

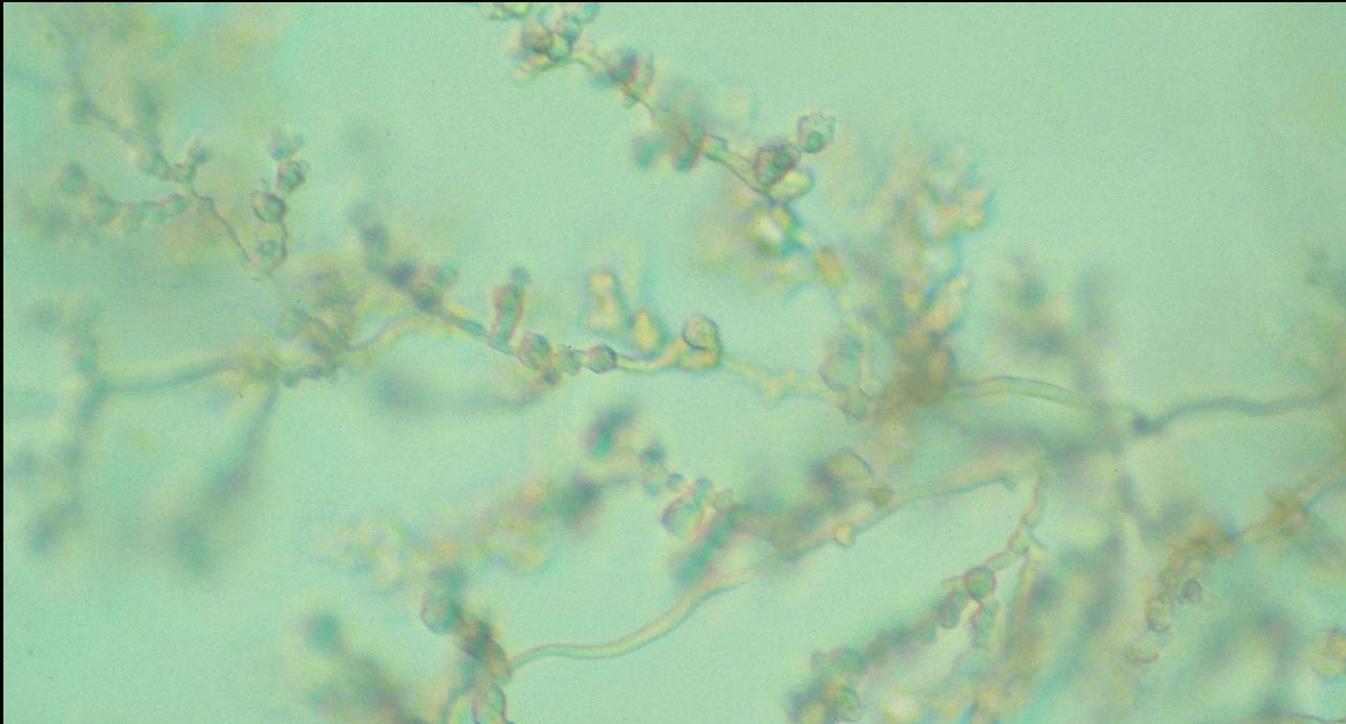
Are there spatial patterns in threats posed
by root rot disease, *Phytophthora
cinnamomi*, in Royal National Park?



David Keith, Keith McDougall, Christopher
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What is *Phytophthora cinnamomi*

A soil-borne water mould (not a fungus!) that infects plants through roots and stem collars



Origins & current distribution

- First isolated from dying heathland plants near Sydney by Lilian Fraser in 1954
- Likely to have been introduced to Australia, possibly from SE Asia(?)
- Now widespread in temperate areas of WA, Vic Tas & NSW



Disease symptoms

- Some infected plant hosts develop disease symptoms
 - necrosis of roots
 - necrosis of vascular tissue
 - stem lesions
- Tissue death reduces ability of plants to absorb water
 - canopy dieback
 - plant death
- There may be other causes of dieback, even when Pc is isolated from dying tissue



Disease susceptibility

Different plant hosts tolerate the pathogen or inhibit its entry to varying degrees

- *Phytophthora* league ladder:
 - NSW genera with most no. of documented susceptible species (Australia-wide)
- Susceptible plant families
 - Fabaceae
 - Proteaceae
 - Ericaceae
 - Myrtaceae
 - Xanthorrhoeaceae

Grevillea - 86 (mostly low)
Banksia - 64 (low to very high)
Leucopogon - 57 (mostly high)
Eucalyptus - 54 (mostly low)
Hakea - 36 (mostly low)
Daviesia - 34 (often high)
Allocasuarina - 25 (low to high)
Hibbertia - 25 (often high)
Acacia - 23 (mostly low)
Persoonia - 22 (low to high)
Pultenaea - 22 (low to high)
Petrophile - 21 (mostly high)
Isopogon - 20 (low to high)
Epacris - 19 (often high)

Astroloma - 15 (low to high)
Xanthorrhoea - 13 (high)
Leptospermum - 10 (mostly low)
Melaleuca - 10 (mostly low)

Effects on plant communities

- Disease fronts cf. sporadic deaths
- Peak mortality during summer drought
- Sequential & selective elimination of susceptible species
- Simplification of vegetation structure
 - Complex heathlands & woodlands to open shrublands & sedgeland
- Limited evidence of recovery (Brisbane Ranges)



Warm temperate east coast

Phytophthora impacts are less severe in Sydney compared to other temperature regions BUT may still result in local extinctions of spp with:

- High susceptibility
- Slow growth rates
- Low fecundity



How does it persist & spread ?

- Spores survive for several years in suitable conditions
- Hyphae may persist in tissues of resistant hosts
- Hyphae do not persist long in dead plants or dry soil

Spores disperse in water or moist soil

- In roadmaking material
- On vehicles
- In nursery plants
- On footwear
- On animals
- In storm runoff

It is not spread in the air!

What conditions favour *Phytophthora cinnamomi*?

- ❖ mean temperature > 7.5°C
- ❖ pH between 5 and 6 (optimally)
- ❖ non-calcareous soils
- ❖ low fertility soils
- ❖ low carbon soils
- ❖ susceptible species
- ❖ poor drainage
- ❖ annual rainfall (400) - > 600 mm

Detecting the pathogen

- Sampling soil
- Sampling roots
- Sampling lower stems
- Followed by baiting onto selective medium in laboratory
- Detectability limitations
 - risk of false negatives
- Inferential limitations
 - is Pc cause of dieback?



Phytophthora survey in Royal NP

- 254 soil survey sites
- Detected at 33 sites

RESEARCH
REPORT

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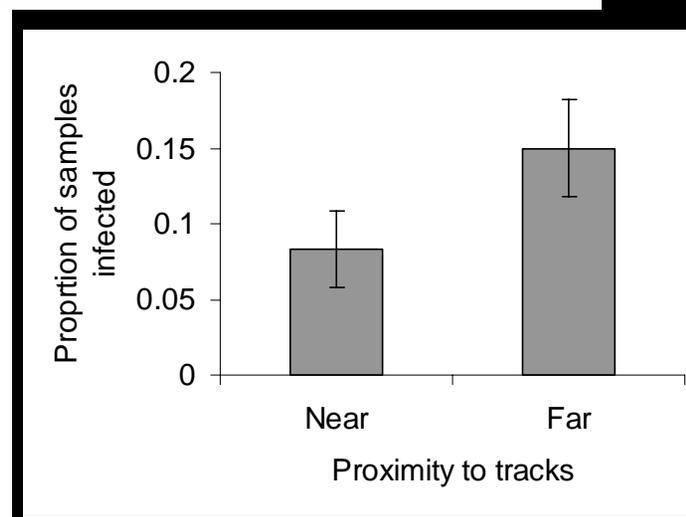
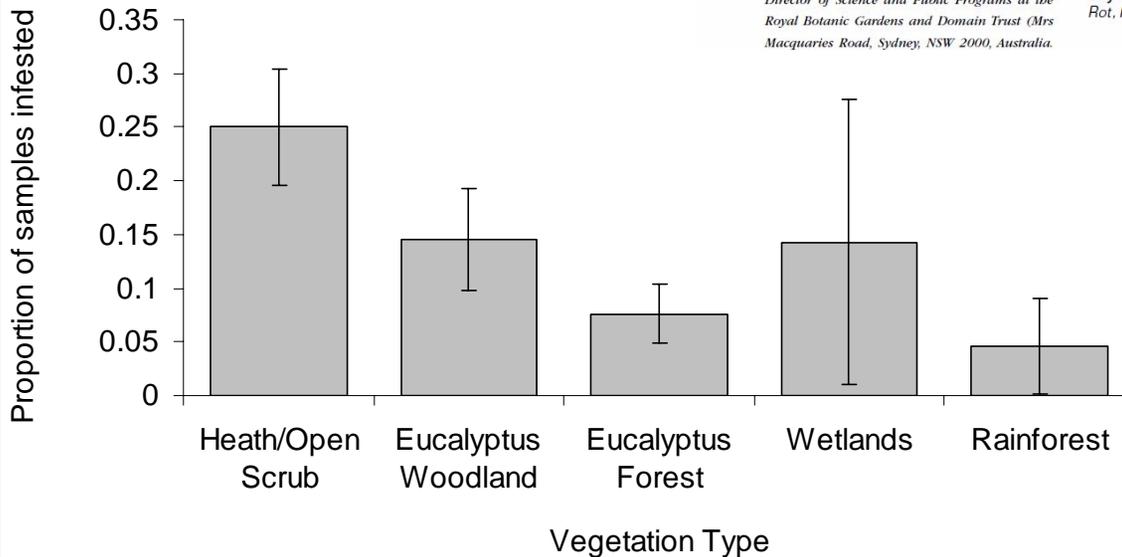
Phytophthora Root Rot: Assessing the potential threat to Australia's oldest national park

By Jillian L. Walsh, David A. Keith, Keith L. McDougall, Brett A. Summerell and Robert J. Whelan

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Summary Royal National Park, Australia's oldest national park, is a significant reserve for conservation of the flora and fauna that are characteristic of the Hawkesbury Sandstone in New South Wales. Since at least 1974, Phytophthora Root Rot (caused by *Phytophthora cinnamomi*) has been known to occur in the Park, but there is no knowledge of the extent of infestation or the potential impacts of the disease within the Park. This study investigated the distribution of the pathogen within Royal National Park at two scales: a systematic survey by vegetation type, and a targeted survey of populations of Waratah and Spear Grass-tree. These two species are known to be susceptible to Phytophthora Root Rot and are therefore potential indicators of the impact of the pathogen on vegetation in Royal National Park. *Phytophthora cinnamomi* was recovered from all vegetation types sampled but most commonly in heathland/open scrub vegetation. The pathogen was easily recovered from sites containing Spear Grass-tree, but was not isolated from any sites containing Waratah. Because of the widespread distribution of *P. cinnamomi*, we conclude that hygiene measures will be of little use to prevent the spread of the pathogen within Royal National Park. Monitoring of the occurrence and spread of disease symptoms in plants and applying phosphite to protect susceptible rare or threatened flora may be the most appropriate management options.

Key words: disease management, natural ecosystems, pathogen survey, *Phytophthora Root Rot*, Royal National Park.



Priorities for management of *Phytophthora*

Where are infections most likely to occur?
– Model probability of infection as a function of environmental variables

Where are the most susceptible species?
– Map plant communities in which susceptible species are most abundant



Risk map for plant diversity

Where are infections most likely to occur?

254 survey sites – soil samples

Phytophthora positively detected at 33 sites

Environmental parameters extracted from GIS layers
for 7 environmental variables

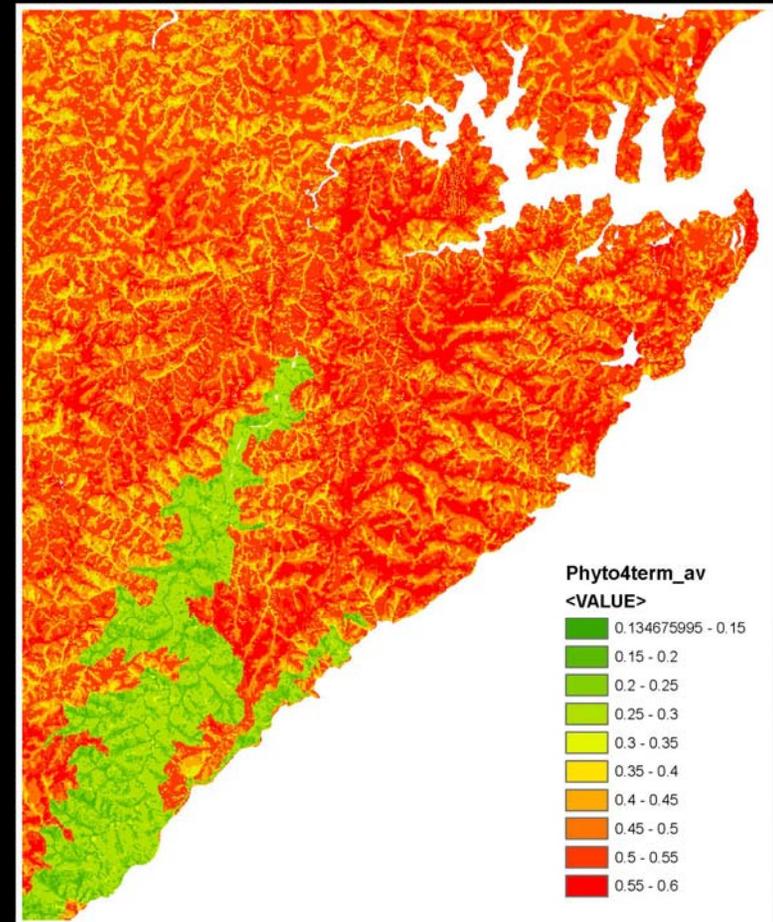
- Soil landscape
- Wetness index
- Topographic position
- Topographic relief
- Slope
- Aspect

Model fitted using Maximum Entropy method

Probability of infection

Best fit model has 4 terms (AUC = 0.55)

- Soil landscape (46%)
- Topographic position (34%)
- Aspect (11%)
- Slope (9%)



Distribution of susceptible flora

284 plant taxa known/suspected to be
'susceptible' (c. one-quarter of Park flora)

- 30-170 in DSF
- 30-140 in Heath
- 10-70 in WSFs & Wetlands
- <50 in RF

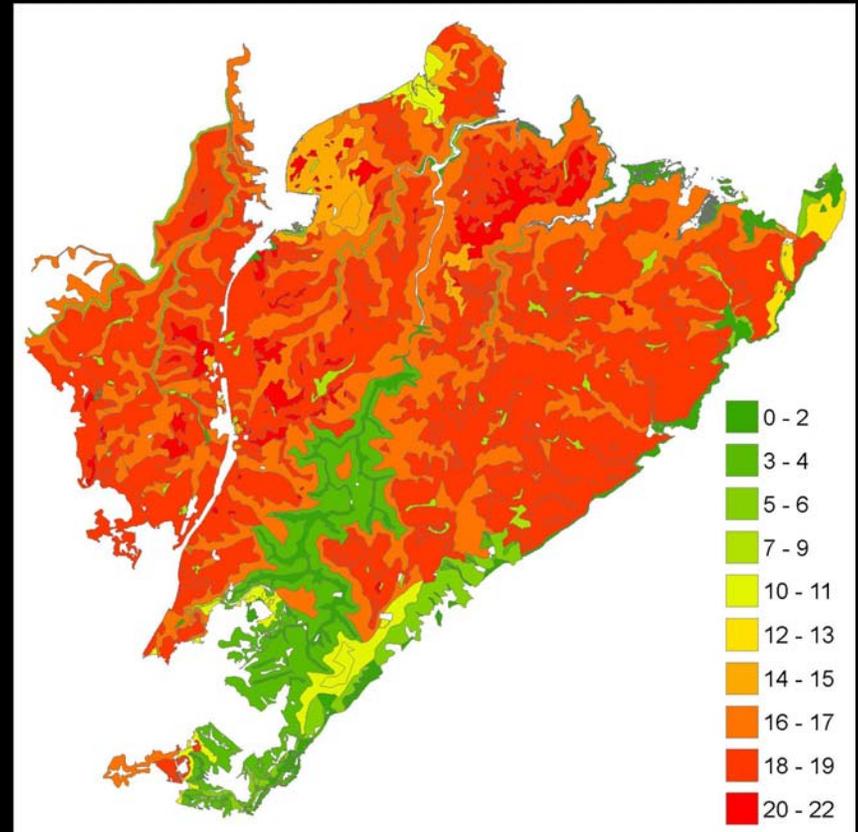
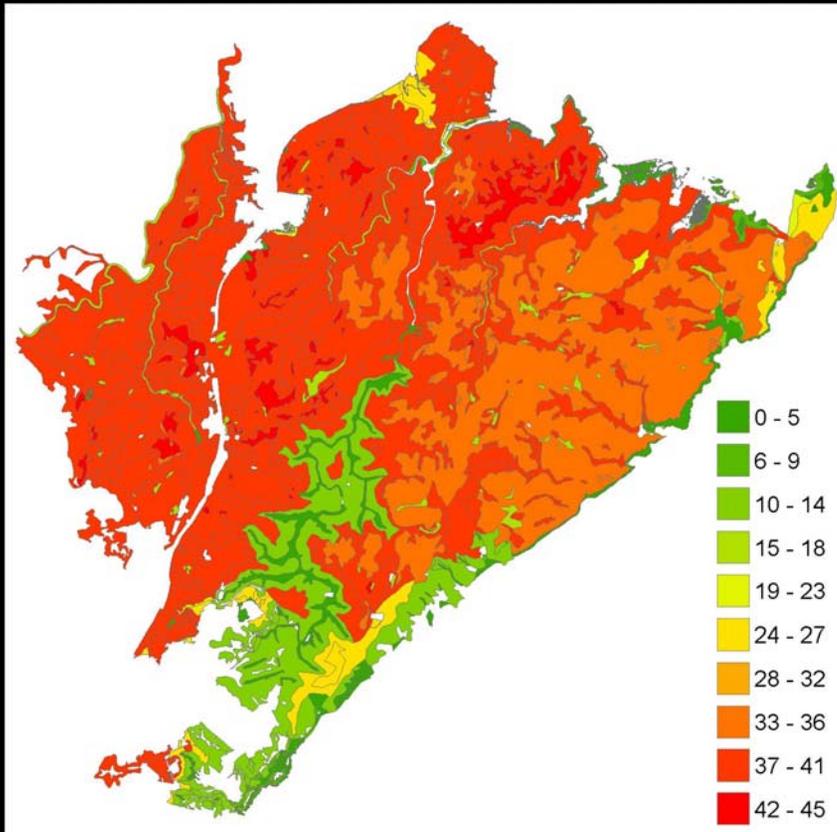
128 taxa known/suspected 'moderately-
highly susceptible'

- 10-80 in DSFs & Heaths
- 5-30 spp in WSF
- <30 spp in RF & Wetlands

Distribution of susceptible flora

Susceptible

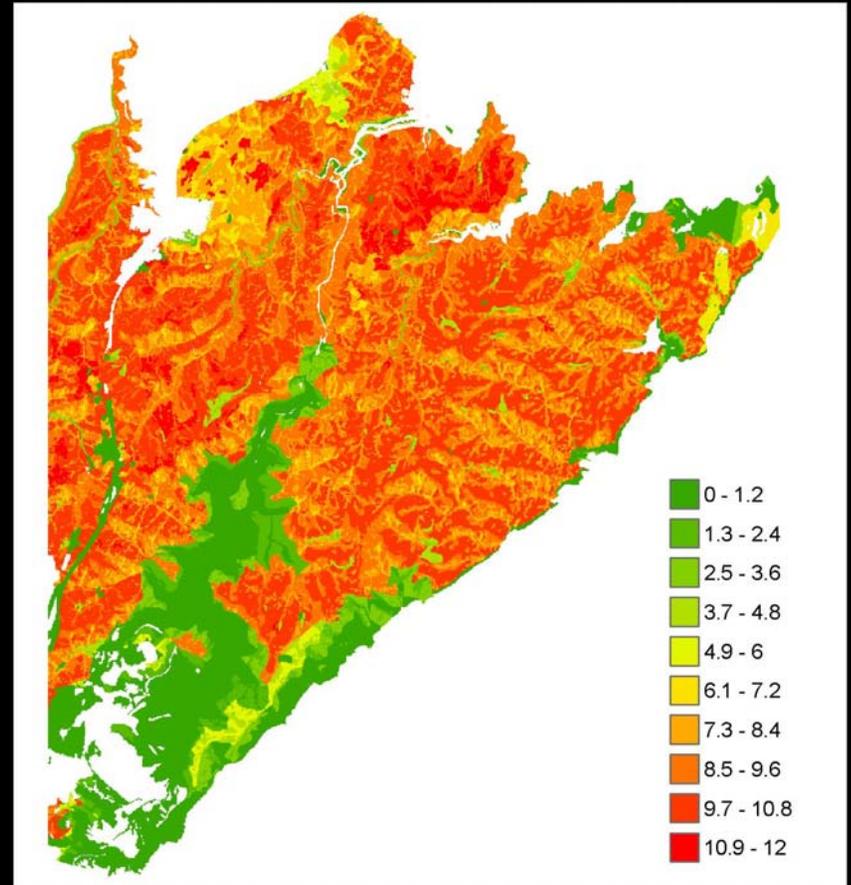
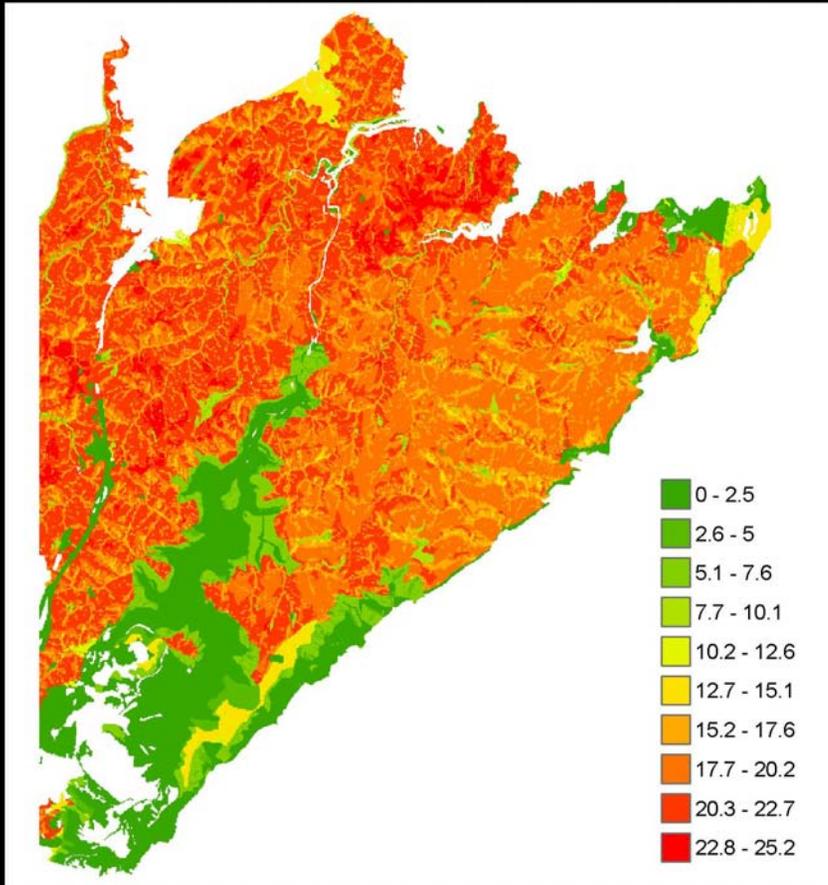
Moderate-highly Susceptible



Risk of plant diversity loss to *Phytophthora*

Susceptible

Moderate-highly Susceptible



Risk = infection probability \times susceptibility

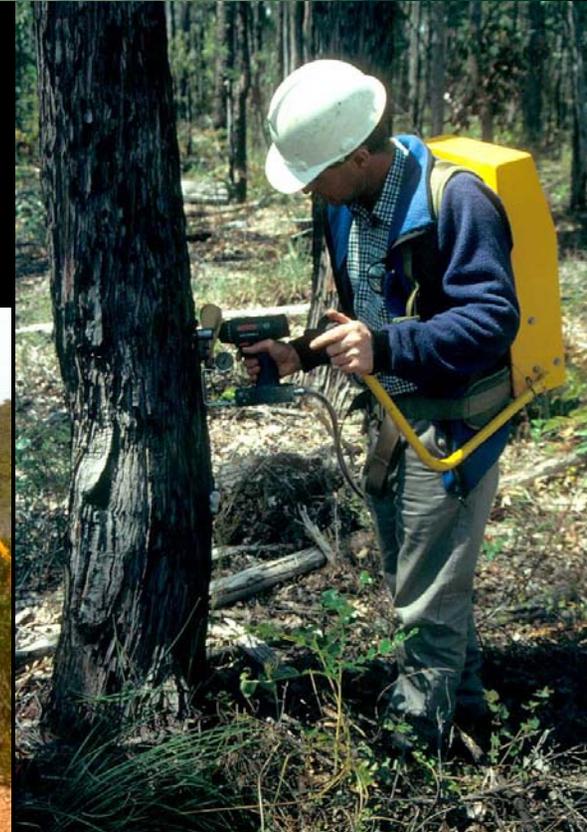
Management options for reducing impacts of *Phytophthora cinnamomi*

- Quarantine
- Targeted closures
- Hygiene
- Chemical treatment



Disease control

- for important assets in diseased areas
- phosphonate is the only widely used chemical control
- fungistatic compound - it does not kill *Phytophthora*
- not licensed for general use in native vegetation but appears to be reasonably benign



Conclusions

- Risks of plant diversity loss appear to be lowest in:
 - Hacking valley wet forests on shale
 - Wetlands
 - Jibbon sandplain woodlands & heaths (?) susceptible spp *cf.* Swan Coastal Plain
- High risk areas:
 - Sandstone plateau top & ridges (Warumbul Rd)
- Model refinement needed
 - Soil landscapes
 - Distance from tracks
- Chemical treatment experiments needed
 - Effect on disease
 - Co-lateral impacts (eutrophication?)

