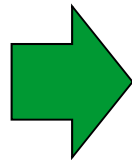


# A simulation approach to determine multi-tree felling and processing efficiency



skog+  
landskap



Helmer Belbo  
Norwegian Forest and Landscape Institute



skog+  
landskap

# What is the technical / theoretical potential efficiency?





skog+  
landskap

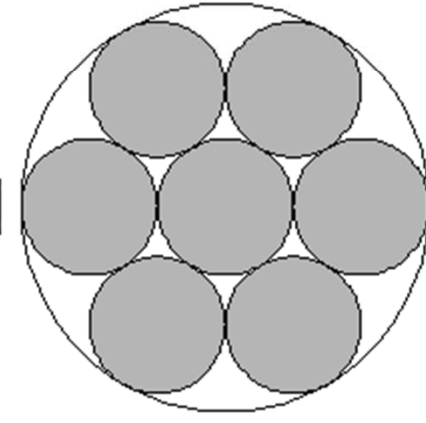
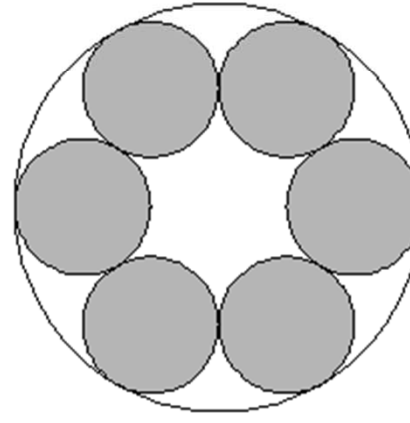
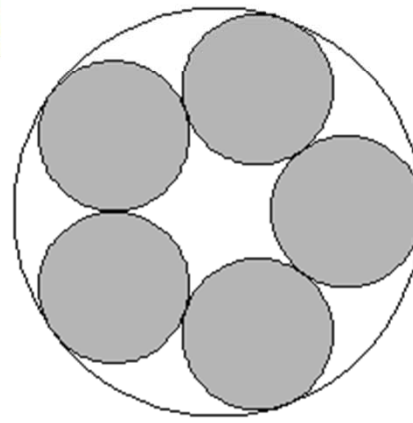
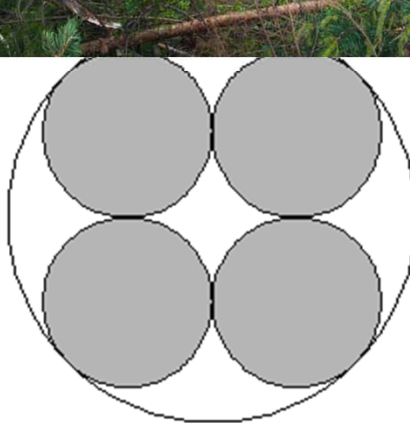
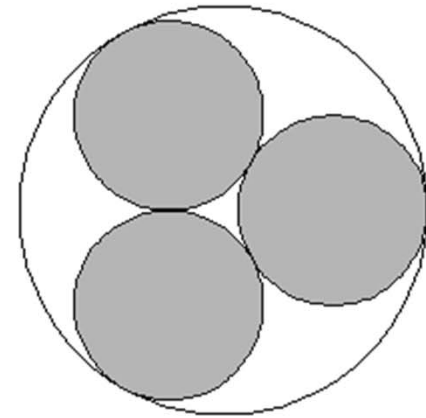
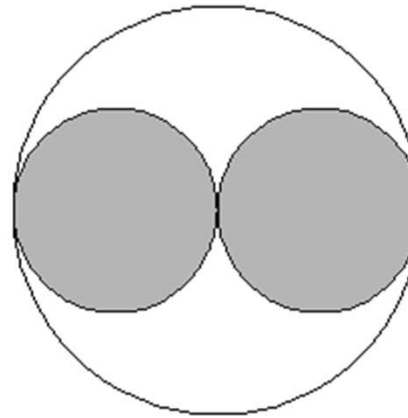
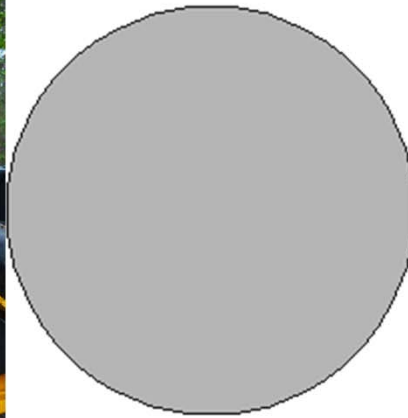
# Which head size would you prefer?



# Accumulation capacity?

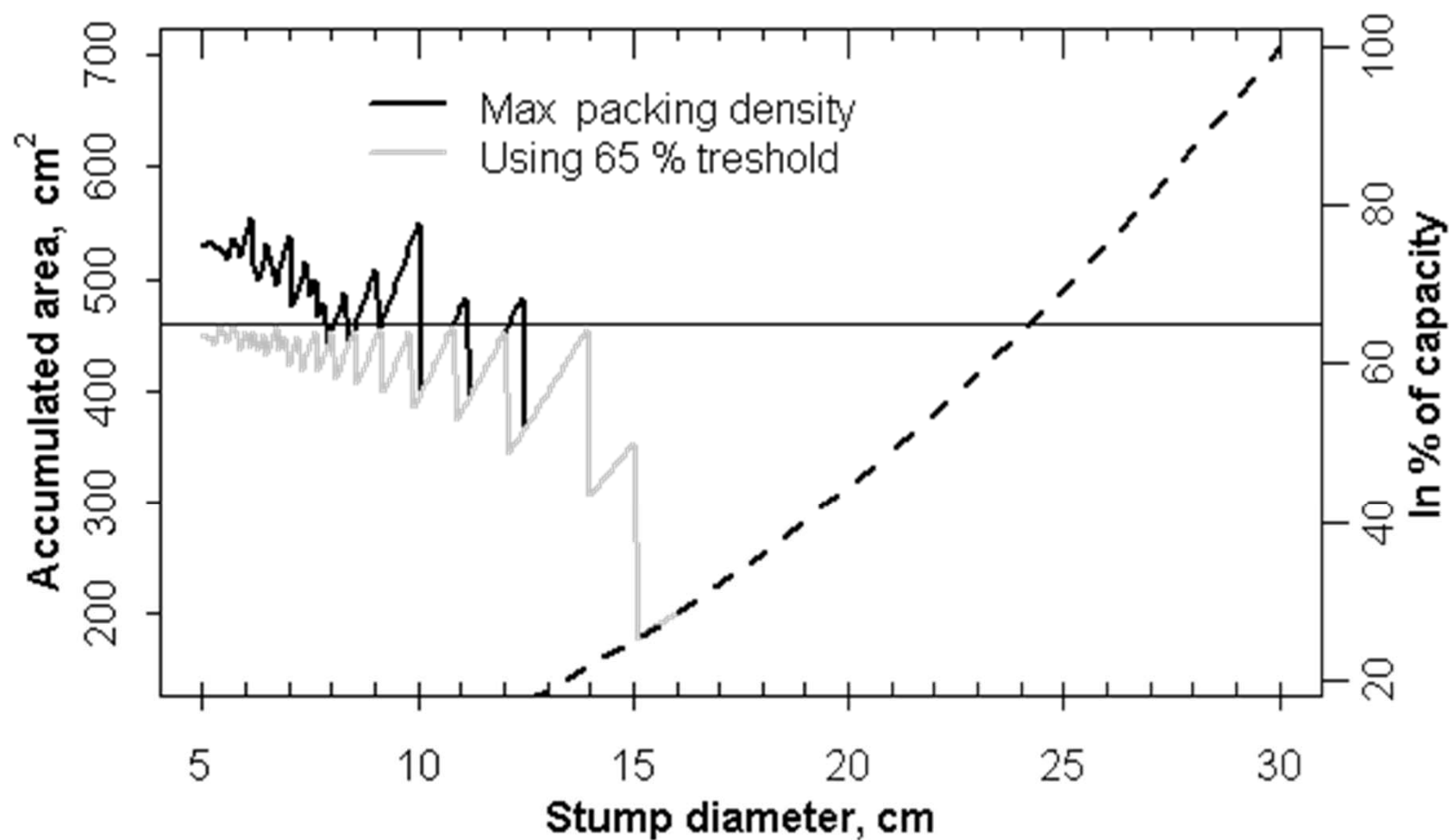


skog+  
landskap





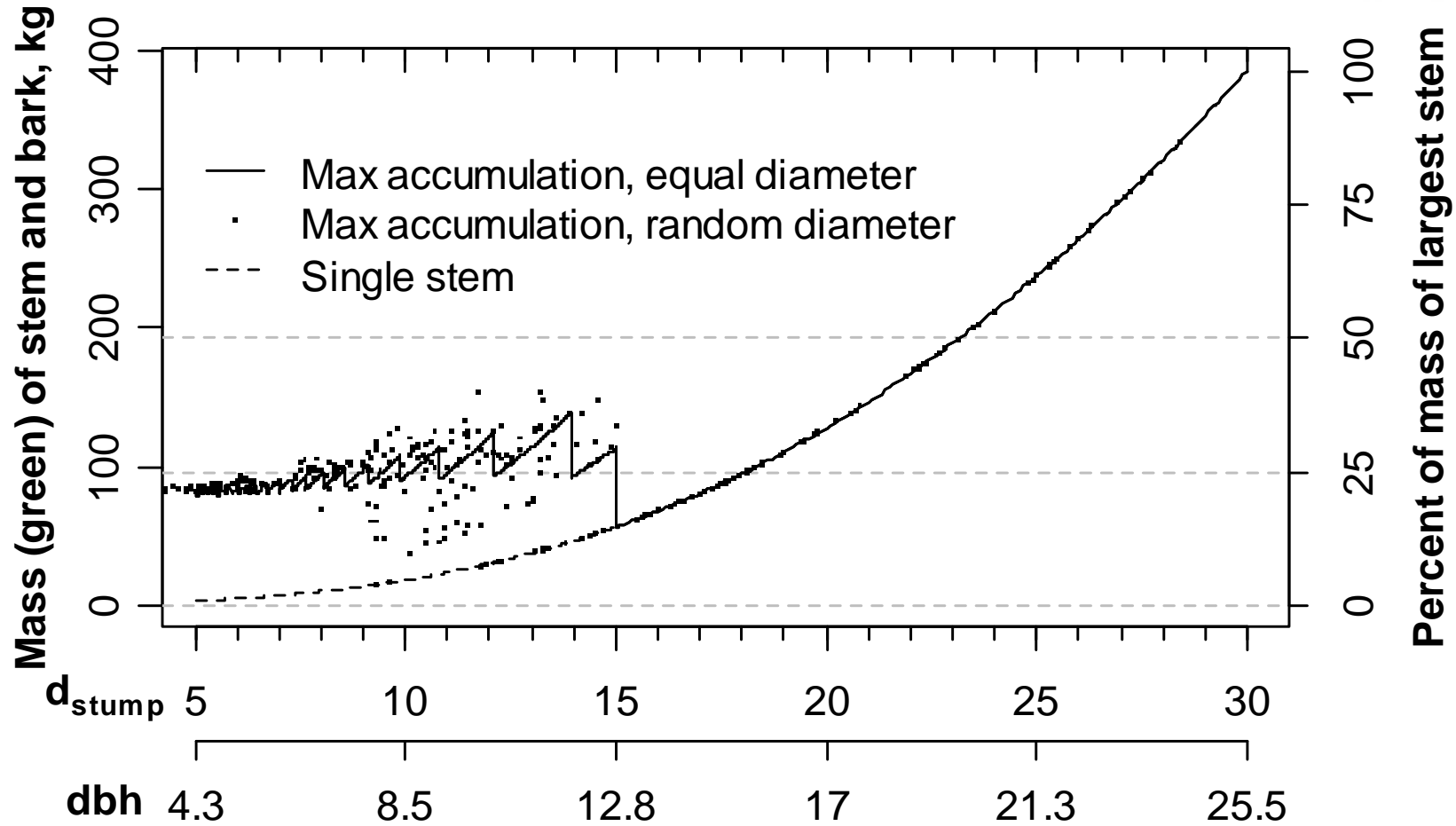
# Restriction of accumulation capacity



# Capacity utilization in accumulation



skog+  
landskap





skog+  
landskap

# Simulation approach

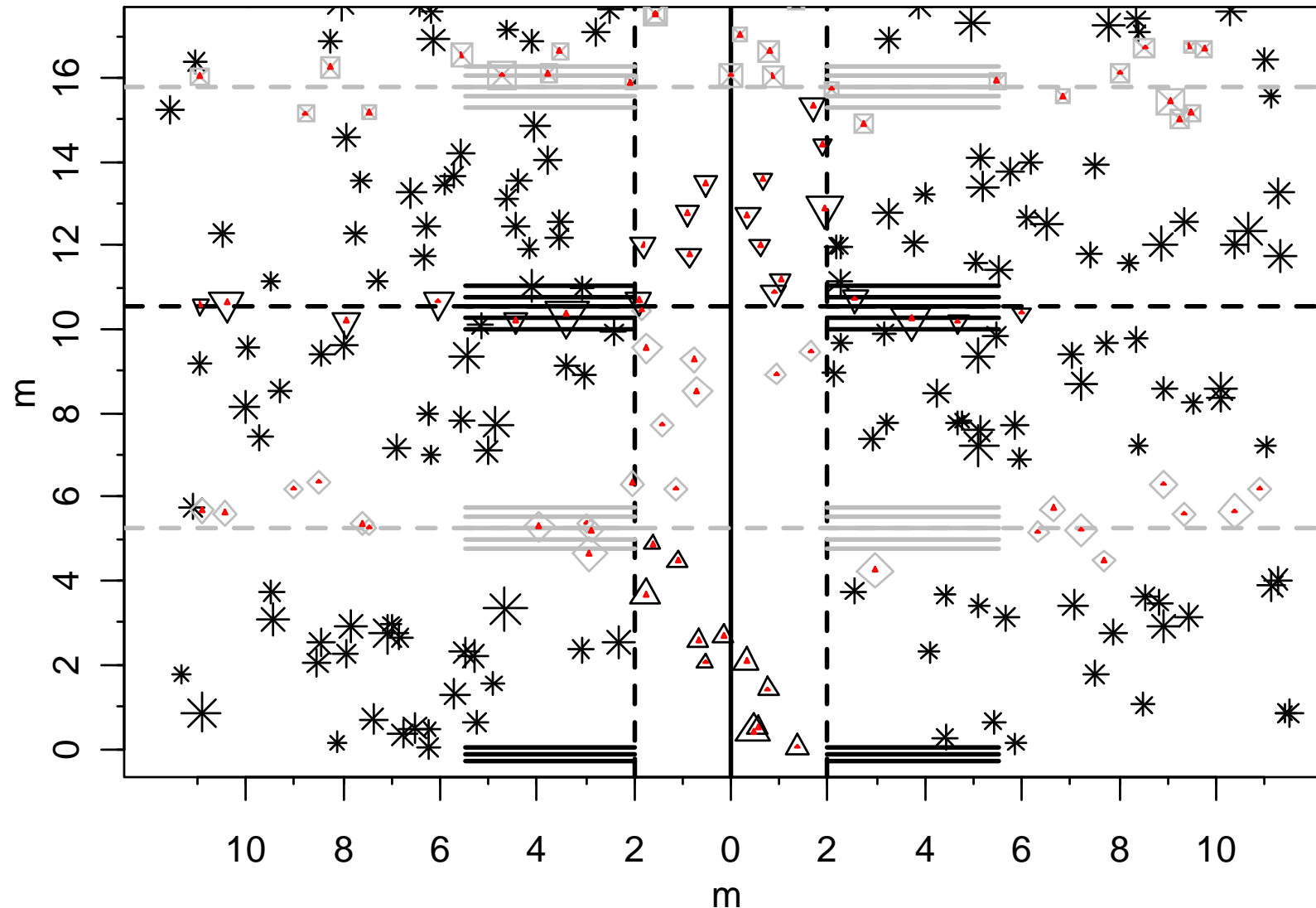
- > Eliasson 1999:
  - > Model for selective thinning with regular harvester head
  - > Modelled by crane speed, delimiting speed, cutting pace, machine movement speed, tree size, tree positions etc
- > Now: adapted for multi-tree handling

# Stand properties and work method



skog+  
landskap

BA = 35m<sup>2</sup> ha<sup>-1</sup> ;  $\overline{\text{dbh}}$  = 7.9 cm ;  $\rho$  = 5775 trees ha<sup>-1</sup>







skog+  
landskap

# Varying factors



skog+  
landskap

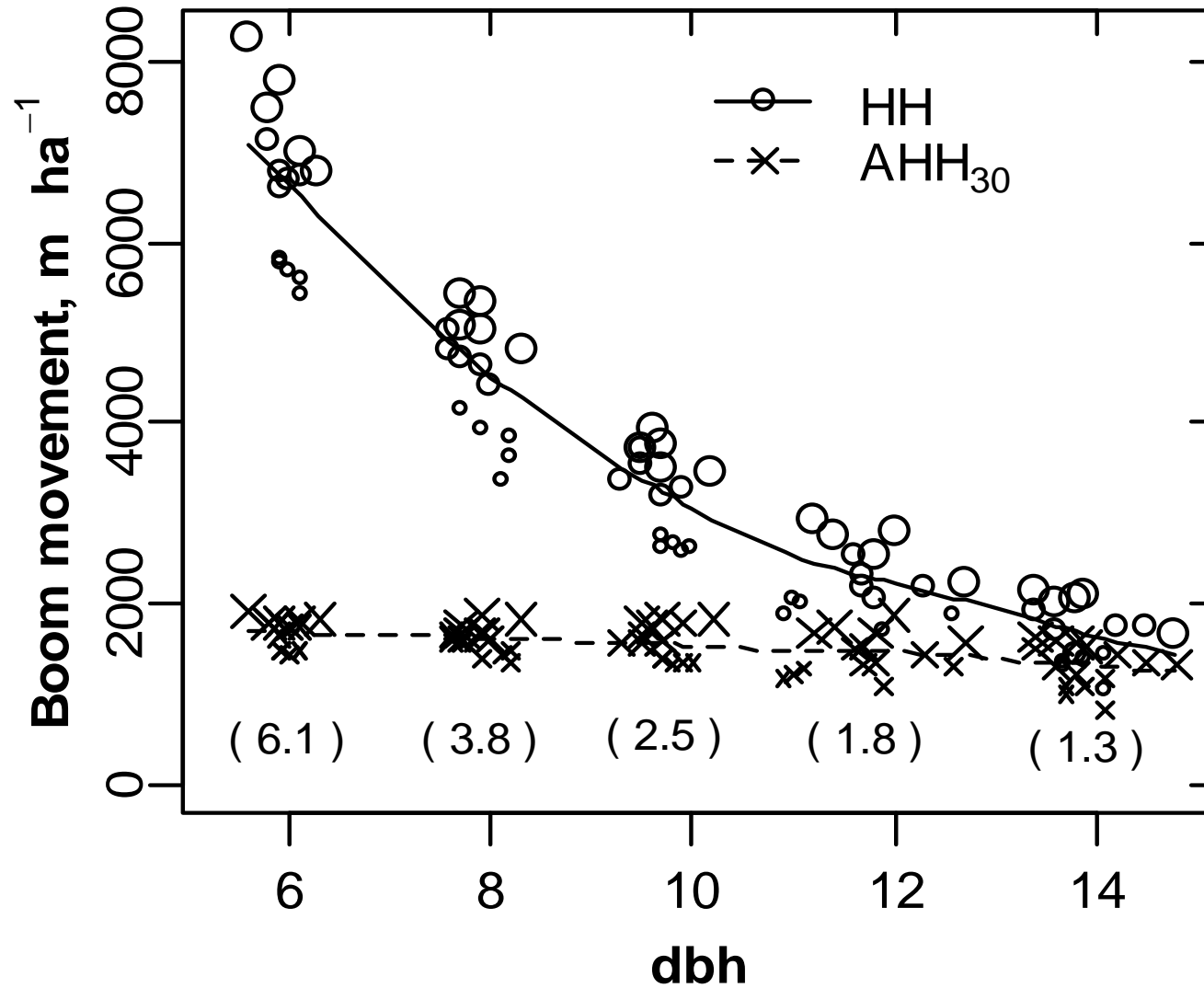
Factor	Levels
Mean tree size, dbh (cm)	6, 8, ..., 14
Average density, m <sup>2</sup> ha <sup>-1</sup>	25, 30, 35
Head max Ø, cm	1,10,20,...,50



# Results: Boom movement distance



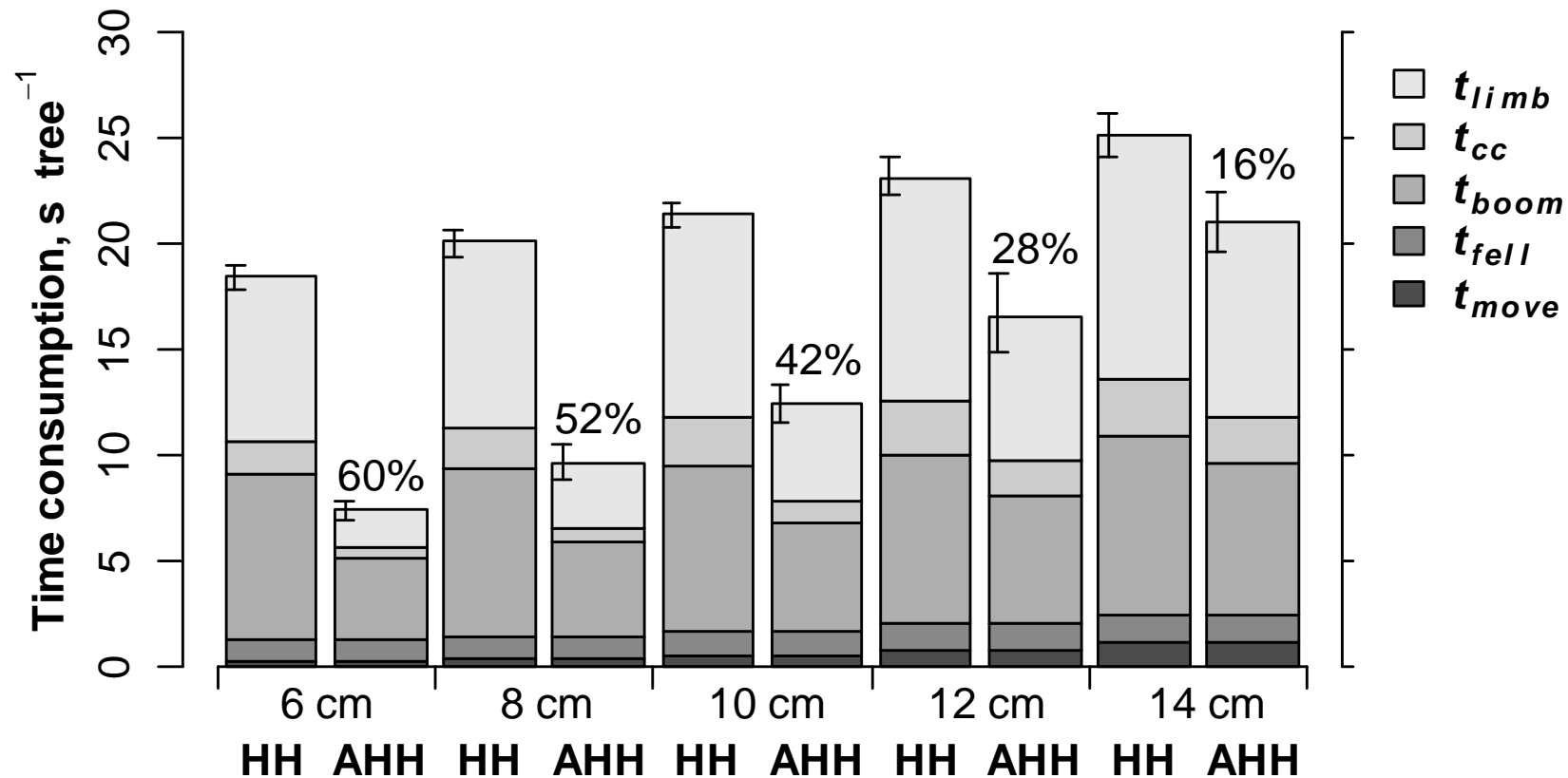
skog+  
landskap



# Results: Time consumption per tree



skog+  
landskap



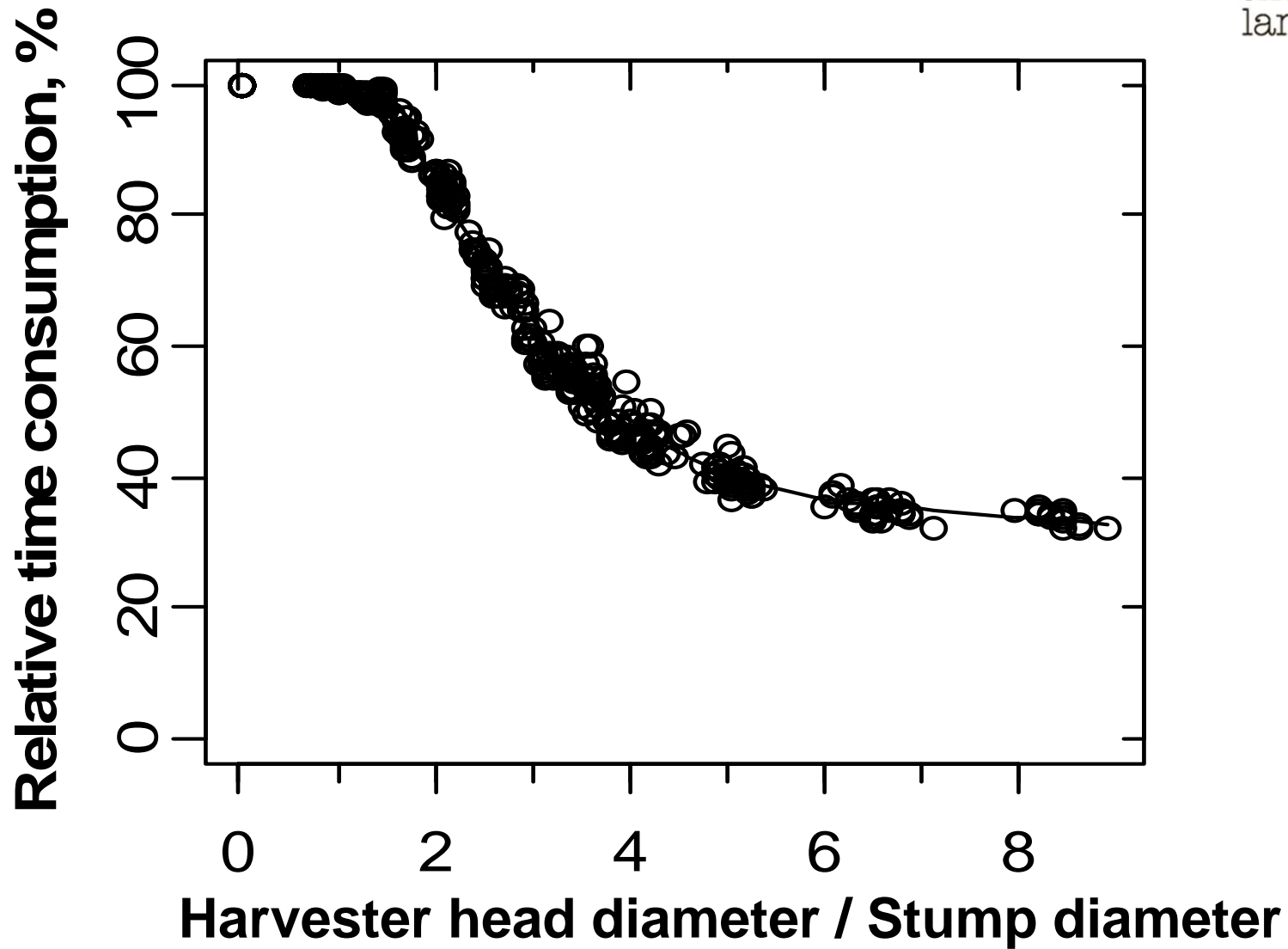
HH = Single tree Harvester Head

AHH = Acc. Harvester Head  $\varnothing = 30$  cm

# Time saving by accumulation



skog+  
landskap





skog+  
landskap

## Main findings

- a) Head size – important for efficiency
- b) Head  $\emptyset$  4-5 times average stump  $\emptyset$

## Further research

- I. Verify model and parameters (empirical tests)
- II. Extend the model to cope for selective and intermediate approaches
- III. Break-even analysis of increasing harvester head and base machine size in first thinning



Photo: Oskar Puschmann,  
Forest + Landscape

Thank you  
Helmer Belbo



skog+  
landskap