# Modelling stem resistance to breakage

Montpellier, October 2009

# Calculating stem resistance to breakage in ForestGales

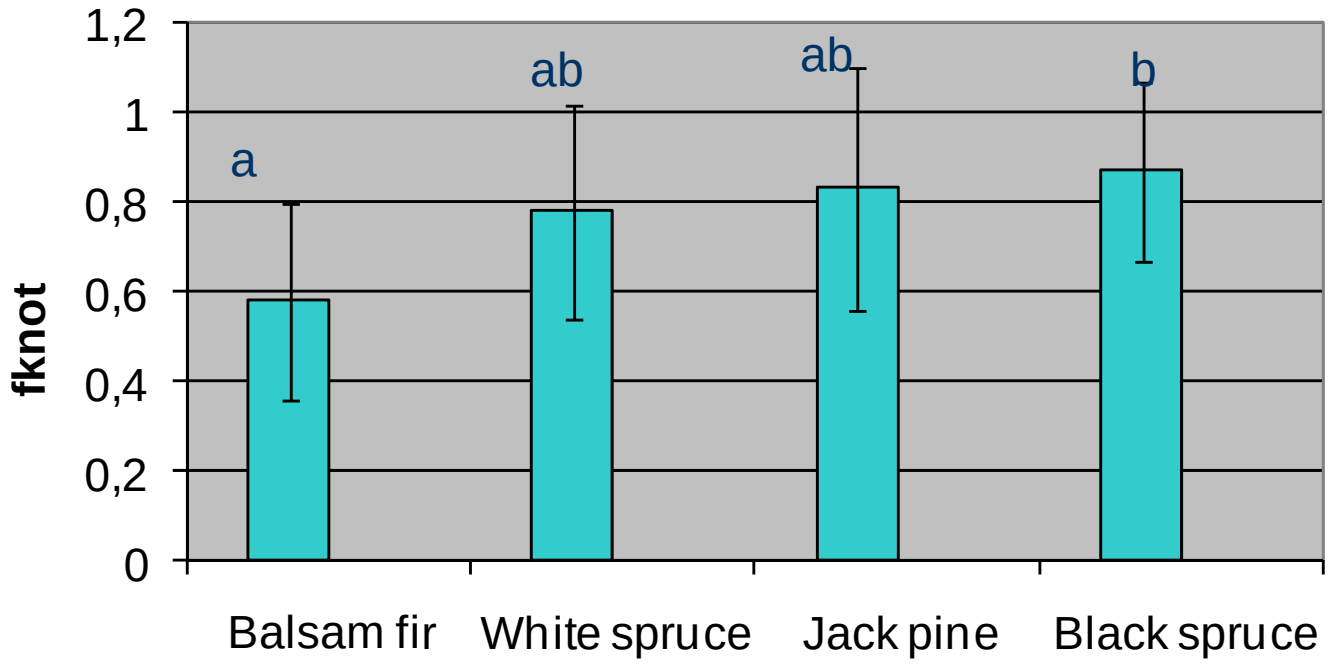
$M_{crit}=(\pi/32)f_{knot}$ x MOR x $dbh^3$

- $M_{crit}$ : Critical moment for stem breakage
- $F_{knot}$: correction factor for MOR to account for defects (knots)
- Previously used values: 0.7-1

# Determining $f_{knot}$ from tree-pulling tests

- Data available for a number of species: balsam fir, white spruce, black spruce, jack pine
- Broken stems: representative ot the whole population?

# Fknot, tree pulling tests, sound stems without external defect




Sample size: balsam fir: 12; white spruce: 5; black spruce: 12; jack pine: 4

# Determining fknot: three-point bending tests

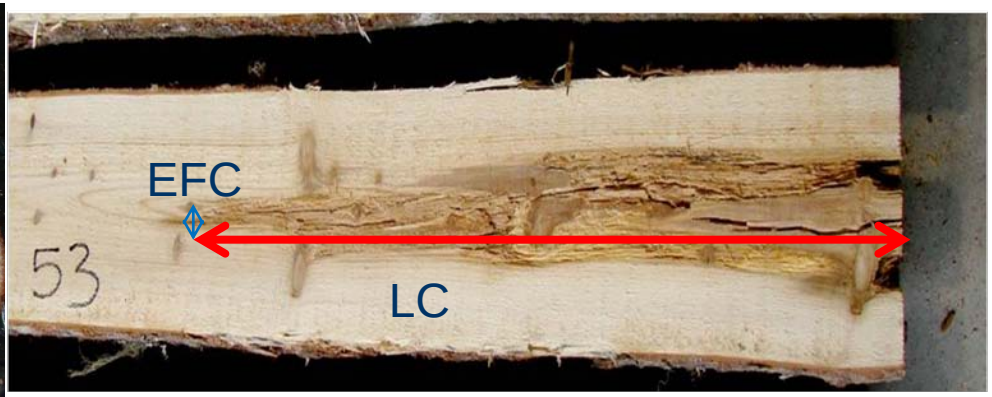
$F_{knot}$:

$MOR_{test}/MOR_{tables}$

# Sample:

- 48 logs (8 feet)
- Diameter at middle of log: 11-22 cm
- Percent decay (% diameter) at the middle of the log:  0-76%

# Measuring decay



# Testing indices of mechanical strength loss at the middle of the log

- d/D x 100
- $d^2/D^2$ x 100
- Wagener index(1963):
  - $d^3/D^3$ x 100
- Coder index(1989):
  - $d^4/D^4$ x 100
- Mattheck et al (1992) index :
  - t/R

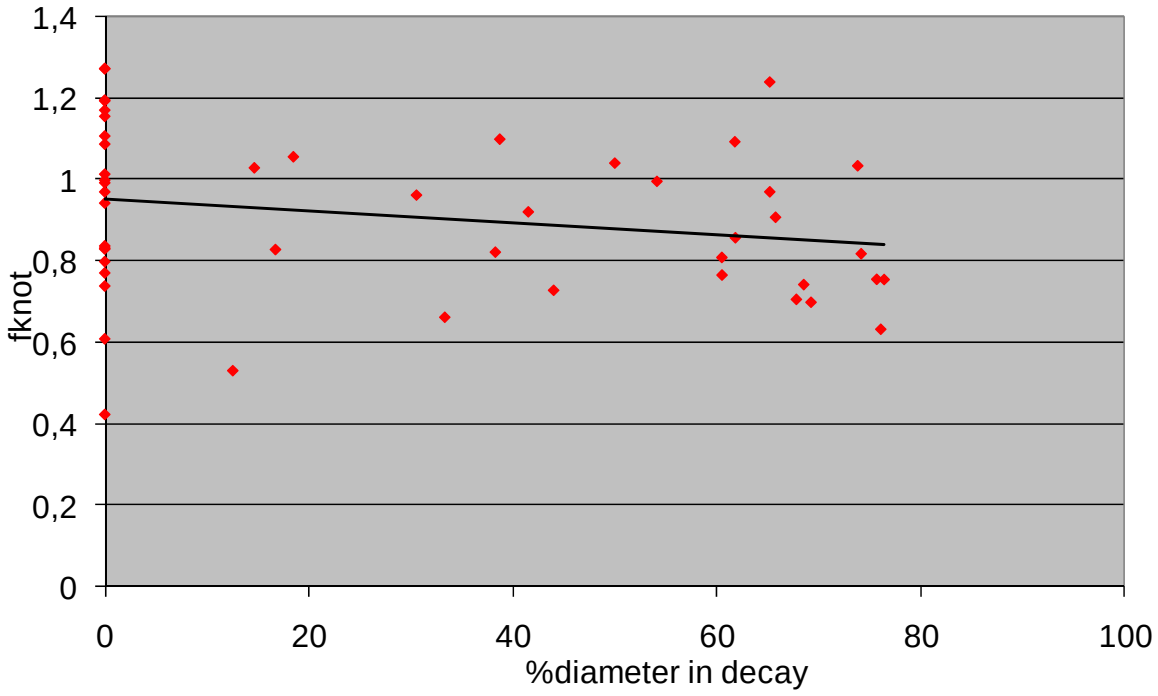
Where d=diameter of decay

D=diameter of section

t=thickness of sound wood

R=radius of section

# Results: percent diameter in decay

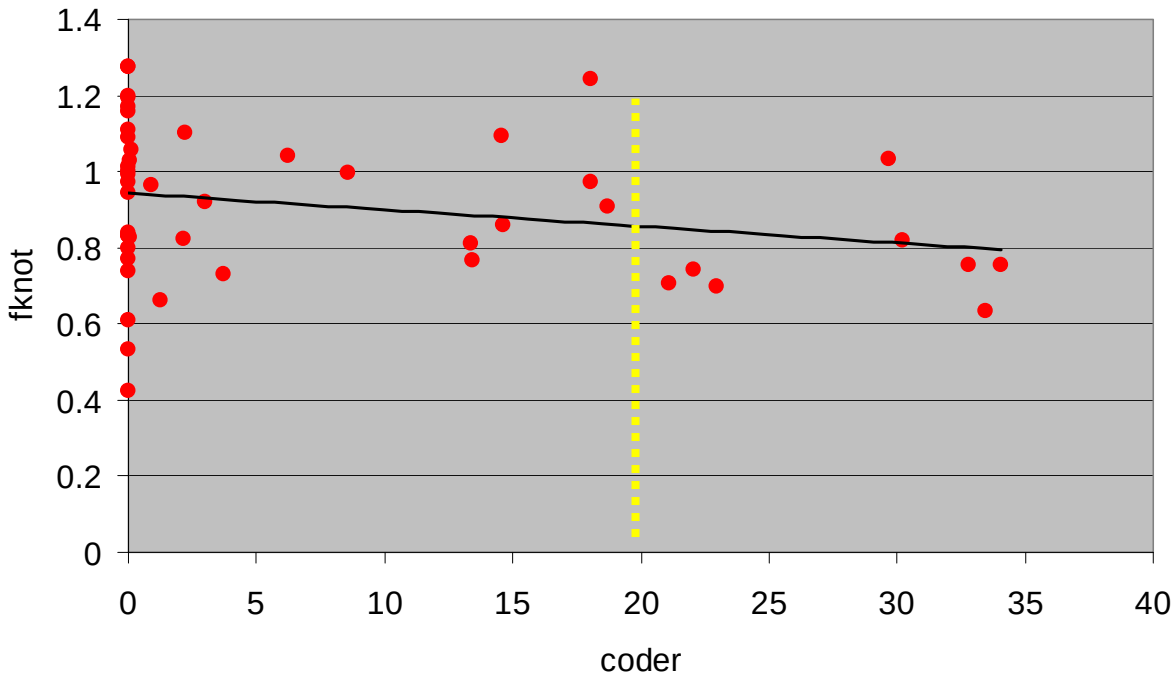



Corr fknot vs index:

R=-0.23

P=0.12

# Résultats indice Coder




Corr fknot vs indice:

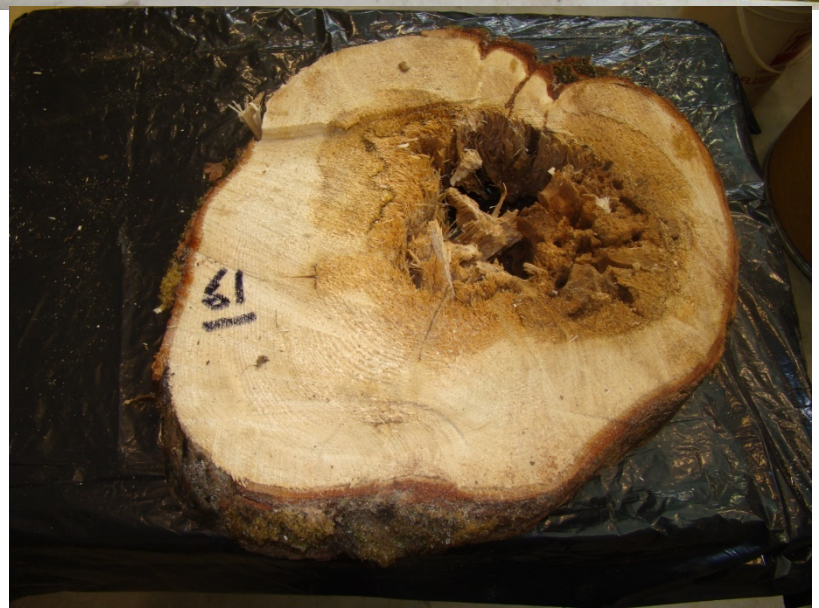
R=-0.24

P=0.10

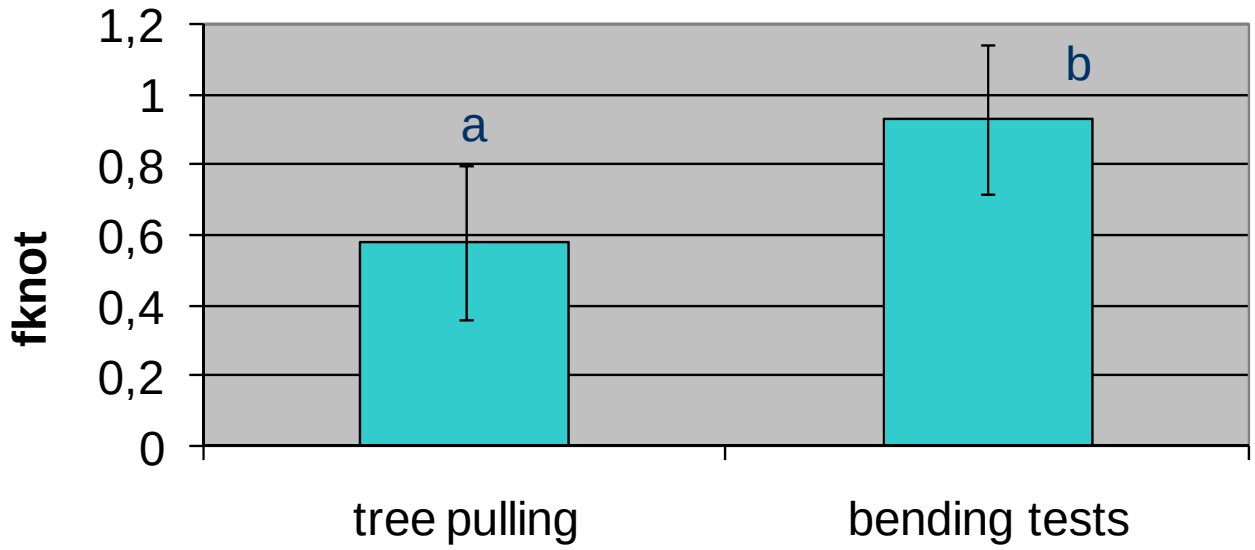
# Stepwise regression

- Independant variables:
  - Number knots, %decay vol, %decay basal area, coder, wagener, mattheck
- Nothing significant at $\alpha=0.05$

# Potential explanations



# Comparing fknot between tree pulling and three-point bending tests, sound stems




Sample size: tree pulling: 12; bending tests: 32