Supplementary Material

Tree heights and crown base heights were estimated by species using nonlinear mixed-effects models. The model formulation by Curtis (1967), adopted from Mehtätalo et al. (2015) was used. In that model, tree height and crown base height estimation is based on the following formula:

$$y_{ij} = 1.3 + (a + \alpha_j)\left(\frac{d_{ij}}{1 + d_{ij}}\right)^{(b+\beta_j)} + \varepsilon_{ij}$$

where y_{ij} (tree height h or crown base height ch in m) of the tree i from site j has been modeled as a function of tree diameter (d_{ij} in cm). a and b are population mean parameters, while α_j and β_j are random parameters for site j and ε_{ij} is the random error of the tree i from site j. Model estimation was conducted with *lmfor* R package (Mehtätalo, 2019) using power type variance functions in order to account for the heteroskedastic residuals. The fitted models are presented in Supplementary Tables 1–2 and the resulting tree and crown base heights in Supplementary Figure 1.

Supplementary Table 1. Fixed effects parameters, random effects parameters, variance-covariance matrix for fixed effects and root mean square errors (RSME) of residuals after fixed and random part of the model for the tree heights by species.

	Scots pine		**Norway spruce**		**Birch**	
Fixed effects						
	a	*b*	*a*	*b*	*a*	*b*
	28.036	10.458	30.695	13.311	23.805	7.475
Random effects for each site						
	α	*β*	*α*	*β*	*α*	*β*
S1	1.221	5.482	-6.393	-0.852	-5.854	-0.51
S2	0.226	1.016	-1.669	0.529	-3.158	-0.137
S3	-0.182	-0.817	0.624	0.138	0.628	0.009
S4	-0.87	-3.908	6.66	1.365	5.698	1.045
S5	-0.395	-1.773	1.511	0.328	2.919	0.801
S6	-	-	-0.732	-1.509	-0.233	-1.208
Variance-covariance matrix for fixed effects						
	a	*b*	*a*	*b*	*a*	*b*
a	0.81		2.691		2.568	
b	1.101	2.796	0.509	0.2	0.43	0.162
RMSE of residuals						
	Fixed	Random	Fixed	Random	Fixed	Random
	2.277	1.646	2.115	1.522	2.702	1.479

Supplementary Table 2. Fixed effects parameters, random effects parameters, variance-covariance matrix for fixed effects and root mean square errors (RSME) of residuals after fixed and random part of the model for the crown base heights by species. Random effect parameter β was not fitted to the Scots pine data because of the low amount of data.

	Scots pine		**Norway spruce**		**Birch**	
Fixed effects						
	a	*b*	*a*	*b*	*a*	*b*
	10.816	2.474	6.843	14.149	10.071	7.087
Random effects for each site						
	α	β	α	β	α	β
S1	-6.194	-	-3.098	-1.211	-2.266	0.254
S2	-0.962	-	-1.387	4.031	-1.961	0.219
S3	1.438	-	0.253	4.904	0.753	-0.084
S4	2.97	-	3.644	0.977	1.159	-0.13
S5	2.747	-	1.009	-1.703	2.431	-0.272
S6	-	-	-0.42	-6.998	-0.116	0.013
Variance-covariance matrix for fixed effects						
	a	*b*	*a*	*b*	*a*	*b*
a	2.909		0.912		0.564	
b	0.93	2.027	0.553	4.022	0.029	0.112
RMSE of residuals						
	Fixed	Random	Fixed	Random	Fixed	Random
	3.046	1.998	1.87	1.529	3.046	1.998

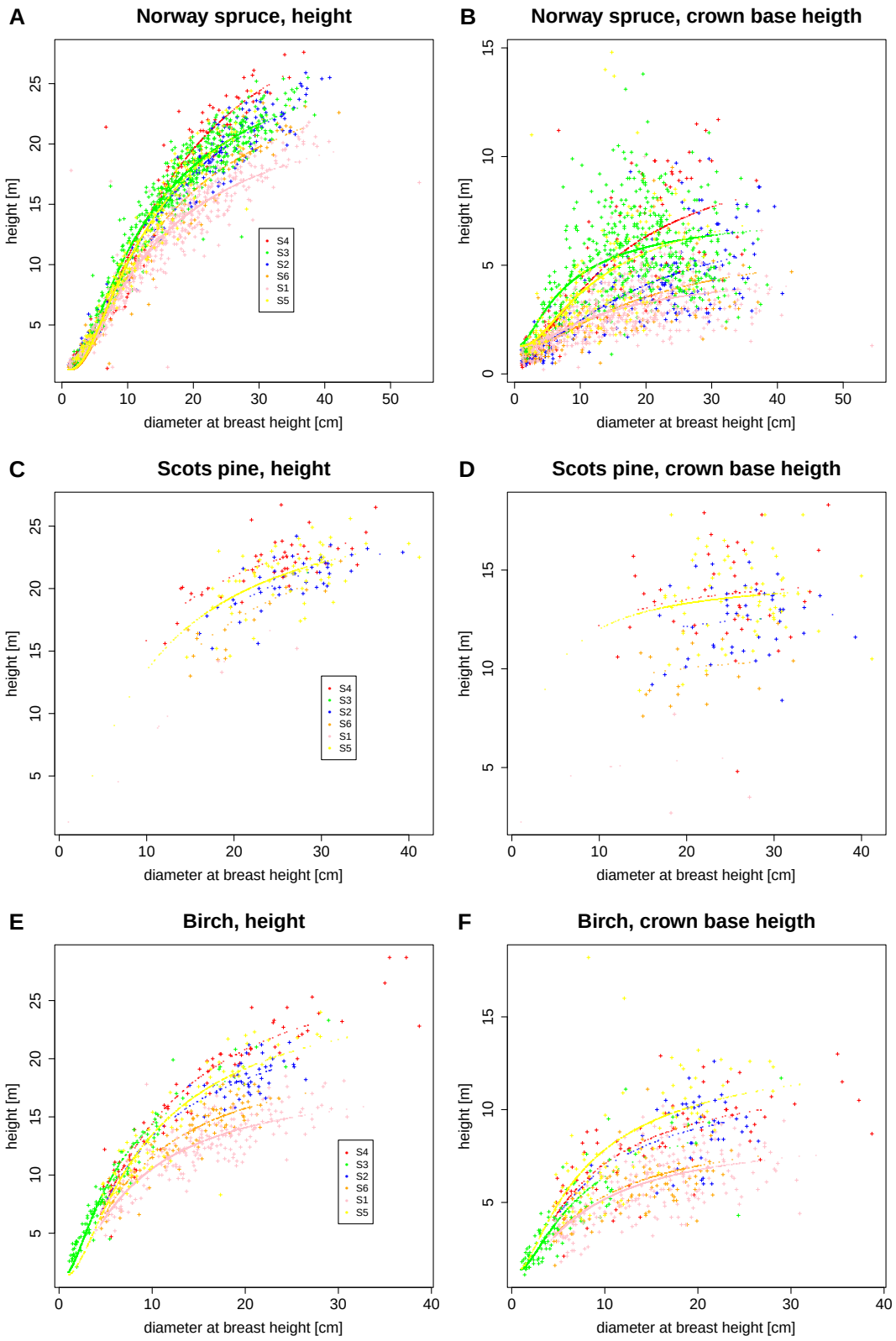
LAI for the trees were then derived based on tree diameter, crown base height and tree height using foliage biomass functions (Tupek et al., 2015; Lehtonen et al., 2020) and specific leaf area values (Härkönen et al., 2015):

$$LAI_{pine} = 6.8 \times \exp\left(-2.103 + 15.291\left(\frac{d_{ski}}{d_{ski}+4}\right) - 12.331\left(\frac{h}{h+1}\right) + 1.048\ln(h-ch) + \frac{0.1855106}{2}\right)$$

$$LAI_{spruce} = 4.7 \times \exp\left(-1.848 + 8.92\left(\frac{d}{d+12}\right) - 1.451\ln(h) + 1.23\ln(h-ch) + \frac{0.1459380}{2}\right)$$

$$LAI_{birch} = 14 \times \exp\left(-7.832 + 10.043\left(\frac{d_{ski}}{d_{ski}+8.37}\right) + 2.875\left(\frac{h-ch}{h}\right) + \frac{0.0000175}{2}\right)$$

where LAI_s is the one-sided leaf area index (m^2) of a tree of species s with height h (m), crown length $h - ch$ (m), and diameter d (cm) or stump diameter $d_{ski} = 2 + 1.25d$. Foliage biomass functions of pine and spruce are based on equations presented by Repola et al. (2009) and Marklund (1988), respectively, but refitted by Lehtonen et al. (2020). Finally, deciduous and coniferous LAI for each plot was obtained by dividing the total LAI of deciduous trees or conifers in the plot by the area of that plot (Supplementary Table 3).



Supplementary Figure 1. Tree height and crown base height measurements (plus signs) and predictions (dots) based on nonlinear mixed-effects models for Norway spruce **(A–B)**, Scots pine **(C–D)** and Birch **(E–F)**.

Supplementary Table 3. Plot characteristics. Stand characteristics in parenthesis indicates values before harvest and control plots are indicates by *.

Site	Plot	Area (m^2)	Basal area (m^2 ha^{-1})	LAI (m^2 m^{-2})	LAI deciduous (m^2 m^{-2})	Dominant tree height (m)	Ditch spacing (m)	Ditch depth (m)
S1	1*	1599	21.3	5	1	13	60	0.8
	2	1517	8.8 (23.3)	2.3 (5.4)	0 (1.1)	15	60	0.6
	3	1624	12.5 (26.2)	3.2 (6.1)	0.1 (1.3)	15	60	0.7
	4	1603	16.4 (23.3)	3.6 (5)	1.3 (2)	15	60	0.6
	5*	1516	30	7.4	1	18	40	0.3
	6	1662	8.3 (26.4)	2.1 (6.7)	0.1 (0.7)	19	45	0.4
	7	1501	12.9 (32)	3.2 (7.6)	0.4 (1.6)	19	45	0.4
	8	1736	14.5 (27.3)	3.7 (6.6)	0.3 (1.1)	18	45	0.8
	9*	1473	27.6	6.8	0.9	16	40	0.6
	10	1469	9 (24.7)	2.4 (5.8)	0 (1.2)	15	40	0.5
	11	1638	12.6 (27.7)	3.3 (6.7)	0.1 (1.2)	17	40	0.6
	12	1632	16.3 (26.9)	4.1 (6.8)	0.4 (0.6)	17	45	0.5
	13*	1530	20.9	5.1	0.9	16	45	0.6
	14	1608	9.4 (22.2)	2.4 (5.3)	0.1 (0.9)	17	50	0.6
	15	1608	13.2 (24.9)	3.3 (5.9)	0.3 (1.1)	17	50	0.6
	16	1593	16.5 (23.7)	3.9 (5.5)	0.9 (1.5)	17	50	0.5
S2	1	1328	17 (23.9)	4 (5.6)	1 (1.2)	20	35	0.4
	2*	1317	22	5.3	1	19	35	0.4
	3	971	16.1 (19.3)	3.5 (4.2)	1.5 (2)	15	30	0.4
	4	2008	12.4 (24.5)	2.6 (5.4)	0.2 (0.6)	20	60	0.4
	5*	985	20.2	4.8	0.8	20	30	0.4
	6	1082	11.3 (29.3)	2.8 (7)	0.2 (1.1)	20	25	0.4
S3	1*	1525	25.5	5.5	0.7	21	30	0.3
	2	1674	13.6 (29.5)	2.9 (5.8)	0.3 (0.6)	22	40	0.3
	3	1785	13.5 (31.4)	3.1 (6.9)	0.3 (0.7)	23	35	0.3
	4*	1332	28.1	6.2	0.7	22	40	0.3
S4	1*	1311	22.9	4.3	0.7	24	40	0.4
	2	1580	12.2 (22.1)	2.3 (4.3)	0.3 (0.5)	23	65	0.4
	3	1252	11.6 (21.7)	2.3 (4.1)	0.5 (1.3)	25	75	0.4
	4	1608	17.2 (24.3)	2.9 (3.9)	0.3 (0.4)	23	70	0.4
	5	1502	17.1 (21.3)	3.4 (4.1)	0.6 (1.2)	24	65	0.4
	6*	1603	22.1	4.3	0.3	24	65	0.4
S5	1	1488	7.3 (27.4)	1.5 (3.8)	0.1 (0.7)	22	50	1
	2*	1506	38.2	5.2	1.1	23	50	0.9
	3	1515	5.5 (21)	1.1 (3.1)	0 (1.4)	21	50	0.95
	4	1562	6.5 (22.2)	1.4 (3.3)	0 (0.5)	21	50	1.05
	5*	1558	29.4	3.8	0.3	22	50	1
	6	1500	0 (24.3)	0.5 (3.6)	0.5 (1.2)	0.5 (22)	50	1
	7	1500	0 (26)	0.5 (4)	0.5 (0.8)	0.5 (22)	50	0.9
	8*	1290	28.3	4	1.1	21	50	1
S6	1	1600	16.9 (24.9)	3.7 (5.4)	0.1 (0.3)	22	65	0.7
	2	1600	13.2 (25.7)	2.8 (5.5)	0.1 (0.1)	22	65	0.65
	3*	1600	26.8	5.7	0.1	22	65	0.7
	4	1600	16.3 (25.3)	3.6 (5.5)	0 (0)	21	65	0.65
	5	1600	11.6 (24.7)	2.5 (5.4)	0.1 (0.1)	21	65	0.65
	6*	1600	23.6	5.2	0	20	65	0.65
	7	1600	16.9 (24.1)	3.5 (5.1)	0 (0)	22	65	0.7
	8	1600	13.1 (22)	2.8 (4.8)	0.1 (0.1)	20	65	0.65
	9*	1600	22.8	5	0	22	65	0.7
	10*	1600	24.3	5.2	0.2	20	65	0.6
	11	1600	17.6 (21.9)	3.8 (4.7)	0.3 (0.3)	19	65	0.55
	12	1600	13 (24.9)	2.8 (5.6)	0.1 (0.1)	21	65	0.6
	13	1500	12.1 (31.3)	2.6 (7)	0.1 (0.1)	23	70	0.55
	14	1500	16.9 (26.7)	3.6 (5.8)	0 (0)	20	70	0.6
	15*	1500	29.7	6.4	0.1	21	70	0.55

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