Appendix A - Supplementary material

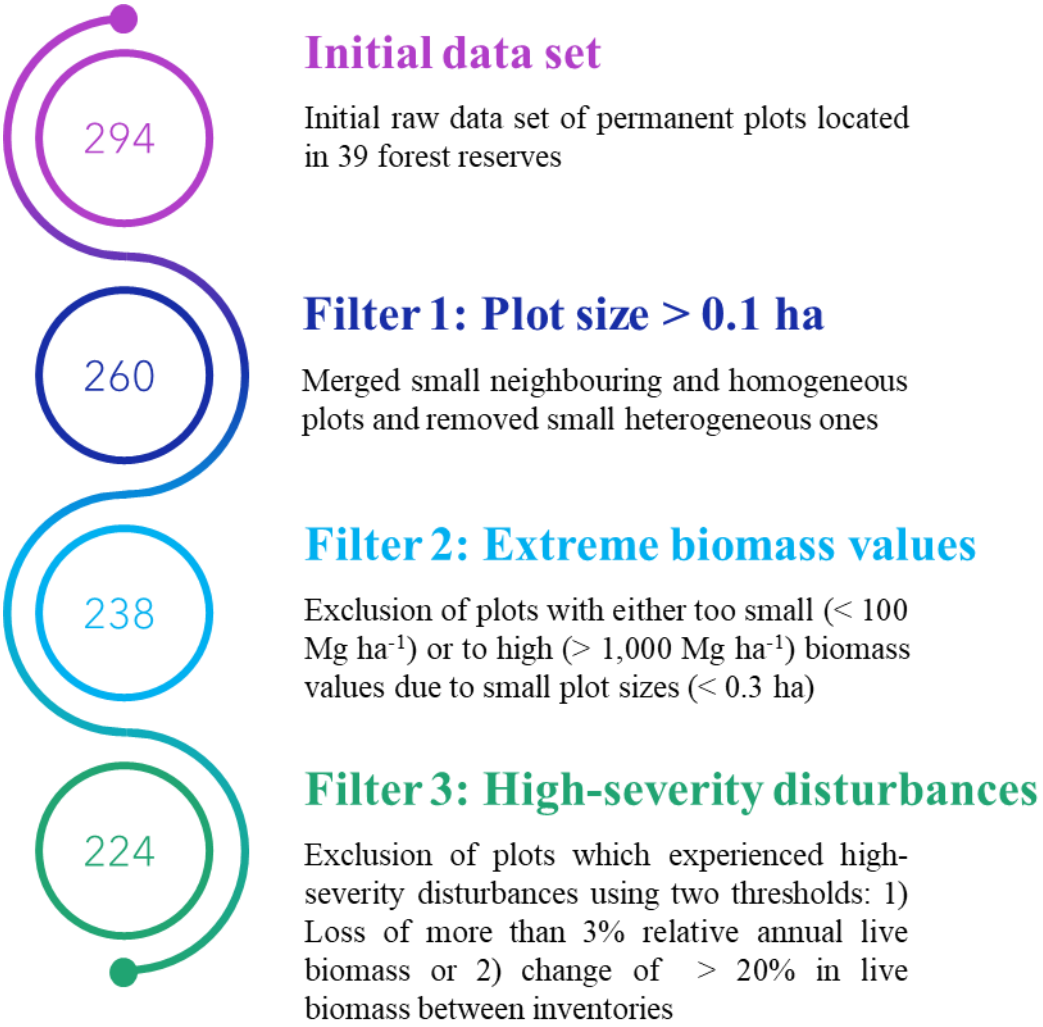

Figure A1. Flowchart of the three filtering steps followed to select the permanent plots used for this analysis and prepare the NFR dataset. Numbers inside the circles show the number of permanent plots at each step. In total, we excluded 70 plots and used the remaining 224 plots, which were located in 37 reserves.

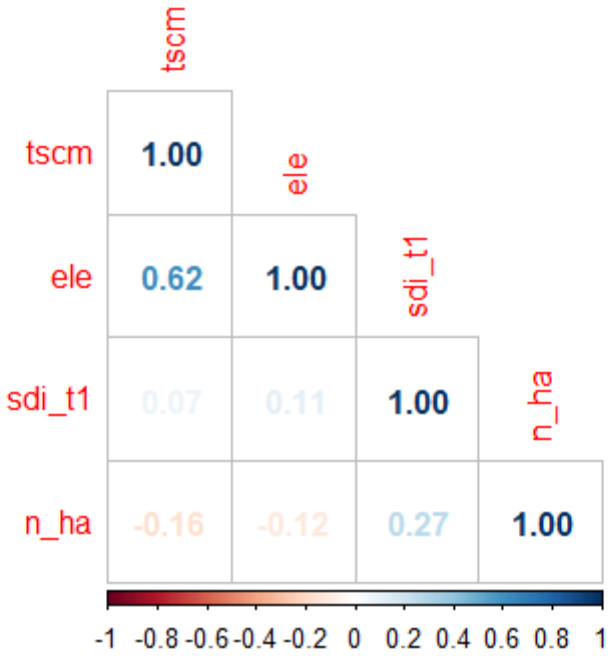

Figure A2. Pearson correlation matrix for the variables considered in the biomass model. They are time since cessation of management (TSCM), elevation (ele), stand density index in the first inventory (sdi_t1) and tree density (n_ha).

Table A1: The acronyms and meaning of the explanatory variables considered in the biomass change model and used in Figures A2 and A3. More detailed information can be found in Table 2.

	Acronyms	**Variable**
Forest structure in the previous inventory	prev_gini	Gini index
	prev_vlt_cat3	Density of trees with a DBH > 80 cm
	prev_vlt_cat2	Density of trees with a DBH > 60 cm
	prev_vlt_cat1	Density of trees with a DBH > 40 cm
	prev_conif	Share of conifers in the total plot biomass
	prev_Ba_ha	Basal area of the plot
	prev_sdi	Stand Density Index
	prev_n_ha	Tree density of the plot
	prev_sp_rich	Richness of species with at least 10 occurrences
Climatic conditions between inventories	prcp_tot_y	Mean annual precipitation
	prcp_tot_gs	Mean growing season precipitation
	WBal_ave_y	Mean annual water balance
	WBal_ave_gs	Mean growing season water balance
	PET_ave_y	Mean annual potential evapotranspiration
	PET_ave_gs	Mean growing season potential evapotranspiration
	DDS_tot_y	Mean annual degree day sum
	DDS_tot_gs	Mean growing season degree day sum
	tave_y	Mean annual temperature
	tave_gs	Mean growing season temperature
	tmax_y	Maximum annual temperature
	tmin_y	Minimum annual temperature

Site conditions	beer_asp	Beer’s aspect
	ele	Elevation
	slope_deg	Slope in degrees
	pH	Mean soil pH
	AWC	Available water capacity

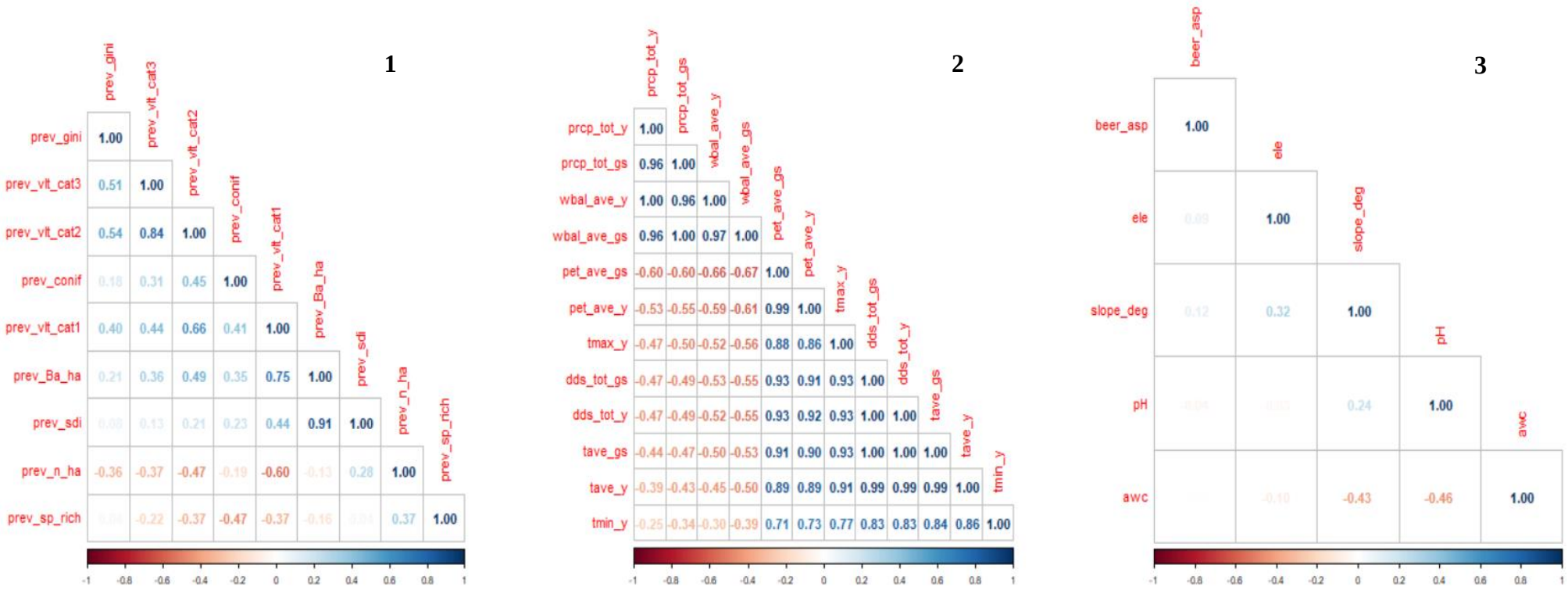

Figure A3. Pearson correlation matrices for the variables considered in the biomass change model that characterise 1) forest structure, 2) climatic conditions and 3) site conditions. Matrix 1 contains the variables related to the forest structure in the previous inventory. Matrix 2 contains the variables related to the climatic conditions between inventories. Matrix 3 contains the variables related to site conditions.

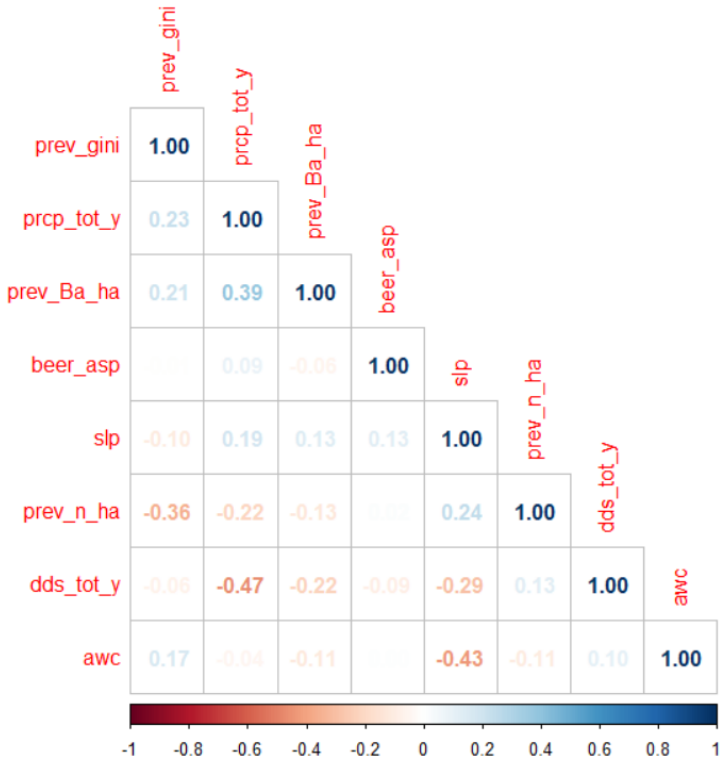

Figure A4. Pearson correlation matrix for the selected abiotic and biotic variables used in the biomass change model.

Table A2: Coefficients of the biomass model, in which live biomass was the response variable and time since cessation of management (TSCM), elevation (ele), stand density index in the first inventory (SDI) and tree density (N) were the explanatory variables. CI represents the 95% confidence interval, *p* the significance value and *df* the degrees of freedom. The symbol σ denotes the standard deviation of the residuals and τ shows the estimated standard deviation of the random intercept (either for plots nested in reserves as grouping variables or for reserves as grouping variable).

	Biomass model			
Fixed effects	*Estimates*	*CI*	*p*	*df*
(Intercept)	-64.90	-159.71 – 29.92	0.179	554.33
TSCM [log10]	165.62	114.97 – 216.27	**<0.001**	672.67
ele	-0.15	-0.23 – -0.07	**<0.001**	275.07
SDI	0.62	0.51 – 0.72	**<0.001**	643.98
N	-0.14	-0.15 – -0.12	**<0.001**	446.75
TSCM [log10] × ele	0.02	-0.02 – 0.06	0.285	382.90
TSCM [log10] × SDI	-0.08	-0.14 – -0.02	**0.007**	676.39
Random Effects				
σ	38.55			
$\tau_{00\ plot.reserve}$	36.96			
$\tau_{00\ reserve}$	48.21			
Number $_{plots}$	34			
Number $_{reserves}$	37			
Observations	695			
Marginal R^2 / Conditional R^2	0.668 / 0.905			

Table A3: Coefficients of the alternative model in which we increased the TSCM of Derborence and Scatlè by 2000 years. CI represents the 95% confidence interval; *p* shows the significance value and *df* the degrees of freedom. The symbol σ denotes the standard deviation of the residuals and τ shows the estimated standard deviation of the random intercept (either for plots nested in reserves as grouping variables or for reserves as grouping variable).

	Biomass model alternative I			
Fixed effects	*Estimates*	*CI*	*p*	*df*
(Intercept)	-52.65	-141.34 – 36.05	0.244	418.12
TSCM [log10]	157.36	112.61 – 202.12	**<0.001**	642.73
ele	-0.08	-0.16 – -0.00	**0.037**	137.28
SDI	0.54	0.45 – 0.64	**<0.001**	475.42
N	-0.13	-0.15 – -0.12	**<0.001**	436.83
TSCM [log10] × ele	-0.02	-0.05 – 0.02	0.290	187.74
TSCM [log10] × SDI	-0.04	-0.09 – 0.01	0.131	535.43
Random Effects				
σ	39.17			
$\tau_{00\ plot:reserve}$	36.63			
$\tau_{00\ reserve}$	50.76			
Number $_{plot}$	34			
Number $_{reserve}$	37			
Observations	695			
Marginal R^2 / Conditional R^2	0.670 / 0.907			

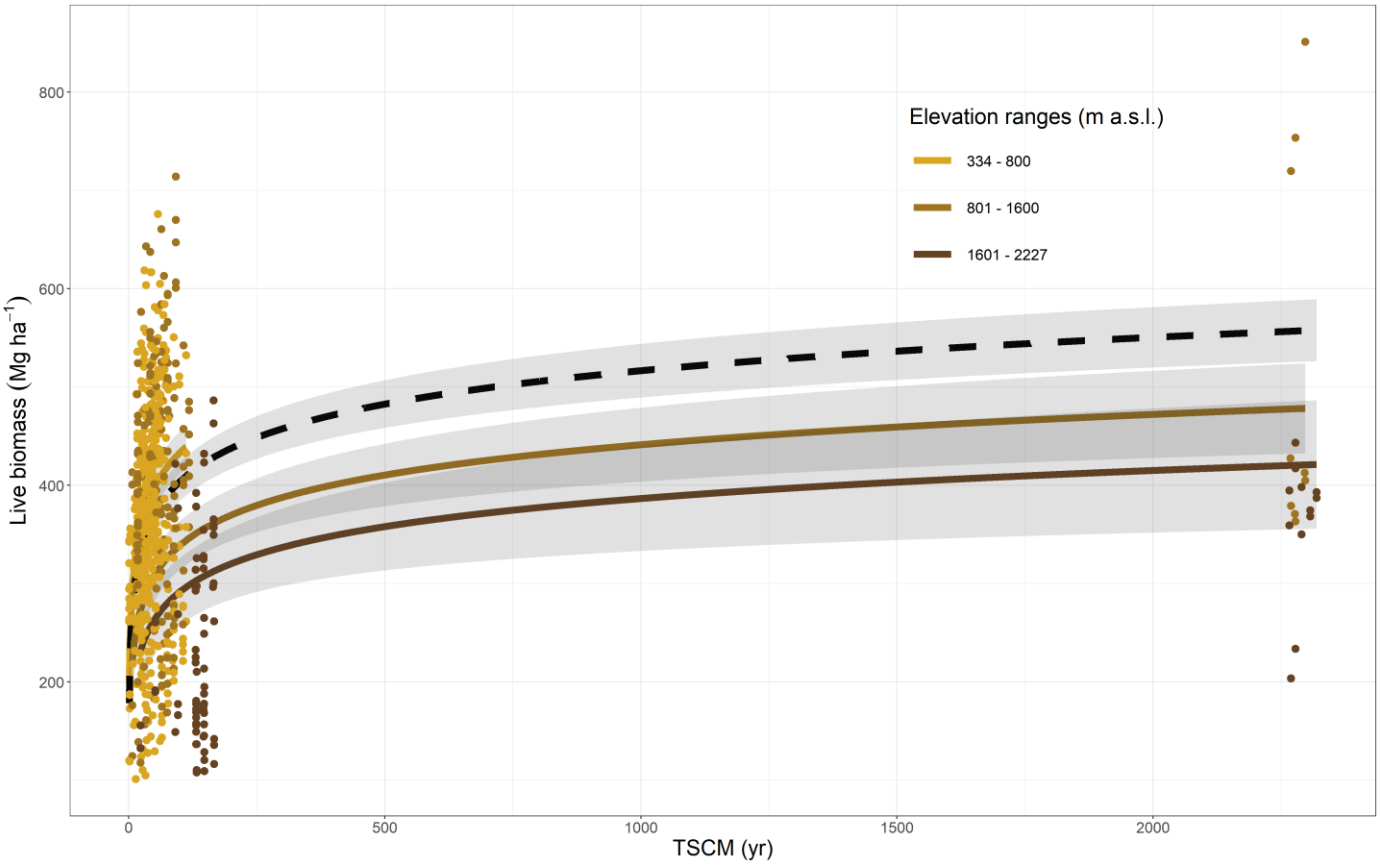

Figure A5: Predicted live biomass based on TSCM and elevation for all the plots using the alternative model in which we increased the TSCM of Derborence and Scatlè by 2000 years. The dots represent the observed values corresponding to each plot, and the colour indicates to which elevation class they belong. The dashed line represents predictions for the mean elevation of all plots (850 m a.s.l.). These curves were predicted using the mean value of all other variables used in the model. The shaded area shows the 95% confidence intervals.

Table A4: Coefficients of alternative model in which we exclude plots with a TSCM > 170 years. CI represents the 95% confidence interval; *p* shows the significance value and *df* the degrees of freedom. The symbol σ denotes the standard deviation of the residuals and τ shows the estimated standard deviation of the random intercept (either for plots nested in reserves as grouping variables or for reserves as grouping variable).

	Biomass model alternative II			
Fixed effects	*Estimates*	*CI*	*p*	*df*
(Intercept)	-86.04	-182.23 – 10.15	0.079	566.25
TSCM [log10]	185.28	132.25 – 238.32	**<0.001**	619.14
ele	-0.17	-0.25 – -0.09	**<0.001**	333.74
SDI	0.66	0.55 – 0.77	**<0.001**	657.05
N	-0.14	-0.16 – -0.12	**<0.001**	428.55
TSCM [log10] × ele	0.04	-0.01 – 0.08	0.087	472.48
TSCM [log10] × SDI	-0.12	-0.18 – -0.06	**<0.001**	650.76
Random Effects				
σ	38.32			
$\tau_{00\ plot:reserve}$	36.20			
$\tau_{00\ reserve}$	49.04			
Number $_{plot}$	34			
Number $_{reserve}$	35			
Observations	674			
Marginal R^2 / Conditional R^2	0.647 / 0.900			

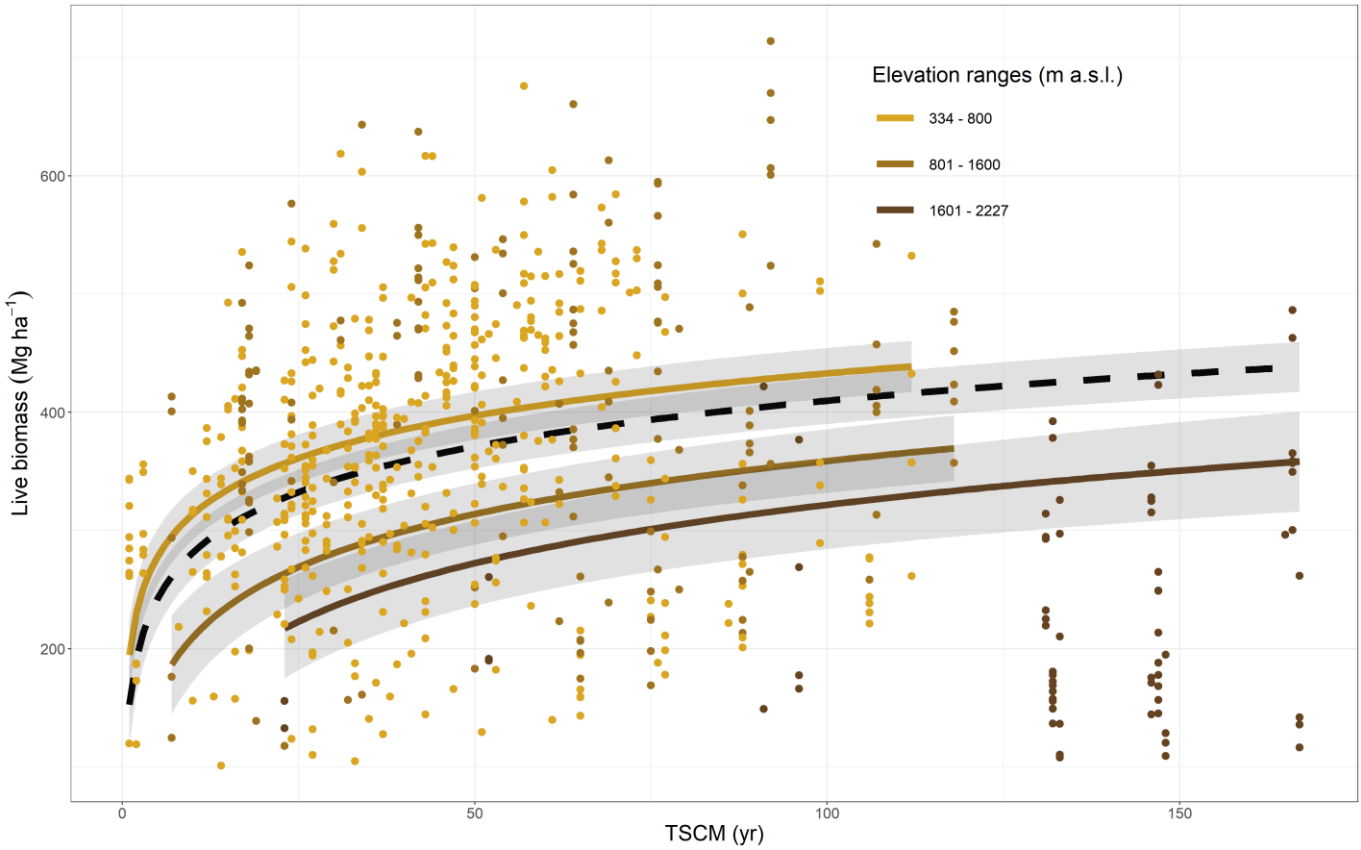

Figure A6: Predicted live biomass based on TSCM and elevation for all the plots using the alternative model in which we excluded plots with a TSCM > 170 years. The dots represent the observed values corresponding to each plot, and the colour indicate to which elevation class they belong. The dashed line represents predictions for the mean elevation of all plots (850 m a.s.l.). These curves were predicted using the mean value of all other variables used in the model. The shaded area shows the 95% confidence intervals.

Table A5: Coefficients of biomass change model. CI represents the 95% confidence interval; *p* shows the significance value and *df* the degrees of freedom. The symbol σ denotes the standard deviation of the residuals and τ shows the estimated standard deviation of the random intercept (either for plots nested in reserves as grouping variables or for reserves as grouping variable).

	Biomass change model			
Fixed effects	*Estimates*	*CI*	*p*	*df*
(Intercept)	8.42	4.68 – 12.16	**<0.001**	89.55
DDS tot y [1st degree]	39.11	-9.74 – 87.96	0.115	75.81
DDS tot y [2nd degree]	-56.23	-87.61 – -24.86	**<0.001**	343.63
prcp tot y	-0.00	-0.01 – -0.00	**0.031**	83.17
prev Ba ha [1st degree]	0.01	-5.68 – 5.70	0.997	185.25
prev Ba ha [2nd degree]	1.02	-4.58 – 6.62	0.720	262.03
prev n ha [1st degree]	13.24	6.31 – 20.18	**<0.001**	222.12
prev n ha [2nd degree]	-6.66	-13.92 – 0.60	0.072	293.78
prev gini	0.73	-2.85 – 4.30	0.689	187.25
slp	-0.03	-0.05 – -0.02	**<0.001**	145.85
beer asp	-0.02	-0.34 – 0.31	0.923	145.41
AWC	-0.00	-0.01 – 0.00	0.183	136.12
DDS tot y [1st degree] × prcp tot y	-0.04	-0.08 – 0.00	0.063	111.80
DDS tot y [2nd degree] × prcp tot y	0.03	-0.00 – 0.05	0.054	383.96
prev Ba ha [1st degree] × prev n ha [1st degree]	208.15	69.72 – 346.59	**0.003**	244.23
prev Ba ha [2nd degree] × prev n ha [1st degree]	36.57	-108.90 – 182.04	0.621	311.52
prev Ba ha [1st degree] × prev n ha [2nd degree]	-6.75	-186.02 – 172.53	0.941	223.45

prev Ba ha [2nd degree] × prev n ha [2nd degree]	120.35	-96.53 – 337.22	0.276	326.30

Random Effects

σ	2.17
$\tau_{00\ plot:reserve}$	0.40
$\tau_{00\ reserve}$	1.33
Number $_{plot}$	34
Number $_{reserve}$	31
Observations	471
Marginal R^2 / Conditional R^2	0.276 / 0.485

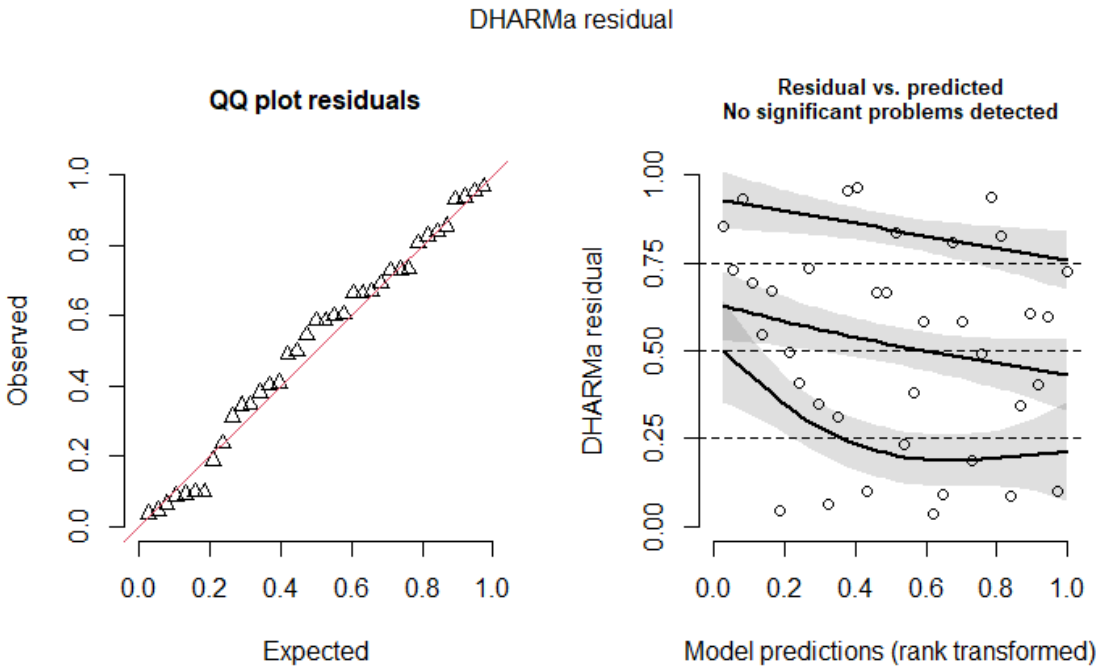

Figure A7: Diagnostic plots of the residuals of the biomass model (Table A2).

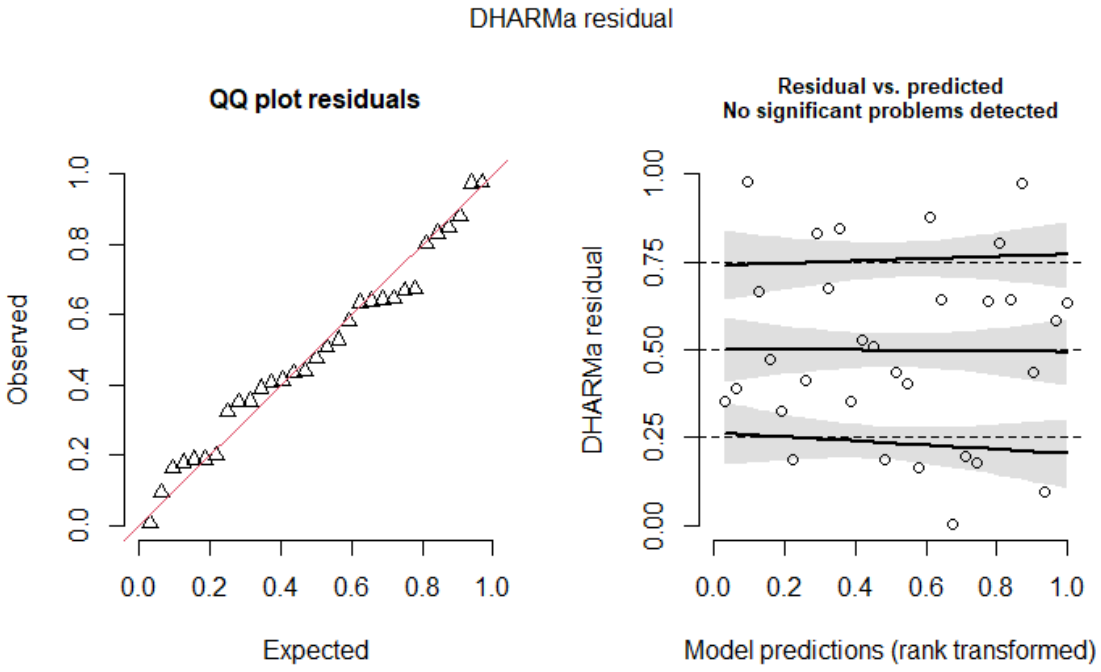

Figure A8: Diagnostic plots of the residuals of the biomass change model (Table A5).