
Disease Symptoms and Management of Phytophthora root and crown rot, Neonectria canker & Brittle cinder

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Foredrag på Norsk Trepleieforum Årsmøtekonferanse 2023

Torsdag & Fredag, 2-3 mars 2023

Trondheim, Scandic Lerkendal



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NORWEGIAN INSTITUTE OF
BIOECONOMY RESEARCH

OUTLINE

- My background
 - Phytophthora root and crown rot on trees and shrubs
 - Neonectria cankers on trees
 - Brittle cinder on deciduous trees
 - Questions
-



Martin Pettersson



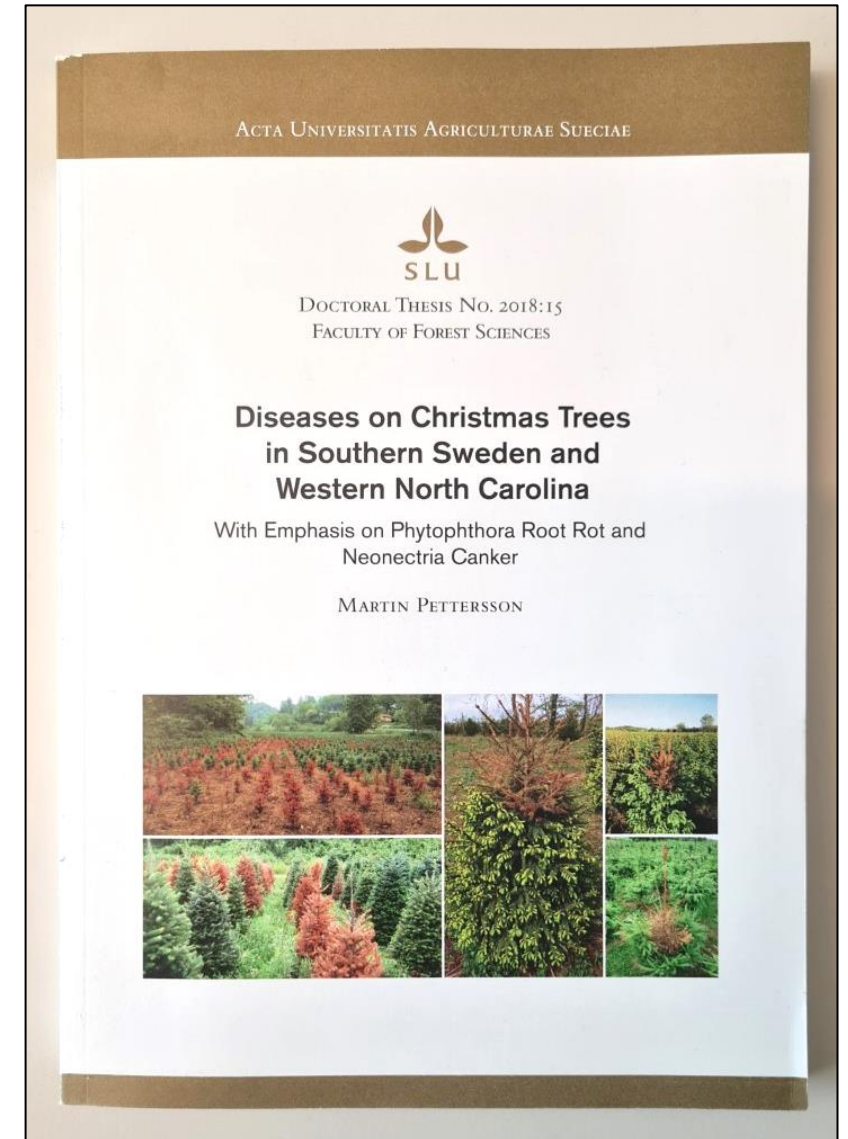
Background

2008-2013 **Master of Science in Forestry**
Swedish University of Agricultural Sciences (SLU). Alnarp.

2014-2018 **PhD in Forestry. Minor in plant pathology**
North Carolina State University. Raleigh, USA.

Began working at NIBIO in August 2018

My research focuses on *Phytophthora* and fungal diseases in forests, ornamental horticulture, Christmas trees and nurseries





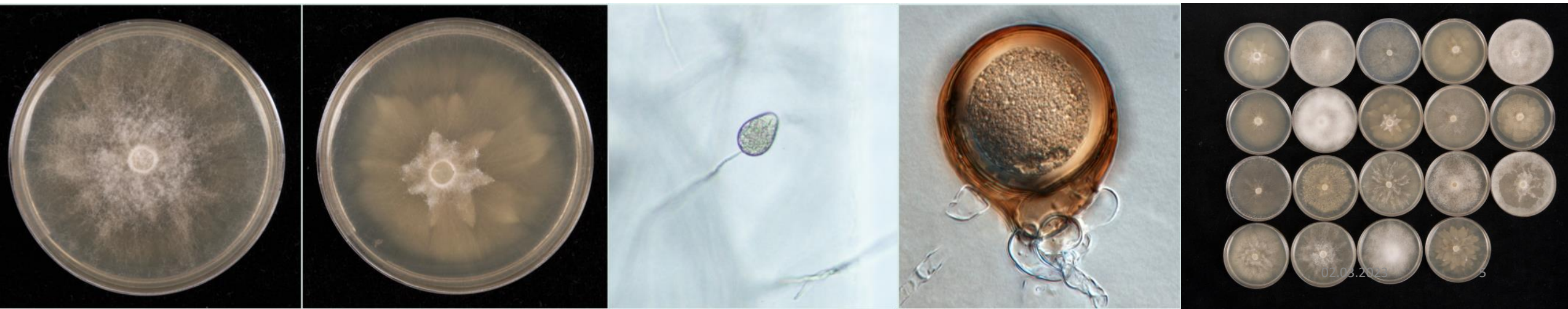
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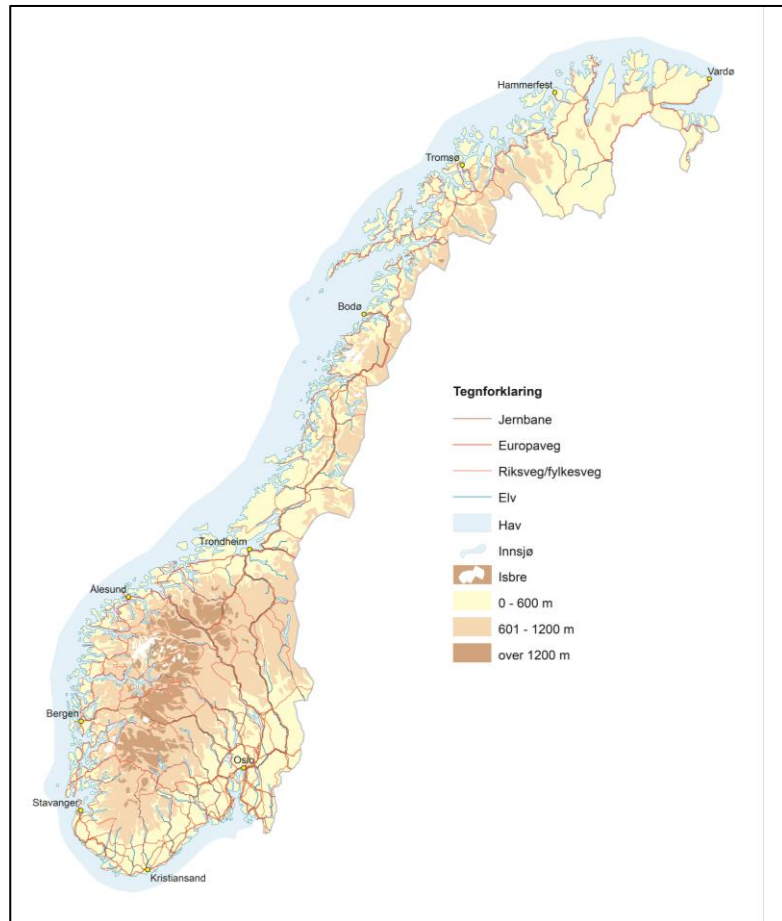
Phytophthora root and crown rot on trees and shrubs

BACKGROUND – *PHYTOPHTHORA* – THE PLANT DESTROYER

- “*Phyto*” means plant; “*pthora*” means destroyer
 - *Phytophthora* = plant destroyer
- *Phytophthora* is one of the most important plant pathogenic genera at global level
- > 200 species where most are primary plant pathogens (feed on living plant roots, stems, leaves etc.)
- ~50 species detected in Norway on imported plants, in greenhouses, urban- and natural areas



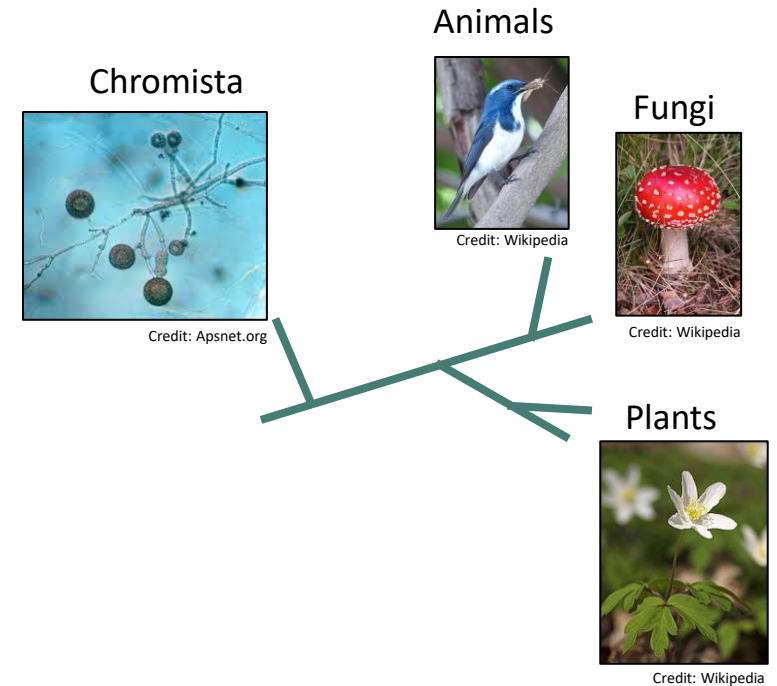
BACKGROUND – NORWAY IS PROTECTED AGAINST NATURAL SPREAD OF PHYTOPHTHORA



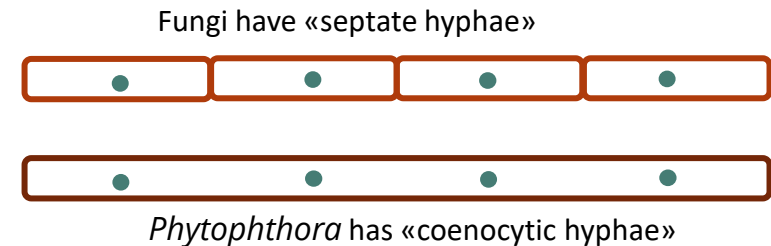
BUT LOTS OF PHYTOPHTHORA IS COMING IN ON IMPORTED PLANTS

BACKGROUND – *PHYTOPHTHORA* ARE NOT FUNGI

- *Phytophthora* species resemble fungi but are not!
 - more closely related to aquatic organisms, such as brown algae and diatoms
 - need water to complete their life cycle
- Differs from the fungi in that they have cellulose and glycan in their cell walls instead of chitin
 - this difference is of practical importance when it comes to management as many fungicides do not work on *Phytophthora*

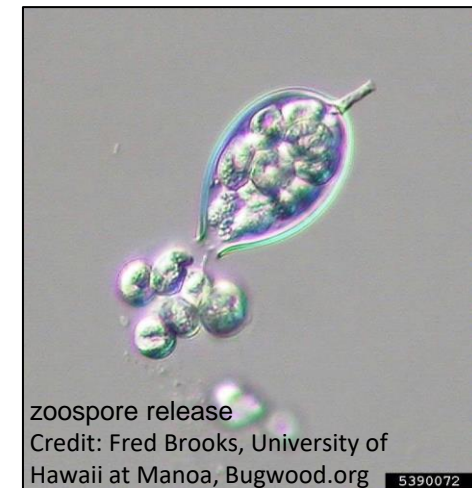


- *Phytophthora* mycelium lacks septa or cross walls



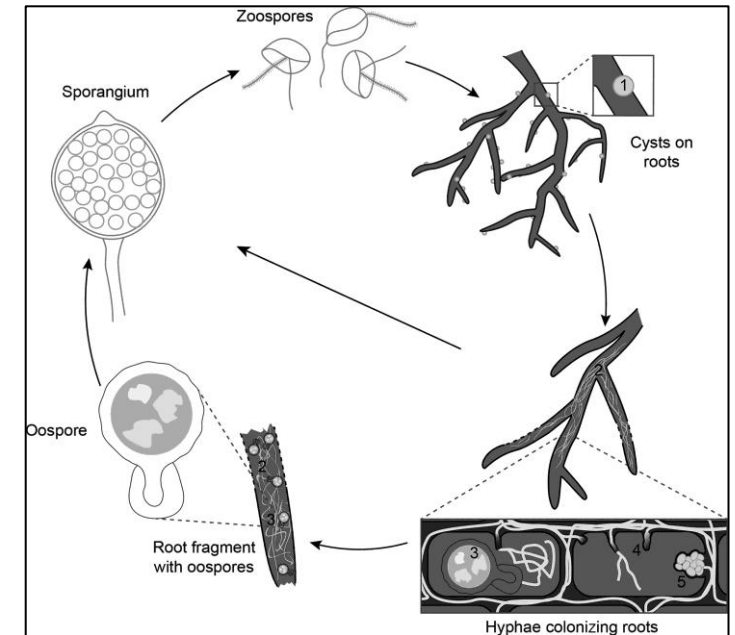
THE BIOLOGY OF PHYTOPHTHORA

- Like true fungi, *Phytophthora* species have hyphal growth and different spore types:
 - zoospores - are released from sporangia during wet soil conditions and are motile in water
 - oospores and/or chlamydospores (resting spores)
 - thick cell walls allow for survival in soil without host plant
 - withstands unfavorable periods such as severe drought or frost



THE BIOLOGY OF PHYTOPHTHORA

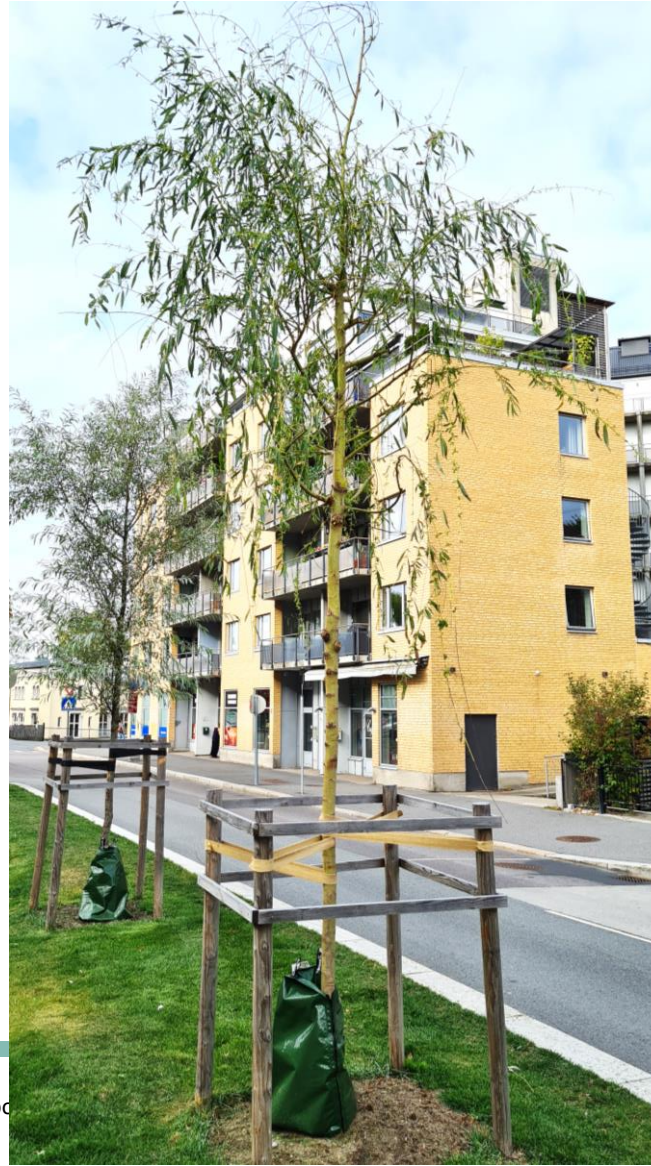
- *Phytophthora* are primary soilborne, but a few have airborne spores
- **Soilborne *Phytophthora*** species mainly infect fine roots, but larger roots, the collar region and lower stem can also be infected, and the pathogen kills the inner bark
 - zoospores released during wet soil conditions are driving the infection
- **Airborne *Phytophthora*** species infect leaves, shoots, fruits and bark of branches and stems
 - caducous sporangia are dispersed by wind and rain splash



Credit: Plant Pathology, Volume: 69, Issue: 1, Pages: 3-16

DISEASE SYMPTOMS OF SOILBORNE PHYTOPHTHORA

- Generally, plants affected by *Phytophthora* appear drought stressed
- Yellowing of leaves, stunted growth, branch and crown dieback etc.



DISEASE SYMPTHOMS OF SOILBORNE PHYTOPHTHORA

- Heavily infested plants often wilt and die with the first warm weather of the season
- Bleeding bark cankers on the lower stem is a classic symptom of advanced infection



Phytophthora cambivora on noble fir (*Abies procera*) i Sørvest-Norge

Credit: Venche Talgø

DISEASE SYMPTOMS OF SOILBORNE PHYTOPHTHORA

- Plants in poorly drained areas or areas regularly flooded are hit the hardest



Phytophthora cambivora on gray alder (*Alnus incana*)
Åkersvika, Hamar 2015

Credit: Venche Talgø

DISEASE SYMPTOMS OF SOILBORNE PHYTOPHTHORA

- Younger trees are more often killed, while big trees with large root systems slowly decline
- Slow decline occurs when the roots are attacked



DISEASE SYMPTOMS OF SOILBORNE PHYTOPHTHORA

- Rapid decline occurs when the basal stem is attacked and girdled



Phytophthora multiformis on black alder (*Alnus glutinosa*)



Phytophthora plurivora on Norway maple (*Acer platanoides*) in Stavanger

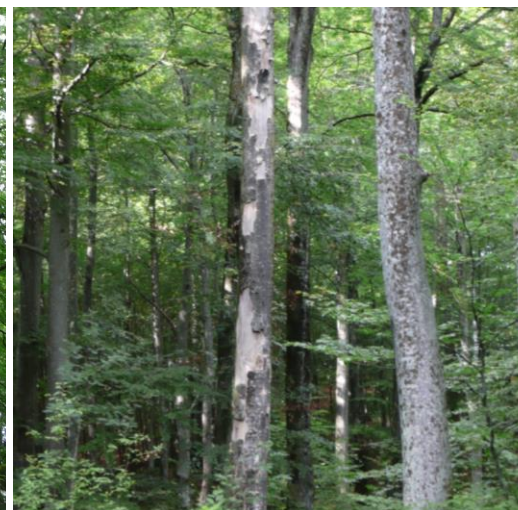


Phytophthora cambivora on beech (*Fagus sylvatica*)



Phytophthora cambivora on beech (*Fagus sylvatica*) in Larvik

Credit: Martin Pettersson



Credit: Venche Falgo

SOILBORNE PHYTOPHTHORA IS DIFFICULT TO DETECT



PHYTOPHTHORA ON LARGE IMPORTED URBAN TREES



Phytophthora multiformis på svartor (*Alnus glutinosa*)





In Norway we find many different tree species attacked by many introduced *Phytophthora* species

EXAMPLES OF DESTRUCTIVE SOILBORNE PHYTOPHTHORA DISEASES

- Jarrah dieback in Western Australia caused by *Phytophthora cinnamomi*



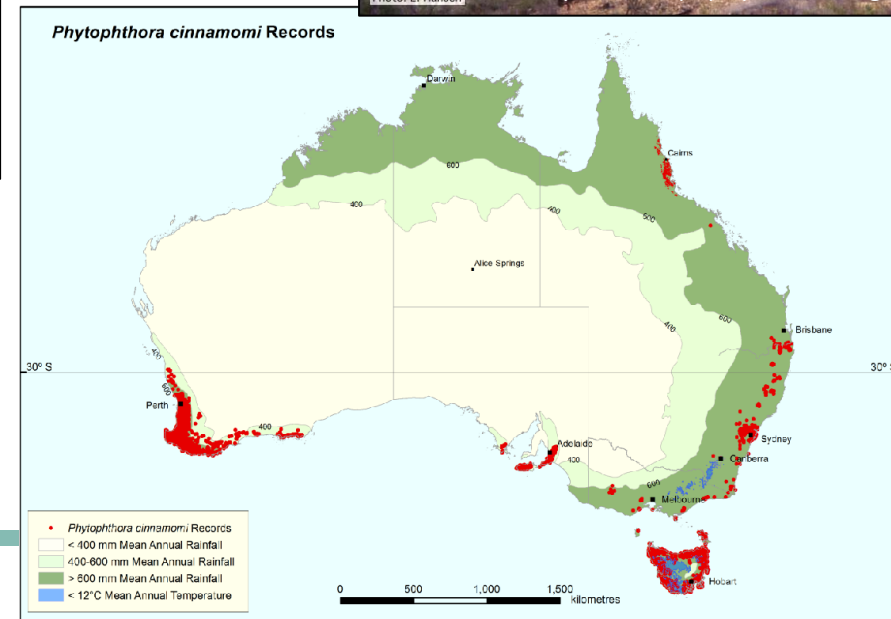
WWF

DIEBACK CONSULTATIVE COUNCIL

Arresting Phytophthora Dieback

The Biological Bulldozer

Credit: https://forestphytophthoras.org/sites/default/files/educational_materials/dieback_report.pdf



Credit: Australian Government Department of the Environment

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?

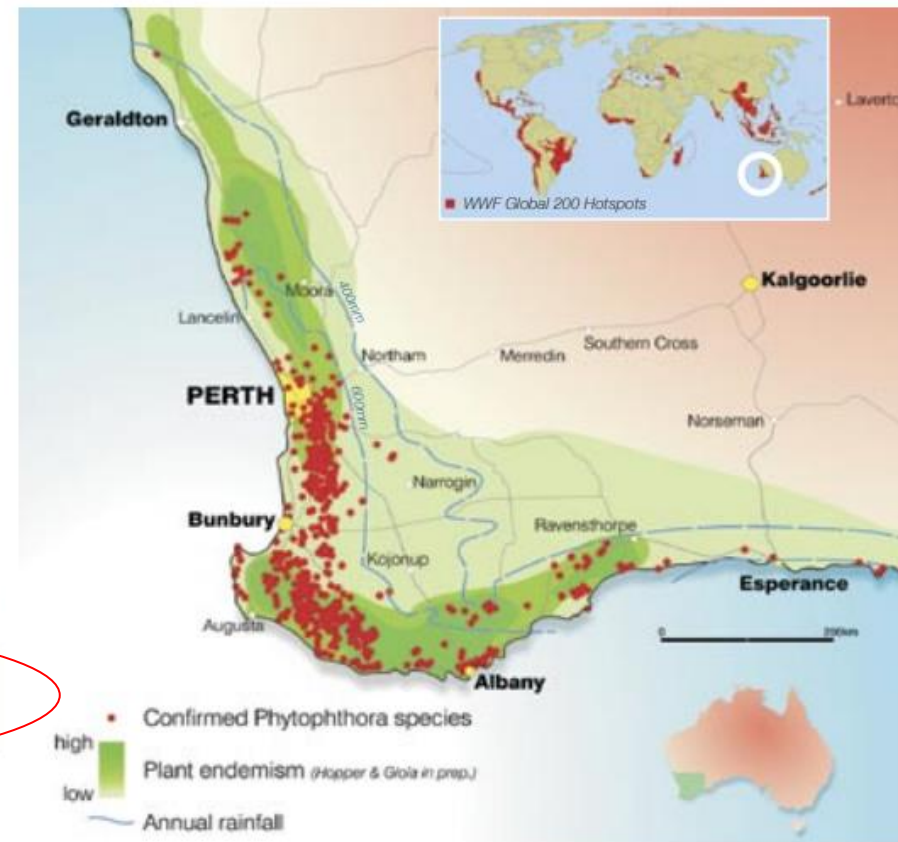
Southwest Australia is one of the world's 25 Biodiversity Hotspots and Australia's only Global Hotspot, reflecting its high level of species richness. Biodiversity hotspots were defined in a study undertaken by Conservation International which was published in February 2000. In this study, a biodiversity 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.



5



Distribution of *Phytophthora dieback* in Southwest Australia



EXAMPLES OF DESTRUCTIVE SOILBORNE PHYTOPHTHORA DISEASES

- Dieback of riparian alder across Europe caused by *P. alni* complex, *P. ×cambivora*, *P. plurivora*
- Decline and dieback of oak and beech in Europe caused by *P. quercina*, *P. cinnamomi*, *P. ×cambivora*, *P. plurivora*
- Dieback of *Austrocedrus chilensis* forests in Argentina cause by *P. austrocedri*

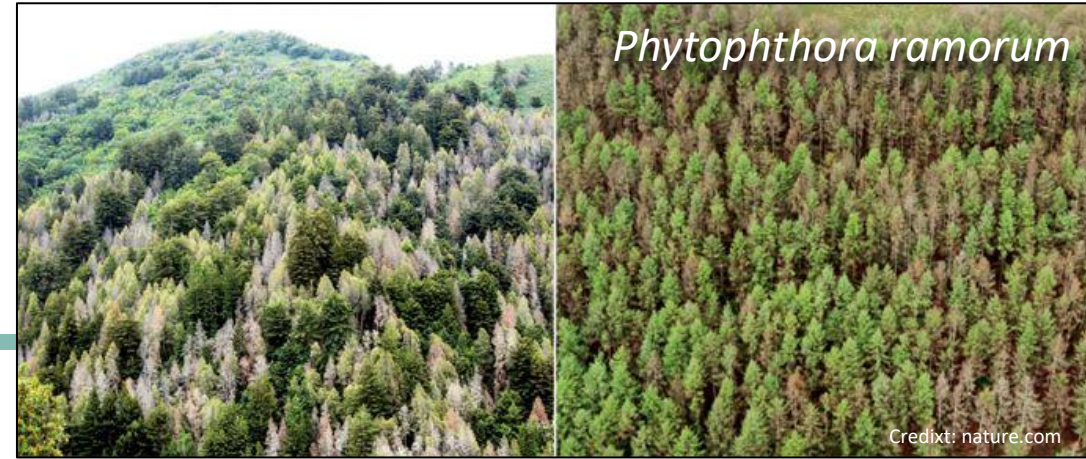


DISEASE SYMPTOMS OF AIRBORNE PHYTOPHTHORA

- leaf necrosis, shoot blights, fruit rots and bleeding bark cankers
 - *Phytophthora ramorum*, *P. kernoviae*, *P. pseudosyringae*, *P. cactorum*, *P. nemorosa*, *P. constricta*, *P. pluvialis*
- *Phytophthora ramorum* is responsible for "sudden oak death" in the USA, "sudden larch death" in the UK, and "ramorum blight"



Credit: Erling Fløistad



Credixt: nature.com

MANAGEMENT OF PHYTOPHTHROA ROOT ROT

Phytophthora cannot be eradicated from a site once it becomes infested

- Prevent introduction & spread!



Credit: The Department of Biodiversity, Conservation and Attractions

DIEBACK PROTECTION AREA



CLEAN ON ENTRY

All vehicles including bikes **MUST BE FREE OF SOIL** before passing this point.

Enter only when vehicles will not pick up and move soil.



Department of Environment and Conservation

www.dieback.org.au

Credit: The Department of Biodiversity, Conservation and Attractions

MANAGEMENT OF PHYTOPHTHROA ROOT ROT

- Losses to *Phytophthora* can be minimized by providing good soil drainage
 - Do not irrigate too much
 - Avoid planting susceptible species on poorly drained or shallow soils
 - Selecting the most tolerant species/rootstocks/varieties
 - Use Norwegian produced plants (we have found more *Phytophthora* on imports)
-
- Phosphite is used to slow the spread and impact of *Phytophthora*
 - Phosphonate products e.g. the fungicide Aliette (fosetyl-al) is used to prevent serious *Phytophthora* infections



SEND SAMPLES TO PLANTEKLINIKKEN

The screenshot shows a web browser window displaying the NIBIO Planteklinikk website. The browser's address bar shows the URL: nibio.no/tema/plantehelse/planteklinikk?locationfilter=true. The website header includes the NIBIO logo and the text "Planteklinikk". Below the header, there is a section for "TEMAARTIKLER" (Topic Articles) and a profile for Kari Ørstad, an Avdelingsingeniør (Division Engineer) for biotechnology and plant health. Her contact information includes a phone number (+47) 959 49 020, an email address kari.orstad@nibio.no, and her office location in Ås. A button labeled "MEDARBEIDERE" (Employees) is visible. The main content area features two paragraphs of text describing the clinic's diagnostic services for Mattilsynet and private entities, as well as for other plant damage agents. Below this, there is a "Tjenester" (Services) section with a bulleted list of services: identification of insects, mites, nematodes, snails, fungi, bacteria, and viruses; identification of weeds and other plants; and identification of different plant damage agents in soil. There are also links to "Prøvetaking og innsending" (Sampling and submission) and "Tjenester og priser" (Services and prices). A "Diagnosemetoder" (Diagnostic methods) section follows, listing visual inspection, morphological identification, isolation of plant pathogens, and molecular methods. The Windows taskbar at the bottom shows the date as 2023-03-01 and the time as 15:01.

Planteklinikk - Nibio

nibio.no/tema/plantehelse/planteklinikk?locationfilter=true

Planteklinikk

TEMAARTIKLER

Kari Ørstad
Avdelingsingeniør - Divisjon for bioteknologi og plantehelse
(+47) 959 49 020
kari.orstad@nibio.no
Kontorsted: Ås - Bygg H7

MEDARBEIDERE →

Telefon til Planteklinikken:
452 11 439.
Telefonen er betjent hverdager fra kl. 09:00 til 14:00

E-post: planteklinikken@nibio.no

Adresse for prøver:
NIBIO Planteklinikken
Høgskolevegen 7,
1433 Ås

Planteklinikken utfører diagnostikk for Mattilsynet og private virksomheter i forbindelse med offentlig kontroll og egenkontroll av karanteneskadegjørere (regulert under Forskrift om plantehelse).

Planteklinikken utfører også diagnostikk av andre planteskadegjørere for planteprodusenter, grossister, importører, vanlige hageeiere og andre interesserte som ønsker å få identifisert årsaken til skader på planter.

Tjenester

- Identifisering av insekter, midd, nematoder, snegler, sopp, bakterier og virus som er skadegjørere på planter
- Identifisering av ugras og andre planter
- Påvisning av ulike planteskadegjørere i jord
- [Kurs i importkontroll og planteskadegjørere](#)

Se [Prøvetaking og innsending](#) for skjema og praktiske tips.
Se [Tjenester og priser](#) for mer info om våre tjenester.

Diagnosemetoder

- Visuell inspeksjon av skadesymptom
- Morfologisk identifikasjon av skadedyr i lupe eller mikroskop
- Isolering av plantepatogene organismer på selektive næringssubstrat
- Molekylære metoder for identifikasjon vha. påvisning av



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***Neonectria* cankers on trees**

Neonectria ditissima (syn. *N. galligena*) - fruit tree canker - Frukttrekreft

Neonectria neomacrospora - Neonectria canker of fir - Edelgranbarkkreft

Neonectria fuckeliana - Neonectria canker - rød bartkreft

NEONECTRIA DITISSIMA (SYN. *N. GALLIGENA*) - FRUIT TREE CANCKER

- Major diseases of apple (*Malus domestica*) and pear (*Pyrus communis*)
 - Broad-leaved forest tree species e.g. alder (*Alder*), birch (*Betula*), beech (*Fagus*) can also be affected
- Symptoms: cankers, branch and crown dieback, fruit rot
- Signs of the pathogen: red fruiting bodies called perithecia
- Management: fungicides (copper), paints with fungicidal agents, pruning & removal/destruction, resistance



NEONECTRIA DITISSIMA (SYN. *N. GALLIGENA*) - FRUIT TREE CANKER



Credit: Robert L. Anderson, USDA Forest Service, Bugwood.org



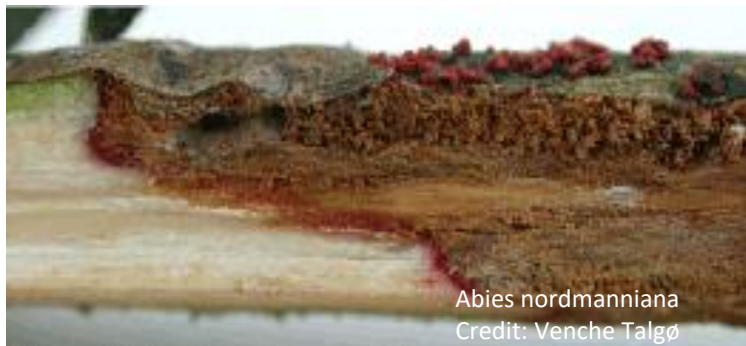
Credit: Joseph OBrien, USDA Forest Service, Bugwood.org



Credit: Robert Anderson, Bugwood.org

NEONECTRIA NEOMACROSPORA - NEONECTRIA CANCKER OF FIR

- Major disease of fir trees (*Abies*)
- Symptoms: cankers or lesions in the bark, crown dieback, tree mortality
- Signs of the pathogen: red fruiting bodies called perithecia
- Management: fungicides, pruning & removal/destruction, resistance (species selection)



NEONECTRIA FUCKELIANA - NEONECTRIA CANKER

- Cankers of Norway spruce (*Picea abies*)
- Symptoms: dark necrotic canker wounds, top-dieback
- Signs of the pathogen: red fruiting bodies called perithecia
- Management: pruning & removal of diseased branches and trees





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Brittle cinder on deciduous trees

Kretzschmaria deusta - brittle cinder - Kullskorpe

KRETZSCHMARIA DEUSTA - BRITTLE CINDER

- Root and butt rot of deciduous trees [beech (*Fagus*), ash (*Fraxinus*), linden (*Tilia*), birch (*Betula*), oak (*Quercus*), maple (*Acer*) etc.]
- Symptoms: stunted growth/undersized foliage, canopy dieback, basal cankers, stem breakage
- Signs of the pathogen: fruiting bodies on roots and around the base of the tree (burnt crust)



Brittle cinder of beech, Teleomorphic stage - burnt crust
Credit: Venche Talgø

Brittle cinder of beech, Anamorphic stage
Credit: Venche Talgø

Brittle cinder on beech, cross-section: show black zonation
Credit: K. H. Telfer, NIBIO

KRETZSCHMARIA DEUSTA - BRITTLE CINDER

- Management: remove trees with fruiting bodies (evidence of advanced infection)



QUESTIONS?

Phytophthora

= plant destroyer



Neonectria canker



Brittle cinder



Thank you for your attention!

Martin Pettersson

Martin.Pettersson@nibio.no



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