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Forest Biosecurity and Protection

Cyclaneusma needle-cast ~ current knowledge and knowledge gaps

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Symptoms

- Scattered individual trees are affected within a stand – susceptibility varies considerably between individuals
- The same individuals are affected from year to year
- Needles turn yellow, then brown
- Symptoms are visible in September/October, and April/May
- Needles detach very easily

Infection process

- Needles are susceptible to infection when >6 months old
- Main infection period is autumn/early winter
- Needles are cast primarily in spring, but a less severe cast occurs in autumn – resulting in two peak spore periods
- The autumn cast produces spores that continue the infection cycle because current year needles are susceptible to infection then
- Spores are produced throughout the year, after rainfall, on needles that are on the ground. Spores are airborne, so travel long distances
- Therefore: wet mild weather in autumn/early winter will lead to heavy needle-cast in spring

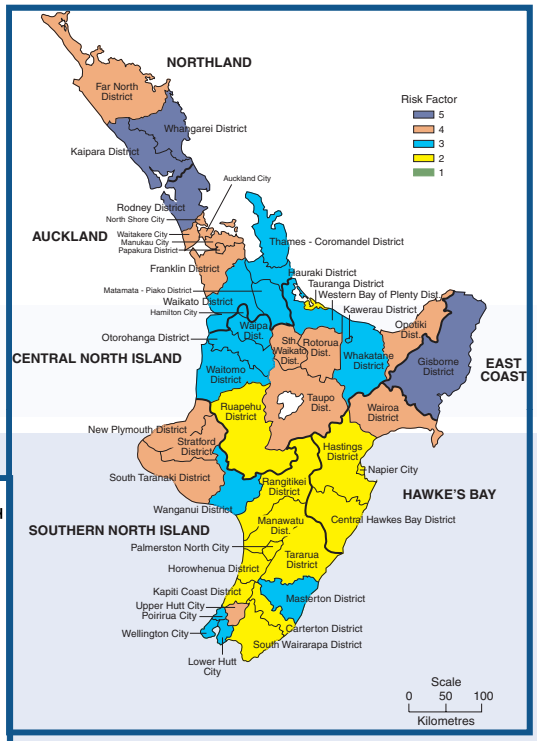
Population variation

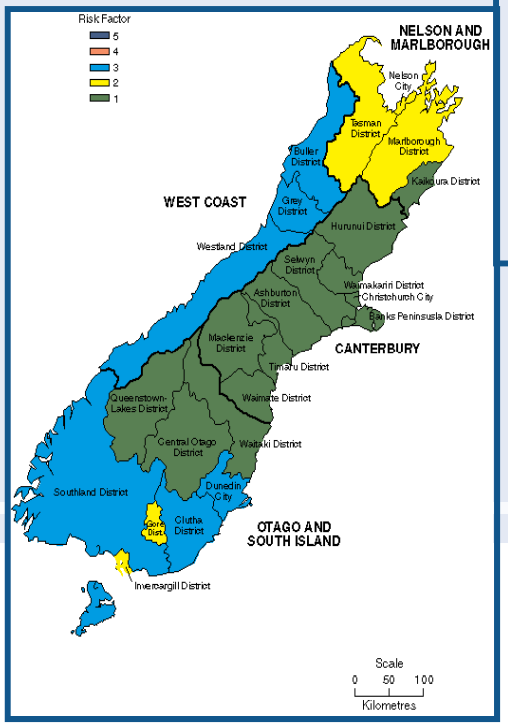
- **Morphological differences indicate that there are at least two types in New Zealand**
- ***C. minus* 'simile' is more common than *C. minus* 'verum'**
- ***C. minus* 'simile' is found more often in the North Island**

Distribution

- **Auckland and Northland, East Cape, Bay of Plenty are the most severely affected regions (approx. 20% of trees have disease severity of over 40%)**

- **Hawke's Bay, Canterbury, Nelson have the least disease**



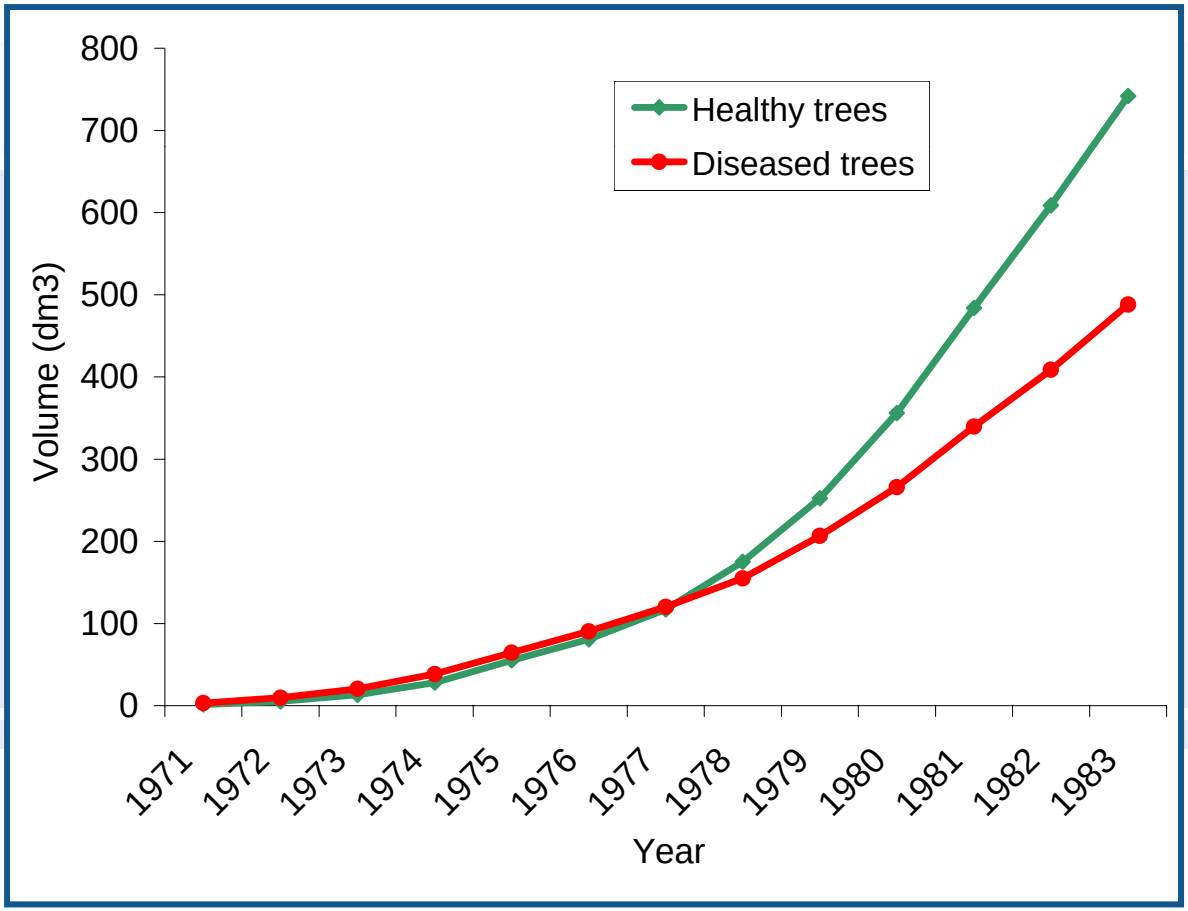


Microsite and crop effects

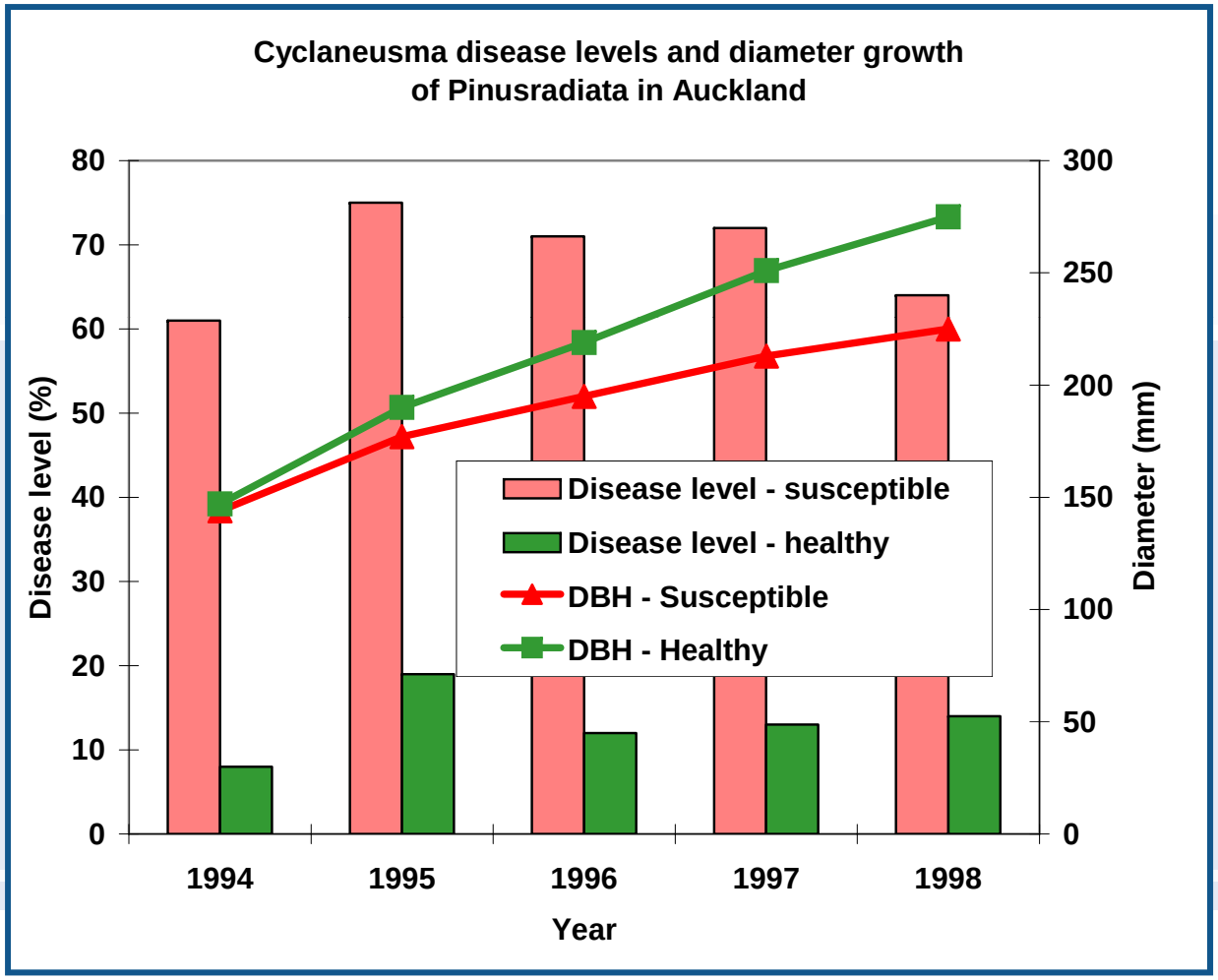
- **Disease severity is worst in moist sites (i.e. gullies or high altitude sites prone to mist)**
- **Disease is most severe in trees aged between 6 and 15 years.**
- **Trees younger than 6 years or older than 20 years are rarely affected**

Impact – volume growth loss

- **Cyclaneusma causes significant growth loss – average disease of 80% resulted in 60% volume loss**



Impact – diameter growth loss



Impact – value loss

- When 50% of the crop is diseased, revenue reduction of $3,200-$3,600/ha may be expected (1984 dollars)
- Average loss in volume of 6.5% per annum is estimated for the national estate aged between 6 and 20 years
- Financial loss is estimated to be $60m per annum

Control

- **Aerial spraying can be effective, but very expensive**
- **Pruning has no effect, because spores are released from needles in litter**
- **Genetic selection has focused on needle retention and not specifically Cyclaneusma**
- **Selections from dry areas had poorer needle retention and growth when planted in Cyclaneusma-prone regions**
- **However, selection for Cyclaneusma resistance has resulted – *Pinus radiata* from the Cambria provenance was identified as highly susceptible to needle-cast and removed from the breeding programme**

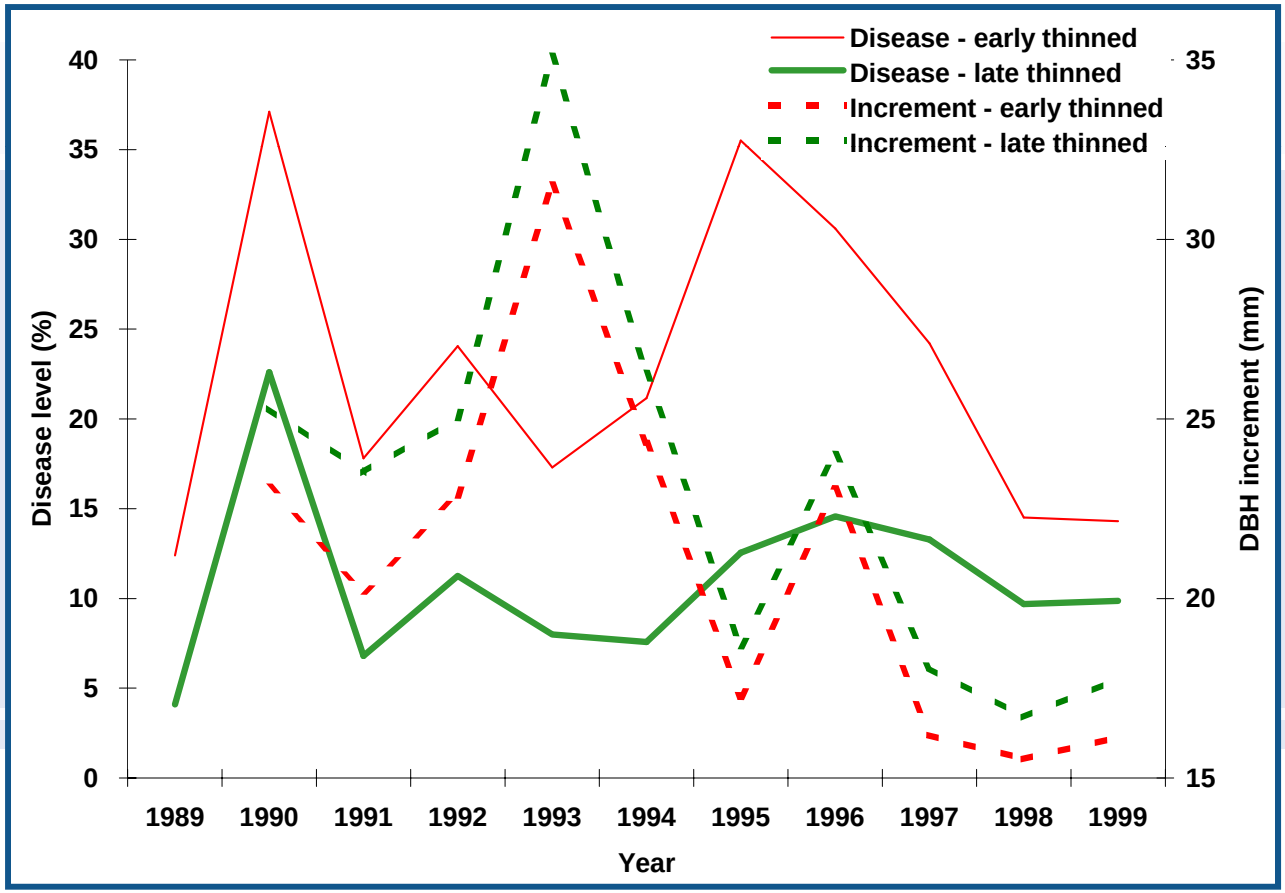
Control

- Selective thinning removes susceptible trees
- Selection must be carried out when symptoms are present – in Spring and when trees are at least 6 years old

Treatment		Disease incidence (%)	Disease severity (%)
Thinned age 4 or 5	After first thinning	48	64
Thinned age 7 or 8	After first thinning	23	62
Thinned age 10	After second thinning	25	53
Thinned age 10	After second thinning	3	50

Control

- **Selective thinning removes susceptible trees resulting in lower disease and increased increment**



Knowledge gaps

- **Genetics**
  - Genetic gains specifically for *Cyclaneusma*
  - Inoculation of aged cuttings
- **Population variation**
  - What is the genetic variability of *Cyclaneusma minus* in NZ? How many types exist?
- **Physiological dynamics that cause *Cyclaneusma* to move from an endophyte to a pathogen**
  - *Cyclaneusma* is present in needles of healthy and susceptible trees
    – what initiates and causes disease in susceptible trees?
    – what factors are involved?

Future New Zealand research priorities

- **Genetics**
  - Assessing genetic gains trials specifically for Cyclaneusma
  - Establishing new trials in Cyclaneusma-prone areas
  - Glasshouse inoculation
  - Gene-assisted selection
- **Selective thinning**
  - Examine economics of selective thinning (i.e. pruning all trees, thinning in spring only, delaying thinning)
- **Effect of infection on wood properties**

Future New Zealand research priorities

- **Habitat preference modelling**
  - Development of a GIS-based overlay to identify high risk microsites at a sub-stand level
  - Use of disease mapping tools (i.e. hyperspectural, digital photographs) with climate/topograhy overlays
  - Leading to a DSS that enables targeted planting of resistant breeds or alternative species