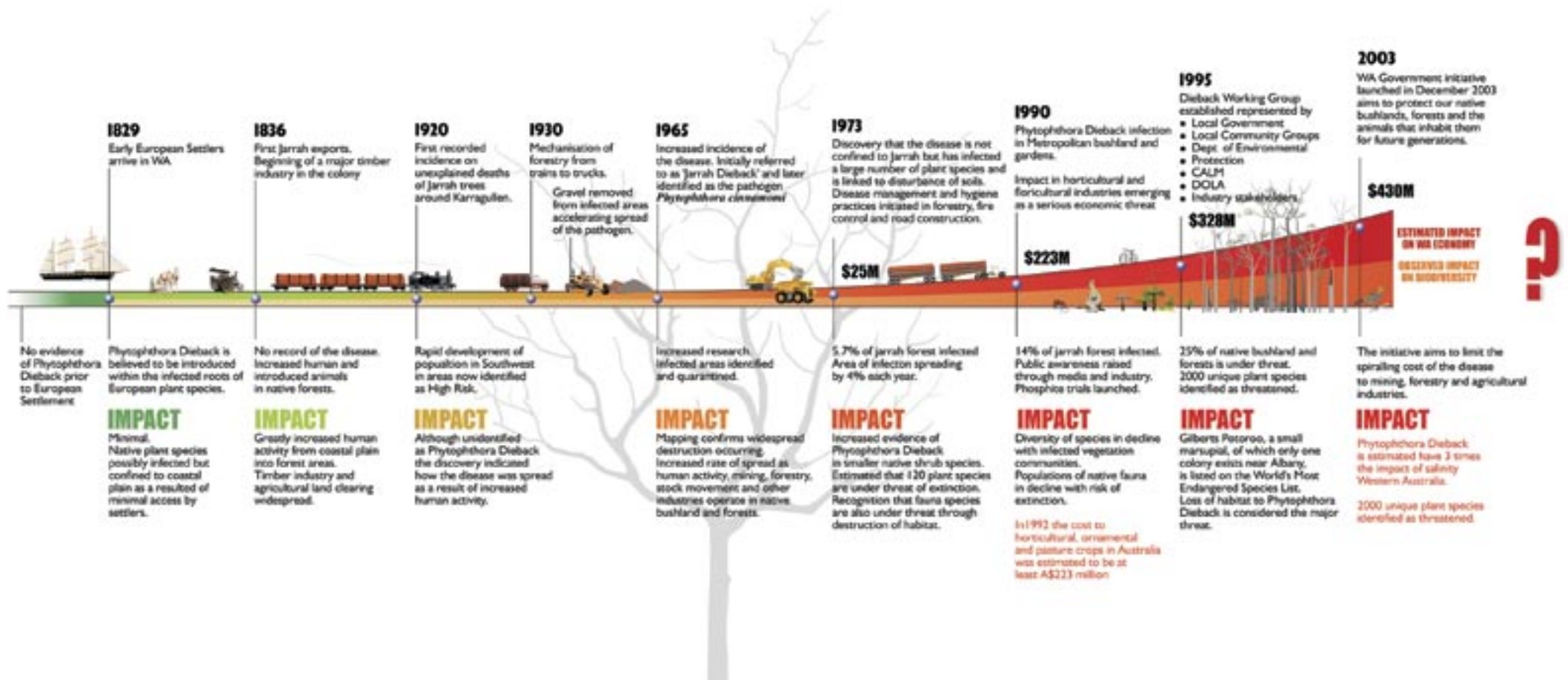


Figure 4
The Rise and Rise of *Phytophthora Dieback* in Western Australia



Critical Investment

The Dieback Consultative Council (DCC) and WWF Australia recommend the following priority projects be coordinated across Southwest Australia with linkage to national networks and initiatives.

Table 1. Priorities and investment required in Western Australia to address Phytophthora dieback management and research

PROJECT	OUTLINE	OUTPUTS	KEY RESPONSIBILITY	NECESSARY INVESTMENT	RISK OF NOT INVESTING
RISK ASSESSMENT METHODOLOGY AND RISK MAPPING	The development of a generic methodology for dieback risk mapping that is widely applicable, widely understood and widely used. This methodology should enable the separation of minor risks from major risks and allow for mitigation strategies and area risk maps to be developed.	Phytophthora dieback risk assessment methodology developed with broad regional application. Phytophthora dieback risk maps for each region developed.	Natural Resource Management Groups (South Coast, South West, Northern Agricultural Region, Avon Wheatbelt, Swan) and Dieback Response Group.	\$1,800,000 is required for initial methodology development and mapping in all regions of Southwest Australia Total: \$1,800,000	High risk areas and areas of future high risk will not be identified. Continued difficulty in identifying high risk areas and the associated strategic use of resources. Methods used to identify high risk areas will continue to be inconsistent and incomparable. No standard, consistent approach developed. Continued difficulty in developing strategic management responses.
PHYTOPHTHORA DIEBACK ATLAS	The development of a Phytophthora dieback Atlas to identify areas of infestation and the relevant biodiversity values of areas infested. This will help to prioritise Phytophthora dieback hotspots across Southwest Australia	Phytophthora dieback Atlas produced and available to the public. Better communication of susceptible species in each region.	Regional NRM Groups, Dieback Working Group, CALM, Murdoch Centre for Phytophthora Science and Management	\$150,000 for the development of the Atlas (revised versions may be required over time). Total: \$150,000	Difficulties in placing Phytophthora dieback infestations and susceptible species in each region into context at a state-wide level resulting in the non-strategic use of resources.
STATE ENVIRONMENTAL PLANNING POLICY	The development of a whole of government Environmental Planning Policy linked to the Environmental Protection Act 1986 to enable the formal assessment of proposals likely to result in the increased spread and infestation of Phytophthora cinnamomi	Statutory whole of government State Environmental Planning Policy Developed and implemented in Western Australia	Department of Environment and DCC	\$200,000 required for the development of policy, adequate public consultation and endorsement by Government. Total: \$200,000	Continued lack of whole-of-government statutory policy that covers Phytophthora dieback management. No policy for land that goes beyond Conservation Commission vested land. No means to enforce Phytophthora dieback management and best practices.
DEVELOPMENT AND IMPLEMENTATION OF A PHYTOPHTHORA DIEBACK COMMUNICATIONS STRATEGY	A communications strategy aimed at eliminating the misconceptions about Phytophthora dieback, raising its profile as a Key Threatening Process, and encouraging government, industry, community and funding bodies to take action.	Development of communication tools - ranging from identification booklets, signage and posters to developing brand recognition and a media and advocacy campaign.	Non-government organisations, government agencies, Dieback Working Group, Regional Natural Resource Management Groups and CALM.	\$100,000/yr is required to develop and implement a communications strategy and the relevant communication tools. Ongoing funds are required to continue community education and capacity building. Total: \$100,000/year	Ongoing lack of community effort to control, identify, report and prevent the spread of Phytophthora dieback. Opportunities for advocacy and investment foregone.
DEVELOPMENT OF BEST PRACTICE GUIDELINES	There is a need to develop Best Practice Guidelines that go beyond Conservation Commission vested lands. There is currently no single agreed code of practice and standards available to land managers outside the Conservation Estate. The development of Best Practice Guidelines for all land tenures will provide agreed guidelines widely applicable to all Phytophthora dieback vulnerable zones.	Best Practice Guidelines across all land tenures in Western Australia. A preventative approach to managing Phytophthora dieback.	Dieback Response Group and CPSM with input from all stakeholders and community.	\$100,000 is required to develop the guidelines, print and communicate across Southwest Australia. Total: \$100,000	Difficulty in promoting Best Practice Phytophthora dieback management will continue. No standard approach. Continued inconsistent and ineffective approaches used throughout Southwest Australia promoted.
SCIENTIFIC RESEARCH AND INVESTIGATION	Identification of priority areas of research to fill knowledge gaps on a national scale, and undertaking of priority research projects through acquisition of adequate resources	Increase knowledge of physical, chemical and biological factors that influence Phytophthora cinnamomi, dispersal, effects of water stress, use of Phosphite, susceptibility of rare flora, impacts on invertebrates and fungi and overall effects on the economy, society and ecological function of the disease	DCC and Murdoch Centre for Phytophthora Science and Management, and expert consultants	Costs of research is estimated at \$3M/Yr Total: \$3,000,000 /year	Knowledge of the most effective ways to predict the spread of the disease, effective rehabilitation of affected sites and cost-effective management and prevention will not be ascertained. Higher costs in the management and abatement of the disease.

Critical Investment

Table 1 (continued). Priorities and investment required in Western Australia to address abatement Phytophthora dieback management and research

PROJECT	OUTLINE	OUTPUTS	KEY RESPONSIBILITY	NECESSARY INVESTMENT	RISK OF NOT INVESTING
BUSINESS CASE STUDY	A business case study that highlights the need to invest in the management of Phytophthora dieback as a matter of urgency to protect industry and an integral component of the State's economy. This case study will highlight the potential economic losses if all tiers of government and industry fail to make a financial commitment and investment now.	Economic analysis of the current impacts and predicted impacts of Phytophthora dieback and recommendations for future investment into protecting natural resources that are adversely by Phytophthora dieback.	DCC, independent consultants, industry and Dieback Response Group	\$100,000 is required to undertake a comprehensive cost-benefit analysis of Phytophthora dieback in Southwest Australia. Total \$100,000	The true costs of Phytophthora dieback will not be known and therefore will not be included in resource prioritisation and decision making processes. The true costs of Phytophthora dieback to our economies will not be established or communicated.
THE ESTABLISHMENT OF TECHNICAL OFFICERS IN EACH PRIORITY REGION AND REGIONALLY BASED MANAGEMENT	Past practices have shown that the employment of technical and field-based staff to assist with on-ground projects and communication to local and regional communities has been important in land management and biodiversity conservation arenas. The presence of Phytophthora dieback extension staff in all regions will provide a conduit between community, industry, local authorities and state government agencies in each region to ensure consistent information, technical advice and project facilitation can occur across Southwest Australia	Employment of extension/technical staff in each priority region in Southwest Australia. Increased access to information, increased on-ground action and increased communication in regions. Increased coordination through collaboration across Southwest Australia Facilitation of site specific and regional Phytophthora dieback management projects Increased regionally based onground management and project delivery.	Dieback Working Group, CALM, DCC, Regional Natural Resource Management Groups, local authorities, industry, and Murdoch Centre for Phytophthora Science and Management.	\$1,000,000 per year across all regions (note: that costs will vary within regions depending on the rate and extent of infestation). This includes salary, travel, equipment, training, mapping software, field expenses and the application of strategic management responses. Total \$1,000,000/year	Effective, coordinated regional-based on-the-ground management and education will not occur in regions at risk from Phytophthora dieback infestation. Site specific/local scale dieback risk mapping and associated strategic management responses will not occur.
FITZGERALD RIVER NATIONAL PARK RESPONSE	Undertake intensive Phytophthora dieback management in Fitzgerald River National Park as a priority flora diversity hotspot in Southwest Australia. Includes aerial spraying, targeted phosphite treatment, monitoring and containment.	Increased conservation status of the communities (and associated flora and fauna) in Fitzgerald River National Park. Increased conservation action for Threatened Species. Prevention of the spread of Phytophthora dieback to adjacent catchment areas.	Department of CALM and other members of the Dieback Response Group	\$250,000 over five years is the required estimated cost of this intensive Phytophthora management project Total: \$250,000	Biodiversity values of Fitzgerald River National Park (Biosphere Reserve) lost forever.
Initial investment total				\$6,700,000	
Investment in each consecutive year after initial investments				\$4,100,000	

Critical Investment

The initial research, management and administrative costs of abating Phytophthora dieback in Southwest Australia is approximately \$6.7million in the first year, with yearly costs estimated at \$4.1 million per year after the initial priority investments are made. This means that over a period of ten years, an estimated \$43.6million is required to adequately control and manage Phytophthora dieback in Southwest Australia alone. Figure 4 illustrates that costs will continue to increase if critical investment is not made now.

All indications are that the figures are justified; however Federal and State governments must consider conducting a cost-benefit analysis for public benefit to reveal the true cost of the Biological Bulldozer and coordinate an efficient response. Nationally it is estimated that 10% of the continent is infested and at risk, that the cost in WA would be a large proportion of this. It is most likely that the cheapest option is to invest now rather than wait.

To justify these figures and provide for a full cost-benefit analysis, it is recommended that a rigorous socio-economic assessment with regard to the disease is undertaken as a matter of priority which will present a detailed investment strategy. In the interim, all efforts must be undertaken to prevent the further spread and destruction that Phytophthora dieback is having on Australia's unique biota.

Arresting the threat

There is much to be done if the mega-diversity of plants and animals, community values, and industries are to be protected from the Biological Bulldozer *Phytophthora dieback*. Often, issues of threat control seem too large to grasp, too complex to understand, and beyond our capacity to change. This is not the case with *Phytophthora dieback* abatement – everyone can contribute to making a difference.

What can you do to help?

Everyone can help in the fight against *Phytophthora dieback*. Some of the ways individuals can contribute include minimising the risk of spread when in an infected area, through to joining a community group focusing on *Phytophthora dieback* issues.

Keeping it clean is keeping it green

The spread of *Phytophthora dieback* involves, predominantly, the movement of soil. Tools used to reduce the spread include temporary seasonal closure of roads and walk trails, signage, permanent roads and trail closures, and the establishment of hygienic entry and clean-down points. It is vital that everyone uses good hygiene practices when visiting potentially non-infested areas. This means observing warnings and avoiding restricted sites even if it may interrupt your visit.

Dieback management in plant nurseries

Asking questions is the best way to establish if your local nursery is 'dieback-friendly'. Don't be afraid to query staff about where the plants come from, whether the nursery and its suppliers are aware of *Phytophthora dieback* and/or have had problems with it in the past. Buying plants from nurseries that have been accredited under the Nursery Industry



*The cartoon character "Gilbert" has been developed as a tool to raise awareness of *Phytophthora dieback* in the community. Gilbert will be widely distributed in printed material, on websites, as part of education programs and visible on qualifying nursery products that are certified *Phytophthora dieback* free.*



Accreditation Scheme can help to ensure that the plants have been cultivated under good hygiene practices. Building a rapport with your regular nursery can give you access to the best information about *Phytophthora dieback* and the knowledge that the plants you purchase are not infested.

See http://www.arc.gov.au/grant_programs/EOI/C087.HTM for information on gardening and *Phytophthora dieback*.

Government support

Questioning your local members of parliament on their knowledge about and views on *Phytophthora dieback* issues brings community concern about the disease to their attention. Investigating what management plans your local authorities have in place will indicate how seriously this problem is being taken.

Community groups

Community groups are integral to stopping the spread of *Phytophthora dieback*. Several such groups exist, run by passionate people dedicated to keeping the environment healthy. By joining one of these groups or forming your own, you can be part of the solution and swell the ranks of those involved in fighting the disease.

*Restricting access to infested and disease-free areas is essential to preventing the spread of *Phytophthora dieback*. A major cause of the spread is uncontrolled off-road motorcycle and 4WD activity.*

Wet or muddy soils transported on vehicle tyres can spread the disease over a large area very quickly. Tyres should be cleaned of soils at appropriate locations.



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Rainbow Bee-eater



Gilbert's potoroo

Conclusion

Phytophthora dieback, the Biological Bulldozer, is devastating natural landscapes, threatening Southwest Australia's natural resource industries and is spreading quickly and unrestrained.

It is destroying the habitats of thousands of species across Southwest Australia and is further threatening endangered and vulnerable species of plants and animals. Animals such as the honey possum, western spinebill and the critically endangered Gilbert's potoroo are in the direct path of the Biological Bulldozer.

The fragmented approach to Phytophthora dieback management employed in the past has resulted in some, yet inadequate progress towards controlling the pathogen. The Biological Bulldozer continues to move into pristine landscapes and areas of high biodiversity value at a rapid rate. Substantial yet reasonable investment into the management of Phytophthora dieback is required, coupled with a coordinated and collaborative approach among stakeholders, interest groups and the community.

With adequate and strategic investment in the control and management of Phytophthora dieback, and through undertaking a cohesive and coordinated approach, there is a much better chance of "Arresting the Threat" of Phytophthora dieback, thereby minimising threats to biodiversity, economies and local communities. It is everyone's responsibility and we must take action today to ensure that this region remains one of the world's global biodiversity hotspots tomorrow.

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Websites:

Information on Dieback Response Framework. http://www.calm.wa.gov.au/projects/dieback_response_framework.html

Access *Phytophthora* research areas, information about susceptible and resistant Western Australian native plants. Centre for *Phytophthora* Science and Management. <http://www.cpsm.murdoch.edu.au/>

Download Threat Abatement Plan at website <http://www.deh.gov.au/biodiversity/threatened/tap/index.html>

Nursery Industry Accreditation Scheme website Information on best practice gardening. <http://www.ngia.com.au/niasa/>

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**The Denmark Dieback Working Group
Friends of Wireless Hill
Friends of Ken Hurst Park
Friends of Ellis Brook Valley**

For contact details of the above and other local community groups working with dieback please contact the Dieback Project Coordinator, Dieback Working Group or the relevant local government authority.





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New Holland Honeyeater



Bluff Knoll, Stirling Ranges



Arresting Phytophthora Dieback

The Biological Bulldozer

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- Conserving the world's biological diversity
- Ensuring that the use of renewable natural resources is sustainable
- Promoting the reduction of pollution and wasteful consumption.

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