Table S1. Main stand variables of the sample plots used to estimate Reineke's maximum stand density and maximum basal area.

Species	*n*		*N*	*Dg*	H_{dom}
Norway spruce	550	Mean	558	34.1	25.5
		SD	345	9.6	4.2
		Min	100	12.2	11.5
		Max	2350	66.1	41.2
European beech	158	Mean	574	29.0	22.5
		SD	327	9.7	5.7
		Min	100	13.7	12.5
		Max	1550	57.6	35.8

n: sample size; *N:* stem density (ha^{-1}); *Dg:* quadratic mean diameter (cm); H_{dom}: dominant height (m); SD: standard deviation.

Table S2. Main variables for the modelling of the annual past radial growth increment.

n: sample size; *APRI*: annual past radial growth increment ($mm \cdot year^{-1}$); *DBH*: diameter at breast height (cm); *BA*: stand basal area ($m^2 \cdot ha^{-1}$); *BAL*: basal area of the trees larger than the subject tree ($m^2 \cdot ha^{-1}$); BAL_{sp}: basal area of the trees of the same species and larger than the subject tree ($m^2 \cdot ha^{-1}$); *t*: sum of the daily mean temperature above 3°C per growing season (degree $days \cdot year^{-1}$); *p*: precipitation sum per growing season ($mm \cdot year^{-1}$); *mi*: mean daily moisture index per growing season (%); SD: standard deviation.

Species	*n*		*APRI*	*DBH*	*BA*	*BAL*	BAL_{sp}	*t*	*p*	*mi*
Norway spruce	22995	Mean	1.57	35.0	47.8	26.0	24.9	2118	860	0.979
		SD	1.30	15.4	22.5	20.1	19.9	544	207	0.029
		Minimum	-12.24	12.5	0.6	0.0	0.0	935	243	0.579
		Maximum	25.55	109.5	293.3	289.8	281.8	4112	1649	1.000
European beech	7105	Mean	1.33	30.6	40.7	24.1	16.8	2701	974	0.963
		SD	1.15	13.8	18.8	18.1	15.2	422	234	0.038
		Minimum	-8.28	12.5	0.7	0.0	0.0	1637	595	0.615
		Maximum	9.02	185.5	281.9	186.1	182.0	3838	1826	1.000

Table S3. Coefficients of the 3- and 2 parameter extended competition density rule estimated using nonlinear regression.

Species	*n*	Alternative	a_0	b_0	a_1	b_1	*RSE*
Norway spruce	550	3P	1.38E-06	3.345	0.729	-	4.626
		2P	-	3.144	0.719	-	4.628
European beech	158	3P	3.20E-05	0.468	-0.145	-	4.836
		2P	-	0.481	-0.145	-	4.831

n: sample size; RSE: residual standard error.

Table S4. Fixed effect parameter estimates for the Norway spruce and European beech annual past radial increment models.

		Norway spruce			European beech		
Parameter	**Coeff**	**Value**	**SE**	**p-value**	**Value**	**SE**	**p-value**
Intercept	β_{i0}	15.404	0.523	<0.0001	5.769	0.498	<0.0001
1/DBH	β_{i1}	-18.677	2.222	<0.0001	-12.319	1.073	<0.0001
ln(DBH)	β_{i2}	-0.790	0.089	<0.0001	-	-	-
ln(BAL/(ln(DBH+1))+1)	β_{i3}	-0.810	0.043	<0.0001	0.113	0.033	0.0008
ln(BA)	β_{i4}	-0.409	0.024	<0.0001	-0.536	0.039	<0.0001
t	β_{i5}	0.001	0.000	<0.0001	0.001	0.000	<0.0001
p	β_{i6}	0.000	0.000	<0.0001	-0.001	0.000	<0.0001
mi	β_{i7}	3.434	0.358	<0.0001	6.560	0.458	<0.0001
$\ln(BAL_{sp}+1)$	β_{i8}	0.376	0.028	<0.0001	-0.239	0.017	<0.0001

SE: standard error.

Table S5. Sample size and goodness of fit statistics for the annual past radial increment models.

Species	n_{tree}	n_{obs}	RMSE
Norway spruce	33649	16172	0.704
European beech	10382	4631	0.690

RMSE: root mean square error.

Table S6. Statistics of the resulting GI.

	Norway spruce	European beech
Mean	1.000	1.004
SD	0.030	0.052
Minimum	0.724	0.718
1st quantile	0.983	0.975
3rd quantile	1.014	1.025
Maximum	1.190	1.331

SD: standard deviation.

Table S7. Sample size and goodness of fit statistics for the growth models using 3P proportions.

Species	n_{obs}	n_{plots}	RMSE
Norway spruce	1346	797	0.1854
European beech	546	322	0.1707

RMSE: root mean square error.

Table S8. Fixed effect parameter estimates for the growth models using different alternatives **(a)** 2P, **(b)** Direct-SNFI, **(c)** Direct-Charru and **(d)** goodness of fit statistics.

(a)	**2P**		**Norway spruce**			**European beech**		
	Parameter	**Coeff**	**Value**	**SE**	**p-value**	**Value**	**SE**	**p-value**
	Intercept	a_i	-5.959	1.360	<0.0001	-6.931	0.776	<0.0001
	t	b_{i1}	4.30E-04	2.69E-05	<0.0001	5.68E-04	4.24E-05	<0.0001
	p	b_{i3}	-2.44E-04	6.72E-05	0.0003	-8.44E-04	7.51E-05	<0.0001
	mi	b_{i5}	7.450	1.286	<0.0001	5.343	0.515	<0.0001
	ln(GI_i)	c_i	10.448	0.340	<0.0001	6.988	0.695	<0.0001
	ln(Dg)	d_{i1}	-0.693	0.146	<0.0001	0.282	0.152	0.0641
	ln(sd)	d_{i2}	0.610	0.020	<0.0001	0.685	0.029	<0.0001
	P_i	e_i	3.416	1.471	0.0206	1.833	0.645	0.0049
	mi x P_i	f_{i1}	-4.774	1.398	0.0007	-	-	-
	ln(GI_i) x P_i	f_{i2}	-	-	-	2.030	0.917	0.028
	ln(Dg) x P_i	f_{i3}	0.415	0.157	0.0085	-0.647	0.183	0.0005
(b)	**Direct-SNFI**		**Norway spruce**			**European beech**		
	Parameter	**Coeff**	**Value**	**SE**	**p-value**	**Value**	**SE**	**p-value**
	Intercept	a_i	-4.478	1.437	0.0019	-7.960	0.762	<0.0001
	t	b_{i1}	4.32E-04	2.69E-05	<0.0001	5.49E-04	4.25E-05	<0.0001
	p	b_{i3}	-2.48E-04	6.73E-05	0.0003	-8.36E-04	7.54E-05	<0.0001
	mi	b_{i5}	7.635	1.362	<0.0001	5.262	0.516	<0.0001
	ln(GI_i)	c_i	10.445	0.340	<0.0001	7.208	0.652	<0.0001
	ln(Dg)	d_{i1}	-1.233	0.153	<0.0001	0.654	0.146	<0.0001
	ln(sd)	d_{i2}	0.613	0.020	<0.0001	0.682	0.029	<0.0001
	P_i	e_i	1.947	1.550	0.2096	3.004	0.626	<0.0001
	mi x P_i	f_{i1}	-4.958	1.477	0.0008	-	-	-
	ln(GI_i) x P_i	f_{i2}	-	-	-	1.758	0.876	0.0461
	ln(Dg) x P_i	f_{i3}	0.952	0.165	<0.0001	-1.027	0.177	<0.0001
(c)	**Direct-Charru**		**Norway spruce**			**European beech**		
	Parameter	**Coeff**	**Value**	**SE**	**p-value**	**Value**	**SE**	**p-value**
	Intercept	a_i	-6.349	1.322	0.0019	-6.447	0.784	<0.0001
	t	b_{i1}	4.37E-04	2.70E-05	<0.0001	5.54E-04	4.23E-05	<0.0001
	p	b_{i3}	-2.51E-04	6.73E-05	0.0002	-8.47E-04	7.47E-05	<0.0001
	mi	b_{i5}	7.249	1.249	<0.0001	5.306	0.512	<0.0001
	ln(GI_i)	c_i	10.443	0.340	<0.0001	6.943	0.716	<0.0001
	ln(Dg)	d_{i1}	-0.498	0.142	0.0005	0.136	0.156	0.3832
	ln(sd)	d_{i2}	0.611	0.020	<0.0001	0.682	0.029	<0.0001
	P_i	e_i	3.745	1.432	0.0092	1.398	0.657	0.0344
	mi x P_i	f_{i1}	-4.529	1.360	0.0009	-	-	-
	ln(GI_i) x P_i	f_{i2}	-	-	-	2.092	0.937	0.0266
	ln(Dg) x P_i	f_{i3}	0.223	0.153	0.1467	-0.492	0.187	0.0091

(d) Goodness of fit statistics

			2P	**Direct-SNFI**	**Direct-Charru**
Species	**n_{obs}**	**n_{plots}**	**RMSE**	**RMSE**	**RMSE**
Norway spruce	1346	797	0.1855	0.1854	0.1852
European beech	546	322	0.1707	0.1699	0.1704

SE: standard error; RMSE: root mean square error.

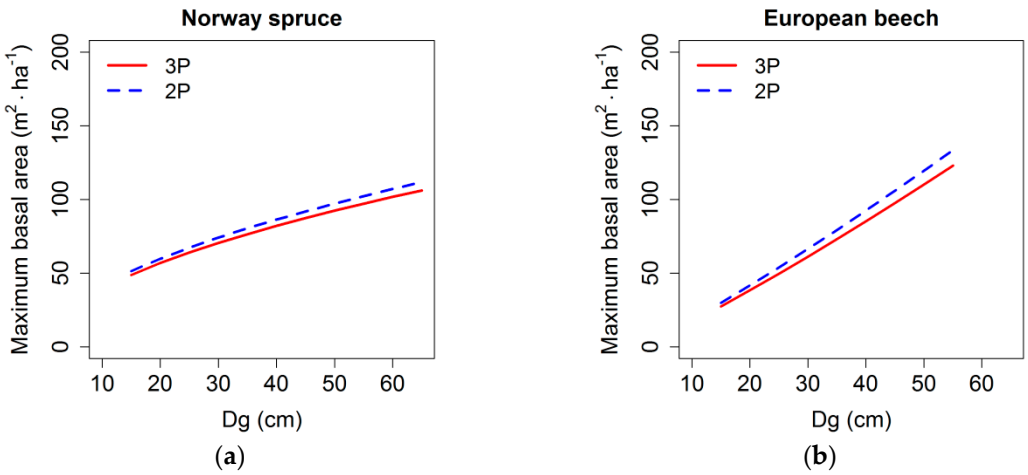

Figure S1. Maximum basal area over quadratic mean diameter fitted using two alternatives (3P, 2P)**.** (**a**) Norway spruce, (**b**) European beech.

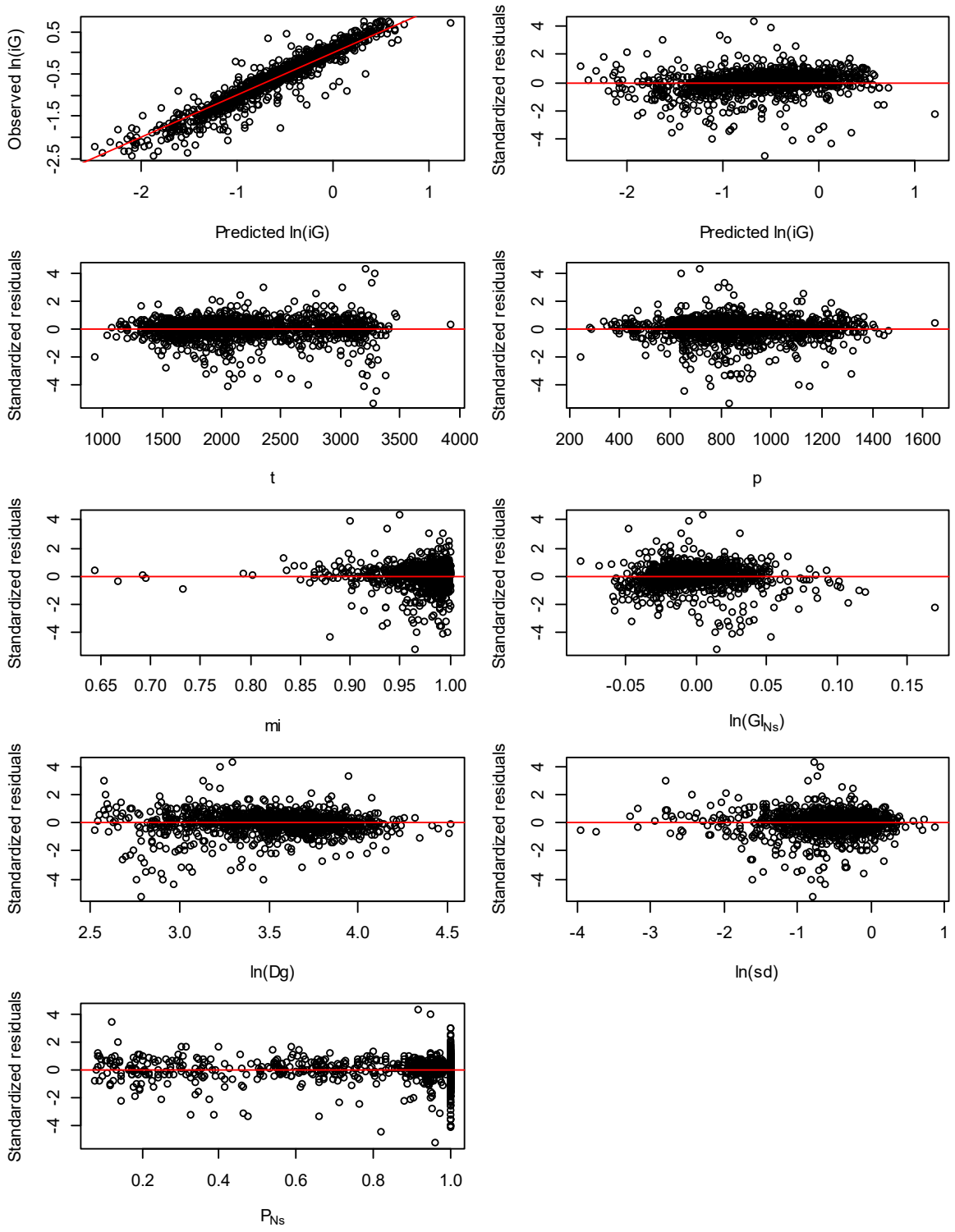

Figure S2. Predicted versus observed data plots and standardized residuals versus explanatory variables plots for the Norway spruce growth model.

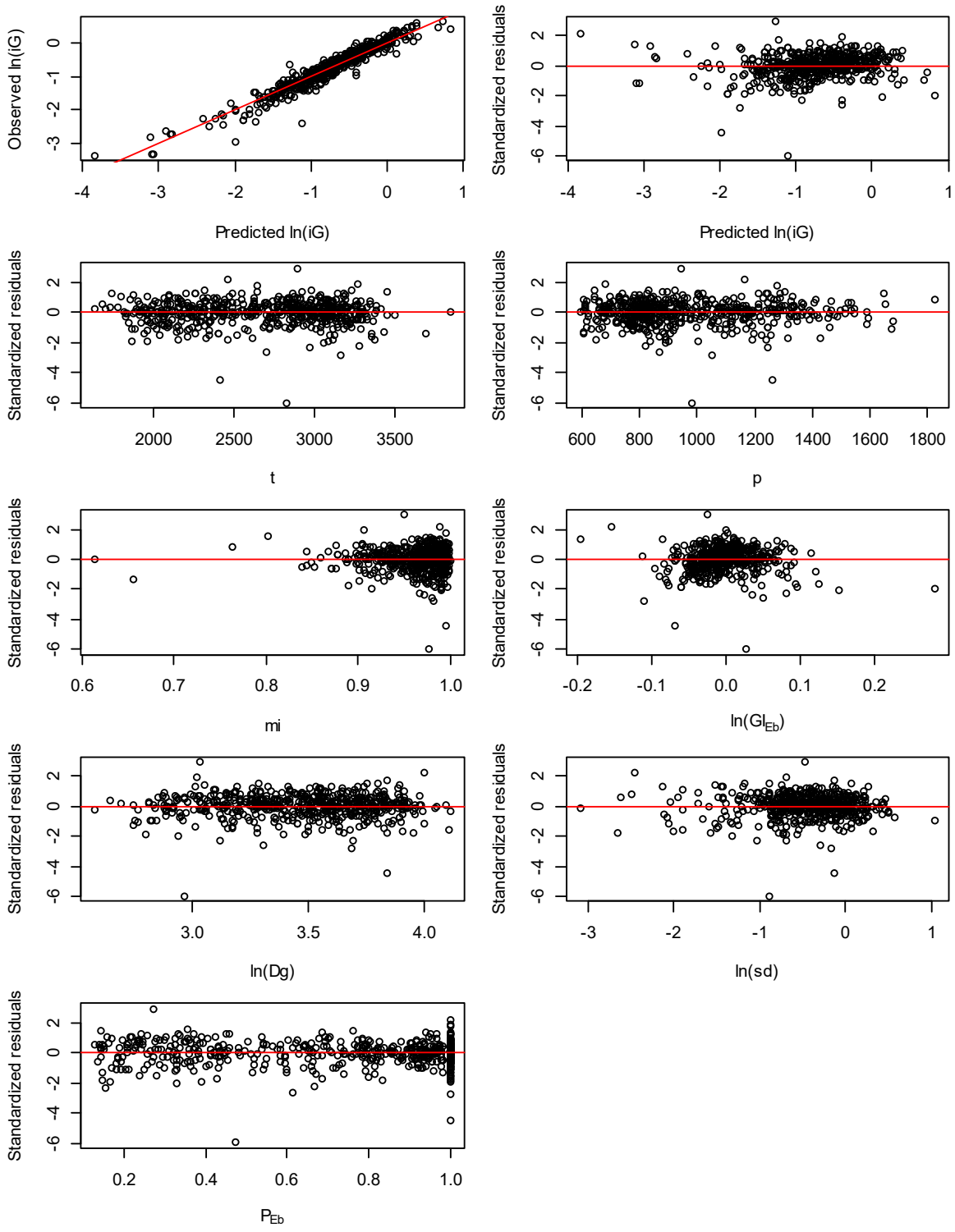

Figure S3. Predicted versus observed data plots and standardized residuals versus explanatory variables plots for the European beech growth model.

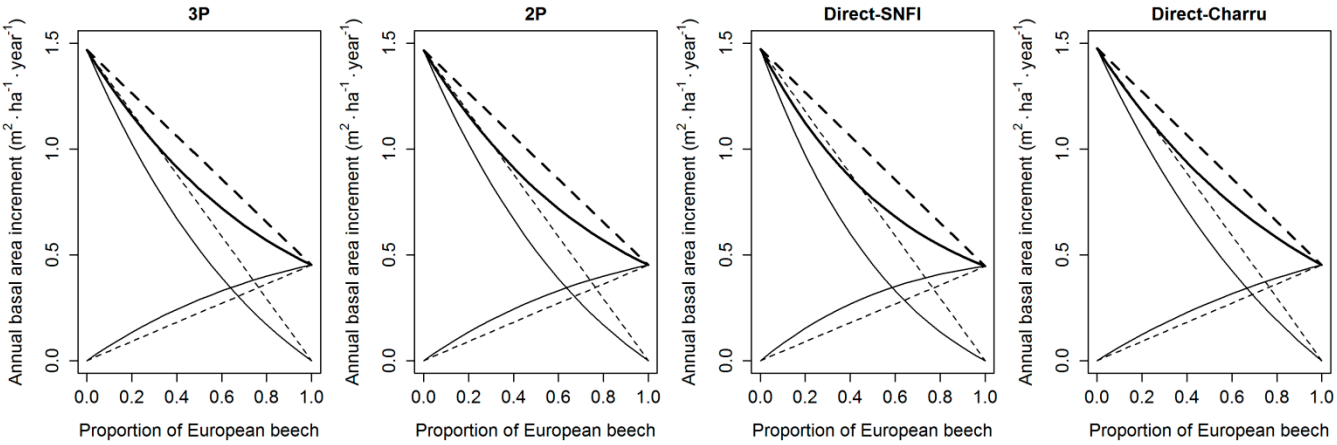

Figure S4. Replacement diagrams of the NFI site showing the lowest underyielding (using the 3P alternative). The basal area increment was predicted for Dg = 35 cm, sd = 0.65, temperature sum = 3307 degree days·year^{-1}, precipitation sum = 655 mm·year^{-1}, moisture index = 0.8803, GI_{Ns} = 1.055, and GI_{Eb} = 0.985.

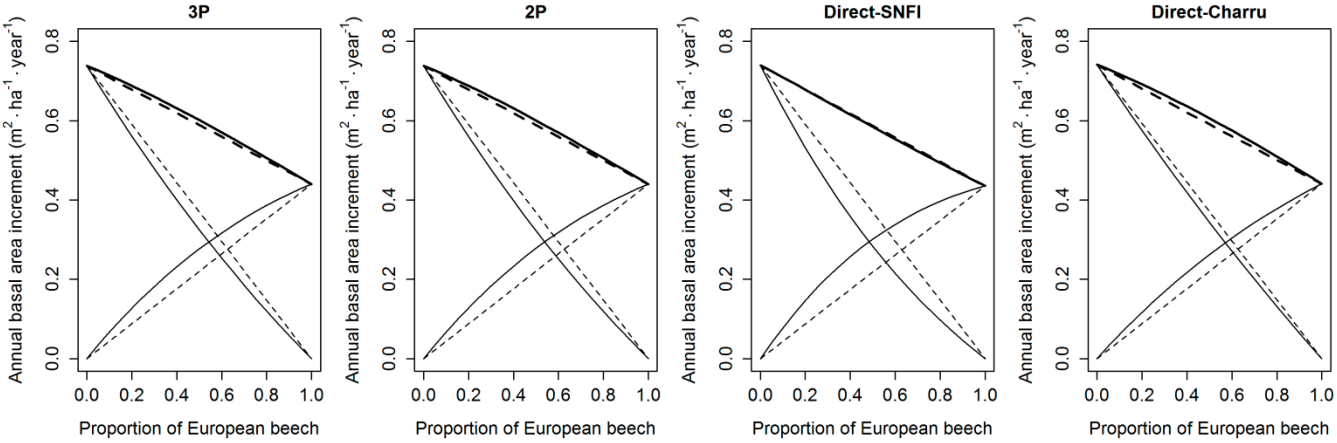

Figure S5. Replacement diagrams of the NFI site showing the mean overyielding (using the 3P alternative). The basal area increment was predicted for Dg = 35 cm, sd = 0.65, temperature sum = 2952 degree days·year^{-1}, precipitation sum = 1165 mm·year^{-1}, moisture index 0.9686, GI_{Ns} = 0.992, and GI_{Eb} = 1.000.

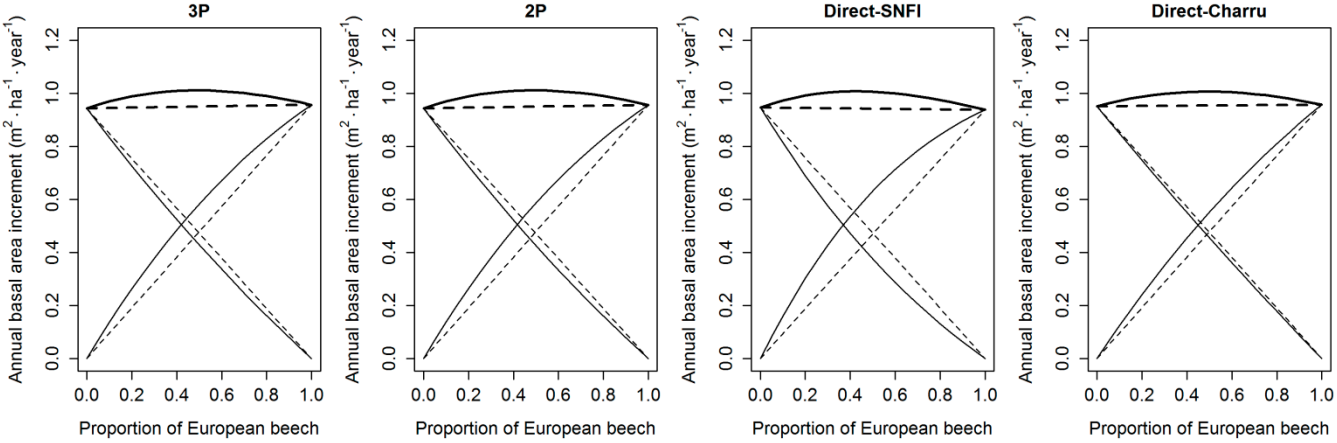

Figure S6. Replacement diagrams of a NFI site showing a transgressive overyielding. The basal area increment was predicted for Dg = 35 cm, sd = 0.65, temperature sum = 3138 degree days·year^{-1}, precipitation sum = 781.9 mm·year^{-1}, moisture index = 0.9821, GI_{Ns} = 0.995, and GI_{Eb} = 1.031.