



International Conference  
MANAGING FORESTS FOR ECOSYSTEM SERVICES:  
CAN SPRUCE FORESTS SHOW THE WAY?

8-11 October 2012 – Edinburgh, Scotland

# Estimation of stem volume with volume functions in Norway spruce and Scots pine thinning experiments

Ulf Johansson, SLU, Sweden

Urban Nilsson, SLU, Sweden

Cristofer Wallentin, Holmen Forest, Sweden

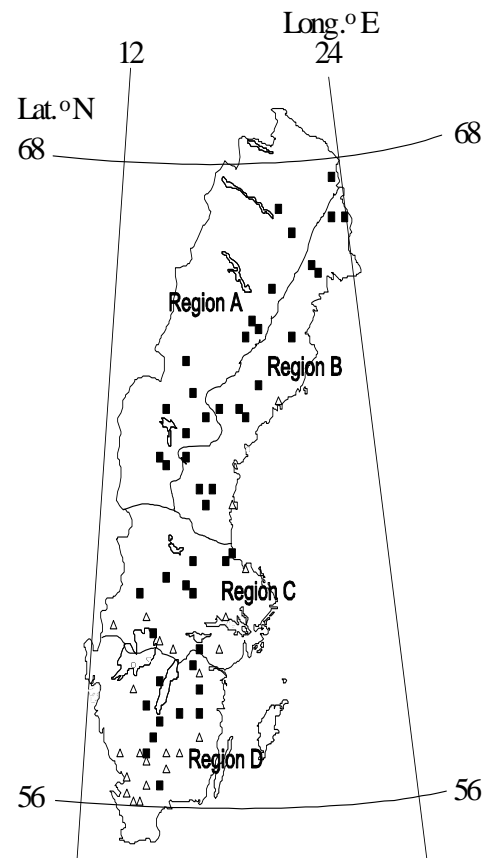
9 October 2012, Edinburgh

# Introduction

- Estimation of the effects of thinning on volume growth
- Single tree stem volume  $V = f(\text{DBH}, H, \text{HLC})$
- Hypotheses:
  1. Overestimation of volume growth after thinning, because of higher diameter growth at breast height
  2. Overestimation of larger tree volumes because of larger taper in the lower part of the trunk

# Materials

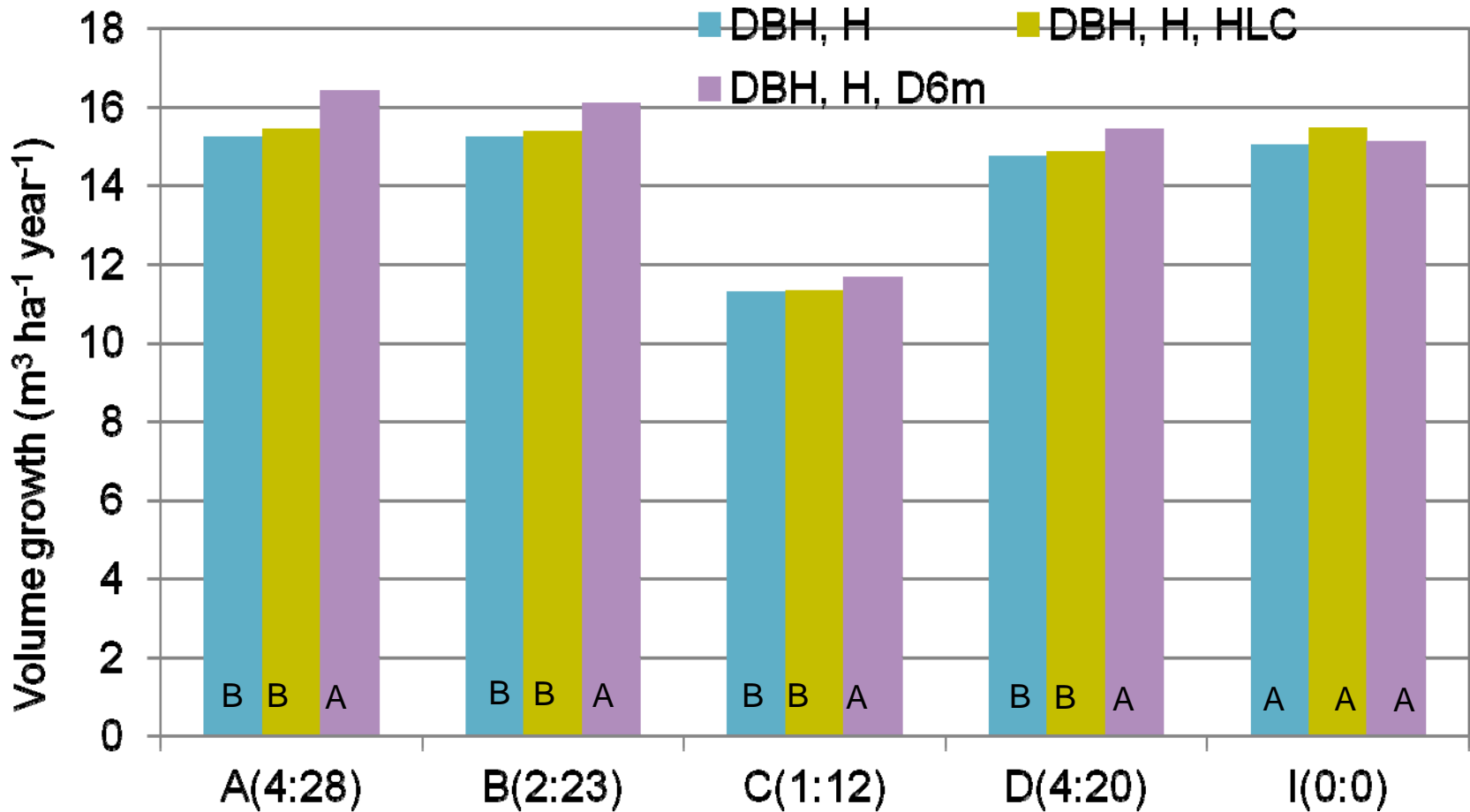
- Thinning experiments
  - Norway spruce, 9 experiments
  - Scots pine, 24 experiments
- Established 1966-1982
- Treatments:
  - A – 3-4 thinning from below
  - B – 2 heavy thinning from below
  - C – 1 extra heavy thinning from below
  - D – 4 extra heavy thinning from below
  - G – 3-4 thinning from below + N-fert.
  - I – unthinned control



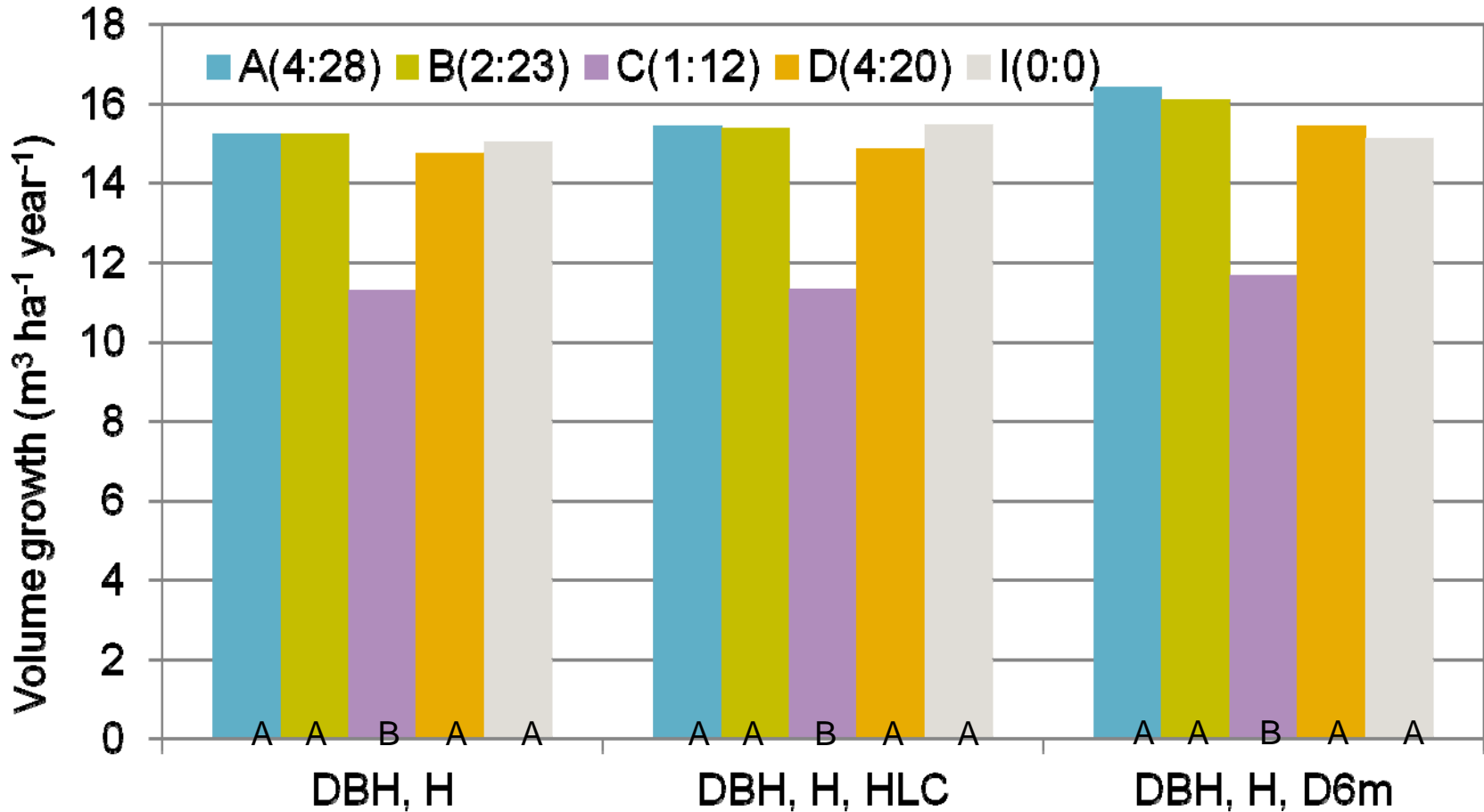
# Methods

- Volume growth based on single tree volume estimations
- Stem volume estimations:
  - Standard  $V = f(\text{DBH}, H, \text{HLC})$
  - Alt 1.  $V = f(\text{DBH}, H)$
  - Alt 2.  $V = f(\text{DBH}, H, \text{D6m})$
- "True" stem volume estimated by stem analysis on felled sample trees

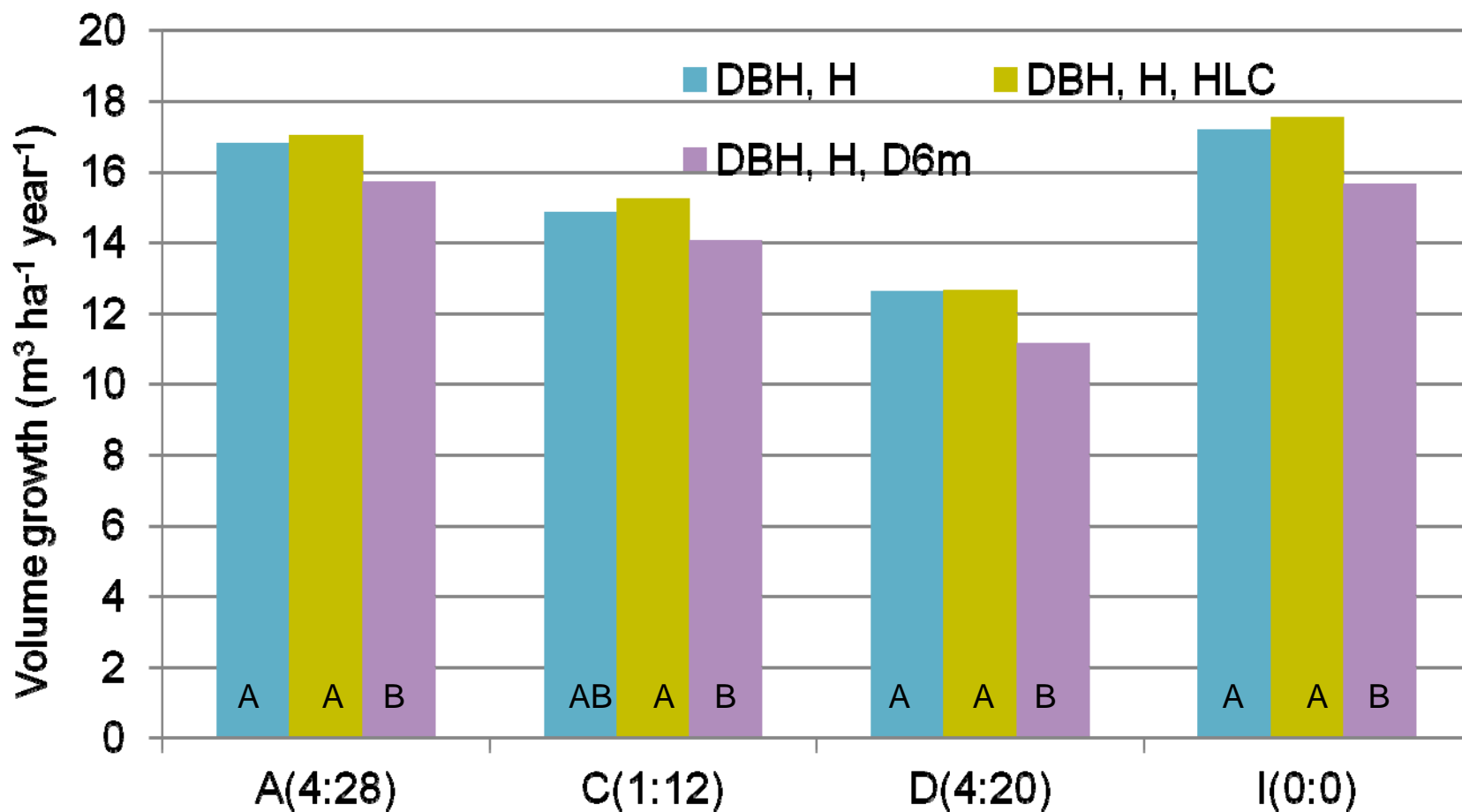
# Volume growth between first and second thinning Norway spruce



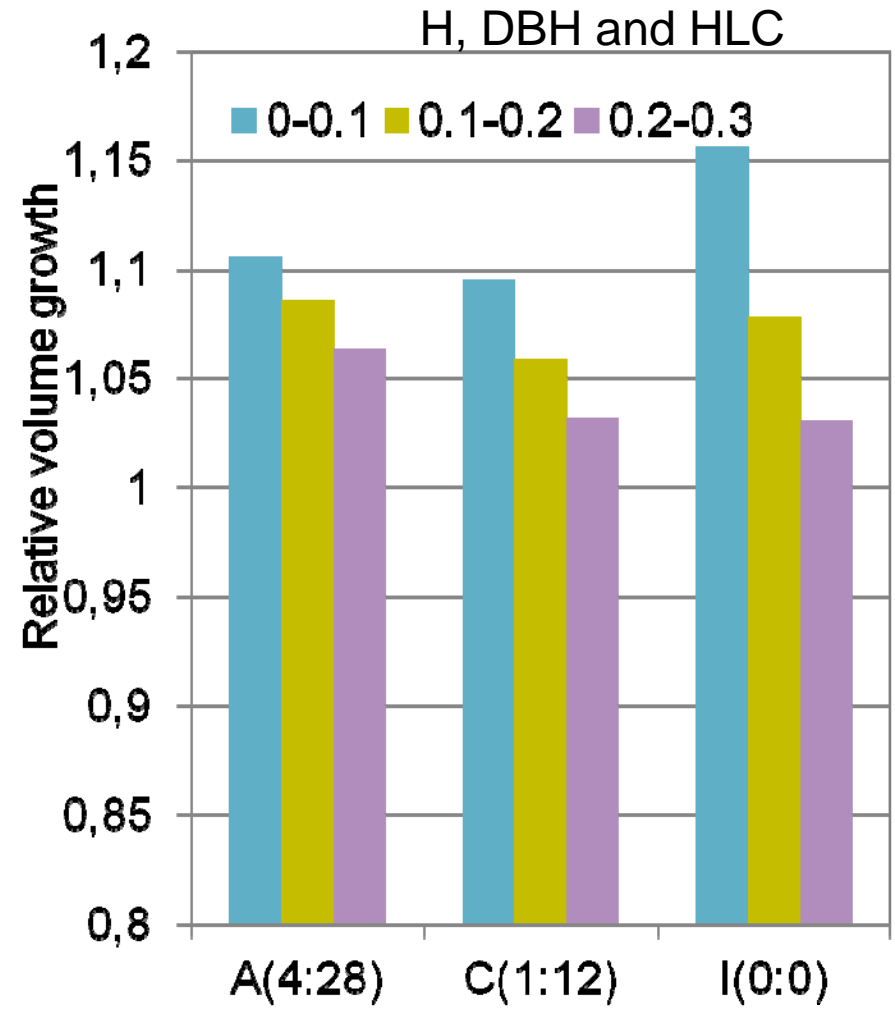
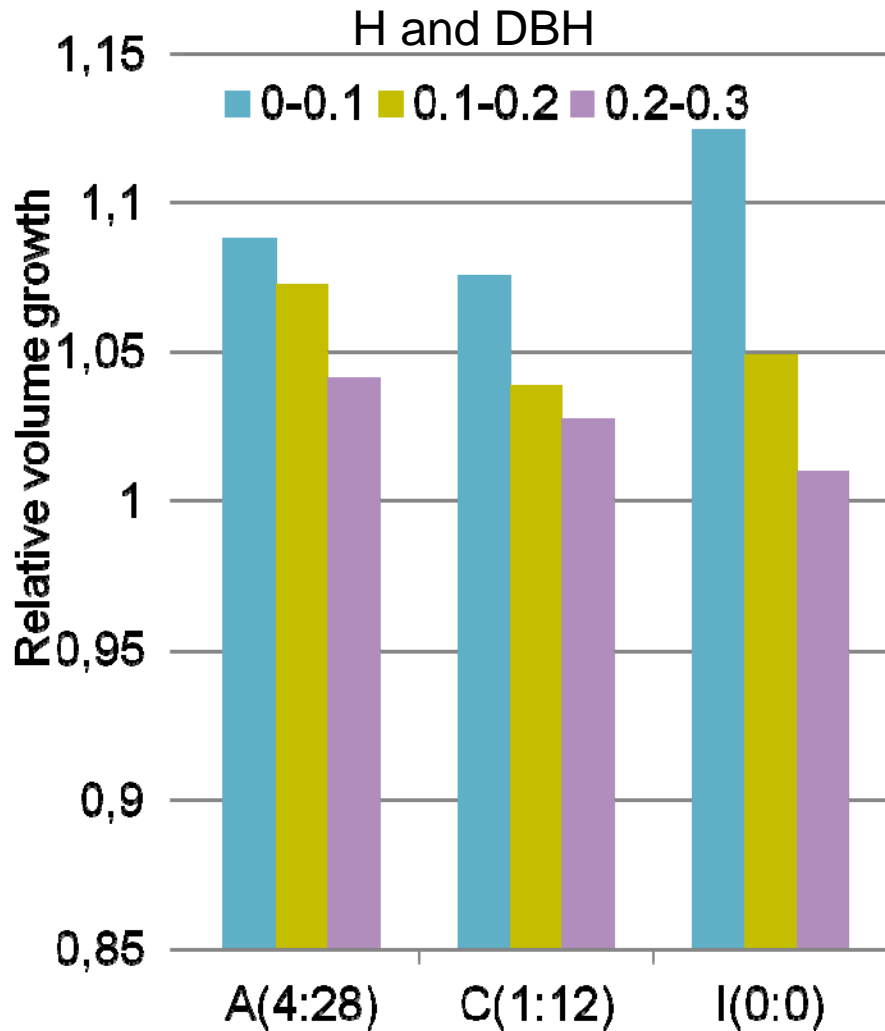
# Volume growth between first and second thinning Norway spruce



# Volume growth between third and fourth thinning Norway spruce

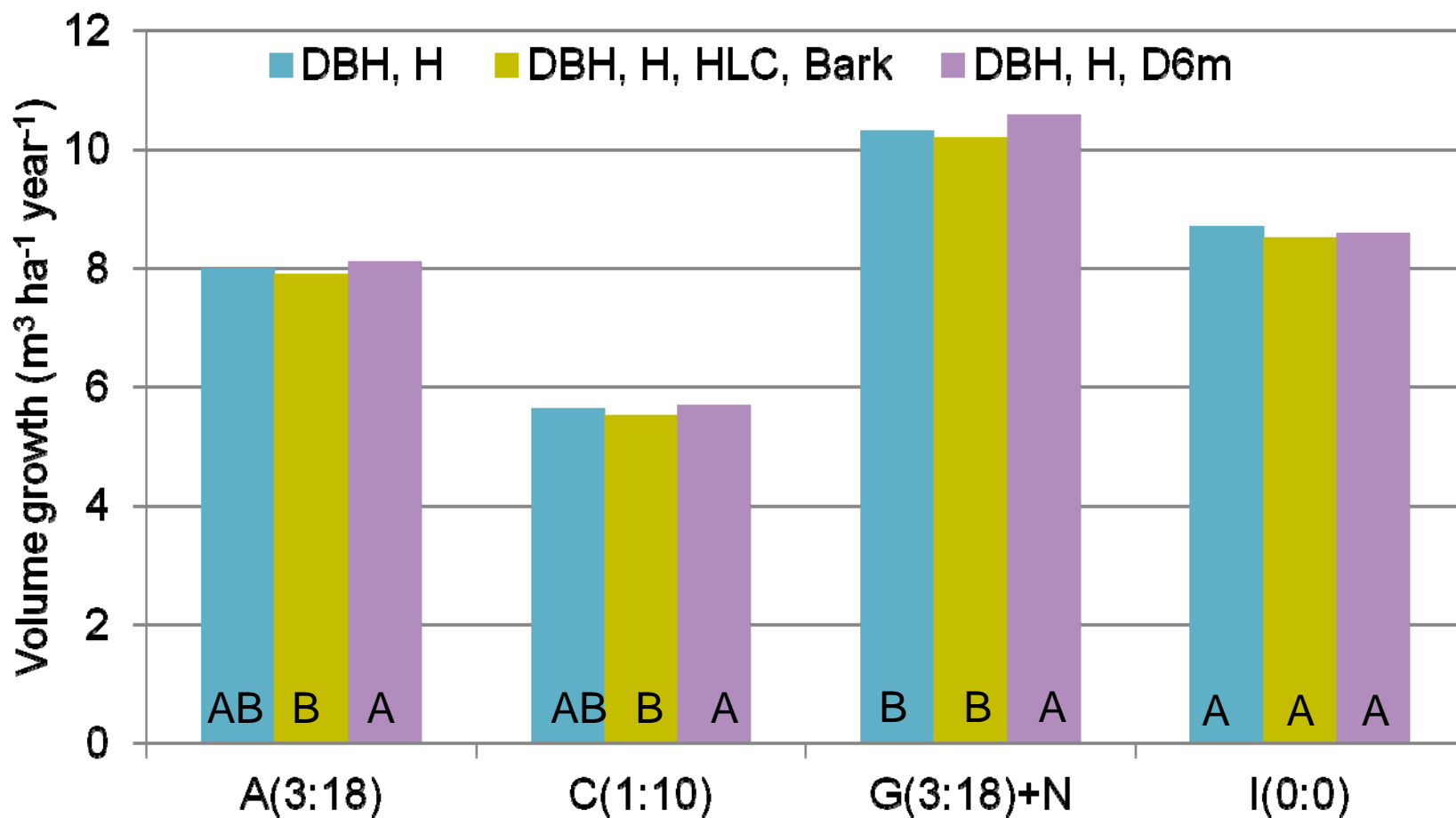


# Volume growth between third and fourth thinning relative to volume growth calculated with diameter at 6 m height (D6m) Norway spruce

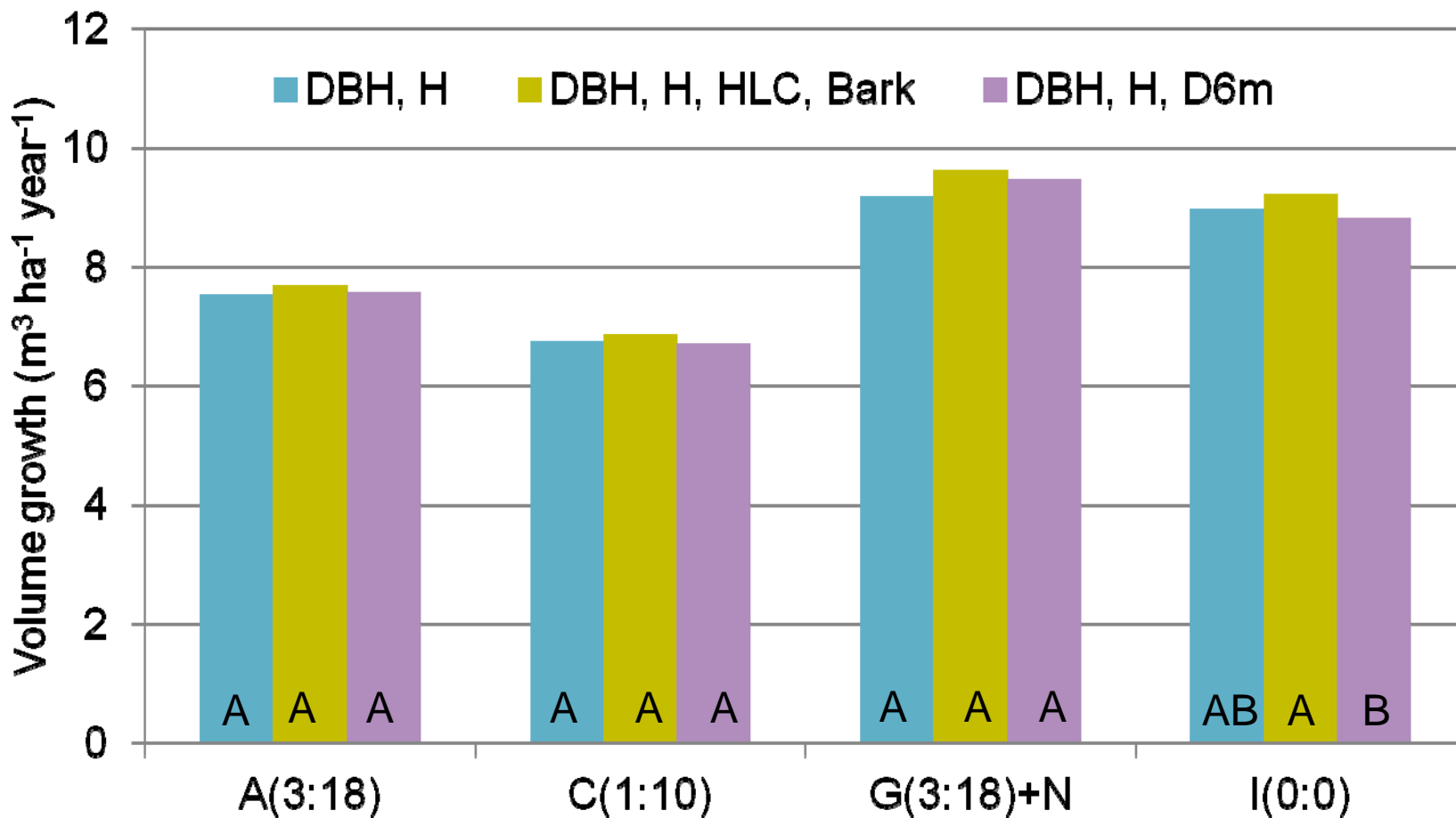




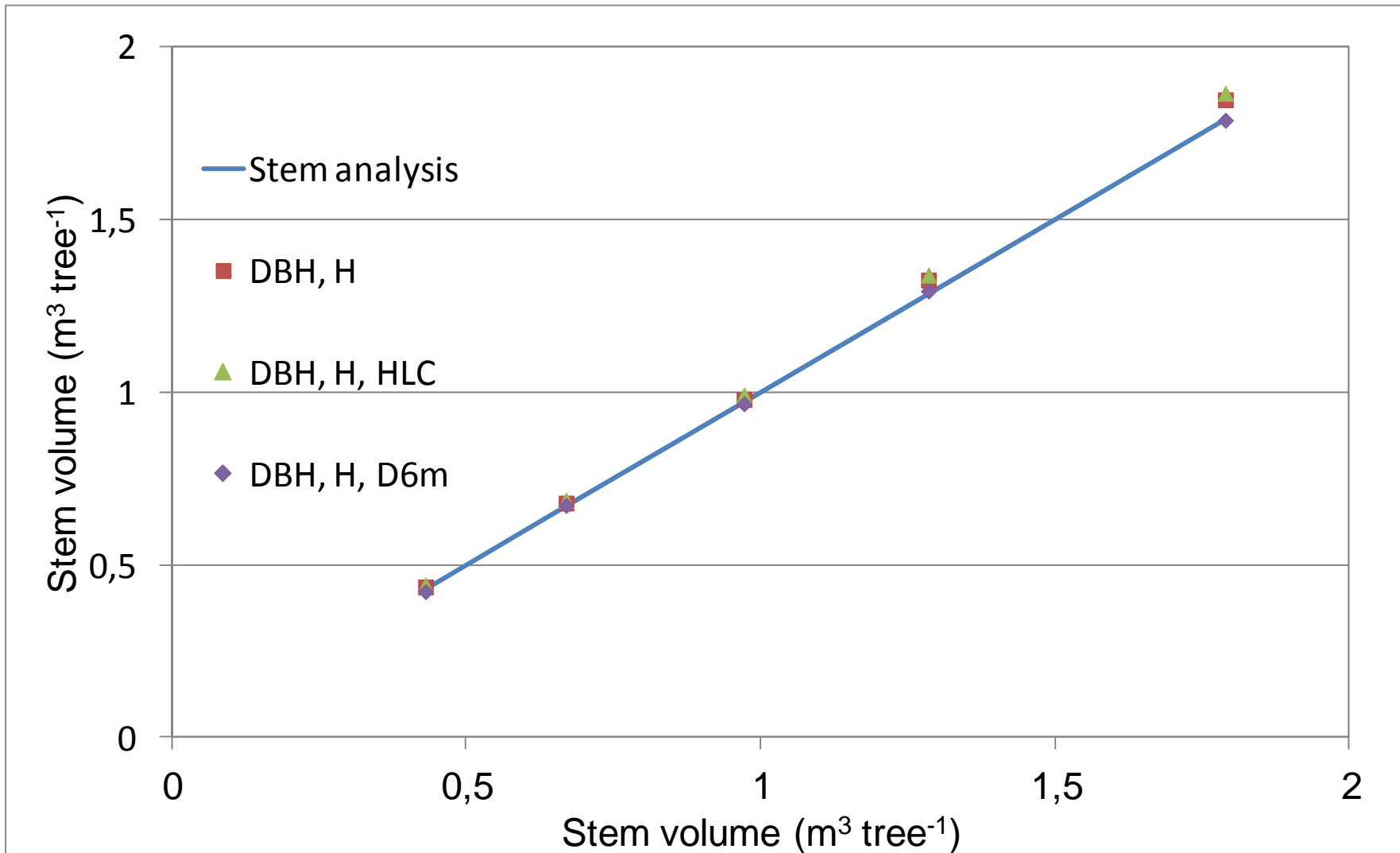
# Volume growth between first and second thinning Scots pine



# Volume growth between second and third thinning Scots pine

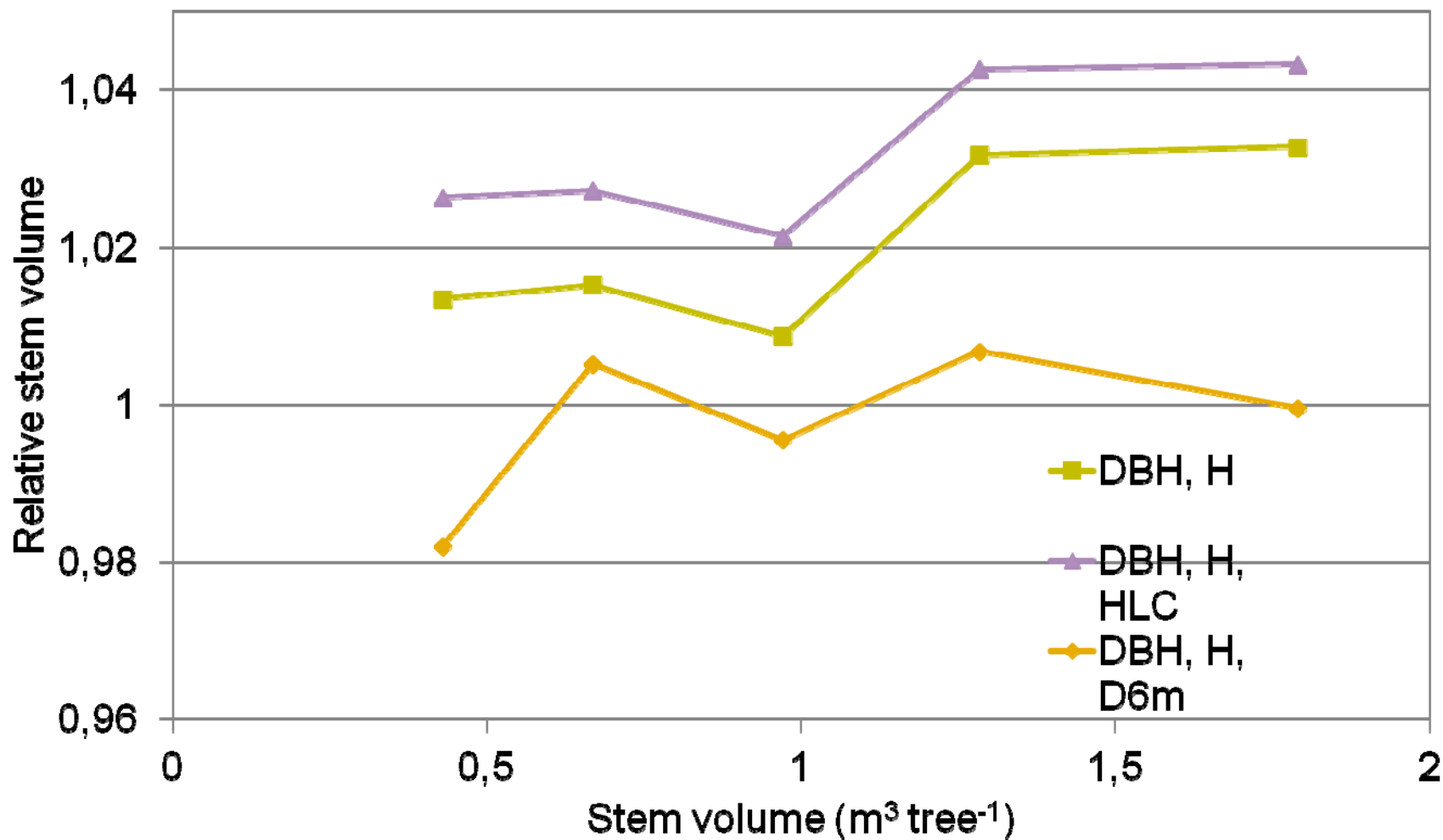


# Comparison of different volume functions



# Comparison of different volume functions

## Stem volume relative to stem analysis



# Conclusions:

- Volume growth after first thinning was underestimated
- Stem volume of large trees was overestimated for Norway spruce but not for Scots pine
- Stem form changes after thinning were important for accurate volume growth estimations
- We need to develop methods/instruments for measurements of stem diameter above breast height