



Age-dependent defenses of lodgepole pine

Nina Modeland & Mary Reid
Environmental Science Program
University of Calgary

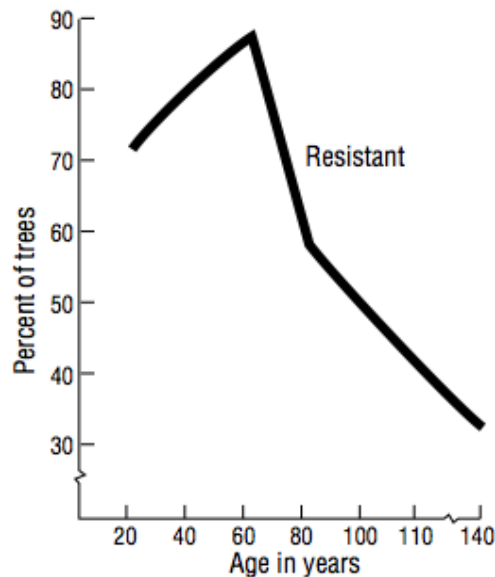


Thanks to Haydeé Peralta-Vásquez, Kristin Hill,
Nancie Lefebvre, Adam Brennan, Callie
Modeland, and Clayton Manning

Forest Management for MPB

•“As a general rule, by the time stands reach 80 to 100 years of age, they are highly susceptible to mountain pine beetle.” Safranyik & Carroll 2006

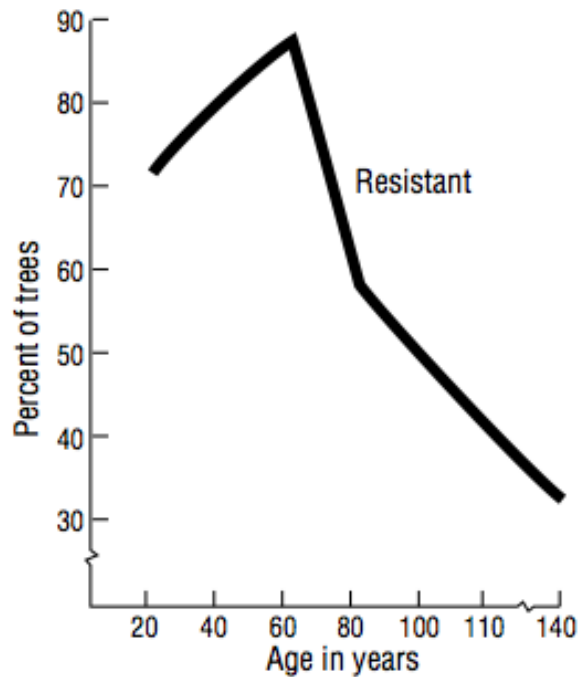
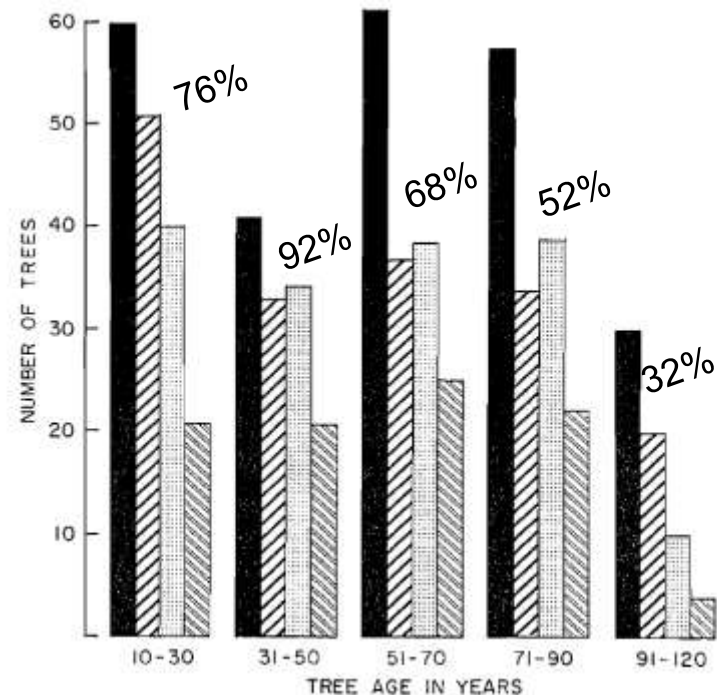
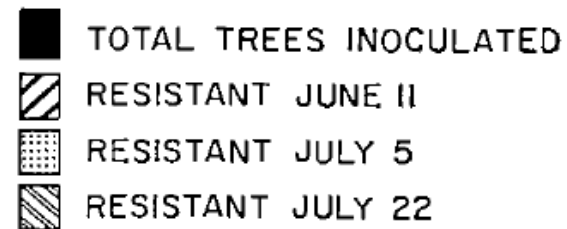
- Reduced capacity to resist colonization using their natural defenses



Safranyik, Shrimpton, Whitney (1974). Management of lodgepole pine to reduce losses from the mountain pine beetle. Environment Canada, Forestry Service.



Support



Shrimpton 1973. Age- and size-related response of lodgepole pine to inoculation with *Euophium clavigerum*. Can. J. Bot. 51: 1155-1160.

Study site: near Radium, BC
Trees aged individually at ca. 1.5 m

Defences

MPB mass-attack live,
mature, large diameter pine



Symbiotic blue-stain fungi,
Grosmannia clavigera



Exuded resin





Determinants of Defence & MPB Success

Stand age

DBH

Growth Rate

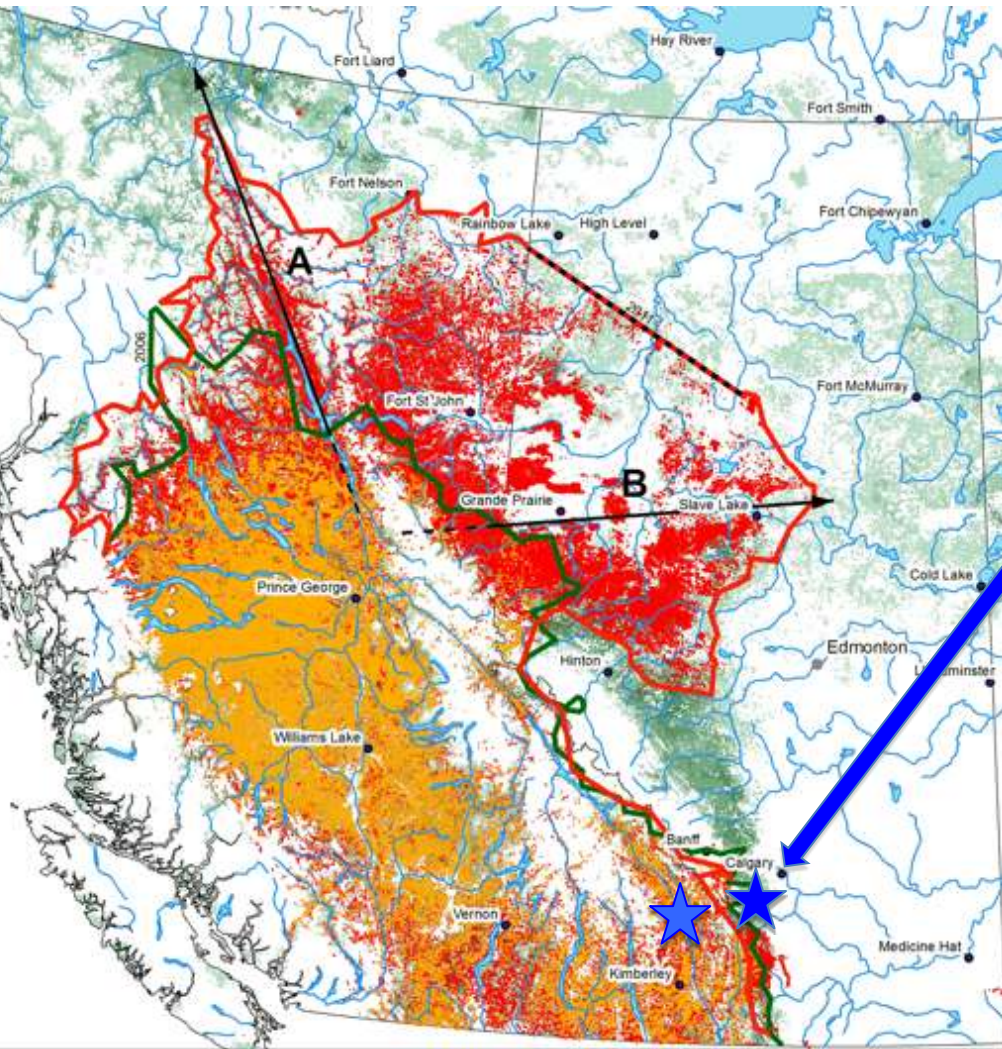
Stand density

Phloem Thickness

Geographic Variation

History of MPB colonization

This study

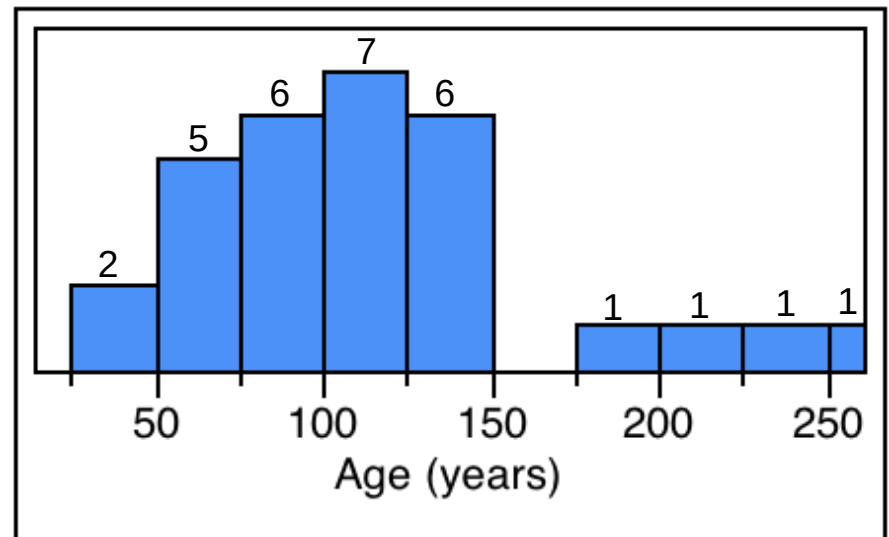


Age-dependent defences
and resource quality of
lodgepole pine in
Kananaskis, AB

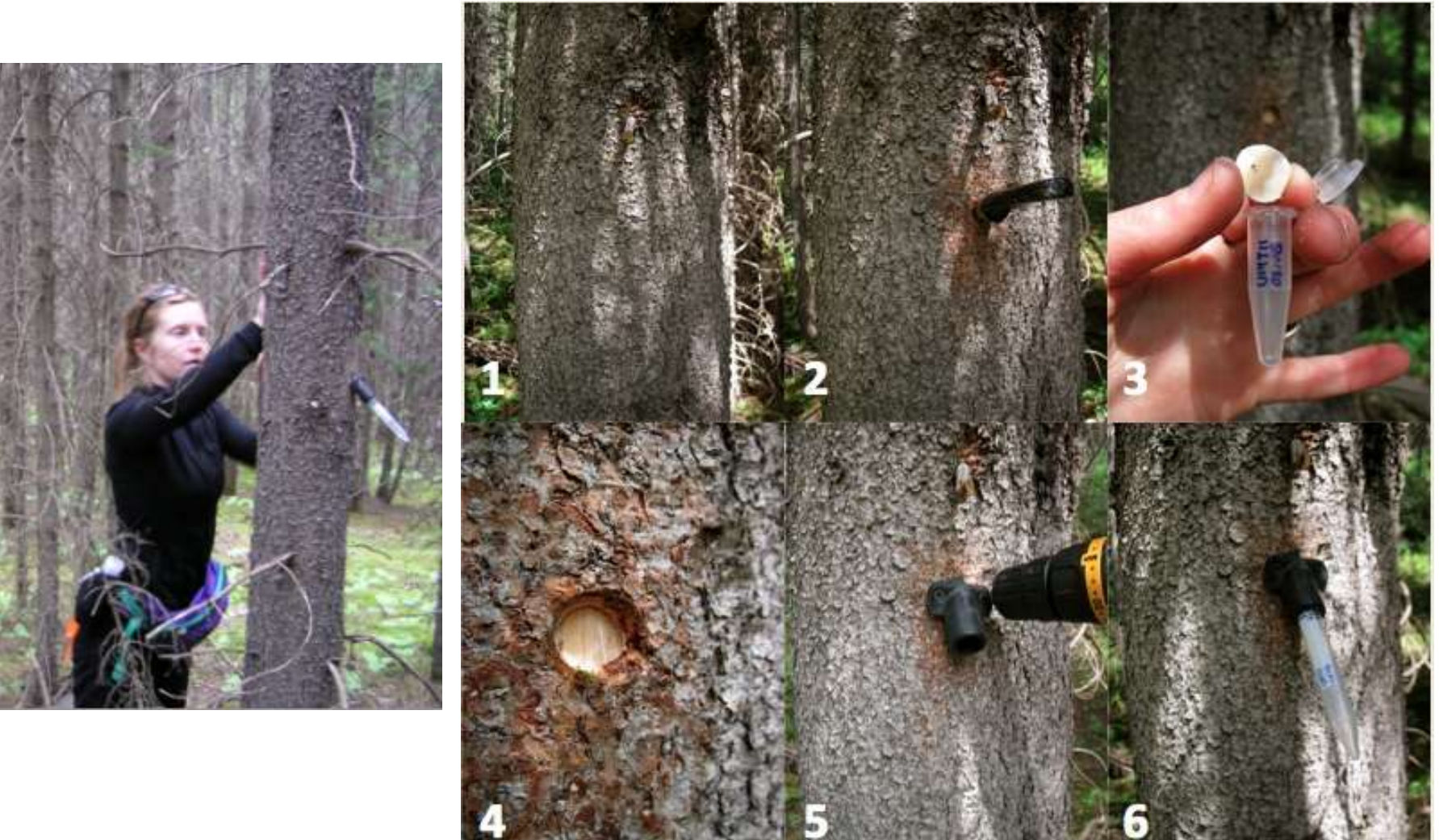
different geography,
climate, and colonization
history from previous work

Methods

- 30 stands
- Age:
 - Max: 258 y
 - Min: 41
 - Mean: 115



Defences: resin collection



5 trees/stand: $n = 150$

Defences: lesions in response to *Grosmannia clavigera*



1 tree/stand: $n = 30$

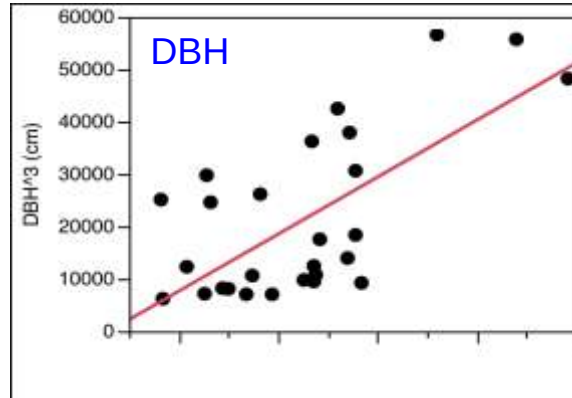
Other Methods



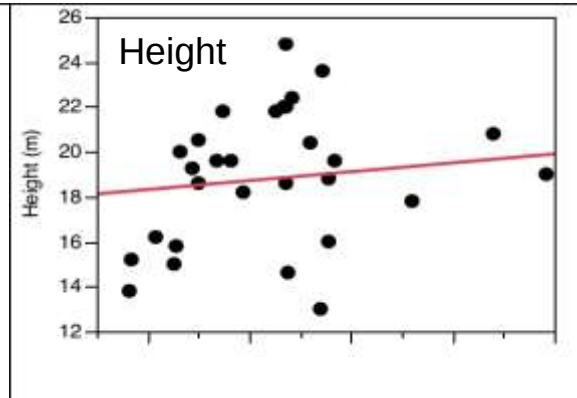
Growth rate: 5 & 10 years
Phloem thickness
Sapwood moisture (% wt)
DBH
Height
Stand density

Tree traits correlated with age

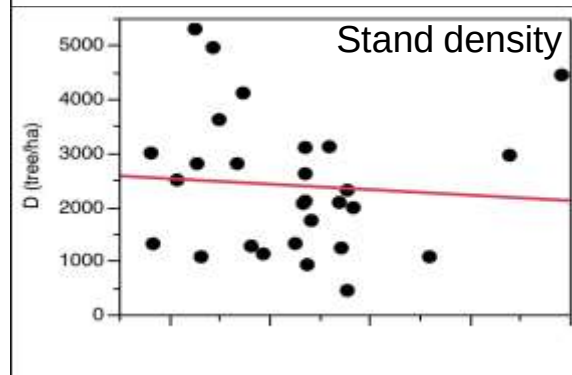
R^2 0.515
p 0.0001



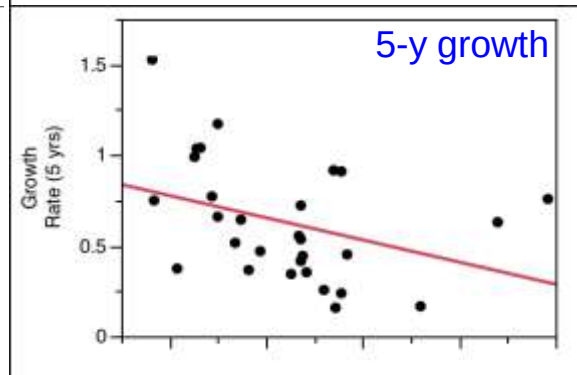
R^2 0.021
p 0.447



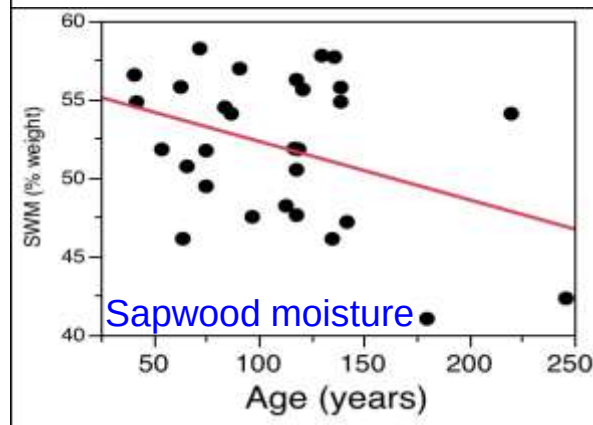
R^2 0.008
p 0.64



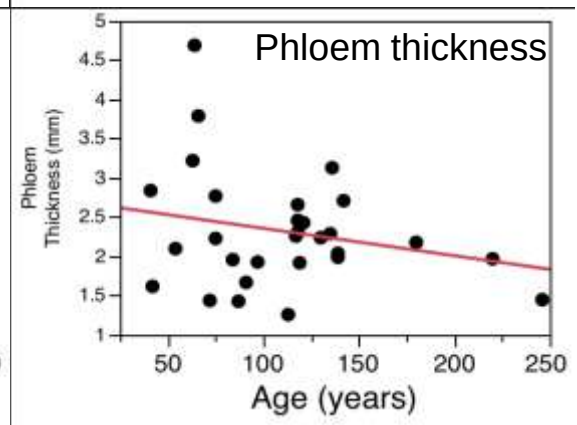
R^2 0.17
p 0.024



R^2 0.18
p 0.018



R^2 0.069
p 0.16



production declined weakly
with tree age

Full model

Age (years)

DBH (cm)

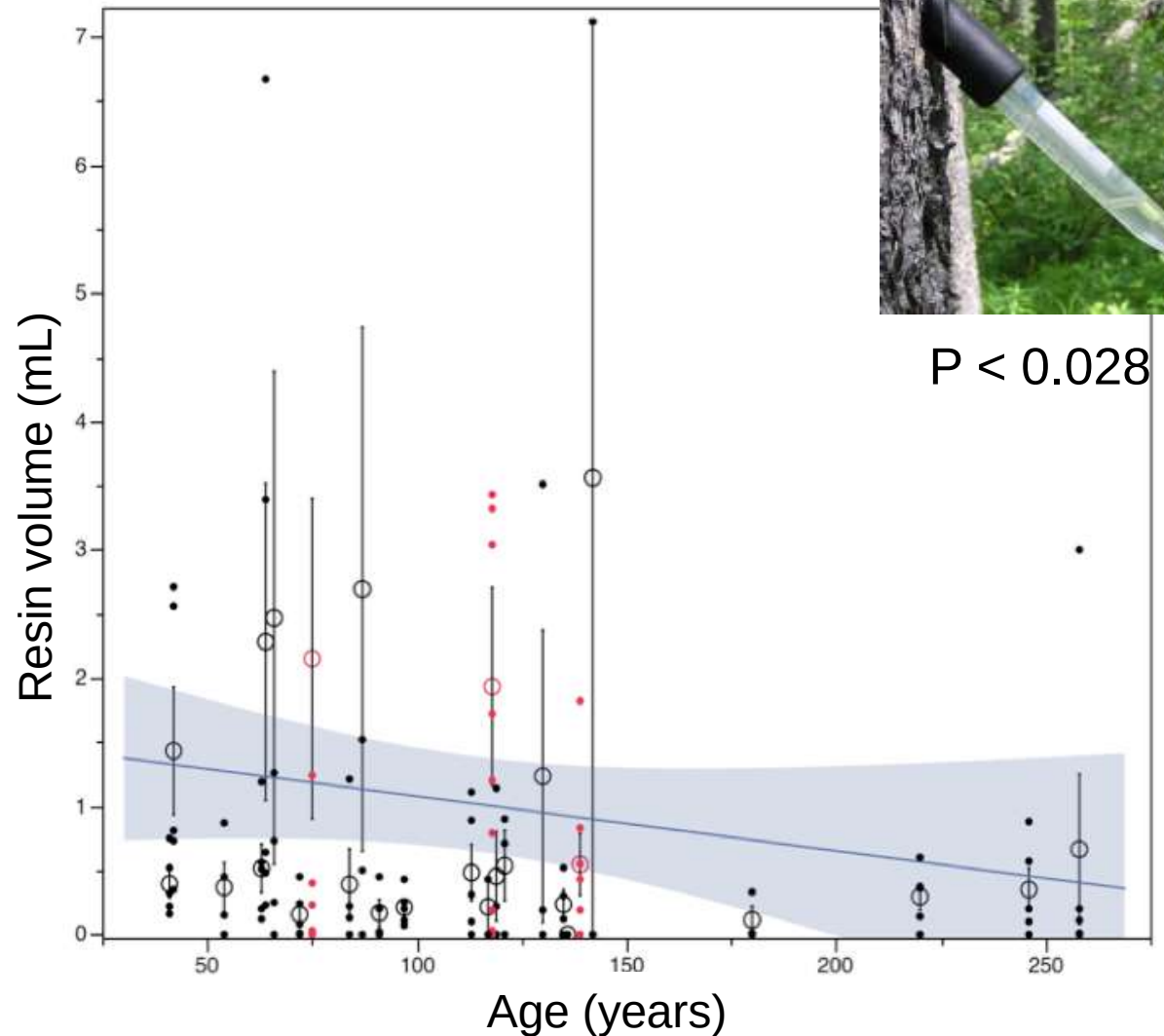
Tree Height (m) (-)

Stand density (Tr/ha)

Growth Rate (5 y)

Sapwood Moisture %

Phloem (mm)



Lesion length did not vary with age or tree traits

Full model

Age (years)

DBH (cm)

Tree Height (m)

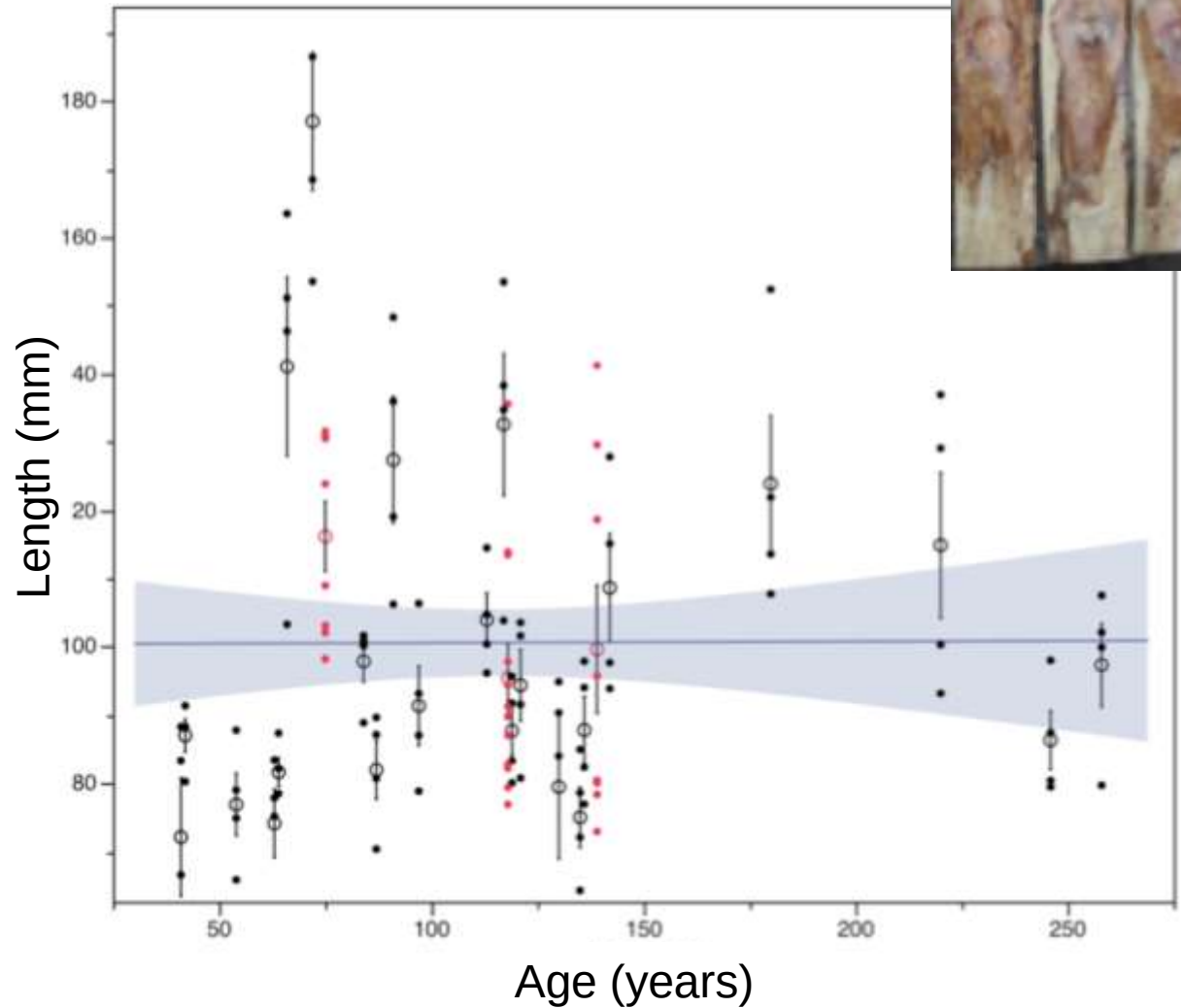
Stand density (Tr/ha)

Growth Rate (5 y)

Sapwood Moisture %

Phloem (mm)

All ns



Conclusions

- **Little change, if any, in defences with stand age**
 - Other stand characteristics more important?
 - Need to consider induced defences?
 - Geographic difference?
- Stand age may be important for other reasons
 - Not phloem thickness
 - DBH or growth rate?

