

# Surveillance to detect new pathogen incursions



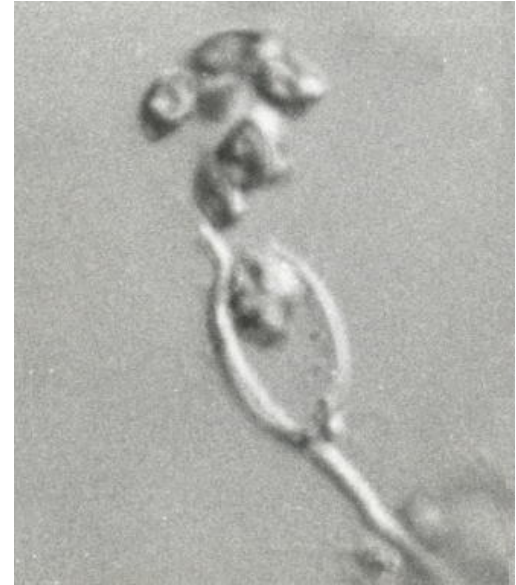
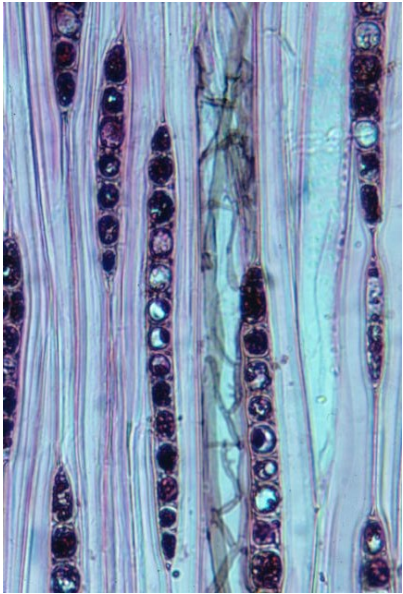
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# Scope of presentation

- The challenge of detecting pathogens
- Methods for detecting the presence of forest pathogens
  - Host (symptomatic, asymptomatic, fruit bodies)
  - Environmental
- Surveillance methods
- The challenge of surveillance for early detection of forest pathogens



# The challenge of detecting pathogens



Vegetative stage usually hidden inside host

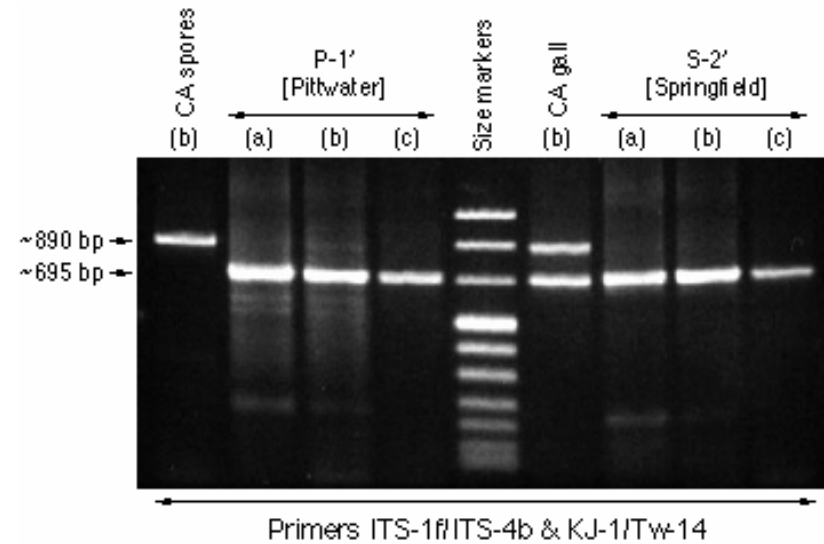
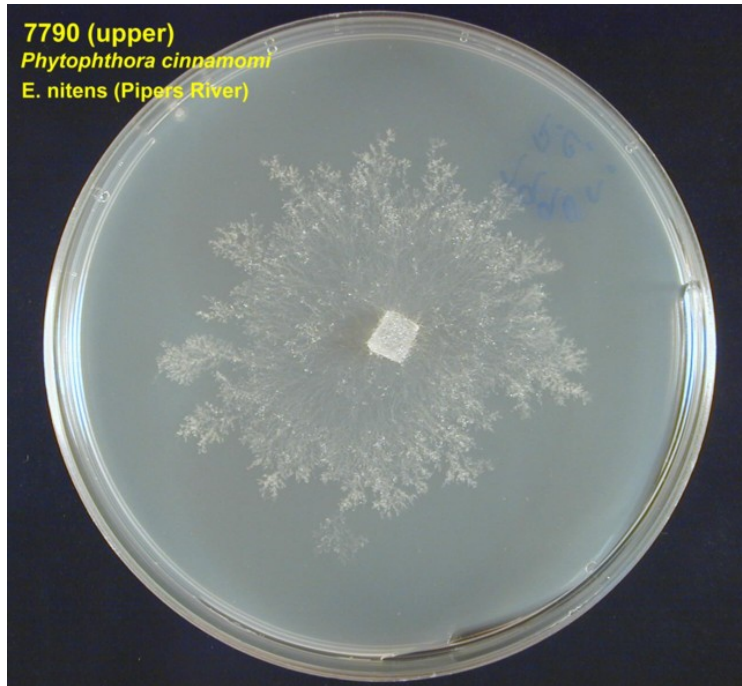
Damage symptoms often non-specific

Fruiting bodies and spores more diagnostic but usually very small



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# The challenge of detecting pathogens



Specialised and expensive methods often needed for confident identification

# Methods of detection

- Visual symptoms
- Fruiting bodies
- Screening asymptomatic plants
  - Culturing onto agar
  - DNA tests
- Environmental sampling - e.g. soil / water baiting for *Phytophthora*

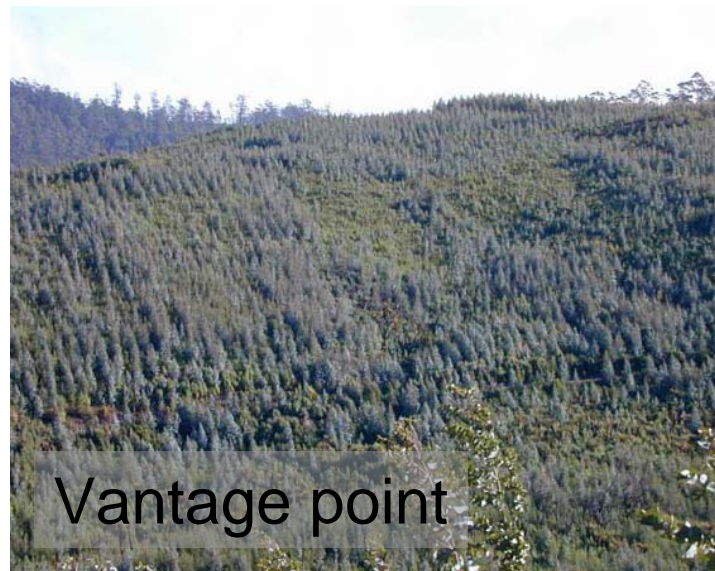


# Surveillance methods

- Forest health surveillance
- Sentinel surveys
- Blitz surveys
- Quarantine screening
- Area freedom surveys
- Ad hoc detection



# Inspection platforms



# Forest health surveillance

- Relies on highly trained observers inspecting forests
- 100% inspection of forest area
- Mix of inspection methods depends on area surveyed
  - Small areas (<1000 ha): ground and roadside
  - Large areas (>10,000 ha) aerial and roadside
- Resolution (ability to detect) influenced by inspection methods used

# Capacity to detect new incursions

- Detection of stem galls on *P. radiata* during routine whole of estate detection survey
- Detected during ground survey
- A fluke or real detection power?



# Ability to detect symptoms

Obvious 
→
 Cryptic



<b>Aerial</b>	+	+	+/- (sev)	+/- (sev)	+/- (sev)	-	-
<b>Road</b>	+/- (sam)	+/- (sam)	+	+	+	-	-
<b>Ground</b>	+/- (sam)	+/- (sam)	+	+	+	+/- (sam)	+/- (sam)

+/- (sev) detection dependent upon severity

+/- (sam) detection dependent on area sampled / incidence

# Ability to detect symptoms using forest health surveillance

Whole tree symptoms



- Detectable at very low incidence from air
- Detectability from roadside or ground dependant upon incidence / area sampled

Crown symptoms



- Detectability from air dependent upon severity
- Symptoms generally at high incidence and therefore detectable from roadside or ground

Stem symptoms



- Not detectable from air
- Detectability from roadside or ground dependant upon incidence / area sampled

# Sentinel tree surveys



- Regular inspection of specifically located trees
- Able to detect new damage to a high level of resolution
- Targeted list of host species
- Most useful when sentinel trees near high hazard sites or in disease-free areas beyond infection fronts



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# Blitz surveys



- Detailed inspection for damage of trees in a local area
- Covers all trees present
- Able to detect low levels of damage
- Able to detect cryptic damage moderately reliably
- Often used in easy accessible areas near high hazard sites



# Quarantine screening

- Focussed on a small number of plants
- General detection based on symptoms
- List-focussed screening of asymptomatic plants of known hosts

e.g. detection of pine pitch canker pathogen by DNA screening of asymptomatic douglas fir seedlings in New Zealand



# Area-freedom surveys



- Survey in defined areas to prove the absence of a pathogen
- Results based on:
  - absence of symptomatic plants
  - negative tests in environmental screening
- Targeted for specific pathogen
- Example quarry surveys to certify the absence of *Phytophthora cinnamomi*

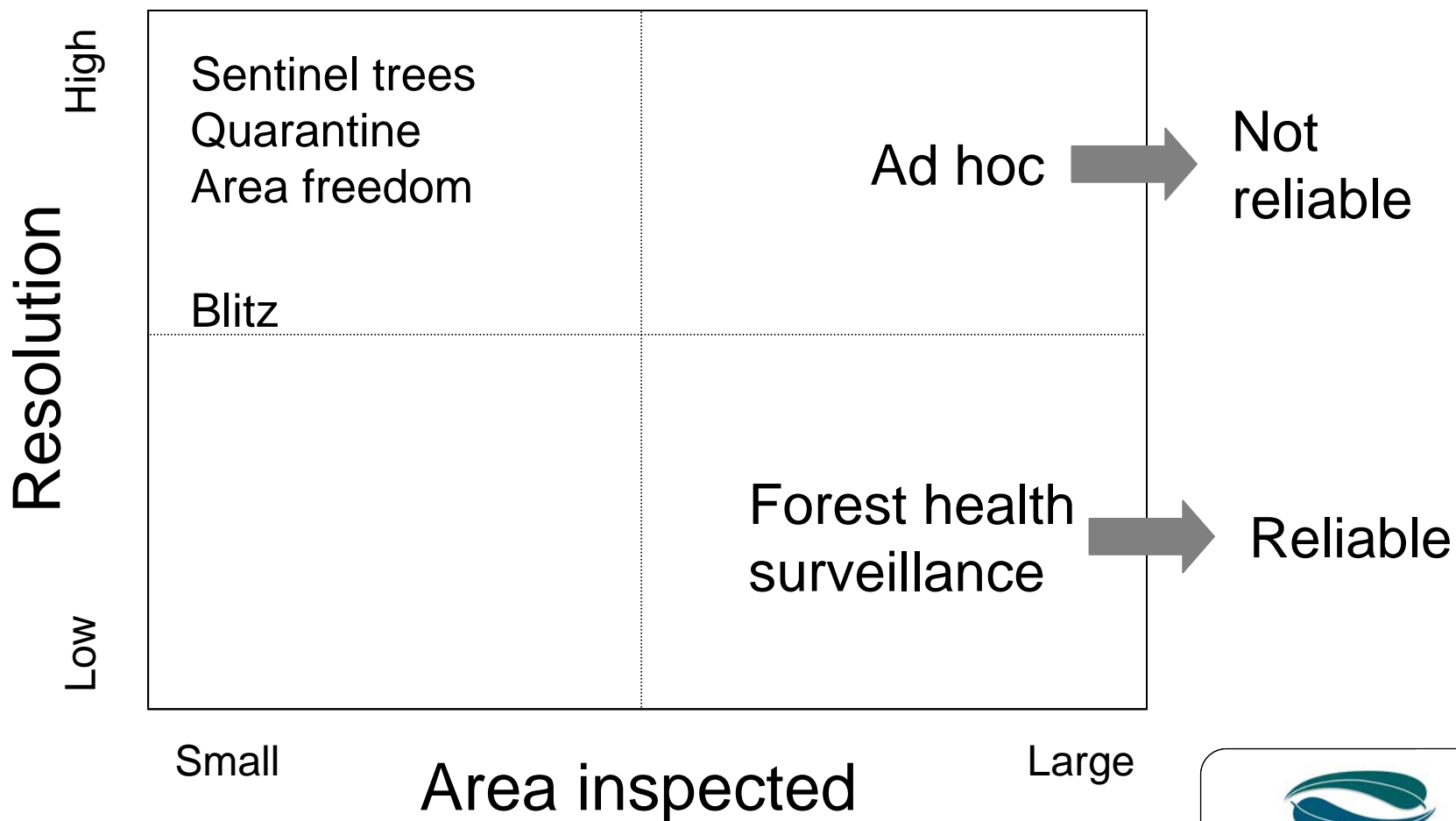
# Ad hoc detection



- Detection made in an unplanned way during course of routine forestry activities
- Reliability very low overall but some significant ad hoc detections
- Awareness training thought to improve reliability but not proven



# Detection surveys: summary



# Surveillance for early detection of forest pathogens



- Must have substantial ground component
- Must be done on a regular cycle
- Must be done by trained people
- .
- .
- Needs to be restricted to relatively small areas or number of trees
- WHERE?



# Surveillance for early detection of forest pathogens



- Where are new incursions likely to first establish?
- Is there a good understanding of pathogen threats to host?
- Is the host present at or near areas where new incursions are most likely?
- How many suitably trained people are available to do inspections?



# Discussion



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# Fungal pathogen life history attributes

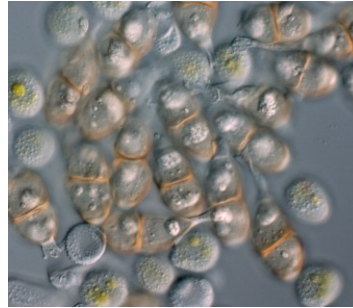
## Vegetative



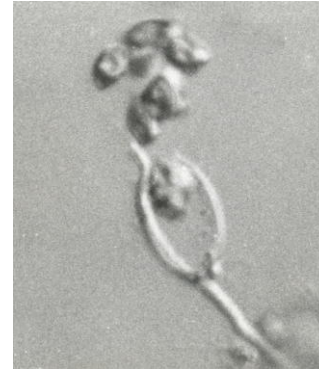
- Mostly confined within host
- Specialised hyphal structures allow growth outside host
- Limited infectivity (host contact)

## Reproductive

### Sexual



### Asexual



- Key dispersal stage
- Sensitive until new infections established
- Sexual stage provides genetic diversity
- Asexual stage allows rapid population build-up

## Survival



- Long term survival in soil, plants.

# Dissemination

- Unassisted spread (autonomous)
  - airborne (spores)
  - rainsplash, mass water flow (spores)
  - contact (vegetative hyphae)
- Assisted spread (vectored)
  - insects
  - trade
  - infected plants
  - soil / gravel transport
  - travellers

