Advancing height growth models for improved material of Scots pine, Norway spruce and Silver birch

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Background

- Forest growth and yield tables/functions as a common practice to predict growth.
- No incorporation of genetic gain in conventional models → might not take into account outcomes from tree breeding programs (10 – 25 % gain in growth traits)?
- Potential underestimations?

Objective → modifications of currently used growth functions for improved forest reproductive material (FRM) categories

Material and Methods

Based on NFI data, generalized algebraic difference approach (GADA) used for King-Prodan equation (Donis et al. 2018):

$$H_2 = 1.3 + \frac{A_2^{b_1}}{b_2 + 100\, b_3 \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} + \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} A_2^{b_1}}$$

Species	b_1	b_2	b_3
Scots pine	1.15697	-27.04027	16.4512
Norway spruce	1.28394	-47.34926	23.60081
Silver birch	1.257	-47.475	21.726

Donis et al. 2018

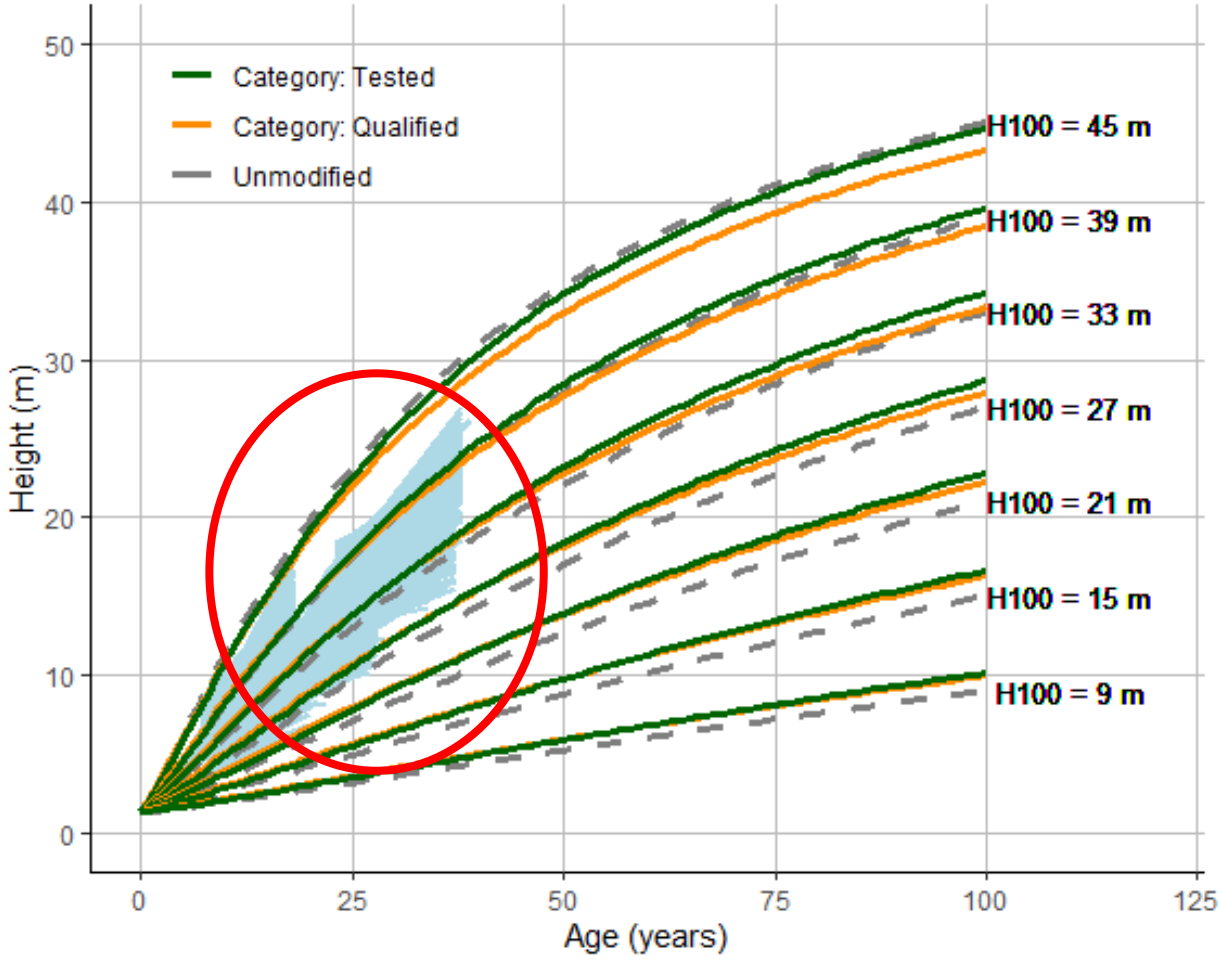
Material and Methods (2)

- Data from open pollinated progeny trials in Latvia
  - -10 % of best performing families «*Tested*»;
  - remaining 90 % – «*Qualified*»
- FRM-cateogry-specific modifiers of GADA model coefficients estimated

$$H_2 = 1.3 + \frac{A_2^{b_1}}{b_2 + 100\, b_3 \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} + \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} A_2^{b_1}}$$

$$H_2 = 1.3 + \frac{A_2^{g_1 \cdot b_1}}{g_2 \cdot b_2 + g_3 \cdot 100\, b_3 \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} + \frac{\frac{A_1^{b_1}}{H_1 - 1.3} - b_2}{100 b_3 + A_1^{b_1}} A_2^{g_1 \cdot b_1}}$$

Results: Scots pine



MRES	MRES%	AMRES	RMSE	RMSE%	MSE	MEF	VR	R2 _efron	N
0.007	0.044	0.950	1.280	8.224	1.650	0.089	0.923	0.918	4308

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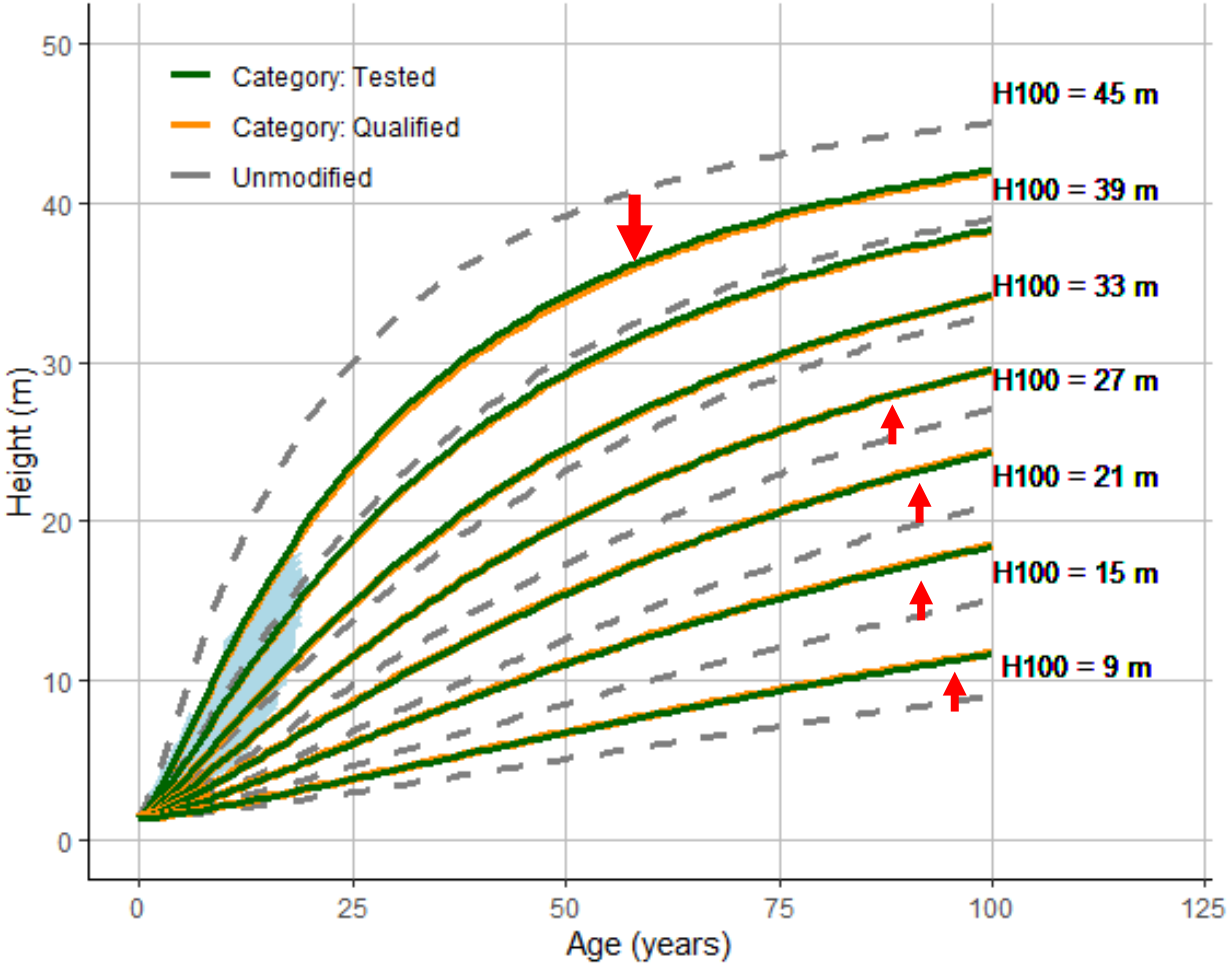
Results: Norway spruce



MRES	MRES%	AMRES	RMSE	RMSE%	MSE	MEF	VR	R2 _efron	N
0.077	1.527	0.441	0.717	14.298	0.514	0.052	1.040	0.945	19219

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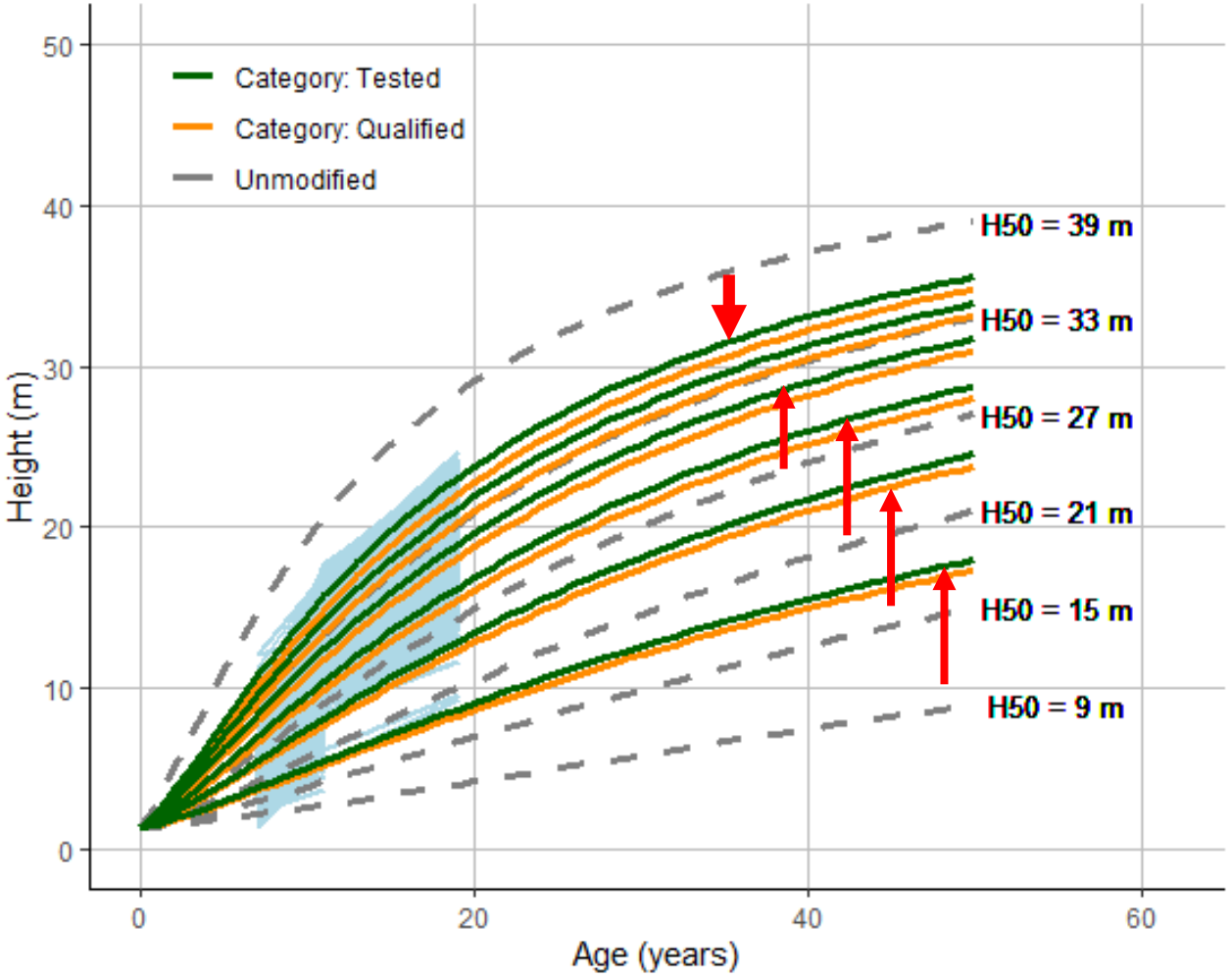
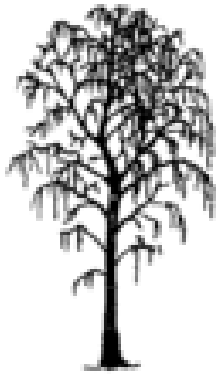
Results: Silver birch



MRES	MRES%	AMRES	RMSE	RMSE%	MSE	MEF	VR	R2 _efron	N
0.050	0.356	1.283	1.600	11.496	2.570	0.205	1.027	0.789	23702



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SOME CONCLUSIONS

- Category-specific modifiers improved accuracy of predictions
- Both improved categories had steeper growth trajectories at young age comparing to unmodified function
- The curve of category “tested” mainly slightly above the one for “qualified” material
- Modifications for separate FRM categories

  - easily applicable for practical use

  -more precisely reflect the actual growth of improved stands,

  - limited to rather high Site indices, where improved FRM is typically used

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Thank you!

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